



## REPORT

# Geotechnical Design Report (GDR)

*Phair Crossing Bridge No. 3259, Presque Isle, Maine (WIN 026434.00)*

Submitted to:

**Bret Grenier, PE**

HNTB CORPORATION  
82 Running Hill Road, Suite 201  
South Portland, ME 04106

Submitted by:

**WSP USA, Inc.**

2 Monument Square, Suite 200, Portland, Maine 04101

207.865.4024

US0025840.9367

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## 1.0 INTRODUCTION

This Geotechnical Design Report (GDR) summarizes the results of WSP USA Inc. (WSP's) geotechnical investigation and geotechnical recommendations for the replacement of the Phair Crossing Bridge No. 3259 of Maine Route 10 over the Maine Northern Railroad in Presque Isle, Maine. Figure 1 shows the site location. The purpose of this report is to: present soil and bedrock information for the bridge replacement project obtained from subsurface investigations and laboratory tests; present recommended geotechnical parameters for design; and provide geotechnical construction recommendations for the replacement bridge.

## 2.0 PROJECT UNDERSTANDING

WSP reviewed the historic plans<sup>1</sup> for the existing bridge structure, including historical subsurface soundings. The existing structure was constructed in 1935 and consists of a three-span bridge with two piers and abutments. The existing western abutment and pier are founded on bedrock at approximately Elevation (EL) 585 feet. The existing eastern abutment and pier are founded at approximately EL 585 feet on spread footings. The proposed replacement design per HNTB's Preliminary Design Report<sup>2</sup> (PDR) and 60% Plans<sup>3</sup> consists of a single span bridge with integral abutments at the top of a riprapped slope, behind the existing abutments. The abutments will be located at EL 610.0 feet for the base of the western abutment and EL 608.0 feet for the base of the eastern abutment that will both be founded on driven H-piles to bedrock. The elevation of the approach embankments is expected to be raised 3 feet and the approach embankments are proposed to be widened to accommodate lane and shoulder width requirements with 2H:1V slopes.

## 3.0 GEOLOGIC SETTING

### 3.1 Regional Surficial Geology

The site lies within the New England Upland Section of the New England physiographic province, characterized by a topographic surface of sharp relief, that has been glaciated and severely eroded.<sup>4</sup> The surficial geology of the site is mapped as Pleistocene-aged end-moraine deposits, described as till and or sand and gravel occurring deposited in marginal zone of the Late Wisconsinan glacier by glacial ice (till) and/or meltwater streams emerging from the ice (sand and gravel). This deposit overlies older Pleistocene-aged glacial till, consisting of a loose to very dense, poorly sorted, massive to weakly stratified mixture of sand, silt, clay, gravel-sized debris and possibly boulders deposited directly by glacial ice. This unit is commonly a blanket deposit that conforms to bedrock surface, and forms glacially streamlined hills (including drumlins), where till thickness locally exceeds 100 feet. The till generally overlies fine-grained limestone and calcareous siltstone bedrock, described below.<sup>5,6,7</sup>

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<sup>1</sup> Maine State Highway Commission. State Highway "K", Phair Crossing, Presque Isle, ME. Dated August 1935.

<sup>2</sup> HNTB, Preliminary Design Report, Phair Crossing Bridge #3259 over Maine Northern Railway, Presque Isle, Maine, WIN 026434.00, 48 pp., provided to WSP USA Inc. on December 02, 2024. Filename: Preliminary Design Report (PDR).pdf

<sup>3</sup> HNTB, 60% Plans, Phair Crossing Bridge #3259 over Maine Northern Railway, Presque Isle, Maine, WIN 026434.00, 37 pp., provided to WSP USA Inc. on May 12, 2025. Filename WIN 026434.00 Presque Isle 60% Plans.pdf

<sup>4</sup> Genes, A.N., 1978. Reconnaissance Surficial Geology of the Mars Hill Quadrangle, Maine. Maine Geological Survey Open-File Report 78-5, 1 sheet, scale 1:62,500.

<sup>5</sup> Pavlides, L., 1968. Relationships of the Carys Mills Formation of Ordovician and Silurian Age, Northeast Maine. U.S. Geological Survey Bulletin 1264, 44 p., 1 sheet, scale 1:250,000

<sup>6</sup> Osberg, P.H., Hussey, A.M., and Boone, G.M., 1985. Bedrock Geologic Map of Maine. Maine Geological Survey, Department of Conservation, 1 sheet, scale 1:500,000.

<sup>7</sup> Pavlides, L., 1978. Geologic Map of the Mars Hill Quadrangle and Vicinity, Aroostook County, Maine. U.S. Geological Survey, Miscellaneous Investigations Series Map I-1064, 1 sheet, scale 1:62,500

## 3.2 Regional Bedrock Geology

The geological composition of the site is characterized by the Silurian-Ordovician-aged Carys Mills Formation. This formation, primarily consisting of a ribbon limestone sequence, varies in thickness from approximately 1500 to at least 12000 feet. The lithology is described as grey blue to blue, with interlayered limestone and calcareous siltstone beds, sometimes alternating with slate. The slate, being more resistant, stands out in relief as small ribs between the more deeply eroded ankeritic or calcic carbonate layers. This formation is part of a series of units deposited in a marine geosynclinal basin in northeastern Maine, spanning from the middle to upper Ordovician to the Devonian period. The western margin of this basin is marked by volcanic deposits of the middle Ordovician Winterville Formation, located about 25 miles west of Caribou, Maine. Since the Ordovician period, both volcanic and sedimentary deposits in this region have undergone up to four known phases of tectonic deformation, leading to the regional scale folding of these rock units.

## 4.0 SUBSURFACE INVESTIGATIONS

WSP completed two (2) test borings (BB-PIPC-101 and BB-PIPC-102) and one (1) probe (BP-PIPC-103) between January 2 and January 4, 2024. The as-drilled boring location and elevation coordinates are summarized in Table 1 and were estimated using swing tie distances from the existing bridge structure and then geolocated on the 60% Plan<sup>3</sup> CADD files provided to WSP by HNTB on May 12, 2025. Boring locations with respect to existing site features are illustrated in the Boring Location Plan (Figure 2). Both borings were performed within the paved roadway of RT 10 on either side of the existing bridge at Presque Isle, and the probe was advanced through the existing bridge deck. The field program included Standard Penetration Testing (SPT) of predominantly coarse-grained soils and recovery of rock core from the bedrock. A WSP geotechnical engineer monitored drilling activities, selected sampling intervals, logged subsurface conditions encountered, and obtained soil samples for use in visual descriptions and subsequent laboratory testing and classification.

WSP subcontracted Seaboard Drilling, LLC (Seaboard) of Bangor, Maine to complete the borings. Seaboard used a Diedrich D-50 drill rig for all borings. To advance boring BB-PIPC-101, Seaboard used solid stem augers (SSA) in the upper 10 feet, 4.25-inch inside diameter hollow stem augers (HSA) to 32.3 feet and then removed the HAS's and drove 3-inch casing seated in rock for rock coring. For boring BB-PIPC-102, Seaboard used SSA's in the upper 15 feet and then advanced the boring using drive and methods using a 4-inch casing to 55 feet, and then 3-inch casing seated in rock for rock coring. For probe BP-PIPC-103, Seaboard used a 4-inch casing through the bridge deck and drive and wash methods to bedrock refusal, and then 3-inch casing seated in rock for rock coring.

Seaboard performed SPT using a calibrated automatic hammer system and standard 2-inch split spoon sampler in general accordance with American Society for Testing and Materials (ASTM) D1586. Sampling was conducted at approximately 5-foot intervals. Seaboard drove split spoons for 24 inches with a 140-pound hammer dropped 30 inches and WSP recorded the number of hammer blows required to advance the sampler through each 6-inch increment. Measured, uncorrected N-values, calculated as the sum of the hammer blows to advance the sampler during the 6-inch to 18-inch intervals, are provided in the boring logs in Appendix A. WSP used a hammer energy transfer ratio of 106.6% for the Diedrich D50 drill rig provided by Seaboard to convert the measured N-values to N<sub>60</sub> values for further calculations. WSP collected and stored soil samples in sealed glass jars for later evaluation and laboratory testing.

Seaboard collected up to 10 feet of rock core using NQ/NX size (1-7/8-inch diameter) diamond tipped core barrels in the two borings following either refusal of casing, or failure to advance the split spoon sampler or roller bit. Rock

core samples were placed in wooden boxes and transported to the WSP office. WSP recorded the lithology, Total Core Recovery (TCR), Rock Quality Designation (RQD), and coring rates for each core run which are provided in the boring logs in Appendix A. A detailed summary of the rock core quality parameters for the recovered rock core is presented in Table 3 and photographs of the rock core are presented in Appendix B.

The boring logs provided in Appendix A present details of the sampling methods used, field data obtained, and soil and rock conditions encountered during the investigation. Soils were field categorized in accordance with ASTM D2488. WSP field characterized the bedrock lithology, and the descriptions were revised in the office. A description of the boring log symbols and terms used for the soil and rock descriptions precedes the boring logs.

## 5.0 LABORATORY TESTING PROGRAM

After reviewing the collected samples in the office, WSP transferred select samples to GeoTesting Express (GTX) of Acton, Massachusetts for geotechnical laboratory testing in accordance with applicable ASTM testing procedures. WSP selected representative SPT split spoon soil samples from the borings for geotechnical laboratory testing to assist in soil classification. The types and numbers of each of the laboratory tests conducted on soil samples are presented in Table 5-1. Measured index and classification test results from soil samples are summarized in Table 4 and include AASHTO and Unified Soil Classification System (USCS) classifications. Soil testing results are included on the boring logs in Appendix A. Measured strength and consolidation test results are summarized in Table 5. Complete laboratory testing results are provided in Appendix C.

**Table 5-1: Number and Type of Laboratory Tests Performed**

| Laboratory Test              | Test Standard | No. Tests Completed |
|------------------------------|---------------|---------------------|
| Moisture content             | ASTM D 2216   | 6                   |
| Grain size analysis (coarse) | ASTM D 6913   | 10                  |
| Grain size (fine)            | ASTM D 7928   | 2                   |

## 6.0 SUBSURFACE CONDITIONS

The soils encountered in the borings generally consist of fill materials placed during construction of the bridge and roadway and naturally occurring sandy/silty gravel interpreted as glacial till. Bedrock encountered consists of limestone and calcareous siltstone Silurian-Ordovician-aged Carys Mills Formation. The boring logs in Appendix A provide detailed descriptions of the soil conditions encountered in the borings. Figure 3 provides WSP's Interpretive Subsurface Profile (ISP) along the centerline of the roadway and proposed bridge. The following descriptions summarize the major stratigraphic units from the existing ground surface to depth.

**Asphalt Pavement:** Asphalt pavement thickness ranged from approximately 10 inches to 6 inches in borings BB-PIPC-101 and BB-PIPC-102, respectively.

**Fill:** A layer of fill was encountered between 0.8 feet and 25 feet below ground surface (bgs) in BB-PIPC-101, between 0.5 feet and 35 feet bgs in BB-PIPC-102, and between 8.3 feet and 28 feet bgs in BP-PIPC-103. The fill consists of brown, very dense to medium dense, fine to coarse sand and gravel, with some to trace silt. Laboratory classifications described the layer as SM and GM (USCS), A-2-4, A-1-b, and A-4 (AASHTO). N<sub>60</sub>-

values ranged from 14 to 80, where values generally decreased with increasing depth, and then increase before transitioning to glacial till.

**Glacial Till:** A layer of glacial till was encountered between 25 feet and 33.6 feet bgs in BB-PIPC-101, between 35 feet and 51.2 feet bgs in BB-PIPC-102, and between 28 feet and 38.9 feet bgs in BP-PIPC-103. The till consists of medium dense to very dense, grey and brown, gravelly fine to coarse sand, and silty, sandy gravel. Laboratory classifications described the layer as SM, GM, and ML (USCS) and A-2-4, A-4, and A-1-b (AASHTO).  $N_{60}$ -values ranged from 21 to greater than 100.

**Bedrock:** Bedrock cored from 33.6 feet to 43.6 feet bgs in BB-PIPC-101, from 55 feet to 65 feet bgs in BB-PIPC-102, and from 38.9 feet to 48.9 feet in BP-PIPC-103. The bedrock consists of grey, fine to coarse grained, medium strong (R3) to strong (R4), fresh (W1) to slightly weathered (W2), limestone, with occasional calcite veins.

**Groundwater:** WSP measured groundwater levels in BB-PIPC-102 and BP-PIPC-103, and no groundwater was observed in BB-PIPC-101. Groundwater was measured in BB-PIPC-102 and BP-PIPC-103 with the casing at a depth of 27.7 feet bgs and 41.5 feet bgs, respectively, at the end of the drilling day. Groundwater levels shown on the ISP in Figure 3 were interpreted based on these water level measurements and on moisture content observed in the soil samples. We note that groundwater levels will fluctuate due to seasonal, regional pumping, and precipitation trends.

## 7.0 GEOTECHNICAL EVALUATIONS AND RECOMMENDATIONS

Based on the PDR and WSP's ISP, Abutment 1 will be located at Station (Sta.) 204+45, approximately 9.1 feet tall from the bottom of the approach slab to its base at approximately EL 610.0 feet and supported by H-piles to bedrock (between approximately EL 579 feet and EL 584 feet) with pile lengths of approximately 25.7 feet to 31.2 feet. Abutment 2 will be located at Sta. 205+85, approximately 8.1 feet tall from the bottom of the approach slab to its base at approximately EL 608.0 feet and supported by H-piles to bedrock at approximately EL 561 feet with pile lengths of approximately 47.0 feet. The bridge location in plan is shown on the BLP (Figure 2) and in profile with respect to stratigraphy on the ISP (Figure 3). Our analyses and recommendations are described in the subsections below. Calculations, references, and assumptions are provided in Appendix D.

### 7.1 Design Parameters

WSP evaluated the subsurface geotechnical data collected and developed geotechnical material design parameters to serve as a basis for calculations, analyses, and evaluations discussed herein. Table 7-1 provides a summary of design parameters for each in situ soil layer (refer to Figure 3) encountered and material properties for fills as identified in the MaineDOT Standard Specifications.<sup>8</sup>

**Table 7-1: Recommended Geotechnical Design Parameters for In Situ Soils and Construction Fills**

| Soil Layer        |                            | $\gamma$ (pcf) | $\phi$ (°) | $^1K_0$ |
|-------------------|----------------------------|----------------|------------|---------|
| In Situ Materials | Historical (Existing) Fill | 125            | 32         | 0.47    |
|                   | Glacial Till               | 135            | 35         | 0.43    |

<sup>8</sup> State of Maine, Department of Transportation. March 2020. Standard Specifications. State of Maine, Department of Transportation. March 2020. Standard Specifications

|                        | Soil Layer                                    | $\gamma$ (pcf) | $\phi$ (°) | $^1K_0$ |
|------------------------|-----------------------------------------------|----------------|------------|---------|
| Construction Materials | Asphalt                                       | 140            | N/A        | N/A     |
|                        | Granular Borrow (Section 703.19) <sup>2</sup> | 125            | 32         | 0.47    |
|                        | Gravel Borrow (Section 703.20)                | 135            | 36         | 0.41    |
|                        | Riprap (Section 703.26)                       | 140            | 42         | N/A     |

Note: <sup>1</sup>Lateral earth pressure coefficient at rest was determined using the  $K_0 = 1 - \sin\phi$ . <sup>2</sup>Refer to Table 7-5 for Granular Borrow  $K_a$  and  $K_p$  values.

## 7.2 Frost Considerations

WSP estimated an average frost penetration depth for roadway and bridge abutment fills using the MaineDOT Bridge Design Guide<sup>9</sup>. The site has an air design freezing index of approximately 2,600 °F-degree days. For roadway and bridge abutment and pier coarse-grained fills with an approximate 20% water content, we estimate a frost penetration depth of 7.5 feet at the site. Refer to the depth of frost penetration calculations in Appendix D.

The base of the proposed bridge abutments is approximately 10 feet laterally from the face of the riprap, resulting in a foundation base depth greater than the frost penetration depth. However, we note that the proposed 3-foot thick riprap layer on the abutment foreslope will have large voids and allow cold air and frost to penetrate more deeply toward the base of the abutment. The water table measured at the time of the boring program performed in winter was between approximately EL 576.2 feet and EL 588.3 feet. These elevations is sufficiently below the base of the abutments (approximately EL 608 feet and EL 610 feet) and beyond the estimated frost penetration depth, and we do not expect groundwater-induced capillary action or ice lenses to result in potential frost heave at the abutment locations.

However, the groundwater table may fluctuate below the ditch (approximately EL 589.8 feet and EL 591.8 feet) such that it is within the estimated frost penetration depth. Laboratory testing for the in situ fill soils expected to remain in place ranges for approximately 20% to 40% fines, which indicates these soils may be moderately frost susceptible and subject to capillary action and ice lens formation if groundwater is available. However, this is likely within the ditch level to no more than 10 feet above the ditch level and will have little influence on the bridge substructure, if it occurs. We recommend regular ditch inspection and maintenance as typical and no changes to the embankment fills as they exist or are proposed.

## 7.3 Seismic Site Classification

WSP analyzed the seismic site classification following the criteria in Article 3.10.3.1 of AASHTO<sup>10</sup> for the soils near proposed Abutment 2 based on BB-PIPC-102 where the bedrock is deeper and there is more soil overburden. The results indicate the site is Site Class D. WSP determined Seismic Zone per Article 3.10.6 of AASHTO<sup>10</sup>. The one-second period response acceleration at the site is less than 0.15g; therefore, the site is in Seismic Zone 1. Table 7-2 provides additional seismic parameters determined using AASHTO<sup>10</sup> for the site. Refer to the full methodology of the analysis, calculations, and locations in Appendix D.

<sup>9</sup> Maine Department of Transportation, Bridge Design Guide, 2003 updated 2018.  
<https://www.maine.gov/mdot/bdg/docs/BDGupdateJune2018.pdf>

<sup>10</sup> American Association of State Highway and Transportation Officials (2020). "AASHTO LRFD Bridge Design Specifications," 9<sup>th</sup> edition, Washington, DC.

**Table 7-2: Seismic Site Parameters**

| PGA   | $A_s$ | $k_{max}$ | $S_{DS}$ | $S_{D1}$ | Site Class | Zone |
|-------|-------|-----------|----------|----------|------------|------|
| -     | 1/s   | 1/s       | 1/s      | 1/s      | -          | -    |
| 0.080 | 0.128 | 0.112     | 0.288    | 0.130    | D          | 1    |

Notes: PGA is peak ground acceleration, g;  $A_s$  is the zero period response seismic coefficient;  $S_{DS}$  is the short period response seismic coefficient (0.2 seconds);  $S_{D1}$  is the long period response seismic coefficient (1.0 seconds).

## 7.4 Settlement

We estimate a net increase in effective stress will occur in the soils below the proposed embankment due to the 35-inch increase in roadway elevation and embankment widening compared to present stress conditions. We evaluated settlement at two locations within the embankment at Sta. 206+66, the location where the existing pile drain below the embankment is located and will be extended. The locations are at the roadway guardrail where fills are expected to be minimal and at approximately 60 feet Left of the centerline within the embankment widening fills. We expect the differential settlement will be useful to HNTB in drainage pipe extension design and material selection so that the pipe will remain intact and undamaged over time.

The loads imposed by the proposed embankment fills were distributed through the subsurface soils using Boussinesq stress distribution theory for the given geometry. The subsurface soils were then discretized into layers less than 10 feet thick, and the effective stress, imposed stresses, and other soil parameters were used to evaluate settlement within each layer. We estimated material properties for the cohesionless layers from the SPT  $N_{60}$  values (see Appendix A boring logs) and used the Hough Method to estimate immediate settlement.

We estimated total settlements of less than one inch in both locations evaluated, which we assume is representative of the proposed embankment expansion in general. We estimated a maximum differential settlement between the proposed roadway edge and existing toe of slope of 0.75 inches.

## 7.5 Global Stability

### 7.5.1 Evaluation

WSP evaluated global stability at two locations: longitudinal to the centerline of RT 10 between Sta. 203+50 and Sta. 207+00 that includes the abutments, abutment foreslopes, and railroad; and transverse to the embankment at Sta. 206+66 where the embankment widening and fills are greatest. The existing abutment substructures will be partially removed to accommodate the new abutments and pile foundations; it is our understanding that the substructures will remain in-place post construction from 2 feet below ground surface and deeper. Our evaluations did not include any portion of the existing substructures or proposed pile foundations in the longitudinal stability evaluation. This allows us to evaluate scenarios where slope stability is dependent on the in situ soils and fills alone, rather than on resistance provided by the historical footings or proposed pile foundations.

We performed the analyses using the two-dimensional limit equilibrium modeling software *Slide2* by Rocscience<sup>11</sup> for existing and post-construction static and pseudo-static seismic conditions. The embankment geometry is from the existing and proposed grades shown in the PDR plans<sup>2,3</sup> and ISP (Figure 3). These analyses incorporated

<sup>11</sup> Rocscience Inc. Slide2 software package, Version 9.031, build date November 8, 2023.

material design parameters estimated from SPT  $N_{60}$  values, field vane shear strengths, and laboratory test data. The pseudo-static seismic analyses are based on FHWA (2011)<sup>12</sup>, which recommends using 50% of the peak average acceleration of the potential failure mass,  $k_{max}$ , determined for the site from the seismic site classification (see Section 7.3).

AASHTO LRFD<sup>10</sup> indicates that global stability of earth slopes with and without foundations should use an appropriate resistance factor, where  $\phi = 0.75$  (FS = 1.3) may be used where geotechnical parameters (e.g., stratigraphy and strength) are well defined and  $\phi = 0.65$  (FS = 1.5) should be used where geotechnical parameters are based on limited information or the subsurface conditions are highly variable. WSP's subsurface investigation consisted of one boring each behind the existing bridge abutments where soil strength in the embankment fill and glacial till was determined using correlations to limited numbers of SPT N-values corrected for hammer efficiency and rod depth. Based on this limited subsurface information, we would normally recommend a minimum FS of 1.5 for the embankments with abutments. However, the existing abutment substructures and center pier substructures are proposed to remain in place post-construction from 2 feet below the proposed ground surface through their base elevations and the presence of these substructure elements will improve global stability. Thus, for this condition we recommend a project-specific minimum FS of 1.3 for the embankments with abutments for global stability evaluations where the presence of these substructures is ignored. We additionally recommend a minimum FS of 1.3 for the embankments. FHWA (2011)<sup>12</sup> recommends a minimum FS of 1.1 for pseudo-static seismic conditions, and our analysis uses this FS = 1.1 for all scenarios.

We analyzed global stability using the Spencer method with auto refined search for circular failure surfaces and the Spencer Method with a Cuckoo search plus surface altering optimization for non-circular failure surfaces. The search algorithm that produced a lower factor of safety was selected, and the analyses show that non-circular surfaces govern potential slope failures. For the longitudinal sections at Abutment 1 and Abutment 2, we evaluated the factors of safety of potential failure surfaces for two scenarios: 1) on the abutment foreslope between the abutment and the railroad tracks comprised mainly of riprap over the existing soils, and 2) extending across the entire slope including below the proposed abutments and approach slabs. For the transverse section we evaluated Sta. 206+66, which we determined from the PDR had the greatest height and lateral extent of proposed embankment fills. For this section, we evaluated the minimum factors of safety for potential failure surfaces, which occur within the proposed embankment and roadway fills, as well as the lowest factor of safety failure surface that extends into the existing in situ embankment soils.

## 7.5.2 Results

Results for both static conditions and pseudo-static seismic conditions are summarized in Table 7-3 and Table 7-4 for the longitudinal and transverse embankment geometries, respectively. Refer to the full methodology of the analysis, material properties, and calculations in Appendix D.

For the longitudinal abutment geometries (Table 7-3):

- Potential failure surfaces do not account for additional resistance to potential global stability failures that may be realized by the presence of proposed pile foundations or portions of the existing bridge abutments that will remain in place after construction.

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<sup>12</sup> FHWA. 2011. Geotechnical Engineering Circular No. 3 - LRFD Seismic Analysis and Design of Transportation Geotechnical Features and Structural Foundations Reference Manual, Publication No. FHWA-NHI-11-032.

- Lower bound factors of safety for potential failure surfaces on the foreslopes exceed the project-specific FS of 1.3 under static conditions.
- Lower bound factors of safety for potential failure surfaces that extend below the abutment and approach slab exceed the project-specific FS of 1.3 under static conditions when Granular Borrow is used as the fill material below and behind the proposed abutment.
- Lower bound factors of safety for potential failure surfaces on the foreslopes are sufficient ( $FS > 1.1$ ) under pseudo-static seismic conditions. Additional evaluations of potential failure surfaces below the abutment and approach slab were not explored as factors of safety are expected to exceed those reported in Table 7-3.

**Table 7-3: Summary of Global Stability Factors of Safety - Longitudinal at Proposed Abutments**

| Condition             | Location   | Abutment Backfill Type | Factor of Safety - Failure Surface in Foreslope <sup>1</sup> | Factor of Safety - Failure Surface including Structure <sup>1</sup> |
|-----------------------|------------|------------------------|--------------------------------------------------------------|---------------------------------------------------------------------|
| Static                | Abutment 1 | Granular Borrow        | 1.34                                                         | 1.41                                                                |
|                       | Abutment 2 |                        | 1.34                                                         | 1.46                                                                |
| Pseudo-static seismic | Abutment 1 | Granular Borrow        | 1.17                                                         | N/A <sup>2</sup>                                                    |
|                       | Abutment 2 |                        | 1.17                                                         | N/A <sup>2</sup>                                                    |

Notes: <sup>1</sup>Minimum project-specific factors of safety under static loading conditions are 1.3 for embankments alone and 1.3 for embankments with structures. The minimum factor of safety under pseudo-static seismic loading conditions is 1.1. <sup>2</sup>Pseudo-static failure surfaces met the minimum requirements of a FS in the foreslope evaluation, thus additional evaluations of potential failure surfaces below the abutment and approach slab were not explored.

For the transverse geometry at Sta. 206+66 (Table 7-4):

- The lower bound factor of safety for potential failure surfaces are less than the project-specific FS of 1.3 under static conditions and just meet the minimum FS of 1.1 under pseudo-static seismic conditions. These lower bound FS potential failure surfaces are shallow and contained entirely within the new embankment fill indicating potential surficial sloughing failure for the transverse embankment. The embankment fill modeled was standard granular borrow with material properties of 125 pounds per cubic foot (pcf) unit weight and 32° friction angle as provided in the MaineDOT Bridge Design Guide<sup>9</sup>. The model geometry is also based on HNTB's proposed 2H:1V slope along the entire embankment. While the modeled embankment slope angle of 26.5° is less than angle of internal friction of the embankment fill material (32°), the fill angle of internal friction is not great enough to result in a  $FS \geq 1.3$ . The factor of safety for these potential surficial failure areas can likely be increased if the slope has an established protective vegetation or riprap layer, by increasing the required compactive effort for placed fill, decreasing the embankment slope angle, or using an embankment fill material with greater frictional resistance (i.e., angle of internal friction) such as Gravel Borrow with a design angle of internal friction of 36°. Based on discussions with MaineDOT, we understand that slopes constructed with material and methods commensurate with MaineDOT Standard Specifications and Standard Details have historically performed adequately.

- The lowest factors of safety for potential failure surfaces that intersect and include in situ soils (historical fills) exceed the required FS of 1.3, thus deeper global instabilities in the greater embankment as proposed are of limit concern.

**Table 7-4: Summary of Global Stability Factors of Safety - Transverse at Approach Embankment Sta. 206+66 (Critical Section)**

| Condition             | Slope | Factor of Safety - Failure Surface In Proposed Fill | Factor of Safety - Failure Surface Extending into Existing Soils |
|-----------------------|-------|-----------------------------------------------------|------------------------------------------------------------------|
| Static                | North | 1.25                                                | 1.36                                                             |
|                       | South | 1.25                                                | 1.34                                                             |
| Pseudo-static seismic | North | 1.09                                                | 1.18                                                             |
|                       | South | 1.09                                                | 1.19                                                             |

Notes: Minimum project-specific factors of safety under static loading conditions are 1.3 for embankments alone and 1.3 for embankments with structures. The minimum factor of safety under pseudo-static seismic loading conditions is 1.1. Values in red are potential sloughing failures and do not meet the required factor of safety, however slopes constructed with Granular Borrow at 2H:1V geometry have performed well when constructed per MaineDOT Standard Specifications.

## 7.6 Lateral Earth Pressure for Abutments

Per the 60% plans<sup>3</sup>, proposed Abutment 1 is approximately 58.3 feet wide, 3.5 feet thick, founded at EL. 610.0 feet, and the base of the approach slab is 9.1 feet above the base of the abutment. Proposed Abutment 2 is approximately 55.3 feet wide, 3.5 feet thick, founded at EL. 608.0 feet, and the base of the approach slab is 8.1 feet above the base of the abutment. HNTB also provided WSP with expected abutment movements of 0.46 inches of thermal expansion. WSP used these dimensions and abutment movements to analyze lateral earth pressure.

Under longitudinal expansion, the abutments will be subject to passive earth pressure. Under longitudinal contraction, the abutments will be subject to active earth pressure. Per AASHTO<sup>10</sup> Table C3.11.1-1, MassDOT (2020) LRFD Bridge Manual<sup>13</sup> Figure 3.10.8-1, the abutment height provided, and the anticipated expansion movement of 0.46 inches, we determined that the maximum wall rotation of 0.005 is less than 0.02 which MassDOT (2020) specifies is required to develop full passive earth pressure. MassDOT guidance may be used to determine the passive earth pressure coefficient when it is less than the maximum passive earth pressure coefficient identified in AASHTO<sup>10</sup> for full passive pressures. When the MassDOT<sup>13</sup> guidance yields a  $K_p$  value less than  $K_p$  determined by Rankine, MaineDOT prefers the use of  $K_p$  determined using the Rankine method. Thus, we evaluated  $K_p$  using both methods. For this case, the MassDOT passive pressure coefficient was greater than the Rankine earth pressure coefficient and is the governing scenario. The Rankine earth pressure coefficient was used to determine active lateral earth pressure (assuming level backfill and no frictional interaction between

<sup>13</sup> MassDOT LRFD Bridge Manual - Part 1, January 2020 Revision (<https://www.mass.gov/doc/chapter-3-lrfd-bridge-design-guidelines/download>)

the abutment wall and the backfill). Table 7-5 summarizes the design lateral earth pressure coefficients for active and passive earth pressures per abutment.

**Table 7-5: Recommended Lateral Earth Pressure Coefficients at the Proposed Abutments.**

| Abutment Fill                                     | $\gamma$ (pcf) | $\phi$ (°) | $^1K_a$ | $^2K_p$ | $^3K_0$ |
|---------------------------------------------------|----------------|------------|---------|---------|---------|
| Abutment 1<br>Granular Borrow<br>(Section 703.19) | 125            | 32         | 0.31    | 3.57    | 0.47    |
| Abutment 2<br>Granular Borrow<br>(Section 703.19) | 125            | 32         | 0.31    | 3.81    | 0.47    |

Notes: <sup>1</sup>Active earth pressure,  $K_a$ , was determined using Rankine Method.; <sup>2</sup>Passive earth pressure,  $K_p$ , was determined using the MassDOT Bridge Design Guide method for a partial passive condition based on proposed abutment rotation. <sup>3</sup>At-rest lateral earth pressure coefficient,  $K_0$ , was determined as  $K_0 = 1 - \sin \phi$ .

WSP estimates that the resultant force generated from passive earth pressure using the MassDOT method at Abutment 1 is an unfactored load of 18,476 pounds per foot of abutment length acting at EL 613.0 feet and at Abutment 2 is an unfactored load of 15,626 pounds per foot of abutment length acting at EL 610.7 feet. These values assume the embankment fills are free draining (i.e., no water pressure is allowed to build up behind the abutment walls). Per the 60% Plans<sup>3</sup>, the wingwalls are proposed to be in line and cast monolithically with the abutments. Therefore, we recommend their design is based on the  $K_p$  lateral earth pressure in Table 7-5. Refer to the full methodology of the analysis, material properties, and calculations in Appendix D.

## 7.7 Proposed Bridge Abutment Pile Foundations

HNTB provided WSP with factored AASHTO<sup>10</sup> Strength I loads for the piles at the abutments. WSP performed the pile design using the provided Strength I vertical loads which resulted in a design load of 389 kips per pile at both Abutment 1 and Abutment 2. HNTB also provided WSP with expected lateral movement at the integral abutments, consisting of a total thermal expansion of 0.46 inches and a total thermal contraction of 0.55 inches. WSP analyzed both the expansion and contraction conditions, the contraction movement controlled the design and is reported in the lateral analysis of the abutment piles. We assumed steel HP 14x89 piles driven to bedrock. Abutment 1 is expected to be supported by piles with lengths of between 25.7 feet and 31.2 feet based on BB-PIPC-101 and BP-PIPC-103, and we've evaluated the shorter pile length of 25.7 feet. Abutment 2 is expected to be supported by piles with a length of 47.0 feet based on BB-PIPC-102. The following describes WSP's axial resistance analyses and lateral response of the abutment piles due to abutment deflection.

WSP's pile evaluation did not include the following:

- Downdrag loading: Per AASHTO<sup>10</sup> LRFD Article 3.11.8, downdrag loads on piles can be assumed to be fully developed when settlement at the soils surrounding the piles is 0.4 inches or greater. We anticipate the grade change of approximately 3 feet will result in minimal settlements in the existing predominantly coarse-grained soils at the proposed abutments. Minor settlement less than 0.4 inches was estimated at nearby Sta. 206+66 (Section 7.4) at the edge of guardrail. Thus, we did not evaluate potential downdrag loading for these piles.

- Section loss from corrosion: We did not consider section loss from corrosion associated with road salts. In a meeting on June 27, 2024 with MaineDOT, corrosion was discussed and it was decided that section loss would not be included in final design.

### 7.7.1 Axial Pile Resistance

WSP analyzed the nominal structural and geotechnical pile resistance of HP 14x89 piles at Abutment 1 and Abutment 2 following the design procedures outlined in the MaineDOT Bridge Design Guide<sup>9</sup> and AASHTO<sup>10</sup> LRFD. Since the piles will be driven to hard rock, the nominal resistance of the piles will be controlled by the lesser of the structural limit state in accordance with AASHTO<sup>10</sup> Article 10.7.3.2.3 or the driveability resistance.

The factored pile structural resistance,  $P_r$ , was calculated for the piles using the results of the LPILE analysis outlined in Section 7.7.4 and resistance factors of  $\phi_c = 0.70$  for combined axial and bending loading and  $\phi_c = 0.50$  for axial compression in the lower segment of the pile based on the potential for hard driving conditions.

As outlined in AASHTO<sup>10</sup> Article 10.7.3.2.3, the nominal axial geotechnical resistance of piles driven to point bearing on hard rock should not exceed the nominal structural resistance values obtained from AASHTO<sup>10</sup> Article 6.9.4.1 with a resistance factor of  $\phi_c = 0.50$ , for severe driving conditions applied. As such, the controlling geotechnical pile resistance is equal to the structural resistance.

We performed driveability analyses using GRLWEAP<sup>14</sup> software to determine that the required pile resistance can be achieved at Abutment 1 and Abutment 2 considering locally used available diesel hammers based on the design axial load. WSP understands it is possible to obtain additional axial resistance with the hammer evaluated and with other hammers; however, the reported nominal pile driving resistance is based on the provided design axial load. Per the MaineDOT Standard Specifications<sup>8</sup> Section 501.042, the driving stresses were limited to 45 ksi (90% of the pile steel yield stress), and the number of hammer blows at the required resistance was limited to between 3 and 15 blows per inch. The nominal pile driving resistance was calculated using a resistance factor  $\phi_{dyn} = 0.65$  for driving criteria that will be established by dynamic testing of at least two piles per site condition or 2% of the production piles. The maximum applied factored axial pile loads should not exceed the governing axial pile resistance shown in Table 7-6.

**Table 7-6: Strength Limit State Factored Axial Pile Resistance**

| Abutment   | Factored Structural Resistance <sup>1</sup><br>$\phi_c = 0.50$<br>(kips) | Factored Geotechnical Resistance <sup>2</sup><br>$\phi_c = 0.50$<br>(kips) | Nominal Pile Driving Resistance <sup>3</sup><br>$\phi_{dyn} = 0.65$<br>(kips) | Governing Axial Pile Resistance<br>(kips) |
|------------|--------------------------------------------------------------------------|----------------------------------------------------------------------------|-------------------------------------------------------------------------------|-------------------------------------------|
| Abutment 1 | 653                                                                      | 653                                                                        | 602                                                                           | 602                                       |
| Abutment 2 | 653                                                                      | 653                                                                        | 605                                                                           | 605                                       |

Notes: <sup>1</sup>The displayed structural resistance is the minimum of the factored resistance in the top segment of the pile ( $P_{r,top}$ ), the factored resistance in the second segment of the pile ( $P_{r,2nd}$ ), and the factored resistance in the bottom segment of the pile ( $P_{r,bottom}$ ). <sup>2</sup>Per AASHTO LRFD Article 10.7.3.2.3, the displayed controlling geotechnical resistance is equal to the factored structural resistance in the bottom segment of the pile ( $P_{r,bottom}$ ). <sup>3</sup>The analyzed drivability resistance is based on a APE D25-42 single acting diesel hammer and the design axial load.

<sup>14</sup> GRLWEAP 14 Software Package Version 14.1.20.1, Built December 1, 2022.

## 7.7.2 Lateral Pile Resistance

Lateral response of the abutment piles was evaluated using L-Pile<sup>15</sup> analysis software. The input parameters were developed based on layer response models defined by the software, laboratory test results, correlations to soil properties determined from the field investigations, correlations to soil properties identified in the FB-MultiPier user manual<sup>16</sup>, and standard properties provided in the MaineDOT Bridge Design Guide<sup>9</sup>. The input parameters are summarized in Appendix D. The piles were modeled for lateral response in the weak axis assuming factored pile loads, 0.55 inches of lateral deflection from bridge expansion, and an HP 14x89 pile size. This assumes an applied axial load of 391 kips and 393 kips for Abutment 1 and Abutment 2 respectively, including the HNTB provided load of 389 kips in Strength I, and the pile weight. The pile head to abutment connection was assumed to be fixed, where maximum deflection is at the pile cap and there is no lateral deflection at the pile tip.

For Abutment 1, WSP analyzed a pile length of 25.7 feet. The analysis indicates a maximum moment of 173.7 kip-feet occurs in the piles under the Strength I load case, and a maximum lateral deflection of 0.55 inches occurs in the pile cap. The piles achieve fixity, with no lateral deflection at the pile tip when driven to, and seated on, bedrock.

For Abutment 2, WSP analyzed a pile length of 47.0 feet. The analysis indicates a maximum moment of 172.7 kip-feet occurs in the piles under the Strength I load case, and a maximum lateral deflection of 0.55 inches occurs in the pile cap. The piles achieve fixity, with no lateral deflection at the pile tip when driven to, and seated on, bedrock. Results of the Abutment 1 and Abutment 2 L-Pile first iteration analyses are summarized in Table 7-7.

**Table 7-7: L-Pile Lateral Analysis Results – First Iteration**

| Location   | Pile Length (feet) | Axial Load Analyzed (kips) | Lateral Deflection (inch) | L-Pile Moment at Pile Head (in-kips) | Plastic Hinge Forms | Plastic Hinge Moment (in-kips) |
|------------|--------------------|----------------------------|---------------------------|--------------------------------------|---------------------|--------------------------------|
| Abutment 1 | 25.7               | 391                        | 0.55                      | 2085                                 | Yes                 | 1942                           |
| Abutment 2 | 47.0               | 393                        | 0.55                      | 2072                                 | Yes                 | 1358                           |

Since a plastic hinge forms at the top of the pile at both abutments, we assume the pile head will enter plastic deformation. We then performed a second L-Pile iteration using the same displacement and axial load conditions as the first iteration but set the pile head moment equal to the plastic hinge moment predicted in the first iteration. Results of the L-Pile second iteration analyses are summarized in Table 7-8 and indicate that the demand ratio for combined bending is less than 1.0 in segment 2, and therefore also show that with the exception of the plastic hinge location, the piles remain within the elastic range over the remainder of its length and are stable against buckling. The results indicate that the nominal structural resistance in segment 1 is sufficient to support the loads analyzed.

<sup>15</sup> Ensoft Inc. (2019). L-Pile, version 2019.11.03.

<sup>16</sup> Bridge Software Institute. "FB-MultiPier Soil Parameter Table (US Customary Units)." Accessed on 4/10/2020. <[https://bsi.ce.ufl.edu/downloads/files/MultiPier\\_Soil\\_Table.pdf](https://bsi.ce.ufl.edu/downloads/files/MultiPier_Soil_Table.pdf)>

**Table 7-8: L-Pile Lateral Analysis Results – Second Iteration**

| Location   | Axial Load Analyzed (kips) | Lateral Deflection (inch) | L-Pile Plastic Hinge Moment at Pile Head (in-kips) | Structural Resistance Demand Ratio Segment 1 <sup>1</sup> | Structural Resistance Demand Ratio Segment 2 <sup>1</sup> | Combined Axial & Bending Demand Ratio Segment 2 <sup>2</sup> |
|------------|----------------------------|---------------------------|----------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|--------------------------------------------------------------|
| Abutment 1 | 391                        | 0.55                      | 1942                                               | 0.70                                                      | 0.47                                                      | 0.49                                                         |
| Abutment 2 | 393                        | 0.55                      | 1358                                               | 0.76                                                      | 0.47                                                      | 0.48                                                         |

**Notes:** <sup>1</sup>The displayed structural resistance demand ratio is the maximum of the ratio in the top segment of the pile ( $P_u/P_{r,top}$ ), the ratio in the second segment of the pile ( $P_u/P_{r,2nd}$ ), and the ratio in the bottom segment of the pile ( $P_u/P_{r,bottom}$ ). The ratio should be less than 1.0 to avoid pile failure and greater than 0.20 to avoid an unnecessarily large pile, as recommended in the MaineDOT BDG page 5-43. <sup>2</sup>The combined axial and bending ratio should be less than 1.0, as per AASHTO LRFD Article 6.9.2.2.1

### 7.7.3 Summary of Pile Analysis and Recommendations

We recommend the abutment piles be driven to, and seated on, bedrock and oriented with the weak axis parallel to the centerline of bearing. The recommended maximum factored loads for design of HP 14x89 piles at Abutment 1 and Abutment 2 including the pile weight, the lengths for piles driven to bedrock, and the recommended pile orientation are summarized in Table 7-9.

**Table 7-9: Summary of HP 14x89 Pile Evaluation**

| Location   | Recommended Nominal Pile Driving Resistance <sup>1</sup> (kips) | Design Maximum Factored Axial Load Per Pile (kips) | Estimated Pile Length to Bedrock <sup>2</sup> (feet) | Minimum Pile Embedment Length <sup>3</sup> (feet) | Pile Axis Orientation |
|------------|-----------------------------------------------------------------|----------------------------------------------------|------------------------------------------------------|---------------------------------------------------|-----------------------|
| Abutment 1 | 602                                                             | 391                                                | 26                                                   | 26                                                | Weak                  |
| Abutment 2 | 605                                                             | 393                                                | 47                                                   | 22                                                | Weak                  |

Note: <sup>1</sup>Using a resistance factor of 0.65 for driving criteria that will be established by dynamic testing of at least two piles per site condition, but no less than 2% of the production piles. <sup>2</sup>WSP evaluated structural and geotechnical resistance for piles driven to bedrock, reflected in these pile lengths. <sup>3</sup>Minimum pile embedment below the base of the abutment (depth to fixity plus 5 feet).

WSP evaluated structural and geotechnical resistance of piles driven to bedrock at each abutment, where piles are driven through medium dense to very dense glacial till. There is the potential that piles may achieve the necessary design capacity at depths that are shallower than the bedrock depth, particularly for Abutment 2. Table 7-9 additionally shows the minimum pile length below the base of each abutment in order to meet the requirements of MaineDOT BDG<sup>9</sup> Section 5.4.2.5, Pile Length Requirement (depth to fixity plus 5 feet). Note, that both the nominal pile driving resistance and fixity must be met for each pile driven.

## 8.0 GEOTECHNICAL CONSTRUCTION RECOMMENDATIONS

All areas proposed for embankment fill placement and abutment construction should be cleared, grubbed, and stripped of existing vegetation, pavement, and topsoil. During the grubbing and stripping process, unsuitable materials exposed at the subgrade level, such as wood, logs, tree stumps, forest mat materials, peat, debris fill, or other materials that may decay or collapse should be removed. Prior to placing new fill materials, the existing slopes should be benched to provide a stable surface for compaction and ensure new fills are keyed into the existing embankment. Bench widths should be at least 3 feet, and each bench should be excavated as the layers of the new embankment are being constructed.

Subgrade surfaces for embankments should be prepared in accordance with MaineDOT Specification<sup>8</sup> Section 203.09 for preparation of the embankment area, which requires a firm, unyielding surface. Embankment fill should meet the requirements of MaineDOT Standard Specification<sup>8</sup> Section 703.19 for Granular Borrow. Embankment excavation and fill placement should follow MaineDOT Specification<sup>8</sup> Section 203.13 for embankment construction and should meet the requirements described in this report and at least 90 percent of the maximum dry density as determined by AASHTO T 180. Structural fill materials and placement methods for abutment construction should meet the requirements of MaineDOT Standard Specifications<sup>8</sup>, specifically Section 203.10 through Section 203.12, and 203.17.

Adequate drainage should be installed behind the integral abutments. We recommend the use of French drains with weep holes per MaineDOT Standard Specification<sup>8</sup> Section 512, rather than the use of geocomposite drainage board, to assure efficacy of abutment drainage throughout the design life of the bridge.

If wet subgrade conditions are encountered in abutment and embankment fill areas, wet and disturbed subgrade material should be excavated and replaced with an appropriate size stone and covered with a geotextile (both per MaineDOT Standard Specifications<sup>8</sup>) to allow proper compaction of overlying fills. If seepages persist over a broad subgrade area, provisions should be made to allow for positive drainage beneath and within the new abutments and embankment fills. Positive drainage could be provided by a column of crushed stone wrapped in filter fabric that daylight beyond the new toe of slope.

The estimated pile lengths provided in this report were based on an interpreted depth to bedrock at the proposed abutment and pier locations. Borings show that bedrock elevation varies at the site parallel to the roadway alignment (see Figure 3, attached) and will likely vary over the centerline of the abutments. We recommend a prefabricated pile tip be used in accordance with MaineDOT Standard Specification<sup>8</sup> 501.048 to account for the sloping bedrock.

To establish the actual pile lengths needed to develop the required axial resistance of the driven piles, we recommend implementing a field-verification program consisting of a wave equation analysis and dynamic testing with signal matching including the following:

- Because of the weak and fractured bedrock encountered in the boring logs, we anticipate the piles will penetrate at least 6 inches into the bedrock. Pile lengths should account for this penetration into rock.
- Prior to the beginning of pile driving, a wave equation analysis should be conducted on the contractor's proposed driving system to ensure the hammer is capable of driving the piles to the required capacities without overstressing the piles to the required penetration depths and within a reasonable number of hammer blow counts, typically 3 to 12 blows per inch at end of driving (EOD). If more than one pile section is used at the site, each different pile section should have its own separate wave equation analysis completed.

- Dynamic testing in accordance with MaineDOT specified procedures should be used to establish the driving criteria at the beginning of production pile driving. Two percent of the production piles or a minimum of one pile per substructure shall be subject to dynamic testing. We recommend the first production pile for each structure be tested. We also recommend a 24-hour restrike test be performed for each tested pile because of anticipated pile penetration into the weak and fractured bedrock encountered on site. Dynamic testing and field inspection should include verification of hammer stroke or bounce chamber pressures and hammer blows throughout the pile driving operations. Signal matching analysis of the dynamic test data using methods described by Rausche et al. (1972)<sup>17</sup> should be conducted to determine pile bearing resistance.
- We recommend that MaineDOT's typical refusal criteria of 10 blows per 0.5 inches be implemented to reduce structural damage to the piles. The Engineer should review all dynamic pile testing results before the piles are accepted.

## 9.0 REPORT AND EXPLORATION LIMITATIONS

This Geotechnical Design Report (GDR) was prepared for the use of MaineDOT for the replacement of Phair Crossing Bridge No. 3259 of Maine Route 10 over the Bangor & Aroostook Railroad in Presque Isle, Maine. We conducted our evaluations and compiled our recommendations in accordance with generally accepted soil and foundation engineering practices in this geographical area and under similar time and financial constraints. WSP makes no other warranty, either express or implied. If changes in the nature, design, or location of the proposed project are planned, WSP should be notified to review the appropriateness of our conclusions and recommendations, and to modify the recommendations as appropriate to reflect the changes in design. In addition, WSP should review the final plans and specifications to evaluate compliance with these recommendations.

Our analyses and recommendations are based, in part, on information obtained from the referenced subsurface explorations completed at the discrete locations described in the report. Variations in the nature and extent of subsurface conditions between explorations should be expected. WSP should be notified if conditions encountered during construction vary from those described in this report so that we may re-evaluate, and if necessary, revise the recommendations made in this report.

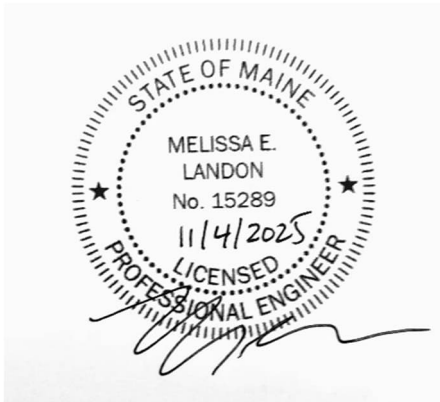
The professional services provided by WSP for this project include only the geotechnical aspects of the subsurface conditions at this site. The presence or implications of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this report and have not been investigated or addressed.

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<sup>17</sup> Rausche, F., F. Moses, and G. G. Goble. 1972. "Soil Resistance Predictions from Pile Dynamics," *Journal of the Soil Mechanics and Foundation Division*. American Society of Civil Engineers, Reston, VA, Vol. 98, No. SM9, pp. 917–937.

## Signature Page

**WSP USA, Inc.**



Melissa E. Landon, PhD, PE  
*Assistant Vice President, Geotechnical Engineering*

Christopher C. Benda, PE  
*Vice President, Geotechnical Engineering*

Daniel E. Burgess  
*Consultant, Geotechnical Engineering*

DEB/MEL/CCB/JDL

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## TABLES

**Table 1: Subsurface Exploration Locations**  
**Preliminary Geotechnical Design Report**  
**Phair Crossing Bridge #3259, Presque Isle, Maine**  
**MaineDOT WIN 026434.00**

| Boring Designation <sup>1,2,3</sup> | As-Drilled Locations <sup>4</sup> |            | Existing Ground Surface Elevation <sup>4</sup><br>(feet) | Maximum Depth of Investigation <sup>5</sup><br>(feet bgs) |
|-------------------------------------|-----------------------------------|------------|----------------------------------------------------------|-----------------------------------------------------------|
|                                     | Northing                          | Easting    |                                                          |                                                           |
| BB-PIPC-101                         | 1024234.81                        | 2280724.24 | 617.9                                                    | 43.6                                                      |
| BB-PIPC-102                         | 1024227.74                        | 2280863.38 | 616.0                                                    | 65.0                                                      |
| BP-PIPC-103                         | 1024219.35                        | 2280745.12 | 617.7                                                    | 48.9                                                      |
| BP-PIPC-103A                        | 1024219.59                        | 2280748.15 | 617.7                                                    | 35.0                                                      |

Notes:

1. Boring locations are shown in Figure 2 - Boring Location Plan of the Preliminary Geotechnical Design Report.
2. Borings BB-PIPC-101, BB-PIPC-102, and BP-PIPC-101 were performed by Seaboard.
3. Boring logs are presented in Appendix A of the Preliminary Geotechnical Design Report.
4. As-drilled locations and elevations for the borings and the probe are derived from swing tie measurements made in the field to locate these with respect to site features. Northings and Eastings were derived from CADD files provided to WSP by HNTB on March 25, 2024.
5. Depth below the existing roadway surface.

Prepared By: DEB  
 Checked By: LMP  
 Reviewed By: MEL

Table 2: Summary of Rock Core Quality  
Preliminary Geotechnical Design Report  
Phair Crossing Bridge #3259, Presque Isle, Maine  
MaineDOT WIN 026434.00

| Test Boring Designation | Core Size [in] | Existing Ground Surface Elevation <sup>1</sup> [ft] | Run |                                           |                                 |      |          |             | TCR <sup>2</sup> |      | RQD <sup>3</sup> |     | Physical Rock Parameters |                         |                                       | Lithologic, Rock Mass and Discontinuity Description <sup>6</sup> |                                                                                                                                                                                                                                                                                            |
|-------------------------|----------------|-----------------------------------------------------|-----|-------------------------------------------|---------------------------------|------|----------|-------------|------------------|------|------------------|-----|--------------------------|-------------------------|---------------------------------------|------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                         |                |                                                     | No. | Midpoint Depth Below Bedrock Surface [ft] | Depth Below Ground Surface [ft] |      |          | Length [ft] | Length [ft]      | %    | Length [ft]      | %   | Designation              | Weathering <sup>4</sup> | Estimated Field Strength <sup>4</sup> |                                                                  | Rock Mass Rating [RMR] <sup>5</sup>                                                                                                                                                                                                                                                        |
|                         |                |                                                     |     |                                           | Start                           | End  | Midpoint |             |                  |      |                  |     |                          |                         |                                       |                                                                  |                                                                                                                                                                                                                                                                                            |
| BB-PIPC-101             | NQ [1.88]      | 617.9                                               | R1  | 2.50                                      | 33.6                            | 38.6 | 36.1     | 5.0         | 1.8              | 36%  | 0.0              | 0%  | Very Poor                | Slightly Weathered (W2) | Strong (R4)                           | 46                                                               | Grey, fine to coarse grained, LIMESTONE [sedimentary rock], strong, slightly weathered; discontinuities low angle to steep dipping, close spacing, tight to open, extremely fractured [SILURIAN-ORDOVICIAN-AGED CARYS MILLS FORMATION].                                                    |
|                         |                |                                                     | R2  | 6.20                                      | 38.6                            | 41.0 | 39.8     | 2.4         | 2.0              | 83%  | 0.5              | 21% | Very Poor                | Slightly Weathered (W2) | Strong (R4)                           | 48                                                               | Grey, fine to coarse grained, LIMESTONE [sedimentary rock], strong, slightly weathered; discontinuities low angle to steep dipping, close spacing, tight to open, extremely fractured [SILURIAN-ORDOVICIAN-AGED CARYS MILLS FORMATION].                                                    |
|                         |                |                                                     | R3  | 8.45                                      | 41.0                            | 43.1 | 42.1     | 2.1         | 1.9              | 90%  | 0.0              | 0%  | Very Poor                | Slightly Weathered (W2) | Strong (R4)                           | 43                                                               | Grey, fine to coarse grained, LIMESTONE [sedimentary rock], strong, slightly weathered; discontinuities steep angle to vertical dipping, close spacing, open, extremely fractured [SILURIAN-ORDOVICIAN-AGED CARYS MILLS FORMATION].                                                        |
|                         |                |                                                     | R4  | 9.75                                      | 43.1                            | 43.6 | 43.4     | 0.5         | 0.5              | 100% | 0.0              | 0%  | Very Poor                | Fresh (W1)              | Strong (R4)                           | 44                                                               | Grey, fine to coarse grained, LIMESTONE [sedimentary rock], strong, fresh; discontinuities steep angle dipping, close spacing, tight, extremely fractured [SILURIAN-ORDOVICIAN-AGED CARYS MILLS FORMATION].                                                                                |
| BB-PIPC-102             | NQ [1.88]      | 616.0                                               | R1  | 6.34                                      | 55.0                            | 60.0 | 57.5     | 5.0         | 4.3              | 86%  | 0.4              | 8%  | Very Poor                | Slightly Weathered (W2) | Strong (R4)                           | 43                                                               | Grey, fine to coarse grained, LIMESTONE [sedimentary rock], strong, slightly weathered; discontinuities low angle to steep dipping, close spacing, open, extremely fractured, frequent calcite intrusions [SILURIAN-ORDOVICIAN-AGED CARYS MILLS FORMATION].                                |
|                         |                |                                                     | R2  | 10.54                                     | 60.0                            | 63.4 | 61.7     | 3.4         | 3.4              | 100% | 0.0              | 0%  | Very Poor                | Slightly Weathered (W2) | Strong (R4)                           | 42                                                               | Grey, fine to coarse grained, LIMESTONE [sedimentary rock], strong, slightly weathered; discontinuities moderate to steep angle dipping, close spacing, tight to open, extremely fractured 61 ft to 63.4 ft, frequent calcite intrusions [SILURIAN-ORDOVICIAN-AGED CARYS MILLS FORMATION]. |
|                         |                |                                                     | R3  | 13.04                                     | 63.4                            | 65.0 | 64.2     | 1.6         | 1.5              | 94%  | 0.3              | 21% | Very Poor                | Slightly Weathered (W2) | Strong (R4)                           | 47                                                               | Grey, fine to coarse grained, LIMESTONE [sedimentary rock], strong, slightly weathered; discontinuities low angle to vertical dipping, close spacing, tight, large calcite intrusion [SILURIAN-ORDOVICIAN-AGED CARYS MILLS FORMATION].                                                     |

Table 2: Summary of Rock Core Quality  
Preliminary Geotechnical Design Report  
Phair Crossing Bridge #3259, Presque Isle, Maine  
MaineDOT WIN 026434.00

| Test Boring Designation | Core Size [in] | Existing Ground Surface Elevation <sup>1</sup> [ft] | Run |                                           |                                 |      |          |             | TCR <sup>2</sup> |      | RQD <sup>3</sup> |     |             | Physical Rock Parameters |                                       |                                     | Lithologic, Rock Mass and Discontinuity Description <sup>6</sup>                                                                                                                                                                                            |
|-------------------------|----------------|-----------------------------------------------------|-----|-------------------------------------------|---------------------------------|------|----------|-------------|------------------|------|------------------|-----|-------------|--------------------------|---------------------------------------|-------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                         |                |                                                     | No. | Midpoint Depth Below Bedrock Surface [ft] | Depth Below Ground Surface [ft] |      |          | Length [ft] | Length [ft]      | %    | Length [ft]      | %   | Designation | Weathering <sup>4</sup>  | Estimated Field Strength <sup>4</sup> | Rock Mass Rating [RMR] <sup>5</sup> |                                                                                                                                                                                                                                                             |
|                         |                |                                                     |     |                                           | Start                           | End  | Midpoint |             |                  |      |                  |     |             |                          |                                       |                                     |                                                                                                                                                                                                                                                             |
| BP-PIPC-103             | NQ [1.88]      | 617.7                                               | R1  | 1.25                                      | 38.9                            | 41.4 | 40.2     | 2.5         | 2.3              | 92%  | 0.0              | 0%  | Very Poor   | Fresh (W1)               | Medium Strong (R3)                    | 42                                  | Grey, fine to coarse grained, LIMESTONE [sedimentary rock], medium strong, fresh; discontinuities horizontal to steep angle dipping, close spacing, tight to open, extremely fractured [SILURIAN-ORDOVICIAN-AGED CARYS MILLS FORMATION].                    |
|                         |                |                                                     | R2  | 3.95                                      | 41.4                            | 44.3 | 42.9     | 2.9         | 2.9              | 100% | 1.2              | 41% | Poor        | Fresh (W1)               | Medium Strong (R3)                    | 47                                  | Grey, fine to coarse grained, LIMESTONE [sedimentary rock], medium strong, fresh; discontinuities horizontal to steep angle dipping, close spacing, tight to open, extremely fractured 43.2 ft to 44.3 ft [SILURIAN-ORDOVICIAN-AGED CARYS MILLS FORMATION]. |
|                         |                |                                                     | R3  | 6.35                                      | 44.3                            | 46.2 | 45.3     | 1.9         | 1.7              | 89%  | 0.0              | 0%  | Very Poor   | Fresh (W1)               | Medium Strong (R3)                    | 38                                  | Grey, fine to coarse grained, LIMESTONE [sedimentary rock], medium strong, fresh; discontinuities horizontal to vertical dipping, close spacing, open, extremely fractured [SILURIAN-ORDOVICIAN-AGED CARYS MILLS FORMATION].                                |
|                         |                |                                                     | R4  | 7.65                                      | 46.2                            | 46.9 | 46.6     | 0.7         | 0.7              | 100% | 0.0              | 0%  | Very Poor   | Fresh (W1)               | Medium Strong (R3)                    | 38                                  | Grey, fine to coarse grained, LIMESTONE [sedimentary rock], medium strong, fresh; discontinuities horizontal to vertical dipping, close spacing, open, extremely fractured [SILURIAN-ORDOVICIAN-AGED CARYS MILLS FORMATION].                                |
|                         |                |                                                     | R5  | 8.30                                      | 46.9                            | 47.5 | 47.2     | 0.6         | 0.6              | 100% | 0.0              | 0%  | Very Poor   | Fresh (W1)               | Medium Strong (R3)                    | 38                                  | Grey, fine to coarse grained, LIMESTONE [sedimentary rock], medium strong, fresh; discontinuities horizontal to vertical dipping, close spacing, open, extremely fractured [SILURIAN-ORDOVICIAN-AGED CARYS MILLS FORMATION].                                |
|                         |                |                                                     | R6  | 9.30                                      | 47.5                            | 48.9 | 48.2     | 1.4         | 0.6              | 43%  | 0.0              | 0%  | Very Poor   | Fresh (W1)               | Medium Strong (R3)                    | 38                                  | Grey, fine to coarse grained, LIMESTONE [sedimentary rock], medium strong, fresh, discontinuities horizontal to vertical dipping, close spacing, open, extremely fractured [SILURIAN-ORDOVICIAN-AGED CARYS MILLS FORMATION]                                 |

**Notes:**

1. As-drilled locations and elevations for the borings and the probe are derived from swing tie measurements made in the field to locate these with respect to site features. Northings and Eastings were derived from CADD files provided to WSP by HNTB on March 25, 2024.

2. TCR = total core recovery. Total core recovery is the length of core recovered divided by the length of the run.

3. RQD = rock quality designation. RQD is the total length of intact, full diameter core pieces recovered with a length greater than or equal to twice the core diameter (i.e., length of 4 inches) measured along the core axis. The percent RQD is the total length of RQD measured versus the run length. Note that vertical discontinuities are not included in determination of RQD.

4. Weathering and Estimated Field Strength based on Tables II.4 and II.3 (respectively) in Willey, 2004 (based on ISRM, 1981).

5. Rock Mass Rating System (RMR; Bieniawski, 1989) assigns numerical ratings to six parameters, including the strength of the intact rock, the RQD, the discontinuity spacing, discontinuity conditions, groundwater conditions, and orientation of discontinuities. These ratings are summed to give the RMR value. As proposed foundations or tie-back designs are not complete, the rating adjustment for joint orientation was assigned a value of 0.

6. ft = feet, in = inches

Prepared by: DEB

Checked by: ATM/KAR

Reviewed by: MEL

**Table 3: Summary of Soil Index and Classification Laboratory Testing Results**  
**Geotechnical Design Report**  
**Phair Crossing Bridge #3259, Presque Isle, Maine**  
**MaineDOT WIN 026434.00**

| Test Boring Designation <sup>1</sup> | Ground Surface Elevation (feet) <sup>1,2</sup> | Sample Number | Sample Depth Below Ground Surface (feet) | Approximate Sample Elevation (feet) <sup>2</sup> | Laboratory Testing <sup>3,4,5</sup> |                               |                                |                                   | Soil Classification |                   |
|--------------------------------------|------------------------------------------------|---------------|------------------------------------------|--------------------------------------------------|-------------------------------------|-------------------------------|--------------------------------|-----------------------------------|---------------------|-------------------|
|                                      |                                                |               |                                          |                                                  | Gravel Content <sup>3</sup> (%)     | Sand Content <sup>3</sup> (%) | Fines Content (%) <sup>3</sup> | Moisture Content <sup>4</sup> (%) | AASHTO <sup>5</sup> | USCS <sup>5</sup> |
| BB-PIPC-101                          | 617.9                                          | 2D            | 5.0 - 7.0                                | 612.9 - 610.9                                    | 30.3                                | 49.2                          | 20.5                           | -                                 | A-1-b (0)           | SM                |
|                                      |                                                | 4D            | 15.0 - 17.0                              | 602.9 - 600.9                                    | 36.6                                | 21.9                          | 41.5                           | 35.8                              | A-4 (0)             | GM                |
|                                      |                                                | 5D            | 20.0 - 22.0                              | 597.9 - 595.9                                    | 43.9                                | 36.0                          | 20.1                           | 7.4                               | A-1-b (0)           | GM                |
|                                      |                                                | 6D            | 25.0 - 27.0                              | 592.9 - 590.9                                    | 6.6                                 | 35.5                          | 57.9                           | 18.3                              | A-4 (0)             | ML                |
|                                      |                                                | 7D            | 30.0 - 32.0                              | 587.9 - 585.9                                    | 43.8                                | 38.8                          | 17.4                           | -                                 | A-1-b (0)           | GM                |
| BB-PIPC-102                          | 616.0                                          | 3D            | 10.0 - 12.0                              | 606.0 - 604.0                                    | 23.7                                | 48.5                          | 27.8                           | -                                 | A-2-4 (0)           | SM                |
|                                      |                                                | 4D            | 15.0 - 17.0                              | 601.0 - 599.0                                    | 26.1                                | 48.7                          | 25.2                           | -                                 | A-2-4 (0)           | SM                |
|                                      |                                                | 8D            | 35.0 - 37.0                              | 581.0 - 579.0                                    | 33.1                                | 31.7                          | 35.2                           | 14.0                              | A-4 (0)             | GM                |
|                                      |                                                | 9D            | 40.0 - 42.0                              | 576.0 - 574.0                                    | 46.4                                | 35.0                          | 18.6                           | 6.1                               | A-1-b (0)           | GM                |
|                                      |                                                | 11D           | 50.0 - 51.2                              | 566.0 - 564.8                                    | 24.9                                | 47.8                          | 27.3                           | 11.8                              | A-2-4 (0)           | SM                |

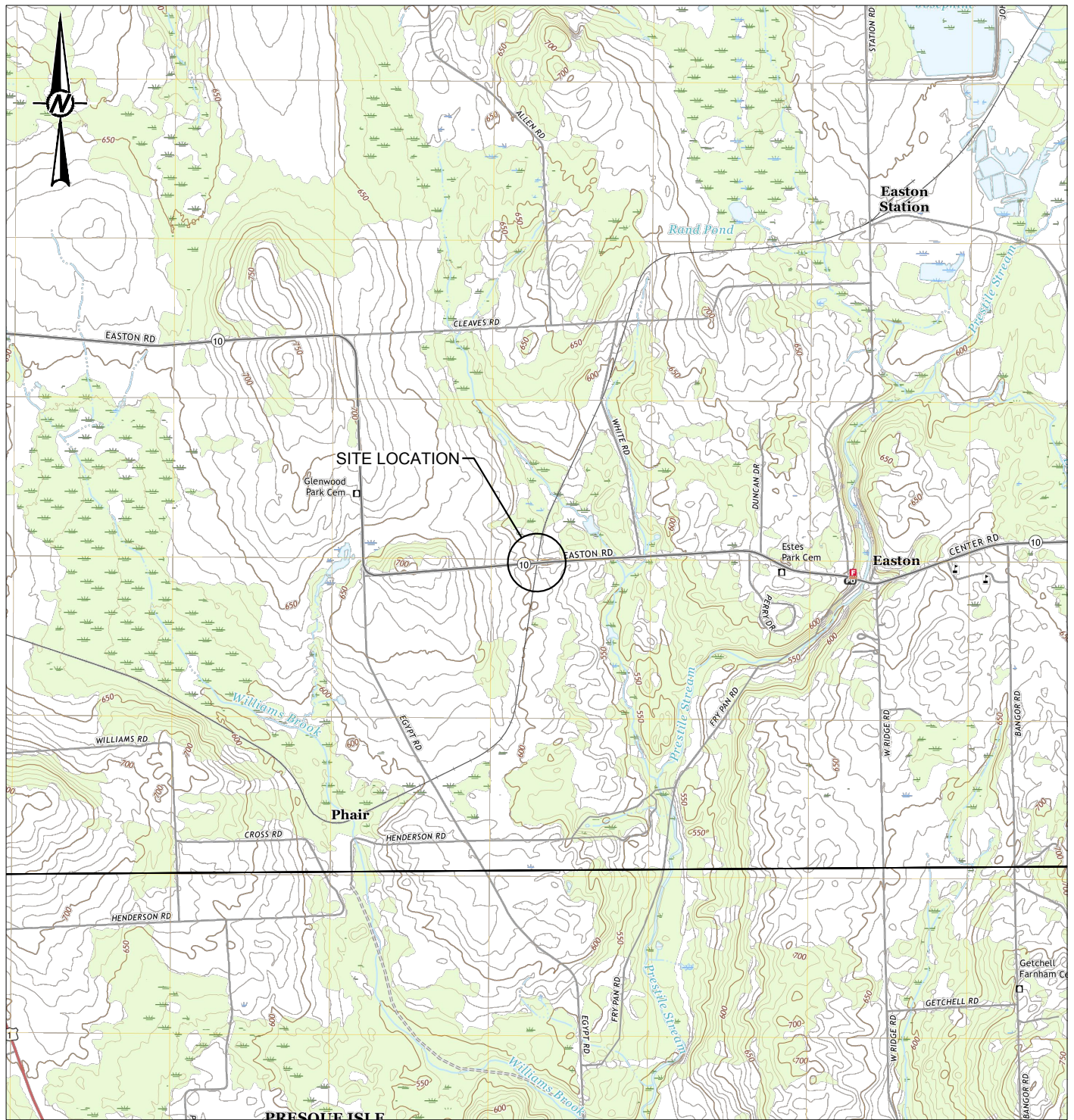
Notes:

1. Test boring locations are illustrated in Figure 2 - Boring Location Map of the Preliminary Geotechnical Design Report.
2. As-drilled locations and elevations for the borings and the probe are derived from swing tie measurements made in the field to locate these with respect to site features. Northings and Eastings were derived from CADD files provided to WSP by HNTB on March 25, 2024.
3. Particle size testing was performed in accordance with ASTM D6913, Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis.
4. Moisture content testing was performed in accordance with ASTM D2216, Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
5. AASHTO and USCS symbols were assigned based on interpreted laboratory test results provided by Geotesting Express on January 8, 2024.
6. Complete laboratory test results for soil testing are provided in Appendix C. Laboratory test results are included on the boring logs in Appendix A.

Prepared By: TJ  
 Checked By: DEB  
 Reviewed By: MEL

## FIGURES

Last Edited By: amonies Date: 2024-04-16 Time: 11:45:46 AM | Printed By: Alkorales Date: 2024-04-16 Time: 11:46:32 AM  
Path: \\golder-gds-complex\data\offices\Manchester\SIMM\EDOT\PresqueIsle99\_PROJ\31407448\0001-001.dwg



#### REFERENCE(S)

BASE MAPS TAKEN FROM U.S.G.S. 7.5 MINUTE QUADRANGLES OF EASTON AND WESTFIELD, MAINE DATED 2023.



#### CLIENT

HNTB CORPORATION  
82 RUNNING HILL ROAD, SUITE 201  
SOUTH PORTLAND, ME 04106

#### CONSULTANT



YYYY-MM-DD 2024-04-16

DESIGNED DEB

PREPARED AM

REVIEWED MEL

APPROVED

#### PROJECT

PHAIR CROSSING BRIDGE NO. 3259  
PRESQUE ISLE, MAINE  
(WIN 026434.00)

#### TITLE

**SITE LOCATION MAP**

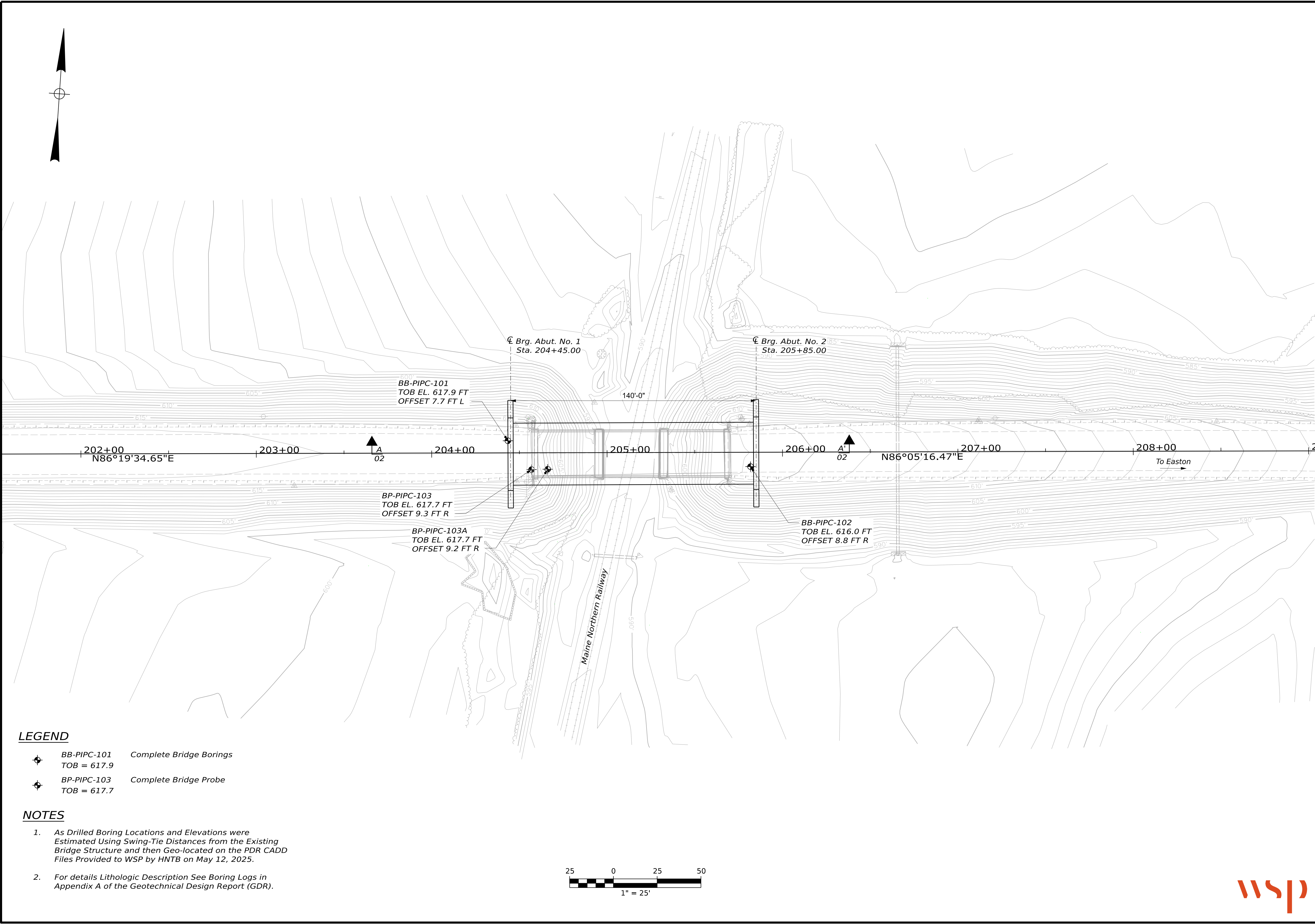
PROJECT NO.  
31407448.000

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FIGURE  
1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI A  
1 in

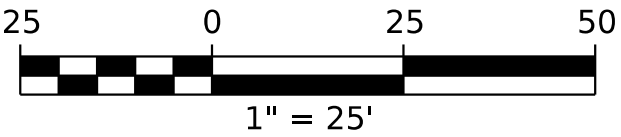


LEGEND

- BB-PIPC-101  
TOB = 617.9      Complete Bridge Borings
- BP-PIPC-103  
TOB = 617.7      Complete Bridge Probe

NOTES

- As Drilled Boring Locations and Elevations were Estimated Using Swing-Tie Distances from the Existing Bridge Structure and then Geo-located on the PDR CADD Files Provided to WSP by HNTB on May 12, 2025.
- For details Lithologic Description See Boring Logs in Appendix A of the Geotechnical Design Report (GDR).



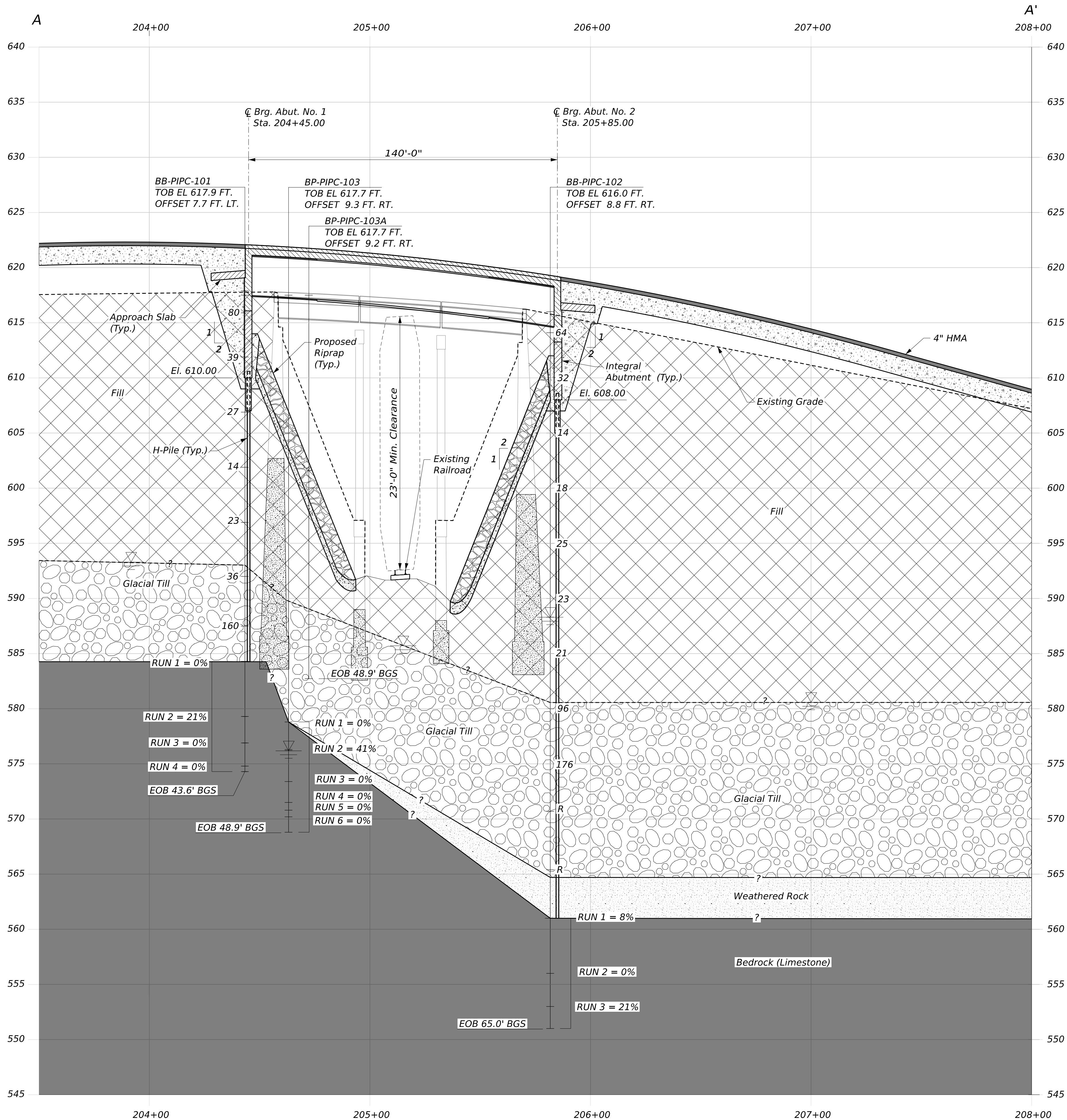
PRESQUE ISLE  
PHAIR CROSSING BRIDGE  
BORING LOCATION PLAN

SHEET NUMBER  
2  
OF 3

|                                                |                 |
|------------------------------------------------|-----------------|
| STATE OF MAINE<br>DEPARTMENT OF TRANSPORTATION |                 |
| 2642400                                        |                 |
| WIN<br>026424.00                               | BRIDGE NO. 3259 |
| BRIDGE PLANS                                   |                 |

| PROJ. MANAGER                  | BY        | DATE     |
|--------------------------------|-----------|----------|
| DESIGN-DETAILED<br>E. CARON    | M. WRIGHT | 9/2/2025 |
| CHECKED-REVIEWED<br>D. BURGESS | M. LANDON | 9/2/2025 |
| DESIGN-DETAILED                |           |          |
| DESIGN-DETAILED                |           |          |
| REVISIONS 1                    |           |          |
| REVISIONS 2                    |           |          |
| REVISIONS 3                    |           |          |
| REVISIONS 4                    |           |          |
| FIELD CHANGES                  |           |          |

SIGNATURE  
P.E. NUMBER  
DATE

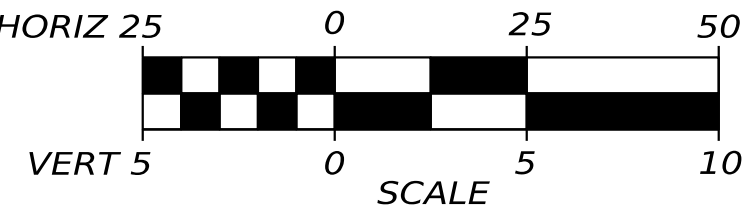


**LEGEND**

- Proposed Asphalt
- Proposed Subbase
- Proposed Riprap
- Brown, Very Dense to Medium Dense Fine to Coarse Sand, Little to Some Silt, Little to Some Gravel (Fill)
- Brown, Dense to Very Dense, Fine to Coarse Gravel, Some Silt, Fine to Coarse Sand (Glacial Till)
- Grey, Flaky and Scaly Weathered Rock
- Grey, Fine Grained to Coarse Grained Limestone
- Proposed Bridge Substructure and Superstructure
- Existing Ground Surface
- Interpreted Ground Water Surface
- Boring Location I.D.
- Elevation
- Offset (Ft.) From Section Line
- Top of Boring Probe
- SPT: N60 - Value (Corrected for Hammer Efficiency)
- Refusal
- Strata Interface
- Run 1 = 92% Rock Core Number and Rock Quality Designation (RQC)
- End of Boring Depth Below Ground Surface (BGS)

**NOTES:**

- As Drilled Boring Locations and Elevations were Estimated Using Swing-Tie Distances from the Existing Bridge Structure and then Geo-Located on the Draft PDR. CADD Files Provided to WSP by HNTB on May 12, 2025.
- For Detailed Lithologic Descriptions see Boring Logs in Appendix A of the Geotechnical Design Report (GDR).
- For Complete Laboratory Data see Laboratory Reports, Appendix C of the Geotechnical Design Report (GDR).
- Groundwater Surface is Interpreted From Localized Surface Water Levels and Measurements Taken During the Subsurface Exploration Programs. See the Geotechnical Design Report (GDR) and Boring Logs in Appendix A.
- This Generalized Subsurface Profile is Intended to Convey Trends in Subsurface Conditions. The Boundaries Between Strata are Approximate and Idealized and Have Been Developed Based on Interpretations of Widely Spaced Explorations. Actual Soil and Rock Transitions may Vary and are Probably More Erratic.



|                                                |           |                                 |             |           |                 |              |
|------------------------------------------------|-----------|---------------------------------|-------------|-----------|-----------------|--------------|
| STATE OF MAINE<br>DEPARTMENT OF TRANSPORTATION | 2642400   |                                 | WIN         | 026424.00 | BRIDGE NO. 3259 | BRIDGE PLANS |
|                                                | SIGNATURE |                                 | P.E. NUMBER |           | DATE            |              |
| PRESQUE ISLE<br>PHAIR CROSSING BRIDGE          |           | INTERPRETIVE SUBSURFACE PROFILE |             |           |                 |              |
| SHEET NUMBER                                   |           | 3                               |             |           |                 |              |
| OF 3                                           |           |                                 |             |           |                 |              |

**APPENDIX A**

# Boring Logs

| UNIFIED SOIL CLASSIFICATION SYSTEM                                                                                                            |                                                                                    |                                                        |                                                         |                                                                                                                      | MODIFIED BURMISTER SYSTEM                                                                                                                                                                                                                                                    |         |                                                                                   |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|--------------------------------------------------------|---------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|-----------------------------------------------------------------------------------|--|
| MAJOR DIVISIONS                                                                                                                               |                                                                                    |                                                        | GROUP SYMBOLS                                           | TYPICAL NAMES                                                                                                        |                                                                                                                                                                                                                                                                              |         |                                                                                   |  |
| COARSE-GRAINED SOILS<br><br>(more than half of material is larger than No. 200 sieve size)                                                    | GRAVELS<br><br>(more than half of coarse fraction is larger than No. 4 sieve size) | CLEAN GRAVELS                                          | GW                                                      | Well-graded gravels, gravel-sand mixtures, little or no fines.                                                       | <u>Descriptive Term</u>                                                                                                                                                                                                                                                      |         | <u>Portion of Total (%)</u>                                                       |  |
|                                                                                                                                               |                                                                                    | (little or no fines)                                   | GP                                                      | Poorly-graded gravels, gravel sand mixtures, little or no fines.                                                     | trace                                                                                                                                                                                                                                                                        |         | 0 - 10                                                                            |  |
|                                                                                                                                               |                                                                                    |                                                        |                                                         |                                                                                                                      | little                                                                                                                                                                                                                                                                       |         | 11 - 20                                                                           |  |
|                                                                                                                                               |                                                                                    |                                                        |                                                         |                                                                                                                      | some                                                                                                                                                                                                                                                                         |         | 21 - 35                                                                           |  |
|                                                                                                                                               |                                                                                    |                                                        |                                                         | adjective (e.g. Sandy, Clayey)                                                                                       |                                                                                                                                                                                                                                                                              | 36 - 50 |                                                                                   |  |
|                                                                                                                                               | SANDS<br><br>(more than half of coarse fraction is smaller than No. 4 sieve size)  | GRAVEL WITH FINES<br><br>(Appreciable amount of fines) | GM                                                      | Silty gravels, gravel-sand-silt mixtures.                                                                            | TERMS DESCRIBING DENSITY/CONSISTENCY                                                                                                                                                                                                                                         |         |                                                                                   |  |
|                                                                                                                                               |                                                                                    | GC                                                     | Clayey gravels, gravel-sand-clay mixtures.              |                                                                                                                      |                                                                                                                                                                                                                                                                              |         |                                                                                   |  |
|                                                                                                                                               |                                                                                    | CLEAN SANDS                                            | SW                                                      | Well-graded sands, Gravelly sands, little or no fines                                                                | <u>Density of Cohesionless Soils</u>                                                                                                                                                                                                                                         |         | <u>Standard Penetration Resistance</u><br>N <sub>60</sub> -Value (blows per foot) |  |
| (little or no fines)                                                                                                                          |                                                                                    | SP                                                     | Poorly-graded sands, Gravelly sand, little or no fines. | Very loose                                                                                                           |                                                                                                                                                                                                                                                                              | 0 - 4   |                                                                                   |  |
| FINE-GRAINED SOILS<br><br>(more than half of material is smaller than No. 200 sieve size)                                                     | SILTS AND CLAYS<br><br>(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. | Loose                                                                                                                                                                                                                                                                        |         | 5 - 10                                                                            |  |
|                                                                                                                                               |                                                                                    |                                                        |                                                         |                                                                                                                      | Medium Dense                                                                                                                                                                                                                                                                 |         | 11 - 30                                                                           |  |
|                                                                                                                                               |                                                                                    |                                                        |                                                         |                                                                                                                      | Dense                                                                                                                                                                                                                                                                        |         | 31 - 50                                                                           |  |
|                                                                                                                                               |                                                                                    |                                                        |                                                         |                                                                                                                      | Very Dense                                                                                                                                                                                                                                                                   |         | > 50                                                                              |  |
|                                                                                                                                               | SILTS AND CLAYS<br><br>(liquid limit greater than 50)                              |                                                        | SM                                                      | Silty sands, sand-silt mixtures                                                                                      | <b>Fine-grained soils</b> (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. |         |                                                                                   |  |
|                                                                                                                                               |                                                                                    |                                                        | SC                                                      | Clayey sands, sand-clay mixtures.                                                                                    |                                                                                                                                                                                                                                                                              |         |                                                                                   |  |
|                                                                                                                                               |                                                                                    |                                                        |                                                         |                                                                                                                      | <u>Consistency of Cohesive soils</u>                                                                                                                                                                                                                                         |         | <u>Approximate Undrained Shear Strength (psf)</u>                                 |  |
|                                                                                                                                               |                                                                                    |                                                        |                                                         |                                                                                                                      | SPT N <sub>60</sub> -Value (blows per foot)                                                                                                                                                                                                                                  |         | <u>Field Guidelines</u>                                                           |  |
| HIGHLY ORGANIC SOILS                                                                                                                          | SILTS AND CLAYS<br><br>(liquid limit greater than 50)                              |                                                        | 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                                               |  |
|                                                                                                                                               | SILTS AND CLAYS<br><br>(liquid limit greater than 50)                              |                                                        | Very Stiff                                              | 16 - 30                                                                                                              | 2000 - 4000                                                                                                                                                                                                                                                                  |         | Indented by thumbnail                                                             |  |
|                                                                                                                                               |                                                                                    |                                                        | Hard                                                    | >30                                                                                                                  | over 4000                                                                                                                                                                                                                                                                    |         | Indented by thumbnail with difficulty                                             |  |
|                                                                                                                                               |                                                                                    |                                                        |                                                         |                                                                                                                      | <b>Rock Quality Designation (RQD):</b>                                                                                                                                                                                                                                       |         |                                                                                   |  |
|                                                                                                                                               |                                                                                    |                                                        |                                                         |                                                                                                                      | RQD (%) = <u>sum of the lengths of intact pieces of core* &gt; 4 inches</u><br>length of core advance<br>*Minimum NQ rock core (1.88 in. OD of core)                                                                                                                         |         |                                                                                   |  |
| Desired Soil Observations (in this order, if applicable):                                                                                     | SILTS AND CLAYS<br><br>(liquid limit greater than 50)                              |                                                        | MH                                                      | Inorganic silts, micaceous or diatomaceous fine Sandy or Silty soils, elastic silts.                                 | <b>Rock Quality Based on RQD</b>                                                                                                                                                                                                                                             |         |                                                                                   |  |
|                                                                                                                                               |                                                                                    |                                                        | CH                                                      | Inorganic clays of high plasticity, fat clays.                                                                       |                                                                                                                                                                                                                                                                              |         |                                                                                   |  |
|                                                                                                                                               |                                                                                    |                                                        | OH                                                      | Organic clays of medium to high plasticity, organic silts.                                                           | <u>Rock Quality</u>                                                                                                                                                                                                                                                          |         | <u>RQD (%)</u>                                                                    |  |
|                                                                                                                                               |                                                                                    |                                                        |                                                         |                                                                                                                      | Very Poor                                                                                                                                                                                                                                                                    |         | ≤25                                                                               |  |
|                                                                                                                                               | HIGHLY ORGANIC SOILS                                                               |                                                        |                                                         |                                                                                                                      | Poor                                                                                                                                                                                                                                                                         |         | 26 - 50                                                                           |  |
|                                                                                                                                               |                                                                                    |                                                        |                                                         |                                                                                                                      | Fair                                                                                                                                                                                                                                                                         |         | 51 - 75                                                                           |  |
|                                                                                                                                               |                                                                                    |                                                        |                                                         |                                                                                                                      | Good                                                                                                                                                                                                                                                                         |         | 76 - 90                                                                           |  |
|                                                                                                                                               |                                                                                    |                                                        |                                                         |                                                                                                                      | Excellent                                                                                                                                                                                                                                                                    |         | 91 - 100                                                                          |  |
| Desired Rock Observations (in this order, if applicable):                                                                                     | SILTS AND CLAYS<br><br>(liquid limit greater than 50)                              |                                                        |                                                         |                                                                                                                      | <b>Desired Rock Observations (in this order, if applicable):</b>                                                                                                                                                                                                             |         |                                                                                   |  |
|                                                                                                                                               |                                                                                    |                                                        |                                                         |                                                                                                                      | Color (Munsell color chart)                                                                                                                                                                                                                                                  |         |                                                                                   |  |
|                                                                                                                                               |                                                                                    |                                                        |                                                         |                                                                                                                      | Texture (aphanitic, fine-grained, etc.)                                                                                                                                                                                                                                      |         |                                                                                   |  |
|                                                                                                                                               |                                                                                    |                                                        |                                                         |                                                                                                                      | Rock Type (granite, schist, sandstone, etc.)                                                                                                                                                                                                                                 |         |                                                                                   |  |
|                                                                                                                                               | HIGHLY ORGANIC SOILS                                                               |                                                        |                                                         |                                                                                                                      | 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.)                                                                                                                                                         |         |                                                                                   |  |
| Maine Department of Transportation<br>Geotechnical Section<br>Key to Soil and Rock Descriptions and Terms<br>Field Identification Information | SILTS AND CLAYS<br><br>(liquid limit greater than 50)                              |                                                        |                                                         |                                                                                                                      | -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.)                                                                                                                                                                                                                      |         |                                                                                   |  |
|                                                                                                                                               | HIGHLY ORGANIC SOILS                                                               |                                                        |                                                         |                                                                                                                      | 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))                                                                                                                                                                                                                                   |         |                                                                                   |  |
| Maine Department of Transportation<br>Geotechnical Section<br>Key to Soil and Rock Descriptions and Terms<br>Field Identification Information | SILTS AND CLAYS<br><br>(liquid limit greater than 50)                              |                                                        |                                                         |                                                                                                                      | <b>Sample Container Labeling Requirements:</b>                                                                                                                                                                                                                               |         |                                                                                   |  |
|                                                                                                                                               |                                                                                    |                                                        |                                                         |                                                                                                                      | WIN                                                                                                                                                                                                                                                                          |         |                                                                                   |  |
|                                                                                                                                               |                                                                                    |                                                        |                                                         |                                                                                                                      | Blow Counts                                                                                                                                                                                                                                                                  |         |                                                                                   |  |
|                                                                                                                                               |                                                                                    |                                                        |                                                         |                                                                                                                      | Bridge Name / Town                                                                                                                                                                                                                                                           |         |                                                                                   |  |
|                                                                                                                                               | HIGHLY ORGANIC SOILS                                                               |                                                        |                                                         |                                                                                                                      | Sample Recovery                                                                                                                                                                                                                                                              |         |                                                                                   |  |
|                                                                                                                                               |                                                                                    |                                                        |                                                         |                                                                                                                      | Boring Number                                                                                                                                                                                                                                                                |         |                                                                                   |  |
|                                                                                                                                               |                                                                                    |                                                        |                                                         |                                                                                                                      | Date                                                                                                                                                                                                                                                                         |         |                                                                                   |  |
|                                                                                                                                               |                                                                                    |                                                        |                                                         |                                                                                                                      | Sample Number                                                                                                                                                                                                                                                                |         |                                                                                   |  |
| Maine Department of Transportation<br>Geotechnical Section<br>Key to Soil and Rock Descriptions and Terms<br>Field Identification Information | SILTS AND CLAYS<br><br>(liquid limit greater than 50)                              |                                                        |                                                         |                                                                                                                      | Personnel Initials                                                                                                                                                                                                                                                           |         |                                                                                   |  |
|                                                                                                                                               |                                                                                    |                                                        |                                                         |                                                                                                                      | Sample Depth                                                                                                                                                                                                                                                                 |         |                                                                                   |  |
|                                                                                                                                               |                                                                                    |                                                        |                                                         |                                                                                                                      |                                                                                                                                                                                                                                                                              |         |                                                                                   |  |
|                                                                                                                                               |                                                                                    |                                                        |                                                         |                                                                                                                      |                                                                                                                                                                                                                                                                              |         |                                                                                   |  |

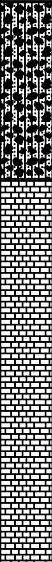
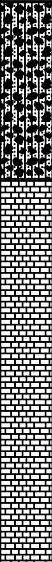
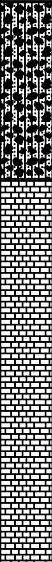
**Table A-2****Classification of Rock Material Strengths<sup>1</sup>**

| Grade | Description           | Field Identification                                                                                                    | Approx. Range of Uniaxial Compressive Strength |               |
|-------|-----------------------|-------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|---------------|
|       |                       |                                                                                                                         | MPa                                            | psi           |
| S1    | Very soft clay        | Easily penetrated several inches by fist                                                                                | <0.025                                         | <4            |
| S2    | Soft clay             | Easily penetrated several inches by thumb                                                                               | 0.025-0.05                                     | 4-7           |
| S3    | Firm clay             | Can be penetrated several inches by thumb with moderate effort                                                          | 0.05-0.10                                      | 7-15          |
| S4    | Stiff clay            | Readily indented by thumb but penetrated only with great effort                                                         | 0.10-0.25                                      | 15-35         |
| S5    | Very stiff clay       | Readily indented by thumbnail                                                                                           | 0.25-0.50                                      | 35-70         |
| S6    | Hard clay             | Indented with difficulty by thumbnail                                                                                   | >0.50                                          | >70           |
| R0    | Extremely weak rock   | Indented by thumbnail                                                                                                   | 0.25-1.0                                       | 35-150        |
| R1    | Very weak rock        | Crumbles under firm blows with point of geological hammer; can be peeled by a pocket knife                              | 1-5                                            | 150-725       |
| R2    | Weak rock             | Can be peeled by a pocket knife with difficulty; shallow indentations made by firm blow with point of geological hammer | 5-25                                           | 725-3,500     |
| R3    | Medium strong rock    | Cannot be scraped or peeled with a pocket knife; specimen can be fractured with single firm blow of geological hammer   | 25-50                                          | 3,500-7,000   |
| R4    | Strong rock           | Specimen requires more than one blow of geological hammer to fracture it                                                | 50-100                                         | 7,000-15,000  |
| R5    | Very strong rock      | Specimen requires many blows of geological hammer to fracture it                                                        | 100-250                                        | 15,000-36,000 |
| R6    | Extremely strong rock | Specimen can only be chipped with geological hammer                                                                     | >250                                           | >36,000       |

Note: Grades S1 to S6 apply to cohesive soils, for example clays, silty clays, and combinations of silts and clays with sand, generally slow draining. Discontinuity wall strength will generally be characterized by grades R0-R6 (rock) while S1-S6 (clay) will generally apply to filled discontinuities. Rock material strength descriptions are included in the rock core descriptions in the boring logs. Rock material strength grades (R0-R6) are not included in the rock core descriptions to avoid confusion with the numbering of the rock core runs.

<sup>1</sup> International Society for Rock Mechanics (ISRM), Commission on standardization of laboratory and field tests (1978): Suggested methods for the quantitative description of discontinuities in rock masses. Int. J. Rock Mech. Min. Sci. & Geomech. Abstr., Vol. 15, No. 6, pp. 319-368.

| <b>Maine Department of Transportation</b><br>Soil/Rock Exploration Log<br>US CUSTOMARY UNITS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                    |                 |                    | <b>Project:</b> Phair Crossing Bridge Replacement<br><b>Location:</b> Presque Isle, Maine                                                                                                                                  |               |                 |              | <b>Boring No.:</b> BB-PIPC-101<br><b>WIN:</b> 026434.00                                                                                                                                                                                                                                                                                                                                                                                                    |             |                                                                                                                                              |                                                       |             |                    |  |  |  |  |  |  |                 |             |                                |                                                       |            |                 |                    |                                               |               |                 |              |   |  |  |  |  |  |  |  |       |  |                   |     |  |    |       |             |             |    |    |  |  |  |         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---------------------------------------------------------------------------------------------------------------|--|--|--|--|--|--|--|--|--|--|--|---|--|--|--|--|--|--|--|--|--|-----------------------------------------------------------------------------------------|-------------------------------|--|----|-------|-------------|-----------|----|----|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|----|--|--|--|--|--|--|--|--|--|----------------------------------------------------------------------------------------------------------------------------------------------|--|--|----|------|---------------|---------|----|----|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|----|--|--|--|--|--|--|--|--|--|------------------------------------------------------------------------------------------------|--------------------------------------------|--|----|------|---------------|---------|---|----|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|----|--|--|--|--|--|--|--|--|--|------------------------------------------------------------------------------|---------------------------------------------|--|----|------|---------------|---------|----|----|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|----|--|--|--|--|--|--|--|-------|--|-----------|--------------------------------------------|--|----|------|---------------|------------|----|----|--|--|--|---------------------------------------------------------------------------------------------|--|--|--|--|--|--|--|--|--|--|--|
| <b>Driller:</b> Seaboard Drilling, LLC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                    |                 |                    | <b>Elevation (ft.)</b> 617.9                                                                                                                                                                                               |               |                 |              | <b>Auger ID/OD:</b> 4-1/4" I.D.                                                                                                                                                                                                                                                                                                                                                                                                                            |             |                                                                                                                                              |                                                       |             |                    |  |  |  |  |  |  |                 |             |                                |                                                       |            |                 |                    |                                               |               |                 |              |   |  |  |  |  |  |  |  |       |  |                   |     |  |    |       |             |             |    |    |  |  |  |         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| <b>Operator:</b> Kevin Hanscom                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         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                                                                                                                                                                                                                                                                                                                                          |             |                                                                                                                                              |                                                       |             |                    |  |  |  |  |  |  |                 |             |                                |                                                       |            |                 |                    |                                               |               |                 |              |   |  |  |  |  |  |  |  |       |  |                   |     |  |    |       |             |             |    |    |  |  |  |         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| <b>Logged By:</b> Daniel Burgess                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                    |                 |                    | <b>Rig Type:</b> Diedrich D-50                                                                                                                                                                                             |               |                 |              | <b>Hammer Wt./Fall:</b> 140 lb/30 ft                                                                                                                                                                                                                                                                                                                                                                                                                       |             |                                                                                                                                              |                                                       |             |                    |  |  |  |  |  |  |                 |             |                                |                                                       |            |                 |                    |                                               |               |                 |              |   |  |  |  |  |  |  |  |       |  |                   |     |  |    |       |             |             |    |    |  |  |  |         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| <b>Date Start/Finish:</b> 8:07 AM-11:31 AM on 1/4/24                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                    |                 |                    | <b>Drilling Method:</b> SSA, HSA, and Drive and Wash                                                                                                                                                                       |               |                 |              | <b>Core Barrel:</b> NQ/NX                                                                                                                                                                                                                                                                                                                                                                                                                                  |             |                                                                                                                                              |                                                       |             |                    |  |  |  |  |  |  |                 |             |                                |                                                       |            |                 |                    |                                               |               |                 |              |   |  |  |  |  |  |  |  |       |  |                   |     |  |    |       |             |             |    |    |  |  |  |         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| <b>Boring Location:</b> Route 10, Presque Isle, Maine                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                    |                 |                    | <b>Casing ID/OD:</b> 3" I.D.                                                                                                                                                                                               |               |                 |              | <b>Water Level*:</b> Not Observed                                                                                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| <b>Hammer Efficiency Factor:</b> 1.066                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                    |                 |                    | <b>Hammer Type:</b> Automatic <input checked="" type="checkbox"/> Hydraulic <input type="checkbox"/> Rope & Cathead <input type="checkbox"/>                                                                               |               |                 |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |                                                                                                                                              |                                                       |             |                    |  |  |  |  |  |  |                 |             |                                |                                                       |            |                 |                    |                                               |               |                 |              |   |  |  |  |  |  |  |  |       |  |                   |     |  |    |       |             |             |    |    |  |  |  |         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| Definitions:<br>D = Split Spoon Sample<br>MD = Unsuccessful Split Spoon Sample Attempt<br>U = Thin Wall Tube Sample<br>MU = Unsuccessful Thin Wall Tube Sample Attempt<br>V = Field Vane Shear Test, PP = Pocket Penetrometer<br>MV = Unsuccessful Field Vane Shear Test Attempt                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                    |                 |                    | R = Rock Core Sample<br>SSA = Solid Stem Auger<br>HSA = Hollow Stem Auger<br>RC = Roller Cone<br>WOH = Weight of 140lb. Hammer<br>WOR/C = Weight of Rods or Casing<br>T <sub>v</sub> = Pocket Torvane Shear Strength (psf) |               |                 |              | S <sub>u</sub> = Peak/Remolded Field Vane Undrained Shear Strength (psf)<br>S <sub>u</sub> (lab) = Lab Vane Undrained Shear Strength (psf)<br>q <sub>p</sub> = Unconfined Compressive Strength (ksf)<br>N-uncorrected = Raw Field SPT N-value<br>Hammer Efficiency Factor = Rig Specific Annual Calibration Value<br>N <sub>60</sub> = SPT N-uncorrected Corrected for Hammer Efficiency<br>N <sub>60</sub> = (Hammer Efficiency Factor/60%)*N-uncorrected |             |                                                                                                                                              |                                                       |             |                    |  |  |  |  |  |  |                 |             |                                |                                                       |            |                 |                    |                                               |               |                 |              |   |  |  |  |  |  |  |  |       |  |                   |     |  |    |       |             |             |    |    |  |  |  |                                                                                                                   |  |  |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |                                                                                         |                               |  |    |       |             |           |    |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |                                                                                                                                              |  |  |    |      |               |         |    |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |                                                                                                |                                            |  |    |      |               |         |   |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |                                                                              |                                             |  |    |      |               |         |    |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |       |  |           |                                            |  |    |      |               |            |    |    |  |  |  |                                                                                             |  |  |  |  |  |  |  |  |  |  |  |
| LI = Liquidity Index<br>WC = Water Content, percent<br>LL = Liquid Limit<br>PL = Plastic Limit<br>PI = Plasticity Index<br>G = Grain Size Analysis<br>C = Consolidation Test                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           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| <table><tr><th rowspan="2">Depth (ft.)</th><th colspan="7">Sample Information</th><th rowspan="2">Elevation (ft.)</th><th rowspan="2">Graphic Log</th><th rowspan="2">Visual Description and Remarks</th><th rowspan="2">Laboratory Testing Results/ AASHTO and Unified Class.</th></tr><tr><th>Sample No.</th><th>Pen./Rec. (in.)</th><th>Sample Depth (ft.)</th><th>Blows (6 in.) Shear Strength (psf) or RQD (%)</th><th>N-uncorrected</th><th>N<sub>60</sub></th><th>Casing Blows</th></tr><tr><td>0</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>617.1</td><td></td><td>10 inches ASPHALT</td><td rowspan="3">0.8</td></tr><tr><td></td><td>1D</td><td>24/16</td><td>1.00 - 3.00</td><td>23-20-25-25</td><td>45</td><td>80</td><td></td><td></td><td></td><td>Brown, dry, very dense, fine to coarse SAND and fine to coarse GRAVEL, little silt, slight petroleum odor [FILL].</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>5</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Light brown to brown, dry, dense, fine to coarse SAND, little silt, some gravel [FILL].</td><td rowspan="3">Fines = 20.5%<br/>A-1b (0), SM</td></tr><tr><td></td><td>2D</td><td>24/13</td><td>5.00 - 7.00</td><td>5-10-12-9</td><td>22</td><td>39</td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>10</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Dark brown, moist, medium dense, Silty fine to medium SAND, little fine gravel, trace organics, petroleum odor, rock in tip of spoon [FILL].</td><td rowspan="3"></td></tr><tr><td></td><td>3D</td><td>24/7</td><td>10.00 - 12.00</td><td>3-7-8-7</td><td>15</td><td>27</td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>15</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Dark brown and olive, moist, medium dense, Silty fine GRAVEL, some coarse to fine sand [FILL].</td><td rowspan="3">WC = 35.8%<br/>Fines = 41.5%<br/>A-4 (0), GM</td></tr><tr><td></td><td>4D</td><td>24/8</td><td>15.00 - 17.00</td><td>3-3-5-5</td><td>8</td><td>14</td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>20</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Brown, moist, medium dense, Sandy fine to coarse GRAVEL, little silt [FILL].</td><td rowspan="3">WC = 7.4%<br/>Fines = 20.1%<br/>A-1-b (0), GM</td></tr><tr><td></td><td>5D</td><td>24/7</td><td>20.00 - 22.00</td><td>3-4-9-6</td><td>13</td><td>23</td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>25</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>592.9</td><td></td><td>-----25.0</td><td rowspan="3">WC = 18.3%<br/>Fines = 57.9%<br/>A-4 (0), ML</td></tr><tr><td></td><td>6D</td><td>24/-</td><td>25.00 - 27.00</td><td>27-13-7-11</td><td>20</td><td>36</td><td></td><td></td><td></td><td>Brown, moist, hard, Sandy SILT, little clay, trace fine gravel, non-plastic [GLACIAL TILL].</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table> |                    |                 |                    |                                                                                                                                                                                                                            |               |                 |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |                                                                                                                                              |                                                       | Depth (ft.) | Sample Information |  |  |  |  |  |  | Elevation (ft.) | Graphic Log | Visual Description and Remarks | Laboratory Testing Results/ AASHTO and Unified Class. | Sample No. | Pen./Rec. (in.) | Sample Depth (ft.) | Blows (6 in.) Shear Strength (psf) or RQD (%) | N-uncorrected | N <sub>60</sub> | Casing Blows | 0 |  |  |  |  |  |  |  | 617.1 |  | 10 inches ASPHALT | 0.8 |  | 1D | 24/16 | 1.00 - 3.00 | 23-20-25-25 | 45 | 80 |  |  |  | Brown, dry, very dense, fine to coarse SAND and fine to coarse GRAVEL, little silt, slight petroleum odor [FILL]. |  |  |  |  |  |  |  |  |  |  |  | 5 |  |  |  |  |  |  |  |  |  | Light brown to brown, dry, dense, fine to coarse SAND, little silt, some gravel [FILL]. | Fines = 20.5%<br>A-1b (0), SM |  | 2D | 24/13 | 5.00 - 7.00 | 5-10-12-9 | 22 | 39 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 10 |  |  |  |  |  |  |  |  |  | Dark brown, moist, medium dense, Silty fine to medium SAND, little fine gravel, trace organics, petroleum odor, rock in tip of spoon [FILL]. |  |  | 3D | 24/7 | 10.00 - 12.00 | 3-7-8-7 | 15 | 27 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 15 |  |  |  |  |  |  |  |  |  | Dark brown and olive, moist, medium dense, Silty fine GRAVEL, some coarse to fine sand [FILL]. | WC = 35.8%<br>Fines = 41.5%<br>A-4 (0), GM |  | 4D | 24/8 | 15.00 - 17.00 | 3-3-5-5 | 8 | 14 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 20 |  |  |  |  |  |  |  |  |  | Brown, moist, medium dense, Sandy fine to coarse GRAVEL, little silt [FILL]. | WC = 7.4%<br>Fines = 20.1%<br>A-1-b (0), GM |  | 5D | 24/7 | 20.00 - 22.00 | 3-4-9-6 | 13 | 23 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 25 |  |  |  |  |  |  |  | 592.9 |  | -----25.0 | WC = 18.3%<br>Fines = 57.9%<br>A-4 (0), ML |  | 6D | 24/- | 25.00 - 27.00 | 27-13-7-11 | 20 | 36 |  |  |  | Brown, moist, hard, Sandy SILT, little clay, trace fine gravel, non-plastic [GLACIAL TILL]. |  |  |  |  |  |  |  |  |  |  |  |
| Depth (ft.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Sample Information |                 |                    |                                                                                                                                                                                                                            |               |                 |              | Elevation (ft.)                                                                                                                                                                                                                                                                                                                                                                                                                                            | Graphic Log | Visual Description and Remarks                                                                                                               | Laboratory Testing Results/ AASHTO and Unified Class. |             |                    |  |  |  |  |  |  |                 |             |                                |                                                       |            |                 |                    |                                               |               |                 |              |   |  |  |  |  |  |  |  |       |  |                   |     |  |    |       |             |             |    |    |  |  |  |         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(in.) | Sample Depth (ft.) | Blows (6 in.) Shear Strength (psf) or RQD (%)                                                                                                                                                                              | N-uncorrected | N <sub>60</sub> | Casing Blows |                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |                                                                                                                                              |                                                       |             |                    |  |  |  |  |  |  |                 |             |                                |                                                       |            |                 |                    |                                               |               |                 |              |   |  |  |  |  |  |  |  |       |  |                   |     |  |    |       |             |             |    |    |  |  |  |                                                                                                                   |  |  |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |                                                                                         |                               |  |    |       |             |           |    |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |                                                                                                                                              |  |  |    |      |               |         |    |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |                                                                                                |                                            |  |    |      |               |         |   |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |                                                                              |                                             |  |    |      |               |         |    |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |       |  |           |                                            |  |    |      |               |            |    |    |  |  |  |                                                                                             |  |  |  |  |  |  |  |  |  |  |  |
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                                                                                                                                                                                                                                                                                                                                          |             | 10 inches ASPHALT                                                                                                                            | 0.8                                                   |             |                    |  |  |  |  |  |  |                 |             |                                |                                                       |            |                 |                    |                                               |               |                 |              |   |  |  |  |  |  |  |  |       |  |                   |     |  |    |       |             |             |    |    |  |  |  |         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3.00        | 23-20-25-25                                                                                                                                                                                                                | 45            | 80              |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             | Brown, dry, very dense, fine to coarse SAND and fine to coarse GRAVEL, little silt, slight petroleum odor [FILL].                            |                                                       |             |                    |  |  |  |  |  |  |                 |             |                                |                                                       |            |                 |                    |                                               |               |                 |              |   |  |  |  |  |  |  |  |       |  |                   |     |  |    |       |             |             |    |    |  |  |  |                                                                                                                   |  |  |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |                                                                                         |                               |  |    |       |             |           |    |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |                                                                                                                                              |  |  |    |      |               |         |    |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |                                                                                                |                                            |  |    |      |               |         |   |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |                                                                              |                                             |  |    |      |               |         |    |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |       |  |           |                                            |  |    |      |               |            |    |    |  |  |  |                                                                                             |  |  |  |  |  |  |  |  |  |  |  |
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| 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      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                                                                                                                                                                                                                                                                                                                                          |             | Light brown to brown, dry, dense, fine to coarse SAND, little silt, some gravel [FILL].                                                      | Fines = 20.5%<br>A-1b (0), SM                         |             |                    |  |  |  |  |  |  |                 |             |                                |                                                       |            |                 |                    |                                               |               |                 |              |   |  |  |  |  |  |  |  |       |  |                   |     |  |    |       |             |             |    |    |  |  |  |         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7.00        | 5-10-12-9                                                                                                                                                                                                                  | 22            | 39              |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |                                                                                                                                              |                                                       |             |                    |  |  |  |  |  |  |                 |             |                                |                                                       |            |                 |                    |                                               |               |                 |              |   |  |  |  |  |  |  |  |       |  |                   |     |  |    |       |             |             |    |    |  |  |  |                                                                                                                   |  |  |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |                                                                                         |                               |  |    |       |             |           |    |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |                                                                                                                                              |  |  |    |      |               |         |    |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |                                                                                                |                                            |  |    |      |               |         |   |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |                                                                              |                                             |  |    |      |               |         |    |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |       |  |           |                                            |  |    |      |               |            |    |    |  |  |  |                                                                                             |  |  |  |  |  |  |  |  |  |  |  |
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| 10                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     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12.00      | 3-7-8-7                                                                                                                                                                                                                    | 15            | 27              |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |                                                                                                                                              |                                                       |             |                    |  |  |  |  |  |  |                 |             |                                |                                                       |            |                 |                    |                                               |               |                 |              |   |  |  |  |  |  |  |  |       |  |                   |     |  |    |       |             |             |    |    |  |  |  |                                                                                                                   |  |  |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |                                                                                         |                               |  |    |       |             |           |    |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |                                                                                                                                              |  |  |    |      |               |         |    |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |                                                                                                |                                            |  |    |      |               |         |   |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |                                                                              |                                             |  |    |      |               |         |    |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |       |  |           |                                            |  |    |      |               |            |    |    |  |  |  |                                                                                             |  |  |  |  |  |  |  |  |  |  |  |
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| 15                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     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                                                                                                                                                                                                                                                                                                                                          |             | Dark brown and olive, moist, medium dense, Silty fine GRAVEL, some coarse to fine sand [FILL].                                               | WC = 35.8%<br>Fines = 41.5%<br>A-4 (0), GM            |             |                    |  |  |  |  |  |  |                 |             |                                |                                                       |            |                 |                    |                                               |               |                 |              |   |  |  |  |  |  |  |  |       |  |                   |     |  |    |       |             |             |    |    |  |  |  |         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17.00      | 3-3-5-5                                                                                                                                                                                                                    | 8             | 14              |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |                                                                                                                                              |                                                       |             |                    |  |  |  |  |  |  |                 |             |                                |                                                       |            |                 |                    |                                               |               |                 |              |   |  |  |  |  |  |  |  |       |  |                   |     |  |    |       |             |             |    |    |  |  |  |                                                                                                                   |  |  |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |                                                                                         |                               |  |    |       |             |           |    |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |                                                                                                                                              |  |  |    |      |               |         |    |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |                                                                                                |                                            |  |    |      |               |         |   |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |                                                                              |                                             |  |    |      |               |         |    |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |       |  |           |                                            |  |    |      |               |            |    |    |  |  |  |                                                                                             |  |  |  |  |  |  |  |  |  |  |  |
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| 20                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     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                                                                                                                                                                                                                                                                                                                                          |             | Brown, moist, medium dense, Sandy fine to coarse GRAVEL, little silt [FILL].                                                                 | WC = 7.4%<br>Fines = 20.1%<br>A-1-b (0), GM           |             |                    |  |  |  |  |  |  |                 |             |                                |                                                       |            |                 |                    |                                               |               |                 |              |   |  |  |  |  |  |  |  |       |  |                   |     |  |    |       |             |             |    |    |  |  |  |         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22.00      | 3-4-9-6                                                                                                                                                                                                                    | 13            | 23              |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             |                                                                                                                                              |                                                       |             |                    |  |  |  |  |  |  |                 |             |                                |                                                       |            |                 |                    |                                               |               |                 |              |   |  |  |  |  |  |  |  |       |  |                   |     |  |    |       |             |             |    |    |  |  |  |                                                                                                                   |  |  |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |                                                                                         |                               |  |    |       |             |           |    |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |                                                                                                                                              |  |  |    |      |               |         |    |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |                                                                                                |                                            |  |    |      |               |         |   |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |                                                                              |                                             |  |    |      |               |         |    |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |       |  |           |                                            |  |    |      |               |            |    |    |  |  |  |                                                                                             |  |  |  |  |  |  |  |  |  |  |  |
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                                                                                                                                                                                                                                                                                                                                          |             | -----25.0                                                                                                                                    | WC = 18.3%<br>Fines = 57.9%<br>A-4 (0), ML            |             |                    |  |  |  |  |  |  |                 |             |                                |                                                       |            |                 |                    |                                               |               |                 |              |   |  |  |  |  |  |  |  |       |  |                   |     |  |    |       |             |             |    |    |  |  |  |         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27.00      | 27-13-7-11                                                                                                                                                                                                                 | 20            | 36              |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                            |             | Brown, moist, hard, Sandy SILT, little clay, trace fine gravel, non-plastic [GLACIAL TILL].                                                  |                                                       |             |                    |  |  |  |  |  |  |                 |             |                                |                                                       |            |                 |                    |                                               |               |                 |              |   |  |  |  |  |  |  |  |       |  |                   |     |  |    |       |             |             |    |    |  |  |  |                                                                                                                   |  |  |  |  |  |  |  |  |  |  |  |   |  |  |  |  |  |  |  |  |  |                                                                                         |                               |  |    |       |             |           |    |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |                                                                                                                                              |  |  |    |      |               |         |    |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |                                                                                                |                                            |  |    |      |               |         |   |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |                                                                              |                                             |  |    |      |               |         |    |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |       |  |           |                                            |  |    |      |               |            |    |    |  |  |  |                                                                                             |  |  |  |  |  |  |  |  |  |  |  |
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| <b>Remarks:</b><br>1. Hammer efficiency factor provided by Seaboard Drilling LLC and taken from "SPT Energy Calibration Gorham, MA" for Diedrich Drill D-50 with Automatic Hammer (S/N:367)" by GRL Engineers, Inc., dated 11/10/2023.<br>2. As-drilled locations and elevations for the borings and the probe are derived from swing tie measurements made in the field to locate these with respect to site features. Northings and Eastings were derived from CADD files provided to WSP by HNTB on March 25, 2024.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           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| Stratification lines represent approximate boundaries between soil types; transitions may be gradual.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  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| * Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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                                                                                                                                                                                                                                                            |             | Boring No.: BB-PIPC-101                                                                                                                      |                                                       |             |                    |  |  |  |  |  |  |                 |             |                                |                                                       |            |                 |                    |                                               |               |                 |              |   |  |  |  |  |  |  |  |       |  |                   |     |  |    |       |             |             |    |    |  |  |  |                                                                                       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| Maine Department of Transportation<br>Soil/Rock Exploration Log<br>US CUSTOMARY UNITS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |            |                 |                    |                                                                                                                                                                                                                                  |               | Project: Phair Crossing Bridge Replacement<br><br>Location: Presque Isle, Maine |                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                | Boring No.: BB-PIPC-101<br><br>WIN: 026434.00                                      |                                                                                                                                                                                               |                                                                                                                                                                                                                                            |                    |  |  |  |  |  |  |  |                                |                                                     |             |            |                 |                    |                                               |               |                 |              |                 |             |    |    |       |               |             |    |     |  |  |                                                                                    |                                                                                             |                            |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |         |               |          |  |  |  |       |  |                                                |  |    |  |  |  |  |  |  |  |  |  |                                                                                                                                                                                                                                            |  |  |  |  |  |  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| Driller: Seaboard Drilling, LLC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |            |                 |                    | Elevation (ft.) 617.9                                                                                                                                                                                                            |               |                                                                                 | Auger ID/OD: 4-1/4" I.D.                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                |                                                                                    |                                                                                                                                                                                               |                                                                                                                                                                                                                                            |                    |  |  |  |  |  |  |  |                              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| Operator: Kevin Hanscom                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |            |                 |                    | Datum:                                                                                                                                                                                                                           |               |                                                                                 | Sampler: Standard Split Spoon                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                |                                                                                    |                                                                                                                                                                                               |                                                                                                                                                                                                                                            |                    |  |  |  |  |  |  |  |                              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| Logged By: Daniel Burgess                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |            |                 |                    | Rig Type: Diedrich D-50                                                                                                                                                                                                          |               |                                                                                 | Hammer Wt./Fall: 140 lb/30 ft                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                |                                                                                    |                                                                                                                                                                                               |                                                                                                                                                                                                                                            |                    |  |  |  |  |  |  |  |                              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| Date Start/Finish: 8:07 AM-11:31 AM on 1/4/24                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |            |                 |                    | Drilling Method: SSA, HSA, and Drive and Wash                                                                                                                                                                                    |               |                                                                                 | Core Barrel: NQ/NX                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                |                                                                                    |                                                                                                                                                                                               |                                                                                                                                                                                                                                            |                    |  |  |  |  |  |  |  |                              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| Boring Location: Route 10, Presque Isle, Maine                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |            |                 |                    | Casing ID/OD: 3" I.D.                                                                                                                                                                                                            |               |                                                                                 | Water Level*: Not Observed                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                |                                                                                    |                                                                                                                                                                                               |                                                                                                                                                                                                                                            |                    |  |  |  |  |  |  |  |                              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| Hammer Efficiency Factor: 1.066                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |            |                 |                    | Hammer Type: Automatic <input checked="" type="checkbox"/> Hydraulic <input type="checkbox"/> Rope & Cathead <input type="checkbox"/>                                                                                            |               |                                                                                 |                                                                          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| <div>Definitions:<br/>D = Split Spoon Sample<br/>MD = Unsuccessful Split Spoon Sample Attempt<br/>U = Thin Wall Tube Sample<br/>MU = Unsuccessful Thin Wall Tube Sample Attempt<br/>V = Field Vane Shear Test, PP = Pocket Penetrometer<br/>MV = Unsuccessful Field Vane Shear Test Attempt</div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |            |                 |                    | <div>R = Rock Core Sample<br/>SSA = Solid Stem Auger<br/>HSA = Hollow Stem Auger<br/>RC = Roller Cone<br/>WOH = Weight of 140 lb. Hammer<br/>WOR/C = Weight of Rods or Casing<br/>TV = Pocket Torvane Shear Strength (psf)</div> |               |                                                                                 | <div>S<sub>u</sub> = Peak/Remolded Field Vane Undrained Shear Strength (psf)<br/>S<sub>u(lab)</sub> = Lab Vane Undrained Shear Strength (psf)<br/>q<sub>p</sub> = Unconfined Compressive Strength (ksf)<br/>N-uncorrected = Raw Field SPT N-value<br/>Hammer Efficiency Factor = Rig Specific Annual Calibration Value<br/>N<sub>60</sub> = SPT N-uncorrected Corrected for Hammer Efficiency<br/>N<sub>60</sub> = (Hammer Efficiency Factor/60%)*N-uncorrected</div> |                                |                                                                                    | <div>LI = Liquidity Index<br/>WC = Water Content, percent<br/>LL = Liquid Limit<br/>PL = Plastic Limit<br/>PI = Plasticity Index<br/>G = Grain Size Analysis<br/>C = Consolidation Test</div> |                                                                                                                                                                                                                                            |                    |  |  |  |  |  |  |  |                                |                                                     |             |            |                 |                    |                                               |               |                 |              |                 |             |    |    |       |               |             |    |     |  |  |                                                                                    |                                                                                             |                            |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |         |               |          |  |  |  |       |  |                                                |  |    |  |  |  |  |  |  |  |  |  |                                                                                                                                                                                                                                            |  |  |  |  |  |  |  |  |  |  |  |                                                                                                                                                                                              |  |  |    |           |               |           |  |  |  |  |  |                                                                                                                                                                                                                                            |  |    |  |  |  |  |  |  |  |  |  |                                                                                                                                                |  |  |    |           |               |          |  |  |  |  |  |                                                                                                                                                                                                                                        |  |  |  |  |  |  |  |  |  |  |  |                                                                                                                                                |  |  |    |     |               |          |  |  |  |       |  |                                                                                                                                                                                                                |  |    |  |  |  |  |  |  |  |  |  |                                                |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <table><tr><th colspan="8">Sample Information</th><th rowspan="2">Visual Description and Remarks</th><th rowspan="2">Laboratory Testing Results/AASHTO and Unified Class</th></tr><tr><th>Depth (ft.)</th><th>Sample No.</th><th>Pen./Rec. (in.)</th><th>Sample Depth (ft.)</th><th>Blows (6 in.) Shear Strength (psf) or RQD (%)</th><th>N-uncorrected</th><th>N<sub>60</sub></th><th>Casing Blows</th><th>Elevation (ft.)</th><th>Graphic Log</th></tr><tr><td>30</td><td>7D</td><td>24/15</td><td>30.00 - 32.00</td><td>19-58-32-30</td><td>90</td><td>160</td><td></td><td></td><td rowspan="16"></td><td>Brown, dry, very dense, Sandy fine GRAVEL, little silt, gravel is fractured [GLACIAL TILL].</td><td>Fines = 17.4% A-1-b (0),GM</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td>R1</td><td>60/21.6</td><td>33.60 - 38.60</td><td>RQD = 0%</td><td></td><td></td><td></td><td>584.3</td><td></td><td>Roller bit refusal.<br/>Top of Bedrock at Elev.</td><td></td></tr><tr><td>35</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>R1: Grey, fine to coarse grained, LIMESTONE [sedimentary rock], strong, slightly weathered; discontinuities low angle to steep dipping, close spacing, tight to open, extremely fractured [SILURIAN-ORDOVICIAN-AGED CARYS MILLS FORMATION]</td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Rock Mass Quality = Very Poor<br/>36% Recovery<br/>Rock Core Rate (min:sec)<br/>33.6-34.6 ft (3:27)<br/>34.6-35.6 ft (3:09)<br/>35.6-36.6 ft (3:29)<br/>36.6-37.6 ft (4:08)<br/>37.6-38.6 ft (6:17)</td><td></td></tr><tr><td></td><td>R2</td><td>28.8/24.0</td><td>38.60 - 41.00</td><td>RQD = 21%</td><td></td><td></td><td></td><td></td><td></td><td>R2: Grey, fine to coarse grained, LIMESTONE [sedimentary rock], strong, slightly weathered; discontinuities low angle to steep dipping, close spacing, tight to open, extremely fractured [SILURIAN-ORDOVICIAN-AGED CARYS MILLS FORMATION]</td><td></td></tr><tr><td>40</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Rock Mass Quality = Very Poor<br/>83% Recovery<br/>Rock Core Rate (min:sec)<br/>38.6-39.6 ft (3:18)<br/>39.6-40.6 ft (3:28)<br/>40.6-41.0 ft (1:53)</td><td></td></tr><tr><td></td><td>R3</td><td>25.2/22.8</td><td>41.00 - 43.10</td><td>RQD = 0%</td><td></td><td></td><td></td><td></td><td></td><td>R3: Grey, fine to coarse grained, LIMESTONE [sedimentary rock], strong, slightly weathered; discontinuities steep angle to vertical dipping, close spacing, open, extremely fractured [SILURIAN-ORDOVICIAN-AGED CARYS MILLS FORMATION]</td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Rock Mass Quality = Very Poor<br/>90% Recovery<br/>Rock Core Rate (min:sec)<br/>41.0-41.6 ft (2:05)<br/>41.6-42.6 ft (3:31)<br/>42.6-43.1 ft (2:08)</td><td></td></tr><tr><td></td><td>R4</td><td>6/6</td><td>43.10 - 43.60</td><td>RQD = 0%</td><td></td><td></td><td></td><td>574.3</td><td></td><td>R4: Grey, fine to coarse grained, LIMESTONE [sedimentary rock], strong, fresh; discontinuities steep angle dipping, close spacing, tight, extremely fractured [SILURIAN-ORDOVICIAN-AGED CARYS MILLS FORMATION]</td><td></td></tr><tr><td>45</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Rock Mass Quality = Very Poor<br/>100% Recovery</td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>50</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>55</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table> |            |                 |                    |                                                                                                                                                                                                                                  |               |                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                |                                                                                    |                                                                                                                                                                                               |                                                                                                                                                                                                                                            | Sample Information |  |  |  |  |  |  |  | Visual Description and Remarks | Laboratory Testing Results/AASHTO and Unified Class | Depth (ft.) | Sample No. | Pen./Rec. (in.) | Sample Depth (ft.) | Blows (6 in.) Shear Strength (psf) or RQD (%) | N-uncorrected | N <sub>60</sub> | Casing Blows | Elevation (ft.) | Graphic Log | 30 | 7D | 24/15 | 30.00 - 32.00 | 19-58-32-30 | 90 | 160 |  |  |  | Brown, dry, very dense, Sandy fine GRAVEL, little silt, gravel is fractured [GLACIAL TILL]. | Fines = 17.4% A-1-b (0),GM |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | R1 | 60/21.6 | 33.60 - 38.60 | RQD = 0% |  |  |  | 584.3 |  | Roller bit refusal.<br>Top of Bedrock at Elev. |  | 35 |  |  |  |  |  |  |  |  |  | R1: Grey, fine to coarse grained, LIMESTONE [sedimentary rock], strong, slightly weathered; discontinuities low angle to steep dipping, close spacing, tight to open, extremely fractured [SILURIAN-ORDOVICIAN-AGED CARYS MILLS FORMATION] |  |  |  |  |  |  |  |  |  |  |  | Rock Mass Quality = Very Poor<br>36% Recovery<br>Rock Core Rate (min:sec)<br>33.6-34.6 ft (3:27)<br>34.6-35.6 ft (3:09)<br>35.6-36.6 ft (3:29)<br>36.6-37.6 ft (4:08)<br>37.6-38.6 ft (6:17) |  |  | R2 | 28.8/24.0 | 38.60 - 41.00 | RQD = 21% |  |  |  |  |  | R2: Grey, fine to coarse grained, LIMESTONE [sedimentary rock], strong, slightly weathered; discontinuities low angle to steep dipping, close spacing, tight to open, extremely fractured [SILURIAN-ORDOVICIAN-AGED CARYS MILLS FORMATION] |  | 40 |  |  |  |  |  |  |  |  |  | Rock Mass Quality = Very Poor<br>83% Recovery<br>Rock Core Rate (min:sec)<br>38.6-39.6 ft (3:18)<br>39.6-40.6 ft (3:28)<br>40.6-41.0 ft (1:53) |  |  | R3 | 25.2/22.8 | 41.00 - 43.10 | RQD = 0% |  |  |  |  |  | R3: Grey, fine to coarse grained, LIMESTONE [sedimentary rock], strong, slightly weathered; discontinuities steep angle to vertical dipping, close spacing, open, extremely fractured [SILURIAN-ORDOVICIAN-AGED CARYS MILLS FORMATION] |  |  |  |  |  |  |  |  |  |  |  | Rock Mass Quality = Very Poor<br>90% Recovery<br>Rock Core Rate (min:sec)<br>41.0-41.6 ft (2:05)<br>41.6-42.6 ft (3:31)<br>42.6-43.1 ft (2:08) |  |  | R4 | 6/6 | 43.10 - 43.60 | RQD = 0% |  |  |  | 574.3 |  | R4: Grey, fine to coarse grained, LIMESTONE [sedimentary rock], strong, fresh; discontinuities steep angle dipping, close spacing, tight, extremely fractured [SILURIAN-ORDOVICIAN-AGED CARYS MILLS FORMATION] |  | 45 |  |  |  |  |  |  |  |  |  | Rock Mass Quality = Very Poor<br>100% Recovery |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 50 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 55 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Sample Information                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     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                                                                                                                                                                                                                                                                                                                                                                                             | Visual Description and Remarks | Laboratory Testing Results/AASHTO and Unified Class                                |                                                                                                                                                                                               |                                                                                                                                                                                                                                            |                    |  |  |  |  |  |  |  |                                |                                                     |             |            |                 |                    |                                               |               |                 |              |                 |             |    |    |       |               |             |    |     |  |  |                                                                                    |                                                                                             |                            |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |         |               |          |  |  |  |       |  |                                                |  |    |  |  |  |  |  |  |  |  |  |                                                                                                                                                                                                                                            |  |  |  |  |  |  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| Depth (ft.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Sample No. | Pen./Rec. (in.) | Sample Depth (ft.) | Blows (6 in.) Shear Strength (psf) or RQD (%)                                                                                                                                                                                    | N-uncorrected | N <sub>60</sub>                                                                 | Casing Blows                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                |                                                                                    | Elevation (ft.)                                                                                                                                                                               | Graphic Log                                                                                                                                                                                                                                |                    |  |  |  |  |  |  |  |                                |                                                     |             |            |                 |                    |                                               |               |                 |              |                 |             |    |    |       |               |             |    |     |  |  |                                                                                    |                                                                                             |                            |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |         |               |          |  |  |  |       |  |                                                |  |    |  |  |  |  |  |  |  |  |  |                                                                                                                                                                                                                                            |  |  |  |  |  |  |  |  |  |  |  |                                                                                                                                                                                              |  |  |    |           |               |           |  |  |  |  |  |                                                                                                                                                                                                                                            |  |    |  |  |  |  |  |  |  |  |  |                                                                                                                                                |  |  |    |           |               |          |  |  |  |  |  |                                                                                                                                                                                                                                        |  |  |  |  |  |  |  |  |  |  |  |                                                                                                                                                |  |  |    |     |               |          |  |  |  |       |  |                                                                                                                                                                                                                |  |    |  |  |  |  |  |  |  |  |  |                                                |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 30                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 7D         | 24/15           | 30.00 - 32.00      | 19-58-32-30                                                                                                                                                                                                                      | 90            | 160                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                |  | Brown, dry, very dense, Sandy fine GRAVEL, little silt, gravel is fractured [GLACIAL TILL].                                                                                                   | Fines = 17.4% A-1-b (0),GM                                                                                                                                                                                                                 |                    |  |  |  |  |  |  |  |                                |                                                     |             |            |                 |                    |                                               |               |                 |              |                 |             |    |    |       |               |             |    |     |  |  |                                                                                    |                                                                                             |                            |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |         |               |          |  |  |  |       |  |                                                |  |    |  |  |  |  |  |  |  |  |  |                                                                                                                                                                                                                                            |  |  |  |  |  |  |  |  |  |  |  |                                                                                                                                                                                              |  |  |    |           |               |           |  |  |  |  |  |                                                                                                                                                                                                                                            |  |    |  |  |  |  |  |  |  |  |  |                                                                                                                                                |  |  |    |           |               |          |  |  |  |  |  |                                                                                                                                                                                                                                        |  |  |  |  |  |  |  |  |  |  |  |                                                                                                                                                |  |  |    |     |               |          |  |  |  |       |  |                                                                                                                                                                                                                |  |    |  |  |  |  |  |  |  |  |  |                                                |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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38.60      | RQD = 0%                                                                                                                                                                                                                         |               |                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 584.3                          |                                                                                    |                                                                                                                                                                                               | Roller bit refusal.<br>Top of Bedrock at Elev.                                                                                                                                                                                             |                    |  |  |  |  |  |  |  |                                |                                                     |             |            |                 |                    |                                               |               |                 |              |                 |             |    |    |       |               |             |    |     |  |  |                                                                                    |                                                                                             |                            |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |         |               |          |  |  |  |       |  |                                                |  |    |  |  |  |  |  |  |  |  |  |                                                                                                                                                                                                                                            |  |  |  |  |  |  |  |  |  |  |  |                                                                                                                                                                                              |  |  |    |           |               |           |  |  |  |  |  |                                                                                                                                                                                                                                            |  |    |  |  |  |  |  |  |  |  |  |                                                                                                                                                |  |  |    |           |               |          |  |  |  |  |  |                                                                                                                                                                                                                                        |  |  |  |  |  |  |  |  |  |  |  |                                                                                                                                                |  |  |    |     |               |          |  |  |  |       |  |                                                                                                                                                                                                                |  |    |  |  |  |  |  |  |  |  |  |                                                |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 35                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     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                                                                                                                                                                                                                                                                                                                                                                                             |                                |                                                                                    |                                                                                                                                                                                               | R1: Grey, fine to coarse grained, LIMESTONE [sedimentary rock], strong, slightly weathered; discontinuities low angle to steep dipping, close spacing, tight to open, extremely fractured [SILURIAN-ORDOVICIAN-AGED CARYS MILLS FORMATION] |                    |  |  |  |  |  |  |  |                                |                                                     |             |            |                 |                    |                                               |               |                 |              |                 |             |    |    |       |               |             |    |     |  |  |                                                                                    |                                                                                             |                            |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |         |               |          |  |  |  |       |  |                                                |  |    |  |  |  |  |  |  |  |  |  |                                                                                                                                                                                                                                            |  |  |  |  |  |  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                                                                                                                                                                                                                                                                                                                                                                                             |                                |                                                                                    |                                                                                                                                                                                               | Rock Mass Quality = Very Poor<br>36% Recovery<br>Rock Core Rate (min:sec)<br>33.6-34.6 ft (3:27)<br>34.6-35.6 ft (3:09)<br>35.6-36.6 ft (3:29)<br>36.6-37.6 ft (4:08)<br>37.6-38.6 ft (6:17)                                               |                    |  |  |  |  |  |  |  |                                |                                                     |             |            |                 |                    |                                               |               |                 |              |                 |             |    |    |       |               |             |    |     |  |  |                                                                                    |                                                                                             |                            |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |         |               |          |  |  |  |       |  |                                                |  |    |  |  |  |  |  |  |  |  |  |                                                                                                                                                                                                                                            |  |  |  |  |  |  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41.00      | RQD = 21%                                                                                                                                                                                                                        |               |                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                |                                                                                    |                                                                                                                                                                                               | R2: Grey, fine to coarse grained, LIMESTONE [sedimentary rock], strong, slightly weathered; discontinuities low angle to steep dipping, close spacing, tight to open, extremely fractured [SILURIAN-ORDOVICIAN-AGED CARYS MILLS FORMATION] |                    |  |  |  |  |  |  |  |                                |                                                     |             |            |                 |                    |                                               |               |                 |              |                 |             |    |    |       |               |             |    |     |  |  |                                                                                    |                                                                                             |                            |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |         |               |          |  |  |  |       |  |                                                |  |    |  |  |  |  |  |  |  |  |  |                                                                                                                                                                                                                                            |  |  |  |  |  |  |  |  |  |  |  |                                                                                                                                                                                              |  |  |    |           |               |           |  |  |  |  |  |                                                                                                                                                                                                                                            |  |    |  |  |  |  |  |  |  |  |  |                                                                                                                                                |  |  |    |           |               |          |  |  |  |  |  |                                                                                                                                                                                                                                        |  |  |  |  |  |  |  |  |  |  |  |                                                                                                                                                |  |  |    |     |               |          |  |  |  |       |  |                                                                                                                                                                                                                |  |    |  |  |  |  |  |  |  |  |  |                                                |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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                                                                                                                                                                                                                                                                                                                                                                                             |                                |                                                                                    |                                                                                                                                                                                               | Rock Mass Quality = Very Poor<br>83% Recovery<br>Rock Core Rate (min:sec)<br>38.6-39.6 ft (3:18)<br>39.6-40.6 ft (3:28)<br>40.6-41.0 ft (1:53)                                                                                             |                    |  |  |  |  |  |  |  |                                |                                                     |             |            |                 |                    |                                               |               |                 |              |                 |             |    |    |       |               |             |    |     |  |  |                                                                                    |                                                                                             |                            |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |         |               |          |  |  |  |       |  |                                                |  |    |  |  |  |  |  |  |  |  |  |                                                                                                                                                                                                                                            |  |  |  |  |  |  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43.10      | RQD = 0%                                                                                                                                                                                                                         |               |                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                |                                                                                    |                                                                                                                                                                                               | R3: Grey, fine to coarse grained, LIMESTONE [sedimentary rock], strong, slightly weathered; discontinuities steep angle to vertical dipping, close spacing, open, extremely fractured [SILURIAN-ORDOVICIAN-AGED CARYS MILLS FORMATION]     |                    |  |  |  |  |  |  |  |                                |                                                     |             |            |                 |                    |                                               |               |                 |              |                 |             |    |    |       |               |             |    |     |  |  |                                                                                    |                                                                                             |                            |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |         |               |          |  |  |  |       |  |                                                |  |    |  |  |  |  |  |  |  |  |  |                                                                                                                                                                                                                                            |  |  |  |  |  |  |  |  |  |  |  |                                                                                                                                                                                              |  |  |    |           |               |           |  |  |  |  |  |                                                                                                                                                                                                                                            |  |    |  |  |  |  |  |  |  |  |  |                                                                                                                                                |  |  |    |           |               |          |  |  |  |  |  |                                                                                                                                                                                                                                        |  |  |  |  |  |  |  |  |  |  |  |                                                                                                                                                |  |  |    |     |               |          |  |  |  |       |  |                                                                                                                                                                                                                |  |    |  |  |  |  |  |  |  |  |  |                                                |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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                                                                                                                                                                                                                                                                                                                                                                                             |                                |                                                                                    |                                                                                                                                                                                               | Rock Mass Quality = Very Poor<br>90% Recovery<br>Rock Core Rate (min:sec)<br>41.0-41.6 ft (2:05)<br>41.6-42.6 ft (3:31)<br>42.6-43.1 ft (2:08)                                                                                             |                    |  |  |  |  |  |  |  |                                |                                                     |             |            |                 |                    |                                               |               |                 |              |                 |             |    |    |       |               |             |    |     |  |  |                                                                                    |                                                                                             |                            |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |         |               |          |  |  |  |       |  |                                                |  |    |  |  |  |  |  |  |  |  |  |                                                                                                                                                                                                                                            |  |  |  |  |  |  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43.60      | RQD = 0%                                                                                                                                                                                                                         |               |                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 574.3                          |                                                                                    |                                                                                                                                                                                               | R4: Grey, fine to coarse grained, LIMESTONE [sedimentary rock], strong, fresh; discontinuities steep angle dipping, close spacing, tight, extremely fractured [SILURIAN-ORDOVICIAN-AGED CARYS MILLS FORMATION]                             |                    |  |  |  |  |  |  |  |                                |                                                     |             |            |                 |                    |                                               |               |                 |              |                 |             |    |    |       |               |             |    |     |  |  |                                                                                    |                                                                                             |                            |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |         |               |          |  |  |  |       |  |                                                |  |    |  |  |  |  |  |  |  |  |  |                                                                                                                                                                                                                                            |  |  |  |  |  |  |  |  |  |  |  |                                                                                                                                                                                              |  |  |    |           |               |           |  |  |  |  |  |                                                                                                                                                                                                                                            |  |    |  |  |  |  |  |  |  |  |  |                                                                                                                                                |  |  |    |           |               |          |  |  |  |  |  |                                                                                                                                                                                                                                        |  |  |  |  |  |  |  |  |  |  |  |                                                                                                                                                |  |  |    |     |               |          |  |  |  |       |  |                                                                                                                                                                                                                |  |    |  |  |  |  |  |  |  |  |  |                                                |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 45                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     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                                                                                                                                                                                                                                                                                                                                                                                             |                                |                                                                                    |                                                                                                                                                                                               | Rock Mass Quality = Very Poor<br>100% Recovery                                                                                                                                                                                             |                    |  |  |  |  |  |  |  |                              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| Remarks:<br>1. Hammer efficiency factor provided by Seaboard Drilling LLC and taken from "SPT Energy Calibration Gorham, MA" for Diedrich Drill D-50 with Automatic Hammer (S/N:367)" by GRL Engineers, Inc., dated 11/10/2023.<br>2. As-drilled locations and elevations for the borings and the probe are derived from swing tie measurements made in the field to locate these with respect to site features. Northings and Eastings were derived from CADD files provided to WSP by HNTB on March 25, 2024.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           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| Stratification lines represent approximate boundaries between soil types; transitions may be gradual.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  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| * Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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                                                                                                                                                                                                                                                                                                               |                                |                                                                                    | Boring No.: BB-PIPC-101                                                                                                                                                                       |                                                                                                                                                                                                                                            |                    |  |  |  |  |  |  |  |                                |                                                     |             |            |                 |                    |                                               |               |                 |              |                 |             |    |    |       |               |             |    |     |  |  |                                                                                    |                                                                                             |                            |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |         |               |          |  |  |  |       |  |                                                |  |    |  |  |  |  |  |  |  |  |  |                                                                                                                                                                                                                                            |  |  |  |  |  |  |  |  |  |  |  |                                                               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| <b>Maine Department of Transportation</b><br><u>Soil/Rock Exploration Log</u><br><u>US CUSTOMARY UNITS</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |            |                 |                    | <b>Project:</b> Phair Crossing Bridge Replacement<br><b>Location:</b> Presque Isle, Maine                                                                                                                       |               |     |              | <b>Boring No.:</b> BB-PIPC-101<br><b>WIN:</b> 026434.00                                                                                                                                                                                                                                                                                                                                       |             |                                                                                                                                                                                                                                                                                                                                             |                                                      |                    |  |  |  |  |  |  |  |  |             |                                |                                                      |             |            |                 |                    |                                               |               |     |              |                 |    |  |  |  |  |  |  |  |  |  |                 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---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|----|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|----|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|----|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|----|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|----|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| <b>Driller:</b> Seaboard Drilling, LLC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |            |                 |                    | <b>Elevation (ft.)</b> 617.9                                                                                                                                                                                    |               |     |              | <b>Auger ID/OD:</b> 4-1/4" I.D.                                                                                                                                                                                                                                                                                                                                                               |             |                                                                                                                                                                                                                                                                                                                                             |                                                      |                    |  |  |  |  |  |  |  |  |             |                                |                                                      |             |            |                 |                    |                                               |               |     |              |                 |    |  |  |  |  |  |  |  |  |  |                 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| <b>Operator:</b> Kevin Hanscom                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |            |                 |                    | <b>Datum:</b>                                                                                                                                                                                                   |               |     |              | <b>Sampler:</b> Standard Split Spoon                                                                                                                                                                                                                                                                                                                                                          |             |                                                                                                                                                                                                                                                                                                                                             |                                                      |                    |  |  |  |  |  |  |  |  |             |                                |                                                      |             |            |                 |                    |                                               |               |     |              |                 |    |  |  |  |  |  |  |  |  |  |                 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| <b>Logged By:</b> Daniel Burgess                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |            |                 |                    | <b>Rig Type:</b> Diedrich D-50                                                                                                                                                                                  |               |     |              | <b>Hammer Wt./Fall:</b> 140 lb/30 ft                                                                                                                                                                                                                                                                                                                                                          |             |                                                                                                                                                                                                                                                                                                                                             |                                                      |                    |  |  |  |  |  |  |  |  |             |                                |                                                      |             |            |                 |                    |                                               |               |     |              |                 |    |  |  |  |  |  |  |  |  |  |                 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 |  |  |  |  |  |
| <b>Date Start/Finish:</b> 8:07 AM-11:31 AM on 1/4/24                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |            |                 |                    | <b>Drilling Method:</b> SSA, HSA, and Drive and Wash                                                                                                                                                            |               |     |              | <b>Core Barrel:</b> NQ/NX                                                                                                                                                                                                                                                                                                                                                                     |             |                                                                                                                                                                                                                                                                                                                                             |                                                      |                    |  |  |  |  |  |  |  |  |             |                                |                                                      |             |            |                 |                    |                                               |               |     |              |                 |    |  |  |  |  |  |  |  |  |  |                 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 |  |  |  |  |  |
| <b>Boring Location:</b> Route 10, Presque Isle, Maine                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |            |                 |                    | <b>Casing ID/OD:</b> 3" I.D.                                                                                                                                                                                    |               |     |              | <b>Water Level*:</b> Not Observed                                                                                                                                                                                                                                                                                                                                                             |             |                                                                                                                                                                                                                                                                                                                                             |                                                      |                    |  |  |  |  |  |  |  |  |             |                                |                                                      |             |            |                 |                    |                                               |               |     |              |                 |    |  |  |  |  |  |  |  |  |  |                 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 |  |  |  |  |  |
| <b>Hammer Efficiency Factor:</b> 1.066                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |            |                 |                    | <b>Hammer Type:</b> Automatic <input checked="" type="checkbox"/> Hydraulic <input type="checkbox"/> Rope & Cathead <input type="checkbox"/>                                                                    |               |     |              |                                                                                                                                                                                                                                                                                                                                                                                               |             |                                                                                                                                                                                                                                                                                                                                             |                                                      |                    |  |  |  |  |  |  |  |  |             |                                |                                                      |             |            |                 |                    |                                               |               |     |              |                 |    |  |  |  |  |  |  |  |  |  |                 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 |  |  |  |  |  |
| Definitions:<br>D = Split Spoon Sample<br>MD = Unsuccessful Split Spoon Sample Attempt<br>U = Thin Wall Tube Sample<br>MU = Unsuccessful Thin Wall Tube Sample Attempt<br>V = Field Vane Shear Test, PP = Pocket Penetrometer<br>MV = Unsuccessful Field Vane Shear Test Attempt                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |            |                 |                    | R = Rock Core Sample<br>SSA = Solid Stem Auger<br>HSA = Hollow Stem Auger<br>RC = Roller Cone<br>WOH = Weight of 140 lb. Hammer<br>WOR/C = Weight of Rods or Casing<br>TV = Pocket Torvane Shear Strength (psf) |               |     |              | Su = Peak/Remolded Field Vane Undrained Shear Strength (psf)<br>Su(lab) = Lab Vane Undrained Shear Strength (psf)<br>qp = Unconfined Compressive Strength (ksf)<br>N-uncorrected = Raw Field SPT N-value<br>Hammer Efficiency Factor = Rig Specific Annual Calibration Value<br>N60 = SPT N-uncorrected Corrected for Hammer Efficiency<br>N60 = (Hammer Efficiency Factor/60%)*N-uncorrected |             |                                                                                                                                                                                                                                                                                                                                             |                                                      |                    |  |  |  |  |  |  |  |  |             |                                |                                                      |             |            |                 |                    |                                               |               |     |              |                 |    |  |  |  |  |  |  |  |  |  |                                                                                                                                                                                                                                                                                                                                             |      |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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Analysis<br>C = Consolidation Test                                                                                                                                                                                                                  |             |                                                                                                                                                                                                                                                                                                                                             |                                                      |                    |  |  |  |  |  |  |  |  |             |                                |                                                      |             |            |                 |                    |                                               |               |     |              |                 |    |  |  |  |  |  |  |  |  |  |     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| <table><thead><tr><th colspan="9">Sample Information</th><th rowspan="2">Graphic Log</th><th rowspan="2">Visual Description and Remarks</th><th rowspan="2">Laboratory Testing Results/ AASHTO and Unified Class</th></tr><tr><th>Depth (ft.)</th><th>Sample No.</th><th>Pen./Rec. (in.)</th><th>Sample Depth (ft.)</th><th>Blows (6 in.) Shear Strength (psf) or RQD (%)</th><th>N-uncorrected</th><th>N60</th><th>Casing Blows</th><th>Elevation (ft.)</th></tr></thead><tbody><tr><td rowspan="5">60</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td rowspan="5"></td><td rowspan="5">Rock Core Rate (min:sec)<br/>43.1-43.6 ft (2:14)<br/><br/><b>Bottom of Exploration at 43.6 feet below ground surface.</b><br/>Backfilled borehole with bentonite chips up to 5 feet below the existing surface, gravel was placed up to the bottom of the existing paved surface and cold patch was placed to match the existing paved surface.</td><td rowspan="5">43.6</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td rowspan="5">65</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td rowspan="5"></td><td rowspan="5"></td><td rowspan="5"></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td rowspan="5">70</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td rowspan="5"></td><td rowspan="5"></td><td rowspan="5"></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td rowspan="5">75</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td rowspan="5"></td><td rowspan="5"></td><td rowspan="5"></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td rowspan="5">80</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td rowspan="5"></td><td rowspan="5"></td><td rowspan="5"></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td rowspan="5">85</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td rowspan="5"></td><td rowspan="5"></td><td rowspan="5"></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></tbody></table> |            |                 |                    |                                                                                                                                                                                                                 |               |     |              |                                                                                                                                                                                                                                                                                                                                                                                               |             |                                                                                                                                                                                                                                                                                                                                             |                                                      | Sample Information |  |  |  |  |  |  |  |  | Graphic Log | Visual Description and Remarks | Laboratory Testing Results/ AASHTO and Unified Class | 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.) | 60 |  |  |  |  |  |  |  |  |  | Rock Core Rate (min:sec)<br>43.1-43.6 ft (2:14)<br><br><b>Bottom of Exploration at 43.6 feet below ground surface.</b><br>Backfilled borehole with bentonite chips up to 5 feet below the existing surface, gravel was placed up to the bottom of the existing paved surface and cold patch was placed to match the existing paved surface. | 43.6 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 65 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 70 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 75 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 80 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 85 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Sample Information                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     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                                                                                                                                                                                                                                        | Graphic Log | Visual Description and Remarks                                                                                                                                                                                                                                                                                                              | Laboratory Testing Results/ AASHTO and Unified Class |                    |  |  |  |  |  |  |  |  |             |                                |                                                      |             |            |                 |                    |                                               |               |     |              |                 |    |  |  |  |  |  |  |  |  |  |                 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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.)                                                                                                                                                                                                                                                                                                                                                                               |             |                                                                                                                                                                                                                                                                                                                                             |                                                      |                    |  |  |  |  |  |  |  |  |             |                                |                                                      |             |            |                 |                    |                                               |               |     |              |                 |    |  |  |  |  |  |  |  |  |  |                                                                                                                                                                                                                                                                                                                                             |      |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| <b>Remarks:</b><br><br>1. Hammer efficiency factor provided by Seaboard Drilling LLC and taken from "SPT Energy Calibration Gorham, MA" for Diedrich Drill D-50 with Automatic Hammer (S/N:367)" by GRL Engineers, Inc., dated 11/10/2023.<br>2. As-drilled locations and elevations for the borings and the probe are derived from swing tie measurements made in the field to locate these with respect to site features. Northings and Eastings were derived from CADD files provided to WSP by HNTB on March 25, 2024.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           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| Stratification lines represent approximate boundaries between soil types; transitions may be gradual.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  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| * Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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| <div>Maine Department of Transportation</div> <div>Soil/Rock Exploration Log</div> <div>US CUSTOMARY UNITS</div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |            |                 |                    | <div>Project: Phair Crossing Bridge Replacement</div> <div>Location: Presque Isle, Maine</div>                                        |               |                 |              | <div>Boring No.: BB-PIPC-102</div> <div>WIN: 026434.00</div> |                                                                                    |                                                                                                       |                                                     |                    |  |  |  |  |  |  |  |                 |             |                                |                                                     |             |            |                 |                    |                                               |               |                 |              |   |    |       |             |             |    |    |     |       |                                                                                    |                  |                             |  |  |  |  |  |  |  |  |  |                                                                                                |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |   |    |      |             |         |    |    |  |  |                       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |      |               |         |   |    |  |  |                                                                                               |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |       |               |         |    |    |    |  |                                                              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--------|--------------|---|----|-------|-------------|-------------|----|----|-----|-------|------------------------------------------------------------------------------------|------------------|-----------------------------|--|--|--|--|--|--|--|--|--|------------------------------------------------------------------------------------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|---|----|------|-------------|---------|----|----|--|--|-----------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|----|----|------|---------------|---------|---|----|--|--|-----------------------------------------------------------------------------------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|----|----|-------|---------------|---------|----|----|----|--|------------------------------------------------------------------------------------------------------|--|--|--|--|--|--|--|----|--|--|--|--|--|--|--|--|--|--|----|--|--|--|--|--|--|--|--|--|--|----|--|--|--|--|--|--|--|--|--|--|----|--|--|--|----|----|------|---------------|---------|----|----|----|--|------------------------|--|--|--|--|--|--|--|----|--|--|--|--|--|--|--|--|--|--|----|--|--|--|--|--|--|--|--|--|--|----|--|--|--|--|--|--|--|--|--|--|----|--|--|--|----|----|------|---------------|---------|----|----|----|--|-------------------------------------------------------------------------------------------------------|--|--|--|--|--|--|--|----|--|--|--|--|--|--|--|--|--|--|----|--|--|--|--|--|--|--|--|--|--|----|--|--|--|
| Driller: Seaboard Drilling, LLC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |            |                 |                    | Elevation (ft.) 616.0                                                                                                                 |               |                 |              | Auger ID/OD: 4" I.D.                                         |                                                                                    |                                                                                                       |                                                     |                    |  |  |  |  |  |  |  |                 |             |                                |                                                     |             |            |                 |                    |                                               |               |              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| Operator: Kevin Hanscom                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |            |                 |                    | Datum:                                                                                                                                |               |                 |              | Sampler: Standard Split Spoon                                |                                                                                    |                                                                                                       |                                                     |                    |  |  |  |  |  |  |  |                 |             |                                |                                                     |             |            |                 |                    |                                               |               |                 |              |   |    |       |             |             |    |    |     |       |                                                                                    |                  |                             |  |  |  |  |  |  |  |  |  |                                                                                                |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |   |    |      |             |         |    |    |  |  |                       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |      |               |         |   |    |  |  |                                                                                               |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |       |               |         |    |    |    |  |                                                              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| Logged By: Daniel Burgess                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |            |                 |                    | Rig Type: Diedrich D-50                                                                                                               |               |                 |              | Hammer Wt./Fall: 140 lb/30 ft                                |                                                                                    |                                                                                                       |                                                     |                    |  |  |  |  |  |  |  |                 |             |                                |                                                     |             |            |                 |                    |                                               |               |              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| Date Start/Finish: 9:40 AM-3:14 PM on 1/2/24                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |            |                 |                    | Drilling Method: SSA, drive and wash                                                                                                  |               |                 |              | Core Barrel: NQ/NX                                           |                                                                                    |                                                                                                       |                                                     |                    |  |  |  |  |  |  |  |                 |             |                                |                                                     |             |            |                 |                    |                                               |               |              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| Boring Location: Route 10, Presque Isle, Maine                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |            |                 |                    | Casing ID/OD: 4" and 3" I.D.                                                                                                          |               |                 |              | Water Level*: 27.7 ft at 2:24 PM on 1/2/24                   |                                                                                    |                                                                                                       |                                                     |                    |  |  |  |  |  |  |  |                 |             |                                |                                                     |             |            |                 |                    |                                               |               |              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| Hammer Efficiency Factor: 1.066                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |            |                 |                    | Hammer Type: Automatic <input checked="" type="checkbox"/> Hydraulic <input type="checkbox"/> Rope & Cathead <input type="checkbox"/> |               |                 |              |                                                              |                                                                                    |                                                                                                       |                                                     |                    |  |  |  |  |  |  |  |                 |             |                                |                                                     |             |            |                 |                    |                                               |               |              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| <div>Definitions:</div> <div><div>D = Split Spoon Sample</div><div>MD = Unsuccessful Split Spoon Sample Attempt</div><div>U = Thin Wall Tube Sample</div><div>MU = Unsuccessful Thin Wall Tube Sample Attempt</div><div>V = Field Vane Shear Test, PP = Pocket Penetrometer</div><div>MV = Unsuccessful Field Vane Shear Test Attempt</div></div> <div><div>R = Rock Core Sample</div><div>SSA = Solid Stem Auger</div><div>HSA = Hollow Stem Auger</div><div>RC = Roller Cone</div><div>WOH = Weight of 140lb. Hammer</div><div>WOR/C = Weight of Rods or Casing</div><div>T<sub>v</sub> = Pocket Torvane Shear Strength (psf)</div></div> <div><div>S<sub>u</sub> = Peak/Remolded Field Vane Undrained Shear Strength (psf)</div><div>S<sub>u(lab)</sub> = Lab Vane Undrained Shear Strength (psf)</div><div>q<sub>p</sub> = Unconfined Compressive Strength (ksf)</div><div>N-uncorrected = Raw Field SPT N-value</div><div>Hammer Efficiency Factor = Rig Specific Annual Calibration Value</div><div>N<sub>60</sub> = SPT N-uncorrected Corrected for Hammer Efficiency</div><div>N<sub>60</sub> = (Hammer Efficiency Factor/60%)*N-uncorrected</div></div> <div><div>LI = Liquidity Index</div><div>WC = Water Content, percent</div><div>LL = Liquid Limit</div><div>PL = Plastic Limit</div><div>PI = Plasticity Index</div><div>G = Grain Size Analysis</div><div>C = Consolidation Test</div></div>                                                                                                                                            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| <table><tr><th colspan="8">Sample Information</th><th rowspan="2">Elevation (ft.)</th><th rowspan="2">Graphic Log</th><th rowspan="2">Visual Description and Remarks</th><th rowspan="2">Laboratory Testing Results/AASHTO and Unified Class</th></tr><tr><th>Depth (ft.)</th><th>Sample No.</th><th>Pen./Rec. (in.)</th><th>Sample Depth (ft.)</th><th>Blows (6 in.) Shear Strength (psf) or RQD (%)</th><th>N-uncorrected</th><th>N<sub>60</sub></th><th>Casing Blows</th></tr><tr><td>0</td><td>1D</td><td>24/14</td><td>0.90 - 2.90</td><td>24-19-17-15</td><td>36</td><td>64</td><td>SSA</td><td>615.5</td><td rowspan="24"></td><td>6 inches ASPHALT</td><td rowspan="24">Fines = 27.8% A-2-4 (0), SM</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Brown, dry, very dense, fine to coarse SAND, little silt, little fine to coarse gravel [FILL].</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>5</td><td>2D</td><td>24/2</td><td>5.00 - 7.00</td><td>6-9-9-6</td><td>18</td><td>32</td><td></td><td></td><td>Poor recovery [FILL].</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>10</td><td>3D</td><td>24/9</td><td>10.00 - 12.00</td><td>4-4-4-3</td><td>8</td><td>14</td><td></td><td></td><td>Brown, dry, dense, fine to coarse SAND, some silt, some gravel, slight petroleum odor [FILL].</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>15</td><td>4D</td><td>24/10</td><td>15.00 - 17.00</td><td>4-5-5-4</td><td>10</td><td>18</td><td>40</td><td></td><td>Brown, dry, medium dense, fine to coarse SAND, some gravel, some silt, slight petroleum odor [FILL].</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>46</td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>44</td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>53</td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>41</td><td></td><td></td><td></td></tr><tr><td>20</td><td>5D</td><td>24/6</td><td>20.00 - 22.00</td><td>8-7-7-9</td><td>14</td><td>25</td><td>36</td><td></td><td>Rocks in spoon [FILL].</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>55</td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>65</td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>80</td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>64</td><td></td><td></td><td></td></tr><tr><td>25</td><td>6D</td><td>24/4</td><td>25.00 - 27.00</td><td>7-5-8-7</td><td>13</td><td>23</td><td>42</td><td></td><td>Poor recovery. Brown, wet, medium dense, fine to coarse SAND and GRAVEL, trace to little silt [FILL].</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>43</td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>52</td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>61</td><td></td><td></td><td></td></tr></table> |            |                 |                    |                                                                                                                                       |               |                 |              |                                                              |                                                                                    |                                                                                                       |                                                     | Sample Information |  |  |  |  |  |  |  | Elevation (ft.) | Graphic Log | Visual Description and Remarks | Laboratory Testing Results/AASHTO and Unified Class | Depth (ft.) | Sample No. | Pen./Rec. (in.) | Sample Depth (ft.) | Blows (6 in.) Shear Strength (psf) or RQD (%) | N-uncorrected | N <sub>60</sub> | Casing Blows | 0 | 1D | 24/14 | 0.90 - 2.90 | 24-19-17-15 | 36 | 64 | SSA | 615.5 |  | 6 inches ASPHALT | Fines = 27.8% A-2-4 (0), SM |  |  |  |  |  |  |  |  |  | Brown, dry, very dense, fine to coarse SAND, little silt, little fine to coarse gravel [FILL]. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 5 | 2D | 24/2 | 5.00 - 7.00 | 6-9-9-6 | 18 | 32 |  |  | Poor recovery [FILL]. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 10 | 3D | 24/9 | 10.00 - 12.00 | 4-4-4-3 | 8 | 14 |  |  | Brown, dry, dense, fine to coarse SAND, some silt, some gravel, slight petroleum odor [FILL]. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 15 | 4D | 24/10 | 15.00 - 17.00 | 4-5-5-4 | 10 | 18 | 40 |  | Brown, dry, medium dense, fine to coarse SAND, some gravel, some silt, slight petroleum odor [FILL]. |  |  |  |  |  |  |  | 46 |  |  |  |  |  |  |  |  |  |  | 44 |  |  |  |  |  |  |  |  |  |  | 53 |  |  |  |  |  |  |  |  |  |  | 41 |  |  |  | 20 | 5D | 24/6 | 20.00 - 22.00 | 8-7-7-9 | 14 | 25 | 36 |  | Rocks in spoon [FILL]. |  |  |  |  |  |  |  | 55 |  |  |  |  |  |  |  |  |  |  | 65 |  |  |  |  |  |  |  |  |  |  | 80 |  |  |  |  |  |  |  |  |  |  | 64 |  |  |  | 25 | 6D | 24/4 | 25.00 - 27.00 | 7-5-8-7 | 13 | 23 | 42 |  | Poor recovery. Brown, wet, medium dense, fine to coarse SAND and GRAVEL, trace to little silt [FILL]. |  |  |  |  |  |  |  | 43 |  |  |  |  |  |  |  |  |  |  | 52 |  |  |  |  |  |  |  |  |  |  | 61 |  |  |  |
| Sample Information                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |            |                 |                    |                                                                                                                                       |               |                 |              | Elevation (ft.)                                              | Graphic Log                                                                        | Visual Description and Remarks                                                                        | Laboratory Testing Results/AASHTO and Unified Class |                    |  |  |  |  |  |  |  |                 |             |                                |                                                     |             |            |                 |                    |                                               |               |                 |              |   |    |       |             |             |    |    |     |       |                                                                                    |                  |                             |  |  |  |  |  |  |  |  |  |                                                                                                |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |   |    |      |             |         |    |    |  |  |                       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |      |               |         |   |    |  |  |                                                                                               |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |       |               |         |    |    |    |  |                                                              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| Depth (ft.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Sample No. | Pen./Rec. (in.) | Sample Depth (ft.) | Blows (6 in.) Shear Strength (psf) or RQD (%)                                                                                         | N-uncorrected | N <sub>60</sub> | Casing Blows |                                                              |                                                                                    |                                                                                                       |                                                     |                    |  |  |  |  |  |  |  |                 |             |                                |                                                     |             |            |                 |                    |                                               |               |                 |              |   |    |       |             |             |    |    |     |       |                                                                                    |                  |                             |  |  |  |  |  |  |  |  |  |                                                                                                |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |   |    |      |             |         |    |    |  |  |                       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |      |               |         |   |    |  |  |                                                                                               |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |       |               |         |    |    |    |  |                                                                                                      |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |    |  |  |  |    |    |      |               |         |    |    |    |  |                        |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |    |  |  |  |    |    |      |               |         |    |    |    |  |                                                                                                       |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |    |  |  |  |
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2.90        | 24-19-17-15                                                                                                                           | 36            | 64              | SSA          | 615.5                                                        |  | 6 inches ASPHALT                                                                                      | Fines = 27.8% A-2-4 (0), SM                         |                    |  |  |  |  |  |  |  |                 |             |                                |                                                     |             |            |                 |                    |                                               |               |                 |              |   |    |       |             |             |    |    |     |       |                                                                                    |                  |                             |  |  |  |  |  |  |  |  |  |                                                                                                |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |   |    |      |             |         |    |    |  |  |                       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |      |               |         |   |    |  |  |                                                                                               |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |       |               |         |    |    |    |  |                                                                                                      |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |    |  |  |  |    |    |      |               |         |    |    |    |  |                        |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |    |  |  |  |    |    |      |               |         |    |    |    |  |                                                                                                       |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |    |  |  |  |
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                                                                                                                                                        |            |                 |                    |                                                                                                                                       |               |                 |              |                                                              |                                                                                    | Brown, dry, very dense, fine to coarse SAND, little silt, little fine to coarse gravel [FILL].        |                                                     |                    |  |  |  |  |  |  |  |                 |             |                                |                                                     |             |            |                 |                    |                                               |               |                 |              |   |    |       |             |             |    |    |     |       |                                                                                    |                  |                             |  |  |  |  |  |  |  |  |  |                                                                                                |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |   |    |      |             |         |    |    |  |  |                       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |      |               |         |   |    |  |  |                                                                                               |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |       |               |         |    |    |    |  |                                                              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| 25                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 6D         | 24/4            | 25.00 - 27.00      | 7-5-8-7                                                                                                                               | 13            | 23              | 42           |                                                              |                                                                                    | Poor recovery. Brown, wet, medium dense, fine to coarse SAND and GRAVEL, trace to little silt [FILL]. |                                                     |                    |  |  |  |  |  |  |  |                 |             |                                |                                                     |             |            |                 |                    |                                               |               |                 |              |   |    |       |             |             |    |    |     |       |                                                                                    |                  |                             |  |  |  |  |  |  |  |  |  |                                                                                                |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |   |    |      |             |         |    |    |  |  |                       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |      |               |         |   |    |  |  |                                                                                               |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |       |               |         |    |    |    |  |                                                                                                      |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |    |  |  |  |    |    |      |               |         |    |    |    |  |                        |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |    |  |  |  |    |    |      |               |         |    |    |    |  |                                                                                                       |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |    |  |  |  |  |  |  |  |  |  |  |    |  |  |  |
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| Remarks: <div>1. Hammer efficiency factor provided by Seaboard Drilling LLC and taken from "SPT Energy Calibration Gorham, MA" for Diedrich Drill D-50 with Automatic Hammer (S/N:367)" by GRL Engineers, Inc., dated 11/10/2023.</div> <div>2. As-drilled locations and elevations for the borings and the probe are derived from swing tie measurements made in the field to locate these with respect to site features. Northings and Eastings were derived from CADD files provided to WSP by HNTB on March 25, 2024.</div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     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| Stratification lines represent approximate boundaries between soil types; transitions may be gradual.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  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| * Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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| <b>Maine Department of Transportation</b><br>Soil/Rock Exploration Log<br>US CUSTOMARY UNITS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |            |                 |                    | <b>Project:</b> Phair Crossing Bridge Replacement<br><b>Location:</b> Presque Isle, Maine                                                                                                                                   |               |                 |              | <b>Boring No.:</b> BB-PIPC-102<br><b>WIN:</b> 026434.00                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                 |                                                                                                                      |                                                      |                    |  |  |  |  |  |  |  |                 |             |                                |                                                      |             |            |                 |                    |                                               |               |                 |              |    |    |      |               |         |    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----|----|----|-------|--|------------------------|--|----|----|----|----|----|----|------|---------------|------------|----|----|----|-------|--|----------------------------------------------------------------------------------------------------|--------------------------------------------|-----|-----|--|--|----|----|-------|---------------|-------------|----|-----|------|-------|--|----------------------------------------------------------------------------------------------------------------------|---------------------------------------------|--|--|--|--|----|-----|-----|---------------|--------|---|--|-------|--|------------------------------------------------------------------------------------------------------------|--|--|--|--|--|----|-----|------|---------------|-------------|---|--|-------|--|-----------------------------------------------------------------------------------------|----------------------------------------------|--|--|--|--|----|----|---------|---------------|----------|--|--|-------|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|--|
| <b>Driller:</b> Seaboard Drilling, LLC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |            |                 |                    | <b>Elevation (ft.)</b> 616.0                                                                                                                                                                                                |               |                 |              | <b>Auger ID/OD:</b> 4" I.D.                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                 |                                                                                                                      |                                                      |                    |  |  |  |  |  |  |  |                 |             |                                |                                                      |             |            |                 |                    |                                               |               |                 |              |    |    |      |               |         |    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    |  |  |       |  |                                                                                                                                                                                                                                                                 |  |  |  |  |  |
| <b>Operator:</b> Kevin Hanscom                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |            |                 |                    | <b>Datum:</b>                                                                                                                                                                                                               |               |                 |              | <b>Sampler:</b> Standard Split Spoon                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                 |                                                                                                                      |                                                      |                    |  |  |  |  |  |  |  |                 |             |                                |                                                      |             |            |                 |                    |                                               |               |                 |              |    |    |      |               |         |    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    |  |  |       |  |                                                                                                                                                                                                                                                                 |  |  |  |  |  |
| <b>Logged By:</b> Daniel Burgess                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |            |                 |                    | <b>Rig Type:</b> Diedrich D-50                                                                                                                                                                                              |               |                 |              | <b>Hammer Wt./Fall:</b> 140 lb/30 ft                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                 |                                                                                                                      |                                                      |                    |  |  |  |  |  |  |  |                 |             |                                |                                                      |             |            |                 |                    |                                               |               |                 |              |    |    |      |               |         |    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    |  |  |       |  |                                                                                                                                                                                                                                                                 |  |  |  |  |  |
| <b>Date Start/Finish:</b> 9:40 AM-3:14 PM on 1/2/24                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |            |                 |                    | <b>Drilling Method:</b> SSA, drive and wash                                                                                                                                                                                 |               |                 |              | <b>Core Barrel:</b> NQ/NX                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                 |                                                                                                                      |                                                      |                    |  |  |  |  |  |  |  |                 |             |                                |                                                      |             |            |                 |                    |                                               |               |                 |              |    |    |      |               |         |    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    |  |  |       |  |                                                                                                                                                                                                                                                                 |  |  |  |  |  |
| <b>Boring Location:</b> Route 10, Presque Isle, Maine                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |            |                 |                    | <b>Casing ID/OD:</b> 4" and 3" I.D.                                                                                                                                                                                         |               |                 |              | <b>Water Level*:</b> 27.7 ft at 2:24 PM on 1/2/24                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                 |                                                                                                                      |                                                      |                    |  |  |  |  |  |  |  |                 |             |                                |                                                      |             |            |                 |                    |                                               |               |                 |              |    |    |      |               |         |    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    |  |  |       |  |                                                                                                                                                                                                                                                                 |  |  |  |  |  |
| <b>Hammer Efficiency Factor:</b> 1.066                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |            |                 |                    | <b>Hammer Type:</b> Automatic <input checked="" type="checkbox"/> Hydraulic <input type="checkbox"/> Rope & Cathead <input type="checkbox"/>                                                                                |               |                 |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                 |                                                                                                                      |                                                      |                    |  |  |  |  |  |  |  |                 |             |                                |                                                      |             |            |                 |                    |                                               |               |                 |              |    |    |      |               |         |    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    |  |  |       |  |                                                                                                                                                                                                                                                                 |  |  |  |  |  |
| Definitions:<br>D = Split Spoon Sample<br>MD = Unsuccessful Split Spoon Sample Attempt<br>U = Thin Wall Tube Sample<br>MU = Unsuccessful Thin Wall Tube Sample Attempt<br>V = Field Vane Shear Test, PP = Pocket Penetrometer<br>MV = Unsuccessful Field Vane Shear Test Attempt                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |            |                 |                    | R = Rock Core Sample<br>SSA = Solid Stem Auger<br>HSA = Hollow Stem Auger<br>RC = Roller Cone<br>WOH = Weight of 140 lb. Hammer<br>WOR/C = Weight of Rods or Casing<br>T <sub>v</sub> = Pocket Torvane Shear Strength (psf) |               |                 |              | S <sub>u</sub> = Peak/Remolded Field Vane Undrained Shear Strength (psf)<br>S <sub>u</sub> (lab) = Lab Vane Undrained Shear Strength (psf)<br>q <sub>p</sub> = Unconfined Compressive Strength (ksf)<br>N-uncorrected = Raw Field SPT N-value<br>Hammer Efficiency Factor = Rig Specific Annual Calibration Value<br>N <sub>60</sub> = SPT N-uncorrected Corrected for Hammer Efficiency<br>N <sub>60</sub> = (Hammer Efficiency Factor/60%)*N-uncorrected |                                                                                                                                                                                                                                                                 |                                                                                                                      |                                                      |                    |  |  |  |  |  |  |  |                 |             |                                |                                                      |             |            |                 |                    |                                               |               |                 |              |    |    |      |               |         |    |    |    |       |  |                        |  |    |    |    |    |    |    |      |               |            |    |    |    |       |  |                                                                                                    |                                            |     |     |  |  |    |    |       |               |             |    |     |      |       |  |                                                                                                                      |                                             |  |  |  |  |    |     |     |               |        |   |  |       |  |                                                                                                            |  |  |  |  |  |    |     |      |               |             |   |  |       |  |                                                                                         |                                              |  |  |  |  |    |    |         |               |          |  |  |       |  |                                                                                                                                                                                                                                                                 |  |  |  |  |  |
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                                                                                                                                                                                                                                                                                                                                                                                                                                            |            |                 |                    | LI = Liquidity Index<br>WC = Water Content, percent<br>LL = Liquid Limit<br>PL = Plastic Limit<br>PI = Plasticity Index<br>G = Grain Size Analysis<br>C = Consolidation Test                                                |               |                 |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                 |                                                                                                                      |                                                      |                    |  |  |  |  |  |  |  |                 |             |                                |                                                      |             |            |                 |                    |                                               |               |                 |              |    |    |      |               |         |    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    |  |  |       |  |                                                                                                                                                                                                                                                                 |  |  |  |  |  |
| <table><thead><tr><th colspan="8">Sample Information</th><th rowspan="2">Elevation (ft.)</th><th rowspan="2">Graphic Log</th><th rowspan="2">Visual Description and Remarks</th><th rowspan="2">Laboratory Testing Results/AASHTO and Unified Class.</th></tr><tr><th>Depth (ft.)</th><th>Sample No.</th><th>Pen./Rec. (in.)</th><th>Sample Depth (ft.)</th><th>Blows (6 in.) Shear Strength (psf) or RQD (%)</th><th>N-uncorrected</th><th>N<sub>60</sub></th><th>Casing Blows</th></tr></thead><tbody><tr><td rowspan="5">30</td><td rowspan="5">7D</td><td rowspan="5">24/1</td><td rowspan="5">30.00 - 32.00</td><td rowspan="5">5-6-6-3</td><td rowspan="5">12</td><td rowspan="5">21</td><td>30</td><td rowspan="5">581.0</td><td rowspan="5"></td><td rowspan="5">Rocks in tip of spoon.</td><td rowspan="5"></td></tr><tr><td>36</td></tr><tr><td>45</td></tr><tr><td>48</td></tr><tr><td>56</td></tr><tr><td rowspan="5">35</td><td rowspan="5">8D</td><td rowspan="5">24/7</td><td rowspan="5">35.00 - 37.00</td><td rowspan="5">8-27-27-21</td><td rowspan="5">54</td><td rowspan="5">96</td><td>77</td><td rowspan="5">581.0</td><td rowspan="5"></td><td rowspan="5">Brown, wet, very dense, fine to coarse GRAVEL, some silt, some fine to coarse sand [GLACIAL TILL].</td><td rowspan="5">WC = 14.0%<br/>Fines = 35.2%<br/>A-4 (0), GM</td></tr><tr><td>187</td></tr><tr><td>105</td></tr><tr><td></td></tr><tr><td></td></tr><tr><td rowspan="5">40</td><td rowspan="5">9D</td><td rowspan="5">24/13</td><td rowspan="5">40.00 - 42.00</td><td rowspan="5">31-51-48-39</td><td rowspan="5">99</td><td rowspan="5">176</td><td>WASH</td><td rowspan="5">581.0</td><td rowspan="5"></td><td rowspan="5">Brown, wet, very dense, fine to coarse GRAVEL, little silt, some fine to coarse sand, fractured rock [GLACIAL TILL].</td><td rowspan="5">WC = 6.1%<br/>Fines = 18.6%<br/>A-1-b (0), GM</td></tr><tr><td></td></tr><tr><td></td></tr><tr><td></td></tr><tr><td></td></tr><tr><td rowspan="5">45</td><td rowspan="5">10D</td><td rowspan="5">6/3</td><td rowspan="5">45.00 - 45.50</td><td rowspan="5">100/6"</td><td rowspan="5">R</td><td></td><td rowspan="5">581.0</td><td rowspan="5"></td><td rowspan="5">Poor recovery.<br/>Brown, wet, very dense, fine to coarse Silty SAND, fine to coarse GRAVEL [GLACIAL TILL].</td><td rowspan="5"></td></tr><tr><td></td></tr><tr><td></td></tr><tr><td></td></tr><tr><td></td></tr><tr><td rowspan="5">50</td><td rowspan="5">11D</td><td rowspan="5">14/7</td><td rowspan="5">50.00 - 51.17</td><td rowspan="5">84-86-50/2"</td><td rowspan="5">R</td><td></td><td rowspan="5">564.8</td><td rowspan="5"></td><td rowspan="5">Gray, wet, very dense, fine to coarse SAND, some silt, some fine gravel [GLACIAL TILL].</td><td rowspan="5">WC = 11.8%<br/>Fines = 27.3%<br/>A-2-4 (0), SM</td></tr><tr><td></td></tr><tr><td></td></tr><tr><td></td></tr><tr><td></td></tr><tr><td rowspan="5">55</td><td rowspan="5">R1</td><td rowspan="5">60/51.6</td><td rowspan="5">55.00 - 60.00</td><td rowspan="5">RQD = 8%</td><td></td><td></td><td rowspan="5">561.0</td><td rowspan="5"></td><td rowspan="5">Roller bit refusal.<br/>Top of Bedrock at Elev.<br/>R1: Grey, fine to coarse grained, LIMESTONE [sedimentary rock], strong, slightly weathered; discontinuities low angle to steep dipping, close spacing, open, extremely fractured, frequent calcite intrusions</td><td rowspan="5"></td></tr><tr><td></td></tr><tr><td></td></tr><tr><td></td></tr><tr><td></td></tr></tbody></table> |            |                 |                    |                                                                                                                                                                                                                             |               |                 |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                 |                                                                                                                      |                                                      | Sample Information |  |  |  |  |  |  |  | Elevation (ft.) | Graphic Log | Visual Description and Remarks | Laboratory Testing Results/AASHTO and Unified Class. | Depth (ft.) | Sample No. | Pen./Rec. (in.) | Sample Depth (ft.) | Blows (6 in.) Shear Strength (psf) or RQD (%) | N-uncorrected | N <sub>60</sub> | Casing Blows | 30 | 7D | 24/1 | 30.00 - 32.00 | 5-6-6-3 | 12 | 21 | 30 | 581.0 |  | Rocks in tip of spoon. |  | 36 | 45 | 48 | 56 | 35 | 8D | 24/7 | 35.00 - 37.00 | 8-27-27-21 | 54 | 96 | 77 | 581.0 |  | Brown, wet, very dense, fine to coarse GRAVEL, some silt, some fine to coarse sand [GLACIAL TILL]. | WC = 14.0%<br>Fines = 35.2%<br>A-4 (0), GM | 187 | 105 |  |  | 40 | 9D | 24/13 | 40.00 - 42.00 | 31-51-48-39 | 99 | 176 | WASH | 581.0 |  | Brown, wet, very dense, fine to coarse GRAVEL, little silt, some fine to coarse sand, fractured rock [GLACIAL TILL]. | WC = 6.1%<br>Fines = 18.6%<br>A-1-b (0), GM |  |  |  |  | 45 | 10D | 6/3 | 45.00 - 45.50 | 100/6" | R |  | 581.0 |  | Poor recovery.<br>Brown, wet, very dense, fine to coarse Silty SAND, fine to coarse GRAVEL [GLACIAL TILL]. |  |  |  |  |  | 50 | 11D | 14/7 | 50.00 - 51.17 | 84-86-50/2" | R |  | 564.8 |  | Gray, wet, very dense, fine to coarse SAND, some silt, some fine gravel [GLACIAL TILL]. | WC = 11.8%<br>Fines = 27.3%<br>A-2-4 (0), SM |  |  |  |  | 55 | R1 | 60/51.6 | 55.00 - 60.00 | RQD = 8% |  |  | 561.0 |  | Roller bit refusal.<br>Top of Bedrock at Elev.<br>R1: Grey, fine to coarse grained, LIMESTONE [sedimentary rock], strong, slightly weathered; discontinuities low angle to steep dipping, close spacing, open, extremely fractured, frequent calcite intrusions |  |  |  |  |  |
| Sample Information                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     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                                                                                                                                                                                                   | Graphic Log                                                                                                                                                                                                                                                     | Visual Description and Remarks                                                                                       | Laboratory Testing Results/AASHTO and Unified Class. |                    |  |  |  |  |  |  |  |                 |             |                                |                                                      |             |            |                 |                    |                                               |               |                 |              |    |    |      |               |         |    |    |    |       |  |                        |  |    |    |    |    |    |    |      |               |            |    |    |    |       |  |                                                                                                    |                                            |     |     |  |  |    |    |       |               |             |    |     |      |       |  |                                                                                                                      |                                             |  |  |  |  |    |     |     |               |        |   |  |       |  |                                                                                                            |  |  |  |  |  |    |     |      |               |             |   |  |       |  |                                                                                         |                                              |  |  |  |  |    |    |         |               |          |  |  |       |  |                                                                                                                                                                                                                                                                 |  |  |  |  |  |
| Depth (ft.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Sample No. | Pen./Rec. (in.) | Sample Depth (ft.) | Blows (6 in.) 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32.00      | 5-6-6-3                                                                                                                                                                                                                     | 12            | 21              | 30           | 581.0                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                 | Rocks in tip of spoon.                                                                                               |                                                      |                    |  |  |  |  |  |  |  |                 |             |                                |                                                      |             |            |                 |                    |                                               |               |                 |              |    |    |      |               |         |    |    |    |       |  |                        |  |    |    |    |    |    |    |      |               |            |    |    |    |       |  |                                                                                                    |                                            |     |     |  |  |    |    |       |               |             |    |     |      |       |  |                                                                                                                      |                                             |  |  |  |  |    |     |     |               |        |   |  |       |  |                                                                                                            |  |  |  |  |  |    |     |      |               |             |   |  |       |  |                                                                                         |                                              |  |  |  |  |    |    |         |               |          |  |  |       |  |                                                                                                                                                                                                                                                                 |  |  |  |  |  |
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| 35                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 8D         | 24/7            | 35.00 - 37.00      | 8-27-27-21                                                                                                                                                                                                                  | 54            | 96              | 77           | 581.0                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                 | Brown, wet, very dense, fine to coarse GRAVEL, some silt, some fine to coarse sand [GLACIAL TILL].                   | WC = 14.0%<br>Fines = 35.2%<br>A-4 (0), GM           |                    |  |  |  |  |  |  |  |                 |             |                                |                                                      |             |            |                 |                    |                                               |               |                 |              |    |    |      |               |         |    |    |    |       |  |                        |  |    |    |    |    |    |    |      |               |            |    |    |    |       |  |                                                                                                    |                                            |     |     |  |  |    |    |       |               |             |    |     |      |       |  |                                                                                                                      |                                             |  |  |  |  |    |     |     |               |        |   |  |       |  |                                                                                                            |  |  |  |  |  |    |     |      |               |             |   |  |       |  |                                                                                         |                                              |  |  |  |  |    |    |         |               |          |  |  |       |  |                                                                                                                                                                                                                                                                 |  |  |  |  |  |
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| 40                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 9D         | 24/13           | 40.00 - 42.00      | 31-51-48-39                                                                                                                                                                                                                 | 99            | 176             | WASH         | 581.0                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                 | Brown, wet, very dense, fine to coarse GRAVEL, little silt, some fine to coarse sand, fractured rock [GLACIAL TILL]. | WC = 6.1%<br>Fines = 18.6%<br>A-1-b (0), GM          |                    |  |  |  |  |  |  |  |                 |             |                                |                                                      |             |            |                 |                    |                                               |               |                 |              |    |    |      |               |         |    |    |    |       |  |                        |  |    |    |    |    |    |    |      |               |            |    |    |    |       |  |                                                                                                    |                                            |     |     |  |  |    |    |       |               |             |    |     |      |       |  |                                                                                                                      |                                             |  |  |  |  |    |     |     |               |        |   |  |       |  |                                                                                                            |  |  |  |  |  |    |     |      |               |             |   |  |       |  |                                                                                         |                                              |  |  |  |  |    |    |         |               |          |  |  |       |  |                                                                                                                                                                                                                                                                 |  |  |  |  |  |
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45.50      | 100/6"                                                                                                                                                                                                                      | R             |                 | 581.0        |                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Poor recovery.<br>Brown, wet, very dense, fine to coarse Silty SAND, fine to coarse GRAVEL [GLACIAL TILL].                                                                                                                                                      |                                                                                                                      |                                                      |                    |  |  |  |  |  |  |  |                 |             |                                |                                                      |             |            |                 |                    |                                               |               |                 |              |    |    |      |               |         |    |    |    |       |  |                        |  |    |    |    |    |    |    |      |               |            |    |    |    |       |  |                                                                                                    |                                            |     |     |  |  |    |    |       |               |             |    |     |      |       |  |                                                                                                                      |                                             |  |  |  |  |    |     |     |               |        |   |  |       |  |                                                                                                            |  |  |  |  |  |    |     |      |               |             |   |  |       |  |                                                                                         |                                              |  |  |  |  |    |    |         |               |          |  |  |       |  |                                                                                                                                                                                                                                                                 |  |  |  |  |  |
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51.17      | 84-86-50/2"                                                                                                                                                                                                                 | R             |                 | 564.8        |                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Gray, wet, very dense, fine to coarse SAND, some silt, some fine gravel [GLACIAL TILL].                                                                                                                                                                         | WC = 11.8%<br>Fines = 27.3%<br>A-2-4 (0), SM                                                                         |                                                      |                    |  |  |  |  |  |  |  |                 |             |                                |                                                      |             |            |                 |                    |                                               |               |                 |              |    |    |      |               |         |    |    |    |       |  |                        |  |    |    |    |    |    |    |      |               |            |    |    |    |       |  |                                                                                                    |                                            |     |     |  |  |    |    |       |               |             |    |     |      |       |  |                                                                                                                      |                                             |  |  |  |  |    |     |     |               |        |   |  |       |  |                                                                                                            |  |  |  |  |  |    |     |      |               |             |   |  |       |  |                                                                                         |                                              |  |  |  |  |    |    |         |               |          |  |  |       |  |                                                                                                                                                                                                                                                                 |  |  |  |  |  |
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| 55                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | R1         | 60/51.6         | 55.00 - 60.00      | RQD = 8%                                                                                                                                                                                                                    |               |                 | 561.0        |                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Roller bit refusal.<br>Top of Bedrock at Elev.<br>R1: Grey, fine to coarse grained, LIMESTONE [sedimentary rock], strong, slightly weathered; discontinuities low angle to steep dipping, close spacing, open, extremely fractured, frequent calcite intrusions |                                                                                                                      |                                                      |                    |  |  |  |  |  |  |  |                 |             |                                |                                                      |             |            |                 |                    |                                               |               |                 |              |    |    |      |               |         |    |    |    |       |  |                        |  |    |    |    |    |    |    |      |               |            |    |    |    |       |  |                                                                                                    |                                            |     |     |  |  |    |    |       |               |             |    |     |      |       |  |                                                                                                                      |                                             |  |  |  |  |    |     |     |               |        |   |  |       |  |                                                                                                            |  |  |  |  |  |    |     |      |               |             |   |  |       |  |                                                                                         |                                              |  |  |  |  |    |    |         |               |          |  |  |       |  |                                                                                                                                                                                                                                                                 |  |  |  |  |  |
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| <b>Remarks:</b><br>1. Hammer efficiency factor provided by Seaboard Drilling LLC and taken from "SPT Energy Calibration Gorham, MA" for Diedrich Drill D-50 with Automatic Hammer (S/N:367)" by GRL Engineers, Inc., dated 11/10/2023.<br>2. As-drilled locations and elevations for the borings and the probe are derived from swing tie measurements made in the field to locate these with respect to site features. Northings and Eastings were derived from CADD files provided to WSP by HNTB on March 25, 2024.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           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| Stratification lines represent approximate boundaries between soil types; transitions may be gradual.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  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| * Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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                                                                                                                     |                                                                                                                                                                                                                                                                 | Boring No.: BB-PIPC-102                                                                                              |                                                      |                    |  |  |  |  |  |  |  |                 |             |                                |                                                      |             |            |                 |                    |                                               |               |                 |              |    |    |      |               |         |    |    |    |       |  |                        |  |    |    |    |    |    |    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| <div>Maine Department of Transportation</div> <div>Soil/Rock Exploration Log</div> <div>US CUSTOMARY UNITS</div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |  |  | <div>Project: Phair Crossing Bridge Replacement</div> <div>Location: Presque Isle, Maine</div>                                                                                                                                                                                        |  |  |  | <div>Boring No.: BB-PIPC-102</div> <div>WIN: 026434.00</div>                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |                                    |  |                                                                                                                                                                                                                                         |  |  |  |
| Driller: Seaboard Drilling, LLC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |  |  | Elevation (ft.): 616.0                                                                                                                                                                                                                                                                |  |  |  | Auger ID/OD: 4" I.D.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  |                                    |  |                                                                                                                                                                                                                                         |  |  |  |
| Operator: Kevin Hanscom                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |  |  | Datum:                                                                                                                                                                                                                                                                                |  |  |  | Sampler: Standard Split Spoon                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |  |                                    |  |                                                                                                                                                                                                                                         |  |  |  |
| Logged By: Daniel Burgess                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |  |  | Rig Type: Diedrich D-50                                                                                                                                                                                                                                                               |  |  |  | Hammer Wt./Fall: 140 lb/30 ft                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |  |                                    |  |                                                                                                                                                                                                                                         |  |  |  |
| Date Start/Finish: 9:40 AM-3:14 PM on 1/2/24                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |  |  |  | Drilling Method: SSA, drive and wash                                                                                                                                                                                                                                                  |  |  |  | Core Barrel: NQ/NX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |                                    |  |                                                                                                                                                                                                                                         |  |  |  |
| Boring Location: Route 10, Presque Isle, Maine                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |  |  | Casing ID/OD: 4" and 3" I.D.                                                                                                                                                                                                                                                          |  |  |  | Water Level*: 27.7 ft at 2:24 PM on 1/2/24                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |                                    |  |                                                                                                                                                                                                                                         |  |  |  |
| Hammer Efficiency Factor: 1.066                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |  |  | Hammer Type: Automatic <input checked="" type="checkbox"/> Hydraulic <input type="checkbox"/> Rope & Cathead <input type="checkbox"/>                                                                                                                                                 |  |  |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |                                    |  |                                                                                                                                                                                                                                         |  |  |  |
| <div>Definitions:</div> <div>D = Split Spoon Sample</div> <div>MD = Unsuccessful Split Spoon Sample Attempt</div> <div>U = Thin Wall Tube Sample</div> <div>MU = Unsuccessful Thin Wall Tube Sample Attempt</div> <div>V = Field Vane Shear Test, PP = Pocket Penetrometer</div> <div>MV = Unsuccessful Field Vane Shear Test Attempt</div>                                                                                                                                                                                                                                                                                                                                                                                    |  |  |  | <div>R = Rock Core Sample</div> <div>SSA = Solid Stem Auger</div> <div>HSA = Hollow Stem Auger</div> <div>RC = Roller Cone</div> <div>WOH = Weight of 140 lb. Hammer</div> <div>WOR/C = Weight of Rods or Casing</div> <div>T<sub>V</sub> = Pocket Torvane Shear Strength (psf)</div> |  |  |  | <div>S<sub>u</sub> = Peak/Remolded Field Vane Undrained Shear Strength (psf)</div> <div>S<sub>u</sub>(lab) = Lab Vane Undrained Shear Strength (psf)</div> <div>q<sub>p</sub> = Unconfined Compressive Strength (ksf)</div> <div>N-uncorrected = Raw Field SPT N-value</div> <div>Hammer Efficiency Factor = Rig Specific Annual Calibration Value</div> <div>N<sub>60</sub> = SPT N-uncorrected Corrected for Hammer Efficiency</div> <div>N<sub>60</sub> = (Hammer Efficiency Factor/60%)*N-uncorrected</div> |  |                                    |  | <div>LI = Liquidity Index</div> <div>WC = Water Content, percent</div> <div>LL = Liquid Limit</div> <div>PL = Plastic Limit</div> <div>PI = Plasticity Index</div> <div>G = Grain Size Analysis</div> <div>C = Consolidation Test</div> |  |  |  |
| <div><div><div><div>Depth (ft.)</div><div>Sample No.</div><div>Pen./Rec. (in.)</div><div>Sample Depth (ft.)</div><div>Blows (6 in.) Shear Strength (psf) or RQD (%)</div><div>N-uncorrected</div><div>N<sub>60</sub></div><div>Casing Blows</div><div>Elevation (ft.)</div></div><div>Sample Information</div><div>Graphic Log</div><div>Visual Description and Remarks</div><div>Laboratory Testing Results/ AASHTO and Unified Class</div></div></div>                                                                                                                                                                                                                                                                       |  |  |  |                                                                                                                                                                                                                                                                                       |  |  |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |                                    |  |                                                                                                                                                                                                                                         |  |  |  |
| <div><div><div><div>60</div><div>R2</div><div>40.8/40.8</div><div>60.00 - 63.40</div><div>RQD = 0%</div><div></div><div></div><div></div><div></div></div><div></div><div></div><div>[SILURIAN-ORDOVICIAN-AGED CARYS MILLS FORMATION]</div><div>Rock Mass Quality = Very Poor</div><div>86% Recovery</div><div>Rock Core Rate (min:sec)</div><div>55.0-56.0 ft (3:42)</div><div>56.0-57.0 ft (3:51)</div><div>57.0-58.0 ft (3:58)</div><div>58.0-59.0 ft (4:45)</div><div>59.0-60.0 ft (4:54)</div></div></div>                                                                                                                                                                                                                |  |  |  |                                                                                                                                                                                                                                                                                       |  |  |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |                                    |  |                                                                                                                                                                                                                                         |  |  |  |
| <div><div><div><div>65</div><div>R3</div><div>19.2/18</div><div>63.40 - 65.00</div><div>RQD = 21%</div><div></div><div></div><div></div><div></div></div><div></div><div></div><div>R2: Grey, fine to coarse grained, LIMESTONE [sedimentary rock], strong, slightly weathered; discontinuities moderate to steep angle dipping, close spacing, tight to open, extremely fractured 61 ft to 63.4 ft, frequent calcite intrusions [SILURIAN-ORDOVICIAN-AGED CARYS MILLS FORMATION]</div><div>Rock Mass Quality = Very Poor</div><div>100% Recovery</div><div>Rock Core Rate (min:sec)</div><div>60.0-61.0 ft (2:24)</div><div>61.0-62.0 ft (2:41)</div><div>62.0-63.0 ft (2:57)</div><div>63.0-63.4 ft (1:11)</div></div></div> |  |  |  |                                                                                                                                                                                                                                                                                       |  |  |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |                                    |  |                                                                                                                                                                                                                                         |  |  |  |
| <div><div><div><div>70</div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div><div></div><div></div><div>R3: Grey, fine to coarse grained, LIMESTONE [sedimentary rock], strong, slightly weathered; discontinuities low angle to vertical dipping, close spacing, tight, large calcite intrusion 52.4 ft to 64.3 ft [SILURIAN-ORDOVICIAN-AGED CARYS MILLS FORMATION]</div><div>Rock Mass Quality = Very Poor</div><div>94% Recover</div><div>Rock Core Rate (min:sec)</div><div>63.4-64.0 ft (1:50)</div><div>64.0-65.0 ft (2:44)</div></div></div>                                                                                                                               |  |  |  |                                                                                                                                                                                                                                                                                       |  |  |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |                                    |  |                                                                                                                                                                                                                                         |  |  |  |
| <div><div><div><div>75</div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div><div></div><div></div><div>Bottom of Exploration at 65.0 feet below ground surface.</div><div>Backfilled borehole with bentonite chips up to 5 feet below the existing surface, gravel was placed up to the bottom of the existing paved surface and cold patch was placed to match the existing paved surface.</div></div></div>                                                                                                                                                                                                                                                                    |  |  |  |                                                                                                                                                                                                                                                                                       |  |  |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |                                    |  |                                                                                                                                                                                                                                         |  |  |  |
| <div><div><div><div>80</div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div><div></div><div></div><div></div></div></div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |  |  |                                                                                                                                                                                                                                                                                       |  |  |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |                                    |  |                                                                                                                                                                                                                                         |  |  |  |
| <div><div><div><div>85</div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div></div><div></div><div></div><div></div></div></div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |  |  |                                                                                                                                                                                                                                                                                       |  |  |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |                                    |  |                                                                                                                                                                                                                                         |  |  |  |
| <div>Remarks:</div> <div>1. Hammer efficiency factor provided by Seaboard Drilling LLC and taken from "SPT Energy Calibration Gorham, MA" for Diedrich Drill D-50 with Automatic Hammer (S/N:367)" by GRL Engineers, Inc., dated 11/10/2023.</div> <div>2. As-drilled locations and elevations for the borings and the probe are derived from swing tie measurements made in the field to locate these with respect to site features. Northings and Eastings were derived from CADD files provided to WSP by HNTB on March 25, 2024.</div>                                                                                                                                                                                     |  |  |  |                                                                                                                                                                                                                                                                                       |  |  |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |                                    |  |                                                                                                                                                                                                                                         |  |  |  |
| <div>Stratification lines represent approximate boundaries between soil types; transitions may be gradual.</div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |  |  |                                                                                                                                                                                                                                                                                       |  |  |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  | <div>Page 3 of 3</div>             |  |                                                                                                                                                                                                                                         |  |  |  |
| <div>* 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.</div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |  |  |  |                                                                                                                                                                                                                                                                                       |  |  |  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  | <div>Boring No.: BB-PIPC-102</div> |  |                                                                                                                                                                                                                                         |  |  |  |

[illegible]

| <div>Maine Department of Transportation</div> <div>Soil/Rock Exploration Log</div> <div>US CUSTOMARY UNITS</div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       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             |                                               |               |                 |              |                 |             |                                |                                                     |    |  |  |  |  |  |  |    |       |  |                                                                   |  |  |  |  |  |  |  |    |  |  |  |  |  |  |    |  |  |  |  |  |  |      |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |         |               |          |  |  |       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |           |               |           |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |           |               |          |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  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--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|----|----|---------|---------------|----------|--|--|--|--|--|--|--|----|---------|---------------|----------|--|--|--|--|--|--|--|----|----------|---------------|----------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| Driller: Seaboard Drilling, LLC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |            |                 |                    | Elevation (ft.) 617.7                                                                                                      |               |                                                                                                | Auger ID/OD: 4" I.D.                       |                 |                                                              |                                                                   |                                                     |             |            |                 |                    |                                               |               |                 |              |                 |             |                                |                                                     |    |  |  |  |  |  |  |    |       |  |                                                                   |  |  |  |  |  |  |  |    |  |  |  |  |  |  |    |  |  |  |  |  |  |      |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |         |               |          |  |  |       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |           |               |           |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |           |               |          |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  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| Operator: Kevin Hanscom                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                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             |                                               |               |                 |              |                 |             |                                |                                                     |    |  |  |  |  |  |  |    |       |  |                                                                   |  |  |  |  |  |  |  |    |  |  |  |  |  |  |    |  |  |  |  |  |  |      |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |         |               |          |  |  |       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |           |               |           |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |           |               |          |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  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| Logged By: Daniel Burgess                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |            |                 |                    | Rig Type: Diedrich D-50                                                                                                    |               |                                                                                                | Hammer Wt./Fall:                           |                 |                                                              |                                                                   |                                                     |             |            |                 |                    |                                               |               |                 |              |                 |             |                                |                                                     |    |  |  |  |  |  |  |    |       |  |                                                                   |  |  |  |  |  |  |  |    |  |  |  |  |  |  |    |  |  |  |  |  |  |      |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |         |               |          |  |  |       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |           |               |           |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |           |               |          |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  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| Date Start/Finish: 10:52 AM-2:25 PM on 1/3/24                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |            |                 |                    | Drilling Method: Drive and Wash                                                                                            |               |                                                                                                | Core Barrel: NQ/NX                         |                 |                                                              |                                                                   |                                                     |             |            |                 |                    |                                               |               |                 |              |                 |             |                                |                                                     |    |  |  |  |  |  |  |    |       |  |                                                                   |  |  |  |  |  |  |  |    |  |  |  |  |  |  |    |  |  |  |  |  |  |      |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |         |               |          |  |  |       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |           |               |           |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |           |               |          |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  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| Boring Location: Route 10, Presque Isle, Maine                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |            |                 |                    | Casing ID/OD: 4" and 3" I.D.                                                                                               |               |                                                                                                | Water Level*: 41.5 ft on 1/3/24 at 1:41 PM |                 |                                                              |                                                                   |                                                     |             |            |                 |                    |                                               |               |                 |              |                 |             |                                |                                                     |    |  |  |  |  |  |  |    |       |  |                                                                   |  |  |  |  |  |  |  |    |  |  |  |  |  |  |    |  |  |  |  |  |  |      |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |         |               |          |  |  |       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |           |               |           |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |           |               |          |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  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| Hammer Efficiency Factor:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |            |                 |                    | Hammer Type: Automatic <input type="checkbox"/> Hydraulic <input type="checkbox"/> Rope & Cathead <input type="checkbox"/> |               |                                                                                                |                                            |                 |                                                              |                                                                   |                                                     |             |            |                 |                    |                                               |               |                 |              |                 |             |                                |                                                     |    |  |  |  |  |  |  |    |       |  |                                                                   |  |  |  |  |  |  |  |    |  |  |  |  |  |  |    |  |  |  |  |  |  |      |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |         |               |          |  |  |       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |           |               |           |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |           |               |          |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  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| <div>Definitions:</div> <div>D = Split Spoon Sample<br/>MD = Unsuccessful Split Spoon Sample Attempt<br/>U = Thin Wall Tube Sample<br/>MU = Unsuccessful Thin Wall Tube Sample Attempt<br/>V = Field Vane Shear Test, PP = Pocket Penetrometer<br/>MV = Unsuccessful Field Vane Shear Test Attempt</div> <div>R = Rock Core Sample<br/>SSA = Solid Stem Auger<br/>HSA = Hollow Stem Auger<br/>RC = Roller Cone<br/>WOH = Weight of 140 lb. Hammer<br/>WOR/C = Weight of Rods or Casing<br/>TV = Pocket Torvane Shear Strength (psf)</div> <div>S<sub>u</sub> = Peak/Remolded Field Vane Undrained Shear Strength (psf)<br/>S<sub>u(lab)</sub> = Lab Vane Undrained Shear Strength (psf)<br/>q<sub>p</sub> = Unconfined Compressive Strength (ksf)<br/>N-uncorrected = Raw Field SPT N-value<br/>Hammer Efficiency Factor = Rig Specific Annual Calibration Value<br/>N<sub>60</sub> = SPT N-uncorrected Corrected for Hammer Efficiency<br/>N<sub>60</sub> = (Hammer Efficiency Factor/60%)*N-uncorrected</div> <div>LI = Liquidity Index<br/>WC = Water Content, percent<br/>LL = Liquid Limit<br/>PL = Plastic Limit<br/>PI = Plasticity Index<br/>G = Grain Size Analysis<br/>C = Consolidation Test</div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |            |                 |                    |                                                                                                                            |               |                                                                                                |                                            |                 |                                                              |                                                                   |                                                     |             |            |                 |                    |                                               |               |                 |              |                 |             |                                |                                                     |    |  |  |  |  |  |  |    |       |  |                                                                   |  |  |  |  |  |  |  |    |  |  |  |  |  |  |    |  |  |  |  |  |  |      |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |         |               |          |  |  |       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |           |               |           |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |           |               |          |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |         |               |          |  |  |  |  |  |  |  |    |         |               |          |  |  |  |  |  |  |  |    |          |               |          |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <div><div><div><div>Sample Information</div><table><thead><tr><th>Depth (ft.)</th><th>Sample No.</th><th>Pen./Rec. (in.)</th><th>Sample Depth (ft.)</th><th>Blows (6 in.) Shear Strength (psf) or RQD (%)</th><th>N-uncorrected</th><th>N<sub>60</sub></th><th>Casing Blows</th><th>Elevation (ft.)</th><th>Graphic Log</th><th>Visual Description and Remarks</th><th>Laboratory Testing Results/AASHTO and Unified Class</th></tr></thead><tbody><tr><td rowspan="4">30</td><td></td><td></td><td></td><td></td><td></td><td></td><td>49</td><td rowspan="8">578.8</td><td rowspan="8"></td><td rowspan="8">Change in straigraphy inferred from change in casing blow counts.</td><td rowspan="8"></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td>74</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td>56</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td>WASH</td></tr><tr><td rowspan="4">35</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td rowspan="4">40</td><td>R1</td><td>30/27.6</td><td>38.90 - 41.40</td><td>RQD = 0%</td><td></td><td></td><td>NQ/NX</td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td rowspan="4">45</td><td>R2</td><td>34.8/34.8</td><td>41.40 - 44.30</td><td>RQD = 41%</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td rowspan="4">50</td><td>R3</td><td>22.8/20.4</td><td>44.30 - 46.20</td><td>RQD = 0%</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td rowspan="4">55</td><td>R4</td><td>8.4/8.4</td><td>46.20 - 46.90</td><td>RQD = 0%</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>R5</td><td>7.2/7.2</td><td>46.90 - 47.50</td><td>RQD = 0%</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>R6</td><td>16.8/7.2</td><td>47.50 - 48.90</td><td>RQD = 0%</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></tbody></table></div></div></div> |            |                 |                    |                                                                                                                            |               |                                                                                                |                                            |                 |                                                              |                                                                   |                                                     | Depth (ft.) | Sample No. | Pen./Rec. (in.) | Sample Depth (ft.) | Blows (6 in.) Shear Strength (psf) or RQD (%) | N-uncorrected | N <sub>60</sub> | Casing Blows | Elevation (ft.) | Graphic Log | Visual Description and Remarks | Laboratory Testing Results/AASHTO and Unified Class | 30 |  |  |  |  |  |  | 49 | 578.8 |  | Change in straigraphy inferred from change in casing blow counts. |  |  |  |  |  |  |  | 74 |  |  |  |  |  |  | 56 |  |  |  |  |  |  | WASH | 35 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 40 | R1 | 30/27.6 | 38.90 - 41.40 | RQD = 0% |  |  | NQ/NX |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 45 | R2 | 34.8/34.8 | 41.40 - 44.30 | RQD = 41% |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 50 | R3 | 22.8/20.4 | 44.30 - 46.20 | RQD = 0% |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 55 | R4 | 8.4/8.4 | 46.20 - 46.90 | RQD = 0% |  |  |  |  |  |  |  | R5 | 7.2/7.2 | 46.90 - 47.50 | RQD = 0% |  |  |  |  |  |  |  | R6 | 16.8/7.2 | 47.50 - 48.90 | RQD = 0% |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Depth (ft.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Sample No. | Pen./Rec. (in.) | Sample Depth (ft.) | Blows (6 in.) Shear Strength (psf) or RQD (%)                                                                              | N-uncorrected | N <sub>60</sub>                                                                                | Casing Blows                               | Elevation (ft.) | Graphic Log                                                  | Visual Description and Remarks                                    | Laboratory Testing Results/AASHTO and Unified Class |             |            |                 |                    |                                               |               |                 |              |                 |             |                                |                                                     |    |  |  |  |  |  |  |    |       |  |                                                                   |  |  |  |  |  |  |  |    |  |  |  |  |  |  |    |  |  |  |  |  |  |      |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |         |               |          |  |  |       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |           |               |           |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |           |               |          |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |         |               |          |  |  |  |  |  |  |  |    |         |               |          |  |  |  |  |  |  |  |    |          |               |          |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 30                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |            |                 |                    |                                                                                                                            |               |                                                                                                | 49                                         | 578.8           |                                                              | Change in straigraphy inferred from change in casing blow counts. |                                                     |             |            |                 |                    |                                               |               |                 |              |                 |             |                                |                                                     |    |  |  |  |  |  |  |    |       |  |                                                                   |  |  |  |  |  |  |  |    |  |  |  |  |  |  |    |  |  |  |  |  |  |      |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |         |               |          |  |  |       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |           |               |           |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |           |               |          |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  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44.30      | RQD = 41%                                                                                                                  |               |                                                                                                |                                            |                 |                                                              |                                                                   |                                                     |             |            |                 |                    |                                               |               |                 |              |                 |             |                                |                                                     |    |  |  |  |  |  |  |    |       |  |                                                                   |  |  |  |  |  |  |  |    |  |  |  |  |  |  |    |  |  |  |  |  |  |      |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |         |               |          |  |  |       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |           |               |           |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |           |               |          |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |         |               |          |  |  |  |  |  |  |  |    |         |               |          |  |  |  |  |  |  |  |    |          |               |          |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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46.90      | RQD = 0%                                                                                                                   |               |                                                                                                |                                            |                 |                                                              |                                                                   |                                                     |             |            |                 |                    |                                               |               |                 |              |                 |             |                                |                                                     |    |  |  |  |  |  |  |    |       |  |                                                                   |  |  |  |  |  |  |  |    |  |  |  |  |  |  |    |  |  |  |  |  |  |      |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |         |               |          |  |  |       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |           |               |           |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |           |               |          |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |         |               |          |  |  |  |  |  |  |  |    |         |               |          |  |  |  |  |  |  |  |    |          |               |          |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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47.50      | RQD = 0%                                                                                                                   |               |                                                                                                |                                            |                 |                                                              |                                                                   |                                                     |             |            |                 |                    |                                               |               |                 |              |                 |             |                                |                                                     |    |  |  |  |  |  |  |    |       |  |                                                                   |  |  |  |  |  |  |  |    |  |  |  |  |  |  |    |  |  |  |  |  |  |      |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |         |               |          |  |  |       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |           |               |           |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |           |               |          |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |         |               |          |  |  |  |  |  |  |  |    |         |               |          |  |  |  |  |  |  |  |    |          |               |          |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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48.90      | RQD = 0%                                                                                                                   |               |                                                                                                |                                            |                 |                                                              |                                                                   |                                                     |             |            |                 |                    |                                               |               |                 |              |                 |             |                                |                                                     |    |  |  |  |  |  |  |    |       |  |                                                                   |  |  |  |  |  |  |  |    |  |  |  |  |  |  |    |  |  |  |  |  |  |      |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |         |               |          |  |  |       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |           |               |           |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |           |               |          |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |         |               |          |  |  |  |  |  |  |  |    |         |               |          |  |  |  |  |  |  |  |    |          |               |          |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| Remarks: <div>1. As-drilled locations and elevations for the borings and the probe are derived from swing tie measurements made in the field to locate these with respect to site features. Northings and Eastings were derived from CADD files provided to WSP by HNTB on March 25, 2024.</div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     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   |          |               |          |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Stratification lines represent approximate boundaries between soil types; transitions may be gradual.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  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             |                                               |               |                 |              |                 |             |                                |                                                     |    |  |  |  |  |  |  |    |       |  |                                                                   |  |  |  |  |  |  |  |    |  |  |  |  |  |  |    |  |  |  |  |  |  |      |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |         |               |          |  |  |       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |           |               |           |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |           |               |          |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  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| * Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |            |                 |                    |                                                                                                                            |               |                                                                                                |                                            |                 |                                                              | Boring No.: BP-PIPC-103                                           |                                                     |             |            |                 |                    |                                               |               |                 |              |                 |             |                                |                                                     |    |  |  |  |  |  |  |    |       |  |                                                                   |  |  |  |  |  |  |  |    |  |  |  |  |  |  |    |  |  |  |  |  |  |      |    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |         |               |          |  |  |       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |           |               |           |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |           |               |          |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |    |    |         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|                                                                                                                                                                                                                                                                                                     |                   |                        |                           |                                                                                                                                                                                                                 |                      |            |                     |                                                                                                                                                                                                                                                                                                                                                                                               |  |  |  |                                                                                                                                                                                                                                                                                                                                                                                                               |  |                                       |  |                                                            |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|------------------------|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|------------|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|---------------------------------------|--|------------------------------------------------------------|--|
| <b>Maine Department of Transportation</b><br>Soil/Rock Exploration Log<br>US CUSTOMARY UNITS                                                                                                                                                                                                        |                   |                        |                           | <b>Project:</b> Phair Crossing Bridge Replacement<br><b>Location:</b> Presque Isle, Maine                                                                                                                       |                      |            |                     | <b>Boring No.:</b> BP-PIPC-103<br><b>WIN:</b> 026434.00                                                                                                                                                                                                                                                                                                                                       |  |  |  |                                                                                                                                                                                                                                                                                                                                                                                                               |  |                                       |  |                                                            |  |
| <b>Driller:</b> Seaboard Drilling, LLC                                                                                                                                                                                                                                                              |                   |                        |                           | <b>Elevation (ft.)</b> 617.7                                                                                                                                                                                    |                      |            |                     | <b>Auger ID/OD:</b> 4" I.D.                                                                                                                                                                                                                                                                                                                                                                   |  |  |  |                                                                                                                                                                                                                                                                                                                                                                                                               |  |                                       |  |                                                            |  |
| <b>Operator:</b> Kevin Hanscom                                                                                                                                                                                                                                                                      |                   |                        |                           | <b>Datum:</b>                                                                                                                                                                                                   |                      |            |                     | <b>Sampler:</b>                                                                                                                                                                                                                                                                                                                                                                               |  |  |  |                                                                                                                                                                                                                                                                                                                                                                                                               |  |                                       |  |                                                            |  |
| <b>Logged By:</b> Daniel Burgess                                                                                                                                                                                                                                                                    |                   |                        |                           | <b>Rig Type:</b> Diedrich D-50                                                                                                                                                                                  |                      |            |                     | <b>Hammer Wt./Fall:</b>                                                                                                                                                                                                                                                                                                                                                                       |  |  |  |                                                                                                                                                                                                                                                                                                                                                                                                               |  |                                       |  |                                                            |  |
| <b>Date Start/Finish:</b> 10:52 AM-2:25 PM on 1/3/24                                                                                                                                                                                                                                                |                   |                        |                           | <b>Drilling Method:</b> Drive and Wash                                                                                                                                                                          |                      |            |                     | <b>Core Barrel:</b> NQ/NX                                                                                                                                                                                                                                                                                                                                                                     |  |  |  |                                                                                                                                                                                                                                                                                                                                                                                                               |  |                                       |  |                                                            |  |
| <b>Boring Location:</b> Route 10, Presque Isle, Maine                                                                                                                                                                                                                                               |                   |                        |                           | <b>Casing ID/OD:</b> 4" and 3" I.D.                                                                                                                                                                             |                      |            |                     | <b>Water Level*:</b> 41.5 ft on 1/3/24 at 1:41 PM                                                                                                                                                                                                                                                                                                                                             |  |  |  |                                                                                                                                                                                                                                                                                                                                                                                                               |  |                                       |  |                                                            |  |
| <b>Hammer Efficiency Factor:</b>                                                                                                                                                                                                                                                                    |                   |                        |                           | <b>Hammer Type:</b> Automatic <input type="checkbox"/> Hydraulic <input type="checkbox"/> Rope & Cathead <input type="checkbox"/>                                                                               |                      |            |                     |                                                                                                                                                                                                                                                                                                                                                                                               |  |  |  |                                                                                                                                                                                                                                                                                                                                                                                                               |  |                                       |  |                                                            |  |
| Definitions:<br>D = Split Spoon Sample<br>MD = Unsuccessful Split Spoon Sample Attempt<br>U = Thin Wall Tube Sample<br>MU = Unsuccessful Thin Wall Tube Sample Attempt<br>V = Field Vane Shear Test, PP = Pocket Penetrometer<br>MV = Unsuccessful Field Vane Shear Test Attempt                    |                   |                        |                           | R = Rock Core Sample<br>SSA = Solid Stem Auger<br>HSA = Hollow Stem Auger<br>RC = Roller Cone<br>WOH = Weight of 140 lb. Hammer<br>WOR/C = Weight of Rods or Casing<br>TV = Pocket Torvane Shear Strength (psf) |                      |            |                     | Su = Peak/Remolded Field Vane Undrained Shear Strength (psf)<br>Su(lab) = Lab Vane Undrained Shear Strength (psf)<br>qp = Unconfined Compressive Strength (ksf)<br>N-uncorrected = Raw Field SPT N-value<br>Hammer Efficiency Factor = Rig Specific Annual Calibration Value<br>N60 = SPT N-uncorrected Corrected for Hammer Efficiency<br>N60 = (Hammer Efficiency Factor/60%)*N-uncorrected |  |  |  |                                                                                                                                                                                                                                                                                                                                                                                                               |  |                                       |  |                                                            |  |
|                                                                                                                                                                                                                                                                                                     |                   |                        |                           |                                                                                                                                                                                                                 |                      |            |                     | LI = Liquidity Index<br>WC = Water Content, percent<br>LL = Liquid Limit<br>PL = Plastic Limit<br>PI = Plasticity Index<br>G = Grain Size Analysis<br>C = Consolidation Test                                                                                                                                                                                                                  |  |  |  |                                                                                                                                                                                                                                                                                                                                                                                                               |  |                                       |  |                                                            |  |
| <b>Sample Information</b>                                                                                                                                                                                                                                                                           |                   |                        |                           |                                                                                                                                                                                                                 |                      |            |                     |                                                                                                                                                                                                                                                                                                                                                                                               |  |  |  | <b>Graphic Log</b>                                                                                                                                                                                                                                                                                                                                                                                            |  | <b>Visual Description and Remarks</b> |  | <b>Laboratory Testing Results/AASHTO and Unified Class</b> |  |
| <b>Depth (ft.)</b>                                                                                                                                                                                                                                                                                  | <b>Sample No.</b> | <b>Pen./Rec. (in.)</b> | <b>Sample Depth (ft.)</b> | <b>Blows (6 in.) Shear Strength (psf) or RQD (%)</b>                                                                                                                                                            | <b>N-uncorrected</b> | <b>N60</b> | <b>Casing Blows</b> | <b>Elevation (ft.)</b>                                                                                                                                                                                                                                                                                                                                                                        |  |  |  |                                                                                                                                                                                                                                                                                                                                                                                                               |  |                                       |  |                                                            |  |
| 60                                                                                                                                                                                                                                                                                                  |                   |                        |                           |                                                                                                                                                                                                                 |                      |            |                     |                                                                                                                                                                                                                                                                                                                                                                                               |  |  |  | 44.3-44.9 ft (2:25)<br>44.9-45.9 ft (3:41)<br>45.9-46.2 ft (1:09)<br><br>R4: Grey, fine to coarse grained, LIMESTONE [sedimentary rock], medium strong, fresh; discontinuities horizontal to vertical dipping, close spacing, open, extremely fractured [SILURIAN-ORDOVICIAN-AGED CARYS MILLS FORMATION]<br>Rock Mass Quality = Very Poor<br>100% Recovery<br>Rock Core Rate (min:sec)<br>46.2-46.9 ft (2:20) |  |                                       |  |                                                            |  |
| 65                                                                                                                                                                                                                                                                                                  |                   |                        |                           |                                                                                                                                                                                                                 |                      |            |                     |                                                                                                                                                                                                                                                                                                                                                                                               |  |  |  | R5: Grey, fine to coarse grained, LIMESTONE [sedimentary rock], medium strong, fresh; discontinuities horizontal to vertical dipping, close spacing, open, extremely fractured [SILURIAN-ORDOVICIAN-AGED CARYS MILLS FORMATION]<br>Rock Mass Quality = Very Poor<br>100% Recovery<br>Rock Core Rate (min:sec)<br>46.9-47.5 ft (3:40)                                                                          |  |                                       |  |                                                            |  |
| 70                                                                                                                                                                                                                                                                                                  |                   |                        |                           |                                                                                                                                                                                                                 |                      |            |                     |                                                                                                                                                                                                                                                                                                                                                                                               |  |  |  | R6: Grey, fine to coarse grained, LIMESTONE [sedimentary rock], medium strong, fresh; discontinuities horizontal to vertical dipping, close spacing, open, extremely fractured [SILURIAN-ORDOVICIAN-AGED CARYS MILLS FORMATION]<br>Rock Mass Quality = Very Poor<br>43% Recovery<br>Rock Core Rate (min:sec)<br>47.5-47.9 ft (1:14)<br>47.9-48.9 ft (2:53)                                                    |  |                                       |  |                                                            |  |
| 75                                                                                                                                                                                                                                                                                                  |                   |                        |                           |                                                                                                                                                                                                                 |                      |            |                     |                                                                                                                                                                                                                                                                                                                                                                                               |  |  |  | 48.9                                                                                                                                                                                                                                                                                                                                                                                                          |  |                                       |  |                                                            |  |
| 80                                                                                                                                                                                                                                                                                                  |                   |                        |                           |                                                                                                                                                                                                                 |                      |            |                     |                                                                                                                                                                                                                                                                                                                                                                                               |  |  |  | <b>Bottom of Exploration at 48.9 feet below ground surface.</b><br>Backfilled borehole with bentonite chips to match existing fill slope below the bridge deck, the bridge deck was patched with concrete to match the existing surface.                                                                                                                                                                      |  |                                       |  |                                                            |  |
| 85                                                                                                                                                                                                                                                                                                  |                   |                        |                           |                                                                                                                                                                                                                 |                      |            |                     |                                                                                                                                                                                                                                                                                                                                                                                               |  |  |  |                                                                                                                                                                                                                                                                                                                                                                                                               |  |                                       |  |                                                            |  |
| <b>Remarks:</b><br><br>1. As-drilled locations and elevations for the borings and the probe are derived from swing tie measurements made in the field to locate these with respect to site features. Northings and Eastings were derived from CADD files provided to WSP by HNTB on March 25, 2024. |                   |                        |                           |                                                                                                                                                                                                                 |                      |            |                     |                                                                                                                                                                                                                                                                                                                                                                                               |  |  |  |                                                                                                                                                                                                                                                                                                                                                                                                               |  |                                       |  |                                                            |  |
| Stratification lines represent approximate boundaries between soil types; transitions may be gradual.                                                                                                                                                                                               |                   |                        |                           |                                                                                                                                                                                                                 |                      |            |                     |                                                                                                                                                                                                                                                                                                                                                                                               |  |  |  | Page 3 of 3                                                                                                                                                                                                                                                                                                                                                                                                   |  |                                       |  |                                                            |  |
| * Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.                                                                                                       |                   |                        |                           |                                                                                                                                                                                                                 |                      |            |                     |                                                                                                                                                                                                                                                                                                                                                                                               |  |  |  | Boring No.: BP-PIPC-103                                                                                                                                                                                                                                                                                                                                                                                       |  |                                       |  |                                                            |  |

[illegible]

[illegible]

**APPENDIX B**

# Rock Core Photographs

**APPENDIX B**  
**ROCK CORE PHOTOGRAPHS**  
**PHAIR CROSSING BRIDGE #3259, PRESQUE ISLE, MAINE**  
**MAINEDOT WIN 026434.00**

| Boring      | Run | Depth Below Surface |   |      | Recovery |   |     | RQD  |      |   | Rock Type | Box Row | Date Cored |     |          |
|-------------|-----|---------------------|---|------|----------|---|-----|------|------|---|-----------|---------|------------|-----|----------|
|             |     | Feet                |   |      | Feet     |   |     | Feet |      |   |           |         |            | %   |          |
| BB-PIPC-101 | R1  | 33.6                | - | 38.6 | 1.8      | / | 5.0 | 36   | 0.00 | / | 5.0       | 0       | LIMESTONE  | 1   | 1/4/2023 |
|             | R2  | 38.6                | - | 41.0 | 2.0      | / | 2.4 | 83   | 0.50 | / | 2.4       | 21      | LIMESTONE  | 1   | 1/4/2023 |
|             | R3  | 41.0                | - | 43.1 | 1.9      | / | 2.1 | 90   | 0.00 | / | 2.1       | 0       | LIMESTONE  | 1,2 | 1/4/2023 |
|             | R4  | 43.1                | - | 43.6 | 0.5      | / | 0.5 | 100  | 0.00 | / | 0.5       | 0       | LIMESTONE  | 2   | 1/4/2023 |



Notes: 1. "Box row" indicates the section of the box where the core is contained: 1 = top, 2 = bottom.  
 2. Top of each core run is on the left and increases with depth to the right.

Prepared By: TJ  
 Checked By: DEB  
 Reviewed By: MEL

**APPENDIX B**  
**ROCK CORE PHOTOGRAPHS**  
**PHAIR CROSSING BRIDGE #3259, PRESQUE ISLE, MAINE**  
**MAINEDOT WIN 026434.00**

| Boring       | Run | Depth Below Surface |   |      | Recovery |   |     | RQD  |      |   | Rock Type | Box Row | Date Cored |     |          |
|--------------|-----|---------------------|---|------|----------|---|-----|------|------|---|-----------|---------|------------|-----|----------|
|              |     | Feet                |   |      | Feet     |   | %   | Feet |      | % |           |         |            |     |          |
| BB-PIPC-102  | R1  | 55.0                | - | 60.0 | 4.3      | / | 5.0 | 86   | 0.42 | / | 5.0       | 8       | LIMESTONE  | 1   | 1/2/2024 |
|              | R2  | 60.0                | - | 63.4 | 3.4      | / | 3.4 | 100  | 0.00 | / | 3.4       | 0       | LIMESTONE  | 2   | 1/2/2024 |
|              | R3  | 63.4                | - | 65.0 | 1.5      | / | 1.6 | 94   | 0.33 | / | 1.6       | 21      | LIMESTONE  | 2   | 1/2/2024 |
| BP-PIPC-103A | R1  | 38.9                | - | 41.4 | 2.3      | / | 2.5 | 92   | 0.00 | / | 2.5       | 0       | LIMESTONE  | 3   | 1/3/2024 |
|              | R2  | 41.4                | - | 44.3 | 2.9      | / | 2.9 | 100  | 1.20 | / | 2.9       | 41      | LIMESTONE  | 3,4 | 1/3/2024 |
|              | R3  | 44.3                | - | 46.2 | 1.7      | / | 1.9 | 89   | 0.00 | / | 1.9       | 0       | LIMESTONE  | 4   | 1/3/2024 |
|              | R4  | 46.2                | - | 46.9 | 0.7      | / | 0.7 | 100  | 0.00 | / | 0.7       | 0       | LIMESTONE  | 4   | 1/3/2024 |
|              | R5  | 46.9                | - | 47.5 | 0.6      | / | 0.6 | 100  | 0.00 | / | 0.6       | 0       | LIMESTONE  | 4   | 1/3/2024 |
|              | R6  | 47.5                | - | 48.9 | 0.6      | / | 1.4 | 43   | 0.00 | / | 1.4       | 0       | LIMESTONE  | 4   | 1/3/2024 |



Notes: 1. "Box row" indicates the section of the box where the core is contained: 1 = top, 4 = bottom.  
 2. Top of each core run is on the left and increases with depth to the right.

Prepared By: TJ  
 Checked By: DEB  
 Reviewed By: MEL

**APPENDIX C**

# Laboratory Test Results



|            |                       |              |            |
|------------|-----------------------|--------------|------------|
| Client:    | WSP USA, Inc.         |              |            |
| Project:   | Phair Crossing Bridge |              |            |
| Location:  | Presque Isle, ME      | Project No:  | GTX-318442 |
| Boring ID: | ---                   | Sample Type: | ---        |
| Sample ID: | ---                   | Test Date:   | 01/17/24   |
| Depth :    | ---                   | Test Id:     | 753513     |
|            |                       | Tested By:   | ckg        |
|            |                       | Checked By:  | ank        |

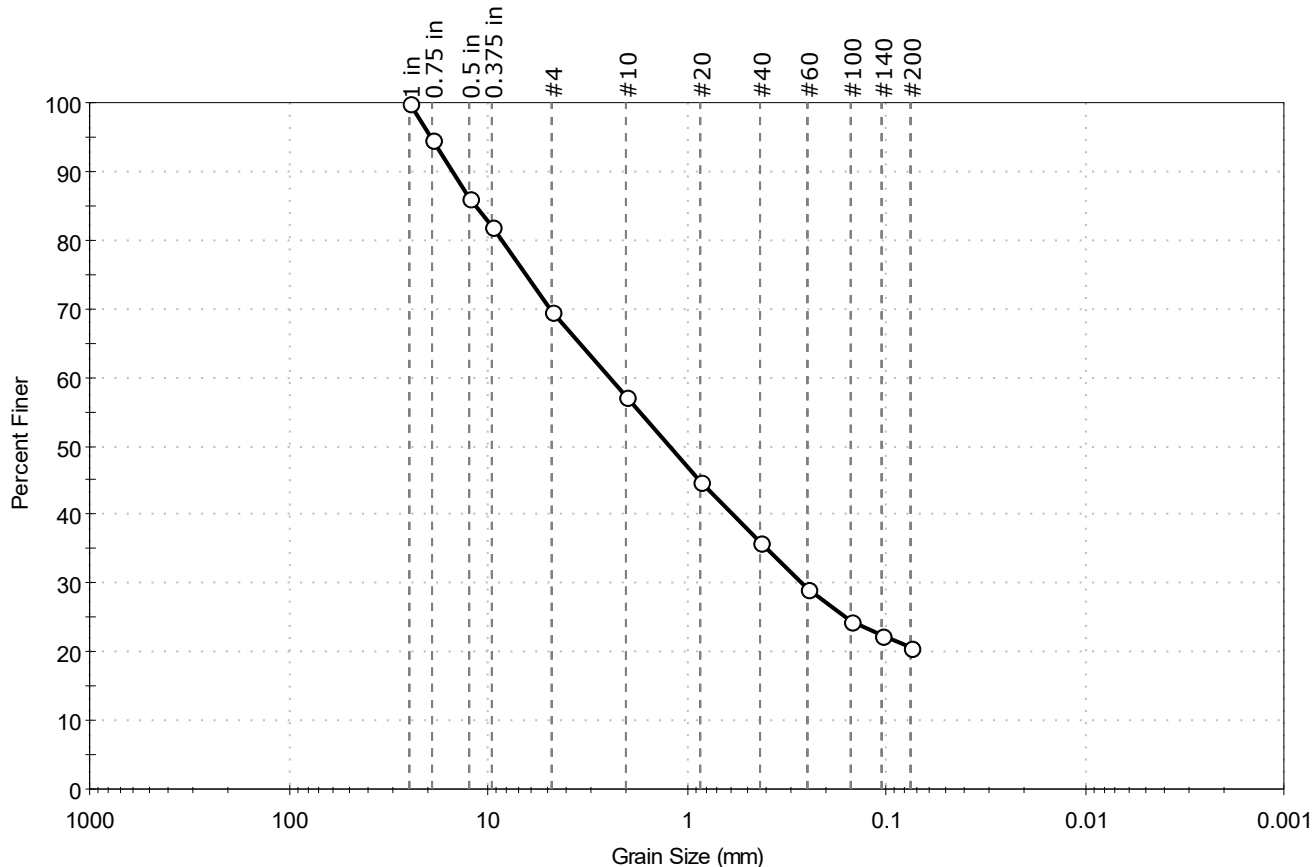
## Moisture Content of Soil and Rock - ASTM D2216

| Boring ID   | Sample ID | Depth    | Description                         | Moisture Content, % |
|-------------|-----------|----------|-------------------------------------|---------------------|
| BB-PIPC-101 | 4D        | 15-17'   | Moist, brown silty gravel with sand | 35.8                |
| BB-PIPC-101 | 5D        | 20-22'   | Moist, brown silty gravel with sand | 7.4                 |
| BB-PIPC-101 | 6D        | 25-27'   | Moist, brown sandy silt             | 18.3                |
| BB-PIPC-102 | 8D        | 35-37'   | Moist, brown silty gravel with sand | 14.0                |
| BB-PIPC-102 | 9D        | 40-42'   | Moist, brown silty gravel with sand | 6.1                 |
| BB-PIPC-102 | 11D       | 50-51.2' | Moist, gray silty sand with gravel  | 11.8                |

Notes: Temperature of Drying : 110° Celsius

|                                                                 |                        |
|-----------------------------------------------------------------|------------------------|
| Client: WSP USA, Inc.                                           | Project No: GTX-318442 |
| Project: Phair Crossing Bridge                                  |                        |
| Location: Presque Isle, ME                                      |                        |
| Boring ID: BB-PIPC-101                                          | Sample Type: tube      |
| Sample ID: 2D                                                   | Tested By: ckg         |
| Depth : 5-7'                                                    | Test Date: 01/16/24    |
|                                                                 | Checked By: ank        |
|                                                                 | Test Id: 753498        |
| Test Comment: ---                                               |                        |
| Visual Description: Moist, reddish brown silty sand with gravel |                        |
| Sample Comment: ---                                             |                        |

## Particle Size Analysis - ASTM D6913



| % Cobble | % Gravel | % Sand | % Silt & Clay Size |
|----------|----------|--------|--------------------|
| —        | 30.3     | 49.2   | 20.5               |

| Sieve Name | Sieve Size, mm | Percent Finer | Spec. Percent | Complies |
|------------|----------------|---------------|---------------|----------|
| 1 in       | 25.00          | 100           |               |          |
| 0.75 in    | 19.00          | 95            |               |          |
| 0.5 in     | 12.50          | 86            |               |          |
| 0.375 in   | 9.50           | 82            |               |          |
| #4         | 4.75           | 70            |               |          |
| #10        | 2.00           | 57            |               |          |
| #20        | 0.85           | 45            |               |          |
| #40        | 0.42           | 36            |               |          |
| #60        | 0.25           | 29            |               |          |
| #100       | 0.15           | 25            |               |          |
| #140       | 0.11           | 22            |               |          |
| #200       | 0.075          | 21            |               |          |
|            |                |               |               |          |
|            |                |               |               |          |

### Coefficients

$D_{85} = 11.6004 \text{ mm}$        $D_{30} = 0.2655 \text{ mm}$   
 $D_{60} = 2.4094 \text{ mm}$        $D_{15} = \text{N/A}$   
 $D_{50} = 1.2123 \text{ mm}$        $D_{10} = \text{N/A}$   
 $C_u = \text{N/A}$        $C_c = \text{N/A}$

### Classification

ASTM N/A

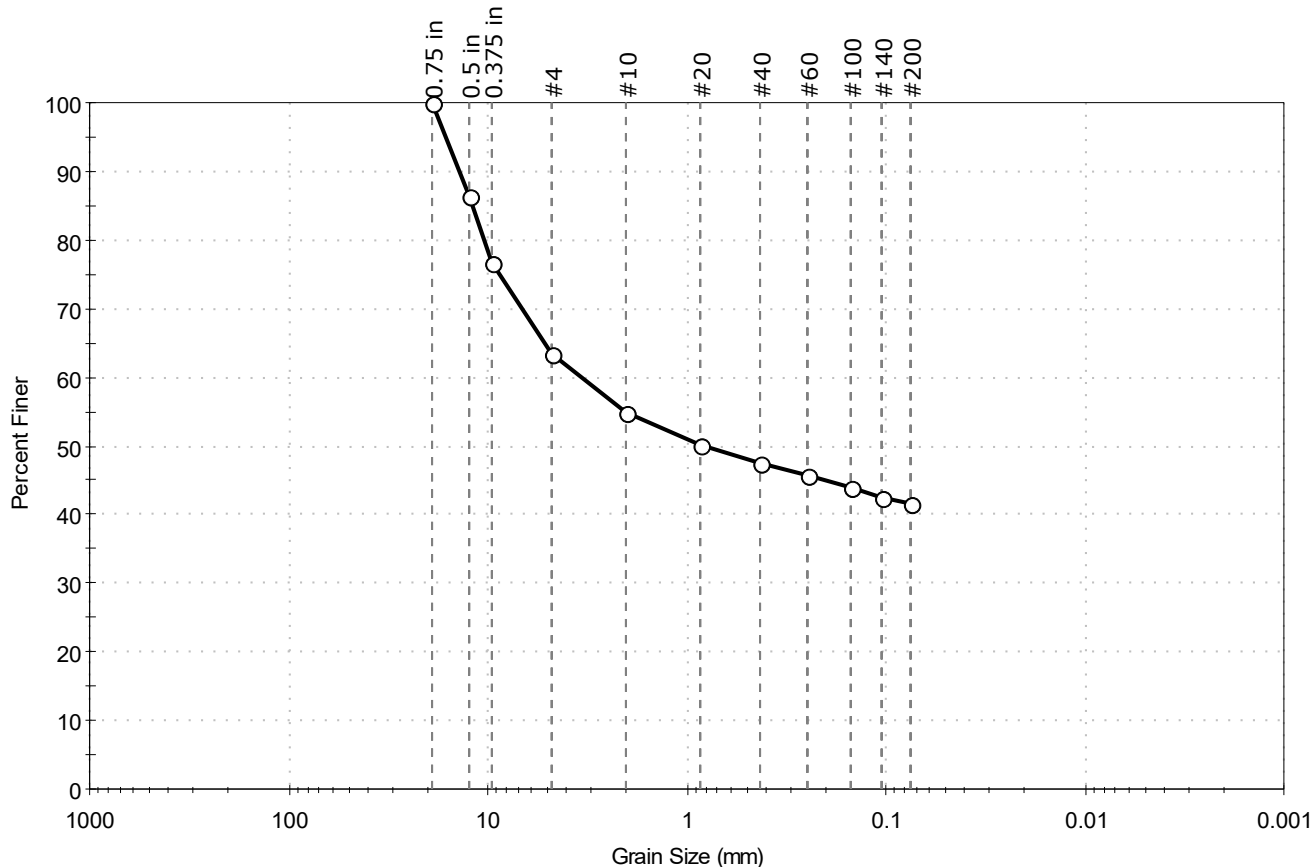
AASHTO Stone Fragments, Gravel and Sand (A-1-b (0))

### Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR  
 Sand/Gravel Hardness : HARD

|                                                         |                        |                 |
|---------------------------------------------------------|------------------------|-----------------|
| Client: WSP USA, Inc.                                   | Project No: GTX-318442 |                 |
| Project: Phair Crossing Bridge                          |                        |                 |
| Location: Presque Isle, ME                              |                        |                 |
| Boring ID: BB-PIPC-101                                  | Sample Type: tube      | Tested By: ckg  |
| Sample ID: 4D                                           | Test Date: 01/16/24    | Checked By: ank |
| Depth: 15-17'                                           | Test Id: 753499        |                 |
| Test Comment: ---                                       |                        |                 |
| Visual Description: Moist, brown silty gravel with sand |                        |                 |
| Sample Comment: ---                                     |                        |                 |

## Particle Size Analysis - ASTM D6913



| % Cobble | % Gravel | % Sand | % Silt & Clay Size |
|----------|----------|--------|--------------------|
| —        | 36.6     | 21.9   | 41.5               |

| Sieve Name | Sieve Size, mm | Percent Finer | Spec. Percent | Complies |
|------------|----------------|---------------|---------------|----------|
| 0.75 in    | 19.00          | 100           |               |          |
| 0.5 in     | 12.50          | 86            |               |          |
| 0.375 in   | 9.50           | 77            |               |          |
| #4         | 4.75           | 63            |               |          |
| #10        | 2.00           | 55            |               |          |
| #20        | 0.85           | 50            |               |          |
| #40        | 0.42           | 48            |               |          |
| #60        | 0.25           | 46            |               |          |
| #100       | 0.15           | 44            |               |          |
| #140       | 0.11           | 43            |               |          |
| #200       | 0.075          | 42            |               |          |
|            |                |               |               |          |
|            |                |               |               |          |

### Coefficients

$D_{85} = 11.9966 \text{ mm}$        $D_{30} = \text{N/A}$   
 $D_{60} = 3.3428 \text{ mm}$        $D_{15} = \text{N/A}$   
 $D_{50} = 0.7894 \text{ mm}$        $D_{10} = \text{N/A}$   
 $C_u = \text{N/A}$        $C_c = \text{N/A}$

### Classification

ASTM N/A

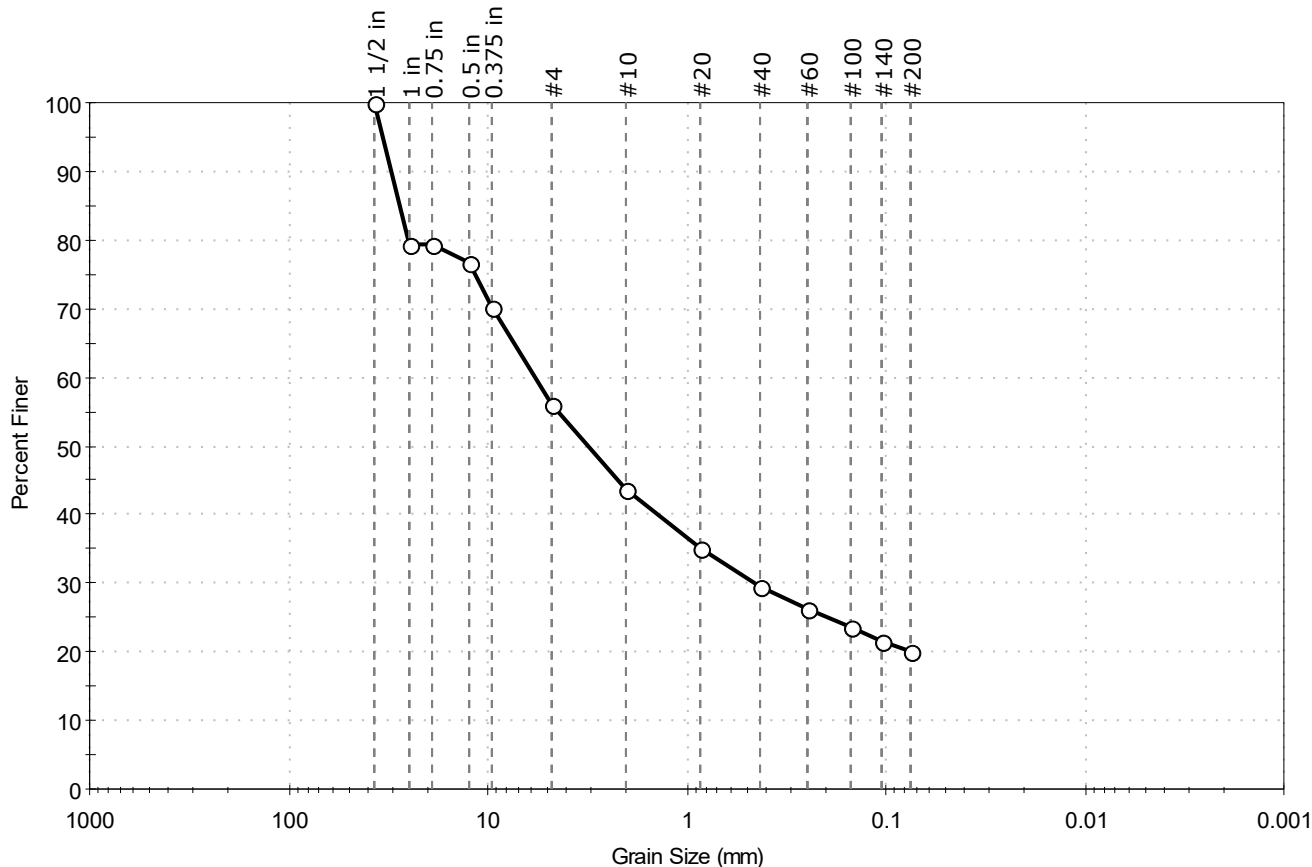
AASHTO Silty Soils (A-4 (0))

### Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR  
 Sand/Gravel Hardness : HARD

|                                                         |                                |                            |                        |
|---------------------------------------------------------|--------------------------------|----------------------------|------------------------|
| Client: WSP USA, Inc.                                   | Project: Phair Crossing Bridge | Location: Presque Isle, ME | Project No: GTX-318442 |
| Boring ID: BB-PIPC-101                                  | Sample Type: tube              | Tested By: ckg             |                        |
| Sample ID: 5D                                           | Test Date: 01/16/24            | Checked By: ank            |                        |
| Depth : 20-22'                                          | Test Id: 753500                |                            |                        |
| Test Comment: ---                                       |                                |                            |                        |
| Visual Description: Moist, brown silty gravel with sand |                                |                            |                        |
| Sample Comment: ---                                     |                                |                            |                        |

## Particle Size Analysis - ASTM D6913



| % Cobble | % Gravel | % Sand | % Silt & Clay Size |
|----------|----------|--------|--------------------|
| —        | 43.9     | 36.0   | 20.1               |

| Sieve Name | Sieve Size, mm | Percent Finer | Spec. Percent | Complies |
|------------|----------------|---------------|---------------|----------|
| 1 1/2 in   | 37.50          | 100           |               |          |
| 1 in       | 25.00          | 79            |               |          |
| 0.75 in    | 19.00          | 79            |               |          |
| 0.5 in     | 12.50          | 77            |               |          |
| 0.375 in   | 9.50           | 70            |               |          |
| #4         | 4.75           | 56            |               |          |
| #10        | 2.00           | 44            |               |          |
| #20        | 0.85           | 35            |               |          |
| #40        | 0.42           | 30            |               |          |
| #60        | 0.25           | 26            |               |          |
| #100       | 0.15           | 24            |               |          |
| #140       | 0.11           | 22            |               |          |
| #200       | 0.075          | 20            |               |          |
|            |                |               |               |          |
|            |                |               |               |          |

### Coefficients

$D_{85} = 27.9571 \text{ mm}$        $D_{30} = 0.4458 \text{ mm}$   
 $D_{60} = 5.7499 \text{ mm}$        $D_{15} = \text{N/A}$   
 $D_{50} = 3.1176 \text{ mm}$        $D_{10} = \text{N/A}$   
 $C_u = \text{N/A}$        $C_c = \text{N/A}$

### Classification

ASTM N/A

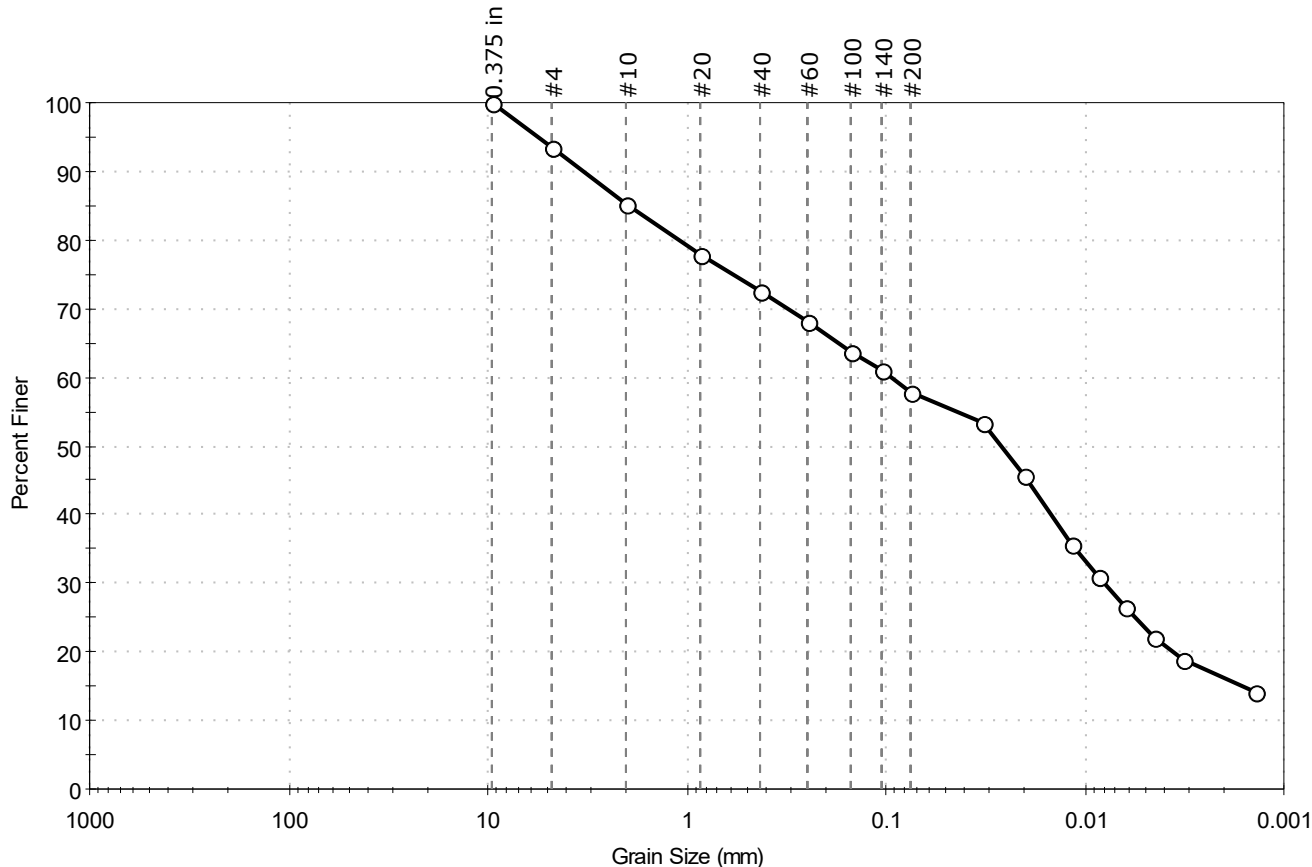
AASHTO Stone Fragments, Gravel and Sand (A-1-b (0))

### Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR  
 Sand/Gravel Hardness : HARD

|                                             |                        |                 |
|---------------------------------------------|------------------------|-----------------|
| Client: WSP USA, Inc.                       | Project No: GTX-318442 |                 |
| Project: Phair Crossing Bridge              |                        |                 |
| Location: Presque Isle, ME                  |                        |                 |
| Boring ID: BB-PIPC-101                      | Sample Type: tube      | Tested By: ckg  |
| Sample ID: 6D                               | Test Date: 01/16/24    | Checked By: ank |
| Depth : 25-27'                              | Test Id: 753506        |                 |
| Test Comment: ---                           |                        |                 |
| Visual Description: Moist, brown sandy silt |                        |                 |
| Sample Comment: ---                         |                        |                 |

## Particle Size Analysis - ASTM D6913/D7928



| % Cobble | % Gravel | % Sand | % Silt & Clay Size |
|----------|----------|--------|--------------------|
| —        | 6.6      | 35.5   | 57.9               |

| Sieve Name | Sieve Size, mm     | Percent Finer | Spec. Percent | Complies |
|------------|--------------------|---------------|---------------|----------|
| 0.375 in   | 9.50               | 100           |               |          |
| #4         | 4.75               | 93            |               |          |
| #10        | 2.00               | 85            |               |          |
| #20        | 0.85               | 78            |               |          |
| #40        | 0.42               | 73            |               |          |
| #60        | 0.25               | 68            |               |          |
| #100       | 0.15               | 64            |               |          |
| #140       | 0.11               | 61            |               |          |
| #200       | 0.075              | 58            |               |          |
| Hydrometer | Particle Size (mm) | Percent Finer | Spec. Percent | Complies |
| ---        | 0.0329             | 53            |               |          |
| ---        | 0.0204             | 46            |               |          |
| ---        | 0.0116             | 36            |               |          |
| ---        | 0.0086             | 31            |               |          |
| ---        | 0.0062             | 27            |               |          |
| ---        | 0.0045             | 22            |               |          |
| ---        | 0.0032             | 19            |               |          |
| ---        | 0.0014             | 14            |               |          |

### Coefficients

D<sub>85</sub> = 1.9570 mm      D<sub>30</sub> = 0.0080 mm  
 D<sub>60</sub> = 0.0949 mm      D<sub>15</sub> = 0.0016 mm  
 D<sub>50</sub> = 0.0266 mm      D<sub>10</sub> = N/A  
 C<sub>u</sub> = N/A                  C<sub>c</sub> = N/A

### Classification

ASTM N/A

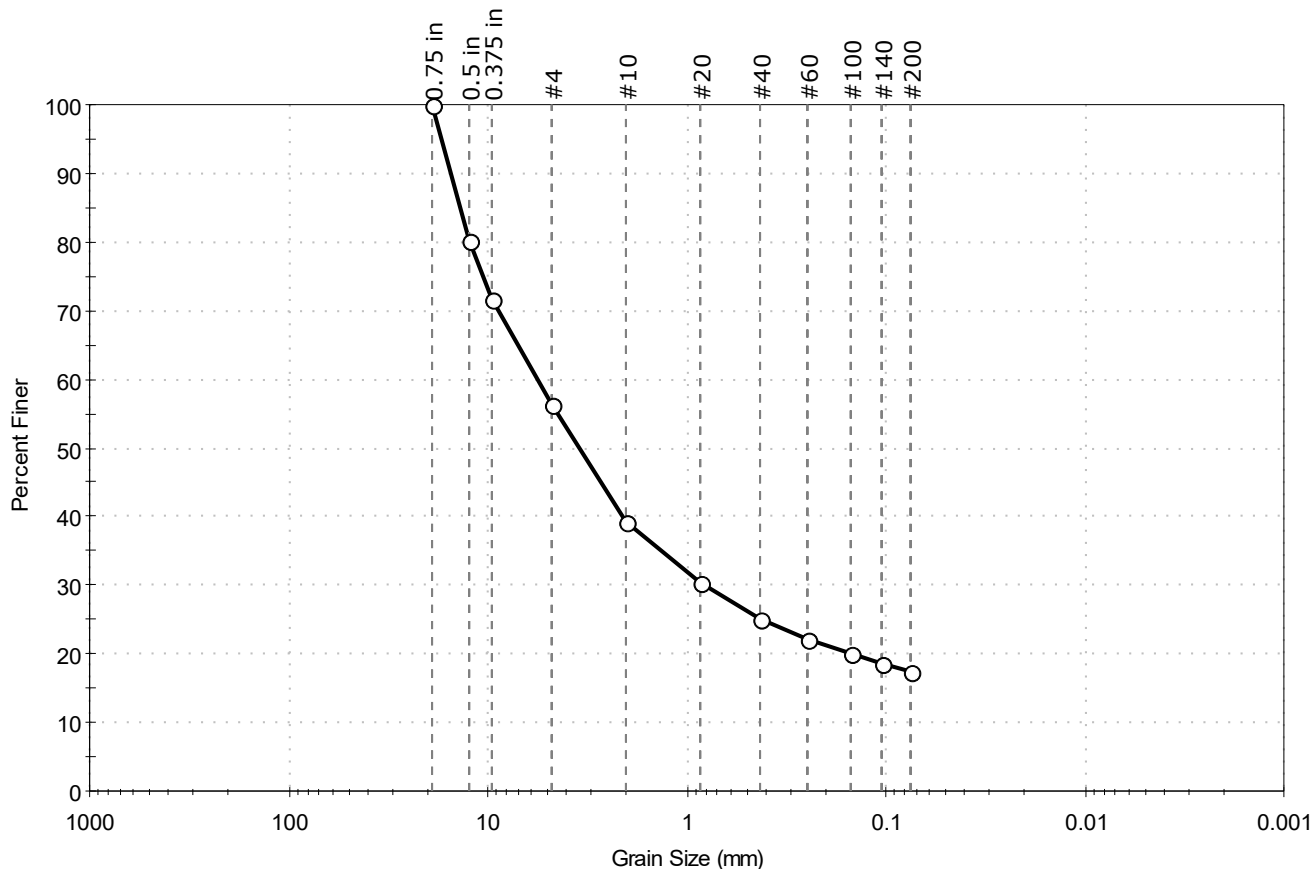
AASHTO Silty Soils (A-4 (0))

### Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR  
 Sand/Gravel Hardness : HARD  
 Dispersion Device : Apparatus A - Mech Mixer  
 Dispersion Period : 1 minute  
 Est. Specific Gravity : 2.65  
 Separation of Sample: #200 Sieve

|                                                        |                        |                 |
|--------------------------------------------------------|------------------------|-----------------|
| Client: WSP USA, Inc.                                  | Project No: GTX-318442 |                 |
| Project: Phair Crossing Bridge                         |                        |                 |
| Location: Presque Isle, ME                             |                        |                 |
| Boring ID: BB-PIPC-101                                 | Sample Type: tube      | Tested By: ckg  |
| Sample ID: 7D                                          | Test Date: 01/16/24    | Checked By: ank |
| Depth : 30-32'                                         | Test Id: 753501        |                 |
| Test Comment: ---                                      |                        |                 |
| Visual Description: Moist, gray silty gravel with sand |                        |                 |
| Sample Comment: ---                                    |                        |                 |

## Particle Size Analysis - ASTM D6913



| % Cobble | % Gravel | % Sand | % Silt & Clay Size |
|----------|----------|--------|--------------------|
| —        | 43.8     | 38.8   | 17.4               |

| Sieve Name | Sieve Size, mm | Percent Finer | Spec. Percent | Complies |
|------------|----------------|---------------|---------------|----------|
| 0.75 in    | 19.00          | 100           |               |          |
| 0.5 in     | 12.50          | 80            |               |          |
| 0.375 in   | 9.50           | 72            |               |          |
| #4         | 4.75           | 56            |               |          |
| #10        | 2.00           | 39            |               |          |
| #20        | 0.85           | 30            |               |          |
| #40        | 0.42           | 25            |               |          |
| #60        | 0.25           | 22            |               |          |
| #100       | 0.15           | 20            |               |          |
| #140       | 0.11           | 19            |               |          |
| #200       | 0.075          | 17            |               |          |
|            |                |               |               |          |
|            |                |               |               |          |

### Coefficients

$D_{85} = 13.8432 \text{ mm}$        $D_{30} = 0.8180 \text{ mm}$   
 $D_{60} = 5.6299 \text{ mm}$        $D_{15} = \text{N/A}$   
 $D_{50} = 3.4563 \text{ mm}$        $D_{10} = \text{N/A}$   
 $C_u = \text{N/A}$        $C_c = \text{N/A}$

### Classification

ASTM N/A

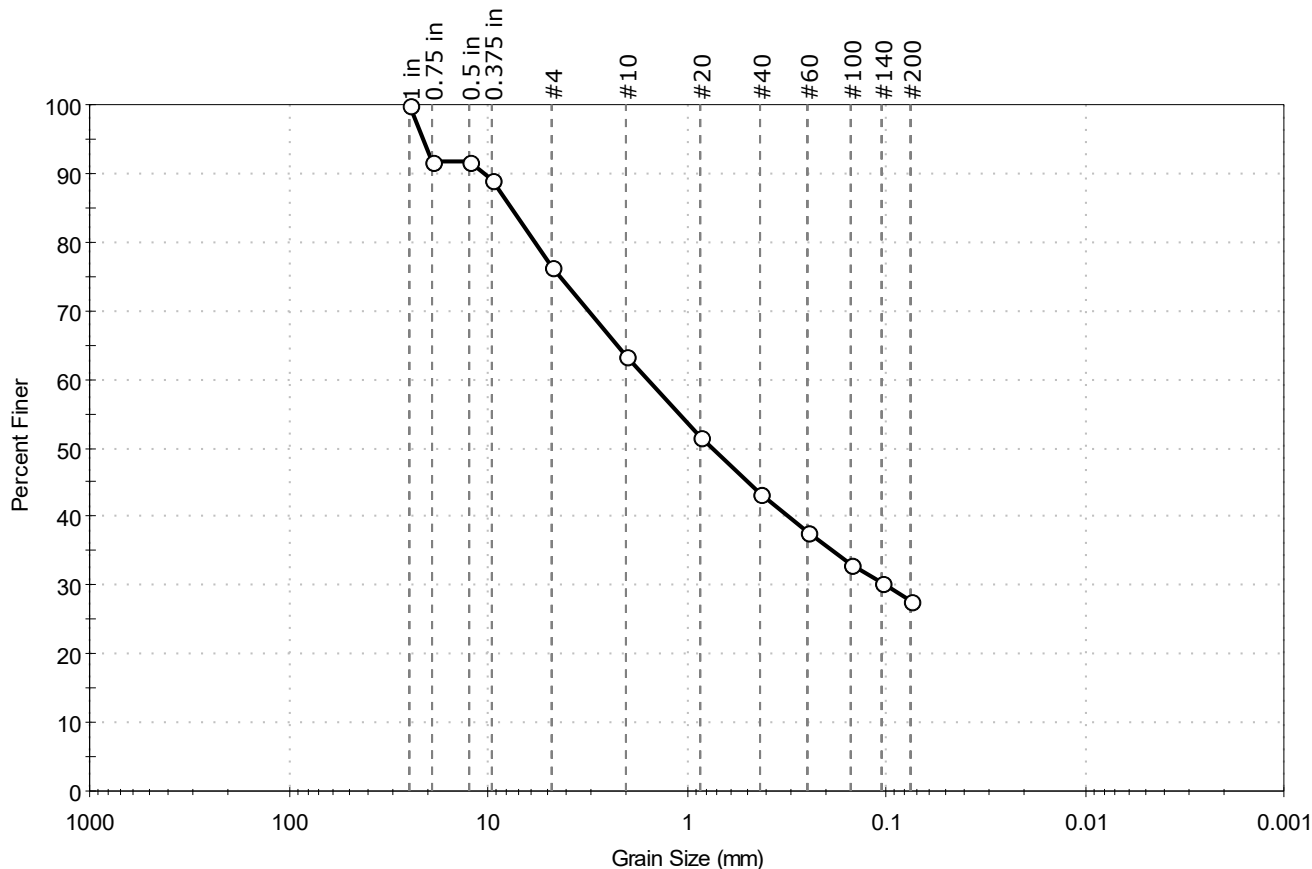
AASHTO Stone Fragments, Gravel and Sand (A-1-b (0))

### Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR  
 Sand/Gravel Hardness : HARD

|                                                         |                        |                 |
|---------------------------------------------------------|------------------------|-----------------|
| Client: WSP USA, Inc.                                   | Project No: GTX-318442 |                 |
| Project: Phair Crossing Bridge                          |                        |                 |
| Location: Presque Isle, ME                              |                        |                 |
| Boring ID: BB-PIPC-102                                  | Sample Type: tube      | Tested By: ckg  |
| Sample ID: 3D                                           | Test Date: 01/16/24    | Checked By: ank |
| Depth : 10-12'                                          | Test Id: 753502        |                 |
| Test Comment: ---                                       |                        |                 |
| Visual Description: Moist, brown silty sand with gravel |                        |                 |
| Sample Comment: ---                                     |                        |                 |

## Particle Size Analysis - ASTM D6913



| % Cobble | % Gravel | % Sand | % Silt & Clay Size |
|----------|----------|--------|--------------------|
| —        | 23.7     | 48.5   | 27.8               |

| Sieve Name | Sieve Size, mm | Percent Finer | Spec. Percent | Complies |
|------------|----------------|---------------|---------------|----------|
| 1 in       | 25.00          | 100           |               |          |
| 0.75 in    | 19.00          | 92            |               |          |
| 0.5 in     | 12.50          | 92            |               |          |
| 0.375 in   | 9.50           | 89            |               |          |
| #4         | 4.75           | 76            |               |          |
| #10        | 2.00           | 63            |               |          |
| #20        | 0.85           | 52            |               |          |
| #40        | 0.42           | 43            |               |          |
| #60        | 0.25           | 38            |               |          |
| #100       | 0.15           | 33            |               |          |
| #140       | 0.11           | 30            |               |          |
| #200       | 0.075          | 28            |               |          |
|            |                |               |               |          |
|            |                |               |               |          |

### Coefficients

$D_{85} = 7.6111 \text{ mm}$        $D_{30} = 0.1019 \text{ mm}$   
 $D_{60} = 1.5666 \text{ mm}$        $D_{15} = \text{N/A}$   
 $D_{50} = 0.7423 \text{ mm}$        $D_{10} = \text{N/A}$   
 $C_u = \text{N/A}$        $C_c = \text{N/A}$

### Classification

ASTM N/A

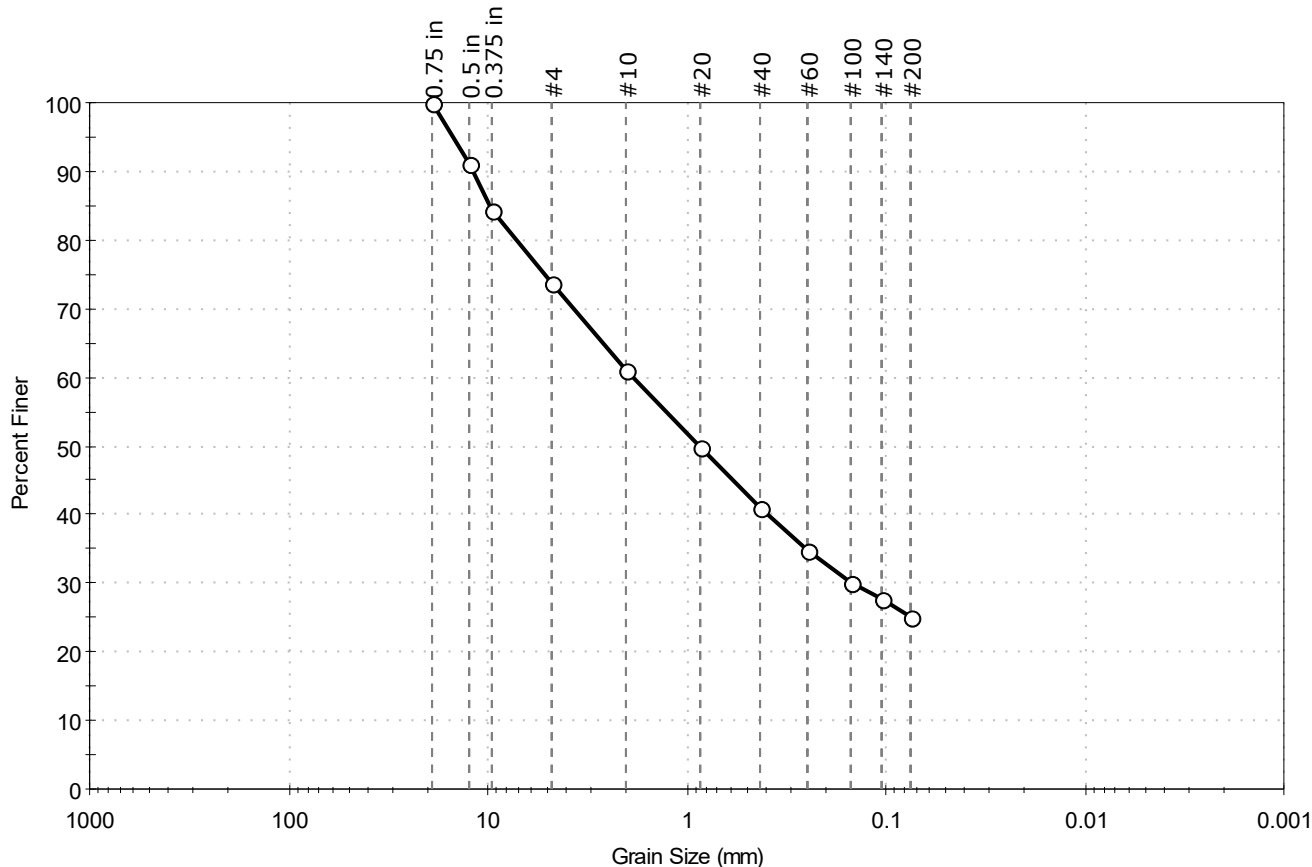
AASHTO Silty Gravel and Sand (A-2-4 (0))

### Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR  
 Sand/Gravel Hardness : HARD

|                                                         |                        |                 |
|---------------------------------------------------------|------------------------|-----------------|
| Client: WSP USA, Inc.                                   | Project No: GTX-318442 |                 |
| Project: Phair Crossing Bridge                          |                        |                 |
| Location: Presque Isle, ME                              |                        |                 |
| Boring ID: BB-PIPC-102                                  | Sample Type: tube      | Tested By: ckg  |
| Sample ID: 4D                                           | Test Date: 01/16/24    | Checked By: ank |
| Depth : 15-17'                                          | Test Id: 753503        |                 |
| Test Comment: ---                                       |                        |                 |
| Visual Description: Moist, brown silty sand with gravel |                        |                 |
| Sample Comment: ---                                     |                        |                 |

## Particle Size Analysis - ASTM D6913



| % Cobble | % Gravel | % Sand | % Silt & Clay Size |
|----------|----------|--------|--------------------|
| —        | 26.1     | 48.7   | 25.2               |

| Sieve Name | Sieve Size, mm | Percent Finer | Spec. Percent | Complies |
|------------|----------------|---------------|---------------|----------|
| 0.75 in    | 19.00          | 100           |               |          |
| 0.5 in     | 12.50          | 91            |               |          |
| 0.375 in   | 9.50           | 84            |               |          |
| #4         | 4.75           | 74            |               |          |
| #10        | 2.00           | 61            |               |          |
| #20        | 0.85           | 50            |               |          |
| #40        | 0.42           | 41            |               |          |
| #60        | 0.25           | 35            |               |          |
| #100       | 0.15           | 30            |               |          |
| #140       | 0.11           | 28            |               |          |
| #200       | 0.075          | 25            |               |          |
|            |                |               |               |          |
|            |                |               |               |          |

### Coefficients

|                             |                             |
|-----------------------------|-----------------------------|
| D <sub>85</sub> = 9.7723 mm | D <sub>30</sub> = 0.1470 mm |
| D <sub>60</sub> = 1.8339 mm | D <sub>15</sub> = N/A       |
| D <sub>50</sub> = 0.8629 mm | D <sub>10</sub> = N/A       |
| C <sub>u</sub> = N/A        | C <sub>c</sub> = N/A        |

### Classification

ASTM N/A

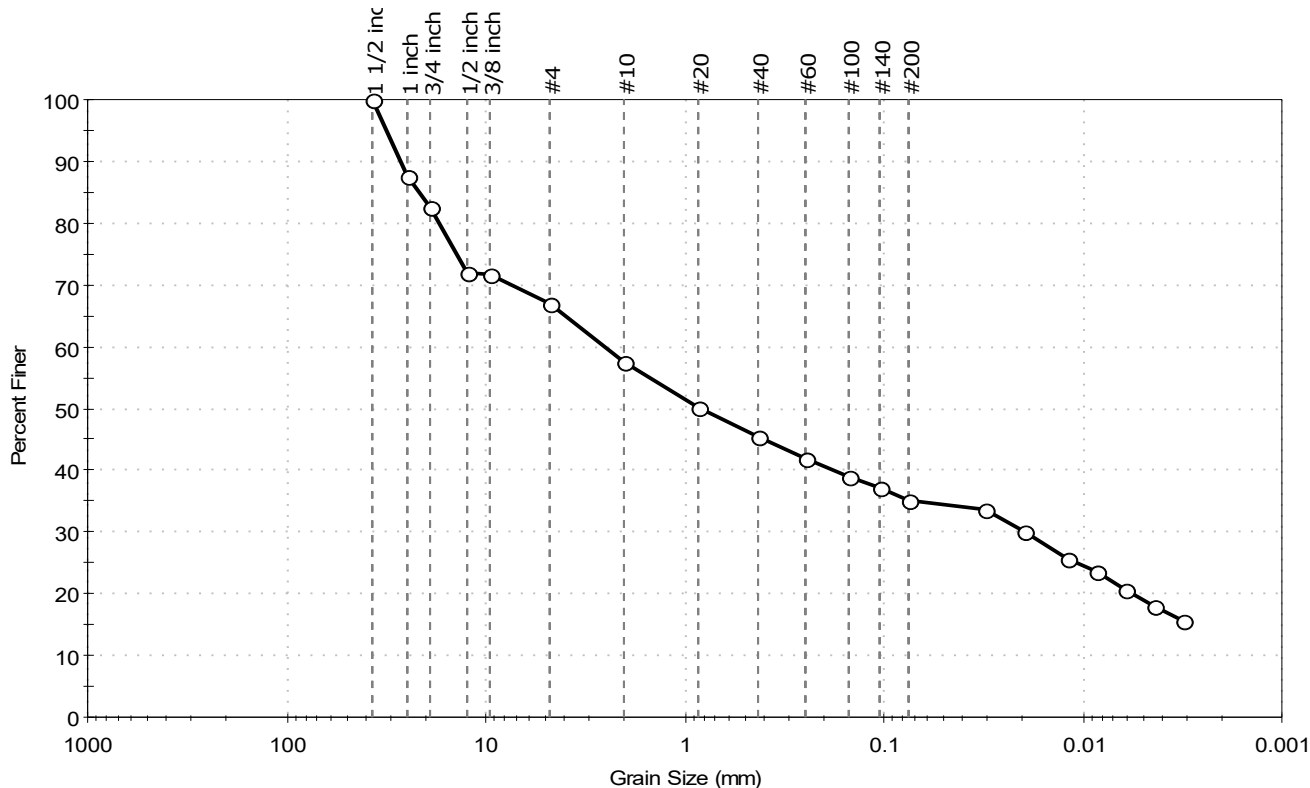
AASHTO Silty Gravel and Sand (A-2-4 (0))

### Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR  
Sand/Gravel Hardness : HARD

|                                                         |                        |
|---------------------------------------------------------|------------------------|
| Client: WSP USA, Inc.                                   | Project No: GTX-318442 |
| Project: Phair Crossing Bridge                          |                        |
| Location: Presque Isle, ME                              |                        |
| Boring ID: BB-PIPC-102                                  | Sample Type: tube      |
| Sample ID: 8D                                           | Tested By: ckg         |
| Depth : 35-37'                                          | Test Date: 01/18/24    |
|                                                         | Checked By: ank        |
|                                                         | Test Id: 753507        |
| Test Comment: ---                                       |                        |
| Visual Description: Moist, brown silty gravel with sand |                        |
| Sample Comment: ---                                     |                        |

## Particle Size Analysis - ASTM D6913/D7928



| % Cobble | % Gravel | % Sand | % Silt & Clay Size |
|----------|----------|--------|--------------------|
| —        | 33.1     | 31.7   | 35.2               |

| Sieve Name | Sieve Size, mm     | Percent Finer | Spec. Percent | Complies |
|------------|--------------------|---------------|---------------|----------|
| 1 1/2 inch | 37.50              | 100           |               |          |
| 1 inch     | 25.00              | 87            |               |          |
| 3/4 inch   | 19.00              | 83            |               |          |
| 1/2 inch   | 12.50              | 72            |               |          |
| 3/8 inch   | 9.50               | 72            |               |          |
| #4         | 4.75               | 67            |               |          |
| #10        | 2.00               | 57            |               |          |
| #20        | 0.85               | 50            |               |          |
| #40        | 0.42               | 45            |               |          |
| #60        | 0.25               | 42            |               |          |
| #100       | 0.15               | 39            |               |          |
| #140       | 0.11               | 37            |               |          |
| #200       | 0.075              | 35            |               |          |
| Hydrometer | Particle Size (mm) | Percent Finer | Spec. Percent | Complies |
| ---        | 0.0311             | 34            |               |          |
| ---        | 0.0200             | 30            |               |          |
| ---        | 0.0119             | 26            |               |          |
| ---        | 0.0085             | 23            |               |          |
| ---        | 0.0061             | 21            |               |          |
| ---        | 0.0044             | 18            |               |          |
| ---        | 0.0031             | 16            |               |          |

### Coefficients

D<sub>85</sub> = 21.6744 mm      D<sub>30</sub> = 0.0195 mm  
 D<sub>60</sub> = 2.5283 mm      D<sub>15</sub> = N/A  
 D<sub>50</sub> = 0.8184 mm      D<sub>10</sub> = N/A  
 C<sub>u</sub> = N/A      C<sub>c</sub> = N/A

### Classification

ASTM N/A

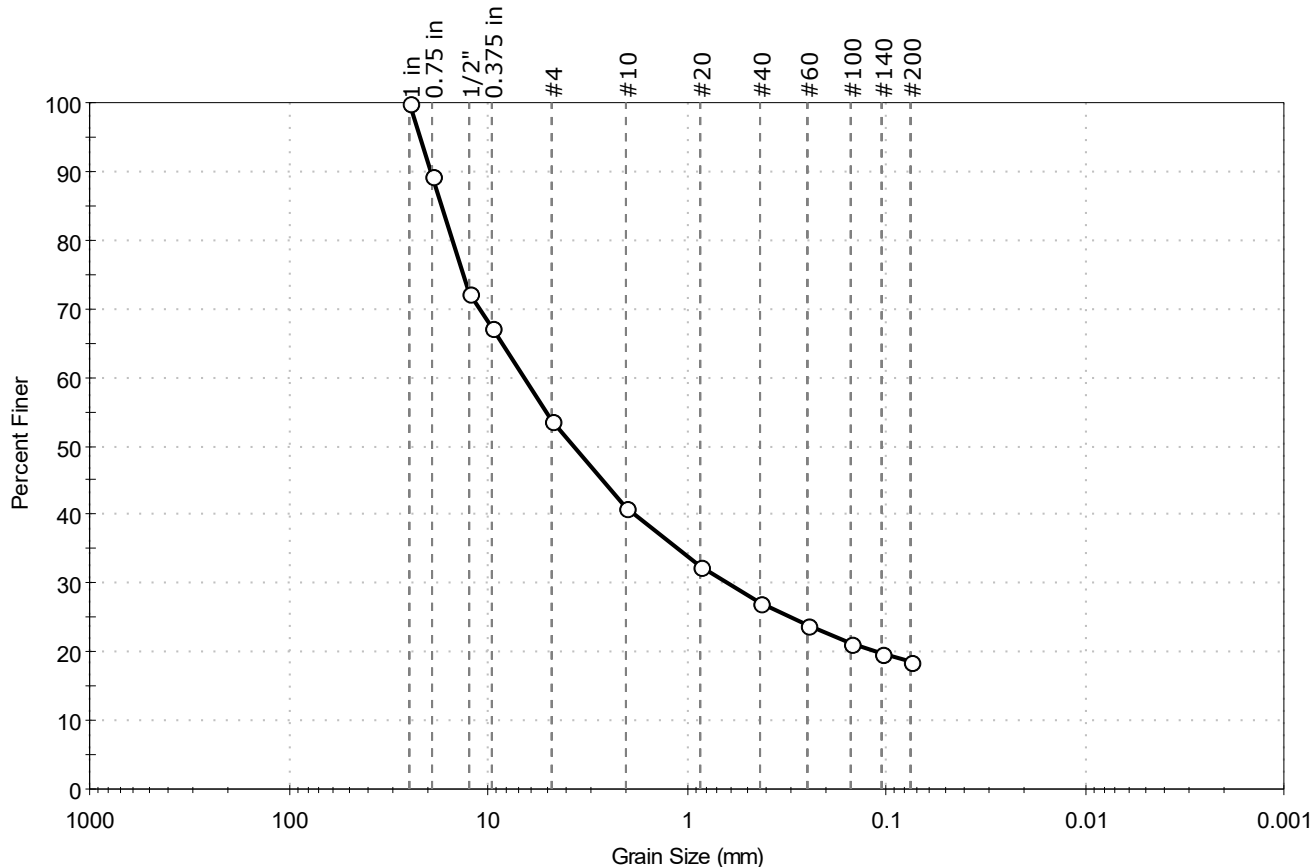
AASHTO Silty Soils (A-4 (0))

### Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR  
 Sand/Gravel Hardness : HARD  
 Dispersion Device : Apparatus A - Mech Mixer  
 Dispersion Period : 1 minute  
 Est. Specific Gravity : 2.65  
 Separation of Sample: #200 Sieve

|                                                         |                        |                 |
|---------------------------------------------------------|------------------------|-----------------|
| Client: WSP USA, Inc.                                   | Project No: GTX-318442 |                 |
| Project: Phair Crossing Bridge                          |                        |                 |
| Location: Presque Isle, ME                              |                        |                 |
| Boring ID: BB-PIPC-102                                  | Sample Type: tube      | Tested By: ckg  |
| Sample ID: 9D                                           | Test Date: 01/15/24    | Checked By: ank |
| Depth : 40-42'                                          | Test Id: 753504        |                 |
| Test Comment: ---                                       |                        |                 |
| Visual Description: Moist, brown silty gravel with sand |                        |                 |
| Sample Comment: ---                                     |                        |                 |

## Particle Size Analysis - ASTM D6913



| % Cobble | % Gravel | % Sand | % Silt & Clay Size |
|----------|----------|--------|--------------------|
| —        | 46.4     | 35.0   | 18.6               |

| Sieve Name | Sieve Size, mm | Percent Finer | Spec. Percent | Complies |
|------------|----------------|---------------|---------------|----------|
| 1 in       | 25.00          | 100           |               |          |
| 0.75 in    | 19.00          | 90            |               |          |
| 1/2"       | 12.50          | 72            |               |          |
| 0.375 in   | 9.50           | 67            |               |          |
| #4         | 4.75           | 54            |               |          |
| #10        | 2.00           | 41            |               |          |
| #20        | 0.85           | 32            |               |          |
| #40        | 0.42           | 27            |               |          |
| #60        | 0.25           | 24            |               |          |
| #100       | 0.15           | 21            |               |          |
| #140       | 0.11           | 20            |               |          |
| #200       | 0.075          | 19            |               |          |
|            |                |               |               |          |
|            |                |               |               |          |

### Coefficients

D<sub>85</sub> = 17.0280 mm      D<sub>30</sub> = 0.6249 mm  
 D<sub>60</sub> = 6.5840 mm      D<sub>15</sub> = N/A  
 D<sub>50</sub> = 3.7095 mm      D<sub>10</sub> = N/A  
 C<sub>u</sub> = N/A      C<sub>c</sub> = N/A

### Classification

ASTM N/A

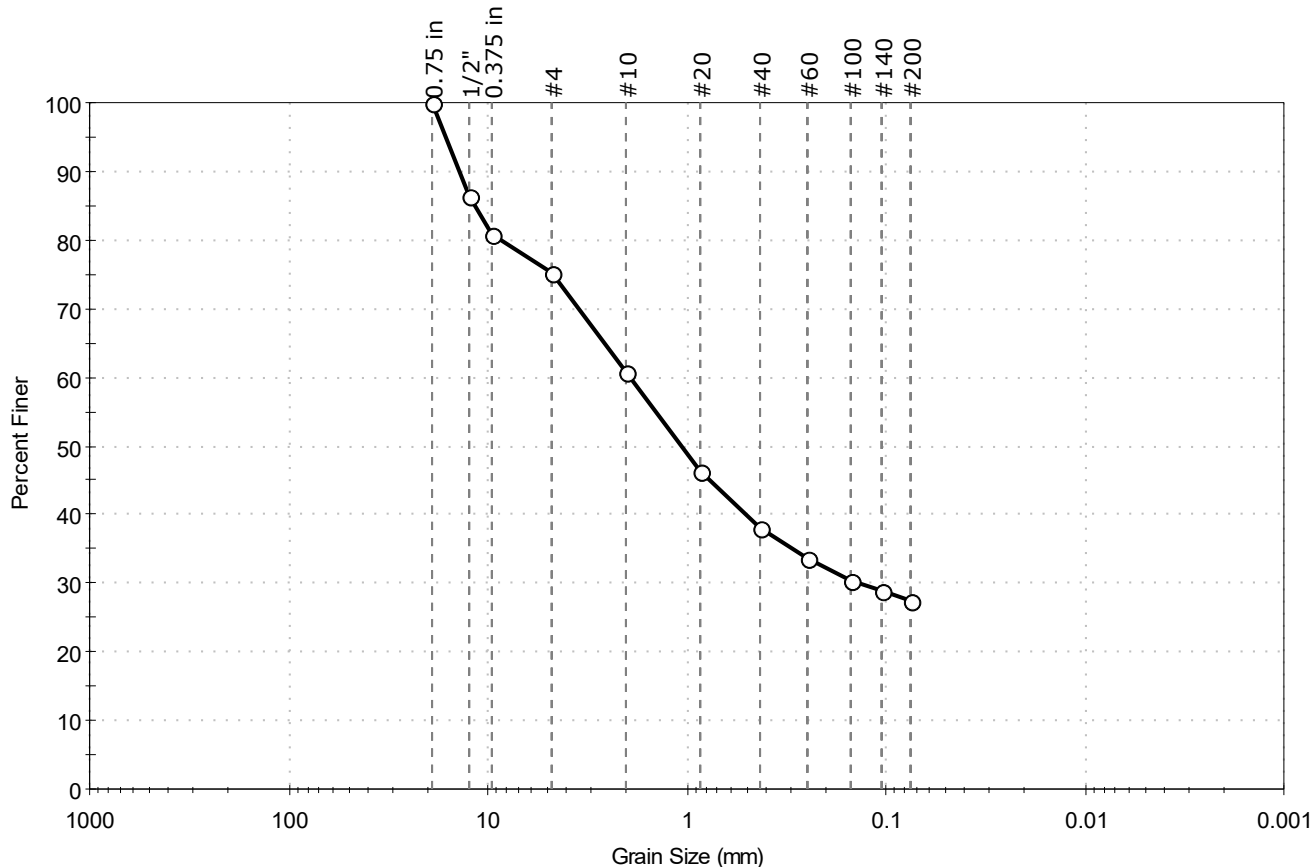
AASHTO Stone Fragments, Gravel and Sand (A-1-b (0))

### Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR  
 Sand/Gravel Hardness : HARD

|                                                        |                        |                 |
|--------------------------------------------------------|------------------------|-----------------|
| Client: WSP USA, Inc.                                  | Project No: GTX-318442 |                 |
| Project: Phair Crossing Bridge                         |                        |                 |
| Location: Presque Isle, ME                             |                        |                 |
| Boring ID: BB-PIPC-102                                 | Sample Type: tube      | Tested By: ckg  |
| Sample ID: 11D                                         | Test Date: 01/15/24    | Checked By: ank |
| Depth : 50-51.2'                                       | Test Id: 753505        |                 |
| Test Comment: ---                                      |                        |                 |
| Visual Description: Moist, gray silty sand with gravel |                        |                 |
| Sample Comment: ---                                    |                        |                 |

## Particle Size Analysis - ASTM D6913



| % Cobble | % Gravel | % Sand | % Silt & Clay Size |
|----------|----------|--------|--------------------|
| —        | 24.9     | 47.8   | 27.3               |

| Sieve Name | Sieve Size, mm | Percent Finer | Spec. Percent | Complies |
|------------|----------------|---------------|---------------|----------|
| 0.75 in    | 19.00          | 100           |               |          |
| 1/2"       | 12.50          | 86            |               |          |
| 0.375 in   | 9.50           | 81            |               |          |
| #4         | 4.75           | 75            |               |          |
| #10        | 2.00           | 61            |               |          |
| #20        | 0.85           | 46            |               |          |
| #40        | 0.42           | 38            |               |          |
| #60        | 0.25           | 34            |               |          |
| #100       | 0.15           | 30            |               |          |
| #140       | 0.11           | 29            |               |          |
| #200       | 0.075          | 27            |               |          |
|            |                |               |               |          |
|            |                |               |               |          |

### Coefficients

$D_{85} = 11.6406 \text{ mm}$        $D_{30} = 0.1372 \text{ mm}$   
 $D_{60} = 1.9128 \text{ mm}$        $D_{15} = \text{N/A}$   
 $D_{50} = 1.0613 \text{ mm}$        $D_{10} = \text{N/A}$   
 $C_u = \text{N/A}$        $C_c = \text{N/A}$

### Classification

ASTM N/A

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

### Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR  
 Sand/Gravel Hardness : HARD

**APPENDIX D**

# Calculations



## CALCULATIONS

|                             |                                                        |                     |     |
|-----------------------------|--------------------------------------------------------|---------------------|-----|
| <b>Date:</b>                | 4/4/2024                                               | <b>Made by:</b>     | MEL |
| <b>Project No.:</b>         | US0025840.9367                                         | <b>Checked by:</b>  | JEF |
| <b>Subject:</b>             | Frost Penetration Depth - Bridge Structures in Fill    | <b>Reviewed by:</b> | CCB |
| <b>Project Short Title:</b> | Phair Crossing Bridge Presque Isle, ME (WIN 026434.00) |                     |     |

### OBJECTIVE

Determine the depth of frost penetration at the existing and proposed bridge site.

### REFERENCES

1. Guertin Elkerton & Associates for Maine Department of Transportation. Bridge Design Guide. Dated August 2003 with 2018 updates.
2. WSP interpreted subsurface section A-A' (Figure 3, Preliminary Geotechnical Design Report).
3. WSP geotechnical test boring logs (Appendix A, Preliminary Geotechnical Design Report).
4. GeoTesting Express laboratory testing results (Appendix C, Preliminary Geotechnical Design Report).

### ASSUMPTIONS

1. Based on the available moisture contents in existing fill materials around the existing bridge, it is assumed the average moisture content in granular fills will be consistent for new fills in this evaluation.
2. New fill is assumed to consist of Granular Borrow, Gravel Borrow, or Riprap.

### CALCULATION

Follow the procedure in the MaineDOT Bridge Design Guide Section 5.2.1 to determine the depth of frost penetration.

The site location is Presque Isle, Maine. Using the Maine Design Freezing Index Map (Reference 1, Figure 5-1), the maximum design freezing index at the site location is 2600 degree-days.

Based on Reference 2, the proposed abutments will be founded within new fill, which is a coarse-grained soil.

Based on References 3 and 4, the range of water contents are 7.4% and 35.8% in the upper coarse-grained fill soils. Average water content is 21.6% for these two samples.

From Reference 1, Table 5-1, with design freezing index = 2,600, coarse-grained soil, and  $w = 20\%$ .

Frost Penetration =            89.9 inches            7.5 feet

### CONCLUSIONS

The depth of frost penetration at the proposed bridge site is estimated to be 7.5 feet in areas where new fill associated with bridge foundations will be placed. The foundations should be embedded below this depth.



|                             |                                                        |                     |     |
|-----------------------------|--------------------------------------------------------|---------------------|-----|
| <b>Date:</b>                | 2/15/2024                                              | <b>Made by:</b>     | ATM |
| <b>Project No.:</b>         | US0025840.9367                                         | <b>Checked by:</b>  | DEB |
| <b>Subject:</b>             | Seismic Site Analysis - Phair Crossing                 | <b>Reviewed by:</b> | MEL |
| <b>Project Short Title:</b> | Phair Crossing Bridge Presque Isle, ME (WIN 026434.00) |                     |     |

### OBJECTIVE

Determine the seismic site class and acceleration coefficient at the proposed bridge over the railroad tracks on Easton Road in Presque Isle, ME

### METHOD

Use the procedure outlined in AASHTO LRFD Section 3.10.3.1 Method B (Ref. 1) to determine site class.

### REFERENCES

1. AASHTO. (2020). AASHTO LRFD Bridge Design Specifications, 9th Ed. American Association of State Highway and Transportation Officials (AASHTO), Washington, D.C.
2. WSP boring logs, included as Appendix A of the Preliminary Geotechnical Design Report.
3. Maine State Highway Commission, Plan and Profile, State Highway "K", Phair Crossing over the track of Bangor and Aroostook Railroad Co., Presque Isle Maine, plans dated August 19th, 1935.
4. HNTB prepared MicroStation file titled "3DTopo\_102722.dgn" received by WSP on January 24th, 2024
5. FHWA. August 2011. Geotechnical Engineering Circular No. 3, LRFD Seismic Analysis and Design of Transportation Geotechnical Features and Structural Foundations: Reference Manual, Rev. 1. Publication No. FHWA-NHI-11-032.

### ASSUMPTIONS

1. Use average  $N_{60}$ -values (corrected only for hammer efficiencies) in the analysis for Method B. Average  $N_{60}$  values were taken as averages from the specific associated boring and layer and are based on values presented in Ref. 2.
2. The strata encountered at BB-PIPC-102 were used to evaluate seismic site class for the site.
3. The bottom strata encountered during drilling at each boring was extended to a depth of 100 feet below ground surface to use the method.
4. Site average  $N_{60}$  values for the Embankment Fill and Glacial Till layers were used for the seismic site class calculation.

### CALCULATIONS

#### Site Class\*

|   |                                                                                         |
|---|-----------------------------------------------------------------------------------------|
| C | $\bar{N} > 50$ ; $\bar{s}_u > 2.0$ ksf; $1200$ ft/s $< \bar{V}_s < 2500$ ft/s           |
| D | $15 < \bar{N} < 50$ ; $1.0 < \bar{s}_u < 2.0$ ksf; $600$ ft/s $< \bar{V}_s < 1200$ ft/s |
| E | $\bar{N} < 15$ ; $\bar{s}_u < 1.0$ ksf; $\bar{V}_s < 600$ ft/s                          |
| F | Peats, organic clays, high plasticity clay, thick soft/medium stiff clays               |

\* Site class A & B pertain to rock and are not included in this table.

**Date:** 2/15/2024  
**Project No.:** US0025840.9367  
**Subject:** Seismic Site Analysis - Phair Crossing  
**Project Short Title:** Phair Crossing Bridge Presque Isle, ME (WIN 026434.00)

**Made by:** ATM  
**Checked by:** DEB  
**Reviewed by:** MEL

**1. Per AASHTO Table C3.10.3.1-1 (Ref 1), use Method B,  $\bar{N}$  method:**

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

where:

$d_i$  = Thickness of a layer between 0 and 100 ft.

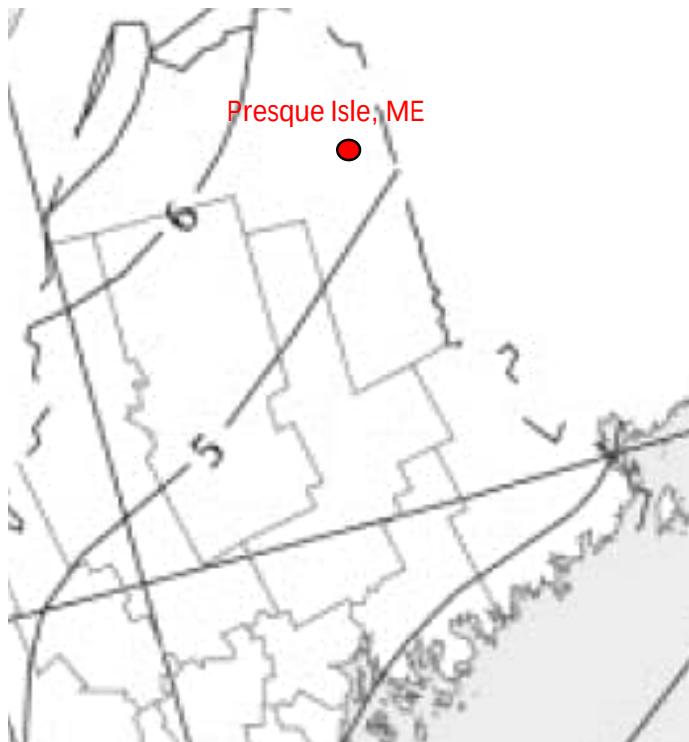
$N_i$  = SPT blow count,  $N_{60}$ , of a layer (not to exceed 100 blows/ft). Where refusal is met for a rock layer,  $N_i$  should be taken as 100 blows/ft.

| BB-PIPC-102 |                 |                 |       |           |
|-------------|-----------------|-----------------|-------|-----------|
| Layer       | Design $N_{60}$ | Deposit         | $d_i$ | $d_i/N_i$ |
| 1           | 22              | Embankment Fill | 25.0  | 1.14      |
| 2           | 27              | Glacial Till    | 30.0  | 1.11      |
| 3           | 100             | Bedrock         | 45.0  | 0.45      |
| Sum:        |                 |                 | 100.0 | 2.70      |
| $\bar{N} =$ |                 | 37.1            |       |           |

$\bar{N} =$  37.1

Site Class: D

**2. Seismic Performance Zone, per AASHTO LRFD 9th Ed. (2020)**



|                             |                                                        |                     |     |
|-----------------------------|--------------------------------------------------------|---------------------|-----|
| <b>Date:</b>                | 2/15/2024                                              | <b>Made by:</b>     | ATM |
| <b>Project No.:</b>         | US0025840.9367                                         | <b>Checked by:</b>  | DEB |
| <b>Subject:</b>             | Seismic Site Analysis - Phair Crossing                 | <b>Reviewed by:</b> | MEL |
| <b>Project Short Title:</b> | Phair Crossing Bridge Presque Isle, ME (WIN 026434.00) |                     |     |

$S_1 = 0.054$  Figure 3.10.2.1-3: 1 second period response acceleration (AASHTO 2020).

AASHTO Equation 3.10.4.2-6  $SD_1 = F_v S_1$   
AASHTO Table 3.10.3.2-3  $F_v = 2.4$   $SD_1 = 0.130$  Seismic Zone: 1  
Seismic Zone 1 per AASHTO 3.10.6 Table 3.10.6-1

### 3. Calculation of Seismic Parameters using AASHTO LRFD 9th Ed. (2020)

Values for PGA,  $S_s$ , and  $S_1$  were obtained comparing the site location to the following geographic charts:

|                                                                                                                                           |                                                                                                                                                                                                     |                                                                                                                                                                                                      |
|-------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| a <sub>1</sub> . Using Figure 3.10.2.1-1<br>*PGA = 0.08<br>*Horizontal ground coefficient with a 7% probability of exceedance in 75 years | a <sub>2</sub> . Using Figure 3.10.2.1-2<br>* $S_s$ = 0.18<br>*Horizontal response spectral acceleration at period of 0.2 s with a 7% probability of exceedance in 75 years and 5% critical damping | a <sub>3</sub> . Using Figure 3.10.2.1-3<br>* $S_1$ = 0.054<br>*Horizontal response spectral acceleration at a period of 1 s with a 7% probability of exceedance in 75 years and 5% critical damping |
|-------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                                                                                                                                                            |                                                                                                                                                              |                                                                                                                                                               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| b <sub>1</sub> . Using Table 3.10.3.2-1<br>Using a site class value of D, taken from calculation step 1 and a PGA of 0.08, taken from step 4a <sub>1</sub> | b <sub>2</sub> . Using Table 3.10.3.2-2<br>Using a site class value of D, taken from calculation step 1 and a $S_s$ of 0.18, taken from step 4a <sub>2</sub> | b <sub>3</sub> . Using Table 3.10.3.2-3<br>Using a site class value of D, taken from calculation step 1 and a $S_1$ of 0.054, taken from step 4a <sub>3</sub> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                 |             |             |
|-----------------|-------------|-------------|
| $F_{pga} = 1.6$ | $F_a = 1.6$ | $F_v = 2.4$ |
|-----------------|-------------|-------------|

|                                            |                                            |                                            |
|--------------------------------------------|--------------------------------------------|--------------------------------------------|
| c <sub>1</sub> . Using Equation 3.10.4.2-2 | c <sub>2</sub> . Using Equation 3.10.4.2-3 | c <sub>3</sub> . Using Equation 3.10.4.2-6 |
|--------------------------------------------|--------------------------------------------|--------------------------------------------|

$$A_s = F_{pga} * PGA$$

$$PGA = 0.08$$

$$F_{pga} = 1.6$$

$$A_s = 0.128$$

$$S_{DS} = F_a * S_s$$

$$S_s = 0.18$$

$$F_a = 1.6$$

$$S_{DS} = 0.288$$

$$S_{D1} = F_v * S_1$$

$$S_1 = 0.054$$

$$F_v = 2.4$$

$$S_{D1} = 0.130$$

Reduce the seismic coefficient  $A_s$  based on the slope height using the method described in FHWA GEC No. 3 Section 6.2.2 (Ref. 5).

$$k_{amax} = \alpha * A_s \quad \text{Ref. 5, Eq. 6-2}$$

$$\alpha = 1 + 0.01 * H * (0.5 * \beta - 1) \quad \text{Ref. 5, Eq. 6-3}$$

Where:

H = height of the slope in the direction of sliding

$$\beta = F_v * S_1 / A_s \quad \text{Ref. 5, Eq. 6-4}$$

**Date:** 2/15/2024  
**Project No.:** US0025840.9367  
**Subject:** Seismic Site Analysis - Phair Crossing  
**Project Short Title:** Phair Crossing Bridge Presque Isle, ME (WIN 026434.00)

**Made by:** ATM  
**Checked by:** DEB  
**Reviewed by:** MEL

|              |       |                 |
|--------------|-------|-----------------|
| H (feet) =   | 25.0  |                 |
| $\beta$ =    | 1.01  | Ref. 5, Eq. 6-4 |
| $\alpha$ =   | 0.88  | Ref. 5, Eq. 6-3 |
| $k_{\max}$ = | 0.112 | Ref. 5, Eq. 6-2 |

| Seismic Parameters |                             |                               |                              |                              |                         |                   |
|--------------------|-----------------------------|-------------------------------|------------------------------|------------------------------|-------------------------|-------------------|
| PGA <sup>1</sup>   | A <sub>s</sub> <sup>2</sup> | k <sub>max</sub> <sup>3</sup> | S <sub>DS</sub> <sup>4</sup> | S <sub>D1</sub> <sup>5</sup> | Site Class <sup>6</sup> | Zone <sup>7</sup> |
| -                  | 1/s                         | 1/s                           | 1/s                          | 1/s                          | -                       | -                 |
| 0.080              | 0.128                       | 0.112                         | 0.288                        | 0.130                        | D                       | 1                 |

<sup>1</sup>Using AASHTO Figure 3.10.2.1-1

<sup>2</sup>Using AASHTO Figure 3.10.2.1-1, Table 3.10.3.2-1, and Equation 3.10.4.2-2

<sup>3</sup>Using FHWA GEC No.3 Section 6.2.2 Equations 6-2 through 6-4

<sup>4</sup>Using AASHTO Figure 3.10.2.1-2, Table 3.10.3.2-2, and Equation 3.10.4.2-3

<sup>5</sup>Using AASHTO Figure 3.10.2.1-3, Table 3.10.3.2-3, and Equation 3.10.4.2-6

<sup>6</sup>Using result of step 1 of calculation package

<sup>7</sup>Using result of step 2 of calculation package

## CONCLUSIONS

Based on the material encountered and the results of the SPT testing completed during the drilling of boring BB-PIPC-102 the Seismic Site Class for the site is D.

As per Section 3.10.4.2 of AASHTO (2020), the 1 second period response acceleration at the site is less than 0.15g, therefore the site is in Seismic Performance Zone 1.



## CALCULATIONS

|                             |                                                        |                     |     |
|-----------------------------|--------------------------------------------------------|---------------------|-----|
| <b>Date:</b>                | 4/18/2024                                              | <b>Made by:</b>     | JEF |
| <b>Project No.:</b>         | US0025840.9367                                         | <b>Checked by:</b>  | LMP |
| <b>Subject:</b>             | Differential Settlement of Existing Drainage Pipe      | <b>Reviewed by:</b> | CCB |
| <b>Project Short Title:</b> | Phair Crossing Bridge Presque Isle, ME (WIN 026434.00) |                     |     |

### OBJECTIVE

Calculate the immediate settlement beneath the existing culvert under Route 10, at the point of greatest proposed fill thickness at the top of the embankment to determine the differential settlement along the existing drainage pipe. The greatest fill thickness was taken at -17.0 feet from the Route 10 centerline, where the proposed guiderail is to be

### REFERENCES

1. WSP Global Stability Analysis, Transverse Stability Section at Station 206+66, calculation package dated April 18,
2. Das, Braja M. 2011. Principles of Foundation Engineering, 7th ed. Cengage Learning, Stamford, CT.
3. State of Maine Department of Transportation, Phair Crossing Bridge, Presque Isle, Aroostook County, State Route 10, Dated 03/2024 (Preliminary Design Report), Working Cross-Sections created by HNTB
4. Holtz, R.D. and Kovacs, W.D. 1981. An Introduction to Geotechnical Engineering, 1st ed. Prentice Hall, Englewood Cliffs, NJ.
5. FHWA. 2002. Geotechnical Engineering Circular No. 6: Shallow Foundations. Report No. FHWA-SA-02-054.
6. Guertin Elkerton & Associates for Maine Department of Transportation. Bridge Design Guide. Dated August 2003 with 2018 updates.
7. WSP Material Properties correlations from field test data, titled Material properties 31407448.000 Phair Crossing.
8. WSP Interpreted subsurface profile - "Cross\_Sections\_Route10 - 206+66.00.dwg"
9. WSP Boring Logs, included as Appendix A of the Preliminary Geotechnical Design Report

### ASSUMPTIONS

- |                                                                                                                                                                                                                                                                        |                                  |       |     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|-------|-----|
| 1. The existing stratigraphy surfaces are estimated from References 1, 8, and 9. The existing ground surface elevation is measured from Reference 8.                                                                                                                   | Existing GS EL =                 | 612.8 | ft  |
| 2. Water table elevation was assumed due to a lack groundwater data encountered during drilling (Reference 9). Water table was assumed to at the interface of Historical Fill and Glacial Till since the only water reading (BP-PIPC-102) was taken after rock coring. | WL EL =                          | 578.3 | ft  |
| 3. $N_{60}$ -values for the soil layers, based on correlation (Reference 2, Equation 18.5) to the design friction angles determined for each layer. Values calculated in Ref. 7:                                                                                       | $N_{60, \text{Historic Fill}} =$ | 22    |     |
|                                                                                                                                                                                                                                                                        | $N_{60, \text{Glacial Till}} =$  | 27    |     |
| 4. The proposed road grade elevation and existing drainage pipe invert elevation at -17.0 feet from the centerline of Route 10 are (Reference 8).                                                                                                                      | Proposed Road EL =               | 615.8 | ft  |
|                                                                                                                                                                                                                                                                        | Existing invert EL =             | 583.2 | ft  |
| 5. The drainage pipe is assumed to be the dry since groundwater elevation is assumed to be below the culvert invert based on the information obtained during the subsurface exploration (References 1, 8, and 9, Assumption1).                                         |                                  |       |     |
| 6. The unit weight for the proposed fill construction material (Reference 6), based on MaineDOT standard practice, are:                                                                                                                                                | Unit weight - Granular Borrow =  | 125   | pcf |
| 7. Localized stress concentration is not considered for the analysis.                                                                                                                                                                                                  |                                  |       |     |

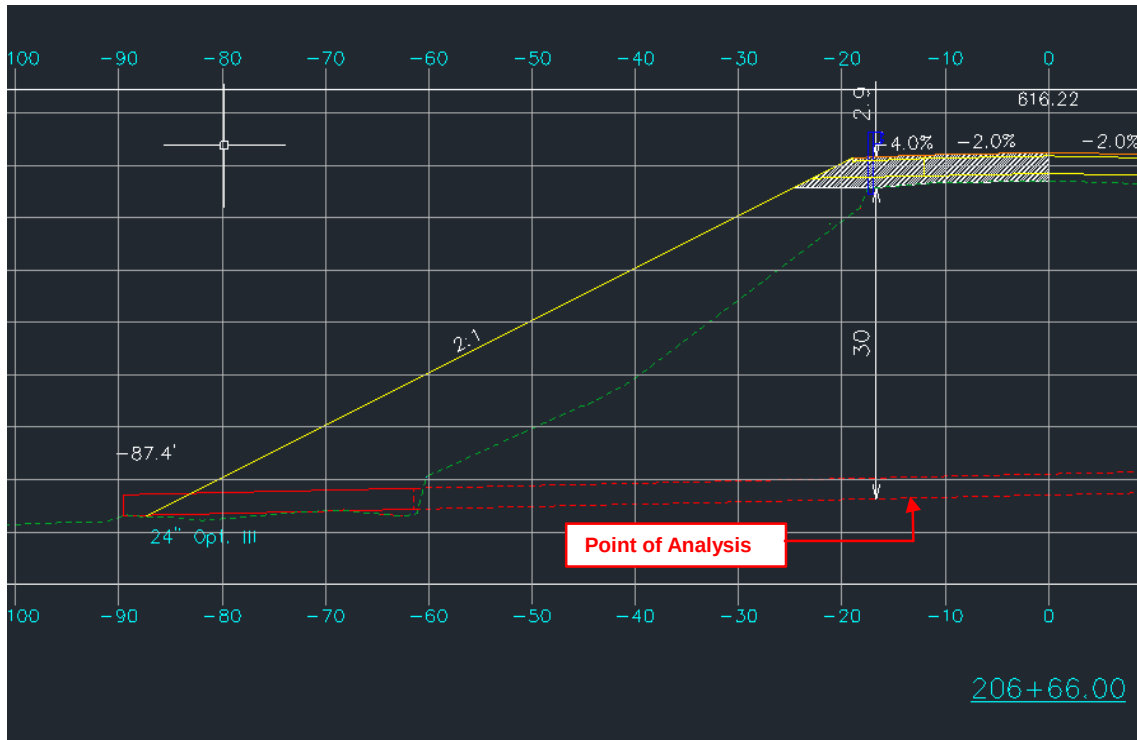


## CALCULATIONS

**Date:** 4/18/2024  
**Project No.:** US0025840.9367  
**Subject:** Differential Settlement of Existing Drainage Pipe  
**Project Short Title:** Phair Crossing Bridge Presque Isle, ME (WIN 026434.00)

**Made by:** JEF  
**Checked by:** LMP  
**Reviewed by:** CCB

Location of Analysis:



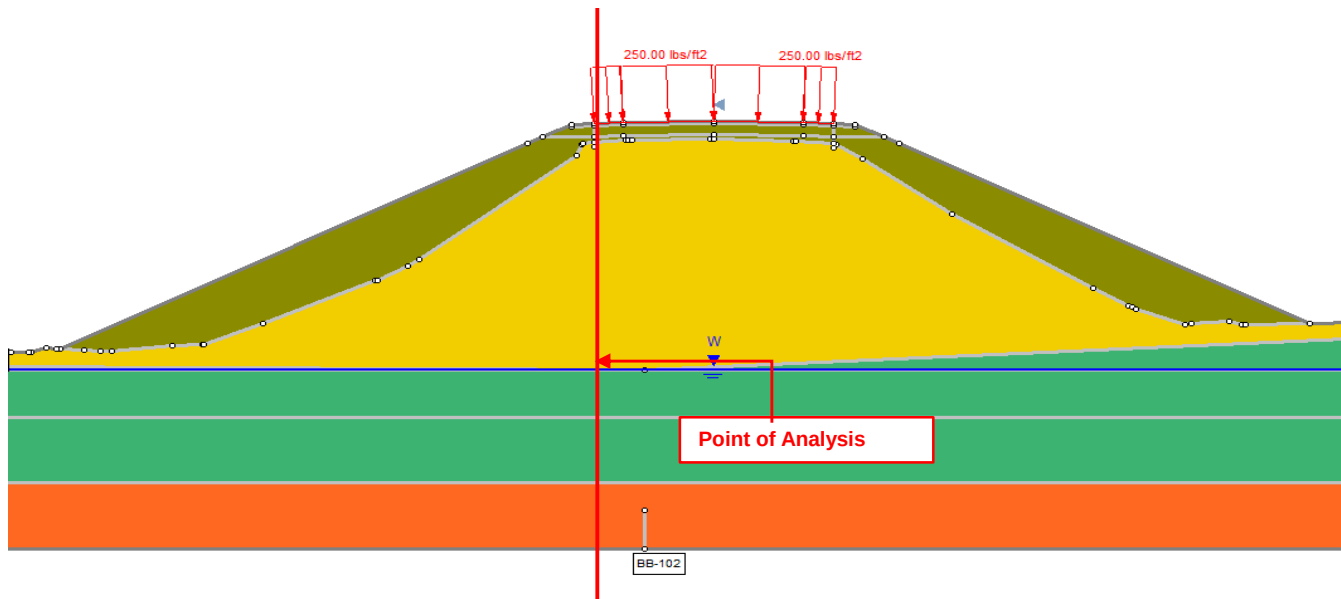
(Reference 3, Sheet 10, measured using Autodesk Civil 3D)



## CALCULATIONS

**Date:** 4/18/2024  
**Project No.:** US0025840.9367  
**Subject:** Differential Settlement of Existing Drainage Pipe  
**Project Short Title:** Phair Crossing Bridge Presque Isle, ME (WIN 026434.00)

**Made by:** JEF  
**Checked by:** LMP  
**Reviewed by:** CCB



(Reference 1)



## CALCULATIONS

**Date:** 4/18/2024  
**Project No.:** US0025840.9367  
**Subject:** Differential Settlement of Existing Drainage Pipe  
**Project Short Title:** Phair Crossing Bridge Presque Isle, ME (WIN 026434.00)

**Made by:** JEF  
**Checked by:** LMP  
**Reviewed by:** CCB

### CALCULATION

**A. Determine the change in effective stress state within the soil beneath the existing drainage pipe to identify if settlement or heave will occur. Calculate the vertical stress change beneath the drainage pipe due to road construction.**

The change in effective stress state due to change in stratigraphy is determined at the lower limit of drainage pipe invert at the location of analysis along the drainage pipe centerline: EL. 583.2 ft (drainage pipe invert EL.). Based on References 1, 3, and 8, the existing drainage pipe is founded within the historical fill layer.

Existing Conditions:

| Layer           | Unit weight<br>(pcf) | Elevation (ft) |        | Thickness (ft) | Vert. Stress<br>Contribution of Layer<br>(psf) | Vert. Effective Stress<br>Contribution of Layer<br>(psf) |
|-----------------|----------------------|----------------|--------|----------------|------------------------------------------------|----------------------------------------------------------|
|                 |                      | Top            | Bottom |                |                                                |                                                          |
| Historical Fill | 125                  | 612.8          | 583.2  | 29.7           | 3708                                           | 3708                                                     |

Note: Historical fill bottom elevation equivalent to drainage pipe invert elevation.

After Construction:

| Layer                  | Unit weight<br>(pcf) | Elevation (ft) |        | Thickness (ft) | Vert. Stress<br>Contribution of Layer<br>(psf) | Vert. Effective Stress<br>Contribution of Layer<br>(psf) |
|------------------------|----------------------|----------------|--------|----------------|------------------------------------------------|----------------------------------------------------------|
|                        |                      | Top            | Bottom |                |                                                |                                                          |
| Pavement               | 140                  | 615.8          | 615.4  | 0.3            | 46                                             | 46                                                       |
| Fill (Granular Borrow) | 125                  | 615.4          | 612.8  | 2.6            | 328                                            | 328                                                      |
| Historical Fill        | 125                  | 612.8          | 583.2  | 29.7           | 3708                                           | 3708                                                     |

Note: Historical fill bottom elevation equivalent to drainage pipe invert elevation.

Calculate the increase or decrease in effective stress as a result of construction.

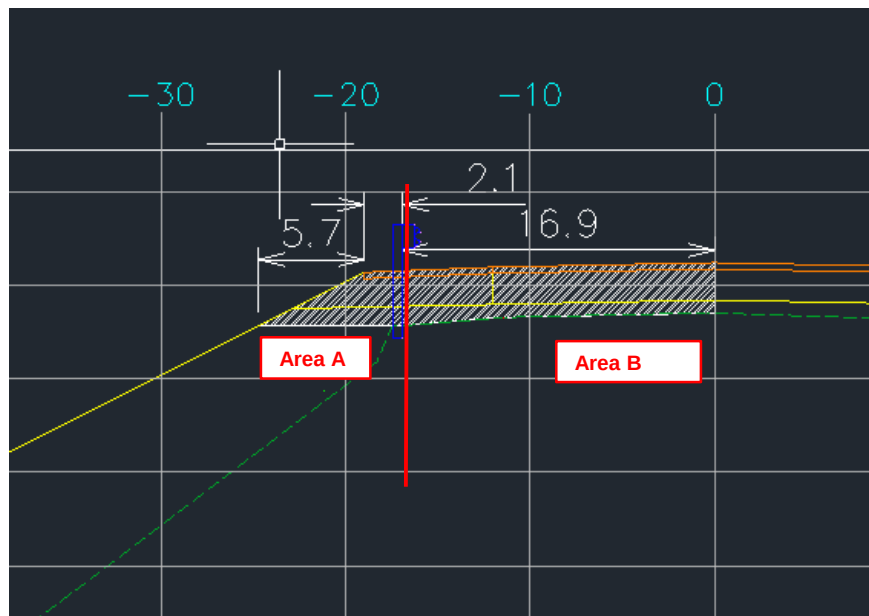
|                     | $\sigma_v$ at Elev.<br>583.2 ft<br>(psf) | $\sigma'_v$ at Elev.<br>583.2 ft<br>(psf) | $\Delta\sigma'_v$ at<br>Elev.<br>583.2ft<br>(psf) | Result     |
|---------------------|------------------------------------------|-------------------------------------------|---------------------------------------------------|------------|
| Existing conditions | 3708                                     | 3708                                      | 374                                               | Settlement |
| After construction  | 4081                                     | 4081                                      |                                                   |            |

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**Subject:** Differential Settlement of Existing Drainage Pipe  
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**Made by:** JEF  
**Checked by:** LMP  
**Reviewed by:** CCB

Subdivide the subsurface soils into layers no larger than 10 ft thick and to a depth of either twice the footing width or to bedrock. Calculate the vertical stress increase at each layer, assuming the Boussinesq stress distribution method for stress under a long trapezoidal embankment. The Boussinesq method was developed for footings but in this case is used for the proposed embankment fill.

Assumed Loading (section view):



$$\sigma_z = q_0 \times I$$

$$\frac{a/z}{b/z}$$

Reference 4, Eqn. 8-30  
 Reference 4, Figure 8.23  
 Reference 4, Figure 8.23

where:

$\sigma_z$  = vertical stress increase, psf  
 $q_0$  = net stress applied by additional fill  
 $a$  = dimension of embankment slope, ft  
 $b$  = dimension of embankment top, ft  
 $z$  = depth to midpoint of layer, ft

| Area A | Area B |     |          |
|--------|--------|-----|----------|
|        | 374    | psf | (Part A) |
| 5.7    | 0.0    | ft  | (Ref. 3) |
| 2.1    | 16.9   | ft  | (Ref. 3) |



## CALCULATIONS

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**Made by:** JEF  
**Checked by:** LMP  
**Reviewed by:** CCB

Area A:

| Layer           |   | Depth below lower limit of culvert (ft) | Layer Thickness (ft) | z (ft) | a/z | b/z | I     | Stress Increase<br>$\sigma_z$ (psf) |
|-----------------|---|-----------------------------------------|----------------------|--------|-----|-----|-------|-------------------------------------|
| Historical Fill | 1 | 0-4.8                                   | 4.8                  | 2.4    | 2.4 | 0.9 | 0.470 | 176                                 |
| Glacial Till    | 2 | 4.8-12.2                                | 7.4                  | 8.5    | 0.7 | 0.2 | 0.280 | 105                                 |
| Glacial Till    | 3 | 12.2-22.2                               | 10.0                 | 17.2   | 0.3 | 0.1 | 0.150 | 56                                  |

Area B:

| Layer           |   | Depth below lower limit of culvert (ft) | Layer Thickness (ft) | z (ft) | a/z | b/z | I     | Stress Increase<br>$\sigma_z$ (psf) |
|-----------------|---|-----------------------------------------|----------------------|--------|-----|-----|-------|-------------------------------------|
| Historical Fill | 1 | 0-4.8                                   | 4.8                  | 2.4    | 0.0 | 7.0 | 0.500 | 187                                 |
| Glacial Till    | 2 | 4.8-12.2                                | 7.4                  | 8.5    | 0.0 | 2.0 | 0.480 | 180                                 |
| Glacial Till    | 3 | 12.2-22.2                               | 10.0                 | 17.2   | 0.0 | 1.0 | 0.410 | 153                                 |

Area A + Area B:

| Layer           |   | Depth below lower limit of culvert (ft) | Stress Increase<br>$\sigma_z$ (psf) |
|-----------------|---|-----------------------------------------|-------------------------------------|
| Historical Fill | 1 | 0-4.8                                   | 363                                 |
| Glacial Till    | 2 | 4.8-12.2                                | 284                                 |
| Glacial Till    | 3 | 12.2-22.2                               | 209                                 |



## CALCULATIONS

|                             |                                                        |                     |     |
|-----------------------------|--------------------------------------------------------|---------------------|-----|
| <b>Date:</b>                | 4/18/2024                                              | <b>Made by:</b>     | JEF |
| <b>Project No.:</b>         | US0025840.9367                                         | <b>Checked by:</b>  | LMP |
| <b>Subject:</b>             | Differential Settlement of Existing Drainage Pipe      | <b>Reviewed by:</b> | CCB |
| <b>Project Short Title:</b> | Phair Crossing Bridge Presque Isle, ME (WIN 026434.00) |                     |     |

### B. Use the Hough method to estimate settlement of the soil layers beneath the existing drainage pipe.

- Determine  $\sigma'_{v0}$  and  $C'$  at layer midpoints for in situ existing soil. Use Ref. 5 Figures 5-18 and 5-19 to obtain corrected  $N'$  and  $C'$  for Historical Fill and Glacial Till, assuming the Historical Fill and Glacial Till are "Well graded silty SAND & GRAVEL."

|                                                                    |                         |
|--------------------------------------------------------------------|-------------------------|
| Stress due to existing soil<br>above point of analysis<br>(Part A) | $\sigma'_{v0}$<br>(psf) |
|                                                                    | 3708                    |

| Layer           |   | Layer<br>Thickness<br>(ft) | Unit<br>Weight of<br>Layer (pcf) | $\sigma'_{v0}$ at layer<br>midpoint (psf) | $\sigma'_{v0}$ at<br>layer<br>midpoint<br>(kPa) | $N_{60}$ | $N'$ | $C'$ |
|-----------------|---|----------------------------|----------------------------------|-------------------------------------------|-------------------------------------------------|----------|------|------|
| Historical Fill | 1 | 4.8                        | 125                              | 4008                                      | 191.8                                           | 22       | 16   | 67   |
| Glacial Till    | 2 | 7.4                        | 67.6                             | 4558                                      | 218.2                                           | 27       | 18   | 72   |
| Glacial Till    | 3 | 10.0                       | 67.6                             | 5146                                      | 246.3                                           | 27       | 17   | 70   |

- Calculate the total settlement of the sand/silt and gravel historical fill (Layers 1 through 4) using the Hough method:

General Equation (Ref. 5, Eqn 5-24)

$$\Delta H_i = H_c \frac{1}{C'} \log \left( \frac{\sigma'_{v0} + \Delta \sigma_v}{\sigma'_{v0}} \right)$$

where:

- $\Delta H_i$  settlement in each layer, ft
- $H_c$  initial height of layer i, ft
- $C'$  bearing capacity index from Ref. 5, Figure 5-19
- $\Delta \sigma_v$  vertical stress increase, ksf



## CALCULATIONS

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**Made by:** JEF  
**Checked by:** LMP  
**Reviewed by:** CCB

|                        |    |       |
|------------------------|----|-------|
| $\Delta H_i$ (Layer 1) | ft | 0.003 |
|                        | in | 0.03  |

|                        |    |       |
|------------------------|----|-------|
| $\Delta H_i$ (Layer 2) | ft | 0.003 |
|                        | in | 0.03  |

|                        |    |       |
|------------------------|----|-------|
| $\Delta H_i$ (Layer 3) | ft | 0.002 |
|                        | in | 0.03  |

| Settlement Based on<br>Calc. Loading Stress |                   |
|---------------------------------------------|-------------------|
| Layer                                       | $\Delta H_i$ (in) |
| 1                                           | 0.03              |
| 2                                           | 0.03              |
| 3                                           | 0.03              |
| Total Settlement (in)                       | 0.09              |

## CONCLUSIONS

The immediate settlement beneath the existing drainage pipe after construction is estimated to be less than one inch. Since clay soil was not encountered beneath the existing drainage pipe location, consolidation settlement is not expected.



## CALCULATIONS

|                             |                                                        |                     |     |
|-----------------------------|--------------------------------------------------------|---------------------|-----|
| <b>Date:</b>                | 4/18/2024                                              | <b>Made by:</b>     | JEF |
| <b>Project No.:</b>         | US0025840.9367                                         | <b>Checked by:</b>  | LMP |
| <b>Subject:</b>             | Differential Settlement of Existing Drainage Pipe      | <b>Reviewed by:</b> | CCB |
| <b>Project Short Title:</b> | Phair Crossing Bridge Presque Isle, ME (WIN 026434.00) |                     |     |

### OBJECTIVE

Calculate the immediate settlement beneath the existing culvert under Route 10 at the point of greatest proposed fill thickness above the outlet to determine the differential settlement along the existing drainage pipe. The greatest fill thickness was taken at -62.5 feet from the Route 10 centerline, where the existing will is thinner due to the drainage pipe outlet.

### REFERENCES

1. WSP Global Stability Analysis, Transverse Stability Section at Station 206+66, calculation package dated April 18, 2024.
2. Das, Braja M. 2011. Principles of Foundation Engineering, 7th ed. Cengage Learning, Stamford, CT.
3. State of Maine Department of Transportation, Phair Crossing Bridge, Presque Isle, Aroostook County, State Route 10, Dated 03/2024 (Preliminary Design Report), Working Cross-Sections created by HNTB
4. Holtz, R.D. and Kovacs, W.D. 1981. An Introduction to Geotechnical Engineering, 1st ed. Prentice Hall, Englewood Cliffs, NJ.
5. FHWA. 2002. Geotechnical Engineering Circular No. 6: Shallow Foundations. Report No. FHWA-SA-02-054.
6. Guertin Elkerton & Associates for Maine Department of Transportation. Bridge Design Guide. Dated August 2003 with 2018 updates.
7. WSP Material Properties correlations from field test data, titled Material properties 31407448.000 Phair Crossing.
8. WSP Interpreted subsurface profile - "Cross\_Sections\_Route10 - 206+66.00.dwg"
9. WSP Boring Logs, included as Appendix A of the Preliminary Geotechnical Design Report

### ASSUMPTIONS

1. The existing stratigraphy surfaces are estimated from References 1, 8, and 9. The existing ground surface elevation is measured from Reference 8.
2. Water table elevation was assumed due to a lack groundwater data encountered during drilling (Reference 9). Water table was assumed to at the interface of Historical Fill and Glacial Till since the only water reading (BP-102) was taken after rock coring.
3.  $N_{60}$ -values for the soil layers, based on correlation (Reference 2, Equation 18.5) to the design friction angles determined for each layer. Values calculated in Ref. 7:
4. The proposed road embankment elevation and existing drainage pipe invert elevation at the point of thickest proposed fill at STA 206+66, -62.5 feet from centerline, are (Reference 8):
5. The drainage pipe is assumed to be the dry since groundwater elevation is assumed to be below the drainage pipe invert based on the information obtained during the subsurface exploration (References 1, 8, and 9, Assumption1).

Existing GS EL = 584.4 ft

WL EL = 578.3 ft

$N_{60, \text{Historic Fill}} = 22$

$N_{60, \text{Glacial Till}} = 27$

Embankment EL = 594.0 ft

Existing invert EL = 582.2 ft



## CALCULATIONS

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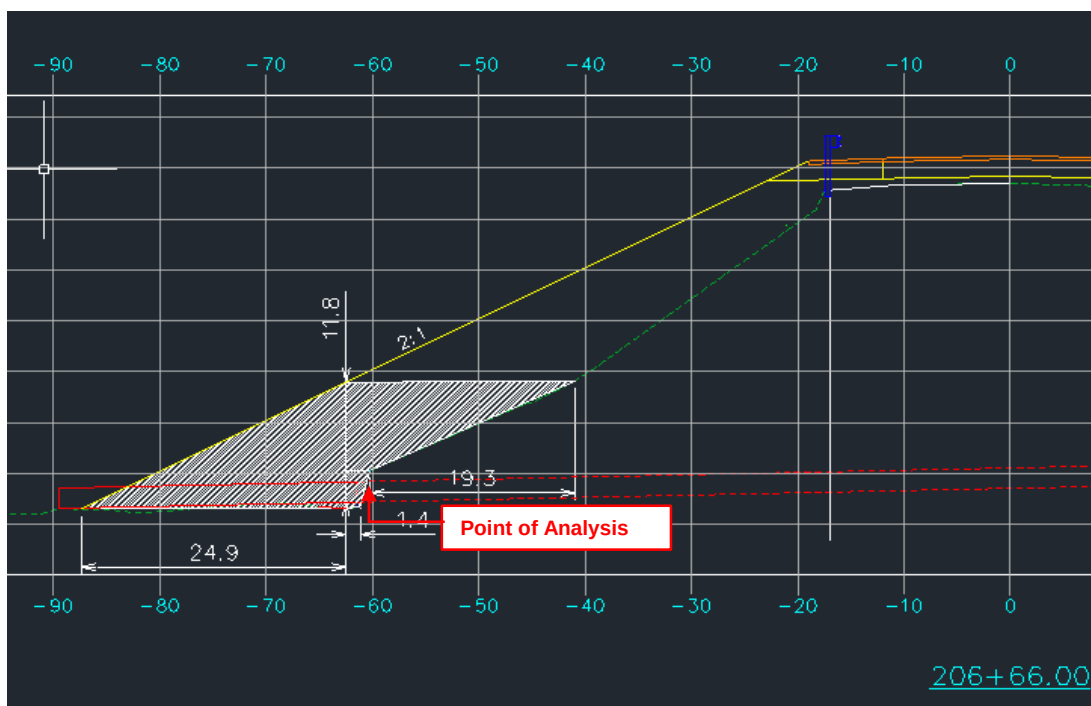
**Made by:** JEF  
**Checked by:** LMP  
**Reviewed by:** CCB

6. The unit weight for the proposed fill construction material (Reference 6), based on MaineDOT standard practice, are:

Unit weight - Granular Borrow = 125 pcf

7. Localized stress concentration is not considered for the analysis.

Location of Analysis:



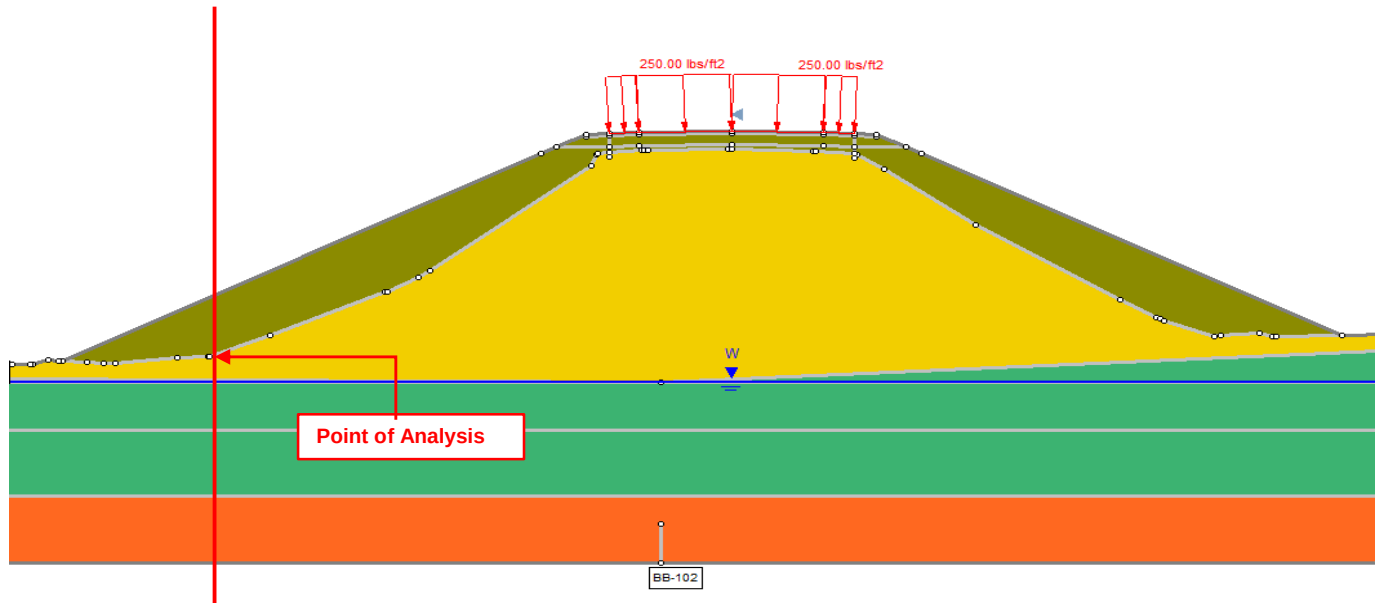
(Reference 3, Sheet 10, measured using Autodesk Civil 3D)



## CALCULATIONS

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(Reference 1)



## CALCULATIONS

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**Made by:** JEF  
**Checked by:** LMP  
**Reviewed by:** CCB

### CALCULATION

**A. Determine the change in effective stress state within the soil beneath the existing drainage pipe to identify if settlement or heave will occur. Calculate the vertical stress change beneath the drainage pipe due to road embankment construction.**

The change in effective stress state due to change in stratigraphy is determined at the lower limit of drainage pipe invert at the location of analysis along the drainage pipe centerline: EL. 582.2 ft (drainage pipe invert EL.). Based on References 1, 3, and 8, the existing drainage pipe is constructed on the historical fill layer at grade.

Existing Conditions:

| Layer           | Unit weight<br>(pcf) | Elevation (ft) |        | Thickness<br>(ft) | Vert. Stress<br>Contribution of Layer<br>(psf) | Vert. Effective Stress<br>Contribution of Layer<br>(psf) |
|-----------------|----------------------|----------------|--------|-------------------|------------------------------------------------|----------------------------------------------------------|
|                 |                      | Top            | Bottom |                   |                                                |                                                          |
| Historical Fill | 125                  | -              | -      | 0.0               | 0                                              | 0                                                        |

Note: Historical fill top elevation equivalent to drainage pipe invert elevation.

After Construction:

| Layer                  | Unit weight<br>(pcf) | Elevation (ft) |        | Thickness<br>(ft) | Vert. Stress<br>Contribution of Layer<br>(psf) | Vert. Effective Stress<br>Contribution of Layer<br>(psf) |
|------------------------|----------------------|----------------|--------|-------------------|------------------------------------------------|----------------------------------------------------------|
|                        |                      | Top            | Bottom |                   |                                                |                                                          |
| Fill (Granular Borrow) | 125                  | 594.0          | 582.2  | 11.8              | 1476                                           | 1476                                                     |

Note: Historical fill top elevation equivalent to drainage pipe invert elevation.

Calculate the increase or decrease in effective stress as a result of construction.

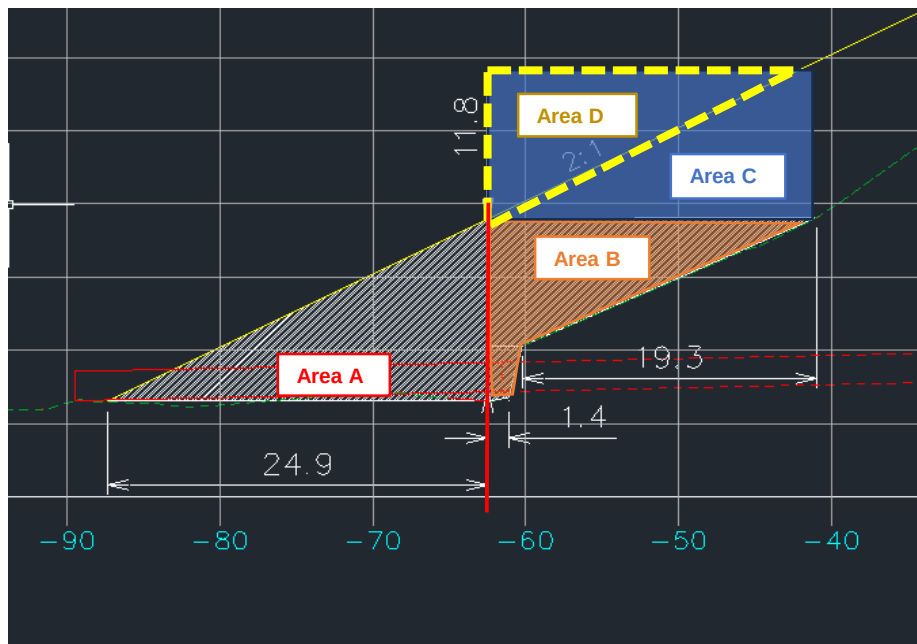
|                     | $\sigma_v$ at Elev.<br>582.2 ft<br>(psf) | $\sigma_v$ at Elev.<br>582.2 ft<br>(psf) | $\Delta\sigma_v$ at<br>Elev.<br>582.2ft<br>(psf) | Result     |
|---------------------|------------------------------------------|------------------------------------------|--------------------------------------------------|------------|
| Existing conditions | 0                                        | 0                                        | 1476                                             | Settlement |
| After construction  | 1476                                     | 1476                                     |                                                  |            |

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**Subject:** Differential Settlement of Existing Drainage Pipe  
**Project Short Title:** Phair Crossing Bridge Presque Isle, ME (WIN 026434.00)

**Made by:** JEF  
**Checked by:** LMP  
**Reviewed by:** CCB

Subdivide the subsurface soils into layers no larger than 10 ft thick and to a depth of either twice the footing width or to bedrock. Calculate the vertical stress increase at each layer, assuming the Boussinesq stress distribution method for stress under a long trapezoidal embankment. The Boussinesq method was developed for footings but in this case is used for the proposed embankment fill.

Assumed Loading (section view):



$$\sigma_z = q_0 \times \left[ \frac{a/z}{b/z} \right]$$

Reference 4, Eqn. 8-30  
 Reference 4, Figure 8.23  
 Reference 4, Figure 8.23

where:

$\sigma_z$  = vertical stress increase, psf  
 $q_0$  = net stress applied by additional fill  
 $a$  = dimension of embankment slope, ft  
 $b$  = dimension of embankment top, ft  
 $z$  = depth to midpoint of layer, ft

|  | Area A | Area B | Area C | Area D  |     |          |
|--|--------|--------|--------|---------|-----|----------|
|  |        |        |        |         | psf | (Part A) |
|  |        | 1476   |        |         |     | (Ref. 3) |
|  | 24.9   | 19.3   | 0      | 20.7 ft |     | (Ref. 3) |
|  | 0      | 1.4    | 20.7   | 0 ft    |     | (Ref. 3) |



## CALCULATIONS

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**Made by:** JEF  
**Checked by:** LMP  
**Reviewed by:** CCB

Area A:

| Layer           |   | Depth below lower limit of culvert (ft) | Layer Thickness (ft) | z (ft) | a/z  | b/z | I     | Stress Increase<br>$\sigma_z$ (psf) |
|-----------------|---|-----------------------------------------|----------------------|--------|------|-----|-------|-------------------------------------|
| Historical Fill | 1 | 0-3.5                                   | 3.5                  | 1.8    | 14.2 | 0.0 | 0.470 | 694                                 |
| Glacial Till    | 2 | 3.5-3.8                                 | 0.3                  | 3.6    | 6.8  | 0.0 | 0.450 | 664                                 |
| Glacial Till    | 3 | 3.8-11.2                                | 7.4                  | 7.5    | 3.3  | 0.0 | 0.412 | 608                                 |
| Glacial Till    | 4 | 11.2-21.2                               | 10.0                 | 16.2   | 1.5  | 0.0 | 0.311 | 459                                 |

Area B:

| Layer           |   | Depth below lower limit of culvert (ft) | Layer Thickness (ft) | z (ft) | a/z  | b/z | I     | Stress Increase<br>$\sigma_z$ (psf) |
|-----------------|---|-----------------------------------------|----------------------|--------|------|-----|-------|-------------------------------------|
| Historical Fill | 1 | 0-3.5                                   | 3.5                  | 1.8    | 11.0 | 0.8 | 0.500 | 738                                 |
| Glacial Till    | 2 | 3.5-3.8                                 | 0.3                  | 3.6    | 5.3  | 0.4 | 0.470 | 694                                 |
| Glacial Till    | 3 | 3.8-11.2                                | 7.4                  | 7.5    | 2.6  | 0.2 | 0.418 | 617                                 |
| Glacial Till    | 4 | 11.2-21.2                               | 10.0                 | 16.2   | 1.2  | 0.1 | 0.322 | 475                                 |

Area C:

| Layer           |   | Depth below lower limit of culvert (ft) | Layer Thickness (ft) | z (ft) | a/z | b/z | I     | Stress Increase<br>$\sigma_z$ (psf) |
|-----------------|---|-----------------------------------------|----------------------|--------|-----|-----|-------|-------------------------------------|
| Historical Fill | 1 | 0-3.5                                   | 3.5                  | 13.6   | 0.0 | 1.5 | 0.460 | 679                                 |
| Glacial Till    | 2 | 3.5-3.8                                 | 0.3                  | 15.5   | 0.0 | 1.3 | 0.443 | 654                                 |
| Glacial Till    | 3 | 3.8-11.2                                | 7.4                  | 19.3   | 0.0 | 1.1 | 0.425 | 627                                 |
| Glacial Till    | 4 | 11.2-21.2                               | 10.0                 | 28.0   | 0.0 | 0.7 | 0.345 | 509                                 |



## CALCULATIONS

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**Made by:** JEF  
**Checked by:** LMP  
**Reviewed by:** CCB

### Area D:

| Layer           |   | Depth below lower limit of culvert (ft) | Layer Thickness (ft) | z (ft) | a/z | b/z | I     | Stress Increase $\sigma_z$ (psf) |
|-----------------|---|-----------------------------------------|----------------------|--------|-----|-----|-------|----------------------------------|
| Historical Fill | 1 | 0-3.5                                   | 3.5                  | 13.6   | 1.5 | 0.0 | 0.311 | 459                              |
| Glacial Till    | 2 | 3.5-3.8                                 | 0.3                  | 15.5   | 1.3 | 0.0 | 0.282 | 416                              |
| Glacial Till    | 3 | 3.8-11.2                                | 7.4                  | 19.3   | 1.1 | 0.0 | 0.260 | 384                              |
| Glacial Till    | 4 | 11.2-21.2                               | 10.0                 | 28.0   | 0.7 | 0.0 | 0.195 | 288                              |

### Area A + Area B + Area C - Area D:

| Layer           |   | Depth below lower limit of culvert | Stress Increase $\sigma_z$ (psf) |
|-----------------|---|------------------------------------|----------------------------------|
| Historical Fill | 1 | 0-3.5                              | 1652                             |
| Glacial Till    | 2 | 3.5-3.8                            | 1596                             |
| Glacial Till    | 3 | 3.8-11.2                           | 1469                             |
| Glacial Till    | 4 | 11.2-21.2                          | 1156                             |

### B. Use the Hough method to estimate settlement of the soil layers beneath the existing drainage pipe.

1

Determine  $\sigma'_{v0}$  and  $C'$  at layer midpoints for in situ existing soil. Use Ref. 5 Figures 5-18 and 5-19 to obtain corrected  $N'$  and  $C'$  for Historical Fill and Glacial Till, assuming the Historical Fill and Glacial Till are "Well graded silty SAND & GRAVEL."

| Stress due to existing soil above point of analysis (Part A) | $\sigma'_{v0}$ (psf) |
|--------------------------------------------------------------|----------------------|
|                                                              | 0                    |

| Layer           |   | Layer Thickness (ft) | Unit Weight of Layer (pcf) | $\sigma'_{v0}$ at layer midpoint (psf) | $\sigma'_{v0}$ at layer midpoint (kPa) | $N_{60}$ | $N'$ | $C'$ |
|-----------------|---|----------------------|----------------------------|----------------------------------------|----------------------------------------|----------|------|------|
| Historical Fill | 1 | 3.5                  | 125                        | 219                                    | 10.5                                   | 22       | 44   | 145  |
| Glacial Till    | 2 | 0.3                  | 130                        | 457                                    | 21.9                                   | 27       | 54   | 185  |
| Glacial Till    | 3 | 7.4                  | 67.6                       | 727                                    | 34.8                                   | 27       | 45   | 150  |
| Glacial Till    | 4 | 10.0                 | 67.6                       | 1315                                   | 62.9                                   | 27       | 33   | 112  |



## CALCULATIONS

**Date:** 4/18/2024  
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**Subject:** Differential Settlement of Existing Drainage Pipe  
**Project Short Title:** Phair Crossing Bridge Presque Isle, ME (WIN 026434.00)

**Made by:** JEF  
**Checked by:** LMP  
**Reviewed by:** CCB

- 2 Calculate the total settlement of the sand/silt and gravel historical fill (Layers 1 through 4) using the Hough method:

General Equation (Ref. 5, Eqn 5-24)

$$\Delta H_i = H_c \frac{1}{C'} \log \left( \frac{\sigma'_{v0} + \Delta \sigma_v}{\sigma'_{v0}} \right)$$

where:

$\Delta H_i$  settlement in each layer, ft  
 $H_c$  initial height of layer i, ft  
 $C'$  bearing capacity index from Ref. 5, Figure 5-19  
 $\Delta \sigma_v$  vertical stress increase, ksf

|                        |    |       |
|------------------------|----|-------|
| $\Delta H_i$ (Layer 1) | ft | 0.022 |
|                        | in | 0.27  |

|                        |    |       |
|------------------------|----|-------|
| $\Delta H_i$ (Layer 2) | ft | 0.001 |
|                        | in | 0.01  |

|                        |    |       |
|------------------------|----|-------|
| $\Delta H_i$ (Layer 3) | ft | 0.024 |
|                        | in | 0.28  |

|                        |    |       |
|------------------------|----|-------|
| $\Delta H_i$ (Layer 4) | ft | 0.024 |
|                        | in | 0.29  |

| Settlement Based on<br>Calc. Loading Stress |                   |
|---------------------------------------------|-------------------|
| Layer                                       | $\Delta H_i$ (in) |
| 1                                           | 0.27              |
| 2                                           | 0.01              |
| 3                                           | 0.28              |
| 4                                           | 0.29              |
| Total Settlement (in)                       | 0.85              |

## CONCLUSIONS

The immediate settlement beneath the existing drainage pipe after construction is estimated to be less than one inch. Since clay soil was not encountered beneath the existing drainage pipe location, consolidation settlement is not expected.



## CALCULATIONS

**Date:** 4/18/2024  
**Project No.:** US0025840.9367  
**Subject:** Global Stability Analysis  
**Project Short** Phair Crossing Bridge Presque Isle, ME (WIN 026434.00)

**Made by:** JEF/DEB  
**Checked by:** ATM/LMP  
**Reviewed by:** CCB

### OBJECTIVE

Determine the factor of safety for proposed conditions for Phair Crossing in Presque Isle, Maine.

### REFERENCES

1. WSP Soil and Rock Exploration Logs, included as Appendix A of the Preliminary Geotechnical Design Report.
2. WSP Corrected  $N_{60}$ -value to friction angle correlation titled "Material Properties 31407448.000 Phair Crossing.xlsx"
3. State of Maine Department of Transportation, Phair Crossing Bridge, Presque Isle, Aroostook County, State Route 10, Dated 03/2024 (Preliminary Design Report).
4. Guertin Elkerton & Associates for Maine Department of Transportation. Bridge Design Guide. Dated August 2003 with 2018 updates.
5. Rocscience Slide2 Software Package Version 9.031 64bit, build date 11/8/2023.
6. American Association of State Highway and Transportation Officials (AASHTO). 2020. LRFD Bridge Design Specifications, 9th Edition.
7. WSP Seismic Site Class Analysis - Phair Crossing titled "31407448.000 Presque Isle Phair Crossing Seismic Site Class.xlsx"
8. LRFD Seismic Bridge Analysis and Design of Transportation Geotechnical Features and Structural Foundations: Reference Manual. U.S. Dept. of Transportation, Federal Highway Administration, 2011.

### ATTACHMENTS

1. Slide2 material properties.
2. Slide2 output figures for model with proposed final loading.

### ASSUMPTIONS

1. Circular surface searches were analyzed using the Spencer method with an auto refine search. Non-circular surfaces searches were analyzed using the Spencer method and cuckoo search with surface altering optimization.
2. The proposed abutments will be located behind the existing full-height abutments, Based on conversations with Maine DOT and HNTB on June 27, 2024, HNTB indicated the existing full-height abutments and center pier substructures will remain in-place post-construction from 2-feet below ground surface to their base elevations. The presence of these substructure elements will improve the global stability. A project-specific minimum FS of 1.3 will be used for the embankments with abutments and for embankments without foundations. A  $FS \geq 1.3$  for static loading is recommended for potential failure surfaces on the embankment slope transverse to the roadway, and for potential failure surfaces on the abutment slopes parallel to the roadway, adjacent to the Maine Northern Railway track.
3. As per Maine Department of Transportation, the load applied by the road and traffic for final design conditions is modeled as a 2-foot equivalent load of soil (Ref. 4, Table 3-4):  $2 \times 125 \text{ pcf (granular borrow)} = 250 \text{ psf}$ .



## CALCULATIONS

**Date:** 4/18/2024  
**Project No.:** US0025840.9367  
**Subject:** Global Stability Analysis  
**Project Short** Phair Crossing Bridge Presque Isle, ME (WIN 026434.00)

**Made by:** JEF/DEB  
**Checked by:** ATM/LMP  
**Reviewed by:** CCB

4. For pseudo-static models, a horizontal seismic load of  $0.5 \times k_{av}$  was applied in the direction of the slope failure as per FHWA GEC-3 2011 (Ref. 8, Section 6.2.2). The value of  $k_{av}$  (height adjusted horizontal peak ground acceleration coefficient scaled by site class factor) was estimated in Ref. 7.
5. The water table elevation analyzed was estimated from subsurface conditions encountered during the subsurface exploration and engineering judgement (Ref. 1).
6. Ground surface elevations for the proposed final conditions were obtained from the Proposed Plans (Ref. 3).
7. Subsurface strata were assumed by plotting subsurface information from the nearest boring locations onto the cross-section and profile (Ref. 1 and 3).
8. STA 206+66 was selected for transverse stability analysis because it had the greatest depth of fill placed over the existing slopes.

### CALCULATION

**Analyze slope stability based on the proposed conditions shown in the Proposed Plans (Ref. 3) along the Route 10 centerline profile from STA. 203+50 to 207+00 and at the STA 206+66 transverse cross section.**

- a. The material properties selected for use in the Slide2 models are shown in the table below and in Attachment 1 figures (Figure 1).
- b. The design unit weight for the Fill (Granular Borrow) material was taken from Ref. 4 Table 3-3. The design unit weights for the other soil layers were determined using typical values, engineering judgement, and knowledge gained from previous experience.
- c. The friction angles for the in-situ soils were correlated to friction angles using Peck, Hanson, & Thornburn (1974) from Skempton (1986) and Peck (1974). The friction angle for the Fill (Granular Borrow) material was taken from Ref. 4 Table 3-3. The friction angles for the Riprap and Pavement layers were determined from engineering judgement and past experience.
- d. The soil layer properties shown below were used to analyze circular surfaces and non-circular surfaces using the Spencer method.

| Material Name                       | Unit Weight (pcf) | Strength Type     | Cohesion (psf) | Friction Angle (°) |
|-------------------------------------|-------------------|-------------------|----------------|--------------------|
| Pavement                            | 140               | Mohr-Coulomb      | 0              | 45                 |
| Historical Fill                     | 125               | Mohr-Coulomb      | 0              | 32                 |
| Fill (Granular Borrow) <sup>1</sup> | 125               | Mohr-Coulomb      | 0              | 32                 |
| Fill (Gravel Borrow) <sup>1</sup>   | 135               | Mohr-Coulomb      | 0              | 36                 |
| Riprap <sup>1</sup>                 | 140               | Mohr-Coulomb      | 0              | 42                 |
| Glacial Till                        | 130               | Mohr-Coulomb      | 0              | 35                 |
| Bedrock                             | 170               | Infinite Strength | -              | -                  |
| Concrete                            | 150               | Infinite Strength | -              | -                  |

1) Proposed material.



## CALCULATIONS

**Date:** 4/18/2024  
**Project No.:** US0025840.9367  
**Subject:** Global Stability Analysis  
**Project Short** Phair Crossing Bridge Presque Isle, ME (WIN 026434.00)

**Made by:** JEF/DEB  
**Checked by:** ATM/LMP  
**Reviewed by:** CCB

The results of the Slide2 stability analyses completed along the Route 10 profile between STA. 203+50 and STA. 207+00 for the proposed conditions are summarized in the following table. The circular stability runs were excluded from the table since the results were either equal to the non-circular failures, or resulted in a higher factor of safety than the non-circular failures. The presence of the existing substructure elements were not included in the global stability evaluations summarized below.

| Location                      | Surface Type                                                | Factor of Safety<br>(Foreslope) | Factor of Safety<br>(Global) | Figure #<br>(Attach. 1) | Condition                    |
|-------------------------------|-------------------------------------------------------------|---------------------------------|------------------------------|-------------------------|------------------------------|
| 203+50 to<br>207+00 (Profile) | Non-Circular Granular Borrow<br>(Abutment 1)                | 1.34                            | 1.41                         | 2A                      | Proposed profile<br>geometry |
|                               | Non-Circular Granular Borrow<br>(Abutment 2)                | 1.34                            | 1.46                         | 2B                      |                              |
|                               | Non-Circular, Granular Borrow<br>Pseudo-static (Abutment 1) | 1.17                            | -                            | 3A                      |                              |
|                               | Non-Circular, Granular Borrow<br>Pseudo-static (Abutment 2) | 1.17                            | -                            | 3B                      |                              |

Note: Pseudo-static failure surfaces met the minimum requirements of a FS of 1.1 or greater in the foreslope evaluation. Thus, additional global pseudo-static evaluations of potential failure surfaces below the abutment and approach slab were not explored.

The results of the Slide2 stability analyses completed at STA. 206+66 for the proposed conditions are summarized in the following table. The circular stability runs were excluded from the table since the results were either equal to the non-circular failures, or resulted in a higher factor of safety than the non-circular failures.

| Station          | Surface Type                                 | Factor of Safety | Factor of Safety - In Situ<br>Soil <sup>1</sup> | Figure #<br>(Attach. 1) | Condition                  |
|------------------|----------------------------------------------|------------------|-------------------------------------------------|-------------------------|----------------------------|
| 206+66 (Station) | Non-Circular (Left Slope)                    | 1.25             | 1.36                                            | 4A                      | Proposed slope<br>geometry |
|                  | Non-Circular (Right Slope)                   | 1.25             | 1.34                                            | 4B                      |                            |
|                  | Non-Circular, Pseudo-static (Left<br>Slope)  | 1.09             | 1.18                                            | 5A                      |                            |
|                  | Non-Circular, Pseudo-static (Right<br>Slope) | 1.09             | 1.19                                            | 5B                      |                            |

Note: <sup>1</sup>The FS values shown represent the lowest FS for failure surfaces through the Historical Fill and In-Situ soil layers.



## CALCULATIONS

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**Date:** 4/18/2024  
**Project No.:** US0025840.9367  
**Subject:** Global Stability Analysis  
**Project Short** Phair Crossing Bridge Presque Isle, ME (WIN 026434.00)

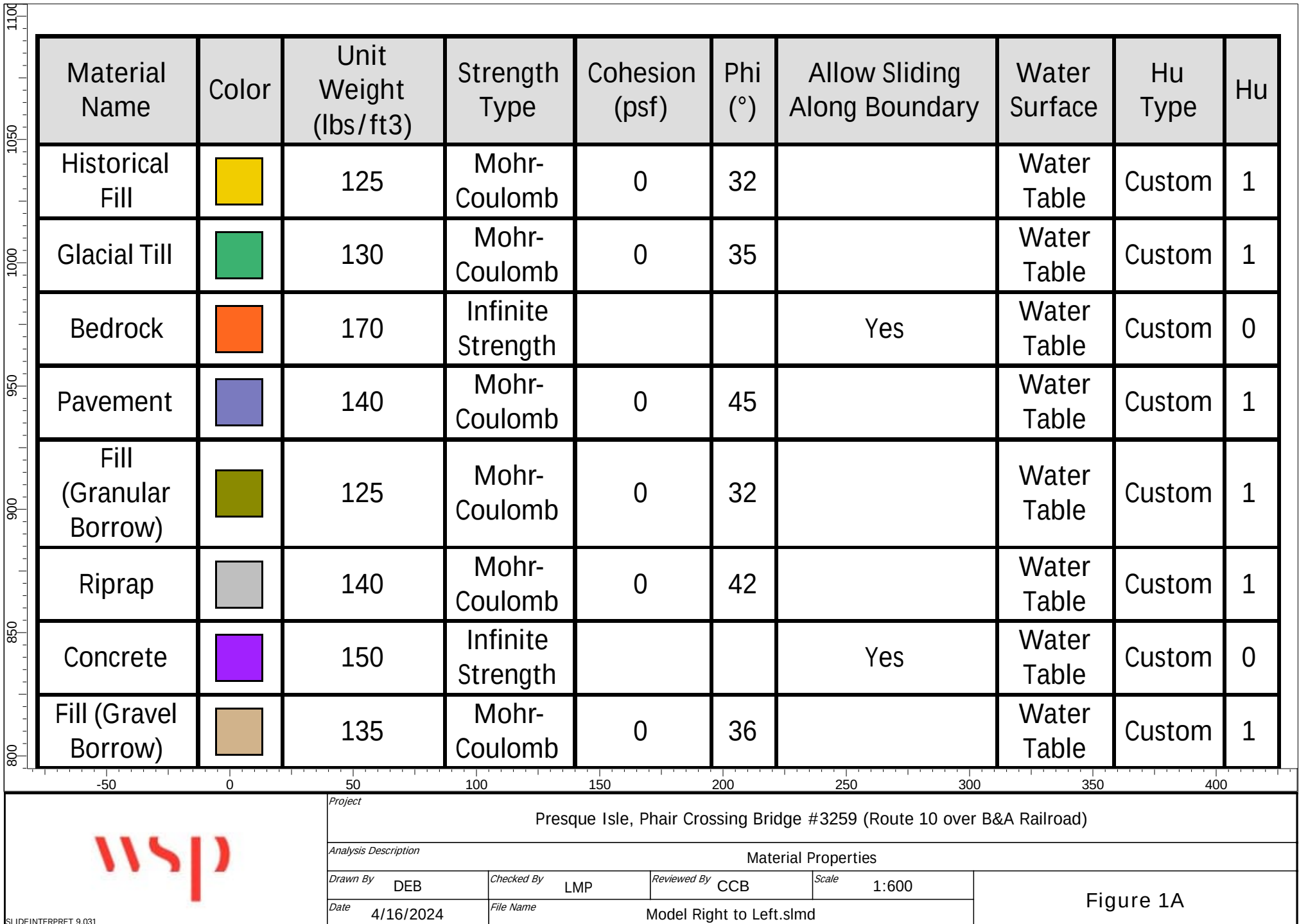
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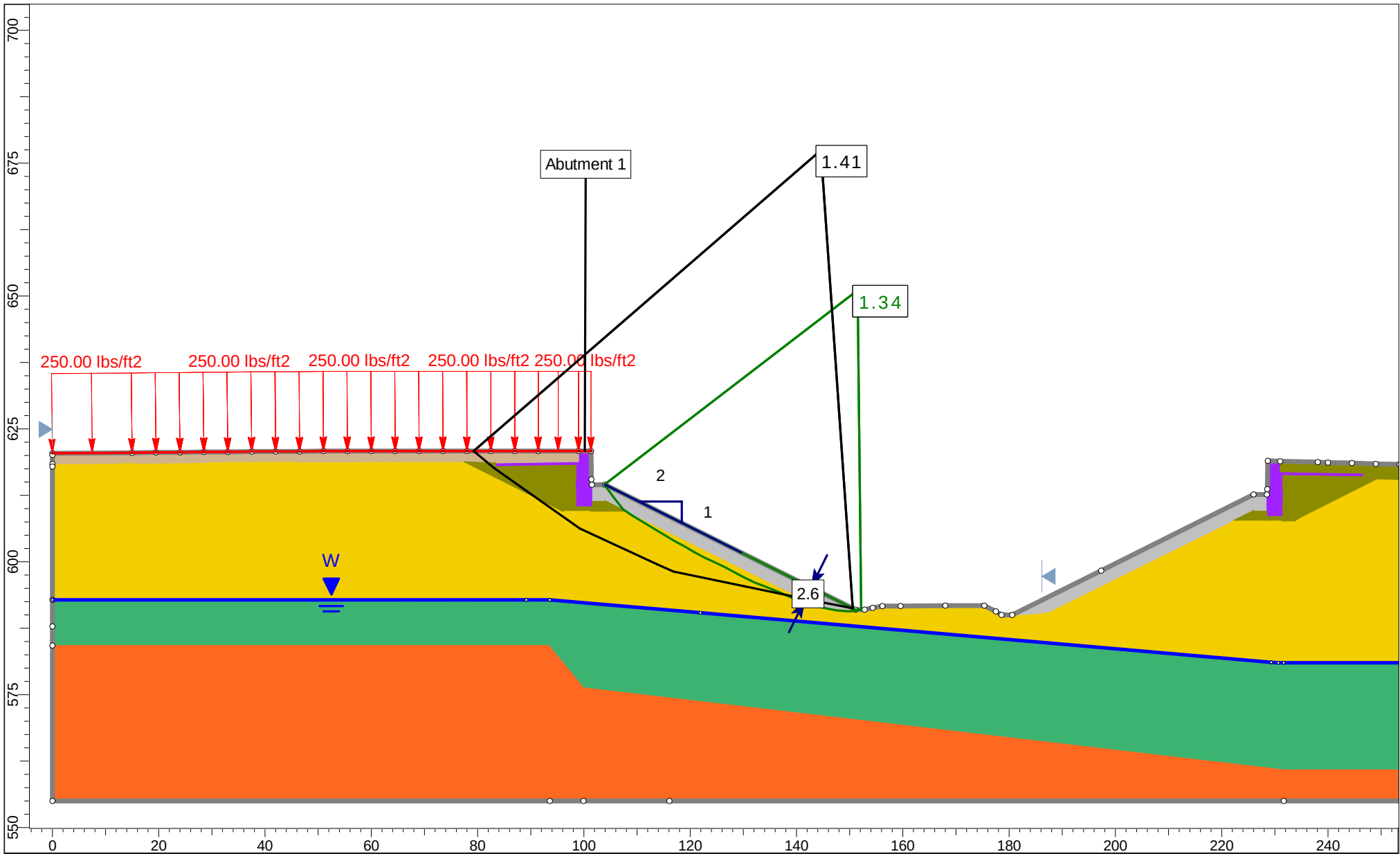
**Made by:** JEF/DEB  
**Checked by:** ATM/LMP  
**Reviewed by:** CCB

### Conclusions

1) The analyzed proposed site conditions along the Route 10 profile from STA. 203+50 to STA. 207+00 have a computed factor of safety that meets the requirements of FS of 1.3 or greater for non-circular potential slope failure surfaces at the abutment foreslopes, and potential slope failure surfaces under the proposed abutments. The proposed conditions meet the minimum FS of 1.1 or greater for pseudo-static conditions on the Abutment slopes.

2) The analyzed proposed site conditions at STA. 206+66 have a computed factor of safety that does not meet the requirement of FS of 1.3 or greater for non-circular potential slope failure surfaces on the left and right slopes. However, the failure surfaces are surficial (the failure surfaces are shallow and remain within the granular fill zone) and can be addressed with suitable slope treatments. The FS increases to greater than 1.3 for static conditions, and greater than 1.1 for pseudo-static conditions when the failure surfaces pass through the underlying historical fill.





Project

Presque Isle, Phair Crossing Bridge #3259 (Route 10 over B&A Railroad)

Analysis Description

Abutment - 1 Proposed Conditions - Granular Borrow (Non-Circular)

Drawn By

DEB

Checked By

LMP

Reviewed By

CCB

Scale

1:300

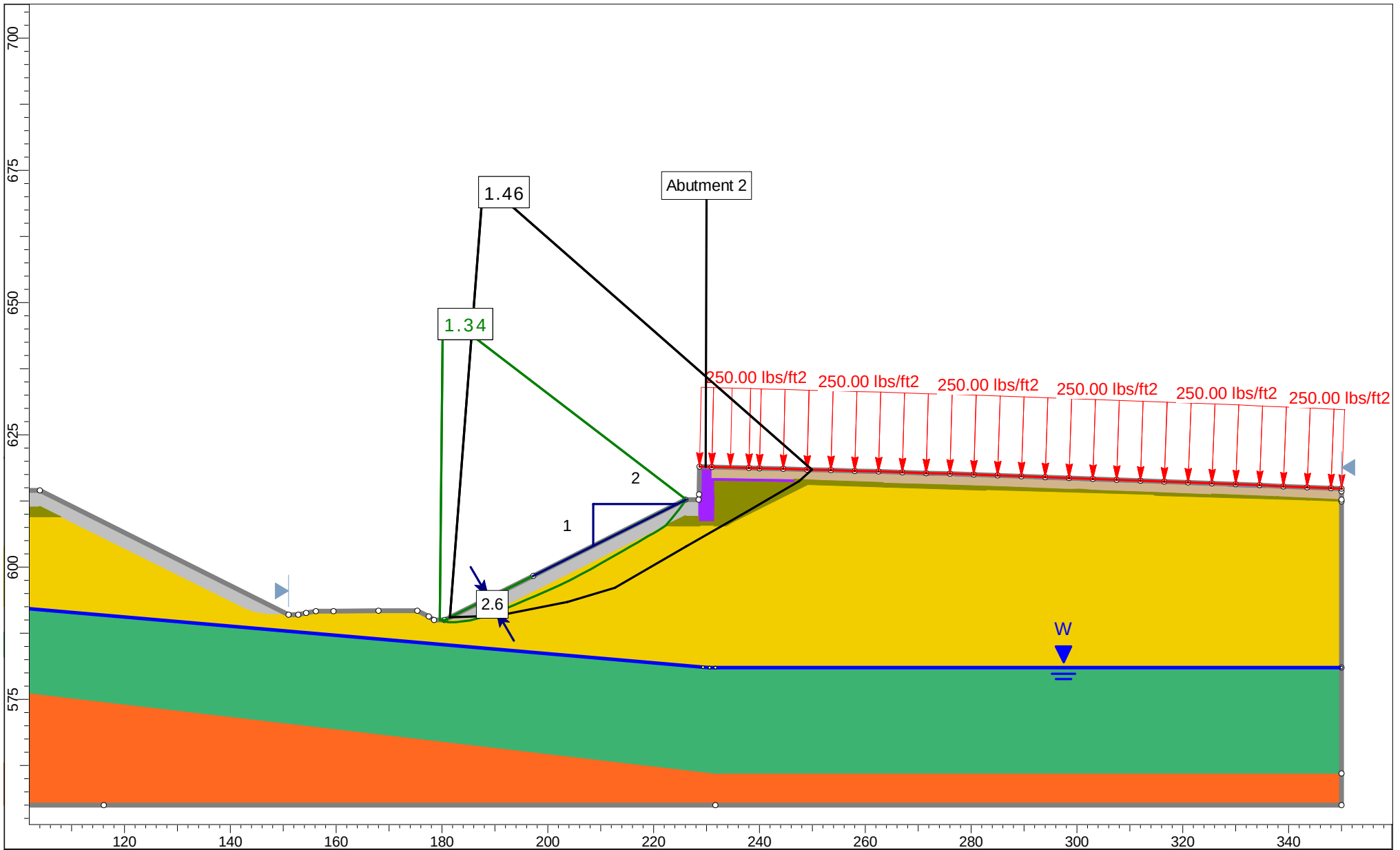
Date

4/17/2024

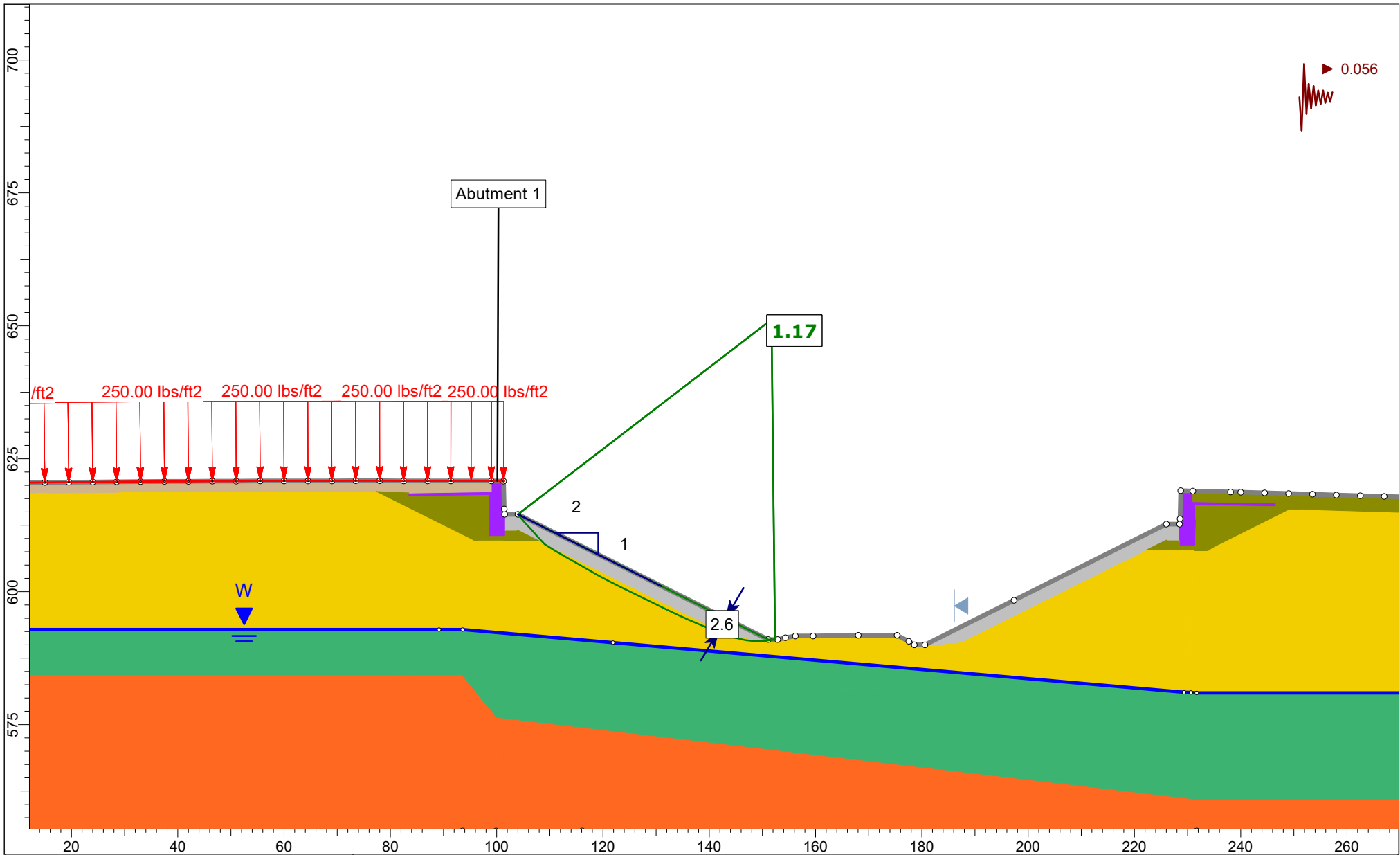
File Name

Model Left to Right (1).slmd

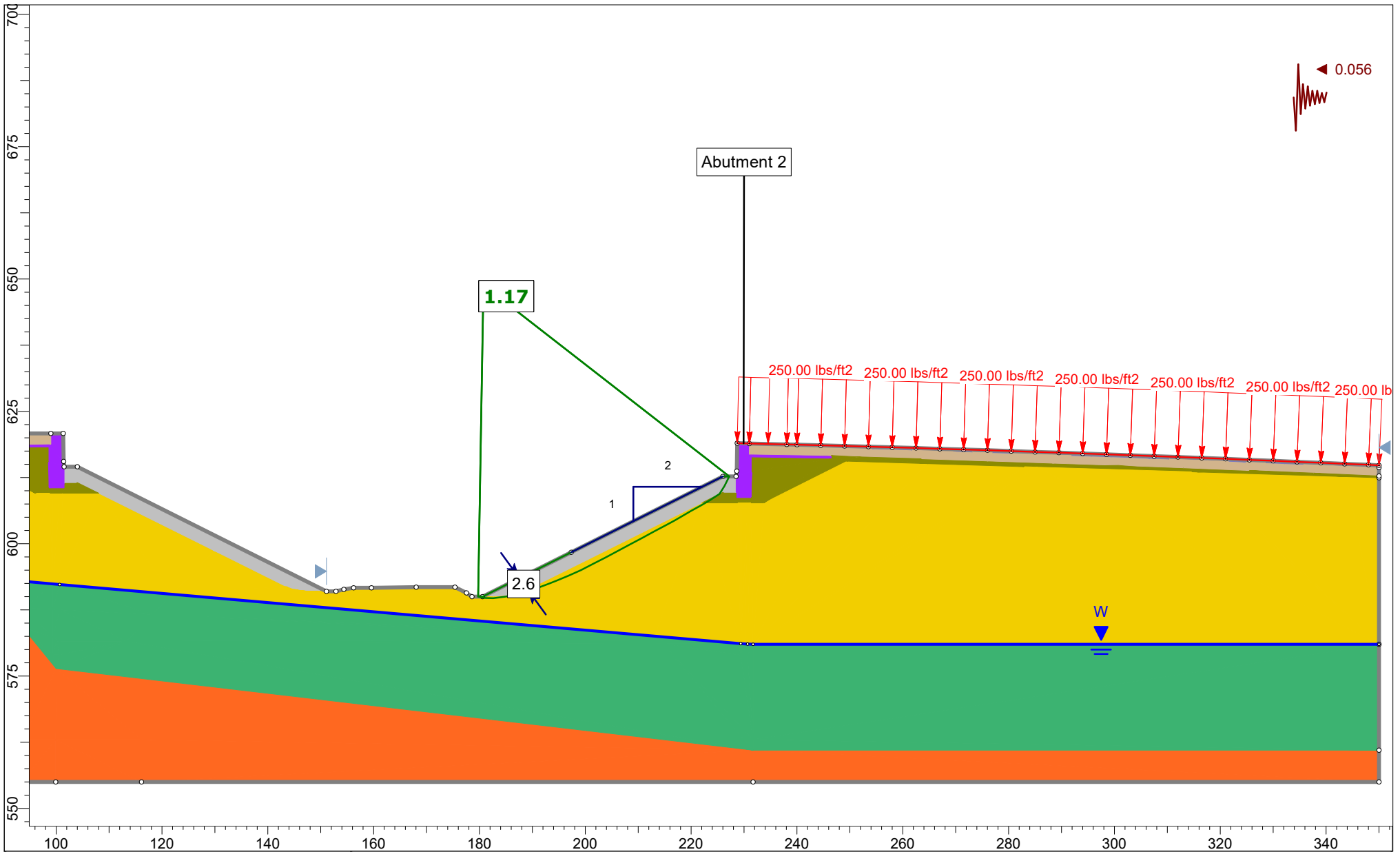
Figure 2A



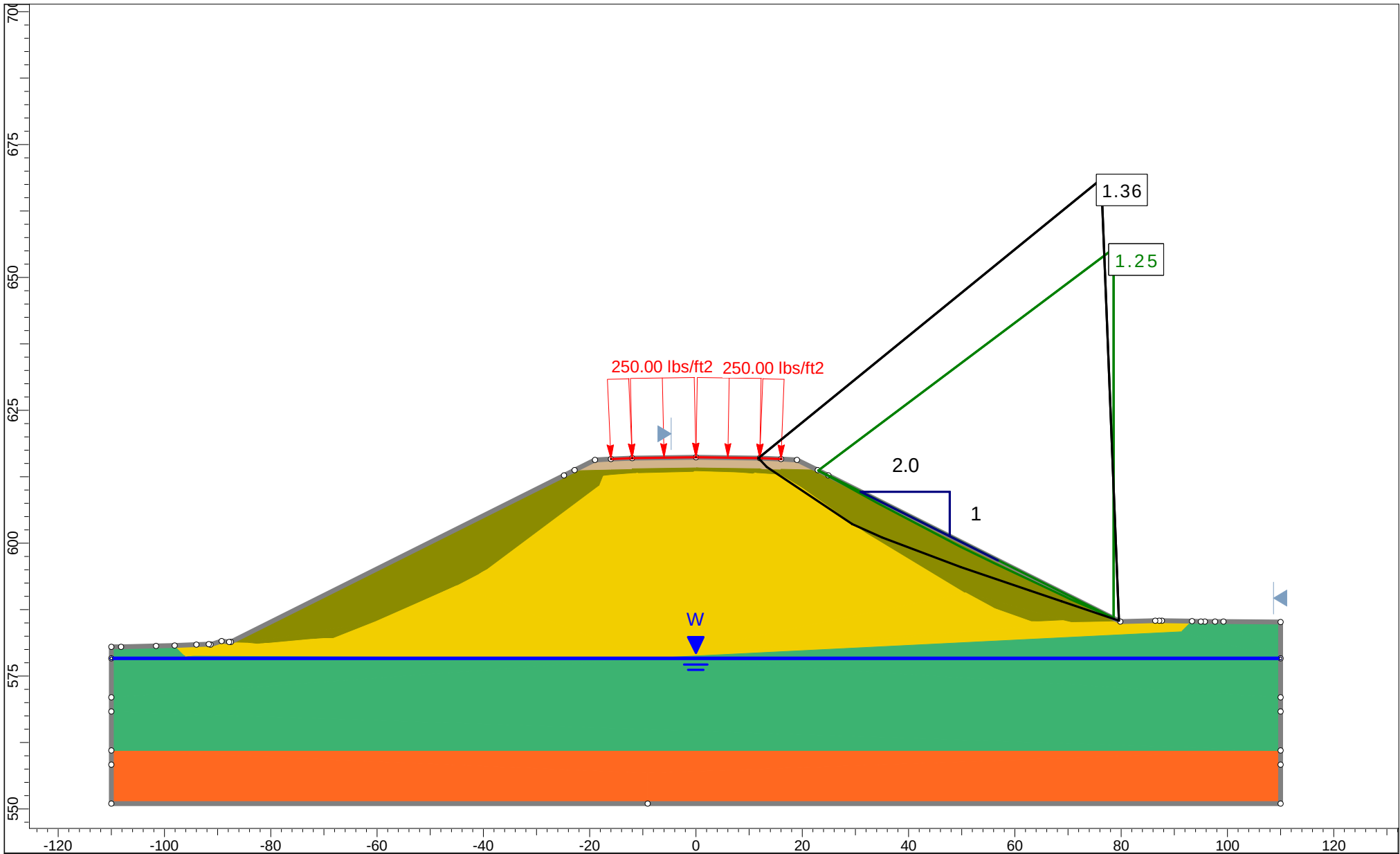
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|------------------------------------------------------------------------|-----------|------------|--------------------------|-------------|-----------|
| Project                                                                |           |            |                          |             |           |
| Presque Isle, Phair Crossing Bridge #3259 (Route 10 over B&A Railroad) |           |            |                          |             |           |
| Analysis Description                                                   |           |            |                          |             |           |
| Abutment 2 - Proposed Conditions - Granular Borrow (Non-Circular)      |           |            |                          |             |           |
| Drawn By                                                               | DEB       | Checked By | LMP                      | Reviewed By | CCB       |
| Date                                                                   | 4/16/2024 | File Name  | Model Right to Left.slmd |             |           |
| Scale                                                                  |           |            |                          |             | 1:300     |
|                                                                        |           |            |                          |             | Figure 2B |



|                      |          |                                                                        |                                  |             |           |
|----------------------|----------|------------------------------------------------------------------------|----------------------------------|-------------|-----------|
| Project              |          | Presque Isle, Phair Crossing Bridge #3259 (Route 10 over B&A Railroad) |                                  |             |           |
| Analysis Description |          | Abutment - 1 - Proposed Conditions (Pseudostatic Non-Circular)         |                                  |             |           |
| Drawn By             | DEB      | Checked By                                                             | LMP                              | Reviewed By | CCB       |
| Date                 | 7/9/2024 | File Name                                                              | Model Left to Right (1) (1).slmd |             |           |
|                      |          |                                                                        |                                  |             | Figure 3A |



|                                                                        |          |            |                              |             |                  |
|------------------------------------------------------------------------|----------|------------|------------------------------|-------------|------------------|
| Project                                                                |          |            |                              |             |                  |
| Presque Isle, Phair Crossing Bridge #3259 (Route 10 over B&A Railroad) |          |            |                              |             |                  |
| Analysis Description                                                   |          |            |                              |             |                  |
| Abutment - 2 - Proposed Conditions (Pseudostatic Non-Circular)         |          |            |                              |             |                  |
| Drawn By                                                               | DEB      | Checked By | LMP                          | Reviewed By | CCB              |
| Date                                                                   | 7/9/2024 | File Name  | Model Right to Left (1).slmd |             |                  |
| Scale                                                                  |          |            |                              |             | 1:300            |
|                                                                        |          |            |                              |             | <b>Figure 3B</b> |



Project

Presque Isle, Phair Crossing Bridge #3259 (Route 10 over B&A Railroad)

Analysis Description

Station 206+66 Left - Proposed Conditions (Non-Circular)

Drawn By

DEB

Checked By

LMP

Reviewed By

CCB

Scale

1:300

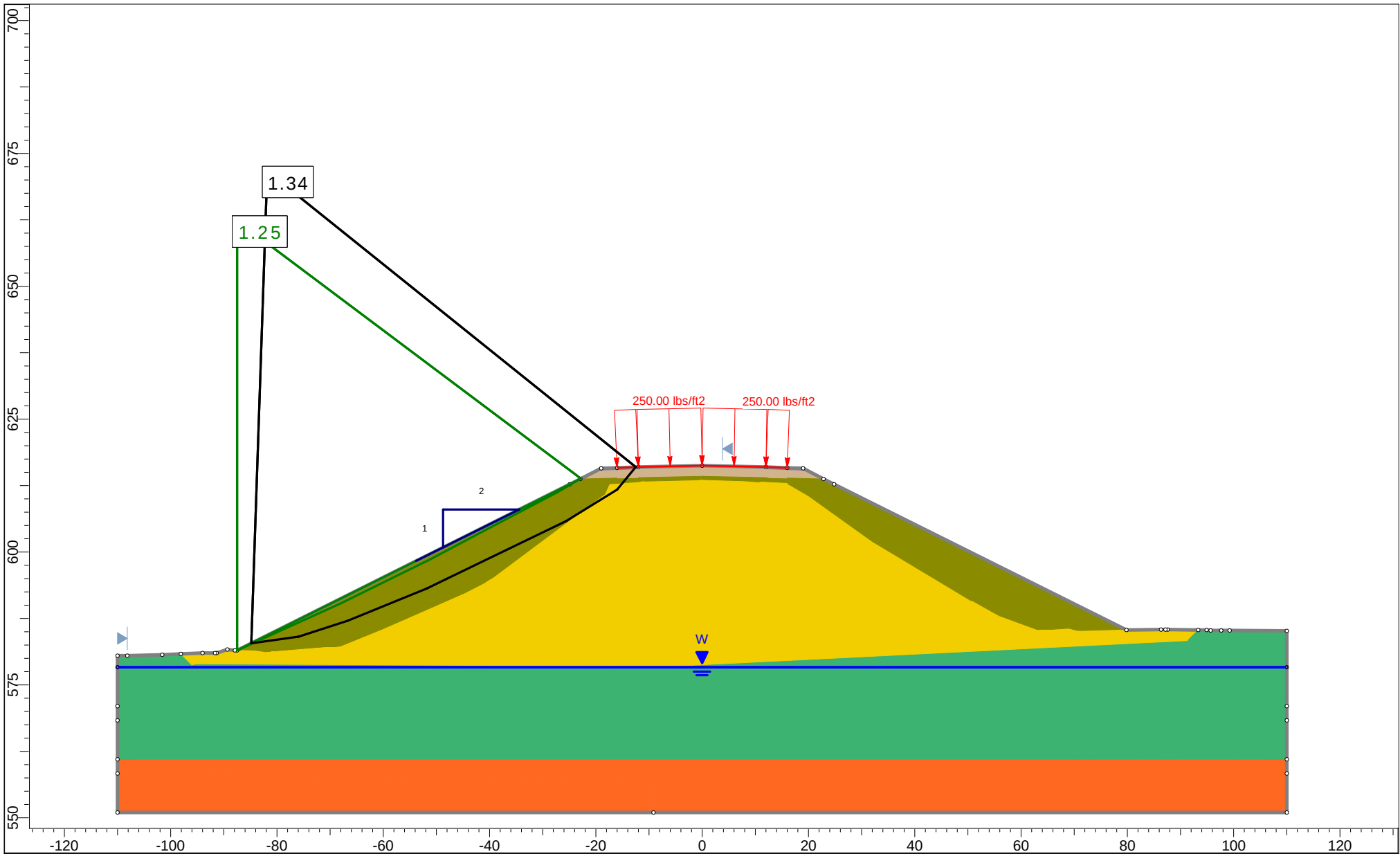
Date

4/17/2024

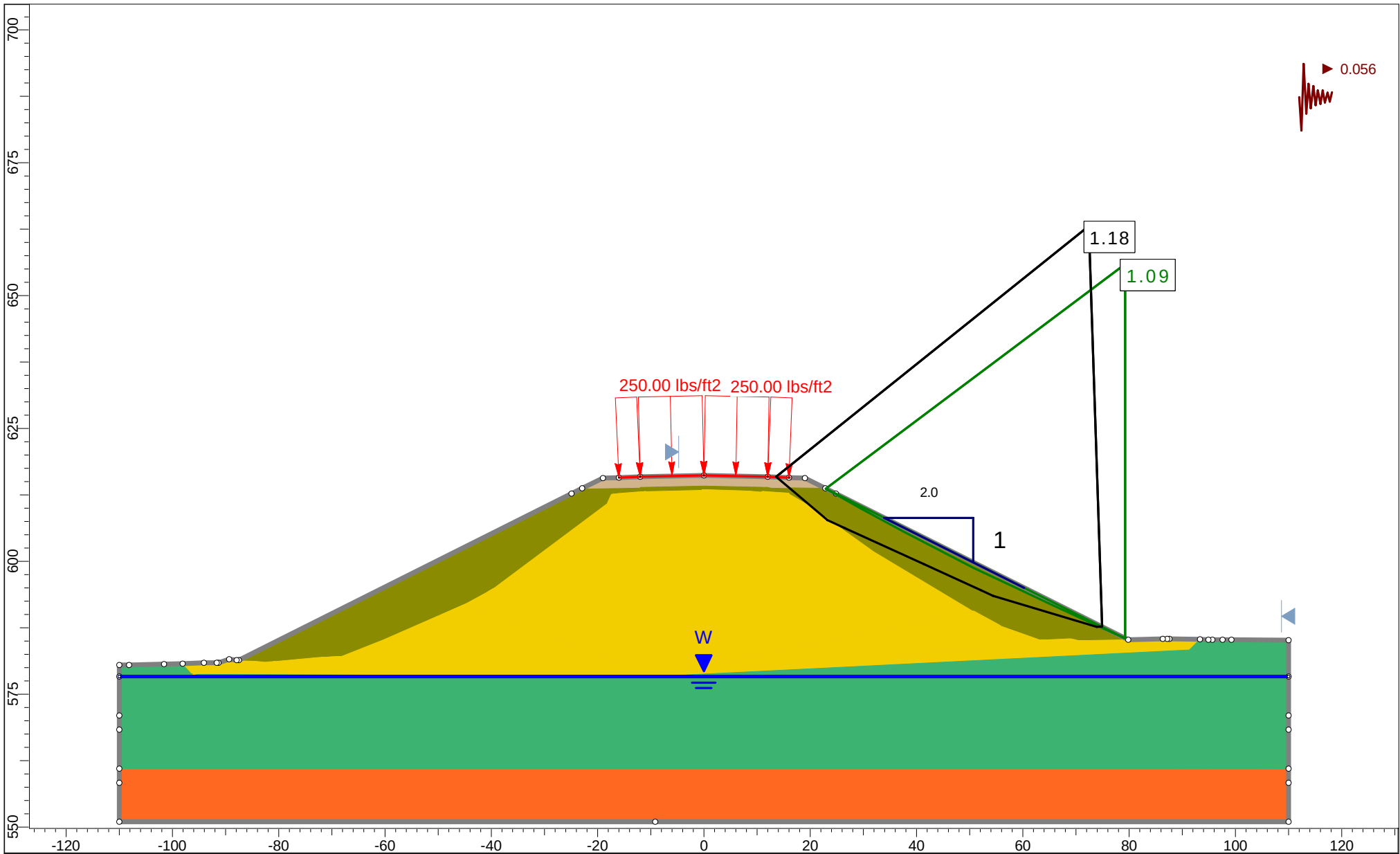
File Name

Model Left to Right (1).slmd

Figure 4A



|                      |  |           |  |            |                                                                        |                          |  |             |  |     |  |       |  |       |  |           |
|----------------------|--|-----------|--|------------|------------------------------------------------------------------------|--------------------------|--|-------------|--|-----|--|-------|--|-------|--|-----------|
| Project              |  |           |  |            | Presque Isle, Phair Crossing Bridge #3259 (Route 10 over B&A Railroad) |                          |  |             |  |     |  |       |  |       |  |           |
| Analysis Description |  |           |  |            | Station 206+66 Right - Proposed Conditions - (Non-Circular)            |                          |  |             |  |     |  |       |  |       |  |           |
| Drawn By             |  | DEB       |  | Checked By |                                                                        | LMP                      |  | Reviewed By |  | CCB |  | Scale |  | 1:300 |  | Figure 4B |
| Date                 |  | 4/16/2024 |  | File Name  |                                                                        | Model Right to Left.slmd |  |             |  |     |  |       |  |       |  |           |



Project

Presque Isle, Phair Crossing Bridge #3259 (Route 10 over B&A Railroad)

Analysis Description

Station 206+66 Left - Proposed Conditions (Pseudostatic Non-Circular)

Drawn By

DEB

Checked By

LMP

Reviewed By

CCB

Scale

1:300

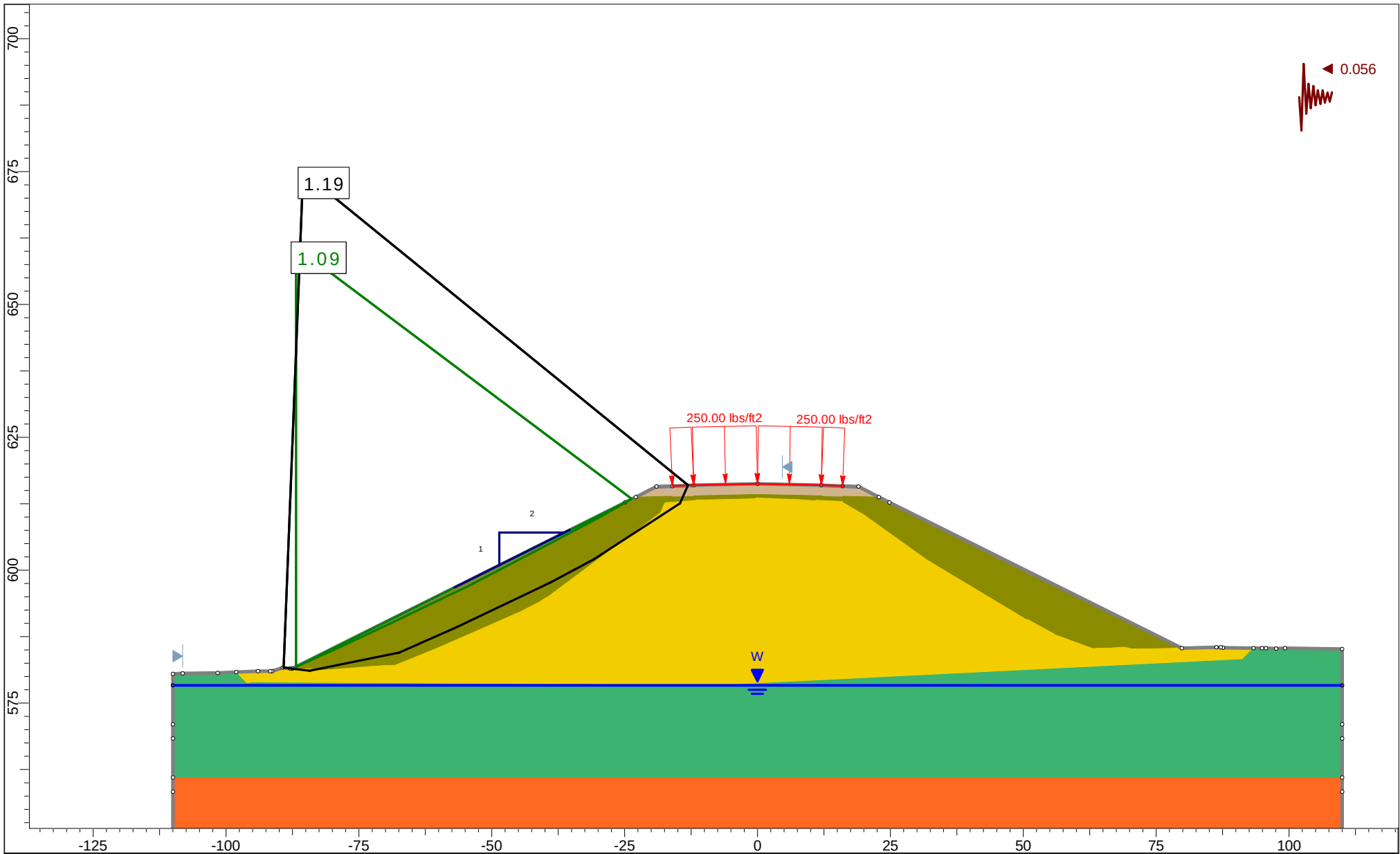
Date

4/17/2024

File Name

Model Left to Right (1).slmd

Figure 5A



Project

Presque Isle, Phair Crossing Bridge #3259 (Route 10 over B&A Railroad)

Analysis Description

Station 206+66 Right - Proposed Conditions - (Pseudostatic Non-Circular)

Drawn By

DEB

Checked By

LMP

Reviewed By

CCB

Scale

1:300

Date

4/16/2024

File Name

Model Right to Left.slmd

Figure 5B



## CALCULATIONS

**Date:** 8/14/2025  
**Project No.:** US0025840.9367 / WIN 026434.00  
**Subject:** Lateral Earth Pressure at Abutments 1 and 2  
**Project Title:** MaineDOT Phair Crossing Presque Isle, ME

**Made by:** LDN  
**Checked by:** RJN  
**Reviewed by:** MEL

### OBJECTIVE

Determine lateral earth pressures acting on the proposed Abutment 1 (West) and Abutment 2 (East)

### REFERENCES

1. Guertin Elkerton & Associates for Maine Department of Transportation. Bridge Design Guide. Dated August 2003 with 2018 updates.
2. AASHTO LRFD Bridge Design Specifications, 9th Ed. 2020.
3. Email from HNTB Corporation to WSP, Subject: WIN 026434.00 Presque Isle - Bridge Movement and Pile Loading and 60% Plans, Received on Monday May 12th, 2025
4. State of Maine Department of Transportation, Presque Isle, Aroostook County, Phair Crossing Bridge over Maine Northern Railway, State Route 10/Easton Road (Sheets 1 - 37), 60% Plans Prepared by HNTB, dated May 2nd, 2025.
5. MassDOT Highway Division. LRFD Bridge Manual - Part I, January 2020 Revision. Chapter 3: Bridge Design Guidelines. <https://www.mass.gov/info-details/part-i-design-guidelines>
6. Das, Braja M. 2011. Principles of Foundation Engineering, 7th ed. Cengage Learning, Stamford, CT.

### ASSUMPTIONS

1. The backfill surface behind each abutment is assumed to be horizontal.
2. The backfill is assumed to be free draining (i.e., no water pressure is allowed to build up behind the abutment wall).

### CALCULATION

#### 1. Calculate expected wall rotation for the integral abutment to select earth pressure case.

Per the MaineDOT Bridge Design Guide Section 5.4.2.11 (Ref. 1), integral abutments should be designed for the passive earth pressure ( $P_p$ ) which results on the back face of the wall when the bridge expands.

Per AASHTO LRFD Table C3.11.1-1 (Ref. 2), in order to develop full passive earth pressure, wall rotation (the ratio of lateral abutment movement to abutment height) must exceed 0.02 for a medium dense cohesionless backfill such as the proposed foamed glass aggregate abutment backfill.

**Table C3.11.1-1—Approximate Values of Relative Movements Required to Reach Active or Passive Earth Pressure Conditions (Clough and Duncan, 1991)**

| Type of Backfill    | Values of $\Delta/H$ |         |
|---------------------|----------------------|---------|
|                     | Active               | Passive |
| Dense sand          | 0.001                | 0.01    |
| Medium dense sand   | 0.002                | 0.02    |
| Loose sand          | 0.004                | 0.04    |
| Compacted silt      | 0.002                | 0.02    |
| Compacted lean clay | 0.010                | 0.05    |
| Compacted fat clay  | 0.010                | 0.05    |

Maximum thermal expansion movement = 0.46 inches = 0.04 feet (Ref. 3)

Abutment 1 height = 9.1 feet (Ref. 4 Sheet 06, measured from the bottom of the approach slab to the bottom of the pile cap as per Ref. 1 Section 5.4.2.11)

Abutment 2 height = 8.1 feet

Maximum wall rotation, Abutment 1 = 0.004

Maximum wall rotation, Abutment 2 = 0.005

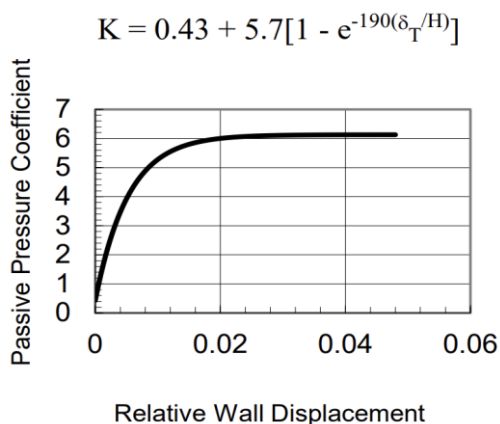
Since the anticipated wall rotation does not exceed 0.02, full passive earth pressure is not expected to develop. The magnitude of partial earth pressure will be calculated using the procedure in the MassDOT LRFD Bridge Manual Section 3.10.8 (Ref. 5).

**Date:** 8/14/2025  
**Project No.:** US0025840.9367 / WIN 026434.00  
**Subject:** Lateral Earth Pressure at Abutments 1 and 2  
**Project Title:** MaineDOT Phair Crossing Presque Isle, ME

**Made by:** LDN  
**Checked by:** RJN  
**Reviewed by:** MEL

## 2. Calculate the movement-dependent passive earth pressure coefficient for conditions between full passive and at-rest earth pressure.

Ref. 5, Figure 3.10.8-1: Plot of Passive Pressure Coefficient,  $K$ , vs. Relative Wall Displacement,  $\delta_r/H$



Abutment 1:  
 $\delta_r/H = 0.004$  (from Step 1)  
 $K = 3.57$  (Ref. 5, Fig. 3.10.8-1)

Abutment 2:  
 $\delta_r/H = 0.005$  (from Step 1)  
 $K = 3.81$  (Ref. 5, Fig. 3.10.8-1)

## 3. Calculate the full passive earth pressure coefficient using Rankine theory for comparison with MassDOT $K_p$ .

$K_p = \tan^2 \left( 45^\circ + \frac{\phi}{2} \right)$  (Ref. 6, Eqn. 13.22)

where:

$\phi$  internal friction angle of backfill = 32 degrees (MaineDOT Granular Borrow Ref. 1 Table 3-3)  
 $K_p = 3.25$

Since the MassDOT procedure produces a passive earth pressure greater than Rankine theory for passive earth pressure, the passive earth pressure will be used in design per MaineDOT.

## 4. Determine the unfactored passive pressure $P_p$ acting on the abutments.

$$P_p = \frac{1}{2} \cdot \gamma_{\text{soil}} \cdot H_{\text{abut}}^2 \cdot k_p \quad (\text{Ref. 1, page 5-51})$$

where:

$\gamma_{\text{soil}}$  = unit weight of backfill = 125 pcf (MaineDOT Granular Borrow Ref.1 Table 3-3)  
 $H_{\text{abut 1}}$  = height of the abutment backwall = 9.1 feet (Ref. 4)  
 $k_p$  = passive earth pressure coefficient = 3.57 (from Step 2)

$$P_p = 18,476 \text{ lbs per foot of abutment width}$$

$\gamma_{\text{soil}}$  = unit weight of backfill = 125 pcf (MaineDOT Granular Borrow Ref.1 Table 3-3)  
 $H_{\text{abut 2}}$  = height of the abutment backwall = 8.1 feet (Ref. 4)  
 $k_p$  = passive earth pressure coefficient = 3.81 (from Step 2)

$$P_p = 15,626 \text{ lbs per foot of abutment width}$$

The resultant lateral earth load acts at a height of  $H/3$  above the base of the wall.

Based on Ref. 4, the base of the proposed Abutment 1 will be at elevation 610.0 feet and the base of the proposed Abutment 2 will be at elevation 608.0 feet.

For Abutment 1, the load acts at: 613.0 feet elevation  
 For Abutment 2, the load acts at: 610.7 feet elevation



## CALCULATIONS

**Date:** 8/14/2025  
**Project No.:** US0025840.9367 / WIN 026434.00  
**Subject:** Lateral Earth Pressure at Abutments 1 and 2  
**Project Title:** MaineDOT Phair Crossing Presque Isle, ME

**Made by:** LDN  
**Checked by:** RJN  
**Reviewed by:** MEL

### 5. Calculate Rankine active earth pressure coefficient.

$$K_a = \tan^2 \left( 45^\circ - \frac{\phi}{2} \right) \quad (\text{Ref. 1, page 3-7})$$

for horizontal backfill surface, where:

$$\begin{aligned} \phi = \text{internal friction angle of backfill} &= 32 \text{ degrees} \quad (\text{MaineDOT Granular Borrow Ref. 1 Table 3-3}) \\ K_a &= 0.31 \end{aligned}$$

### 6. Calculate the at-rest lateral earth pressure coefficient.

$$K_0 = 1 - \sin \phi \quad (\text{Ref. 6, Eqn. 7.4}) \quad \text{For normally consolidated soils}$$

where:

$$\begin{aligned} \phi \text{ internal friction angle of backfill} &= 32 \text{ degrees} \quad (\text{MaineDOT Granular Borrow Ref. 1 Table 3-3}) \\ K_0 &= 0.47 \end{aligned}$$

## CONCLUSION

With the wall geometry and thermal lateral movement provided by HNTB, the calculated rotation is less than that required to develop full passive earth pressure. Thus the MassDOT method was used to determine the partial passive earth pressure. For the recommended soil parameters and given wall geometry, the partial passive earth pressure coefficient is  $K_p = 3.57$ , which corresponds to an unfactored passive earth force of  $P_p = 18,476$  pounds per linear foot acting at elevation 613.0 feet on Abutment No. 1. The partial passive earth pressure coefficient is  $K_p = 3.81$ , which corresponds to an unfactored passive earth force of  $P_p = 15,626$  pounds per linear foot acting at elevation 610.7 feet on Abutment No. 2. The Rankine method was used to determine the active earth pressure coefficient of  $K_a = 0.31$  and the at-rest lateral earth pressure coefficient of  $K_0 = 0.47$  for granular borrow backfill.



## CALCULATIONS

**Date:** 7/22/2025  
**Project No.:** US0025840.9367  
**Subject:** HP14x89 Pile Design at Proposed Abutment 1  
**Project Title:** Phair Crossing Bridge Presque Isle, ME (WIN 026434.00)

**Made by:** DEB  
**Checked by:** KAR  
**Reviewed by:** CCB

### OBJECTIVE

Determine if the proposed HP14x89 piles will provide adequate support for Abutment 1 based on the anticipated thermal movement and final design loads.

### METHOD

Use the procedure outlined in AASHTO LRFD (Ref. 1) and the design method provided in the MaineDOT Bridge Design Guide (Ref. 2).

### REFERENCES

1. AASHTO LRFD Bridge Design Specifications, 9th Ed. 2020.
2. Guertin Elkerton & Associates for Maine Department of Transportation. Bridge Design Guide. Dated August 2003 with 2018 updates.
3. Maine Department of Transportation, Bridge Program. 60% Plans, dated May 2, 2025: Phair Crossing Bridge #3259 over Maine Northern Railway, Presque Isle, Maine, WIN 026434.00.
4. WSP Interpretive Subsurface Profile A-A', included as Sheet 2 of the Preliminary Geotechnical Design Report.
5. Final loads and movements provided by HNTB via email on 5/12/2025.
6. AISC Shapes Database v15.0. November 2017. <https://www.aisc.org/globalassets/aisc/manual/v15.0-shapes-database/aisc-shapes-database-v15.0.xlsx>
7. WSP Boring Logs, included as Appendix A of the Preliminary Geotechnical Design Report.
8. WSP Material Properties 31407448.000 Phair Crossing.xlsx
9. Bridge Software Institute. FB-MultiPier Soil Parameter Table (US Customary Units). Accessed February 2023. [https://bsi.ce.ufl.edu/downloads/files/MultiPier\\_Soil\\_Table.pdf](https://bsi.ce.ufl.edu/downloads/files/MultiPier_Soil_Table.pdf)
10. VTrans Structures Section, Integral Abutment Committee. 2008. Integral Abutment Bridge Design Guidelines, 2nd Ed.
11. AISC Steel Construction Manual, 14th Ed. 2011.
12. FHWA. July 2016. GEC-012: Design and Construction of Driven Pile Foundations, Volume 1. Publication No. FHWA-NHI-16-009.
13. FHWA. September 2018. GEC-010: Drilled Shafts: Construction Procedures and Design Methods. Publication No. FHWA-NHI 18-024.

### ASSUMPTIONS

1. The proposed abutment is assumed to be supported on five HP14x89 Grade 50 piles with a center-to-center pile spacing of 9.75 feet, Ref. 3, sheet 25 of 38 Abutment No. 1. The piles are assumed to be driven to bedrock and thus end-bearing.
2. The selected pile orientation is weak axis bending (Ref. 2, page 5-42).
3. The vertical load is assumed to be evenly distributed.
4. The soil profile used in the analysis is based on Ref. 4 at the centerline of the proposed Abutment 1.
5. An UCS for rock of 7,000 psi is assumed based on a field characterization of R3 (Medium Strong Rock) to R4 (Strong Rock) from Ref. 7.
6. Section loss due to corrosion not considered.
7. Depth to fixity for deflection taken as the depth along the pile to the point of zero lateral deflection; zero deflection assumed to be deflection values less than 0.001 inches (Ref. 2 section 5.4.2.5). Depth to fixity for bending moment taken as the depth along the pile where the bending moment is less than 5% of the maximum bending moment (Ref. 13 page 12-19).
8. The piles are modeled in L-Pile as a fixed connection at the top of the pile.



## CALCULATIONS

**Date:** 7/22/2025  
**Project No.:** US0025840.9367  
**Subject:** HP14x89 Pile Design at Proposed Abutment 1  
**Project Title:** Phair Crossing Bridge Presque Isle, ME (WIN 026434.00)

**Made by:** DEB  
**Checked by:** KAR  
**Reviewed by:** CCB

### ATTACHMENTS

1. LPile analysis output for Strength I

### CALCULATION

#### 1. Select the pile section parameters.

|                                                   | Intact<br>Section<br>(Ref. 6) |                 |
|---------------------------------------------------|-------------------------------|-----------------|
| Pile depth, $d$ =                                 | 13.8                          | inches          |
| Pile width, $b_f$ =                               | 14.7                          | inches          |
| Web thickness, $t_w$ =                            | 0.615                         | inches          |
| Flange thickness, $t_f$ =                         | 0.615                         | inches          |
| Fillet area =                                     | 0.3                           | in <sup>2</sup> |
| Section area =                                    | 26.1                          | in <sup>2</sup> |
| Moment of inertia about the x-axis, $I_x$ =       | 888                           | in <sup>4</sup> |
| Moment of inertia about the y-axis, $I_y$ =       | 326                           | in <sup>4</sup> |
| Radius of gyration about the x-axis, $r_x$ =      | 5.83                          | in              |
| Radius of gyration about the y-axis, $r_y$ =      | 3.53                          | in              |
| Elastic section modulus about the x-axis, $S_x$ = | 129                           | in <sup>3</sup> |
| Elastic section modulus about the y-axis, $S_y$ = | 44.3                          | in <sup>3</sup> |
| Plastic section modulus about the x-axis, $Z_x$ = | 143                           | in <sup>3</sup> |
| Plastic section modulus about the y-axis, $Z_y$ = | 67.6                          | in <sup>3</sup> |

#### 2. Determine pile loads and select the preliminary pile size.

Determine the factored substructure vertical dead and live load ( $P_u$ ) distributed to each pile.

Strength I factored vertical  
load per pile = 389 kips (Ref. 5)

Pile weight = 0.089 kip/ft x 25.7 ft = 2.3 kips

$P_u$  = 391 kips (Total factored axial load including pile weight)

Select the steel pile strength.

$F_y$  = 50 ksi (Assumption 1)  
 $E$  = 29,000 ksi (typical value for steel)

Determine resistance factors ( $\Phi_c$  and  $\Phi_t$ ) for the structural strength in the upper and lower zones of the pile.

$\Phi_{cl}$  = 0.50 for axial resistance in the lower zone of the pile (Ref. 2, page 5-41)  
 $\Phi_{cu}$  = 0.70 for axial resistance in the upper zone of the pile under combined axial and flexural loading (Ref. 2, page 5-42)  
 $\Phi_f$  = 1.00 for flexural resistance in the upper zone of the pile under combined axial and flexural loading (Ref. 2, page 5-42)

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**Made by:** DEB  
**Checked by:** KAR  
**Reviewed by:** CCB

Determine the maximum required nominal axial pile resistance (Ref. 1, Article 6.9.2.1).

$$R_{n,upper} = \frac{P_u}{\phi_{cu}}$$

$$R_{n,upper} = 559 \text{ kips}$$

$$R_{n,lower} = \frac{P_u}{\phi_{cl}}$$

$$R_{n,lower} = 783 \text{ kips}$$

$$R_n = \max(R_{n,upper}, R_{n,lower})$$

$$R_n = 783 \text{ kips}$$

Use the required nominal axial pile resistance to estimate an approximate initial pile area.

$$A_{s,req} = \frac{R_n}{0.80 F_y} \quad (\text{Ref. 2, page 5-42})$$

$$A_{s,req} = 19.6 \text{ in}^2$$

Select a pile size with an area of approximately  $A_{s,req}$ .

Intact HP 14x89 section as per Assumption 1 and Step 1:

$$A_s = 26.1 \text{ in}^2 \quad (\text{Step 1})$$

## 3. Use LPILE analysis to determine the pile unbraced length and maximum moment at the top of the pile.

The following input parameters were used in the LPILE analysis:

### Pile Properties

|                                  |                      |                                                       |
|----------------------------------|----------------------|-------------------------------------------------------|
| Section type:                    | Steel H Section      | (Assumption 2)                                        |
|                                  | Weak Axis            |                                                       |
| Length of section:               | 25.7 ft              | (piles driven to bedrock)                             |
| Flange width, $b_f$ :            | 14.7 in              | (Step 1)                                              |
| Section depth, $d$ :             | 13.8 in              | (Step 1)                                              |
| Flange thickness, $t_f$ :        | 0.615 in             | (Step 1)                                              |
| Web thickness, $t_w$ :           | 0.615 in             | (Step 1)                                              |
| Moment of inertia, $I_y$ :       | 326 in <sup>4</sup>  | (Step 1) about the weak axis, since weak-axis bending |
| Plastic section modulus, $Z_y$ : | 67.6 in <sup>3</sup> | (Step 1) about the weak axis, since weak-axis bending |
| Elastic section modulus, $S_y$ : | 44.3 in <sup>3</sup> | (Step 1) about the weak axis, since weak-axis bending |
| Radius of gyration, $r_y$ :      | 3.53 in              | (Step 1) about the weak axis, since weak-axis bending |
| Pile batter:                     | Vertical             | (pile battering not required)                         |



## CALCULATIONS

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**Subject:** HP14x89 Pile Design at Proposed Abutment 1  
**Project Title:** Phair Crossing Bridge Presque Isle, ME (WIN 026434.00)

**Made by:** DEB  
**Checked by:** KAR  
**Reviewed by:** CCB

### Pile Loading

Lateral deflection due to abutment thermal expansion or contraction: 0.55 in (Ref. 5)  
 Axial load: 391,000 lbs (from Step 2)

### Soil Layers

| Layer           | Depth below base of abutment <sup>1</sup> | Lateral Model                 | Effective Unit Weight (pcf) <sup>2</sup> | Undrained Shear Strength (psf) <sup>2</sup> | Friction Angle (°) <sup>2</sup> | Subgrade Modulus (pci) <sup>3</sup> | Major Principal Strain at 50% <sup>3</sup> | UCS (psi) <sup>4</sup> |
|-----------------|-------------------------------------------|-------------------------------|------------------------------------------|---------------------------------------------|---------------------------------|-------------------------------------|--------------------------------------------|------------------------|
| Granular Borrow | 0.0 - 1.0 ft                              | Sand (Reese)                  | 125                                      | -                                           | 32                              | 88.3                                | -                                          | -                      |
| Fill            | 1.0 - 22.7 ft                             | Sand (Reese)                  | 125                                      | -                                           | 32                              | 88.3                                | -                                          | -                      |
| Glacial Till    | 22.7 - 25.7 ft                            | Sand (Reese)                  | 67.6                                     | -                                           | 35                              | 88.3                                | -                                          | -                      |
| Bedrock         | > 25.7 ft                                 | Strong Rock (Vuggy Limestone) | 107.6                                    | -                                           | -                               | -                                   | -                                          | 7,000                  |

- 1) Ref. 4
- 2) Ref. 8
- 3) Ref. 9 - interpolation based on friction angle or undrained shear strength value for each layer.
- 4) Assumption 5.

The full LPILE output is provided in Attachment 1.

Obtain the maximum moment in the top segment of the pile.

$$M_{u,Top} = 2085 \text{ in-kips (from LPILE)}$$

Obtain the unbraced lengths of the top segment and the second segment of the upper zone of the pile.

$$l_{b,top} = 4.7 \text{ ft (from LPILE)}$$

$$l_{b,top} = 56.2 \text{ in}$$

$$l_{b,2nd} = 12.2 \text{ ft (from LPILE)}$$

$$l_{b,2nd} = 146.5 \text{ in}$$

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**4. Determine if the applied moment on the pile will cause pile head plastic deformation by using the interaction of combined axial and flexural load effects on a single pile.**

Determine K values for the top and bottom of the pile and calculate the column slenderness factor ( $\lambda$ ) for each segment.

For the top segment (rotation fixed with no plastic hinge):

$$\lambda_{\text{top}} = \frac{K_{\text{top}} I_{b,\text{top}}}{r_y} \leq 120 \quad (\text{Ref. 1, Article 6.9.3})$$

where:

$$\begin{aligned} K_{\text{top}} &= 1.2 & (\text{Ref. 1, Table C4.6.2.5-1}) \\ r_y &= 3.53 \text{ in} & (\text{Step 1}) \end{aligned}$$

$$\lambda_{\text{top}} = 19.1 \quad \text{OK}$$

For the second segment (pinned at top and bottom):

$$\lambda_{2\text{nd}} = \frac{K_{2\text{nd}} I_{b,2\text{nd}}}{r_y} \leq 120 \quad (\text{Ref. 1, Article 6.9.3})$$

where:

$$K_{2\text{nd}} = 1.0 \quad (\text{Ref. 1, Table C4.6.2.5-1})$$

$$\lambda_{2\text{nd}} = 41.5 \quad \text{OK}$$

Calculate the critical elastic buckling resistance,  $P_e$ , and the nominal yield resistance,  $P_o$ .

Use Ref. 1 Table 6.9.4.1.1-1 to select equation for  $P_e$  based on cross-section shape and potential buckling mode.

$$P_e = \frac{\pi^2 E}{\left(\frac{K I_b}{r_y}\right)^2} A_s \quad (\text{Ref. 1, Eqn 6.9.4.1.2-1})$$

$$P_{e,\text{top}} = 20524 \text{ kips}$$

$$P_{e,2\text{nd}} = 4347 \text{ kips}$$

$$P_o = F_y A_s \quad (\text{Ref. 1, Article 6.9.4.1})$$

$$P_o = 1306 \text{ kips}$$

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**Made by:** DEB  
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Calculate the nominal structural pile resistance,  $P_n$ , for both segments of the upper zone of the pile as well as the lower zone of the pile.

Determine  $P_o/P_e$  to select equation for  $P_n$  as per Ref. 1 Article 6.9.4.1.

$$\begin{aligned} P_o/P_{e,top} &= 0.06 & \leq & 2.25 \\ P_o/P_{e,2nd} &= 0.30 & \leq & 2.25 \end{aligned}$$

thus use Ref. 1 Eqn 6.9.4.1.1-1:

$$P_n = \left[ 0.658^{\left( \frac{P_o}{P_e} \right)} \right] P_o$$

$$\begin{aligned} P_{n,top} &= 1271 & \text{kips} \\ P_{n,2nd} &= 1151 & \text{kips} \end{aligned}$$

$$P_{n,bottom} = (0.658^{(0)}) P_o \quad (0 \text{ for a fully braced pile - Ref. 10, Appendix B, Eqn 6-9})$$

$$P_{n,bottom} = 1306 \quad \text{kips}$$

Calculate the factored structural pile resistance,  $P_r$ , for both segments of the upper zone of the pile as well as the lower zone of the pile.

$$\begin{aligned} P_{r,top} &= \phi_{cu} P_{n,top} & (\text{Ref. 1, Eqn. 6.9.2.1-1}) \\ P_{r,top} &= 890 & \text{kips} \end{aligned}$$

$$\begin{aligned} P_{r,2nd} &= \phi_{cu} P_{n,2nd} & (\text{Ref. 1, Eqn. 6.9.2.1-1}) \\ P_{r,2nd} &= 806 & \text{kips} \end{aligned}$$

$$\begin{aligned} P_{r,bottom} &= \phi_{cl} P_{n,bottom} & (\text{Ref. 1, Eqn. 6.9.2.1-1}) \\ P_{r,bottom} &= 653 & \text{kips} \end{aligned}$$

Compare the ratio of  $P_u$  to the structural resistance in the upper portion of the pile – the pile size should be such that the ratio is not less than 0.20 (Ref. 2, page 5-43).

$$\frac{P_u}{P_{r,top}} = 0.44 \quad \text{OK}$$

$$\frac{P_u}{P_{r,2nd}} = 0.49 \quad \text{OK}$$

Since the lower zone of the pile will have virtually no moment, the entire section can carry the required vertical loads (Ref. 10, Appendix B). Make sure the applied load will not exceed the resistance of the lower zone.

$$\text{Check } \left( \frac{P_u}{P_{r,bottom}} < 1 \right)$$

$$\frac{P_u}{P_{r,bottom}} = 0.60 \quad \text{OK}$$

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Determine the nominal and factored flexural resistance about the H-pile weak axis.

Slenderness ratio for the flange:

$$\lambda_f = \frac{b_f}{2t_f} \quad (\text{Ref. 1, Eqn 6.12.2.2.1-3})$$

$$\lambda_f = 12.0$$

Limiting slenderness ratio for a compact flange:

$$\lambda_{pf} = 0.38 \sqrt{\frac{E}{F_y}} \quad (\text{Ref. 1, Eqn 6.12.2.2.1-4})$$

$$\lambda_{pf} = 9.2$$

Limiting slenderness ratio for a noncompact flange:

$$\lambda_{rf} = 0.83 \sqrt{\frac{E}{F_y}} \quad (\text{Ref. 1, Eqn 6.12.2.2.1-5})$$

$$\lambda_{rf} = 20.0$$

Elastic and plastic section moduli about the weak axis:

$$S_y = 44.3 \text{ in}^3 \quad (\text{Step 1})$$

$$Z_y = 67.6 \text{ in}^3 \quad (\text{Step 1})$$

Nominal flexural resistance:

$$M_n = M_p = 1.5F_y S_y \quad \text{if } \lambda_f \leq \lambda_{pf} \quad (\text{Ref. 1, Eqn 6.12.2.2.1-1})$$

$$M_n = \left[ 1 - \left( 1 - \frac{S_y}{Z_y} \right) \left( \frac{\lambda_f - \lambda_{pf}}{0.45 \sqrt{\frac{E}{F_y}}} \right) \right] F_y Z_y \quad \text{if } \lambda_{pf} < \lambda_f \leq \lambda_{rf} \quad (\text{Ref. 1, Eqn 6.12.2.2.1-2})$$

Since  $\lambda_{pf} < \lambda_f \leq \lambda_{rf}$ ,

$$M_n = 3081 \text{ in-kips}$$

Factored flexural resistance:

$$\phi_f = 1.00 \quad (\text{Ref. 2, page 5-42})$$

$$M_r = \phi_f M_n$$

$$M_r = 3081 \text{ in-kips}$$

Calculate the moment that will cause a plastic hinge at the top of the pile,  $M_p'$ .

$$M_p' = \frac{9}{8} \left( 1 - \frac{P_u}{P_{r,top}} \right) M_r \quad (\text{Ref. 1, Eqn 6.9.2.2.1-2; Ref. 10, Eqn 4.5.2-4})$$

$$M_p' = 1942 \text{ in-kips} = 1941939 \text{ inch-lb}$$

|                       |                                                        |                     |     |
|-----------------------|--------------------------------------------------------|---------------------|-----|
| <b>Date:</b>          | 7/22/2025                                              | <b>Made by:</b>     | DEB |
| <b>Project No.:</b>   | US0025840.9367                                         | <b>Checked by:</b>  | KAR |
| <b>Subject:</b>       | HP14x89 Pile Design at Proposed Abutment 1             | <b>Reviewed by:</b> | CCB |
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If the applied moment exceeds the moment that would cause a plastic hinge, it can be assumed that the pile head has entered plastic deformation, and therefore the moment that can be applied to the pile head cannot exceed  $M_p'$ .

$$\begin{array}{llll} M_{u,Top} = & 2085 & \text{in-kips} & (\text{From Step 3}) \\ M_{u,Top} & > & M_p' & \text{Plastic Hinge Forms} \end{array}$$

Check the second segment of the upper zone of the pile to ensure that this segment of the pile does not form a plastic hinge.

$$M_{u,2nd} = 727 \quad \text{in-kips} \quad (\text{LPile})$$

$$\text{Check: } \frac{P_u}{P_{r,2nd}} + \frac{8}{9} \left( \frac{M_{u,2nd}}{M_r} \right) < 1 \quad (\text{Ref. 1, Eqn 6.9.2.2.1-2; Ref. 10, Eqn 4.5.2-3})$$

$$\text{Check: } 0.70 < 1 \quad \text{OK}$$

**5. Run another LPile analysis with displacement, plastic moment ( $M_p'$ ), and  $P_u$  as load conditions, and calculate**

$$l_{b,top} = 11.5 \quad \text{ft} \quad (\text{LPile})$$

$$l_{b,top} = 137.8 \quad \text{in}$$

$$l_{b,2nd} = 10.5 \quad \text{ft} \quad (\text{LPile})$$

$$l_{b,2nd} = 126.6 \quad \text{in}$$

$$M_{u,2nd} = 81 \quad \text{in-kips} \quad (\text{LPile})$$

Since a plastic hinge developed at the pile head, the value of K for the top segment becomes 2.1 for free rotation condition (Ref. 2, page 5-43).

$$K_{top} = 2.1 \quad (\text{Ref. 1, Table C4.6.2.5-1})$$

$$K_{2nd} = 1.0 \quad (\text{Ref. 1, Table C4.6.2.5-1})$$

$$\lambda_{top} = 81.89 < 120 \quad \text{OK}$$

$$\lambda_{2nd} = 35.83 < 120 \quad \text{OK}$$

$$P_{e,top} = 1114 \quad \text{kips}$$

$$P_{e,2nd} = 5822 \quad \text{kips}$$

$$P_o/P_{e,top} = 1.17 \leq 2.25 \quad (\text{to select } P_n \text{ equation})$$

$$P_o/P_{e,2nd} = 0.22 \leq 2.25 \quad (\text{to select } P_n \text{ equation})$$

$$P_{n,top} = 800 \quad \text{kips}$$

$$P_{n,2nd} = 1189 \quad \text{kips}$$

$$P_{r,top} = 560 \quad \text{kips}$$

$$P_{r,2nd} = 832 \quad \text{kips}$$

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$$\frac{P_u}{P_{r,top}} = 0.70 > 0.20 \quad \text{OK}$$

$$\frac{P_u}{P_{r,2nd}} = 0.47 > 0.20 \quad \text{OK}$$

Check the second segment of the upper zone of the pile to ensure that this segment of the pile does not form a plastic

$$M_{u,2nd} = 81 \quad \text{in-kips} \quad (\text{LPile})$$

$$\text{Check: } \frac{P_u}{P_{r,2nd}} + \frac{8}{9} \left( \frac{M_{u,2nd}}{M_r} \right) < 1 \quad (\text{Ref. 1, Eqn 6.9.2.2.1-2; Ref. 11, Eqn 4.5.2-3})$$

$$\text{Check: } 0.49 < 1 \quad \text{OK}$$

**6. Because the piles have weak axis orientation and the flanges resist the shear as opposed to the web, check the maximum shear from the LPile output against the structural shear resistance per AISC G7.**

$$V_u = 22.1 \quad \text{kips} \quad (\text{from LPile})$$

AASHTO LRFD does not directly address weak axis shear. This analysis will use the AISC Steel Construction Manual 13th edition, Specifications G2 and G7 (Ref. 11) to ensure the pile will not shear under the longitudinal load.

Per Ref. 11 Section G7: for singly and doubly symmetric shapes loaded in the weak axis without torsion, the nominal shear strength  $V_n$  for each shear resisting element shall be determined using Equation G2-1 and Section G2.1(b) with  $A_w = b_f t_f$  and  $k_v = 1.2$ .

$$V_n = 0.6 F_y A_w C_v \quad (\text{Ref. 11, Eqn G2-1})$$

where:

$$C_v = 1.0 \quad \text{for HP shapes with } F_y \leq 50 \text{ ksi} \quad (\text{Ref. 12, Section G7})$$

$$A_w = b_f t_f = 9.0 \quad \text{in}^2 \quad (\text{Ref. 11, Section G7})$$

Since there are two shear resisting elements (i.e., two flanges):

$$2 \times A_w = 18.1 \quad \text{in}^2$$

$$V_n = 542 \quad \text{kips}$$

$$V_r = \phi_v V_n$$

$$\phi_v = 1.00 \quad (\text{Ref. 1, Article 6.5.4.2})$$

$$V_r = 542 \quad \text{kips}$$

Check that the shear resistance is sufficient:

$$V_u < V_r \quad \text{OK}$$

|                       |                                                        |                     |     |
|-----------------------|--------------------------------------------------------|---------------------|-----|
| <b>Date:</b>          | 7/22/2025                                              | <b>Made by:</b>     | DEB |
| <b>Project No.:</b>   | US0025840.9367                                         | <b>Checked by:</b>  | KAR |
| <b>Subject:</b>       | HP14x89 Pile Design at Proposed Abutment 1             | <b>Reviewed by:</b> | CCB |
| <b>Project Title:</b> | Phair Crossing Bridge Presque Isle, ME (WIN 026434.00) |                     |     |

## 7. Check that the maximum factored applied pile load does not exceed the factored pile drivability resistance.

For steel piles in compression, driving stresses should not exceed 90% of the yield strength of the pile material (Ref. 2, page 5-104).

$$\sigma_{dr} = 0.9 \times 50 \text{ ksi} = 45 \text{ ksi}$$

This translates into an ultimate maximum driving force that can be applied to the pile of:

$$P_{dr} = \sigma_{dr} A_s \quad (\text{Ref. 10, Appendix B, Eqn 7-23})$$

$$P_{dr} = 1175 \text{ kips}$$

Calculate the nominal pile driving resistance ( $R_{ndr}$ ) from the applied load divided by the resistance factor associated with the pile monitoring method. In this design, the pile will be bearing on rock. The driving criteria will be established by dynamic testing.

$$\phi_{dyn} = 0.65 \quad (\text{Ref. 1, Table 10.5.5.2.3-1})$$

$$R_{ndr} = \frac{P_u}{\phi_{dyn}} \quad (\text{Ref. 10, Appendix B, Eqn 7-25})$$

$$R_{ndr} = 602 \text{ kips}$$

The nominal pile driving resistance ( $R_{ndr}$ ) should not exceed the nominal structural pile resistance ( $P_n$ ) or the maximum driving force ( $P_{dr}$ ) calculated above.

$$P_{n,top} = 1271 \text{ kips} \quad (\text{From Step 4})$$

$$P_{n,2nd} = 1151 \text{ kips} \quad (\text{From Step 4})$$

$$\text{Check } R_{ndr} < P_n: \quad \text{OK}$$

$$\text{Check } R_{ndr} < P_{dr}: \quad \text{OK}$$

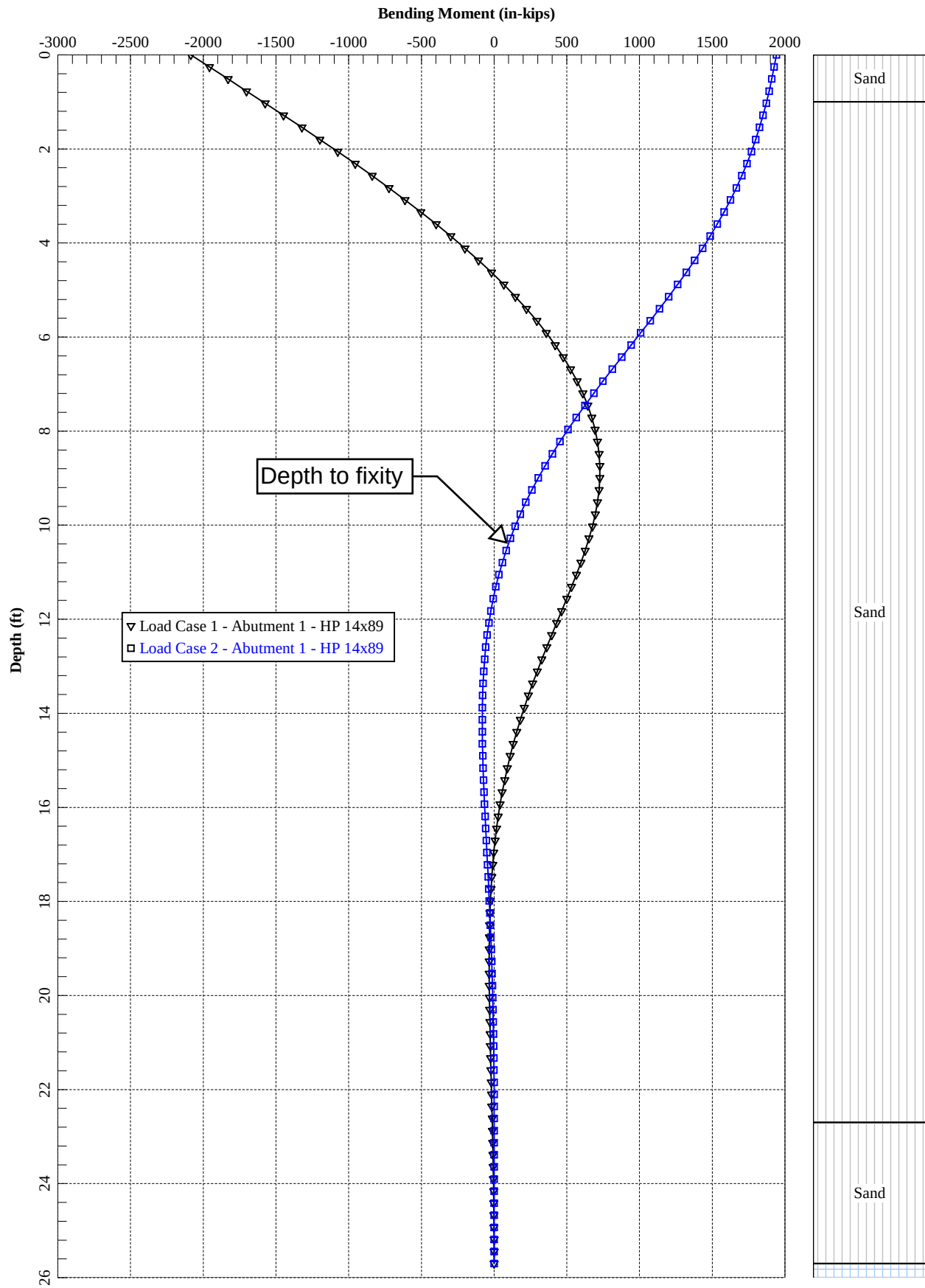
## 8. Determine if fixity is achieved within the pile length Assumption 7.

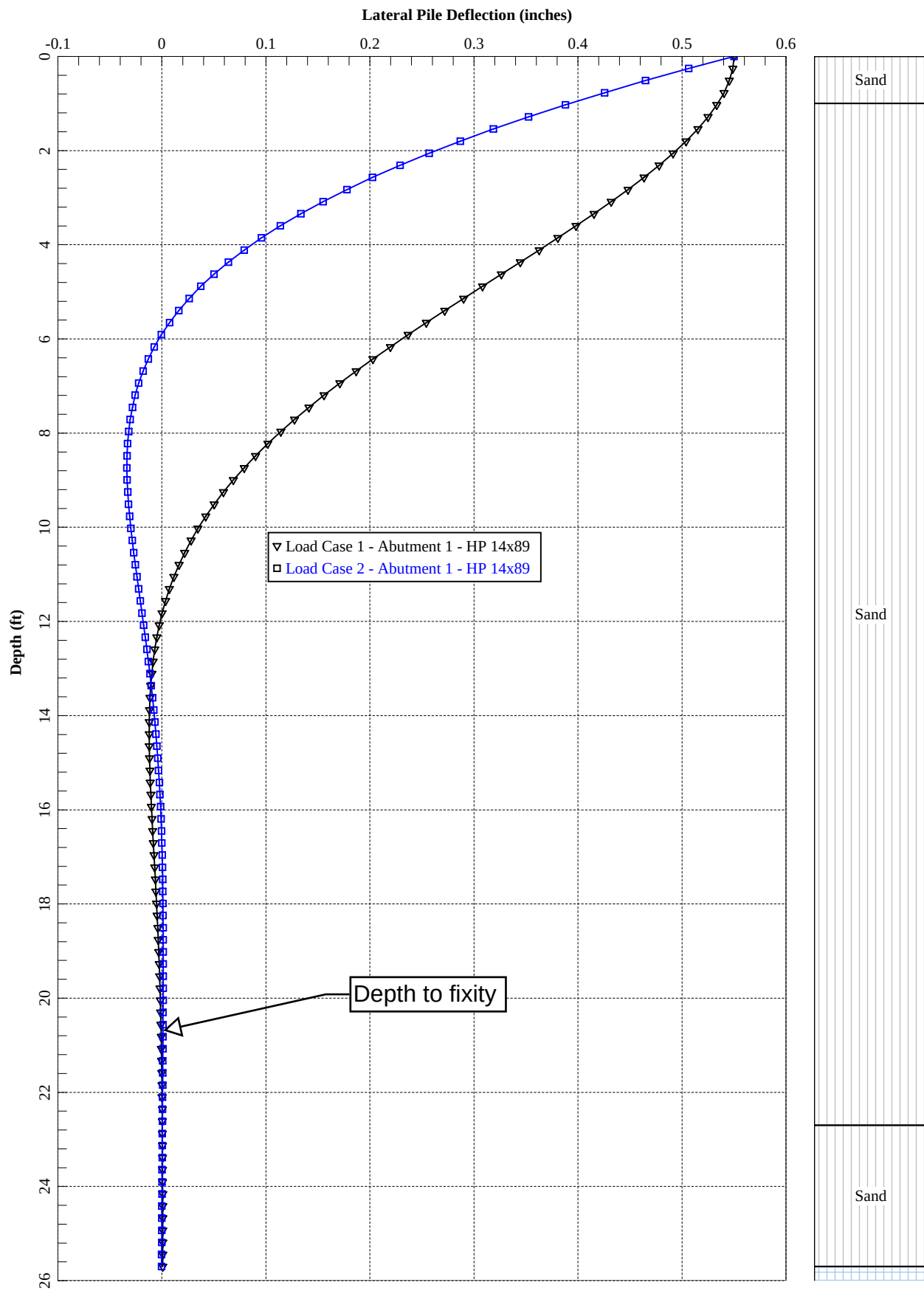
$$\text{Fixity for Deflection} = 5.0 \text{ feet above bedrock surface}$$

$$\text{Fixity for Bending Moment} = 15.3 \text{ feet above bedrock surface}$$

## CONCLUSIONS

The results of the analysis indicate that a maximum moment of 1942 in-kips (162 ft-kips) occurs at the top of the pile under the Strength I load case with a maximum bridge expansion or contraction of 0.55 inches. The results indicate that the depth to bedrock is sufficient for driven piles to achieve fixity for deflection and bending moment. Based on the intact pile section used in the analysis, the HP 14x89 piles are adequately sized to accommodate the anticipated design loads and thermal movement at Abutment 1 at the end of the 75 year bridge design life.





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LPILE for Windows, Version 2019-11.006

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:

\Users\USDB712838\Desktop\Presque Isle\Final Pile design\

Name of input data file:

7.8.25 Final Abutment 1-HP14x89.lp11d

Name of output report file:

7.8.25 Final Abutment 1-HP14x89.lp11o

Name of plot output file:

7.8.25 Final Abutment 1-HP14x89.lp11p

Name of runtime message file:

7.8.25 Final Abutment 1-HP14x89.lp11r

-----

Date and Time of Analysis

-----

Date: July 8, 2025

Time: 16:28:30

---

Problem Title

---

Project Name: 31407448.000

Job Number: 31407448.000

Client: Phair Crossing Bridge Presque Isle, ME

Engineer: DEB

Description: Abutment 1 HP14x89

---

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
- Input of side resistance moment along pile 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                      | = | 25.700 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<br>No. | Depth Below<br>Pile Head<br>feet | Pile<br>Diameter<br>inches |
|--------------|----------------------------------|----------------------------|
| 1            | 0.000                            | 14.7000                    |
| 2            | 25.700                           | 14.7000                    |

#### Input Structural Properties for Pile Sections:

---

##### Pile Section No. 1:

|                                       |                |
|---------------------------------------|----------------|
| Section 1 is a H weak axis steel pile |                |
| Length of section                     | = 25.700000 ft |
| Pile width                            | = 13.800000 in |

Shear capacity of section = 0.0000 lbs

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Ground Slope and Pile Batter Angles

---

Ground Slope Angle = 0.000 degrees  
= 0.000 radians

Pile Batter Angle = 0.000 degrees  
= 0.000 radians

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Soil and Rock Layering Information

---

The soil profile is modelled using 4 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 = 1.000000 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 = 32.000000 deg.  
Friction angle at bottom of layer = 32.000000 deg.  
Subgrade k at top of layer = 88.300000 pci  
Subgrade k at bottom of layer = 88.300000 pci

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

Distance from top of pile to top of layer = 1.000000 ft  
Distance from top of pile to bottom of layer = 22.700000 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 = 32.000000 deg.  
Friction angle at bottom of layer = 32.000000 deg.  
Subgrade k at top of layer = 88.300000 pci  
Subgrade k at bottom of layer = 88.300000 pci

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

Distance from top of pile to top of layer = 22.700000 ft  
Distance from top of pile to bottom of layer = 25.700000 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           | = | 35.000000 deg. |
| Friction angle at bottom of layer        | = | 35.000000 deg. |
| Subgrade k at top of layer               | = | 88.300000 pci  |
| Subgrade k at bottom of layer            | = | 88.300000 pci  |

Layer 4 is strong rock (vuggy limestone)

|                                                  |   |                |
|--------------------------------------------------|---|----------------|
| Distance from top of pile to top of layer        | = | 25.700000 ft   |
| Distance from top of pile to bottom of layer     | = | 50.000000 ft   |
| Effective unit weight at top of layer            | = | 107.600000 pcf |
| Effective unit weight at bottom of layer         | = | 107.600000 pcf |
| Uniaxial compressive strength at top of layer    | = | 7000. psi      |
| Uniaxial compressive strength at bottom of layer | = | 7000. psi      |

(Depth of the lowest soil layer extends 24.300 ft below the pile tip)

-----  
Summary of Input Soil Properties  
-----

| Layer                       | Soil Type                | Layer       | Effective       | Angle of         | Uniaxial  |
|-----------------------------|--------------------------|-------------|-----------------|------------------|-----------|
| Layer<br>kpy<br>Num.<br>pci | Name<br>(p-y Curve Type) | Depth<br>ft | Unit Wt.<br>pcf | Friction<br>deg. | qu<br>psi |
| -----                       | -----                    | -----       | -----           | -----            | -----     |
| 1                           | Sand                     | 0.00        | 125.0000        | 32.0000          | --        |
| 88.3000                     | (Reese, et al.)          | 1.0000      | 125.0000        | 32.0000          | --        |
| 88.3000                     | 2                        | 1.0000      | 125.0000        | 32.0000          | --        |
| 88.3000                     | Sand                     | 1.0000      | 125.0000        | 32.0000          | --        |
| 88.3000                     | (Reese, et al.)          | 22.7000     | 125.0000        | 32.0000          | --        |
| 88.3000                     | 3                        | 22.7000     | 67.6000         | 35.0000          | --        |
| 88.3000                     | Sand                     | 22.7000     | 67.6000         | 35.0000          | --        |
| 88.3000                     | (Reese, et al.)          | 25.7000     | 67.6000         | 35.0000          | --        |
| 88.3000                     | 4                        | 25.7000     | 107.6000        | --               | 7000.     |
| --                          | Strong Rock              | 25.7000     | 107.6000        | --               | 7000.     |
| --                          | (Vuggy Limestone)        | 50.0000     | 107.6000        | --               | 7000.     |
| --                          |                          |             |                 |                  |           |

---

### 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<br>Compute<br>No. | Load<br>Top y<br>Type<br>vs. Pile Length | Condition<br>Run Analysis<br>1 | Condition<br>2      | Axial Thrust<br>Force, lbs |
|------------------------|------------------------------------------|--------------------------------|---------------------|----------------------------|
| 1                      | 5                                        | y = 0.550000 in                | S = 0.0000 in/in    | 391000.                    |
| N.A.                   |                                          | Yes                            |                     |                            |
| 2                      | 4                                        | y = 0.550000 in                | M = 1941939. in-lbs | 391000.                    |
| 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                = 25.700000 ft
Flange Width                    = 14.700000 in
Section Depth                  = 13.800000 in
Flange Thickness               = 0.615000 in
Web Thickness                  = 0.615000 in
Yield Stress of Pipe           = 50.000000 ksi
Elastic Modulus                = 29000. ksi
Cross-sectional Area           = 25.811550 sq. in.
Moment of Inertia              = 325.837265 in^4
Elastic Bending Stiffness      = 9449281. kip-in^2
Plastic Modulus, Z             = 67.636247in^3
Plastic Moment Capacity = Fy Z = 3382.in-kip

```

#### Axial Structural Capacities:

```

-----
Nom. Axial Structural Capacity = Fy As = 1290.578 kips
Nominal Axial Tensile Capacity = -1290.578 kips

```

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

| Number | Axial Thrust Force<br>kips |
|--------|----------------------------|
| 1      | 391.000                    |

#### Definition of Run Messages:

Y = part of pipe section has yielded.

Axial Thrust Force = 391.000 kips

| Bending<br>Curvature<br>rad/in. | Bending<br>Moment<br>in-kip | Bending<br>Stiffness<br>kip-in2 | Depth to<br>N Axis<br>in | Max Total<br>Stress<br>ksi | Run<br>Msg |
|---------------------------------|-----------------------------|---------------------------------|--------------------------|----------------------------|------------|
| 0.00000436                      | 41.2285396                  | 9448389.                        | 127.0583664              | 16.0690475                 |            |
| 0.00000873                      | 82.4570792                  | 9448389.                        | 67.2041832               | 16.9898377                 |            |
| 0.00001309                      | 123.6856188                 | 9448389.                        | 47.2527888               | 17.9106281                 |            |
| 0.00001745                      | 164.9141585                 | 9448389.                        | 37.2770916               | 18.8314181                 |            |
| 0.00002182                      | 206.1426981                 | 9448389.                        | 31.2916733               | 19.7522085                 |            |
| 0.00002618                      | 247.3712377                 | 9448389.                        | 27.3013944               | 20.6729986                 |            |
| 0.00003054                      | 288.5997773                 | 9448389.                        | 24.4511952               | 21.5937888                 |            |
| 0.00003491                      | 329.8283169                 | 9448389.                        | 22.3135458               | 22.5145791                 |            |

|            |             |          |            |            |   |
|------------|-------------|----------|------------|------------|---|
| 0.00003927 | 371.0568565 | 9448389. | 20.6509296 | 23.4353693 |   |
| 0.00004364 | 412.2853961 | 9448389. | 19.3208366 | 24.3561596 |   |
| 0.00004800 | 453.5139358 | 9448389. | 18.2325788 | 25.2769499 |   |
| 0.00005236 | 494.7424754 | 9448389. | 17.3256972 | 26.1977401 |   |
| 0.00005673 | 535.9710150 | 9448389. | 16.5583359 | 27.1185304 |   |
| 0.00006109 | 577.1995546 | 9448389. | 15.9005976 | 28.0393205 |   |
| 0.00006545 | 618.4280942 | 9448389. | 15.3305578 | 28.9601109 |   |
| 0.00006982 | 659.6566338 | 9448389. | 14.8317729 | 29.8809011 |   |
| 0.00007418 | 700.8851734 | 9448389. | 14.3916686 | 30.8016914 |   |
| 0.00007854 | 742.1137131 | 9448389. | 14.0004648 | 31.7224816 |   |
| 0.00008291 | 783.3422527 | 9448389. | 13.6504403 | 32.6432718 |   |
| 0.00008727 | 824.5707923 | 9448389. | 13.3354183 | 33.5640621 |   |
| 0.00009163 | 865.7993319 | 9448389. | 13.0503984 | 34.4848523 |   |
| 0.00009600 | 907.0278715 | 9448389. | 12.7912894 | 35.4056425 |   |
| 0.0001004  | 948.2564111 | 9448389. | 12.5547116 | 36.3264327 |   |
| 0.0001047  | 989.4849507 | 9448389. | 12.3378486 | 37.2472230 |   |
| 0.0001091  | 1031.       | 9448389. | 12.1383347 | 38.1680132 |   |
| 0.0001135  | 1072.       | 9448389. | 11.9541679 | 39.0888035 |   |
| 0.0001178  | 1113.       | 9448389. | 11.7836432 | 40.0095937 |   |
| 0.0001222  | 1154.       | 9448389. | 11.6252988 | 40.9303840 |   |
| 0.0001265  | 1196.       | 9448389. | 11.4778747 | 41.8511742 |   |
| 0.0001309  | 1237.       | 9448389. | 11.3402789 | 42.7719644 |   |
| 0.0001353  | 1278.       | 9448389. | 11.2115602 | 43.6927547 |   |
| 0.0001396  | 1319.       | 9448389. | 11.0908865 | 44.6135449 |   |
| 0.0001440  | 1361.       | 9448389. | 10.9775263 | 45.5343351 |   |
| 0.0001484  | 1402.       | 9448389. | 10.8708343 | 46.4551254 |   |
| 0.0001527  | 1443.       | 9448389. | 10.7702390 | 47.3759157 |   |
| 0.0001571  | 1484.       | 9448389. | 10.6752324 | 48.2967059 |   |
| 0.0001615  | 1525.       | 9448389. | 10.5853613 | 49.2174961 |   |
| 0.0001658  | 1567.       | 9447284. | 10.5004230 | 50.0000000 | Y |
| 0.0001702  | 1606.       | 9437523. | 10.4214502 | 50.0000000 | Y |
| 0.0001789  | 1681.       | 9396271. | 10.2794768 | 50.0000000 | Y |
| 0.0001876  | 1751.       | 9331633. | 10.1561145 | 50.0000000 | Y |
| 0.0001964  | 1816.       | 9250182. | 10.0484174 | 50.0000000 | Y |
| 0.0002051  | 1878.       | 9157276. | 9.9538940  | 50.0000000 | Y |
| 0.0002138  | 1936.       | 9055706. | 9.8707887  | 50.0000000 | Y |
| 0.0002225  | 1992.       | 8948927. | 9.7973362  | 50.0000000 | Y |
| 0.0002313  | 2044.       | 8839583. | 9.7320492  | 50.0000000 | Y |
| 0.0002400  | 2095.       | 8727463. | 9.6742670  | 50.0000000 | Y |
| 0.0002487  | 2143.       | 8615531. | 9.6225894  | 50.0000000 | Y |
| 0.0002574  | 2189.       | 8503942. | 9.5764156  | 50.0000000 | Y |
| 0.0002662  | 2234.       | 8392960. | 9.5351890  | 50.0000000 | Y |
| 0.0002749  | 2277.       | 8283718. | 9.4981522  | 50.0000000 | Y |
| 0.0002836  | 2319.       | 8176458. | 9.4648434  | 50.0000000 | Y |
| 0.0002924  | 2360.       | 8071380. | 9.4348533  | 50.0000000 | Y |
| 0.0003011  | 2399.       | 7968652. | 9.4078176  | 50.0000000 | Y |
| 0.0003098  | 2438.       | 7868407. | 9.3834108  | 50.0000000 | Y |
| 0.0003185  | 2475.       | 7770753. | 9.3613402  | 50.0000000 | Y |
| 0.0003273  | 2512.       | 7675239. | 9.3411937  | 50.0000000 | Y |
| 0.0003360  | 2546.       | 7577309. | 9.3214163  | 50.0000000 | Y |

|           |       |          |           |            |   |
|-----------|-------|----------|-----------|------------|---|
| 0.0003447 | 2578. | 7477105. | 9.3022700 | 50.0000000 | Y |
| 0.0003534 | 2607. | 7376138. | 9.2834412 | 50.0000000 | Y |
| 0.0003622 | 2635. | 7275120. | 9.2648686 | 50.0000000 | Y |
| 0.0003709 | 2661. | 7173883. | 9.2467693 | 50.0000000 | Y |
| 0.0003796 | 2685. | 7072728. | 9.2289009 | 50.0000000 | Y |
| 0.0003884 | 2708. | 6972809. | 9.2112003 | 50.0000000 | Y |
| 0.0003971 | 2729. | 6873497. | 9.1941663 | 50.0000000 | Y |
| 0.0004058 | 2750. | 6776238. | 9.1772171 | 50.0000000 | Y |
| 0.0004145 | 2769. | 6679638. | 9.1608535 | 50.0000000 | Y |
| 0.0004233 | 2787. | 6584816. | 9.1443049 | 50.0000000 | Y |
| 0.0004320 | 2804. | 6491352. | 9.1285591 | 50.0000000 | Y |
| 0.0004407 | 2821. | 6400093. | 9.1128353 | 50.0000000 | Y |
| 0.0004494 | 2836. | 6309817. | 9.0973786 | 50.0000000 | Y |
| 0.0004582 | 2851. | 6221930. | 9.0823541 | 50.0000000 | Y |
| 0.0004669 | 2865. | 6135544. | 9.0672583 | 50.0000000 | Y |
| 0.0004756 | 2878. | 6050770. | 9.0527897 | 50.0000000 | Y |
| 0.0004844 | 2891. | 5968048. | 9.0383751 | 50.0000000 | Y |
| 0.0004931 | 2903. | 5886959. | 9.0241136 | 50.0000000 | Y |
| 0.0005018 | 2914. | 5807576. | 9.0103938 | 50.0000000 | Y |
| 0.0005105 | 2925. | 5729859. | 8.9966108 | 50.0000000 | Y |
| 0.0005193 | 2936. | 5654182. | 8.9830577 | 50.0000000 | Y |
| 0.0005542 | 2974. | 5366479. | 8.9313381 | 50.0000000 | Y |
| 0.0005891 | 3006. | 5103614. | 8.8828466 | 50.0000000 | Y |
| 0.0006240 | 3034. | 4862436. | 8.8372306 | 50.0000000 | Y |
| 0.0006589 | 3058. | 4641569. | 8.7944517 | 50.0000000 | Y |
| 0.0006938 | 3080. | 4438654. | 8.7538191 | 50.0000000 | Y |
| 0.0007287 | 3098. | 4251448. | 8.7154875 | 50.0000000 | Y |
| 0.0007636 | 3115. | 4078786. | 8.6791183 | 50.0000000 | Y |
| 0.0007985 | 3129. | 3918988. | 8.6448561 | 50.0000000 | Y |
| 0.0008334 | 3143. | 3770688. | 8.6117948 | 50.0000000 | Y |
| 0.0008683 | 3154. | 3632623. | 8.5808287 | 50.0000000 | Y |
| 0.0009033 | 3165. | 3504207. | 8.5512284 | 50.0000000 | Y |
| 0.0009382 | 3175. | 3384575. | 8.5230399 | 50.0000000 | Y |
| 0.0009731 | 3184. | 3272102. | 8.4960786 | 50.0000000 | Y |

-----  
Summary of Results for Nominal Moment Capacity for Section 1  
-----

| Load<br>No. | Axial<br>Thrust<br>kips | Nominal<br>Moment<br>Capacity<br>in-kips |
|-------------|-------------------------|------------------------------------------|
| ----        | -----                   | -----                                    |
| 1           | 391.0000000000          | 3184.                                    |

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.

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Layering Correction Equivalent Depths of Soil & Rock Layers

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| 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                      | 769.8689                  |
| 2         | 1.0000                          | 0.9998                                  | Yes                            | No                                   | 769.8689                  | 1032183.                  |
| 3         | 22.7000                         | 20.4452                                 | Yes                            | No                                   | 1032953.                  | 487380.                   |
| 4         | 25.7000                         | 25.7000                                 | No                             | Yes                                  | N.A.                      | 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.

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

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Pile-head conditions are Displacement and Pile-head Rotation (Loading Type 5)  
 Displacement of pile head = 0.550000 inches  
 Rotation of pile head = 0.000E+00 radians  
 Axial load on pile head = 391000.0 lbs

| Depth Res. | Deflect. Soil Spr. | Bending Distrib. | Shear | Slope   | Total  | Bending   | Soil |
|------------|--------------------|------------------|-------|---------|--------|-----------|------|
| X          | y                  | Moment           | Force | S       | Stress | Stiffness | p    |
| Es*H       | Lat. Load          |                  |       |         |        |           |      |
| feet       | inches             | in-lbs           | lbs   | radians | psi*   | lb-in^2   |      |

| lb/inch   | lb/inch  | lb/inch   |        |           |        |          |
|-----------|----------|-----------|--------|-----------|--------|----------|
| -----     | -----    | -----     | -----  | -----     | -----  | -----    |
| 0.00      | 0.5500   | -2084572. | 41126. | 0.00      | 62171. | 8.75E+09 |
| 0.00      | 0.00     | 0.00      |        |           |        |          |
| 0.2570    | 0.5489   | -1957466. | 41025. | -7.12E-04 | 59303. | 8.75E+09 |
| -30.0866  | 169.0522 | 0.00      |        |           |        |          |
| 0.5140    | 0.5456   | -1829813. | 40879. | -0.00136  | 56424. | 9.23E+09 |
| -64.6431  | 365.3908 | 0.00      |        |           |        |          |
| 0.7710    | 0.5405   | -1702038. | 40622. | -0.00195  | 53542. | 9.38E+09 |
| -101.8599 | 581.2392 | 0.00      |        |           |        |          |
| 1.0280    | 0.5336   | -1574557. | 40249. | -0.00249  | 50666. | 9.45E+09 |
| -139.9378 | 808.8079 | 0.00      |        |           |        |          |
| 1.2850    | 0.5251   | -1447786. | 39760. | -0.00298  | 47806. | 9.45E+09 |
| -177.5392 | 1043.    | 0.00      |        |           |        |          |
| 1.5420    | 0.5152   | -1322135. | 39156. | -0.00343  | 44972. | 9.45E+09 |
| -213.7035 | 1279.    | 0.00      |        |           |        |          |
| 1.7990    | 0.5040   | -1197995. | 38447. | -0.00384  | 42172. | 9.45E+09 |
| -246.5484 | 1509.    | 0.00      |        |           |        |          |
| 2.0560    | 0.4915   | -1075729. | 37636. | -0.00421  | 39414. | 9.45E+09 |
| -278.8580 | 1750.    | 0.00      |        |           |        |          |
| 2.3130    | 0.4780   | -955692.  | 36732. | -0.00455  | 36706. | 9.45E+09 |
| -307.5791 | 1985.    | 0.00      |        |           |        |          |
| 2.5700    | 0.4635   | -838204.  | 35745. | -0.00484  | 34056. | 9.45E+09 |
| -332.5064 | 2213.    | 0.00      |        |           |        |          |
| 2.8270    | 0.4481   | -723549.  | 34687. | -0.00509  | 31470. | 9.45E+09 |
| -353.6292 | 2434.    | 0.00      |        |           |        |          |
| 3.0840    | 0.4321   | -611972.  | 33572. | -0.00531  | 28953. | 9.45E+09 |
| -369.4555 | 2637.    | 0.00      |        |           |        |          |
| 3.3410    | 0.4154   | -503668.  | 32404. | -0.00549  | 26510. | 9.45E+09 |
| -387.9970 | 2881.    | 0.00      |        |           |        |          |
| 3.5980    | 0.3982   | -398856.  | 31188. | -0.00564  | 24145. | 9.45E+09 |
| -400.9453 | 3105.    | 0.00      |        |           |        |          |
| 3.8550    | 0.3806   | -297701.  | 29924. | -0.00575  | 21864. | 9.45E+09 |
| -418.3251 | 3390.    | 0.00      |        |           |        |          |
| 4.1120    | 0.3627   | -200407.  | 28607. | -0.00584  | 19669. | 9.45E+09 |
| -435.7153 | 3705.    | 0.00      |        |           |        |          |
| 4.3690    | 0.3446   | -107179.  | 27244. | -0.00589  | 17566. | 9.45E+09 |
| -448.3133 | 4012.    | 0.00      |        |           |        |          |
| 4.6260    | 0.3264   | -18172.   | 25850. | -0.00591  | 15558. | 9.45E+09 |
| -455.5141 | 4304.    | 0.00      |        |           |        |          |
| 4.8830    | 0.3082   | 66510.    | 24444. | -0.00590  | 16649. | 9.45E+09 |
| -456.7269 | 4571.    | 0.00      |        |           |        |          |
| 5.1400    | 0.2900   | 146821.   | 23007. | -0.00586  | 18460. | 9.45E+09 |
| -475.2549 | 5054.    | 0.00      |        |           |        |          |
| 5.3970    | 0.2720   | 222554.   | 21514. | -0.00580  | 20168. | 9.45E+09 |
| -493.0508 | 5590.    | 0.00      |        |           |        |          |
| 5.6540    | 0.2542   | 293511.   | 19969. | -0.00572  | 21769. | 9.45E+09 |
| -508.3738 | 6167.    | 0.00      |        |           |        |          |
| 5.9110    | 0.2367   | 359516.   | 18382. | -0.00561  | 23258. | 9.45E+09 |

|           |          |         |           |           |        |          |
|-----------|----------|---------|-----------|-----------|--------|----------|
| -520.9910 | 6787.    | 0.00    |           |           |        |          |
| 6.1680    | 0.2196   | 420425. | 16759.    | -0.00548  | 24632. | 9.45E+09 |
| -531.4516 | 7463.    | 0.00    |           |           |        |          |
| 6.4250    | 0.2029   | 476114. | 15099.    | -0.00534  | 25888. | 9.45E+09 |
| -545.0959 | 8285.    | 0.00    |           |           |        |          |
| 6.6820    | 0.1867   | 526431. | 13401.    | -0.00517  | 27023. | 9.45E+09 |
| -556.1891 | 9188.    | 0.00    |           |           |        |          |
| 6.9390    | 0.1710   | 571251. | 11673.    | -0.00500  | 28034. | 9.45E+09 |
| -564.5817 | 10183.   | 0.00    |           |           |        |          |
| 7.1960    | 0.1559   | 610476. | 9923.     | -0.00480  | 28919. | 9.45E+09 |
| -570.1405 | 11280.   | 0.00    |           |           |        |          |
| 7.4530    | 0.1414   | 644039. | 8161.     | -0.00460  | 29676. | 9.45E+09 |
| -572.7496 | 12495.   | 0.00    |           |           |        |          |
| 7.7100    | 0.1275   | 671900. | 6395.     | -0.00438  | 30304. | 9.45E+09 |
| -572.3097 | 13842.   | 0.00    |           |           |        |          |
| 7.9670    | 0.1143   | 694054. | 4635.     | -0.00416  | 30804. | 9.45E+09 |
| -568.7385 | 15341.   | 0.00    |           |           |        |          |
| 8.2240    | 0.1019   | 710525. | 2892.     | -0.00393  | 31176. | 9.45E+09 |
| -561.9694 | 17016.   | 0.00    |           |           |        |          |
| 8.4810    | 0.09009  | 721372. | 1174.     | -0.00370  | 31420. | 9.45E+09 |
| -551.9502 | 18895.   | 0.00    |           |           |        |          |
| 8.7380    | 0.07905  | 726685. | -507.4188 | -0.00346  | 31540. | 9.45E+09 |
| -538.6403 | 21015.   | 0.00    |           |           |        |          |
| 8.9950    | 0.06874  | 726589. | -2143.    | -0.00322  | 31538. | 9.45E+09 |
| -522.0075 | 23420.   | 0.00    |           |           |        |          |
| 9.2520    | 0.05916  | 721242. | -3722.    | -0.00299  | 31418. | 9.45E+09 |
| -502.0220 | 26169.   | 0.00    |           |           |        |          |
| 9.5090    | 0.05031  | 710837. | -5234.    | -0.00275  | 31183. | 9.45E+09 |
| -478.6484 | 29340.   | 0.00    |           |           |        |          |
| 9.7660    | 0.04218  | 695599. | -6645.    | -0.00252  | 30839. | 9.45E+09 |
| -436.4571 | 31913.   | 0.00    |           |           |        |          |
| 10.0230   | 0.03474  | 675936. | -7887.    | -0.00230  | 30396. | 9.45E+09 |
| -368.9828 | 32753.   | 0.00    |           |           |        |          |
| 10.2800   | 0.02799  | 652498. | -8926.    | -0.00208  | 29867. | 9.45E+09 |
| -304.8710 | 33593.   | 0.00    |           |           |        |          |
| 10.5370   | 0.02189  | 625904. | -9773.    | -0.00187  | 29267. | 9.45E+09 |
| -244.4139 | 34433.   | 0.00    |           |           |        |          |
| 10.7940   | 0.01642  | 596738. | -10440.   | -0.00168  | 28609. | 9.45E+09 |
| -187.8421 | 35273.   | 0.00    |           |           |        |          |
| 11.0510   | 0.01156  | 565551. | -10938.   | -0.00149  | 27906. | 9.45E+09 |
| -135.3264 | 36113.   | 0.00    |           |           |        |          |
| 11.3080   | 0.00726  | 532854. | -11281.   | -0.00131  | 27168. | 9.45E+09 |
| -86.9815  | 36952.   | 0.00    |           |           |        |          |
| 11.5650   | 0.00350  | 499121. | -11481.   | -0.00114  | 26407. | 9.45E+09 |
| -42.8691  | 37792.   | 0.00    |           |           |        |          |
| 11.8220   | 2.40E-04 | 464783. | -11552.   | -9.81E-04 | 25632. | 9.45E+09 |
| -3.0020   | 38632.   | 0.00    |           |           |        |          |
| 12.0790   | -0.00255 | 430233. | -11506.   | -8.35E-04 | 24853. | 9.45E+09 |
| 32.6517   | 39472.   | 0.00    |           |           |        |          |
| 12.3360   | -0.00491 | 395825. | -11357.   | -7.00E-04 | 24077. | 9.45E+09 |

|          |          |         |           |           |        |          |
|----------|----------|---------|-----------|-----------|--------|----------|
| 64.1643  | 40312.   | 0.00    |           |           |        |          |
| 12.5930  | -0.00687 | 361872. | -11117.   | -5.76E-04 | 23311. | 9.45E+09 |
| 91.6443  | 41151.   | 0.00    |           |           |        |          |
| 12.8500  | -0.00846 | 328647. | -10798.   | -4.64E-04 | 22562. | 9.45E+09 |
| 115.2315 | 41991.   | 0.00    |           |           |        |          |
| 13.1070  | -0.00973 | 296389. | -10412.   | -3.62E-04 | 21834. | 9.45E+09 |
| 135.0928 | 42831.   | 0.00    |           |           |        |          |
| 13.3640  | -0.01069 | 265300. | -9970.    | -2.70E-04 | 21133. | 9.45E+09 |
| 151.4178 | 43671.   | 0.00    |           |           |        |          |
| 13.6210  | -0.01139 | 235546. | -9483.    | -1.88E-04 | 20462. | 9.45E+09 |
| 164.4143 | 44511.   | 0.00    |           |           |        |          |
| 13.8780  | -0.01185 | 207263. | -8961.    | -1.16E-04 | 19824. | 9.45E+09 |
| 174.3046 | 45351.   | 0.00    |           |           |        |          |
| 14.1350  | -0.01211 | 180556. | -8412.    | -5.26E-05 | 19221. | 9.45E+09 |
| 181.3216 | 46190.   | 0.00    |           |           |        |          |
| 14.3920  | -0.01218 | 155503. | -7846.    | 2.28E-06  | 18656. | 9.45E+09 |
| 185.7046 | 47030.   | 0.00    |           |           |        |          |
| 14.6490  | -0.01209 | 132155. | -7270.    | 4.92E-05  | 18129. | 9.45E+09 |
| 187.6966 | 47870.   | 0.00    |           |           |        |          |
| 14.9060  | -0.01187 | 110540. | -6692.    | 8.88E-05  | 17642. | 9.45E+09 |
| 187.5411 | 48710.   | 0.00    |           |           |        |          |
| 15.1630  | -0.01154 | 90665.  | -6117.    | 1.22E-04  | 17193. | 9.45E+09 |
| 185.4788 | 49550.   | 0.00    |           |           |        |          |
| 15.4200  | -0.01112 | 72519.  | -5550.    | 1.48E-04  | 16784. | 9.45E+09 |
| 181.7458 | 50390.   | 0.00    |           |           |        |          |
| 15.6770  | -0.01063 | 56073.  | -4998.    | 1.69E-04  | 16413. | 9.45E+09 |
| 176.5709 | 51229.   | 0.00    |           |           |        |          |
| 15.9340  | -0.01008 | 41284.  | -4463.    | 1.85E-04  | 16080. | 9.45E+09 |
| 170.1741 | 52069.   | 0.00    |           |           |        |          |
| 16.1910  | -0.00949 | 28097.  | -3950.    | 1.97E-04  | 15782. | 9.45E+09 |
| 162.7646 | 52909.   | 0.00    |           |           |        |          |
| 16.4480  | -0.00887 | 16448.  | -3461.    | 2.04E-04  | 15519. | 9.45E+09 |
| 154.5398 | 53749.   | 0.00    |           |           |        |          |
| 16.7050  | -0.00823 | 6261.   | -2998.    | 2.07E-04  | 15289. | 9.45E+09 |
| 145.6841 | 54589.   | 0.00    |           |           |        |          |
| 16.9620  | -0.00759 | -2542.  | -2563.    | 2.08E-04  | 15206. | 9.45E+09 |
| 136.3684 | 55429.   | 0.00    |           |           |        |          |
| 17.2190  | -0.00695 | -10047. | -2157.    | 2.06E-04  | 15375. | 9.45E+09 |
| 126.7492 | 56268.   | 0.00    |           |           |        |          |
| 17.4760  | -0.00632 | -16342. | -1781.    | 2.02E-04  | 15517. | 9.45E+09 |
| 116.9684 | 57108.   | 0.00    |           |           |        |          |
| 17.7330  | -0.00570 | -21519. | -1436.    | 1.96E-04  | 15634. | 9.45E+09 |
| 107.1534 | 57948.   | 0.00    |           |           |        |          |
| 17.9900  | -0.00511 | -25668. | -1120.    | 1.88E-04  | 15727. | 9.45E+09 |
| 97.4170  | 58788.   | 0.00    |           |           |        |          |
| 18.2470  | -0.00454 | -28881. | -834.3699 | 1.79E-04  | 15800. | 9.45E+09 |
| 87.8576  | 59628.   | 0.00    |           |           |        |          |
| 18.5040  | -0.00401 | -31246. | -577.7542 | 1.69E-04  | 15853. | 9.45E+09 |
| 78.5598  | 60467.   | 0.00    |           |           |        |          |
| 18.7610  | -0.00350 | -32852. | -349.3001 | 1.59E-04  | 15889. | 9.45E+09 |

|          |           |           |           |          |        |          |
|----------|-----------|-----------|-----------|----------|--------|----------|
| 69.5946  | 61307.    | 0.00      |           |          |        |          |
| 19.0180  | -0.00303  | -33783.   | -147.8921 | 1.48E-04 | 15910. | 9.45E+09 |
| 61.0202  | 62147.    | 0.00      |           |          |        |          |
| 19.2750  | -0.00259  | -34121.   | 27.7466   | 1.37E-04 | 15918. | 9.45E+09 |
| 52.8829  | 62987.    | 0.00      |           |          |        |          |
| 19.5320  | -0.00218  | -33942.   | 179.0175  | 1.26E-04 | 15914. | 9.45E+09 |
| 45.2175  | 63827.    | 0.00      |           |          |        |          |
| 19.7890  | -0.00181  | -33320.   | 307.4134  | 1.15E-04 | 15900. | 9.45E+09 |
| 38.0483  | 64667.    | 0.00      |           |          |        |          |
| 20.0460  | -0.00148  | -32322.   | 414.4869  | 1.04E-04 | 15877. | 9.45E+09 |
| 31.3898  | 65506.    | 0.00      |           |          |        |          |
| 20.3030  | -0.00117  | -31014.   | 501.8221  | 9.36E-05 | 15848. | 9.45E+09 |
| 25.2478  | 66346.    | 0.00      |           |          |        |          |
| 20.5600  | -9.01E-04 | -29453.   | 571.0088  | 8.37E-05 | 15813. | 9.45E+09 |
| 19.6203  | 67186.    | 0.00      |           |          |        |          |
| 20.8170  | -6.57E-04 | -27694.   | 623.6195  | 7.44E-05 | 15773. | 9.45E+09 |
| 14.4981  | 68026.    | 0.00      |           |          |        |          |
| 21.0740  | -4.42E-04 | -25786.   | 661.1888  | 6.57E-05 | 15730. | 9.45E+09 |
| 9.8659   | 68866.    | 0.00      |           |          |        |          |
| 21.3310  | -2.52E-04 | -23774.   | 685.1960  | 5.76E-05 | 15685. | 9.45E+09 |
| 5.7030   | 69706.    | 0.00      |           |          |        |          |
| 21.5880  | -8.67E-05 | -21698.   | 697.0498  | 5.01E-05 | 15638. | 9.45E+09 |
| 1.9843   | 70545.    | 0.00      |           |          |        |          |
| 21.8450  | 5.70E-05  | -19595.   | 698.0757  | 4.34E-05 | 15590. | 9.45E+09 |
| -1.3190  | 71385.    | 0.00      |           |          |        |          |
| 22.1020  | 1.81E-04  | -17497.   | 689.5058  | 3.74E-05 | 15543. | 9.45E+09 |
| -4.2386  | 72225.    | 0.00      |           |          |        |          |
| 22.3590  | 2.87E-04  | -15432.   | 672.4711  | 3.20E-05 | 15496. | 9.45E+09 |
| -6.8085  | 73065.    | 0.00      |           |          |        |          |
| 22.6160  | 3.78E-04  | -13426.   | 647.9957  | 2.73E-05 | 15451. | 9.45E+09 |
| -9.0641  | 73905.    | 0.00      |           |          |        |          |
| 22.8730  | 4.56E-04  | -11501.   | 616.9929  | 2.32E-05 | 15408. | 9.45E+09 |
| -11.0415 | 74745.    | 0.00      |           |          |        |          |
| 23.1300  | 5.21E-04  | -9677.    | 580.2641  | 1.97E-05 | 15367. | 9.45E+09 |
| -12.7774 | 75584.    | 0.00      |           |          |        |          |
| 23.3870  | 5.77E-04  | -7970.    | 538.4990  | 1.69E-05 | 15328. | 9.45E+09 |
| -14.3076 | 76424.    | 0.00      |           |          |        |          |
| 23.6440  | 6.25E-04  | -6396.    | 492.2775  | 1.45E-05 | 15293. | 9.45E+09 |
| -15.6674 | 77264.    | 0.00      |           |          |        |          |
| 23.9010  | 6.67E-04  | -4969.    | 442.0734  | 1.27E-05 | 15260. | 9.45E+09 |
| -16.8903 | 78104.    | 0.00      |           |          |        |          |
| 24.1580  | 7.03E-04  | -3700.    | 388.2606  | 1.13E-05 | 15232. | 9.45E+09 |
| -18.0078 | 78944.    | 0.00      |           |          |        |          |
| 24.4150  | 7.36E-04  | -2601.    | 331.1193  | 1.02E-05 | 15207. | 9.45E+09 |
| -19.0488 | 79783.    | 0.00      |           |          |        |          |
| 24.6720  | 7.67E-04  | -1682.    | 270.8453  | 9.52E-06 | 15186. | 9.45E+09 |
| -20.0393 | 80623.    | 0.00      |           |          |        |          |
| 24.9290  | 7.95E-04  | -953.2698 | 207.5603  | 9.09E-06 | 15170. | 9.45E+09 |
| -21.0015 | 81463.    | 0.00      |           |          |        |          |
| 25.1860  | 8.23E-04  | -423.8054 | 141.3233  | 8.87E-06 | 15158. | 9.45E+09 |

|          |          |           |         |          |        |          |
|----------|----------|-----------|---------|----------|--------|----------|
| -21.9537 | 82303.   | 0.00      |         |          |        |          |
| 25.4430  | 8.50E-04 | -102.9769 | 72.1445 | 8.78E-06 | 15151. | 9.45E+09 |
| -22.9093 | 83143.   | 0.00      |         |          |        |          |
| 25.7000  | 8.77E-04 | 0.00      | 0.00    | 8.77E-06 | 15148. | 9.45E+09 |
| -23.8770 | 41991.   | 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             | = | 0.55000000 inches             |
| Computed slope at pile head      | = | 0.000000 radians              |
| Maximum bending moment           | = | -2084572. inch-lbs            |
| Maximum shear force              | = | 41126. 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             | = | 9                             |
| Number of zero deflection points | = | 2                             |

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

Pile-head conditions are Displacement and Moment (Loading Type 4)

|                           |   |                  |
|---------------------------|---|------------------|
| Displacement of pile head | = | 0.550000 inches  |
| Moment at pile head       | = | 1941939.0 in-lbs |
| Axial load at pile head   | = | 391000.0 lbs     |

| Depth<br>Res. | Soil<br>X | Deflect.<br>Spr. y | Bending<br>Distrib.<br>Moment | Shear<br>Force | Slope<br>S | Total<br>Stress | Bending<br>Stiffness | Soil<br>p |
|---------------|-----------|--------------------|-------------------------------|----------------|------------|-----------------|----------------------|-----------|
|               | Es*H      | Lat. Load          |                               |                |            |                 |                      |           |
| feet          | inches    | in-lbs             | lbs                           | radians        | psi*       | lb-in^2         |                      |           |
| lb/inch       | lb/inch   | lb/inch            |                               |                |            |                 |                      |           |
| 0.00          | 0.5500    | 1941939.           | -10649.                       | -0.01444       | 58953.     | 9.03E+09        |                      |           |
| 0.00          | 0.00      | 0.00               |                               |                |            |                 |                      |           |
| 0.2570        | 0.5065    | 1926110.           | -10694.                       | -0.01378       | 58596.     | 9.03E+09        |                      |           |
| -29.0401      | 176.8249  | 0.00               |                               |                |            |                 |                      |           |
| 0.5140        | 0.4650    | 1909211.           | -10832.                       | -0.01313       | 58215.     | 9.10E+09        |                      |           |

|           |           |          |         |          |        |          |
|-----------|-----------|----------|---------|----------|--------|----------|
| -60.2190  | 399.3838  | 0.00     |         |          |        |          |
| 0.7710    | 0.4255    | 1890960. | -11066. | -0.01249 | 57803. | 9.13E+09 |
| -91.6752  | 664.4309  | 0.00     |         |          |        |          |
| 1.0280    | 0.3880    | 1871067. | -11395. | -0.01185 | 57354. | 9.17E+09 |
| -121.8806 | 968.7698  | 0.00     |         |          |        |          |
| 1.2850    | 0.3524    | 1849256. | -11814. | -0.01123 | 56862. | 9.20E+09 |
| -149.7831 | 1311.     | 0.00     |         |          |        |          |
| 1.5420    | 0.3188    | 1825273. | -12315. | -0.01061 | 56321. | 9.24E+09 |
| -174.8841 | 1692.     | 0.00     |         |          |        |          |
| 1.7990    | 0.2870    | 1798891. | -12886. | -0.01001 | 55726. | 9.27E+09 |
| -195.8462 | 2105.     | 0.00     |         |          |        |          |
| 2.0560    | 0.2570    | 1769925. | -13520. | -0.00942 | 55073. | 9.31E+09 |
| -215.0810 | 2581.     | 0.00     |         |          |        |          |
| 2.3130    | 0.2289    | 1738207. | -14207. | -0.00884 | 54357. | 9.34E+09 |
| -230.2476 | 3102.     | 0.00     |         |          |        |          |
| 2.5700    | 0.2025    | 1703606. | -14934. | -0.00827 | 53577. | 9.37E+09 |
| -241.1856 | 3673.     | 0.00     |         |          |        |          |
| 2.8270    | 0.1779    | 1666036. | -15688. | -0.00771 | 52729. | 9.40E+09 |
| -248.1365 | 4302.     | 0.00     |         |          |        |          |
| 3.0840    | 0.1549    | 1625447. | -16456. | -0.00718 | 51814. | 9.43E+09 |
| -249.5015 | 4966.     | 0.00     |         |          |        |          |
| 3.3410    | 0.1336    | 1581844. | -17223. | -0.00665 | 50830. | 9.44E+09 |
| -248.1385 | 5727.     | 0.00     |         |          |        |          |
| 3.5980    | 0.1139    | 1535257. | -17976. | -0.00614 | 49779. | 9.45E+09 |
| -240.0617 | 6499.     | 0.00     |         |          |        |          |
| 3.8550    | 0.09574   | 1485784. | -18702. | -0.00565 | 48663. | 9.45E+09 |
| -230.9771 | 7440.     | 0.00     |         |          |        |          |
| 4.1120    | 0.07907   | 1433528. | -19394. | -0.00517 | 47485. | 9.45E+09 |
| -217.8878 | 8498.     | 0.00     |         |          |        |          |
| 4.3690    | 0.06384   | 1378636. | -20036. | -0.00471 | 46247. | 9.45E+09 |
| -198.2344 | 9577.     | 0.00     |         |          |        |          |
| 4.6260    | 0.04999   | 1321316. | -20607. | -0.00427 | 44954. | 9.45E+09 |
| -172.2875 | 10629.    | 0.00     |         |          |        |          |
| 4.8830    | 0.03748   | 1261837. | -21090. | -0.00385 | 43612. | 9.45E+09 |
| -140.8140 | 11588.    | 0.00     |         |          |        |          |
| 5.1400    | 0.02623   | 1200522. | -21494. | -0.00345 | 42229. | 9.45E+09 |
| -121.0467 | 14231.    | 0.00     |         |          |        |          |
| 5.3970    | 0.01620   | 1137584. | -21823. | -0.00307 | 40809. | 9.45E+09 |
| -92.6198  | 17636.    | 0.00     |         |          |        |          |
| 5.6540    | 0.00731   | 1073317. | -22034. | -0.00271 | 39359. | 9.45E+09 |
| -43.7649  | 18476.    | 0.00     |         |          |        |          |
| 5.9110    | -5.05E-04 | 1008211. | -22096. | -0.00237 | 37891. | 9.45E+09 |
| 3.1653    | 19316.    | 0.00     |         |          |        |          |
| 6.1680    | -0.00730  | 942738.  | -22018. | -0.00205 | 36414. | 9.45E+09 |
| 47.7163   | 20156.    | 0.00     |         |          |        |          |
| 6.4250    | -0.01315  | 877349.  | -21806. | -0.00175 | 34939. | 9.45E+09 |
| 89.5078   | 20996.    | 0.00     |         |          |        |          |
| 6.6820    | -0.01811  | 812465.  | -21470. | -0.00148 | 33475. | 9.45E+09 |
| 128.2305  | 21835.    | 0.00     |         |          |        |          |
| 6.9390    | -0.02226  | 748481.  | -21021. | -0.00122 | 32032. | 9.45E+09 |

|          |          |         |         |           |        |          |
|----------|----------|---------|---------|-----------|--------|----------|
| 163.4252 | 22645.   | 0.00    |         |           |        |          |
| 7.1960   | -0.02565 | 685757. | -20475. | -9.88E-04 | 30617. | 9.45E+09 |
| 190.3170 | 22884.   | 0.00    |         |           |        |          |
| 7.4530   | -0.02835 | 624572. | -19849. | -7.74E-04 | 29237. | 9.45E+09 |
| 215.6238 | 23456.   | 0.00    |         |           |        |          |
| 7.7100   | -0.03042 | 565193. | -19147. | -5.80E-04 | 27897. | 9.45E+09 |
| 239.4623 | 24274.   | 0.00    |         |           |        |          |
| 7.9670   | -0.03193 | 507869. | -18374. | -4.05E-04 | 26604. | 9.45E+09 |
| 261.8601 | 25294.   | 0.00    |         |           |        |          |
| 8.2240   | -0.03292 | 452836. | -17535. | -2.48E-04 | 25363. | 9.45E+09 |
| 282.7997 | 26492.   | 0.00    |         |           |        |          |
| 8.4810   | -0.03346 | 400314. | -16635. | -1.09E-04 | 24178. | 9.45E+09 |
| 300.6686 | 27714.   | 0.00    |         |           |        |          |
| 8.7380   | -0.03359 | 350495. | -15692. | 1.37E-05  | 23054. | 9.45E+09 |
| 311.0217 | 28554.   | 0.00    |         |           |        |          |
| 8.9950   | -0.03337 | 303495. | -14722. | 1.20E-04  | 21994. | 9.45E+09 |
| 318.0851 | 29394.   | 0.00    |         |           |        |          |
| 9.2520   | -0.03285 | 259402. | -13735. | 2.12E-04  | 21000. | 9.45E+09 |
| 322.0343 | 30234.   | 0.00    |         |           |        |          |
| 9.5090   | -0.03206 | 218269. | -12740. | 2.90E-04  | 20072. | 9.45E+09 |
| 323.0671 | 31074.   | 0.00    |         |           |        |          |
| 9.7660   | -0.03106 | 180123. | -11746. | 3.55E-04  | 19211. | 9.45E+09 |
| 321.3985 | 31913.   | 0.00    |         |           |        |          |
| 10.0230  | -0.02987 | 144963. | -10761. | 4.08E-04  | 18418. | 9.45E+09 |
| 317.2569 | 32753.   | 0.00    |         |           |        |          |
| 10.2800  | -0.02854 | 112763. | -9793.  | 4.50E-04  | 17692. | 9.45E+09 |
| 310.8796 | 33593.   | 0.00    |         |           |        |          |
| 10.5370  | -0.02709 | 83476.  | -8847.  | 4.82E-04  | 17031. | 9.45E+09 |
| 302.5094 | 34433.   | 0.00    |         |           |        |          |
| 10.7940  | -0.02556 | 57033.  | -7929.  | 5.05E-04  | 16435. | 9.45E+09 |
| 292.3907 | 35273.   | 0.00    |         |           |        |          |
| 11.0510  | -0.02398 | 33348.  | -7046.  | 5.20E-04  | 15901. | 9.45E+09 |
| 280.7666 | 36113.   | 0.00    |         |           |        |          |
| 11.3080  | -0.02236 | 12321.  | -6200.  | 5.28E-04  | 15426. | 9.45E+09 |
| 267.8757 | 36952.   | 0.00    |         |           |        |          |
| 11.5650  | -0.02072 | -6163.  | -5395.  | 5.29E-04  | 15287. | 9.45E+09 |
| 253.9502 | 37792.   | 0.00    |         |           |        |          |
| 11.8220  | -0.01910 | -22230. | -4634.  | 5.24E-04  | 15650. | 9.45E+09 |
| 239.2128 | 38632.   | 0.00    |         |           |        |          |
| 12.0790  | -0.01749 | -36012. | -3920.  | 5.14E-04  | 15961. | 9.45E+09 |
| 223.8758 | 39472.   | 0.00    |         |           |        |          |
| 12.3360  | -0.01592 | -47652. | -3254.  | 5.01E-04  | 16223. | 9.45E+09 |
| 208.1387 | 40312.   | 0.00    |         |           |        |          |
| 12.5930  | -0.01440 | -57292. | -2637.  | 4.84E-04  | 16441. | 9.45E+09 |
| 192.1874 | 41151.   | 0.00    |         |           |        |          |
| 12.8500  | -0.01294 | -65083. | -2069.  | 4.64E-04  | 16616. | 9.45E+09 |
| 176.1933 | 41991.   | 0.00    |         |           |        |          |
| 13.1070  | -0.01154 | -71172. | -1550.  | 4.41E-04  | 16754. | 9.45E+09 |
| 160.3125 | 42831.   | 0.00    |         |           |        |          |
| 13.3640  | -0.01022 | -75708. | -1080.  | 4.17E-04  | 16856. | 9.45E+09 |

|          |           |         |           |           |        |          |
|----------|-----------|---------|-----------|-----------|--------|----------|
| 144.6852 | 43671.    | 0.00    |           |           |        |          |
| 13.6210  | -0.00897  | -78838. | -657.0049 | 3.92E-04  | 16927. | 9.45E+09 |
| 129.4359 | 44511.    | 0.00    |           |           |        |          |
| 13.8780  | -0.00780  | -80706. | -280.5888 | 3.66E-04  | 16969. | 9.45E+09 |
| 114.6731 | 45351.    | 0.00    |           |           |        |          |
| 14.1350  | -0.00671  | -81452. | 51.1927   | 3.40E-04  | 16986. | 9.45E+09 |
| 100.4900 | 46190.    | 0.00    |           |           |        |          |
| 14.3920  | -0.00570  | -81210. | 340.2469  | 3.13E-04  | 16980. | 9.45E+09 |
| 86.9642  | 47030.    | 0.00    |           |           |        |          |
| 14.6490  | -0.00478  | -80108. | 588.6987  | 2.87E-04  | 16955. | 9.45E+09 |
| 74.1589  | 47870.    | 0.00    |           |           |        |          |
| 14.9060  | -0.00393  | -78270. | 798.8464  | 2.61E-04  | 16914. | 9.45E+09 |
| 62.1236  | 48710.    | 0.00    |           |           |        |          |
| 15.1630  | -0.00317  | -75811. | 973.1198  | 2.36E-04  | 16858. | 9.45E+09 |
| 50.8942  | 49550.    | 0.00    |           |           |        |          |
| 15.4200  | -0.00248  | -72837. | 1114.     | 2.12E-04  | 16791. | 9.45E+09 |
| 40.4948  | 50390.    | 0.00    |           |           |        |          |
| 15.6770  | -0.00186  | -69450. | 1224.     | 1.88E-04  | 16715. | 9.45E+09 |
| 30.9379  | 51229.    | 0.00    |           |           |        |          |
| 15.9340  | -0.00132  | -65741. | 1306.     | 1.66E-04  | 16631. | 9.45E+09 |
| 22.2259  | 52069.    | 0.00    |           |           |        |          |
| 16.1910  | -8.37E-04 | -61794. | 1363.     | 1.46E-04  | 16542. | 9.45E+09 |
| 14.3519  | 52909.    | 0.00    |           |           |        |          |
| 16.4480  | -4.19E-04 | -57687. | 1396.     | 1.26E-04  | 16450. | 9.45E+09 |
| 7.3006   | 53749.    | 0.00    |           |           |        |          |
| 16.7050  | -5.93E-05 | -53488. | 1409.     | 1.08E-04  | 16355. | 9.45E+09 |
| 1.0497   | 54589.    | 0.00    |           |           |        |          |
| 16.9620  | 2.46E-04  | -49258. | 1404.     | 9.11E-05  | 16259. | 9.45E+09 |
| -4.4294  | 55429.    | 0.00    |           |           |        |          |
| 17.2190  | 5.03E-04  | -45050. | 1383.     | 7.57E-05  | 16164. | 9.45E+09 |
| -9.1703  | 56268.    | 0.00    |           |           |        |          |
| 17.4760  | 7.13E-04  | -40912. | 1348.     | 6.17E-05  | 16071. | 9.45E+09 |
| -13.2109 | 57108.    | 0.00    |           |           |        |          |
| 17.7330  | 8.83E-04  | -36883. | 1302.     | 4.90E-05  | 15980. | 9.45E+09 |
| -16.5926 | 57948.    | 0.00    |           |           |        |          |
| 17.9900  | 0.00102   | -32998. | 1247.     | 3.76E-05  | 15893. | 9.45E+09 |
| -19.3589 | 58788.    | 0.00    |           |           |        |          |
| 18.2470  | 0.00111   | -29284. | 1184.     | 2.74E-05  | 15809. | 9.45E+09 |
| -21.5551 | 59628.    | 0.00    |           |           |        |          |
| 18.5040  | 0.00118   | -25763. | 1115.     | 1.84E-05  | 15729. | 9.45E+09 |
| -23.2274 | 60467.    | 0.00    |           |           |        |          |
| 18.7610  | 0.00123   | -22454. | 1041.     | 1.06E-05  | 15655. | 9.45E+09 |
| -24.4222 | 61307.    | 0.00    |           |           |        |          |
| 19.0180  | 0.00125   | -19367. | 964.6338  | 3.74E-06  | 15585. | 9.45E+09 |
| -25.1854 | 62147.    | 0.00    |           |           |        |          |
| 19.2750  | 0.00125   | -16513. | 886.3813  | -2.12E-06 | 15521. | 9.45E+09 |
| -25.5620 | 62987.    | 0.00    |           |           |        |          |
| 19.5320  | 0.00124   | -13895. | 807.4962  | -7.08E-06 | 15462. | 9.45E+09 |
| -25.5956 | 63827.    | 0.00    |           |           |        |          |
| 19.7890  | 0.00121   | -11515. | 728.9723  | -1.12E-05 | 15408. | 9.45E+09 |

|          |           |           |          |           |        |          |
|----------|-----------|-----------|----------|-----------|--------|----------|
| -25.3278 | 64667.    | 0.00      |          |           |        |          |
| 20.0460  | 0.00117   | -9372.    | 651.6782 | -1.46E-05 | 15360. | 9.45E+09 |
| -24.7981 | 65506.    | 0.00      |          |           |        |          |
| 20.3030  | 0.00112   | -7460.    | 576.3647 | -1.74E-05 | 15317. | 9.45E+09 |
| -24.0434 | 66346.    | 0.00      |          |           |        |          |
| 20.5600  | 0.00106   | -5775.    | 503.6728 | -1.95E-05 | 15279. | 9.45E+09 |
| -23.0979 | 67186.    | 0.00      |          |           |        |          |
| 20.8170  | 9.97E-04  | -4306.    | 434.1425 | -2.12E-05 | 15245. | 9.45E+09 |
| -21.9930 | 68026.    | 0.00      |          |           |        |          |
| 21.0740  | 9.30E-04  | -3046.    | 368.2221 | -2.24E-05 | 15217. | 9.45E+09 |
| -20.7569 | 68866.    | 0.00      |          |           |        |          |
| 21.3310  | 8.59E-04  | -1981.    | 306.2774 | -2.32E-05 | 15193. | 9.45E+09 |
| -19.4147 | 69706.    | 0.00      |          |           |        |          |
| 21.5880  | 7.86E-04  | -1101.    | 248.6018 | -2.37E-05 | 15173. | 9.45E+09 |
| -17.9885 | 70545.    | 0.00      |          |           |        |          |
| 21.8450  | 7.13E-04  | -390.7036 | 195.4251 | -2.40E-05 | 15157. | 9.45E+09 |
| -16.4970 | 71385.    | 0.00      |          |           |        |          |
| 22.1020  | 6.39E-04  | 162.4999  | 146.9242 | -2.40E-05 | 15152. | 9.45E+09 |
| -14.9563 | 72225.    | 0.00      |          |           |        |          |
| 22.3590  | 5.65E-04  | 573.3896  | 103.2312 | -2.39E-05 | 15161. | 9.45E+09 |
| -13.3790 | 73065.    | 0.00      |          |           |        |          |
| 22.6160  | 4.91E-04  | 856.8050  | 64.4431  | -2.36E-05 | 15168. | 9.45E+09 |
| -11.7754 | 73905.    | 0.00      |          |           |        |          |
| 22.8730  | 4.19E-04  | 1028.     | 30.6301  | -2.33E-05 | 15171. | 9.45E+09 |
| -10.1527 | 74745.    | 0.00      |          |           |        |          |
| 23.1300  | 3.47E-04  | 1102.     | 1.8433   | -2.30E-05 | 15173. | 9.45E+09 |
| -8.5158  | 75584.    | 0.00      |          |           |        |          |
| 23.3870  | 2.77E-04  | 1095.     | -21.8779 | -2.26E-05 | 15173. | 9.45E+09 |
| -6.8676  | 76424.    | 0.00      |          |           |        |          |
| 23.6440  | 2.08E-04  | 1022.     | -40.4995 | -2.23E-05 | 15171. | 9.45E+09 |
| -5.2087  | 77264.    | 0.00      |          |           |        |          |
| 23.9010  | 1.40E-04  | 898.6226  | -53.9870 | -2.20E-05 | 15169. | 9.45E+09 |
| -3.5381  | 78104.    | 0.00      |          |           |        |          |
| 24.1580  | 7.24E-05  | 741.6139  | -62.3008 | -2.17E-05 | 15165. | 9.45E+09 |
| -1.8535  | 78944.    | 0.00      |          |           |        |          |
| 24.4150  | 5.86E-06  | 566.6845  | -65.3926 | -2.15E-05 | 15161. | 9.45E+09 |
| -0.1516  | 79783.    | 0.00      |          |           |        |          |
| 24.6720  | -6.01E-05 | 390.0905  | -63.2028 | -2.13E-05 | 15157. | 9.45E+09 |
| 1.5717   | 80623.    | 0.00      |          |           |        |          |
| 24.9290  | -1.26E-04 | 228.2913  | -55.6591 | -2.12E-05 | 15153. | 9.45E+09 |
| 3.3205   | 81463.    | 0.00      |          |           |        |          |
| 25.1860  | -1.91E-04 | 97.9836   | -42.6764 | -2.12E-05 | 15150. | 9.45E+09 |
| 5.0989   | 82303.    | 0.00      |          |           |        |          |
| 25.4430  | -2.56E-04 | 16.1332   | -24.1584 | -2.12E-05 | 15149. | 9.45E+09 |
| 6.9102   | 83143.    | 0.00      |          |           |        |          |
| 25.7000  | -3.22E-04 | 0.00      | 0.00     | -2.12E-05 | 15148. | 9.45E+09 |
| 8.7567   | 41991.    | 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           =      0.55000000 inches
Computed slope at pile head   =     -0.01444015 radians
Maximum bending moment        =      1941939. inch-lbs
Maximum shear force           =      -22096. lbs
Depth of maximum bending moment =      0.000000 feet below pile head
Depth of maximum shear force   =      5.91100000 feet below pile head
Number of iterations          =              16
Number of zero deflection points =              3
```

## 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       | 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      | 0.5500    | S, rad    | 0.00      | 391000. | 0.5500     | 0.00     |     |
| 41126.  | -2084572.  |           |           |           |         |            |          |     |
| 2       | y, in      | 0.5500    | M, in-lb  | 1941939.  | 391000. | 0.5500     | -0.01444 |     |
| -22096. | 1941939.   |           |           |           |         |            |          |     |

Maximum pile-head deflection = 0.5500000000 inches  
Maximum pile-head rotation = -0.0144401483 radians = -0.827360 deg.

The analysis ended normally.



## CALCULATIONS

|                       |                                                        |                     |     |
|-----------------------|--------------------------------------------------------|---------------------|-----|
| <b>Date:</b>          | 7/22/2025                                              | <b>Made by:</b>     | DEB |
| <b>Project No.:</b>   | US0025840.9367                                         | <b>Checked by:</b>  | KAR |
| <b>Subject:</b>       | HP14x89 Pile Design at Proposed Abutment 2             | <b>Reviewed by:</b> | CCB |
| <b>Project Title:</b> | Phair Crossing Bridge Presque Isle, ME (WIN 026424.00) |                     |     |

### OBJECTIVE

Determine if the proposed HP14x89 piles will provide adequate support for Abutment 2 based on the anticipated thermal movement and final design loads.

### METHOD

Use the procedure outlined in AASHTO LRFD (Ref. 1) and the design method provided in the MaineDOT Bridge Design Guide (Ref. 2).

### REFERENCES

1. AASHTO LRFD Bridge Design Specifications, 9th Ed. 2020.
2. Guertin Elkerton & Associates for Maine Department of Transportation. Bridge Design Guide. Dated August 2003 with 2018 updates.
3. Maine Department of Transportation, Bridge Program. 60% Plans, dated May 2, 2025: Phair Crossing Bridge #3259 over Maine Northern Railway, Presque Isle, Maine, WIN 026434.00.
4. WSP Interpretive Subsurface Profile A-A', included as Sheet 2 of the Preliminary Geotechnical Design Report.
5. Final loads and movements provided by HNTB via email on 5/12/2025.
6. AISC Shapes Database v15.0. November 2017. <https://www.aisc.org/globalassets/aisc/manual/v15.0-shapes-database/aisc-shapes-database-v15.0.xlsx>
7. WSP Boring Logs, included as Appendix A of the Preliminary Geotechnical Design Report.
8. WSP Material Properties 31407448.000 Phair Crossing.xlsx
9. Bridge Software Institute. FB-MultiPier Soil Parameter Table (US Customary Units). Accessed February 2023. [https://bsi.ce.ufl.edu/downloads/files/MultiPier\\_Soil\\_Table.pdf](https://bsi.ce.ufl.edu/downloads/files/MultiPier_Soil_Table.pdf)
10. VTrans Structures Section, Integral Abutment Committee. 2008. Integral Abutment Bridge Design Guidelines, 2nd Ed.
11. AISC Steel Construction Manual, 14th Ed. 2011.
12. FHWA. July 2016. GEC-012: Design and Construction of Driven Pile Foundations, Volume 1. Publication No. FHWA-NHI-16-009.

### ASSUMPTIONS

1. The proposed abutment is assumed to be supported on five HP14x89 Grade 50 piles with a center-to-center pile spacing of 9.75 feet, Ref. 3, sheet 26 of 38 Abutment No. 2. The piles are assumed to be driven to bedrock and thus end-bearing.
2. The selected pile orientation is weak axis bending (Ref. 2, page 5-42).
3. The vertical load is assumed to be evenly distributed.
4. The soil profile used in the analysis is based on Ref. 4 at the centerline of the proposed Abutment 2.
5. An UCS for rock of 7,000 psi is assumed based on a field characterization of R3 (Medium Strong Rock) to R4 (Strong Rock) from Ref. 7.
6. Section loss due to corrosion not considered.
7. The piles are modeled in L-Pile as a fixed connection at the top of the pile.

### ATTACHMENTS

1. LPile analysis output for Strength I



## CALCULATIONS

**Date:** 7/22/2025  
**Project No.:** US0025840.9367  
**Subject:** HP14x89 Pile Design at Proposed Abutment 2  
**Project Title:** Phair Crossing Bridge Presque Isle, ME (WIN 026424.00)

**Made by:** DEB  
**Checked by:** KAR  
**Reviewed by:** CCB

### CALCULATION

#### 1. Select the pile section parameters.

|                                                   | Intact<br>Section<br>(Ref. 6) |                 |
|---------------------------------------------------|-------------------------------|-----------------|
| Pile depth, $d$ =                                 | 13.8                          | inches          |
| Pile width, $b_f$ =                               | 14.7                          | inches          |
| Web thickness, $t_w$ =                            | 0.615                         | inches          |
| Flange thickness, $t_f$ =                         | 0.615                         | inches          |
| Fillet area =                                     | 0.3                           | in <sup>2</sup> |
| Section area =                                    | 26.1                          | in <sup>2</sup> |
| Moment of inertia about the x-axis, $I_x$ =       | 888                           | in <sup>4</sup> |
| Moment of inertia about the y-axis, $I_y$ =       | 326                           | in <sup>4</sup> |
| Radius of gyration about the x-axis, $r_x$ =      | 5.83                          | in              |
| Radius of gyration about the y-axis, $r_y$ =      | 3.53                          | in              |
| Elastic section modulus about the x-axis, $S_x$ = | 129                           | in <sup>3</sup> |
| Elastic section modulus about the y-axis, $S_y$ = | 44.3                          | in <sup>3</sup> |
| Plastic section modulus about the x-axis, $Z_x$ = | 143                           | in <sup>3</sup> |
| Plastic section modulus about the y-axis, $Z_y$ = | 67.6                          | in <sup>3</sup> |

#### 2. Determine pile loads and select the preliminary pile size.

Determine the factored substructure vertical dead and live load ( $P_u$ ) distributed to each pile.

Strength I factored vertical  
load per pile = 389 kips (Ref. 5)

Pile weight = 0.089 kip/ft x 47.0 ft = 4.2 kips

$P_u$  = 393 kips (Total factored axial load including pile weight)

Select the steel pile strength.

$F_y$  = 50 ksi (Assumption 1)  
 $E$  = 29,000 ksi (typical value for steel)

Determine resistance factors ( $\Phi_c$  and  $\Phi_f$ ) for the structural strength in the upper and lower zones of the pile.

$\Phi_{cl}$  = 0.50 for axial resistance in the lower zone of the pile (Ref. 2, page 5-41)  
 $\Phi_{cu}$  = 0.70 for axial resistance in the upper zone of the pile under combined axial and flexural loading (Ref. 2, page 5-42)  
 $\Phi_f$  = 1.00 for flexural resistance in the upper zone of the pile under combined axial and flexural loading (Ref. 2, page 5-42)



## CALCULATIONS

**Date:** 7/22/2025  
**Project No.:** US0025840.9367  
**Subject:** HP14x89 Pile Design at Proposed Abutment 2  
**Project Title:** Phair Crossing Bridge Presque Isle, ME (WIN 026424.00)

**Made by:** DEB  
**Checked by:** KAR  
**Reviewed by:** CCB

Determine the maximum required nominal axial pile resistance (Ref. 1, Article 6.9.2.1).

$$R_{n,upper} = \frac{P_u}{\phi_{cu}}$$

$$R_{n,upper} = 562 \text{ kips}$$

$$R_{n,lower} = \frac{P_u}{\phi_{cl}}$$

$$R_{n,lower} = 786 \text{ kips}$$

$$R_n = \max(R_{n,upper}, R_{n,lower})$$

$$R_n = 786 \text{ kips}$$

Use the required nominal axial pile resistance to estimate an approximate initial pile area.

$$A_{s,req} = \frac{R_n}{0.80 F_y} \quad (\text{Ref. 2, page 5-42})$$

$$A_{s,req} = 19.7 \text{ in}^2$$

Select a pile size with an area of approximately  $A_{s,req}$ .

Intact HP 14x102 section as per Assumption 1 and Step 1:

$$A_s = 26.1 \text{ in}^2 \quad (\text{Step 1})$$

### 3. Use LPILE analysis to determine the pile unbraced length and maximum moment at the top of the pile.

The following input parameters were used in the LPILE analysis:

#### Pile Properties

|                                  |                      |                                                       |
|----------------------------------|----------------------|-------------------------------------------------------|
| Section type:                    | Steel H Section      | (Assumption 2)                                        |
|                                  | Weak Axis            |                                                       |
| Length of section:               | 47.0 ft              | (piles driven to bedrock)                             |
| Flange width, $b_f$ :            | 14.7 in              | (Step 1)                                              |
| Section depth, $d$ :             | 13.8 in              | (Step 1)                                              |
| Flange thickness, $t_f$ :        | 0.615 in             | (Step 1)                                              |
| Web thickness, $t_w$ :           | 0.615 in             | (Step 1)                                              |
| Moment of inertia, $I_y$ :       | 326 in <sup>4</sup>  | (Step 1) about the weak axis, since weak-axis bending |
| Plastic section modulus, $Z_y$ : | 67.6 in <sup>3</sup> | (Step 1) about the weak axis, since weak-axis bending |
| Elastic section modulus, $S_y$ : | 44.3 in <sup>3</sup> | (Step 1) about the weak axis, since weak-axis bending |
| Radius of gyration, $r_y$ :      | 3.53 in              | (Step 1) about the weak axis, since weak-axis bending |
| Pile batter:                     | Vertical             | (pile battering not required)                         |

#### Pile Loading

Lateral deflection due to abutment thermal expansion or contraction: 0.55 in (Ref. 5)  
 Axial load: 393,000 lbs (from Step 2)



## CALCULATIONS

**Date:** 7/22/2025  
**Project No.:** US0025840.9367  
**Subject:** HP14x89 Pile Design at Proposed Abutment 2  
**Project Title:** Phair Crossing Bridge Presque Isle, ME (WIN 026424.00)

**Made by:** DEB  
**Checked by:** KAR  
**Reviewed by:** CCB

### Soil Layers

| Layer           | Depth below base of abutment <sup>1</sup> | Lateral Model                 | Effective Unit Weight (pcf) <sup>2</sup> | Undrained Shear Strength (psf) <sup>2</sup> | Friction Angle (°) <sup>2</sup> | Subgrade Modulus (pci) <sup>3</sup> | Major Principal Strain at 50% <sup>3</sup> | UCS (psi) <sup>4</sup> |
|-----------------|-------------------------------------------|-------------------------------|------------------------------------------|---------------------------------------------|---------------------------------|-------------------------------------|--------------------------------------------|------------------------|
| Granular Borrow | 0.0 - 1.0 ft                              | Sand (Reese)                  | 125                                      | -                                           | 32                              | 88.3                                | -                                          | -                      |
| Fill            | 1.0 - 27.0 ft                             | Sand (Reese)                  | 125                                      | -                                           | 32                              | 88.3                                | -                                          | -                      |
| Glacial Till    | 27.0 - 47.0 ft                            | Sand (Reese)                  | 67.6                                     | -                                           | 35                              | 88.3                                | -                                          | -                      |
| Bedrock         | > 47.0 ft                                 | Strong Rock (Vuggy Limestone) | 107.6                                    | -                                           | -                               | -                                   | -                                          | 7,000                  |

- 1) Ref. 4
- 2) Ref. 8
- 3) Ref. 9 - interpolation based on friction angle or undrained shear strength value for each layer.
- 4) Assumption 5.

The full LPILE output is provided in Attachment 1.

Obtain the maximum moment in the top segment of the pile.

$$M_{u,Top} = 2072 \text{ in-kips (from LPILE)}$$

Obtain the unbraced lengths of the top segment and the second segment of the upper zone of the pile.

$$l_{b,top} = 16.9 \text{ ft (from LPILE)}$$

$$l_{b,top} = 202.6 \text{ in}$$

$$l_{b,2nd} = 9.4 \text{ ft (from LPILE)}$$

$$l_{b,2nd} = 112.5 \text{ in}$$

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## 4. Determine if the applied moment on the pile will cause pile head plastic deformation by using the interaction of combined axial and flexural load effects on a single pile.

Determine K values for the top and bottom of the pile and calculate the column slenderness factor ( $\lambda$ ) for each segment.

For the top segment (rotation fixed with no plastic hinge):

$$\lambda_{top} = \frac{K_{top} I_{b,top}}{r_y} \leq 120 \quad (\text{Ref. 1, Article 6.9.3})$$

where:

$$\begin{aligned} K_{top} &= 1.2 & (\text{Ref. 1, Table C4.6.2.5-1}) \\ r_y &= 3.53 \text{ in} & (\text{Step 1}) \end{aligned}$$

$$\lambda_{top} = 68.8 \quad \text{OK}$$

For the second segment (pinned at top and bottom):

$$\lambda_{2nd} = \frac{K_{2nd} I_{b,2nd}}{r_y} \leq 120 \quad (\text{Ref. 1, Article 6.9.3})$$

where:

$$K_{2nd} = 1.0 \quad (\text{Ref. 1, Table C4.6.2.5-1})$$

$$\lambda_{2nd} = 31.8 \quad \text{OK}$$

Calculate the critical elastic buckling resistance,  $P_e$ , and the nominal yield resistance,  $P_o$ .

Use Ref. 1 Table 6.9.4.1.1-1 to select equation for  $P_e$  based on cross-section shape and potential buckling mode.

$$P_e = \frac{\pi^2 E}{\left( \frac{K I_b}{r_y} \right)^2} A_s \quad (\text{Ref. 1, Eqn 6.9.4.1.2-1})$$

$$P_{e,top} = 1578 \text{ kips}$$

$$P_{e,2nd} = 7367 \text{ kips}$$

$$P_o = F_y A_s \quad (\text{Ref. 1, Article 6.9.4.1})$$

$$P_o = 1306 \text{ kips}$$

Calculate the nominal structural pile resistance,  $P_n$ , for both segments of the upper zone of the pile as well as the lower zone of the pile.

|                       |                                                        |                     |     |
|-----------------------|--------------------------------------------------------|---------------------|-----|
| <b>Date:</b>          | 7/22/2025                                              | <b>Made by:</b>     | DEB |
| <b>Project No.:</b>   | US0025840.9367                                         | <b>Checked by:</b>  | KAR |
| <b>Subject:</b>       | HP14x89 Pile Design at Proposed Abutment 2             | <b>Reviewed by:</b> | CCB |
| <b>Project Title:</b> | Phair Crossing Bridge Presque Isle, ME (WIN 026424.00) |                     |     |

Determine  $P_o/P_e$  to select equation for  $P_n$  as per Ref. 1 Article 6.9.4.1.

$$\begin{aligned} P_o/P_{e,top} &= 0.83 & \leq & 2.25 \\ P_o/P_{e,2nd} &= 0.18 & \leq & 2.25 \end{aligned}$$

thus use Ref. 1 Eqn 6.9.4.1.1-1:

$$P_n = \left[ 0.658 \left( \frac{P_o}{P_e} \right) \right] P_o$$

$$\begin{aligned} P_{n,top} &= 923 & \text{kips} \\ P_{n,2nd} &= 1212 & \text{kips} \end{aligned}$$

$$P_{n,bottom} = (0.658^{(0)}) P_o \quad (0 \text{ for a fully braced pile - Ref. 10, Appendix B, Eqn 6-9})$$

$$P_{n,bottom} = 1306 \quad \text{kips}$$

Calculate the factored structural pile resistance,  $P_r$ , for both segments of the upper zone of the pile as well as the lower zone of the pile.

$$\begin{aligned} P_{r,top} &= \phi_{cu} P_{n,top} & (\text{Ref. 1, Eqn. 6.9.2.1-1}) \\ P_{r,top} &= 646 & \text{kips} \end{aligned}$$

$$\begin{aligned} P_{r,2nd} &= \phi_{cu} P_{n,2nd} & (\text{Ref. 1, Eqn. 6.9.2.1-1}) \\ P_{r,2nd} &= 849 & \text{kips} \end{aligned}$$

$$\begin{aligned} P_{r,bottom} &= \phi_{cl} P_{n,bottom} & (\text{Ref. 1, Eqn. 6.9.2.1-1}) \\ P_{r,bottom} &= 653 & \text{kips} \end{aligned}$$

Compare the ratio of  $P_u$  to the structural resistance in the upper portion of the pile – the pile size should be such that the ratio is not less than 0.20 (Ref. 2, page 5-43).

$$\frac{P_u}{P_{r,top}} = 0.61 \quad \text{OK}$$

$$\frac{P_u}{P_{r,2nd}} = 0.46 \quad \text{OK}$$

Since the lower zone of the pile will have virtually no moment, the entire section can carry the required vertical loads (Ref. 10, Appendix B). Make sure the applied load will not exceed the resistance of the lower zone.

$$\text{Check } \left( \frac{P_u}{P_{r,bottom}} < 1 \right)$$

$$\frac{P_u}{P_{r,bottom}} = 0.60 \quad \text{OK}$$

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**Made by:** DEB  
**Checked by:** KAR  
**Reviewed by:** CCB

Determine the nominal and factored flexural resistance about the H-pile weak axis.

Slenderness ratio for the flange:

$$\lambda_f = \frac{b_f}{2t_f} \quad (\text{Ref. 1, Eqn 6.12.2.2.1-3})$$

$$\lambda_f = 12.0$$

Limiting slenderness ratio for a compact flange:

$$\lambda_{pf} = 0.38 \sqrt{\frac{E}{F_y}} \quad (\text{Ref. 1, Eqn 6.12.2.2.1-4})$$

$$\lambda_{pf} = 9.2$$

Limiting slenderness ratio for a noncompact flange:

$$\lambda_{rf} = 0.83 \sqrt{\frac{E}{F_y}} \quad (\text{Ref. 1, Eqn 6.12.2.2.1-5})$$

$$\lambda_{rf} = 20.0$$

Elastic and plastic section moduli about the weak axis:

$$S_y = 44.3 \text{ in}^3 \quad (\text{Step 1})$$

$$Z_y = 67.6 \text{ in}^3 \quad (\text{Step 1})$$

Nominal flexural resistance:

$$M_n = M_p = 1.5F_y S_y \quad \text{if } \lambda_f \leq \lambda_{pf} \quad (\text{Ref. 1, Eqn 6.12.2.2.1-1})$$

$$M_n = \left[ 1 - \left( 1 - \frac{S_y}{Z_y} \right) \left( \frac{\lambda_f - \lambda_{pf}}{0.45 \sqrt{\frac{E}{F_y}}} \right) \right] F_y Z_y \quad \text{if } \lambda_{pf} < \lambda_f \leq \lambda_{rf} \quad (\text{Ref. 1, Eqn 6.12.2.2.1-2})$$

Since  $\lambda_{pf} < \lambda_f \leq \lambda_{rf}$ ,

$$M_n = 3081 \text{ in-kips}$$

Factored flexural resistance:

$$\phi_f = 1.00 \quad (\text{Ref. 2, page 5-42})$$

$$M_r = \phi_f M_n$$

$$M_r = 3081 \text{ in-kips}$$

Calculate the moment that will cause a plastic hinge at the top of the pile,  $M_p'$ .

$$M_p' = \frac{9}{8} \left( 1 - \frac{P_u}{P_{r, \text{top}}} \right) M_r \quad (\text{Ref. 1, Eqn 6.9.2.2.1-2; Ref. 10, Eqn 4.5.2-4})$$

$$M_p' = 1358 \text{ in-kips} = 1357664 \text{ inch-lb}$$



## CALCULATIONS

**Date:** 7/22/2025  
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If the applied moment exceeds the moment that would cause a plastic hinge, it can be assumed that the pile head has entered plastic deformation, and therefore the moment that can be applied to the pile head cannot exceed  $M_p'$ .

$$\begin{array}{llll} M_{u,Top} = & 2072 & \text{in-kips} & (\text{From Step 3}) \\ M_{u,Top} & > & M_p' & \text{Plastic Hinge Forms} \end{array}$$

Check the second segment of the upper zone of the pile to ensure that this segment of the pile does not form a plastic hinge.

$$M_{u,2nd} = 726 \quad \text{in-kips} \quad (\text{LPile})$$

$$\text{Check: } \frac{P_u}{P_{r,2nd}} + \frac{8}{9} \left( \frac{M_{u,2nd}}{M_r} \right) < 1 \quad (\text{Ref. 1, Eqn 6.9.2.2.1-2; Ref. 10, Eqn 4.5.2-3})$$

$$\text{Check: } 0.67 < 1 \quad \text{OK}$$

### 5. Run another LPILE analysis with displacement, plastic moment ( $M_p'$ ), and $P_u$ as load conditions, and

$$l_{b,top} = 12.4 \quad \text{ft} \quad (\text{LPile})$$

$$l_{b,top} = 148.7 \quad \text{in}$$

$$l_{b,2nd} = 9.9 \quad \text{ft} \quad (\text{LPile})$$

$$l_{b,2nd} = 119.0 \quad \text{in}$$

$$M_{u,2nd} = 60 \quad \text{in-kips} \quad (\text{LPile})$$

Since a plastic hinge developed at the pile head, the value of K for the top segment becomes 2.1 for free rotation condition (Ref. 2, page 5-43).

$$K_{top} = 2.1 \quad (\text{Ref. 1, Table C4.6.2.5-1})$$

$$K_{2nd} = 1.0 \quad (\text{Ref. 1, Table C4.6.2.5-1})$$

$$\lambda_{top} = 88.43 < 120 \quad \text{OK}$$

$$\lambda_{2nd} = 33.68 < 120 \quad \text{OK}$$

$$P_{e,top} = 956 \quad \text{kips}$$

$$P_{e,2nd} = 6589 \quad \text{kips}$$

$$P_o/P_{e,top} = 1.37 \leq 2.25 \quad (\text{to select } P_n \text{ equation})$$

$$P_o/P_{e,2nd} = 0.20 \leq 2.25 \quad (\text{to select } P_n \text{ equation})$$

$$P_{n,top} = 737 \quad \text{kips}$$

$$P_{n,2nd} = 1202 \quad \text{kips}$$

$$P_{r,top} = 516 \quad \text{kips}$$

$$P_{r,2nd} = 841 \quad \text{kips}$$



## CALCULATIONS

|                       |                                                        |                     |     |
|-----------------------|--------------------------------------------------------|---------------------|-----|
| <b>Date:</b>          | 7/22/2025                                              | <b>Made by:</b>     | DEB |
| <b>Project No.:</b>   | US0025840.9367                                         | <b>Checked by:</b>  | KAR |
| <b>Subject:</b>       | HP14x89 Pile Design at Proposed Abutment 2             | <b>Reviewed by:</b> | CCB |
| <b>Project Title:</b> | Phair Crossing Bridge Presque Isle, ME (WIN 026424.00) |                     |     |

$$\frac{P_u}{P_{r,top}} = 0.76 > 0.20 \quad \text{OK}$$

$$\frac{P_u}{P_{r,2nd}} = 0.47 > 0.20 \quad \text{OK}$$

Check the second segment of the upper zone of the pile to ensure that this segment of the pile does not form a plastic hinge.

$$M_{u,2nd} = 60 \quad \text{in-kips} \quad (\text{LPile})$$

$$\text{Check: } \frac{P_u}{P_{r,2nd}} + \frac{8}{9} \left( \frac{M_{u,2nd}}{M_r} \right) < 1 \quad (\text{Ref. 1, Eqn 6.9.2.2.1-2; Ref. 11, Eqn 4.5.2-3})$$

$$\text{Check: } 0.48 < 1 \quad \text{OK}$$

**6. Because the piles have weak axis orientation and the flanges resist the shear as opposed to the web, check the maximum shear from the LPile output against the structural shear resistance per AISC G7.**

$$V_u = 17.1 \quad \text{kips} \quad (\text{from LPile})$$

AASHTO LRFD does not directly address weak axis shear. This analysis will use the AISC Steel Construction Manual 14th edition, Specifications G2 and G7 (Ref. 11) to ensure the pile will not shear under the longitudinal load.

Per Ref. 11 Section G7: for singly and doubly symmetric shapes loaded in the weak axis without torsion, the nominal shear strength  $V_n$  for each shear resisting element shall be determined using Equation G2-1 and Section G2.1(b) with  $A_w = b_f t_f$  and  $k_v = 1.2$ .

$$V_n = 0.6 F_y A_w C_v \quad (\text{Ref. 11, Eqn G2-1})$$

where:

$$C_v = 1.0 \quad \text{for HP shapes with } F_y \leq 50 \text{ ksi} \quad (\text{Ref. 12, Section G7})$$

$$A_w = b_f t_f = 9.0 \quad \text{in}^2 \quad (\text{Ref. 11, Section G7})$$

Since there are two shear resisting elements (i.e., two flanges):

$$2 \times A_w = 18.1 \quad \text{in}^2$$

$$V_n = 542 \quad \text{kips}$$

$$V_r = \phi_v V_n$$

$$\phi_v = 1.00 \quad (\text{Ref. 1, Article 6.5.4.2})$$

$$V_r = 542 \quad \text{kips}$$

Check that the shear resistance is sufficient:

$$V_u < V_r \quad \text{OK}$$



## CALCULATIONS

|                       |                                                        |                     |     |
|-----------------------|--------------------------------------------------------|---------------------|-----|
| <b>Date:</b>          | 7/22/2025                                              | <b>Made by:</b>     | DEB |
| <b>Project No.:</b>   | US0025840.9367                                         | <b>Checked by:</b>  | KAR |
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| <b>Project Title:</b> | Phair Crossing Bridge Presque Isle, ME (WIN 026424.00) |                     |     |

### 7. Check that the maximum factored applied pile load does not exceed the factored pile drivability resistance.

For steel piles in compression, driving stresses should not exceed 90% of the yield strength of the pile material (Ref. 2, page 5-104).

$$\sigma_{dr} = 0.9 \times 50 \text{ ksi} = 45 \text{ ksi}$$

This translates into an ultimate maximum driving force that can be applied to the pile of:

$$P_{dr} = \sigma_{dr} A_s \quad (\text{Ref. 10, Appendix B, Eqn 7-23})$$

$$P_{dr} = 1175 \text{ kips}$$

Calculate the nominal pile driving resistance ( $R_{ndr}$ ) from the applied load divided by the resistance factor associated with the pile monitoring method. In this design, the pile will be bearing on rock. The driving criteria will be established by dynamic testing.

$$\phi_{dyn} = 0.65 \quad (\text{Ref. 1, Table 10.5.5.2.3-1})$$

$$R_{ndr} = \frac{P_u}{\phi_{dyn}} \quad (\text{Ref. 9, Appendix B, Eqn 7-25})$$

$$R_{ndr} = 605 \text{ kips}$$

The nominal pile driving resistance ( $R_{ndr}$ ) should not exceed the nominal structural pile resistance ( $P_n$ ) or the maximum driving force ( $P_{dr}$ ) calculated above.

$$P_{n,top} = 923 \text{ kips} \quad (\text{From Step 4})$$

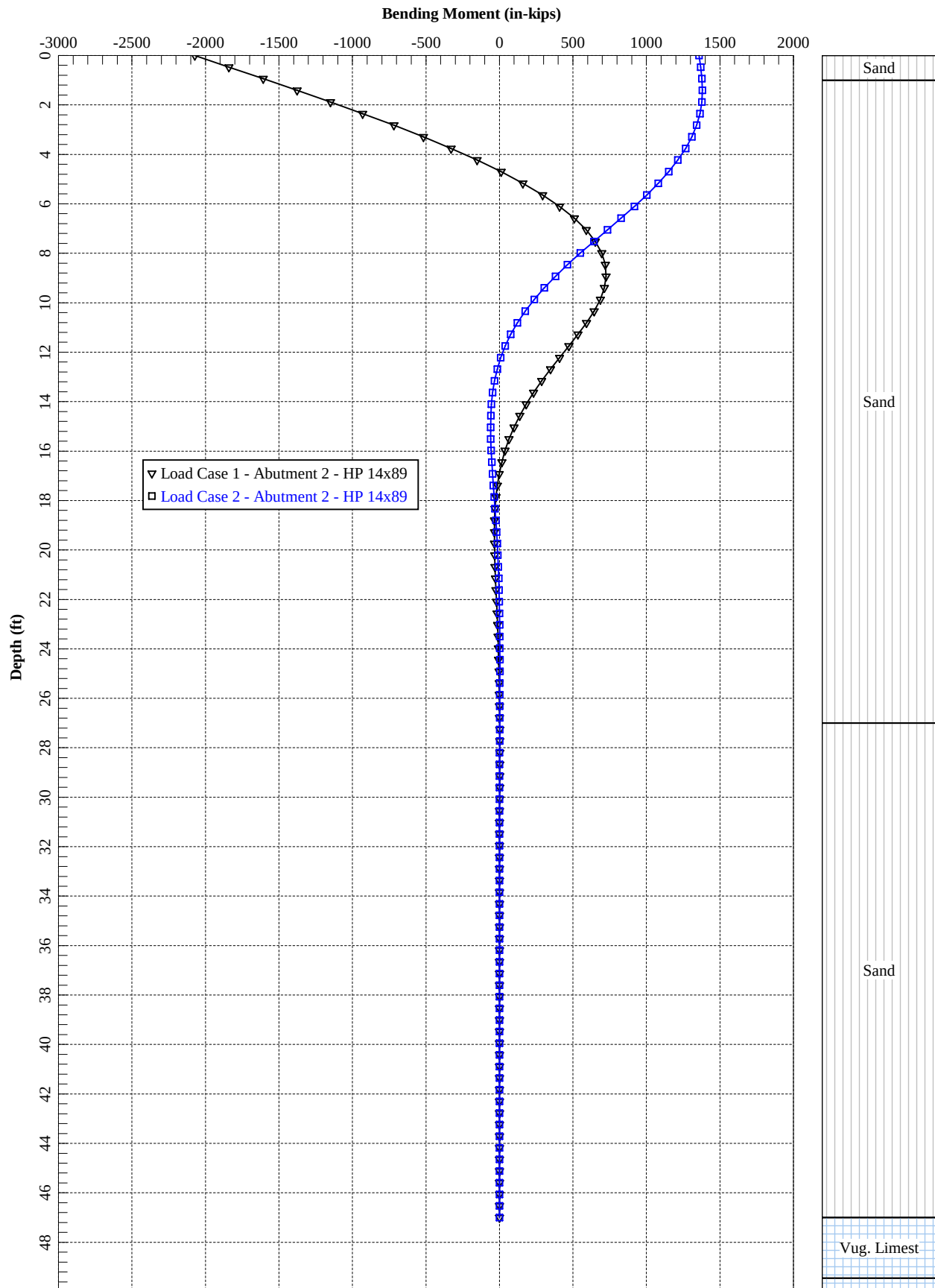
$$P_{n,2nd} = 1212 \text{ kips} \quad (\text{From Step 4})$$

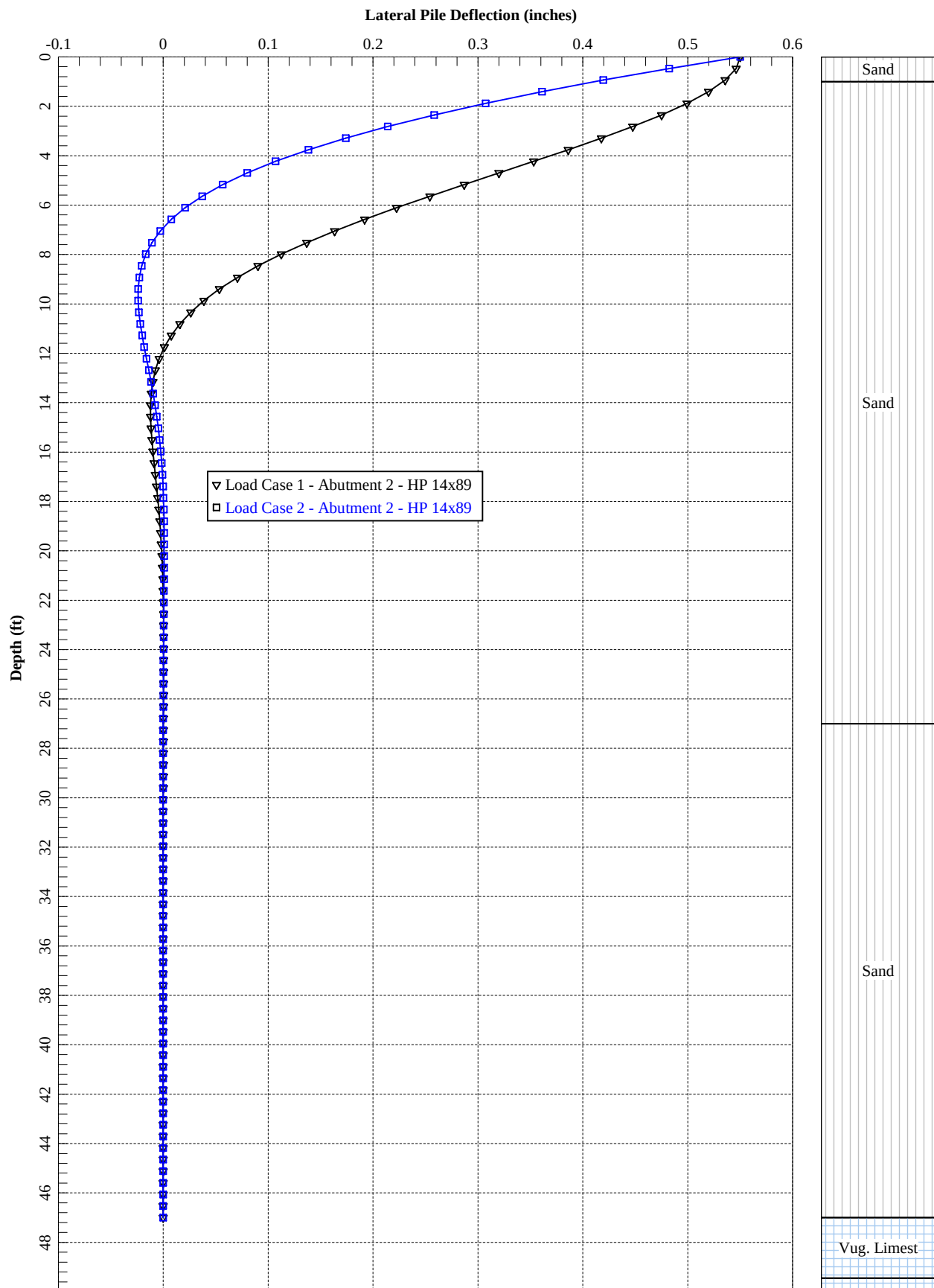
$$\text{Check } R_{ndr} < P_n: \quad \text{OK}$$

$$\text{Check } R_{ndr} < P_{dr}: \quad \text{OK}$$

## CONCLUSIONS

The results of the analysis indicate that a maximum moment of 1358 in-kips (113 ft-kips) occurs at the top of the pile under the Strength I load case with a maximum bridge expansion or contraction of 0.55 inches. The results indicate that the depth to bedrock is sufficient for driven piles to achieve fixity. Based on the intact pile section used in the analysis, the HP 14x89 piles are adequately sized to accommodate the anticipated design loads and thermal movement at Abutment 2 at the end of the 75 year bridge design life.





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LPILE for Windows, Version 2019-11.006

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:

\Users\USDB712838\Desktop\Presque Isle\Final Pile design\

Name of input data file:

7.8.25 Final Abutment 2-HP14x89.lp11d

Name of output report file:

7.8.25 Final Abutment 2-HP14x89.lp11o

Name of plot output file:

7.8.25 Final Abutment 2-HP14x89.lp11p

Name of runtime message file:

7.8.25 Final Abutment 2-HP14x89.lp11r

-----

Date and Time of Analysis

-----

Date: July 8, 2025

Time: 16:57:35

---

Problem Title

---

Project Name: 31407448.000

Job Number: 31407448.000

Client: Phair Crossing Bridge Presque Isle, ME

Engineer: DEB

Description: Abutment 2 HP 14x89

---

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
- Input of side resistance moment along pile 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                      | = | 47.000 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<br>No. | Depth Below<br>Pile Head<br>feet | Pile<br>Diameter<br>inches |
|--------------|----------------------------------|----------------------------|
| 1            | 0.000                            | 14.7000                    |
| 2            | 47.000                           | 14.7000                    |

#### Input Structural Properties for Pile Sections:

---

##### Pile Section No. 1:

|                                       |                |
|---------------------------------------|----------------|
| Section 1 is a H weak axis steel pile |                |
| Length of section                     | = 47.000000 ft |
| Pile width                            | = 13.800000 in |

Shear capacity of section = 0.0000 lbs

---

Ground Slope and Pile Batter Angles

---

Ground Slope Angle = 0.000 degrees  
= 0.000 radians

Pile Batter Angle = 0.000 degrees  
= 0.000 radians

---

Soil and Rock Layering Information

---

The soil profile is modelled using 4 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 = 1.000000 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 = 32.000000 deg.  
Friction angle at bottom of layer = 32.000000 deg.  
Subgrade k at top of layer = 88.300000 pci  
Subgrade k at bottom of layer = 88.300000 pci

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

Distance from top of pile to top of layer = 1.000000 ft  
Distance from top of pile to bottom of layer = 27.000000 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 = 32.000000 deg.  
Friction angle at bottom of layer = 32.000000 deg.  
Subgrade k at top of layer = 88.300000 pci  
Subgrade k at bottom of layer = 88.300000 pci

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

Distance from top of pile to top of layer = 27.000000 ft  
Distance from top of pile to bottom of layer = 47.000000 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           | = | 35.000000 deg. |
| Friction angle at bottom of layer        | = | 35.000000 deg. |
| Subgrade k at top of layer               | = | 88.300000 pci  |
| Subgrade k at bottom of layer            | = | 88.300000 pci  |

Layer 4 is strong rock (vuggy limestone)

|                                                  |   |                |
|--------------------------------------------------|---|----------------|
| Distance from top of pile to top of layer        | = | 47.000000 ft   |
| Distance from top of pile to bottom of layer     | = | 60.000000 ft   |
| Effective unit weight at top of layer            | = | 107.600000 pcf |
| Effective unit weight at bottom of layer         | = | 107.600000 pcf |
| Uniaxial compressive strength at top of layer    | = | 7000. psi      |
| Uniaxial compressive strength at bottom of layer | = | 7000. psi      |

(Depth of the lowest soil layer extends 13.000 ft below the pile tip)

-----  
Summary of Input Soil Properties  
-----

| Layer                       | Soil Type                | Layer       | Effective       | Angle of         | Uniaxial  |
|-----------------------------|--------------------------|-------------|-----------------|------------------|-----------|
| Layer<br>kpy<br>Num.<br>pci | Name<br>(p-y Curve Type) | Depth<br>ft | Unit Wt.<br>pcf | Friction<br>deg. | qu<br>psi |
| -----                       | -----                    | -----       | -----           | -----            | -----     |
| 1                           | Sand                     | 0.00        | 125.0000        | 32.0000          | --        |
| 88.3000                     | (Reese, et al.)          | 1.0000      | 125.0000        | 32.0000          | --        |
| 88.3000                     |                          |             |                 |                  |           |
| 2                           | Sand                     | 1.0000      | 125.0000        | 32.0000          | --        |
| 88.3000                     | (Reese, et al.)          | 27.0000     | 125.0000        | 32.0000          | --        |
| 88.3000                     |                          |             |                 |                  |           |
| 3                           | Sand                     | 27.0000     | 67.6000         | 35.0000          | --        |
| 88.3000                     | (Reese, et al.)          | 47.0000     | 67.6000         | 35.0000          | --        |
| 88.3000                     |                          |             |                 |                  |           |
| 4                           | Strong Rock              | 47.0000     | 107.6000        | --               | 7000.     |
| --                          | (Vuggy Limestone)        | 60.0000     | 107.6000        | --               | 7000.     |
| --                          |                          |             |                 |                  |           |

---

### 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<br>Compute<br>No. | Load<br>Top y<br>Type<br>vs. Pile Length | Condition<br>Run Analysis<br>1 | Condition<br>2      | Axial Thrust<br>Force, lbs |
|------------------------|------------------------------------------|--------------------------------|---------------------|----------------------------|
| 1                      | 5                                        | y = 0.550000 in                | S = 0.0000 in/in    | 393000.                    |
| N.A.                   |                                          | Yes                            |                     |                            |
| 2                      | 4                                        | y = 0.550000 in                | M = 1357664. in-lbs | 393000.                    |
| 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                = 47.000000 ft
Flange Width                    = 14.700000 in
Section Depth                  = 13.800000 in
Flange Thickness               = 0.615000 in
Web Thickness                  = 0.615000 in
Yield Stress of Pipe           = 50.000000 ksi
Elastic Modulus                = 29000. ksi
Cross-sectional Area           = 25.811550 sq. in.
Moment of Inertia              = 325.837265 in^4
Elastic Bending Stiffness      = 9449281. kip-in^2
Plastic Modulus, Z             = 67.636247in^3
Plastic Moment Capacity = Fy Z = 3382.in-kip

```

Axial Structural Capacities:

```

-----
Nom. Axial Structural Capacity = Fy As = 1290.578 kips
Nominal Axial Tensile Capacity = -1290.578 kips

```

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

| Number | Axial Thrust Force<br>kips |
|--------|----------------------------|
| 1      | 393.000                    |

Definition of Run Messages:

Y = part of pipe section has yielded.

Axial Thrust Force = 393.000 kips

| Bending<br>Curvature<br>rad/in. | Bending<br>Moment<br>in-kip | Bending<br>Stiffness<br>kip-in2 | Depth to<br>N Axis<br>in | Max Total<br>Stress<br>ksi | Run<br>Msg |
|---------------------------------|-----------------------------|---------------------------------|--------------------------|----------------------------|------------|
| 0.00000436                      | 41.1828059                  | 9448389.                        | 127.8043022              | 16.1455108                 |            |
| 0.00000872                      | 82.3656118                  | 9448389.                        | 67.5771511               | 17.0652796                 |            |
| 0.00001308                      | 123.5484177                 | 9448389.                        | 47.5014341               | 17.9850482                 |            |
| 0.00001743                      | 164.7312235                 | 9448389.                        | 37.4635756               | 18.9048173                 |            |
| 0.00002179                      | 205.9140294                 | 9448389.                        | 31.4408604               | 19.8245860                 |            |
| 0.00002615                      | 247.0968353                 | 9448389.                        | 27.4257170               | 20.7443549                 |            |
| 0.00003051                      | 288.2796412                 | 9448389.                        | 24.5577575               | 21.6641237                 |            |
| 0.00003487                      | 329.4624471                 | 9448389.                        | 22.4067878               | 22.5838926                 |            |

|            |             |          |            |            |   |
|------------|-------------|----------|------------|------------|---|
| 0.00003923 | 370.6452530 | 9448389. | 20.7338114 | 23.5036613 |   |
| 0.00004359 | 411.8280589 | 9448389. | 19.3954302 | 24.4234302 |   |
| 0.00004795 | 453.0108647 | 9448389. | 18.3003911 | 25.3431990 |   |
| 0.00005230 | 494.1936706 | 9448389. | 17.3878585 | 26.2629679 |   |
| 0.00005666 | 535.3764765 | 9448389. | 16.6157156 | 27.1827367 |   |
| 0.00006102 | 576.5592824 | 9448389. | 15.9538787 | 28.1025056 |   |
| 0.00006538 | 617.7420883 | 9448389. | 15.3802868 | 29.0222744 |   |
| 0.00006974 | 658.9248942 | 9448389. | 14.8783939 | 29.9420432 |   |
| 0.00007410 | 700.1077000 | 9448389. | 14.4355472 | 30.8618120 |   |
| 0.00007846 | 741.2905059 | 9448389. | 14.0419057 | 31.7815809 |   |
| 0.00008282 | 782.4733118 | 9448389. | 13.6897001 | 32.7013497 |   |
| 0.00008717 | 823.6561177 | 9448389. | 13.3727151 | 33.6211186 |   |
| 0.00009153 | 864.8389236 | 9448389. | 13.0859192 | 34.5408874 |   |
| 0.00009589 | 906.0217295 | 9448389. | 12.8251956 | 35.4606563 |   |
| 0.0001003  | 947.2045354 | 9448389. | 12.5871436 | 36.3804250 |   |
| 0.0001046  | 988.3873412 | 9448389. | 12.3689293 | 37.3001939 |   |
| 0.0001090  | 1030.       | 9448389. | 12.1681721 | 38.2199628 |   |
| 0.0001133  | 1071.       | 9448389. | 11.9828578 | 39.1397316 |   |
| 0.0001177  | 1112.       | 9448389. | 11.8112705 | 40.0595004 |   |
| 0.0001220  | 1153.       | 9448389. | 11.6519394 | 40.9792693 |   |
| 0.0001264  | 1194.       | 9448389. | 11.5035966 | 41.8990381 |   |
| 0.0001308  | 1235.       | 9448389. | 11.3651434 | 42.8188069 |   |
| 0.0001351  | 1277.       | 9448389. | 11.2356227 | 43.7385758 |   |
| 0.0001395  | 1318.       | 9448389. | 11.1141969 | 44.6583446 |   |
| 0.0001438  | 1359.       | 9448389. | 11.0001304 | 45.5781134 |   |
| 0.0001482  | 1400.       | 9448389. | 10.8927736 | 46.4978822 |   |
| 0.0001526  | 1441.       | 9448389. | 10.7915515 | 47.4176511 |   |
| 0.0001569  | 1483.       | 9448389. | 10.6959528 | 48.3374199 |   |
| 0.0001613  | 1524.       | 9448389. | 10.6055217 | 49.2571887 |   |
| 0.0001656  | 1565.       | 9446974. | 10.5201099 | 50.0000000 | Y |
| 0.0001700  | 1604.       | 9436920. | 10.4406886 | 50.0000000 | Y |
| 0.0001787  | 1679.       | 9395130. | 10.2978863 | 50.0000000 | Y |
| 0.0001874  | 1749.       | 9329748. | 10.1738302 | 50.0000000 | Y |
| 0.0001961  | 1814.       | 9247883. | 10.0654531 | 50.0000000 | Y |
| 0.0002049  | 1875.       | 9154604. | 9.9703106  | 50.0000000 | Y |
| 0.0002136  | 1933.       | 9052920. | 9.8865872  | 50.0000000 | Y |
| 0.0002223  | 1989.       | 8945828. | 9.8126172  | 50.0000000 | Y |
| 0.0002310  | 2041.       | 8836251. | 9.7468425  | 50.0000000 | Y |
| 0.0002397  | 2091.       | 8724016. | 9.6885844  | 50.0000000 | Y |
| 0.0002484  | 2140.       | 8612024. | 9.6364535  | 50.0000000 | Y |
| 0.0002572  | 2186.       | 8500209. | 9.5899068  | 50.0000000 | Y |
| 0.0002659  | 2231.       | 8389186. | 9.5482859  | 50.0000000 | Y |
| 0.0002746  | 2274.       | 8279906. | 9.5108807  | 50.0000000 | Y |
| 0.0002833  | 2315.       | 8172613. | 9.4772269  | 50.0000000 | Y |
| 0.0002920  | 2356.       | 8067506. | 9.4469131  | 50.0000000 | Y |
| 0.0003008  | 2395.       | 7964752. | 9.4195734  | 50.0000000 | Y |
| 0.0003095  | 2434.       | 7864485. | 9.3948803  | 50.0000000 | Y |
| 0.0003182  | 2471.       | 7766811. | 9.3725399  | 50.0000000 | Y |
| 0.0003269  | 2508.       | 7671813. | 9.3522864  | 50.0000000 | Y |
| 0.0003356  | 2542.       | 7574365. | 9.3324143  | 50.0000000 | Y |

|           |       |          |           |            |   |
|-----------|-------|----------|-----------|------------|---|
| 0.0003443 | 2574. | 7474731. | 9.3131365 | 50.0000000 | Y |
| 0.0003531 | 2603. | 7374186. | 9.2942343 | 50.0000000 | Y |
| 0.0003618 | 2631. | 7273481. | 9.2755720 | 50.0000000 | Y |
| 0.0003705 | 2657. | 7172365. | 9.2572472 | 50.0000000 | Y |
| 0.0003792 | 2682. | 7071573. | 9.2393333 | 50.0000000 | Y |
| 0.0003879 | 2705. | 6972102. | 9.2215441 | 50.0000000 | Y |
| 0.0003966 | 2726. | 6873110. | 9.2044816 | 50.0000000 | Y |
| 0.0004054 | 2747. | 6776153. | 9.1875129 | 50.0000000 | Y |
| 0.0004141 | 2766. | 6679555. | 9.1709326 | 50.0000000 | Y |
| 0.0004228 | 2784. | 6585024. | 9.1543718 | 50.0000000 | Y |
| 0.0004315 | 2801. | 6491907. | 9.1385766 | 50.0000000 | Y |
| 0.0004402 | 2818. | 6400637. | 9.1226545 | 50.0000000 | Y |
| 0.0004489 | 2833. | 6310604. | 9.1072103 | 50.0000000 | Y |
| 0.0004577 | 2848. | 6223035. | 9.0921460 | 50.0000000 | Y |
| 0.0004664 | 2862. | 6136545. | 9.0769266 | 50.0000000 | Y |
| 0.0004751 | 2875. | 6052069. | 9.0624279 | 50.0000000 | Y |
| 0.0004838 | 2888. | 5969323. | 9.0478396 | 50.0000000 | Y |
| 0.0004925 | 2900. | 5888433. | 9.0336177 | 50.0000000 | Y |
| 0.0005013 | 2912. | 5809025. | 9.0197326 | 50.0000000 | Y |
| 0.0005100 | 2923. | 5731570. | 9.0059357 | 50.0000000 | Y |
| 0.0005187 | 2934. | 5655790. | 8.9922883 | 50.0000000 | Y |
| 0.0005536 | 2972. | 5368437. | 8.9403341 | 50.0000000 | Y |
| 0.0005884 | 3004. | 5105867. | 8.8916598 | 50.0000000 | Y |
| 0.0006233 | 3032. | 4864780. | 8.8456919 | 50.0000000 | Y |
| 0.0006582 | 3056. | 4643939. | 8.8026681 | 50.0000000 | Y |
| 0.0006930 | 3078. | 4441159. | 8.7619119 | 50.0000000 | Y |
| 0.0007279 | 3097. | 4254076. | 8.7233846 | 50.0000000 | Y |
| 0.0007628 | 3113. | 4081415. | 8.6868615 | 50.0000000 | Y |
| 0.0007976 | 3128. | 3921509. | 8.6522677 | 50.0000000 | Y |
| 0.0008325 | 3141. | 3773207. | 8.6190899 | 50.0000000 | Y |
| 0.0008674 | 3153. | 3635177. | 8.5879626 | 50.0000000 | Y |
| 0.0009023 | 3164. | 3506791. | 8.5582172 | 50.0000000 | Y |
| 0.0009371 | 3174. | 3387090. | 8.5298295 | 50.0000000 | Y |
| 0.0009720 | 3183. | 3274589. | 8.5027603 | 50.0000000 | Y |

-----  
Summary of Results for Nominal Moment Capacity for Section 1  
-----

| Load<br>No. | Axial<br>Thrust<br>kips | Nominal<br>Moment<br>Capacity<br>in-kips |
|-------------|-------------------------|------------------------------------------|
| 1           | 393.0000000000          | 3183.                                    |

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.

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Layering Correction Equivalent Depths of Soil & Rock Layers

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| 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                      | 769.8689                  |
| 2         | 1.0000                          | 0.9998                                  | Yes                            | No                                   | 769.8689                  | 1562957.                  |
| 3         | 27.0000                         | 23.6581                                 | Yes                            | No                                   | 1563727.                  | 4695980.                  |
| 4         | 47.0000                         | 47.0000                                 | No                             | Yes                                  | N.A.                      | 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.

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

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Pile-head conditions are Displacement and Pile-head Rotation (Loading Type 5)  
 Displacement of pile head = 0.550000 inches  
 Rotation of pile head = 0.000E+00 radians  
 Axial load on pile head = 393000.0 lbs

| Depth Res.        | Deflect. Soil Spr.       | Bending Distrib. Moment | Shear Force | Slope S | Total Stress | Bending Stiffness | Soil p |
|-------------------|--------------------------|-------------------------|-------------|---------|--------------|-------------------|--------|
| X<br>Es*H<br>feet | y<br>Lat. Load<br>inches | in-lbs                  | lbs         | radians | psi*         | lb-in^2           |        |

| lb/inch   | lb/inch  | lb/inch   |         |          |        |          |
|-----------|----------|-----------|---------|----------|--------|----------|
| -----     | -----    | -----     | -----   | -----    | -----  | -----    |
| 0.00      | 0.5500   | -2072006. | 41077.  | 0.00     | 61965. | 8.77E+09 |
| 0.00      | 0.00     | 0.00      |         |          |        |          |
| 0.4700    | 0.5462   | -1839948. | 40718.  | -0.00126 | 56730. | 8.77E+09 |
| -58.4755  | 603.7664 | 0.00      |         |          |        |          |
| 0.9400    | 0.5358   | -1607125. | 40196.  | -0.00233 | 51478. | 9.44E+09 |
| -126.8754 | 1336.    | 0.00      |         |          |        |          |
| 1.4100    | 0.5200   | -1376209. | 39287.  | -0.00322 | 46269. | 9.45E+09 |
| -195.3580 | 2119.    | 0.00      |         |          |        |          |
| 1.8800    | 0.4995   | -1149687. | 38013.  | -0.00398 | 41160. | 9.45E+09 |
| -256.5267 | 2897.    | 0.00      |         |          |        |          |
| 2.3500    | 0.4751   | -929803.  | 36412.  | -0.00460 | 36200. | 9.45E+09 |
| -311.0396 | 3692.    | 0.00      |         |          |        |          |
| 2.8200    | 0.4476   | -718583.  | 34540.  | -0.00509 | 31435. | 9.45E+09 |
| -352.7723 | 4445.    | 0.00      |         |          |        |          |
| 3.2900    | 0.4177   | -517634.  | 32462.  | -0.00546 | 26902. | 9.45E+09 |
| -384.2786 | 5189.    | 0.00      |         |          |        |          |
| 3.7600    | 0.3861   | -328224.  | 30221.  | -0.00571 | 22630. | 9.45E+09 |
| -410.2183 | 5993.    | 0.00      |         |          |        |          |
| 4.2300    | 0.3533   | -151428.  | 27820.  | -0.00585 | 18642. | 9.45E+09 |
| -441.3767 | 7046.    | 0.00      |         |          |        |          |
| 4.7000    | 0.3200   | 11528.    | 25290.  | -0.00589 | 15486. | 9.45E+09 |
| -455.5721 | 8028.    | 0.00      |         |          |        |          |
| 5.1700    | 0.2868   | 159977.   | 22662.  | -0.00584 | 18834. | 9.45E+09 |
| -476.3510 | 9367.    | 0.00      |         |          |        |          |
| 5.6400    | 0.2541   | 293062.   | 19891.  | -0.00571 | 21836. | 9.45E+09 |
| -506.3414 | 11238.   | 0.00      |         |          |        |          |
| 6.1100    | 0.2224   | 409653.   | 16977.  | -0.00550 | 24466. | 9.45E+09 |
| -526.9955 | 13363.   | 0.00      |         |          |        |          |
| 6.5800    | 0.1921   | 508938.   | 13939.  | -0.00522 | 26706. | 9.45E+09 |
| -550.4269 | 16160.   | 0.00      |         |          |        |          |
| 7.0500    | 0.1635   | 590041.   | 10792.  | -0.00490 | 28535. | 9.45E+09 |
| -565.4554 | 19506.   | 0.00      |         |          |        |          |
| 7.5200    | 0.1369   | 652376.   | 7588.   | -0.00453 | 29942. | 9.45E+09 |
| -570.8503 | 23523.   | 0.00      |         |          |        |          |
| 7.9900    | 0.1124   | 695690.   | 4382.   | -0.00412 | 30919. | 9.45E+09 |
| -565.9942 | 28389.   | 0.00      |         |          |        |          |
| 8.4600    | 0.09036  | 720079.   | 1233.   | -0.00370 | 31469. | 9.45E+09 |
| -550.4521 | 34357.   | 0.00      |         |          |        |          |
| 8.9300    | 0.07070  | 726006.   | -1797.  | -0.00327 | 31602. | 9.45E+09 |
| -523.9423 | 41796.   | 0.00      |         |          |        |          |
| 9.4000    | 0.05349  | 714306.   | -4645.  | -0.00284 | 31339. | 9.45E+09 |
| -486.2695 | 51275.   | 0.00      |         |          |        |          |
| 9.8700    | 0.03868  | 686192.   | -7157.  | -0.00242 | 30704. | 9.45E+09 |
| -404.4916 | 58985.   | 0.00      |         |          |        |          |
| 10.3400   | 0.02618  | 644304.   | -9107.  | -0.00202 | 29759. | 9.45E+09 |
| -286.7993 | 61793.   | 0.00      |         |          |        |          |
| 10.8100   | 0.01585  | 592441.   | -10427. | -0.00165 | 28590. | 9.45E+09 |

|           |           |         |           |           |        |          |
|-----------|-----------|---------|-----------|-----------|--------|----------|
| -181.5029 | 64602.    | 0.00    |           |           |        |          |
| 11.2800   | 0.00751   | 534020. | -11192.   | -0.00132  | 27272. | 9.45E+09 |
| -89.7561  | 67411.    | 0.00    |           |           |        |          |
| 11.7500   | 9.71E-04  | 472037. | -11480.   | -0.00102  | 25874. | 9.45E+09 |
| -12.0901  | 70220.    | 0.00    |           |           |        |          |
| 12.2200   | -0.00398  | 409046. | -11368.   | -7.55E-04 | 24453. | 9.45E+09 |
| 51.5109   | 73028.    | 0.00    |           |           |        |          |
| 12.6900   | -0.00755  | 347152. | -10937.   | -5.30E-04 | 23057. | 9.45E+09 |
| 101.5243  | 75837.    | 0.00    |           |           |        |          |
| 13.1600   | -0.00995  | 288027. | -10259.   | -3.40E-04 | 21723. | 9.45E+09 |
| 138.7983  | 78646.    | 0.00    |           |           |        |          |
| 13.6300   | -0.01139  | 232937. | -9404.    | -1.85E-04 | 20480. | 9.45E+09 |
| 164.4615  | 81455.    | 0.00    |           |           |        |          |
| 14.1000   | -0.01204  | 182770. | -8433.    | -6.06E-05 | 19349. | 9.45E+09 |
| 179.8361  | 84264.    | 0.00    |           |           |        |          |
| 14.5700   | -0.01207  | 138082. | -7400.    | 3.52E-05  | 18340. | 9.45E+09 |
| 186.3580  | 87072.    | 0.00    |           |           |        |          |
| 15.0400   | -0.01164  | 99139.  | -6352.    | 1.06E-04  | 17462. | 9.45E+09 |
| 185.5054  | 89881.    | 0.00    |           |           |        |          |
| 15.5100   | -0.01088  | 65966.  | -5324.    | 1.55E-04  | 16714. | 9.45E+09 |
| 178.7386  | 92690.    | 0.00    |           |           |        |          |
| 15.9800   | -0.00989  | 38391.  | -4348.    | 1.86E-04  | 16092. | 9.45E+09 |
| 167.4498  | 95499.    | 0.00    |           |           |        |          |
| 16.4500   | -0.00877  | 16092.  | -3445.    | 2.03E-04  | 15589. | 9.45E+09 |
| 152.9255  | 98308.    | 0.00    |           |           |        |          |
| 16.9200   | -0.00760  | -1364.  | -2629.    | 2.07E-04  | 15257. | 9.45E+09 |
| 136.3186  | 101116.   | 0.00    |           |           |        |          |
| 17.3900   | -0.00644  | -14482. | -1910.    | 2.02E-04  | 15552. | 9.45E+09 |
| 118.6309  | 103925.   | 0.00    |           |           |        |          |
| 17.8600   | -0.00532  | -23807. | -1292.    | 1.91E-04  | 15763. | 9.45E+09 |
| 100.7051  | 106734.   | 0.00    |           |           |        |          |
| 18.3300   | -0.00428  | -29897. | -772.9231 | 1.75E-04  | 15900. | 9.45E+09 |
| 83.2238   | 109543.   | 0.00    |           |           |        |          |
| 18.8000   | -0.00335  | -33301. | -350.0951 | 1.56E-04  | 15977. | 9.45E+09 |
| 66.7152   | 112352.   | 0.00    |           |           |        |          |
| 19.2700   | -0.00253  | -34538. | -16.5485  | 1.36E-04  | 16005. | 9.45E+09 |
| 51.5637   | 115160.   | 0.00    |           |           |        |          |
| 19.7400   | -0.00182  | -34089. | 236.0885  | 1.15E-04  | 15995. | 9.45E+09 |
| 38.0239   | 117969.   | 0.00    |           |           |        |          |
| 20.2100   | -0.00123  | -32386. | 417.3043  | 9.54E-05  | 15956. | 9.45E+09 |
| 26.2371   | 120778.   | 0.00    |           |           |        |          |
| 20.6800   | -7.42E-04 | -29805. | 537.1154  | 7.69E-05  | 15898. | 9.45E+09 |
| 16.2491   | 123587.   | 0.00    |           |           |        |          |
| 21.1500   | -3.58E-04 | -26668. | 605.5774  | 6.00E-05  | 15827. | 9.45E+09 |
| 8.0282    | 126395.   | 0.00    |           |           |        |          |
| 21.6200   | -6.47E-05 | -23240. | 632.3970  | 4.51E-05  | 15750. | 9.45E+09 |
| 1.4823    | 129204.   | 0.00    |           |           |        |          |
| 22.0900   | 1.51E-04  | -19735. | 626.6376  | 3.23E-05  | 15671. | 9.45E+09 |
| -3.5246   | 132013.   | 0.00    |           |           |        |          |
| 22.5600   | 2.99E-04  | -16315. | 596.5133  | 2.15E-05  | 15594. | 9.45E+09 |

|          |           |           |          |           |        |          |
|----------|-----------|-----------|----------|-----------|--------|----------|
| -7.1578  | 134822.   | 0.00      |          |           |        |          |
| 23.0300  | 3.93E-04  | -13101.   | 549.2598 | 1.27E-05  | 15521. | 9.45E+09 |
| -9.5988  | 137631.   | 0.00      |          |           |        |          |
| 23.5000  | 4.43E-04  | -10176.   | 491.0723 | 5.80E-06  | 15455. | 9.45E+09 |
| -11.0351 | 140439.   | 0.00      |          |           |        |          |
| 23.9700  | 4.59E-04  | -7588.    | 427.0979 | 4.93E-07  | 15397. | 9.45E+09 |
| -11.6509 | 143248.   | 0.00      |          |           |        |          |
| 24.4400  | 4.49E-04  | -5360.    | 361.4723 | -3.37E-06 | 15347. | 9.45E+09 |
| -11.6206 | 146057.   | 0.00      |          |           |        |          |
| 24.9100  | 4.21E-04  | -3495.    | 297.3887 | -6.01E-06 | 15305. | 9.45E+09 |
| -11.1041 | 148866.   | 0.00      |          |           |        |          |
| 25.3800  | 3.81E-04  | -1979.    | 237.1893 | -7.65E-06 | 15270. | 9.45E+09 |
| -10.2432 | 151675.   | 0.00      |          |           |        |          |
| 25.8500  | 3.34E-04  | -785.8832 | 182.4718 | -8.47E-06 | 15243. | 9.45E+09 |
| -9.1602  | 154483.   | 0.00      |          |           |        |          |
| 26.3200  | 2.85E-04  | 116.8678  | 134.2012 | -8.67E-06 | 15228. | 9.45E+09 |
| -7.9571  | 157292.   | 0.00      |          |           |        |          |
| 26.7900  | 2.37E-04  | 766.3533  | 92.8226  | -8.41E-06 | 15243. | 9.45E+09 |
| -6.7162  | 160101.   | 0.00      |          |           |        |          |
| 27.2600  | 1.90E-04  | 1201.     | 58.3690  | -7.82E-06 | 15253. | 9.45E+09 |
| -5.5014  | 162910.   | 0.00      |          |           |        |          |
| 27.7300  | 1.48E-04  | 1459.     | 30.5617  | -7.03E-06 | 15259. | 9.45E+09 |
| -4.3594  | 165718.   | 0.00      |          |           |        |          |
| 28.2000  | 1.11E-04  | 1577.     | 8.8994   | -6.12E-06 | 15261. | 9.45E+09 |
| -3.3223  | 168527.   | 0.00      |          |           |        |          |
| 28.6700  | 7.93E-05  | 1587.     | -7.2641  | -5.18E-06 | 15262. | 9.45E+09 |
| -2.4095  | 171336.   | 0.00      |          |           |        |          |
| 29.1400  | 5.28E-05  | 1518.     | -18.6550 | -4.25E-06 | 15260. | 9.45E+09 |
| -1.6299  | 174145.   | 0.00      |          |           |        |          |
| 29.6100  | 3.14E-05  | 1395.     | -26.0266 | -3.38E-06 | 15257. | 9.45E+09 |
| -0.9842  | 176954.   | 0.00      |          |           |        |          |
| 30.0800  | 1.46E-05  | 1239.     | -30.1186 | -2.59E-06 | 15254. | 9.45E+09 |
| -0.4669  | 179762.   | 0.00      |          |           |        |          |
| 30.5500  | 2.10E-06  | 1067.     | -31.6271 | -1.91E-06 | 15250. | 9.45E+09 |
| -0.06805 | 182571.   | 0.00      |          |           |        |          |
| 31.0200  | -6.85E-06 | 891.1911  | -31.1840 | -1.32E-06 | 15246. | 9.45E+09 |
| 0.2252   | 185380.   | 0.00      |          |           |        |          |
| 31.4900  | -1.28E-05 | 721.2352  | -29.3440 | -8.40E-07 | 15242. | 9.45E+09 |
| 0.4273   | 188189.   | 0.00      |          |           |        |          |
| 31.9600  | -1.63E-05 | 563.9164  | -26.5795 | -4.57E-07 | 15238. | 9.45E+09 |
| 0.5530   | 190998.   | 0.00      |          |           |        |          |
| 32.4300  | -1.80E-05 | 423.4434  | -23.2798 | -1.62E-07 | 15235. | 9.45E+09 |
| 0.6171   | 193806.   | 0.00      |          |           |        |          |
| 32.9000  | -1.82E-05 | 302.0392  | -19.7544 | 5.45E-08  | 15233. | 9.45E+09 |
| 0.6330   | 196615.   | 0.00      |          |           |        |          |
| 33.3700  | -1.73E-05 | 200.3720  | -16.2399 | 2.04E-07  | 15230. | 9.45E+09 |
| 0.6132   | 199424.   | 0.00      |          |           |        |          |
| 33.8400  | -1.59E-05 | 117.9468  | -12.9075 | 2.99E-07  | 15228. | 9.45E+09 |
| 0.5685   | 202233.   | 0.00      |          |           |        |          |
| 34.3100  | -1.40E-05 | 53.4478   | -9.8727  | 3.51E-07  | 15227. | 9.45E+09 |

|           |           |          |          |           |        |          |
|-----------|-----------|----------|----------|-----------|--------|----------|
| 0.5077    | 205042.   | 0.00     |          |           |        |          |
| 34.7800   | -1.19E-05 | 5.0290   | -7.2042  | 3.68E-07  | 15226. | 9.45E+09 |
| 0.4385    | 207850.   | 0.00     |          |           |        |          |
| 35.2500   | -9.81E-06 | -29.4476 | -4.9338  | 3.61E-07  | 15226. | 9.45E+09 |
| 0.3666    | 210659.   | 0.00     |          |           |        |          |
| 35.7200   | -7.83E-06 | -52.2239 | -3.0643  | 3.36E-07  | 15227. | 9.45E+09 |
| 0.2964    | 213468.   | 0.00     |          |           |        |          |
| 36.1900   | -6.02E-06 | -65.5041 | -1.5775  | 3.01E-07  | 15227. | 9.45E+09 |
| 0.2309    | 216277.   | 0.00     |          |           |        |          |
| 36.6600   | -4.43E-06 | -71.3535 | -0.4409  | 2.60E-07  | 15227. | 9.45E+09 |
| 0.1722    | 219085.   | 0.00     |          |           |        |          |
| 37.1300   | -3.08E-06 | -71.6317 | 0.3868   | 2.18E-07  | 15227. | 9.45E+09 |
| 0.1213    | 221894.   | 0.00     |          |           |        |          |
| 37.6000   | -1.98E-06 | -67.9557 | 0.9510   | 1.76E-07  | 15227. | 9.45E+09 |
| 0.07875   | 224703.   | 0.00     |          |           |        |          |
| 38.0700   | -1.10E-06 | -61.6847 | 1.2980   | 1.37E-07  | 15227. | 9.45E+09 |
| 0.04430   | 227512.   | 0.00     |          |           |        |          |
| 38.5400   | -4.28E-07 | -53.9228 | 1.4722   | 1.03E-07  | 15227. | 9.45E+09 |
| 0.01746   | 230321.   | 0.00     |          |           |        |          |
| 39.0100   | 6.17E-08  | -45.5343 | 1.5142   | 7.31E-08  | 15227. | 9.45E+09 |
| -0.00255  | 233129.   | 0.00     |          |           |        |          |
| 39.4800   | 3.98E-07  | -37.1666 | 1.4601   | 4.85E-08  | 15227. | 9.45E+09 |
| -0.01663  | 235938.   | 0.00     |          |           |        |          |
| 39.9500   | 6.08E-07  | -29.2788 | 1.3406   | 2.86E-08  | 15226. | 9.45E+09 |
| -0.02575  | 238747.   | 0.00     |          |           |        |          |
| 40.4200   | 7.21E-07  | -22.1715 | 1.1809   | 1.33E-08  | 15226. | 9.45E+09 |
| -0.03086  | 241556.   | 0.00     |          |           |        |          |
| 40.8900   | 7.58E-07  | -16.0166 | 1.0013   | 1.88E-09  | 15226. | 9.45E+09 |
| -0.03285  | 244365.   | 0.00     |          |           |        |          |
| 41.3600   | 7.42E-07  | -10.8854 | 0.8170   | -6.15E-09 | 15226. | 9.45E+09 |
| -0.03251  | 247173.   | 0.00     |          |           |        |          |
| 41.8300   | 6.89E-07  | -6.7740  | 0.6392   | -1.14E-08 | 15226. | 9.45E+09 |
| -0.03053  | 249982.   | 0.00     |          |           |        |          |
| 42.3000   | 6.13E-07  | -3.6247  | 0.4756   | -1.45E-08 | 15226. | 9.45E+09 |
| -0.02748  | 252791.   | 0.00     |          |           |        |          |
| 42.7700   | 5.25E-07  | -1.3447  | 0.3310   | -1.60E-08 | 15226. | 9.45E+09 |
| -0.02379  | 255600.   | 0.00     |          |           |        |          |
| 43.2400   | 4.32E-07  | 0.1804   | 0.2081   | -1.64E-08 | 15226. | 9.45E+09 |
| -0.01981  | 258408.   | 0.00     |          |           |        |          |
| 43.7100   | 3.41E-07  | 1.0749   | 0.1077   | -1.60E-08 | 15226. | 9.45E+09 |
| -0.01577  | 261217.   | 0.00     |          |           |        |          |
| 44.1800   | 2.52E-07  | 1.4662   | 0.02995  | -1.52E-08 | 15226. | 9.45E+09 |
| -0.01181  | 264026.   | 0.00     |          |           |        |          |
| 44.6500   | 1.69E-07  | 1.4801   | -0.02588 | -1.43E-08 | 15226. | 9.45E+09 |
| -0.00799  | 266835.   | 0.00     |          |           |        |          |
| 45.1200   | 9.04E-08  | 1.2379   | -0.06060 | -1.35E-08 | 15226. | 9.45E+09 |
| -0.00432  | 269644.   | 0.00     |          |           |        |          |
| 45.5900   | 1.62E-08  | 0.8566   | -0.07500 | -1.29E-08 | 15226. | 9.45E+09 |
| -7.84E-04 | 272452.   | 0.00     |          |           |        |          |
| 46.0600   | -5.51E-08 | 0.4491   | -0.06962 | -1.25E-08 | 15226. | 9.45E+09 |

|         |           |        |          |           |        |          |
|---------|-----------|--------|----------|-----------|--------|----------|
| 0.00269 | 275261.   | 0.00   |          |           |        |          |
| 46.5300 | -1.25E-07 | 0.1267 | -0.04467 | -1.23E-08 | 15226. | 9.45E+09 |
| 0.00616 | 278070.   | 0.00   |          |           |        |          |
| 47.0000 | -1.94E-07 | 0.00   | 0.00     | -1.23E-08 | 15226. | 9.45E+09 |
| 0.00968 | 140439.   | 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             | = | 0.55000000 inches             |
| Computed slope at pile head      | = | 0.000000 radians              |
| Maximum bending moment           | = | -2072006. inch-lbs            |
| Maximum shear force              | = | 41077. 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             | = | 9                             |
| Number of zero deflection points | = | 5                             |

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

Pile-head conditions are Displacement and Moment (Loading Type 4)

|                           |   |                  |
|---------------------------|---|------------------|
| Displacement of pile head | = | 0.550000 inches  |
| Moment at pile head       | = | 1357664.0 in-lbs |
| Axial load at pile head   | = | 393000.0 lbs     |

| Depth<br>Res. | Soil<br>X | Deflect.<br>Spr. y | Bending<br>Distrib.<br>Moment | Shear<br>Force | Slope<br>S | Total<br>Stress | Bending<br>Stiffness | Soil<br>p |
|---------------|-----------|--------------------|-------------------------------|----------------|------------|-----------------|----------------------|-----------|
|               | Es*H      | Lat. Load          |                               |                |            |                 |                      |           |
| feet          | inches    | lb/inch            | in-lbs                        | lbs            | radians    | psi*            | lb-in^2              |           |
| lb/inch       | lb/inch   | lb/inch            | lb/inch                       |                |            |                 |                      |           |
| 0.00          | 0.5500    | 1357664.           | -2587.                        | -0.01239       | 45851.     | 9.45E+09        |                      |           |
| 0.00          | 0.00      | 0.00               |                               |                |            |                 |                      |           |
| 0.4700        | 0.4824    | 1369637.           | -2743.                        | -0.01157       | 46121.     | 9.45E+09        |                      |           |
| -55.3253      | 646.8199  | 0.00               |                               |                |            |                 |                      |           |
| 0.9400        | 0.4194    | 1378039.           | -3220.                        | -0.01075       | 46311.     | 9.45E+09        |                      |           |

|           |          |          |         |           |        |          |
|-----------|----------|----------|---------|-----------|--------|----------|
| -113.8739 | 1531.    | 0.00     |         |           |        |          |
| 1.4100    | 0.3611   | 1380994. | -4012.  | -0.00993  | 46377. | 9.45E+09 |
| -166.9730 | 2608.    | 0.00     |         |           |        |          |
| 1.8800    | 0.3074   | 1376812. | -5073.  | -0.00911  | 46283. | 9.45E+09 |
| -209.4021 | 3842.    | 0.00     |         |           |        |          |
| 2.3500    | 0.2584   | 1364146. | -6348.  | -0.00829  | 45997. | 9.45E+09 |
| -242.6897 | 5298.    | 0.00     |         |           |        |          |
| 2.8200    | 0.2139   | 1341956. | -7776.  | -0.00748  | 45497. | 9.45E+09 |
| -263.5897 | 6950.    | 0.00     |         |           |        |          |
| 3.2900    | 0.1740   | 1309606. | -9283.  | -0.00669  | 44767. | 9.45E+09 |
| -270.8030 | 8779.    | 0.00     |         |           |        |          |
| 3.7600    | 0.1384   | 1266908. | -10792. | -0.00592  | 43804. | 9.45E+09 |
| -264.5388 | 10778.   | 0.00     |         |           |        |          |
| 4.2300    | 0.1072   | 1214120. | -12248. | -0.00518  | 42613. | 9.45E+09 |
| -251.6351 | 13243.   | 0.00     |         |           |        |          |
| 4.7000    | 0.07999  | 1151721. | -13573. | -0.00448  | 41205. | 9.45E+09 |
| -218.2341 | 15387.   | 0.00     |         |           |        |          |
| 5.1700    | 0.05669  | 1080856. | -14721. | -0.00381  | 39607. | 9.45E+09 |
| -188.8254 | 18786.   | 0.00     |         |           |        |          |
| 5.6400    | 0.03703  | 1002554. | -15714. | -0.00319  | 37841. | 9.45E+09 |
| -163.2162 | 24862.   | 0.00     |         |           |        |          |
| 6.1100    | 0.02074  | 917734.  | -16526. | -0.00261  | 35927. | 9.45E+09 |
| -124.7477 | 33926.   | 0.00     |         |           |        |          |
| 6.5800    | 0.00754  | 827732.  | -17026. | -0.00209  | 33897. | 9.45E+09 |
| -52.5795  | 39323.   | 0.00     |         |           |        |          |
| 7.0500    | -0.00287 | 734962.  | -17114. | -0.00163  | 31804. | 9.45E+09 |
| 21.4349   | 42132.   | 0.00     |         |           |        |          |
| 7.5200    | -0.01081 | 641901.  | -16810. | -0.00122  | 29705. | 9.45E+09 |
| 86.1024   | 44941.   | 0.00     |         |           |        |          |
| 7.9900    | -0.01658 | 550730.  | -16172. | -8.60E-04 | 27649. | 9.45E+09 |
| 140.3787  | 47749.   | 0.00     |         |           |        |          |
| 8.4600    | -0.02050 | 463296.  | -15257. | -5.57E-04 | 25676. | 9.45E+09 |
| 183.7865  | 50558.   | 0.00     |         |           |        |          |
| 8.9300    | -0.02286 | 381095.  | -14129. | -3.05E-04 | 23822. | 9.45E+09 |
| 216.3410  | 53367.   | 0.00     |         |           |        |          |
| 9.4000    | -0.02394 | 305271.  | -12847. | -1.00E-04 | 22112. | 9.45E+09 |
| 238.4684  | 56176.   | 0.00     |         |           |        |          |
| 9.8700    | -0.02399 | 236629.  | -11466. | 6.16E-05  | 20563. | 9.45E+09 |
| 250.9214  | 58985.   | 0.00     |         |           |        |          |
| 10.3400   | -0.02325 | 175656.  | -10041. | 1.85E-04  | 19188. | 9.45E+09 |
| 254.6966  | 61793.   | 0.00     |         |           |        |          |
| 10.8100   | -0.02191 | 122552.  | -8615.  | 2.74E-04  | 17990. | 9.45E+09 |
| 250.9549  | 64602.   | 0.00     |         |           |        |          |
| 11.2800   | -0.02016 | 77269.   | -7228.  | 3.33E-04  | 16969. | 9.45E+09 |
| 240.9497  | 67411.   | 0.00     |         |           |        |          |
| 11.7500   | -0.01815 | 39548.   | -5911.  | 3.68E-04  | 16118. | 9.45E+09 |
| 225.9627  | 70220.   | 0.00     |         |           |        |          |
| 12.2200   | -0.01601 | 8962.    | -4689.  | 3.83E-04  | 15428. | 9.45E+09 |
| 207.2496  | 73028.   | 0.00     |         |           |        |          |
| 12.6900   | -0.01383 | -15043.  | -3580.  | 3.81E-04  | 15565. | 9.45E+09 |

|          |           |           |           |           |        |          |
|----------|-----------|-----------|-----------|-----------|--------|----------|
| 185.9961 | 75837.    | 0.00      |           |           |        |          |
| 13.1600  | -0.01171  | -33111.   | -2595.    | 3.66E-04  | 15973. | 9.45E+09 |
| 163.2840 | 78646.    | 0.00      |           |           |        |          |
| 13.6300  | -0.00970  | -45942.   | -1740.    | 3.43E-04  | 16262. | 9.45E+09 |
| 140.0675 | 81455.    | 0.00      |           |           |        |          |
| 14.1000  | -0.00784  | -54257.   | -1014.    | 3.13E-04  | 16450. | 9.45E+09 |
| 117.1585 | 84264.    | 0.00      |           |           |        |          |
| 14.5700  | -0.00617  | -58773.   | -415.5270 | 2.79E-04  | 16551. | 9.45E+09 |
| 95.2204  | 87072.    | 0.00      |           |           |        |          |
| 15.0400  | -0.00469  | -60182.   | 63.8406   | 2.44E-04  | 16583. | 9.45E+09 |
| 74.7682  | 89881.    | 0.00      |           |           |        |          |
| 15.5100  | -0.00342  | -59133.   | 433.1018  | 2.08E-04  | 16560. | 9.45E+09 |
| 56.1755  | 92690.    | 0.00      |           |           |        |          |
| 15.9800  | -0.00234  | -56219.   | 703.4295  | 1.74E-04  | 16494. | 9.45E+09 |
| 39.6854  | 95499.    | 0.00      |           |           |        |          |
| 16.4500  | -0.00146  | -51968.   | 887.0385  | 1.41E-04  | 16398. | 9.45E+09 |
| 25.4242  | 98308.    | 0.00      |           |           |        |          |
| 16.9200  | -7.48E-04 | -46840.   | 996.5737  | 1.12E-04  | 16282. | 9.45E+09 |
| 13.4181  | 101116.   | 0.00      |           |           |        |          |
| 17.3900  | -1.96E-04 | -41223.   | 1045.     | 8.57E-05  | 16156. | 9.45E+09 |
| 3.6105   | 103925.   | 0.00      |           |           |        |          |
| 17.8600  | 2.18E-04  | -35437.   | 1043.     | 6.28E-05  | 16025. | 9.45E+09 |
| -4.1211  | 106734.   | 0.00      |           |           |        |          |
| 18.3300  | 5.12E-04  | -29735.   | 1003.     | 4.33E-05  | 15896. | 9.45E+09 |
| -9.9474  | 109543.   | 0.00      |           |           |        |          |
| 18.8000  | 7.06E-04  | -24310.   | 935.7440  | 2.72E-05  | 15774. | 9.45E+09 |
| -14.0729 | 112352.   | 0.00      |           |           |        |          |
| 19.2700  | 8.19E-04  | -19300.   | 848.9063  | 1.42E-05  | 15661. | 9.45E+09 |
| -16.7207 | 115160.   | 0.00      |           |           |        |          |
| 19.7400  | 8.66E-04  | -14797.   | 750.6516  | 4.00E-06  | 15560. | 9.45E+09 |
| -18.1214 | 117969.   | 0.00      |           |           |        |          |
| 20.2100  | 8.64E-04  | -10851.   | 647.3718  | -3.65E-06 | 15471. | 9.45E+09 |
| -18.5026 | 120778.   | 0.00      |           |           |        |          |
| 20.6800  | 8.25E-04  | -7478.    | 544.2059  | -9.13E-06 | 15394. | 9.45E+09 |
| -18.0810 | 123587.   | 0.00      |           |           |        |          |
| 21.1500  | 7.61E-04  | -4671.    | 445.1180  | -1.28E-05 | 15331. | 9.45E+09 |
| -17.0565 | 126395.   | 0.00      |           |           |        |          |
| 21.6200  | 6.81E-04  | -2401.    | 353.0046  | -1.49E-05 | 15280. | 9.45E+09 |
| -15.6079 | 129204.   | 0.00      |           |           |        |          |
| 22.0900  | 5.93E-04  | -623.6896 | 269.8191  | -1.58E-05 | 15240. | 9.45E+09 |
| -13.8906 | 132013.   | 0.00      |           |           |        |          |
| 22.5600  | 5.03E-04  | 712.5192  | 196.7074  | -1.57E-05 | 15242. | 9.45E+09 |
| -12.0356 | 134822.   | 0.00      |           |           |        |          |
| 23.0300  | 4.16E-04  | 1665.     | 134.1457  | -1.50E-05 | 15263. | 9.45E+09 |
| -10.1495 | 137631.   | 0.00      |           |           |        |          |
| 23.5000  | 3.34E-04  | 2292.     | 82.0737   | -1.38E-05 | 15277. | 9.45E+09 |
| -8.3158  | 140439.   | 0.00      |           |           |        |          |
| 23.9700  | 2.60E-04  | 2652.     | 40.0214   | -1.24E-05 | 15286. | 9.45E+09 |
| -6.5964  | 143248.   | 0.00      |           |           |        |          |
| 24.4400  | 1.94E-04  | 2799.     | 7.2225    | -1.07E-05 | 15289. | 9.45E+09 |

|          |           |           |          |           |        |          |
|----------|-----------|-----------|----------|-----------|--------|----------|
| -5.0344  | 146057.   | 0.00      |          |           |        |          |
| 24.9100  | 1.39E-04  | 2781.     | -17.2841 | -9.08E-06 | 15288. | 9.45E+09 |
| -3.6559  | 148866.   | 0.00      |          |           |        |          |
| 25.3800  | 9.20E-05  | 2644.     | -34.5695 | -7.46E-06 | 15285. | 9.45E+09 |
| -2.4736  | 151675.   | 0.00      |          |           |        |          |
| 25.8500  | 5.44E-05  | 2424.     | -45.7437 | -5.95E-06 | 15280. | 9.45E+09 |
| -1.4888  | 154483.   | 0.00      |          |           |        |          |
| 26.3200  | 2.49E-05  | 2154.     | -51.8997 | -4.58E-06 | 15274. | 9.45E+09 |
| -0.6942  | 157292.   | 0.00      |          |           |        |          |
| 26.7900  | 2.68E-06  | 1859.     | -54.0716 | -3.38E-06 | 15268. | 9.45E+09 |
| -0.07601 | 160101.   | 0.00      |          |           |        |          |
| 27.2600  | -1.33E-05 | 1559.     | -53.2045 | -2.36E-06 | 15261. | 9.45E+09 |
| 0.3835   | 162910.   | 0.00      |          |           |        |          |
| 27.7300  | -2.40E-05 | 1270.     | -50.1363 | -1.52E-06 | 15254. | 9.45E+09 |
| 0.7046   | 165718.   | 0.00      |          |           |        |          |
| 28.2000  | -3.04E-05 | 1001.     | -45.5872 | -8.41E-07 | 15248. | 9.45E+09 |
| 0.9086   | 168527.   | 0.00      |          |           |        |          |
| 28.6700  | -3.35E-05 | 759.0661  | -40.1577 | -3.16E-07 | 15243. | 9.45E+09 |
| 1.0167   | 171336.   | 0.00      |          |           |        |          |
| 29.1400  | -3.40E-05 | 548.9460  | -34.3324 | 7.43E-08  | 15238. | 9.45E+09 |
| 1.0490   | 174145.   | 0.00      |          |           |        |          |
| 29.6100  | -3.26E-05 | 371.4679  | -28.4871 | 3.49E-07  | 15234. | 9.45E+09 |
| 1.0238   | 176954.   | 0.00      |          |           |        |          |
| 30.0800  | -3.00E-05 | 226.0644  | -22.9002 | 5.27E-07  | 15231. | 9.45E+09 |
| 0.9574   | 179762.   | 0.00      |          |           |        |          |
| 30.5500  | -2.67E-05 | 110.8155  | -17.7647 | 6.28E-07  | 15228. | 9.45E+09 |
| 0.8637   | 182571.   | 0.00      |          |           |        |          |
| 31.0200  | -2.30E-05 | 22.8951   | -13.2013 | 6.68E-07  | 15226. | 9.45E+09 |
| 0.7545   | 185380.   | 0.00      |          |           |        |          |
| 31.4900  | -1.92E-05 | -41.0553  | -9.2717  | 6.62E-07  | 15227. | 9.45E+09 |
| 0.6390   | 188189.   | 0.00      |          |           |        |          |
| 31.9600  | -1.55E-05 | -84.6257  | -5.9911  | 6.25E-07  | 15228. | 9.45E+09 |
| 0.5243   | 190998.   | 0.00      |          |           |        |          |
| 32.4300  | -1.21E-05 | -111.4048 | -3.3397  | 5.66E-07  | 15228. | 9.45E+09 |
| 0.4159   | 193806.   | 0.00      |          |           |        |          |
| 32.9000  | -9.10E-06 | -124.8083 | -1.2729  | 4.96E-07  | 15229. | 9.45E+09 |
| 0.3171   | 196615.   | 0.00      |          |           |        |          |
| 33.3700  | -6.51E-06 | -127.9609 | 0.2703   | 4.20E-07  | 15229. | 9.45E+09 |
| 0.2301   | 199424.   | 0.00      |          |           |        |          |
| 33.8400  | -4.35E-06 | -123.6233 | 1.3595   | 3.45E-07  | 15229. | 9.45E+09 |
| 0.1561   | 202233.   | 0.00      |          |           |        |          |
| 34.3100  | -2.61E-06 | -114.1569 | 2.0676   | 2.74E-07  | 15228. | 9.45E+09 |
| 0.09502  | 205042.   | 0.00      |          |           |        |          |
| 34.7800  | -1.26E-06 | -101.5168 | 2.4664   | 2.10E-07  | 15228. | 9.45E+09 |
| 0.04639  | 207850.   | 0.00      |          |           |        |          |
| 35.2500  | -2.45E-07 | -87.2667  | 2.6231   | 1.54E-07  | 15228. | 9.45E+09 |
| 0.00917  | 210659.   | 0.00      |          |           |        |          |
| 35.7200  | 4.74E-07  | -72.6097  | 2.5983   | 1.06E-07  | 15227. | 9.45E+09 |
| -0.01794 | 213468.   | 0.00      |          |           |        |          |
| 36.1900  | 9.49E-07  | -58.4273  | 2.4451   | 6.68E-08  | 15227. | 9.45E+09 |

|           |           |          |          |           |        |          |
|-----------|-----------|----------|----------|-----------|--------|----------|
| -0.03640  | 216277.   | 0.00     |          |           |        |          |
| 36.6600   | 1.23E-06  | -45.3255 | 2.2079   | 3.58E-08  | 15227. | 9.45E+09 |
| -0.04768  | 219085.   | 0.00     |          |           |        |          |
| 37.1300   | 1.35E-06  | -33.6805 | 1.9233   | 1.22E-08  | 15227. | 9.45E+09 |
| -0.05324  | 221894.   | 0.00     |          |           |        |          |
| 37.6000   | 1.37E-06  | -23.6846 | 1.6198   | -4.88E-09 | 15226. | 9.45E+09 |
| -0.05441  | 224703.   | 0.00     |          |           |        |          |
| 38.0700   | 1.30E-06  | -15.3881 | 1.3186   | -1.65E-08 | 15226. | 9.45E+09 |
| -0.05237  | 227512.   | 0.00     |          |           |        |          |
| 38.5400   | 1.18E-06  | -8.7371  | 1.0351   | -2.37E-08 | 15226. | 9.45E+09 |
| -0.04815  | 230321.   | 0.00     |          |           |        |          |
| 39.0100   | 1.03E-06  | -3.6064  | 0.7792   | -2.74E-08 | 15226. | 9.45E+09 |
| -0.04260  | 233129.   | 0.00     |          |           |        |          |
| 39.4800   | 8.70E-07  | 0.1742   | 0.5565   | -2.84E-08 | 15226. | 9.45E+09 |
| -0.03639  | 235938.   | 0.00     |          |           |        |          |
| 39.9500   | 7.10E-07  | 2.7970   | 0.3692   | -2.76E-08 | 15226. | 9.45E+09 |
| -0.03004  | 238747.   | 0.00     |          |           |        |          |
| 40.4200   | 5.59E-07  | 4.4605   | 0.2169   | -2.54E-08 | 15226. | 9.45E+09 |
| -0.02394  | 241556.   | 0.00     |          |           |        |          |
| 40.8900   | 4.23E-07  | 5.3566   | 0.09771  | -2.25E-08 | 15226. | 9.45E+09 |
| -0.01834  | 244365.   | 0.00     |          |           |        |          |
| 41.3600   | 3.06E-07  | 5.6623   | 0.00824  | -1.92E-08 | 15226. | 9.45E+09 |
| -0.01339  | 247173.   | 0.00     |          |           |        |          |
| 41.8300   | 2.07E-07  | 5.5345   | -0.05540 | -1.58E-08 | 15226. | 9.45E+09 |
| -0.00917  | 249982.   | 0.00     |          |           |        |          |
| 42.3000   | 1.27E-07  | 5.1076   | -0.09732 | -1.27E-08 | 15226. | 9.45E+09 |
| -0.00569  | 252791.   | 0.00     |          |           |        |          |
| 42.7700   | 6.42E-08  | 4.4929   | -0.1216  | -9.79E-09 | 15226. | 9.45E+09 |
| -0.00291  | 255600.   | 0.00     |          |           |        |          |
| 43.2400   | 1.65E-08  | 3.7797   | -0.1319  | -7.32E-09 | 15226. | 9.45E+09 |
| -7.58E-04 | 258408.   | 0.00     |          |           |        |          |
| 43.7100   | -1.84E-08 | 3.0374   | -0.1317  | -5.29E-09 | 15226. | 9.45E+09 |
| 8.51E-04  | 261217.   | 0.00     |          |           |        |          |
| 44.1800   | -4.31E-08 | 2.3181   | -0.1236  | -3.69E-09 | 15226. | 9.45E+09 |
| 0.00202   | 264026.   | 0.00     |          |           |        |          |
| 44.6500   | -6.00E-08 | 1.6599   | -0.1099  | -2.50E-09 | 15226. | 9.45E+09 |
| 0.00284   | 266835.   | 0.00     |          |           |        |          |
| 45.1200   | -7.13E-08 | 1.0898   | -0.09226 | -1.68E-09 | 15226. | 9.45E+09 |
| 0.00341   | 269644.   | 0.00     |          |           |        |          |
| 45.5900   | -7.89E-08 | 0.6267   | -0.07189 | -1.17E-09 | 15226. | 9.45E+09 |
| 0.00381   | 272452.   | 0.00     |          |           |        |          |
| 46.0600   | -8.45E-08 | 0.2841   | -0.04951 | -8.96E-10 | 15226. | 9.45E+09 |
| 0.00412   | 275261.   | 0.00     |          |           |        |          |
| 46.5300   | -8.91E-08 | 0.07227  | -0.02550 | -7.90E-10 | 15226. | 9.45E+09 |
| 0.00439   | 278070.   | 0.00     |          |           |        |          |
| 47.0000   | -9.34E-08 | 0.00     | 0.00     | -7.68E-10 | 15226. | 9.45E+09 |
| 0.00465   | 140439.   | 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           =      0.55000000 inches
Computed slope at pile head    =     -0.01238859 radians
Maximum bending moment         =      1380994. inch-lbs
Maximum shear force            =       -17114. lbs
Depth of maximum bending moment =      1.41000000 feet below pile head
Depth of maximum shear force    =      7.05000000 feet below pile head
Number of iterations           =              9
Number of zero deflection points =             5
  
```

-----

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 | Load 1 | Load 2   | Axial Loading | Pile-head Deflection | Pile-head Rotation | Max in lbs |
|---------------|-----------|--------|----------|---------------|----------------------|--------------------|------------|
| 1             | y, in     | 0.5500 | S, rad   | 0.00          | 393000.              | 0.5500             | 0.00       |
| 2             | y, in     | 0.5500 | M, in-lb | 1357664.      | 393000.              | 0.5500             | -0.01239   |
|               |           |        |          |               |                      |                    |            |

```

Maximum pile-head deflection = 0.5500000000 inches
Maximum pile-head rotation   = -0.0123885925 radians = -0.709814 deg.
  
```

The analysis ended normally.



## CALCULATIONS

**Date:** 8/21/2025  
**Project No.:** US0025840.9367  
**Subject:** Pile Drivability at Abutment 1 - HP14x89 - Driving  
**Project Title:** Phair Crossing Bridge Presque Isle, ME (WIN 026434.00)

**Made by:** DEB  
**Checked by:** KAR  
**Reviewed by:** CCB

### OBJECTIVE

Perform a drivability analysis using GRLWEAP to determine if the proposed H-piles at Abutment 1 can be driven to the nominal pile driving resistance while maintaining blow counts and pile stresses within the specified limits.

### REFERENCES

1. GRLWEAP 14 Software Package Version 14.1.20.1, Built December 1, 2022.
2. AISC Shapes Database v15.0. November 2017. <https://www.aisc.org/globalassets/aisc/manual/v15.0-shapes-database/aisc-shapes-database-v15.0.xlsx>
3. Maine Department of Transportation, Bridge Program. 60% Plans, dated May 2, 2025: Phair Crossing Bridge #3259 over Maine Northern Railway, Presque Isle, Maine, WIN 026434.00.
4. State of Maine, Department of Transportation. March 2020. Standard Specifications.
5. Guertin Elkerton & Associates for Maine Department of Transportation. Bridge Design Guide. Dated August 2003 with 2018 updates.
6. WSP calculation package titled HP 14x89 Pile Design at Proposed Abutment 1, dated 6/25/2025.
7. APE Model D25-42 Single Acting Diesel Impact Hammer, <https://www.americanpiledriving.com/pdfs/diesels/specs/d25-42.pdf>, Accessed April 2025.
8. AASHTO LRFD Bridge Design Specifications, 9th Ed. 2020.
9. FHWA. July 2016. GEC-012: Design and Construction of Driven Pile Foundations, Volume 1. Publication No. FHWA-NHI-16-009.

### ASSUMPTIONS

1. The proposed abutment is assumed to be supported on five (5) HP14x89 Grade 50 piles with a center-to-center pile spacing of 9.75 feet , Ref 3, Sheet 25 of 38 Abutment No. 1. The piles are to be driven to bedrock.
2. The soil profile used in the analysis is based on Ref. 6 at the centerline of the proposed Abutment 1.
3. As per the MaineDOT Standard Specifications Section 501.042 (Ref. 4), the number of hammer blows at the required resistance indicated by the wave equation analysis shall be between 3 and 15 blows per inch, and the driving stresses shall not exceed 90% of the specified yield stress of the pile material.
4. An APE D 25-42 single acting diesel pile driving hammer with a box lead size of 26 inches, and a DB 26 drive cap, DB-26 Micarta cushion, and DB-26 strike plate is assumed for the analysis (Ref. 7).
5. This analysis looks at resistance during driving and upon reaching the tip elevation in bedrock. A resistance distribution of 90% shaft resistance and 10% toe resistance is assumed during driving, and 10% shaft resistance and 90% toe resistance is assumed upon reaching the tip elevation.

### ATTACHMENTS

1. GRLWEAP tables of recommended quake and damping values for impact driven piles.
2. GRLWEAP output for a variable resistance analysis using the APE D25-42 hammer.

**Date:** 8/21/2025  
**Project No.:** US0025840.9367  
**Subject:** Pile Drivability at Abutment 1 - HP14x89 - Driving  
**Project Title:** Phair Crossing Bridge Presque Isle, ME (WIN 026434.00)

**Made by:** DEB  
**Checked by:** KAR  
**Reviewed by:** CCB

**CALCULATION**
**1. Determine the input parameters.**
*Cushion Information:*

Using Micarta cushion and DB 26 Striker Plate and drive cap (Assumption 4).

Cushion area = 398.0 in<sup>2</sup> (Ref. 7)  
 Elastic modulus = 285.0 ksi (Ref. 7)  
 Cushion thickness = 3.5 in (Ref. 7)  
 Coefficient of restitution = 0.80 (Ref. 7)  
 Helmet weight = 2.7 kips (Ref. 7)

*Pile Information:*

For an HP14x89 pile section:

**Intact Section**

Section depth,  $d$  = 13.8 in (Ref. 2)  
 Section width,  $b_f$  = 14.7 in (Ref. 2)  
 Web thickness,  $t_w$  = 0.615 in (Ref. 2)  
 Flange thickness,  $t_f$  = 0.615 in (Ref. 2)  
 Cross-sectional area,  $A_s$  = 26.1 in<sup>2</sup> = 0.18 ft<sup>2</sup> (Ref. 2)  
  
 Steel yield stress,  $F_y$  = 50 ksi (Assumption 1)  
 90% of steel yield stress = 45 ksi  
 Steel elastic modulus,  $E_{st}$  = 29,000 ksi (typical value for steel)  
 Steel unit weight = 491 pcf  
 Box perimeter =  $(d \times 2) + (b_f \times 2) = 57.0$  in = 4.8 ft  
 Pile head elevation = 613.0 ft (Ref. 3, Sheet 25 of 38, with 3-foot pile cap embedment)  
 Pile tip elevation = 584.3 ft (Ref. 6)  
 Pile length below abutment = 25.7 ft (Ref. 6) (excluding pile cap embedment)

*Ultimate Capacities:*

Axial load on pile,  $P_u$  = 391 kips (Ref. 6)  
 $\Phi_{dyn}$  = 0.65 (Ref. 8, Table 10.5.5.2.3-1)  
 Pile driving resistance,  $R_{ndr}$  = 602 kips

*Quake and Damping Soil Parameters:*

Shaft quake = 0.10 in (Ref. 1, included as Attachment 1)  
 Toe quake during driving = 0.123 in D/120 for very dense soils (Ref. 1, included as Attach. 1)  
 Toe quake reaching tip elev. = 0.04 in for hard rock (Ref. 1, included as Attachment 1)  
 Shaft damping = 0.05 s/ft for non-cohesive soils (Ref. 1, included as Attachment 1)  
 Toe damping = 0.15 s/ft (Ref. 1, included as Attachment 1)

*Soil Profile Input, to calculate Variable Resistance Distribution:*

(Ref. 6)

Pile head elevation = 610.0 ft Does not include embedment in pile cap  
 Groundwater elevation = 587.3 ft = 22.7 ft below pile head

| Soil Layer<br>(input into GRLWEAP) | Elevation (ft) |        | Depth below pile head<br>(ft) |        | Unit Weight<br>(pcf) | Friction<br>Angle (°) | Average<br>Undrained<br>Shear<br>Strength<br>(psf) | Skin<br>Friction <sup>1</sup><br>(ksf) | End<br>Bearing <sup>1</sup><br>(ksf) | Soil Type  |
|------------------------------------|----------------|--------|-------------------------------|--------|----------------------|-----------------------|----------------------------------------------------|----------------------------------------|--------------------------------------|------------|
|                                    | Top            | Bottom | Top                           | Bottom |                      |                       |                                                    |                                        |                                      |            |
| Granular Borrow                    | 610.0          | 609.0  | 0.0                           | 1.0    | 125                  | 32                    | -                                                  | 0.05                                   | 3.75                                 | Sand       |
| Fill                               | 609.0          | 587.3  | 1.0                           | 22.7   | 125                  | 32                    | -                                                  | 1.16                                   | 85                                   | Sand       |
| Glacial Till                       | 587.3          | 584.3  | 22.7                          | 25.7   | 130                  | 35                    | -                                                  | 0.61                                   | 177.03                               | Sand       |
| Bedrock                            | 584.3          | -      | 25.7                          | -      | 170                  | -                     | -                                                  | 24.0                                   | 1008.0                               | Rock Other |

Note: <sup>1</sup>Skin friction and end bearing values for soils are generated by GRLWEAP, bedrock values are based on FHWA GEC 12 (Ref. 9) Table 7-13 for limestone.



## CALCULATIONS

**Date:** 8/21/2025  
**Project No.:** US0025840.9367  
**Subject:** Pile Drivability at Abutment 1 - HP14x89 - Driving  
**Project Title:** Phair Crossing Bridge Presque Isle, ME (WIN 026434.00)

**Made by:** DEB  
**Checked by:** KAR  
**Reviewed by:** CCB

2. Analyze an open ended diesel (OED) hammer to determine the  $R_{ndr}$  for the abutment based on the stress and blow counts outline in Ref. 4.

| Analysis Case          | Shaft Resistance | Toe Resistance | Hammer     | Energy / Power (lb-ft) | Fuel Setting (%)     | $R_{ndr}$ (kips) | Blows/in | Stress (ksi) | Percent of Steel $F_y$ (ksi) |
|------------------------|------------------|----------------|------------|------------------------|----------------------|------------------|----------|--------------|------------------------------|
| During Driving         | 90%              | 10%            | APE D25-42 | 55,814                 | Fuel Setting 3 (90%) | 602              | 5.6      | 28.96        | 58%                          |
| Reaching tip elevation | 10%              | 90%            | APE D25-42 | 55,814                 | Fuel Setting 3 (90%) | 602              | 6.4      | 40.98        | 82%                          |

### CONCLUSIONS

The analysis indicates the APE D25-42 hammer operated at fuel setting 3 (90% of the combustion pressure) while driving through soil and upon reaching bedrock should be able to overcome the soil resistance in order to drive the plumb piles at Abutment 1 to bedrock and a nominal resistance of 602 kips while staying at a blow count between 3 and 15 blows per inch and limiting the driving stresses to below 45 kips per square inch (ksi), in accordance with Section 501.042 of the MaineDOT Standard Specifications.

[Reference Tables](#)


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## Table of Recommended Quake Values

### Recommended Quake Values for Impact Driven Piles\*

|             | Soil Type                 | Pile Type or Size                               | Quake (in) | Quake (mm) |
|-------------|---------------------------|-------------------------------------------------|------------|------------|
| Shaft Quake | All soil types            | All Types                                       | 0.10       | 2.5        |
| Toe Quake   | All soil types, soft Rock | Non-displacement piles** i.e. driving unplugged | 0.10       | 2.5        |
|             | Very dense or hard soils  | Displacement Piles*** of diameter or width D    | D/120      | D/120      |
|             | Loose or soft soils       | Displacement Piles*** of diameter or width D    | D/60       | D/60       |
|             | Hard Rock                 | All Types                                       | 0.04       | 1.0        |

\*For vibratory driven piles in cohesive soils, quakes should be doubled.

\*\* Non-displacement piles are sheet pile, H-Piles, or open-ended pipe piles which are not plugging during driving. Normally it can be assumed that pipe piles with diameters of 30 inches (900 mm) or more will not plug during driving while H-Piles and pipe piles of diameter 20 inches (500 mm) or less will plug during driving into a bearing layer. Between 20 and 30 inches (500 and 750 mm), pipe piles may or may not plug.

\*\*\* Displacement piles are closed-ended pipe piles, pipe piles, or H-Piles that are plugged during driving and solid concrete piles. Normally, we would analyze H-Piles and pipe piles with diameters 20 inches (500 mm) or less as displacement piles.

Recommended quake values, both shaft and toe, for vibratory driven piles are somewhat speculative recommendations as not much experience exists.

## Table of Recommended Damping Values

### Recommended Damping Values for Impact Driven Piles:

|                  | Soil Type               | Damping Factor<br>s/ft | Damping Factor<br>s/m |
|------------------|-------------------------|------------------------|-----------------------|
| Shaft<br>Damping | Non-cohesive<br>soils** | 0.05                   | .16                   |
|                  | Cohesive soils**        | 0.20                   | .65                   |
| Toe<br>damping   | In all soil types       | 0.15                   | 0.50                  |

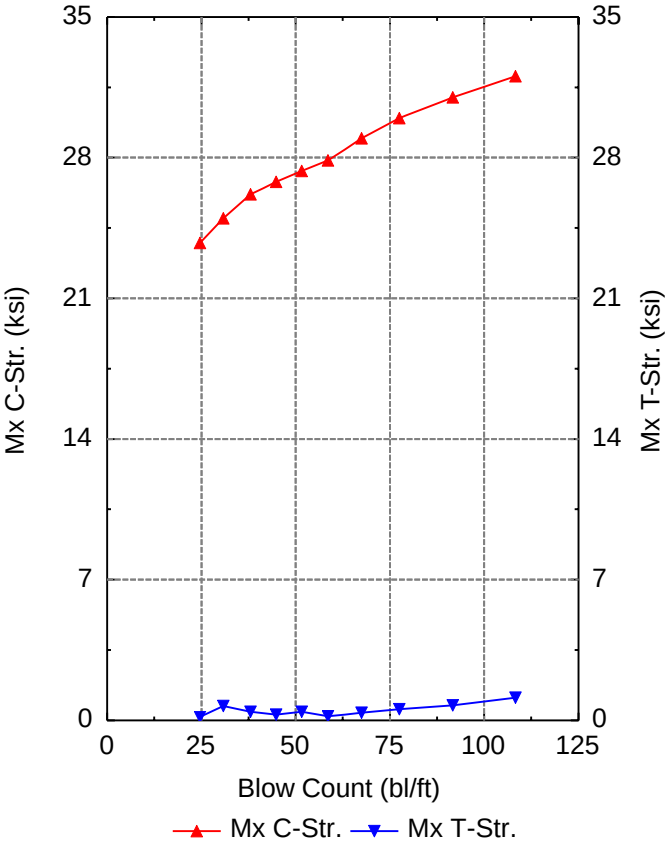
\* For vibratory driven piles, use double values (Smith-viscous).

\*\* For mixed soils, intermediate values may be appropriate; for example, a sandy silt or clayey sand may be modeled with 0.10 s/ft (0.33 s/m), a cohesive silt or a sandy clay with 0.15 s/ft (0.50 s/m).

In general the [Smith Soil Damping Option](#) should be used. An exception would be a [Residual Stress Analysis](#) for which the [Smith-Viscous Soil Damping Option](#) would be more appropriate and Vibratory Hammer Analysis. All other [Soil Damping Options](#) are experimental. Smith damping factors and Smith-Viscous damping are both considered independent of pile type or pile size and have the same dimensions.

It is recommended that the user perform sensitivity analyses with reasonable ranges of quake and damping factors whenever a situation is ambiguous. If either quake or damping values are known from measurements such values also should be tried. Note that small quake values tend to make capacity values higher (non-conservative) for the same blow count. However, stresses would be predicted conservatively higher, particularly in cases of concentrated end bearing. On the other hand, choosing damping values too low would make capacity results non-conservative.

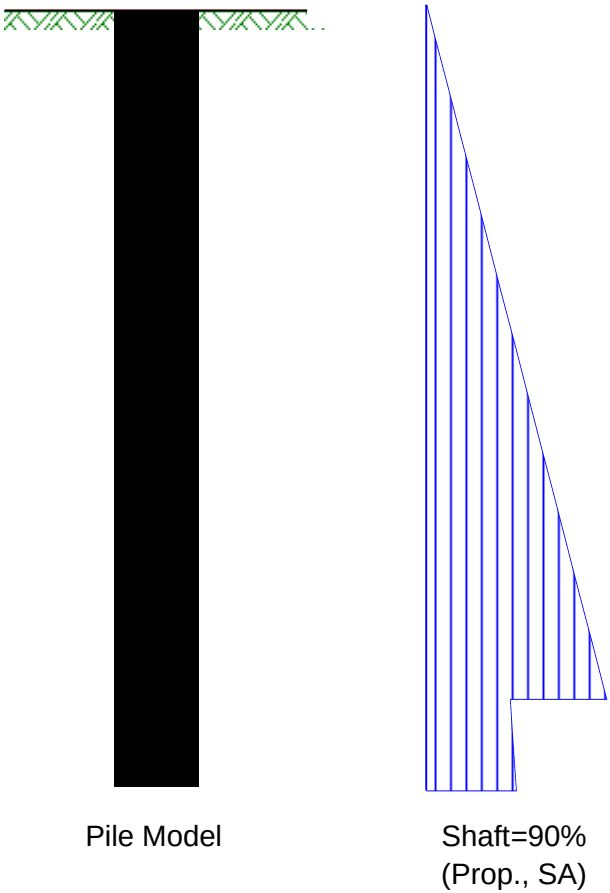
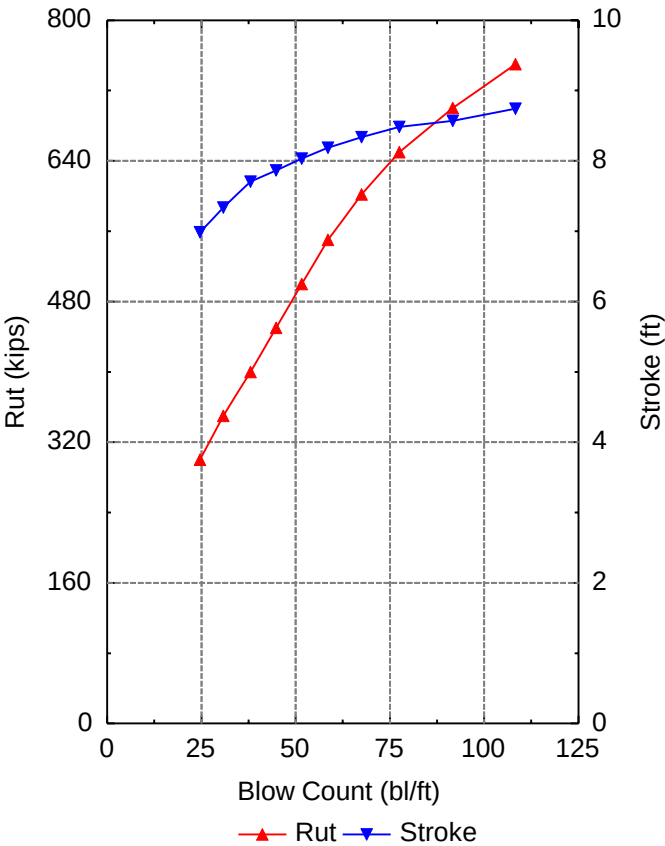
Note that the different soil damping types may be chosen under **Options/General Options/Damping**. The above recommendations are only available for Smith or Smith-viscous models; no recommendations can be made for the other damping options.



APE D 25-42

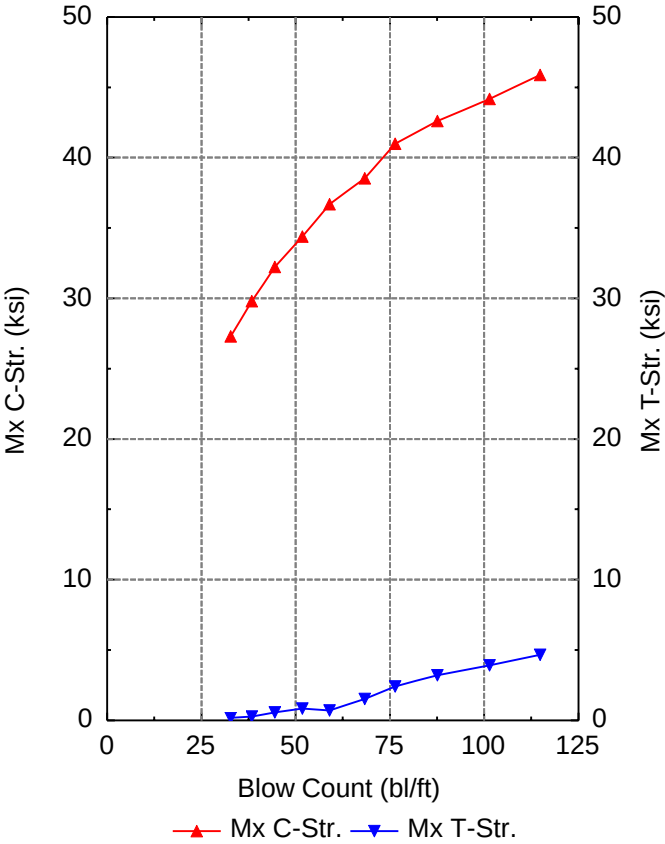
|                  |              |                 |
|------------------|--------------|-----------------|
| Ram Weight       | 5.51         | kips            |
| Efficiency       | 0.800        |                 |
| Pressure         | 1282.5 (90%) | psi             |
| Helmet Weight    | 2.700        | kips            |
| Hammer Cushion   | 32408.9      | kips/in         |
| COR of H.C.      | 0.800        |                 |
| Skin Quake       | 0.100        | in              |
| Toe Quake        | 0.123        | in              |
| Skin Damping     | 0.050        | s/ft            |
| Toe Damping      | 0.150        | s/ft            |
| Pile Length      | 25.70        | ft              |
| Pile Penetration | 25.70        | ft              |
| Pile Top Area    | 26.10        | in <sup>2</sup> |

RSA No



## Bearing Graph Summary — APE D 25-42

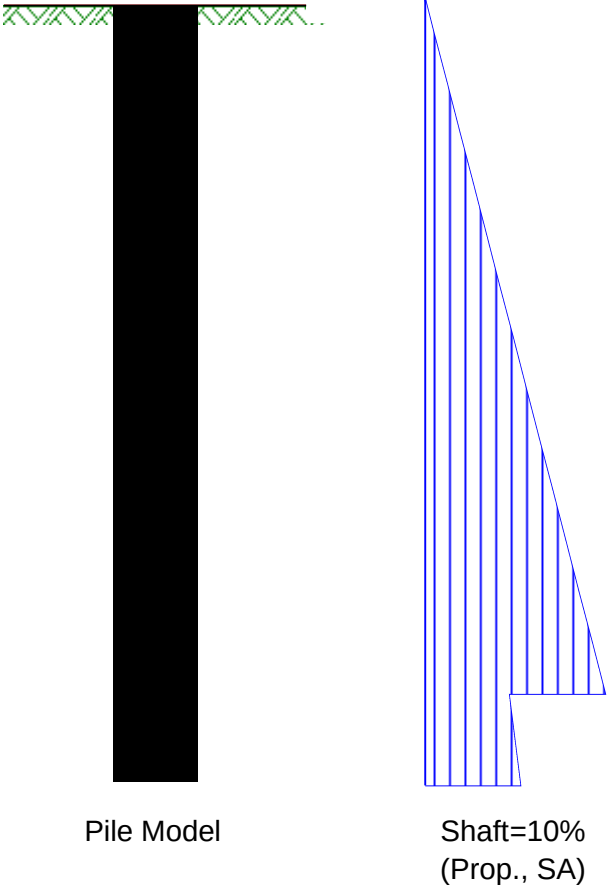
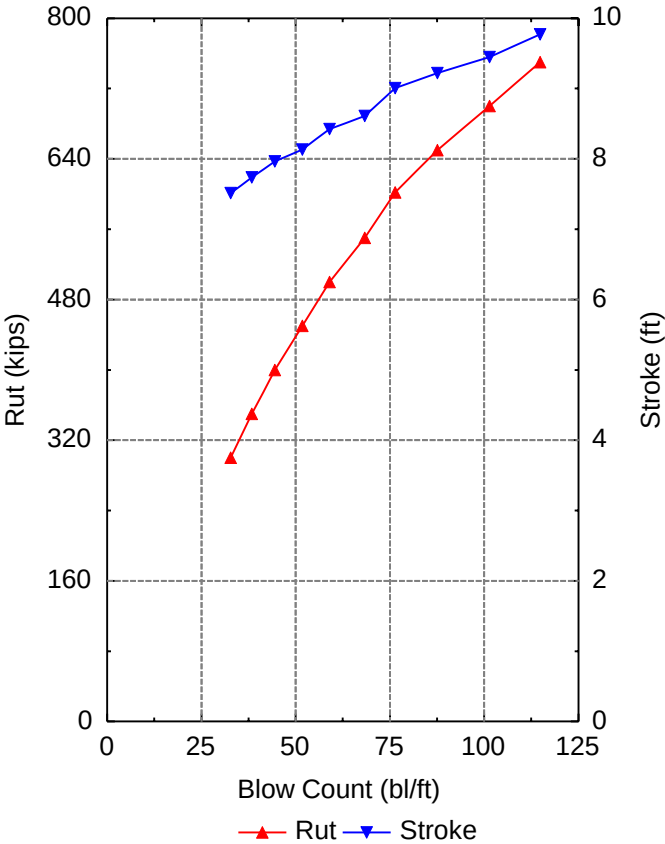
| Rut<br>kips | Mx C-Str.<br>ksi | Top Str.<br>ksi | Mx T-Str.<br>ksi | Blow Ct<br>bl/ft | Stroke<br>ft | ENTHRU<br>kip-ft | Ham. Pow.<br>APE | Trfr. R.<br>% |
|-------------|------------------|-----------------|------------------|------------------|--------------|------------------|------------------|---------------|
| 300.0       | 23.76            | 23.61           | 0.18             | 24.6             | 6.99         | 19.25            | D 25-42          | 31.0          |
| 350.0       | 24.99            | 24.80           | 0.70             | 30.8             | 7.33         | 19.08            | D 25-42          | 30.8          |
| 400.0       | 26.17            | 25.95           | 0.42             | 38.0             | 7.70         | 19.20            | D 25-42          | 31.0          |
| 450.0       | 26.79            | 26.56           | 0.28             | 44.8             | 7.86         | 19.24            | D 25-42          | 31.0          |
| 500.0       | 27.34            | 27.08           | 0.43             | 51.6             | 8.03         | 19.18            | D 25-42          | 30.9          |
| 550.0       | 27.87            | 27.80           | 0.21             | 58.6             | 8.19         | 19.04            | D 25-42          | 30.7          |
| 602.0       | 28.96            | 28.96           | 0.37             | 67.5             | 8.34         | 18.85            | D 25-42          | 30.4          |
| 650.0       | 29.97            | 29.97           | 0.56             | 77.5             | 8.48         | 19.06            | D 25-42          | 30.7          |
| 700.0       | 30.99            | 30.99           | 0.74             | 91.7             | 8.57         | 19.19            | D 25-42          | 31.0          |
| 750.0       | 32.05            | 32.05           | 1.13             | 108.3            | 8.74         | 19.52            | D 25-42          | 31.5          |



APE D 25-42

|                  |              |                 |
|------------------|--------------|-----------------|
| Ram Weight       | 5.51         | kips            |
| Efficiency       | 0.800        |                 |
| Pressure         | 1282.5 (90%) | psi             |
| Helmet Weight    | 2.700        | kips            |
| Hammer Cushion   | 32408.9      | kips/in         |
| COR of H.C.      | 0.800        |                 |
| Skin Quake       | 0.100        | in              |
| Toe Quake        | 0.040        | in              |
| Skin Damping     | 0.050        | s/ft            |
| Toe Damping      | 0.150        | s/ft            |
| Pile Length      | 25.70        | ft              |
| Pile Penetration | 25.70        | ft              |
| Pile Top Area    | 26.10        | in <sup>2</sup> |

RSA No



## Bearing Graph Summary — APE D 25-42

| Rut<br>kips | Mx C-Str.<br>ksi | Top Str.<br>ksi | Mx T-Str.<br>ksi | Blow Ct<br>bl/ft | Stroke<br>ft | ENTHRU<br>kip-ft | Ham. Pow.<br>APE | Trfr. R.<br>% |
|-------------|------------------|-----------------|------------------|------------------|--------------|------------------|------------------|---------------|
| 300.0       | 27.28            | 24.99           | 0.17             | 32.8             | 7.51         | 18.92            | D 25-42          | 30.5          |
| 350.0       | 29.79            | 25.67           | 0.26             | 38.4             | 7.74         | 18.98            | D 25-42          | 30.6          |
| 400.0       | 32.23            | 26.33           | 0.56             | 44.5             | 7.96         | 19.12            | D 25-42          | 30.8          |
| 450.0       | 34.39            | 29.22           | 0.83             | 51.8             | 8.14         | 19.09            | D 25-42          | 30.8          |
| 500.0       | 36.68            | 32.13           | 0.70             | 59.0             | 8.42         | 19.55            | D 25-42          | 31.5          |
| 550.0       | 38.54            | 34.72           | 1.52             | 68.3             | 8.61         | 19.73            | D 25-42          | 31.8          |
| 602.0       | 40.98            | 37.69           | 2.41             | 76.4             | 9.01         | 20.70            | D 25-42          | 33.4          |
| 650.0       | 42.60            | 39.89           | 3.21             | 87.6             | 9.22         | 21.14            | D 25-42          | 34.1          |
| 700.0       | 44.17            | 42.04           | 3.91             | 101.4            | 9.45         | 21.60            | D 25-42          | 34.8          |
| 750.0       | 45.87            | 44.23           | 4.66             | 114.8            | 9.77         | 22.35            | D 25-42          | 36.0          |



## CALCULATIONS

**Date:** 8/21/2025  
**Project No.:** US0025840.9367  
**Subject:** Pile Drivability at Abutment 2 - HP14x89 - Driving  
**Project Title:** Phair Crossing Bridge Presque Isle, ME (WIN 026434.00)

**Made by:** DEB  
**Checked by:** KAR  
**Reviewed by:** CCB

### OBJECTIVE

Perform a drivability analysis using GRLWEAP to determine if the proposed H-piles at Abutment 2 can be driven to the nominal pile driving resistance while maintaining blow counts and pile stresses within the specified limits.

### REFERENCES

1. GRLWEAP 14 Software Package Version 14.1.20.1, Built December 1, 2022.
2. AISC Shapes Database v15.0. November 2017. <https://www.aisc.org/globalassets/aisc/manual/v15.0-shapes-database/aisc-shapes-database-v15.0.xlsx>
3. Maine Department of Transportation, Bridge Program. 60% Plans, dated May 2, 2025: Phair Crossing Bridge #3259 over Maine Northern Railway, Presque Isle, Maine, WIN 026434.00.
4. State of Maine, Department of Transportation. March 2020. Standard Specifications.
5. Guertin Elkerton & Associates for Maine Department of Transportation. Bridge Design Guide. Dated August 2003 with 2018 updates.
6. WSP calculation package titled HP 14x89 Pile Design at Proposed Abutment 1, dated 6/25/2025.
7. APE Model D25-42 Single Acting Diesel Impact Hammer, <https://www.americanpiledriving.com/pdfs/diesels/specs/d25-42.pdf>, Accessed April 2025.
8. AASHTO LRFD Bridge Design Specifications, 9th Ed. 2020.

### ASSUMPTIONS

1. The proposed abutment is assumed to be supported on five (5) HP14x89 Grade 50 piles with a center-to-center pile spacing of 9.75 feet , Ref 3, Sheet 26 of 38 Abutment No. 2. The piles are to be driven to bedrock.
2. The soil profile used in the analysis is based on Ref. 6 at the centerline of the proposed Abutment 2.
3. As per the MaineDOT Standard Specifications Section 501.042 (Ref. 4), the number of hammer blows at the required resistance indicated by the wave equation analysis shall be between 3 and 15 blows per inch, and the driving stresses shall not exceed 90% of the specified yield stress of the pile material.
4. An APE D 25-42 single acting diesel pile driving hammer with a box lead size of 26 inches, and a DB 26 drive cap, DB-26 Micarta cushion, and DB-26 strike plate is assumed for the analysis (Ref. 7).
5. This analysis looks at resistance during driving and upon reaching the tip elevation in bedrock. A resistance distribution of 90% shaft resistance and 10% toe resistance is assumed during driving, and 10% shaft resistance and 90% toe resistance is assumed upon reaching the tip elevation.

### ATTACHMENTS

1. GRLWEAP tables of recommended quake and damping values for impact driven piles.
2. GRLWEAP output for a variable resistance analysis using the APE D25-42 hammer.



## CALCULATIONS

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**Made by:** DEB  
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### CALCULATION

#### 1. Determine the input parameters.

##### Cushion Information:

Using Micarta cushion and DB 26 Striker Plate and drive cap (Assumption 4).

Cushion area = 398.0 in<sup>2</sup> (Ref. 7)  
 Elastic modulus = 285.0 ksi (Ref. 7)  
 Cushion thickness = 3.5 in (Ref. 7)  
 Coefficient of restitution = 0.80 (Ref. 7)  
 Helmet weight = 2.7 kips (Ref. 7)

##### Pile Information:

For an HP14x89 pile section:

##### Intact Section

Section depth, d = 13.8 in (Ref. 2)  
 Section width, b<sub>f</sub> = 14.7 in (Ref. 2)  
 Web thickness, t<sub>w</sub> = 0.615 in (Ref. 2)  
 Flange thickness, t<sub>f</sub> = 0.615 in (Ref. 2)  
 Cross-sectional area, A<sub>s</sub> = 26.1 in<sup>2</sup> = 0.18 ft<sup>2</sup> (Ref. 2)  
 Steel yield stress, F<sub>y</sub> = 50 ksi (Assumption 1)  
 90% of steel yield stress = 45 ksi  
 Steel elastic modulus, E<sub>st</sub> = 29,000 ksi (typical value for steel)  
 Steel unit weight = 491 pcf  
 Box perimeter = (d × 2) + (b<sub>f</sub> × 2) = 57.0 in = 4.8 ft  
 Pile head elevation = 611.0 ft (Ref. 3, Sheet 25 of 38, with 3-foot pile cap embedment)  
 Pile tip elevation = 561.0 ft (Ref. 6)  
 Pile length below abutment = 47.0 ft (Ref. 6) (excluding pile cap embedment)

##### Ultimate Capacities:

Axial load on pile, P<sub>u</sub> = 393 kips (Ref. 6)  
 Φ<sub>dyn</sub> = 0.65 (Ref. 8, Table 10.5.5.2.3-1)  
 Pile driving resistance, R<sub>ndr</sub> = 605 kips

##### Quake and Damping Soil Parameters:

Shaft quake = 0.10 in (Ref. 1, included as Attachment 1)  
 Toe quake during driving = 0.123 in D/120 for very dense soils (Ref. 1, included as Attach. 1)  
 Toe quake reaching tip elev. = 0.04 in for hard rock (Ref. 1, included as Attachment 1)  
 Shaft damping = 0.05 s/ft for non-cohesive soils (Ref. 1, included as Attachment 1)  
 Toe damping = 0.15 s/ft (Ref. 1, included as Attachment 1)

##### Soil Profile Input, to calculate Variable Resistance Distribution:

(Ref. 6)

Pile head elevation = 608.0 ft Does not include embedment in pile cap  
 Groundwater elevation = 581.0 ft = 27.0 ft below pile head

| Soil Layer<br>(input into<br>GRLWEAP) | Elevation (ft) |        | Depth below pile head<br>(ft) |        | Unit Weight<br>(pcf) | Friction<br>Angle (°) | Average<br>Undrained<br>Shear<br>Strength<br>(psf) | Skin<br>Friction <sup>1</sup><br>(ksf) | End<br>Bearing <sup>1</sup><br>(ksf) | Soil Type  |
|---------------------------------------|----------------|--------|-------------------------------|--------|----------------------|-----------------------|----------------------------------------------------|----------------------------------------|--------------------------------------|------------|
|                                       | Top            | Bottom | Top                           | Bottom |                      |                       |                                                    |                                        |                                      |            |
| Granular Borrow                       | 608.0          | 607.0  | 0.0                           | 1.0    | 125                  | 32                    | -                                                  | 0.05                                   | 3.75                                 | Sand       |
| Fill                                  | 607.0          | 581.0  | 1.0                           | 27.0   | 125                  | 32                    | -                                                  | 1.17                                   | 85.71                                | Sand       |
| Glacial Till                          | 581.0          | 561.0  | 27.0                          | 47.0   | 130                  | 35                    | -                                                  | 0.58                                   | 166.77                               | Sand       |
| Bedrock                               | 561.0          | -      | 47.0                          | -      | 170                  | -                     | -                                                  | 24.0                                   | 1008.0                               | Rock Other |

Note: <sup>1</sup>Skin friction and end bearing values for soils are generated by GRLWEAP, bedrock values are based on FHWA GEC 12 (Ref. 9) Table 7-13 for limestone.



## CALCULATIONS

**Date:** 8/21/2025  
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**Subject:** Pile Drivability at Abutment 2 - HP14x89 - Driving  
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**Made by:** DEB  
**Checked by:** KAR  
**Reviewed by:** CCB

2. Analyze an open ended diesel (OED) hammer to determine the  $R_{ndr}$  for the abutment based on the stress and blow counts outline in Ref. 4.

| Analysis Case          | Shaft Resistance | Toe Resistance | Hammer     | Energy / Power (lb-ft) | Fuel Setting (%)     | $R_{ndr}$ (kips) | Blows/in | Stress (ksi) | Percent of Steel $F_y$ (ksi) |
|------------------------|------------------|----------------|------------|------------------------|----------------------|------------------|----------|--------------|------------------------------|
| During Driving         | 90%              | 10%            | APE D25-42 | 55,814                 | Fuel Setting 3 (90%) | 605              | 6.2      | 28.41        | 57%                          |
| Reaching tip elevation | 10%              | 90%            | APE D25-42 | 55,814                 | Fuel Setting 3 (90%) | 605              | 7.5      | 41.14        | 82%                          |

### CONCLUSIONS

The analysis indicates the APE D25-42 hammer operated at fuel setting 3 (90% of the combustion pressure) while driving through soil and upon reaching bedrock should be able to overcome the soil resistance in order to drive the plumb piles at Abutment 2 to bedrock and a nominal resistance of 605 kips while staying at a blow count between 3 and 15 blows per inch and limiting the driving stresses to below 45 kips per square inch (ksi), in accordance with Section 501.042 of the MaineDOT Standard Specifications.

[Reference Tables](#)


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## Table of Recommended Quake Values

### Recommended Quake Values for Impact Driven Piles\*

|             | Soil Type                 | Pile Type or Size                               | Quake (in) | Quake (mm) |
|-------------|---------------------------|-------------------------------------------------|------------|------------|
| Shaft Quake | All soil types            | All Types                                       | 0.10       | 2.5        |
| Toe Quake   | All soil types, soft Rock | Non-displacement piles** i.e. driving unplugged | 0.10       | 2.5        |
|             | Very dense or hard soils  | Displacement Piles*** of diameter or width D    | D/120      | D/120      |
|             | Loose or soft soils       | Displacement Piles*** of diameter or width D    | D/60       | D/60       |
|             | Hard Rock                 | All Types                                       | 0.04       | 1.0        |

\*For vibratory driven piles in cohesive soils, quakes should be doubled.

\*\* Non-displacement piles are sheet pile, H-Piles, or open-ended pipe piles which are not plugging during driving. Normally it can be assumed that pipe piles with diameters of 30 inches (900 mm) or more will not plug during driving while H-Piles and pipe piles of diameter 20 inches (500 mm) or less will plug during driving into a bearing layer. Between 20 and 30 inches (500 and 750 mm), pipe piles may or may not plug.

\*\*\* Displacement piles are closed-ended pipe piles, pipe piles, or H-Piles that are plugged during driving and solid concrete piles. Normally, we would analyze H-Piles and pipe piles with diameters 20 inches (500 mm) or less as displacement piles.

Recommended quake values, both shaft and toe, for vibratory driven piles are somewhat speculative recommendations as not much experience exists.

[Reference Tables](#)


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## Table of Recommended Damping Values

### Recommended Damping Values for Impact Driven Piles:

|                  | Soil Type               | Damping Factor<br>s/ft | Damping Factor<br>s/m |
|------------------|-------------------------|------------------------|-----------------------|
| Shaft<br>Damping | Non-cohesive<br>soils** | 0.05                   | .16                   |
|                  | Cohesive soils**        | 0.20                   | .65                   |
| Toe<br>damping   | In all soil types       | 0.15                   | 0.50                  |

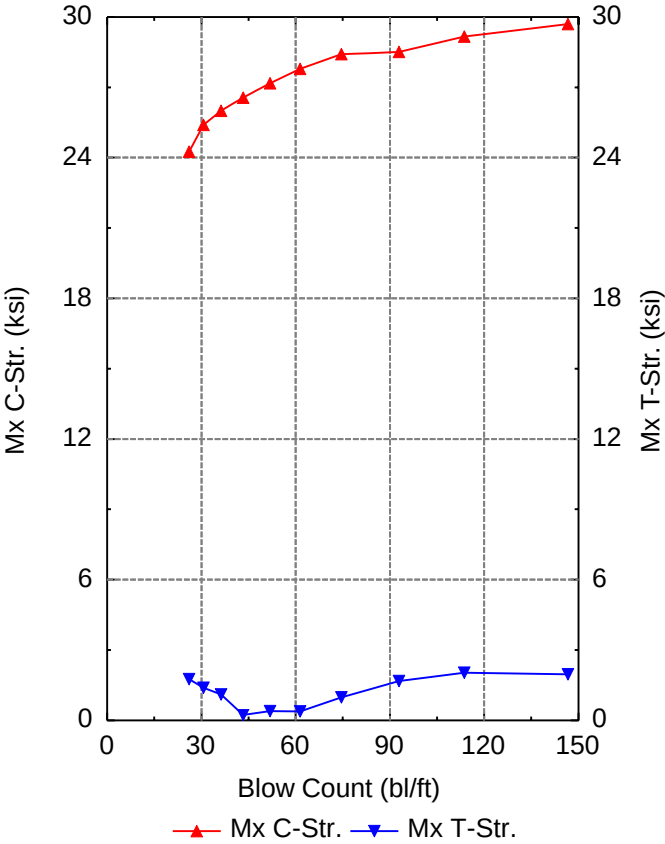
\* For vibratory driven piles, use double values (Smith-viscous).

\*\* For mixed soils, intermediate values may be appropriate; for example, a sandy silt or clayey sand may be modeled with 0.10 s/ft (0.33 s/m), a cohesive silt or a sandy clay with 0.15 s/ft (0.50 s/m).

In general the [Smith Soil Damping Option](#) should be used. An exception would be a [Residual Stress Analysis](#) for which the [Smith-Viscous Soil Damping Option](#) would be more appropriate and Vibratory Hammer Analysis. All other [Soil Damping Options](#) are experimental. Smith damping factors and Smith-Viscous damping are both considered independent of pile type or pile size and have the same dimensions.

It is recommended that the user perform sensitivity analyses with reasonable ranges of quake and damping factors whenever a situation is ambiguous. If either quake or damping values are known from measurements such values also should be tried. Note that small quake values tend to make capacity values higher (non-conservative) for the same blow count. However, stresses would be predicted conservatively higher, particularly in cases of concentrated end bearing. On the other hand, choosing damping values too low would make capacity results non-conservative.

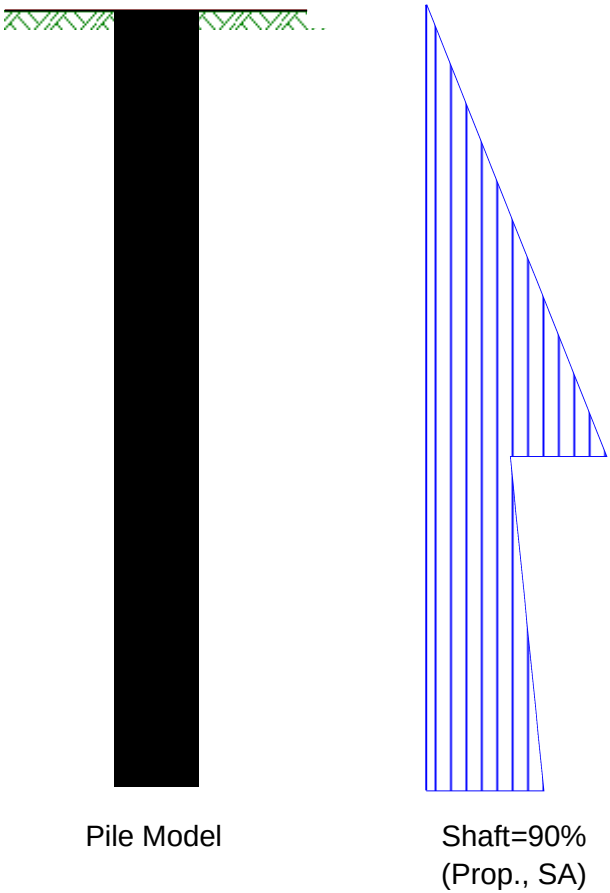
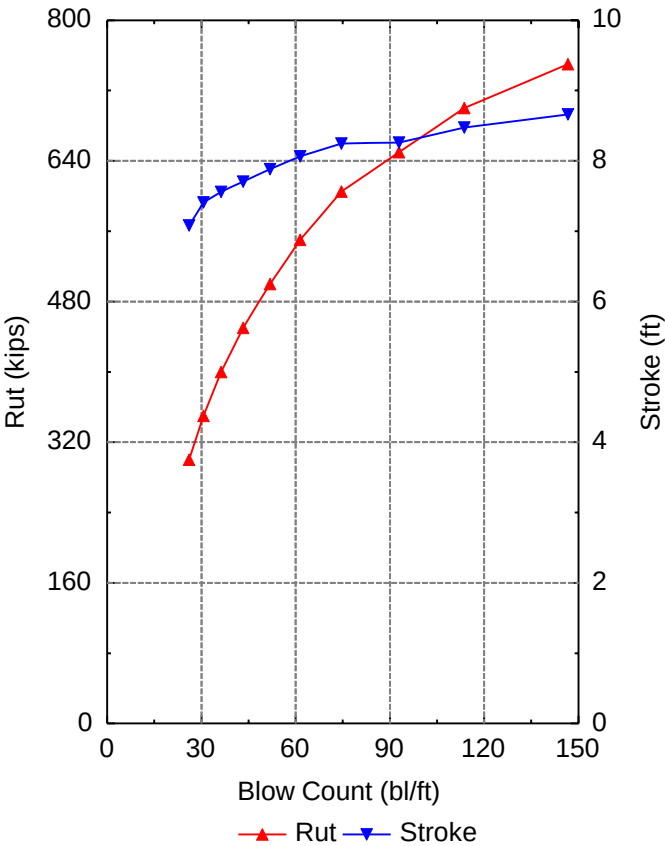
Note that the different soil damping types may be chosen under **Options/General Options/Damping**. The above recommendations are only available for Smith or Smith-viscous models; no recommendations can be made for the other damping options.



APE D 25-42

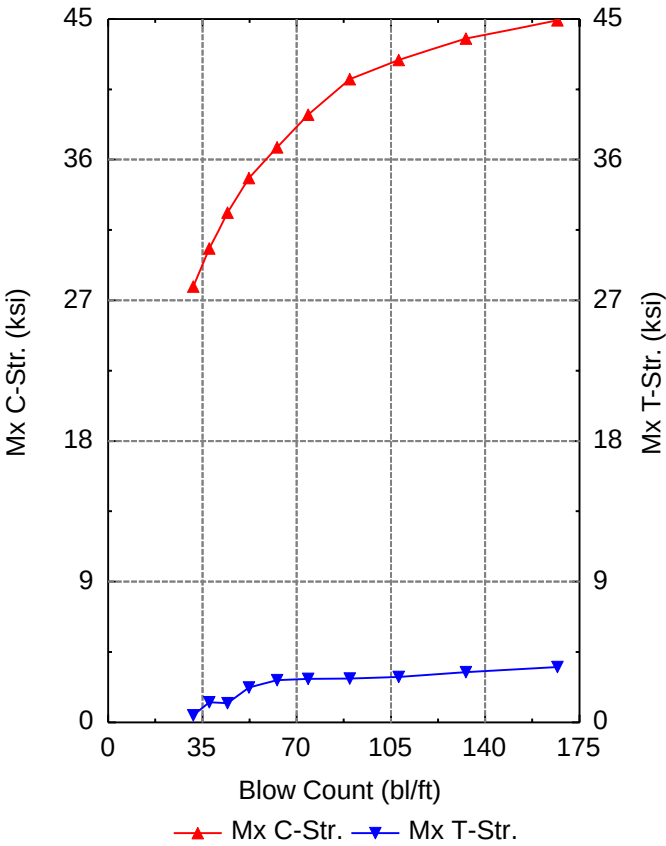
|                  |              |                 |
|------------------|--------------|-----------------|
| Ram Weight       | 5.51         | kips            |
| Efficiency       | 0.800        |                 |
| Pressure         | 1282.5 (90%) | psi             |
| Helmet Weight    | 2.700        | kips            |
| Hammer Cushion   | 32408.9      | kips/in         |
| COR of H.C.      | 0.800        |                 |
| Skin Quake       | 0.100        | in              |
| Toe Quake        | 0.123        | in              |
| Skin Damping     | 0.050        | s/ft            |
| Toe Damping      | 0.150        | s/ft            |
| Pile Length      | 47.00        | ft              |
| Pile Penetration | 47.00        | ft              |
| Pile Top Area    | 26.10        | in <sup>2</sup> |

RSA No



## Bearing Graph Summary — APE D 25-42

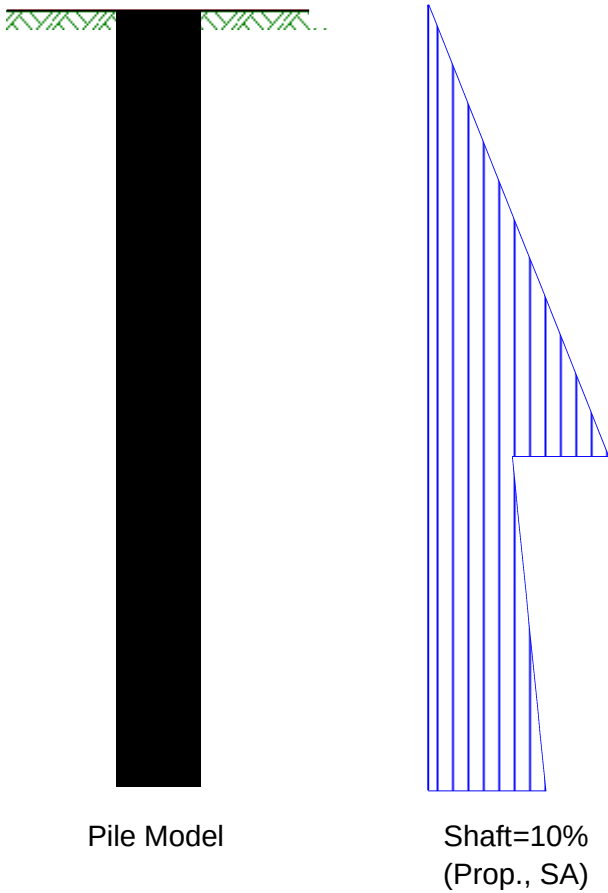
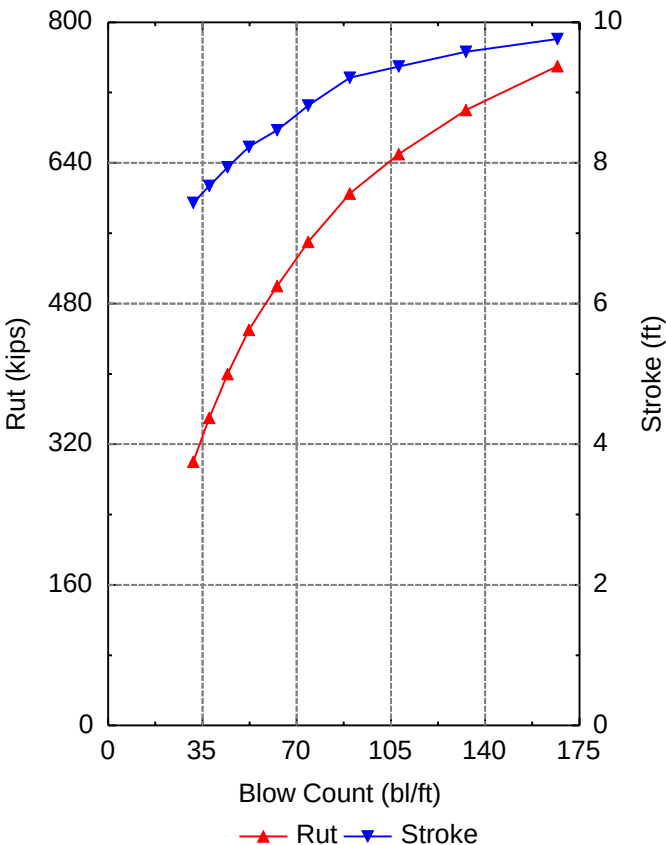
| Rut<br>kips | Mx C-Str.<br>ksi | Top Str.<br>ksi | Mx T-Str.<br>ksi | Blow Ct<br>bl/ft | Stroke<br>ft | ENTHRU<br>kip-ft | Ham. Pow.<br>APE | Trfr. R.<br>% |
|-------------|------------------|-----------------|------------------|------------------|--------------|------------------|------------------|---------------|
| 300.0       | 24.25            | 24.02           | 1.75             | 26.1             | 7.08         | 19.29            | D 25-42          | 31.1          |
| 350.0       | 25.40            | 25.21           | 1.39             | 30.7             | 7.41         | 19.24            | D 25-42          | 31.0          |
| 400.0       | 26.01            | 25.81           | 1.10             | 36.3             | 7.56         | 18.74            | D 25-42          | 30.2          |
| 450.0       | 26.56            | 26.34           | 0.23             | 43.3             | 7.70         | 18.72            | D 25-42          | 30.2          |
| 500.0       | 27.17            | 26.98           | 0.39             | 51.8             | 7.88         | 18.91            | D 25-42          | 30.5          |
| 550.0       | 27.79            | 27.57           | 0.38             | 61.4             | 8.07         | 19.11            | D 25-42          | 30.8          |
| 605.0       | 28.41            | 28.23           | 0.98             | 74.6             | 8.25         | 19.26            | D 25-42          | 31.1          |
| 650.0       | 28.50            | 28.33           | 1.68             | 92.9             | 8.26         | 18.89            | D 25-42          | 30.5          |
| 700.0       | 29.16            | 28.99           | 2.03             | 113.7            | 8.48         | 19.21            | D 25-42          | 31.0          |
| 750.0       | 29.70            | 29.53           | 1.96             | 146.7            | 8.66         | 19.40            | D 25-42          | 31.3          |



APE D 25-42

|                  |              |                 |
|------------------|--------------|-----------------|
| Ram Weight       | 5.51         | kips            |
| Efficiency       | 0.800        |                 |
| Pressure         | 1282.5 (90%) | psi             |
| Helmet Weight    | 2.700        | kips            |
| Hammer Cushion   | 32408.9      | kips/in         |
| COR of H.C.      | 0.800        |                 |
| Skin Quake       | 0.100        | in              |
| Toe Quake        | 0.040        | in              |
| Skin Damping     | 0.050        | s/ft            |
| Toe Damping      | 0.150        | s/ft            |
| Pile Length      | 47.00        | ft              |
| Pile Penetration | 47.00        | ft              |
| Pile Top Area    | 26.10        | in <sup>2</sup> |

RSA No



## Bearing Graph Summary — APE D 25-42

| Rut<br>kips | Mx C-Str.<br>ksi | Top Str.<br>ksi | Mx T-Str.<br>ksi | Blow Ct<br>bl/ft | Stroke<br>ft | ENTHRU<br>kip-ft | Ham. Pow.<br>APE | Trfr. R.<br>% |
|-------------|------------------|-----------------|------------------|------------------|--------------|------------------|------------------|---------------|
| 300.0       | 27.89            | 24.57           | 0.44             | 31.6             | 7.43         | 19.76            | D 25-42          | 31.9          |
| 350.0       | 30.31            | 25.38           | 1.28             | 37.6             | 7.67         | 20.04            | D 25-42          | 32.3          |
| 400.0       | 32.60            | 26.19           | 1.22             | 44.3             | 7.94         | 20.54            | D 25-42          | 33.1          |
| 450.0       | 34.82            | 27.05           | 2.22             | 52.3             | 8.23         | 21.08            | D 25-42          | 34.0          |
| 500.0       | 36.78            | 27.73           | 2.69             | 62.7             | 8.47         | 21.46            | D 25-42          | 34.6          |
| 550.0       | 38.88            | 28.72           | 2.78             | 74.3             | 8.81         | 22.44            | D 25-42          | 36.2          |
| 605.0       | 41.14            | 31.18           | 2.79             | 89.7             | 9.21         | 23.69            | D 25-42          | 38.2          |
| 650.0       | 42.39            | 32.80           | 2.89             | 107.9            | 9.37         | 24.21            | D 25-42          | 39.0          |
| 700.0       | 43.75            | 34.48           | 3.21             | 132.9            | 9.58         | 24.83            | D 25-42          | 40.0          |
| 750.0       | 44.91            | 35.97           | 3.54             | 166.8            | 9.76         | 25.36            | D 25-42          | 40.9          |



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