GEOTECHNICAL DESIGN REPORT

17-1515

April 9, 2018

Explorations and Geotechnical Engineering Services

Light Pole Structures
I-295, Exit 22
Freeport, Maine
WIN 022871.00

PREPARED FOR:
Maine Department of Transportation
Attention: Kate Maguire, P.E.
State House Station 16
Augusta, ME 04333-0016

PREPARED BY:
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S.W.COLE ENGINEERING, INC.

- *Geotechnical Engineering*
- *Construction Materials Testing and Special Inspections*
- *GeoEnvironmental Services*
- *Test Boring Explorations*

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Subject: Geotechnical Design Report
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Dear Kate:

In accordance with our Proposal, dated December 28, 2017, and project Assignment Letter #4, dated January 3, 2018, we have made the requested subsurface explorations for the subject project. The purpose of our services was to obtain subsurface information in order to develop geotechnical parameters and recommendations to assist design of new mast pole luminaire structures. The services provided by S. W. Cole Engineering, Inc. (S.W.COLE) were conducted in accordance with our Multi-PIN Agreement with the Maine Department of Transportation (MaineDOT), No. 20150720000000000085, dated July 20, 2015. This contents of this report are subject to the limitations in Appendix A.

1.0 INTRODUCTION

1.1 Site and Proposed Construction

The project is located along I-295 near Exit 22 in Freeport, Maine. The project location is shown on the *Site Location Map* attached in Appendix B.

Based on the provided Preliminary Plans, we understand the proposed construction includes eleven new mast pole luminaire (light pole) structures. We understand the light poles will be 70 to 100 feet high supported on drilled shaft foundations. Based on

MaineDOT Standard Details Section 626, we understand the foundations may extend up to 20 feet below ground surface.

2.0 EXPLORATIONS AND TESTING

2.1 Explorations

Eleven test borings (HB-FREE-101 through HB-FREE-111) were made at the site from February 12 through February 16, 2018 by S. W. Cole Explorations, LLC using a track-mounted CME 850 drill rig. The exploration locations were selected and established in the field by S.W.COLE using measurements from existing site features. The approximate exploration locations are shown on the *Boring Location Plans* attached in Appendix B. Logs of the test borings and a Key to Soil and Rock Descriptions and Terms used on the logs are attached in Appendix C. Approximate station and offset at exploration locations are provided on individual boring logs and summarized in the table below.

Structure Number	Boring Number	Approximate Station & Location
1	HB-FREE-101	Sta. 225+98.4, 24.8 ft Lt / I-295 NB
2	HB-FREE-102	Sta. 1+15.3, 85.7 ft Rt. / Ramp C
3	HB-FREE-103	Sta. 12+39.8, 19.4 ft Rt. / Ramp D
4	HB-FREE-104	Sta. 239+81.4, 33.1 ft Rt. / I-295 NB
5	HB-FREE-105	Sta. 242+72.9, 27.0 ft Rt. / I-295 NB
6	HB-FREE-106	Sta. 212+99.2, 23.5 ft Lt. / I-295 SB
7	HB-FREE-107	Sta. 215+99.0, 23.8 ft Lt. / I-295 SB
8	HB-FREE-108	Sta. 13+97.4, 11.3 ft Rt. / Ramp A
9	HB-FREE-109	Sta. 3+34.9, 27.4 feet Lt / Ramp B
10	HB-FREE-110	Sta. 21+14.9, 13.5 ft Lt / Mallet Dr. (Rt 136)
11	HB-FREE-111	Sta. 28+87.7, 20.6 ft Rt. / Mallet Dr (Rt 136)

2.2 Testing

The test borings were drilled using a combination of solid-stem auger and cased-wash boring and rock core drilling techniques. The soils were sampled at 2 to 5-foot intervals using a split-spoon sampler and Standard Penetration Testing (SPT) methods using a calibrated automatic hammer. Upon encountering bedrock, borings HB-FREE-101, -102 and -106 were advanced about 5 feet into bedrock using NQ2 rock coring techniques. The hammer efficiency factor (0.813), uncorrected SPT blow counts, raw field N-values, corrected N-values (N_{60}) and rock core intervals are shown on the logs in Appendix C.

The drill rig was equipped with a calibrated automatic hammer to drive the split-spoon. Corrected N-values in this report were computed by applying an average energy transfer of 0.813 for the calibrated automatic hammer to the raw field N-values. Pocket penetrometer tests were performed on disturbed samples of stiffer cohesive soils where encountered.

Soils samples recovered from the test borings were visually classified in our laboratory and transported to the MaineDOT Laboratory in Bangor, Maine for possible laboratory testing.

3.0 SUBSURFACE CONDITIONS

3.1 Surficial and Bedrock Geology

According to the Maine Geological Survey (MGS) mapping of the Portland Quadrangle (Open-File 06-1), mapped surficial geology units within the site vicinity consist of glacial thin drift deposits overlying bedrock. The thin drift deposits generally consist of marine deposits in low areas and glacial till on upland slopes and hills. The subsurface conditions encountered were generally consistent with the mapped surficial geology; however, the explorations also encountered fill soils from previous site development.

Bedrock in the site vicinity is mapped as biotite-quartz-plagioclase granofels of the Hutchins Corner Formation and quartz-plagioclase-biotite schist of the Richmond Corner Formation (MGS Open-File 98-1). The bedrock cored at HB-FREE-101, -102 and -106 was composed of fine- to medium-grained, hard, slightly- to moderately-weathered biotite schist with quartz zoning and is generally consistent with the mapped bedrock geology.

3.2 Soil and Bedrock

The test borings encountered a soils profile generally consisting of a surface layer of topsoil or pavement overlying fill overlying glacial till or glaciomarine silt and clay deposits overlying glacial till and refusal surfaces. The principal strata encountered in the explorations are summarized below; refer to the attached logs for more detailed subsurface information.

Topsoil: Topsoil was encountered at the ground surface in borings HB-FREE-101, -102, -103 and -109. The topsoil was generally about 2 to 4 inches thick, where encountered.

Pavement: Bituminous concrete pavement was encountered at the ground surface in borings HB-FREE-106, -107, -108, -110 and -111. The bituminous concrete pavement thickness was about 5 to 7 inches.

Fill: Below the topsoil and pavement or at ground surface, the borings, except HB-FREE-102, encountered fill soils extending to depths of about 5 to 20.3 feet bgs. The fill soils generally consisted of:

- Brown, SAND, some to trace gravel, some to trace silt;
- Brown, Sandy SILT, trace gravel, trace organics (rootlets); and
- Grey-brown, Silty SAND, little gravel, trace clay.

The fill varied from loose to very dense with SPT N_{60} values ranging from 4 to 123 blows per foot (bpf).

Glaciomarine Silt and Clay: Below the topsoil or fill, the borings, except HB-FREE-110, encountered thin drift glaciomarine silt and clay generally extending to depths ranging from about 5 to 46 feet bgs, where penetrated. The silt and clay deposit was generally about 4 to 17 feet thick, except at HB-FREE-109 where the clay deposit was observed to be about 36 feet thick. In general, the deposit consisted of:

- Grey-brown to grey, Silty CLAY, little to trace sand; and
- Dark brown, Sandy SILT, trace organics (rootlets).

The thin drift silt and clay was generally stiff to hard becoming softer with depth. SPT N_{60} values ranged from weight of hammer to 34 bpf. Pocket penetrometer tests performed on disturbed soil samples ranged from about 3,500 to 9,000 psf, correlating to approximate shear strengths of about 1,750 to 4,500 psf.

Glacial Till: Below the silt and clay or fill soils, the borings encountered glacial till generally consisting of:

- Brown to grey, Silty SAND, some to trace gravel; and
- Brown, SAND, some silt, trace gravel.

The glacial till was generally medium dense to very dense with SPT N_{60} values ranging from 19 bpf to refusal (greater than 50 blows per 6 inch increment of drive).

Refusal: Refusal surfaces were encountered in borings HB-FREE-103, -104, -107, -108 and -110 at depths ranging from about 20 to 26.3 feet bgs. The nature of the refusal surface was not determined in these borings. Bedrock was encountered and sampled in borings HB-FREE-101, -102 and -106 at depths of about 18, 8.5 and 10 feet bgs, respectively. The sampled bedrock consisted of light grey, hard, slight to moderately weathered, fine to medium grained, biotite schist with quartz zoning of the Richmond Corner Formation. Joints were generally low angle to steep, very close to close and open.

Rock quality designation (RQD) values for the bedrock ranged from was 28 to 80 percent correlating to a Rock Mass Quality (RMQ) of poor to good.

3.3 Groundwater

The soils encountered at the test borings were damp to wet from the ground surface. Water was introduced into the borings during drilling; therefore, stabilized groundwater levels were not measured. Wet soil samples were encountered at depths of about 5 to 15 feet bgs. Long term groundwater information is not available. It should be anticipated that groundwater levels will fluctuate seasonally, particularly in response to periods of snowmelt and precipitation, as well as changes in site use.

4.0 EVALUATION AND RECOMMENDATIONS

4.1 General Findings

Below a surface layer of topsoil or pavement, the soils encountered generally included fill, silt and clay, glacial till and areas of shallow bedrock. Based on the subsurface findings, drilled shafts appear suitable for foundation support of the proposed light pole structures. Drilled shaft foundations with specific geotechnical considerations include:

- The drilled shafts for Structure 5 shall extend through glaciomarine clays to bear on stable glacial till encountered at a depth of 18 feet bgs.
- The drilled shaft at Structure 9 shall bear in the fill or glaciomarine clay no deeper than 15 feet to preclude penetrating the stiff clay that is underlain by a thicker deposit of softer clay encountered in boring HB-FREE-109.
- Bedrock sockets or dowels into bedrock may be required for drilled shafts at Structures 2 and 6 considering the thin overburden soils encountered in borings HB-FREE-102 and -106. Rock sockets or dowels shall be completed in accordance with MaineDOT Standard Details Section 626.

4.2 Frost Considerations

Based on the Maine Design Freezing Index Map[1], the design freezing index for the Freeport, Maine area is approximately 1,300 freezing degree-days. Based on Section 5.2.1 of the MaineDOT BDG and subsurface findings, the maximum seasonal frost penetration is estimated to be on the order of about 6.4 feet. We recommend foundations have at least 6.4 feet of soil cover to provide frost protection.

4.3 Design Soil Parameters

Three soil units were generally encountered within the upper 20 feet of the ground surface in the borings:

- Loose to very dense, sand with varying amounts of gravel and silt (Fill);
- Medium stiff, sandy silt with varying amounts of gravel trace organics (Fill);
- Medium stiff to very stiff, silty clay; and
- Medium dense to very dense, silty sand, varying amounts of gravel (Glacial Till).

Site specific soil parameters were evaluated in accordance with AASHTO LRFD Section 10.4.6.2.4 and MaineDOT BDG Table 3.3. Site-specific structural design of the foundations should be completed in accordance with based on MaineDOT Standard Details Section 626, using the following soil parameters:

Design Soil Parameters				
Strata	**Structures**	**Unit Weight (pcf)**	**Friction Angle, ϕ (degrees)**	**Shear Strength, s_u (psf)**
Fill / Till	4	125	28	
Fill / Till	5*, 8, 10	125	30	
Silt / Clay	1, 2*, 3, 6*, 7, 9*, 11	120		1,200

*Notes: Structure 5 shall bear on glacial till at 18 feet bgs.
Structure 9 shall bear in fill or glaciomarine clay no deeper than 15 feet bgs.
Structures 2 and 6 dowel reinforcing into competent rock, if needed, per MaineDOT Standard Detail 626.36.

The design of drilled shafts should be in accordance with AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals (2015, 6th Ed.), MaineDOT Standard Detail Items 626, provided site-specific soils

[1] Maine Department of Transportation, Bridge Design Guide (BDG), August 2003, with Revisions through 2014, Figure 5-1.

parameters and structural loads. Structural design should consider both geotechnical lateral and axial resistance, although lateral resistance will likely control.

4.4 Construction Considerations

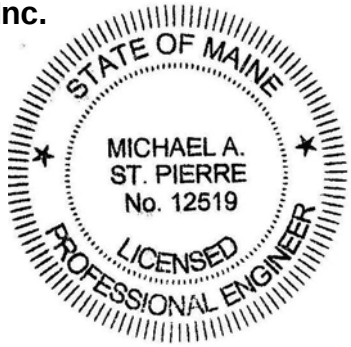
Drilled shafts shall be uncased (concrete cast against soil) below the frost zone. Temporary casing used during construction shall be removed following placement of concrete. The level of concrete shall be at least 5 feet above the bottom of casing at all times during casing removal. Backfill used to repair disturbed areas around the drilled shafts should consist of MaineDOT Specification 703.19 “Granular Borrow for Embankment Construction” and grading adjacent to the shafts should direct surface water runoff away from the structure.

5.0 CLOSURE

We trust this information meets your present needs. Please contact us if you have any questions or need further assistance.

Sincerely,

S. W. Cole Engineering, Inc.



Michael A. St. Pierre, P.E.
Geotechnical Engineer

NDS/MAS:ejb/tjb

S.W.COLE ENGINEERING, INC.

APPENDIX A

Limitations

This report has been prepared for the exclusive use of the Maine Department of Transportation for specific application to the proposed Light Pole Structures along I-295 at Exit 22 (MaineDOT WIN 022871.00) in Freeport, Maine. S. W. Cole Engineering, Inc. (S.W.COLE) has endeavored to conduct our services in accordance with generally accepted soil and foundation engineering practices. No warranty, expressed or implied, is made.

The soil profiles described in the report are intended to convey general trends in subsurface conditions. The boundaries between strata are approximate and are based upon interpretation of exploration data and samples.

The analyses performed during this investigation and recommendations presented in this report are based in part upon the data obtained from subsurface explorations made at the site. Variations in subsurface conditions may occur between explorations and may not become evident until construction. If variations in subsurface conditions become evident after submission of this report, it will be necessary to evaluate their nature and to review the recommendations of this report.

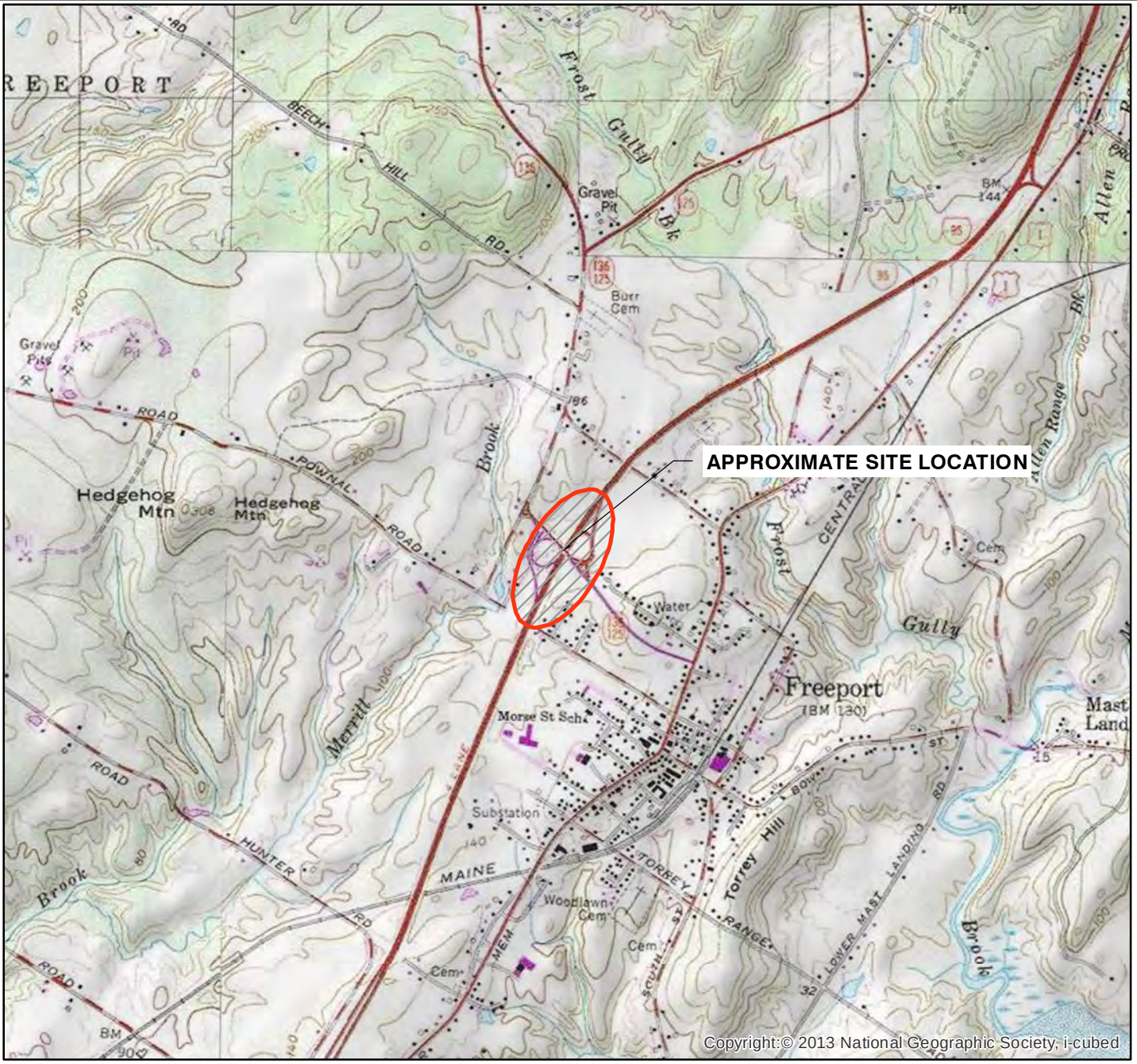
Observations have been made during exploration work to assess site groundwater levels. Fluctuations in water levels will occur due to variations in rainfall, temperature, and other factors.

Recommendations contained in this report are based substantially upon information provided by others regarding the proposed project. In the event that any changes are made in the design, nature, or location of the proposed project, S.W.COLE should review such changes as they relate to analyses associated with this report. Recommendations contained in this report shall not be considered valid unless the changes are reviewed by S.W.COLE.

S.W.COLE ENGINEERING, INC.

APPENDIX B

Figures



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Scale in Feet

S.W.COLE ENGINEERING, INC.

MAINE DEPARTMENT OF TRANSPORTATION

SITE LOCATION MAP

WIN 022871.00
LIGHT POLE STRUCTURES
I-295, EXIT 22
FREEPORT, MAINE

Job No.	17-1515	Scale	1:24000
Date:	03/26/2018	Sheet	1

NOTE:
SITE LOCATION MAP PREPARED FROM ESRI ArcGIS ONLINE AND DATA PARTNERS INCLUDING USGS AND © 2007 NATIONAL GEOGRAPHIC SOCIETY.

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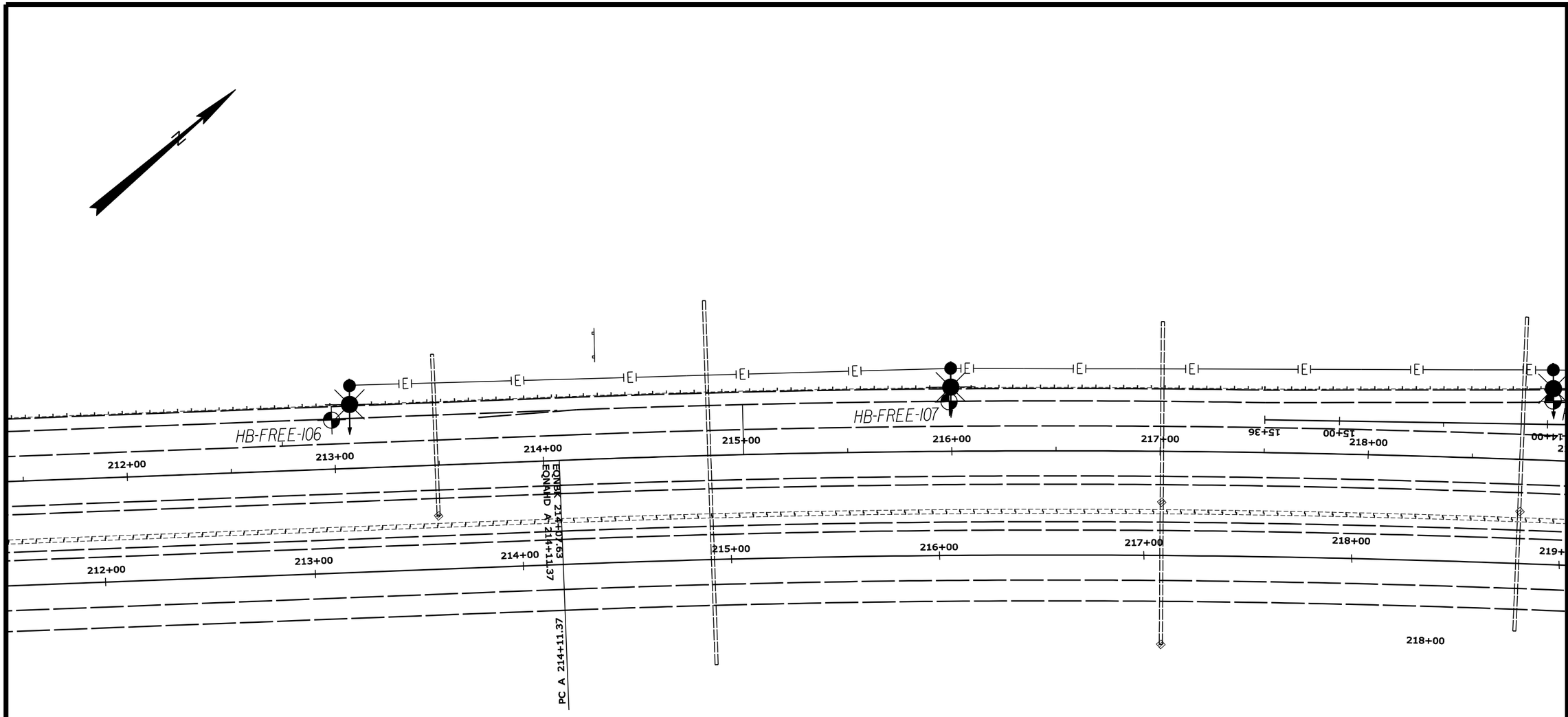

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NHPP-2287(100)

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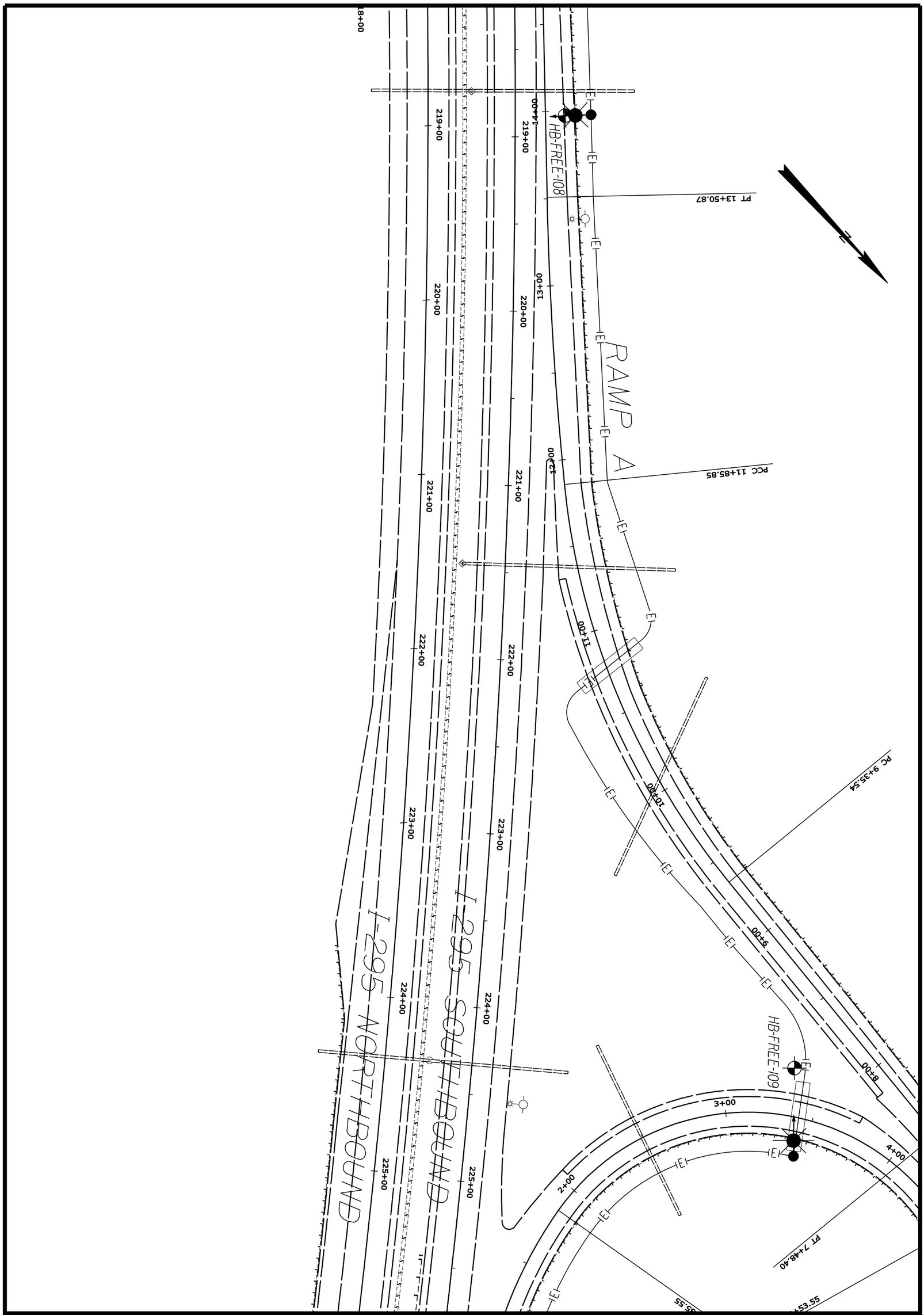

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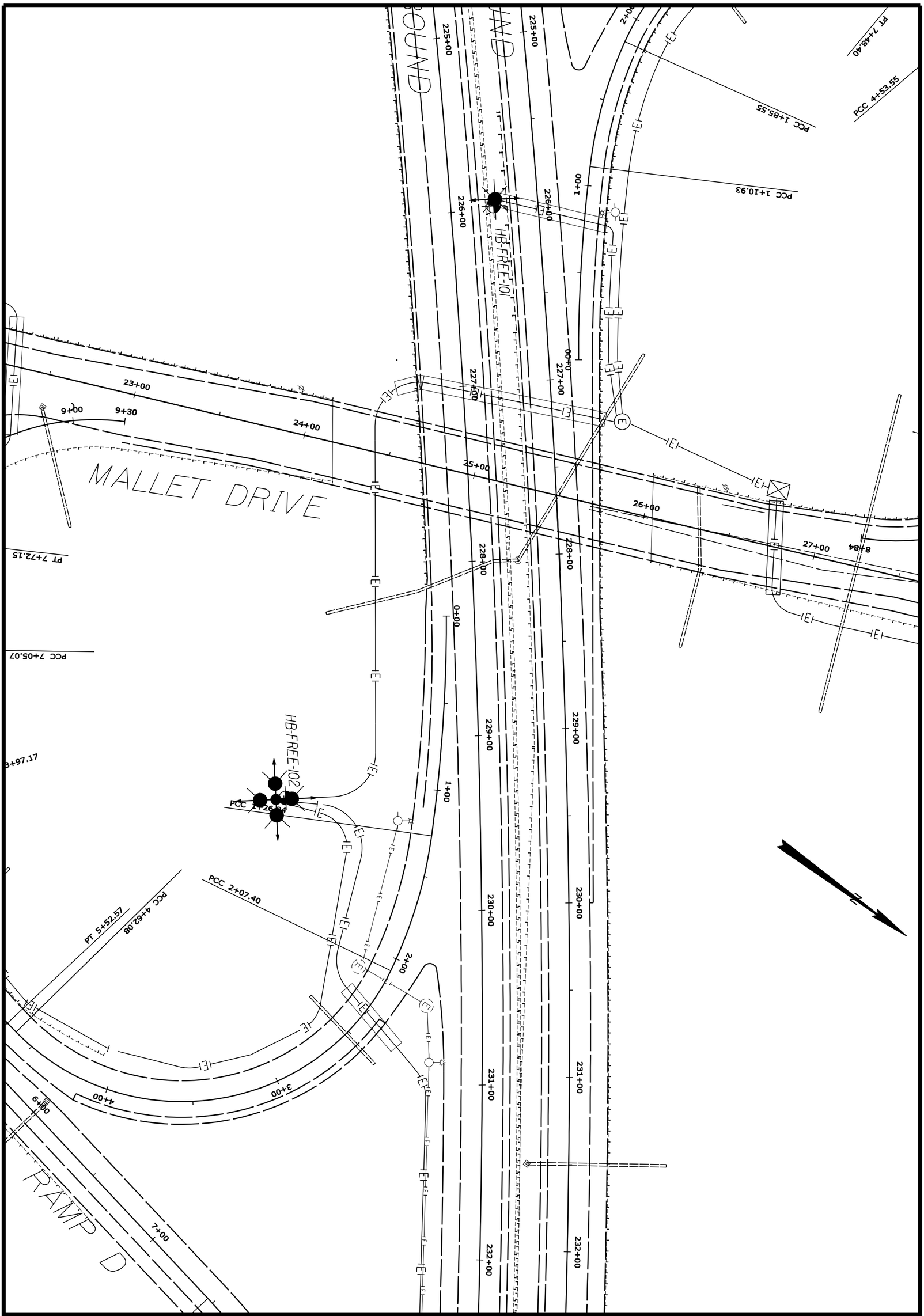

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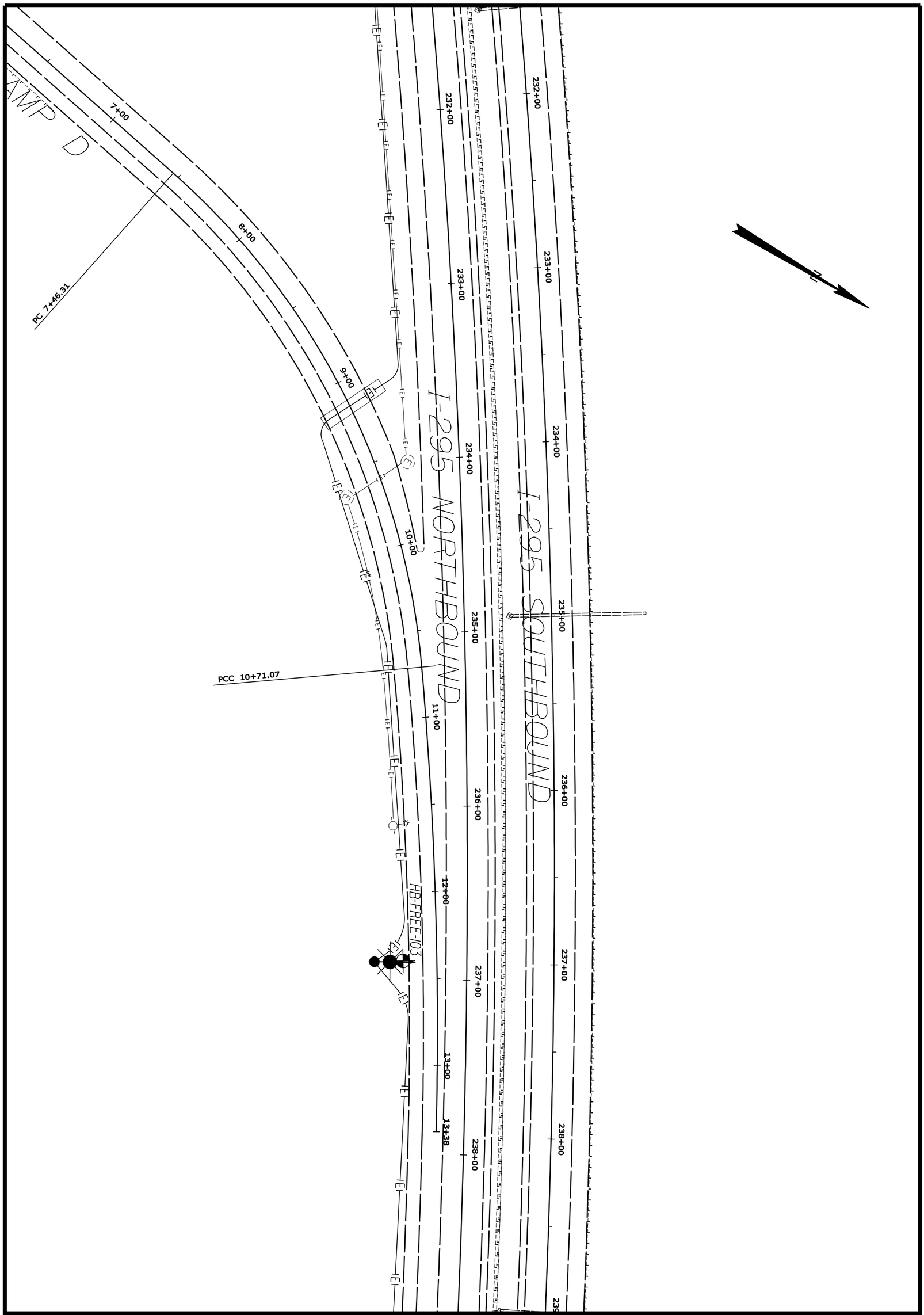

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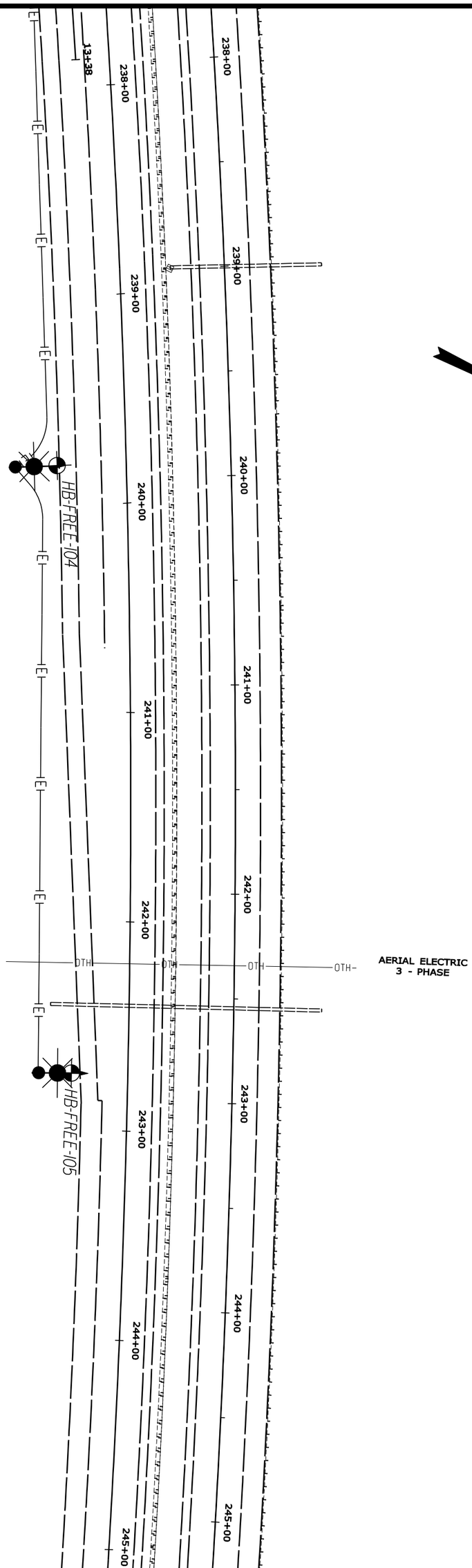

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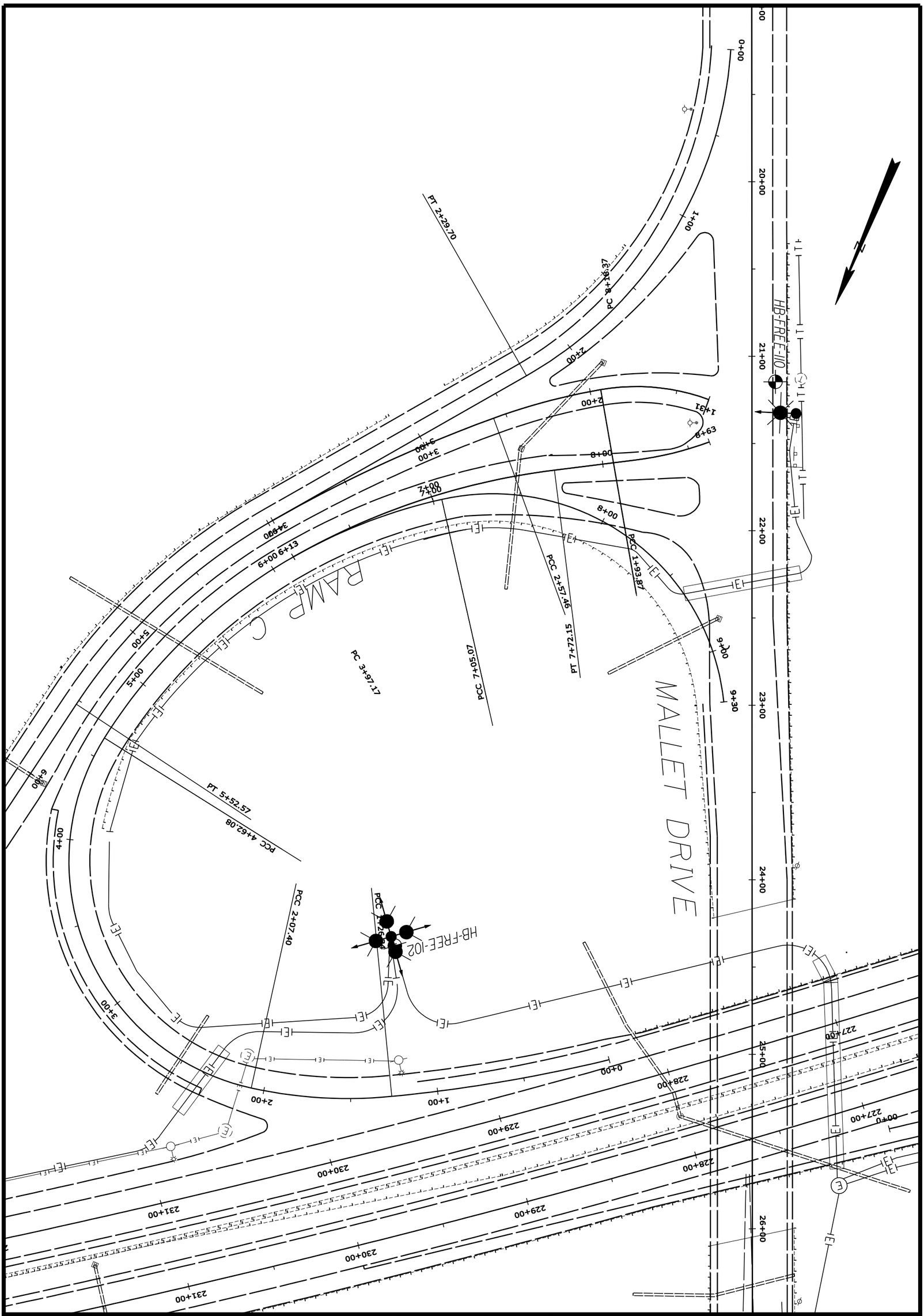

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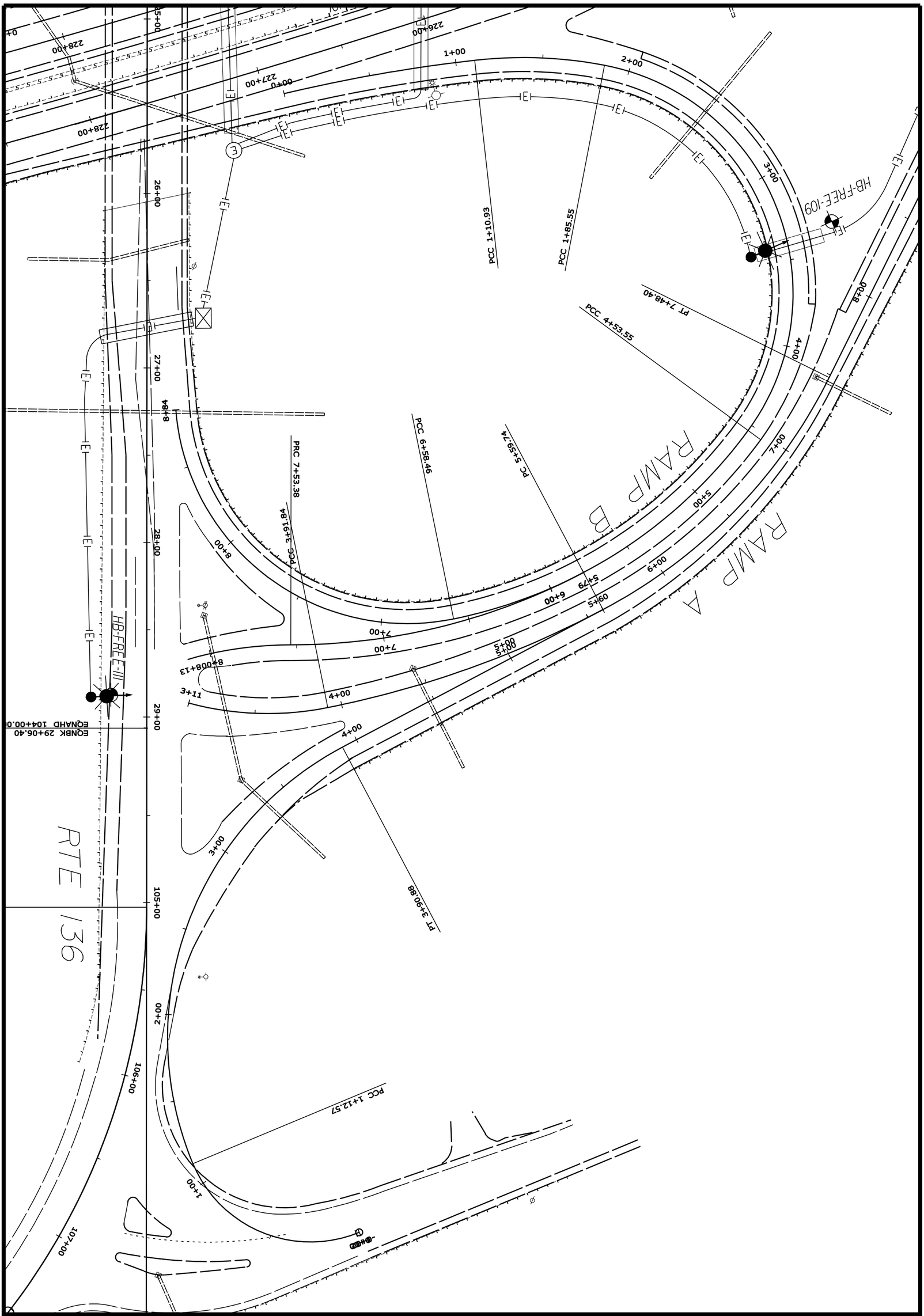

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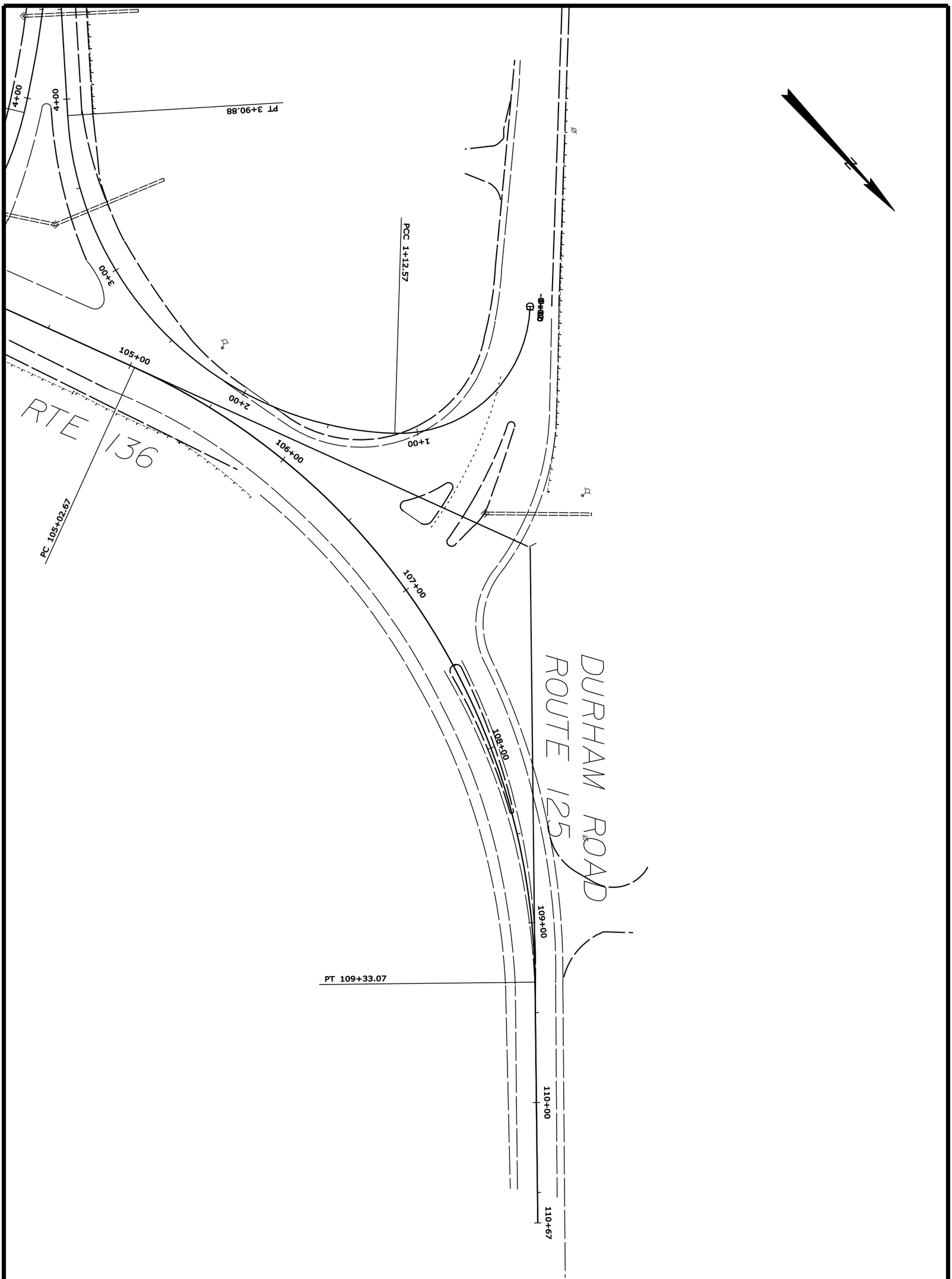

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APPENDIX C

Boring Logs & Key to Soil and Rock Descriptions and Terms

UNIFIED SOIL CLASSIFICATION SYSTEM

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

Desired Soil Observations (in this order, if applicable):

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

MODIFIED BURMISTER SYSTEM

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

TERMS DESCRIBING DENSITY/CONSISTENCY

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

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

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

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

Rock Quality Designation (RQD):

RQD (%) = sum of the lengths of intact pieces of core* > 4 inches / length of core advance

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

Correlation of RQD to Rock Mass Quality

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

Desired Rock Observations (in this order, if applicable):

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

Formation (Waterville, Ellsworth, Cape Elizabeth, etc.)
RQD and correlation to rock mass quality (very poor, poor, etc.)
ref: ASTM D6032 and AASHTO Standard Specification for Highway Bridges, 17th Ed. Table 4.4.8.1.2A
Recovery (inch/inch and percentage)
Rock Core Rate (X.X ft - Y.Y ft (min:sec))

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

Sample Container Labeling Requirements:

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

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Interstate 295, Exit 22 Light Pole Structures
Location: Freeport, ME

Boring No.: HB-FREE-101
WIN: 022871.00

Driller:	S. W. Cole Explorations, LLC	**Elevation (ft.)**	Not Surveyed	**Auger ID/OD:**	5 inch Solid-Stem Auger
Operator:	J. Lee	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	T. Demers	**Rig Type:**	CME 850	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	02-12-2018 / 02-12-2018	**Drilling Method:**	Cased Wash	**Core Barrel:**	NQ2 2 inch
Boring Location:	Sta. 225+98.4, 24.8 feet Lt; I-295 NB	**Casing ID/OD:**	HW 4/4.5 inch	**Water Level*:**	Not Observed
Hammer Efficiency Factor: 0.813		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0							SSA			2" Topsoil — 0.2	
	1D	24/16	2.00 - 4.00	5/4/2/3	6	8				1D(A) Brown, damp, loose, SAND, little gravel, trace silt, (Fill). 1D(B) Olive, moist, medium stiff, Silty CLAY, little sand, trace gravel, (Fill).	
5	2D	24/16	5.00 - 7.00	1/2/3/3	5	7				5.0 Brown-grey, moist, medium stiff, Silty CLAY, little sand, trace gravel, trace organics (rootlets).	
10	3D	24/24	10.00 - 12.00	3/4/4/10	8	11	61			Grey, moist, stiff, Silty CLAY, little sand.	
							69				
							103				
							146				
							134				
15	4D	24/17	15.00 - 17.00	6/12/13/18	25	34	129			15.0 Brown, moist, dense, Silty SAND, some gravel, (Glacial Till).	
							136				
							124				
	R1	60/56	18.10 - 23.10	RQD = 80%			95 NQ2			18.1 Top of Bedrock R1:Bedrock: Light grey, fine- to medium-grained, biotite SCHIST with quartz zoning, hard, slight weathering, fractures are horizontal to low-angle, close, and open, (Richmond Corner Formation). Rock Mass Quality = Good R1:Core Times (min:sec) 18.1-19.1 feet (2:44) 19.1-21.1 feet (3:43) 20.1-21.1 feet (3:01) 21.1-22.1 feet (3:34) 22.1-23.1 feet (4:35) 93% Recovery	
20											
25										23.1 **Bottom of Exploration at 23.1 feet below ground surface.**	

Remarks:

-Autohammer SN 295792
-bgs = below ground surface.
2 ft of frost at time of drilling.

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

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

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Interstate 295, Exit 22 Light Pole Structures
Location: Freeport, ME

Boring No.: HB-FREE-102
WIN: 022871.00

Driller:	S. W. Cole Explorations, LLC	**Elevation (ft.)**	Not Surveyed	**Auger ID/OD:**	5 inch Solid-Stem Auger
Operator:	J. Lee	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	T. Demers	**Rig Type:**	CME 850	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	02-14-2018 / 02-14-2018	**Drilling Method:**	Cased Wash	**Core Barrel:**	NQ2 2 inch
Boring Location:	Sta. 1+15.3, 85.7 feet Rt; Ramp C	**Casing ID/OD:**	HW 4/4.5 inch	**Water Level*:**	Not Observed
Hammer Efficiency Factor: 0.813		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Sample Information

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/16	0.00 - 2.00	1/1/4/8	5	7	SSA			4" Topsoil 0.3 Brown, moist, medium stiff, Silty CLAY, little sand.	
5	2D	24/16	5.00 - 7.00	9/14/13/22	27	37				5.0 Brown, wet, dense, Silty SAND, little gravel, (Glacial Till).	
	R1	60/48	8.50 - 13.50	RQD = 28%			NQ2			8.5 Top of Bedrock R1:Bedrock: Light grey, fine- to medium-grained, biotite SCHIST with quartz zoning, hard, slight to moderate weathering, fractures are horizontal to steep, very close to close, and open, (Richmond Corner Formation). Rock Mass Quality = Poor R1:Core Times (min:sec) 8.5-9.5 feet (2:13) 9.5-10.5 feet (2:22) 10.5-11.5 feet (2:24) 11.5-12.5 feet (2:53) 12.5-13.5 feet (2:45) 80% Recovery	
10											
15										13.5 **Bottom of Exploration at 13.5 feet below ground surface.**	
20											
25											

Remarks:

-Autohammer SN 295792
-bgs = below ground surface.

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

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Interstate 295, Exit 22 Light Pole Structures
Location: Freeport, ME

Boring No.: HB-FREE-103
WIN: 022871.00

Driller:	S. W. Cole Explorations, LLC	**Elevation (ft.)**	Not Surveyed	**Auger ID/OD:**	5 inch Solid-Stem Auger
Operator:	J. Lee	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	T. Demers	**Rig Type:**	CME 850	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	02-13-2018 / 02-13-2018	**Drilling Method:**	Cased Wash	**Core Barrel:**	N/A
Boring Location:	Sta. 12+39.8, 19.4 feet Rt; Ramp D	**Casing ID/OD:**	HW 4/4.5 inch	**Water Level*:**	Not Observed
Hammer Efficiency Factor: 0.813		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0							SSA			2" Topsoil	
										0.2	
	1D	24/18	2.00 - 4.00	1/1/2/12	3	4				Brown, moist, medium stiff, Sandy SILT, trace gravel, trace organics (rootlets), (Fill).	
5										Cobble.	
							52			5.5	
							20				
	2D	24/6	7.00 - 9.00	4/6/7/9	13	18	37			Grey, moist, very stiff, Silty CLAY, trace sand. PP=5 ksf	
							62				
							121				
10	3D	24/18	10.00 - 12.00	6/8/11/16	19	26	126			Similar to above. PP=8-9 ksf	
							120				
							105				
							114				
							118				
15	4D	24/12	15.00 - 17.00	12/9/8/8	17	23	74			15.0 Grey, wet, medium dense, Silty SAND, trace gravel, (Glacial Till).	
							84				
							102				
							132				
							117				
20	5D	15/6	20.00 - 21.25	14/10/50-3"	- -					Grey, wet, very dense, Silty SAND, little gravel, (Glacial Till).	
										21.3	
										Bottom of Exploration at 21.3 feet below ground surface. Refusal.	
25											

Remarks:

-Autohammer SN 295792
-bgs = below ground surface.

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Interstate 295, Exit 22 Light Pole Structures
Location: Freeport, ME

Boring No.: HB-FREE-104
WIN: 022871.00

Driller:	S. W. Cole Explorations, LLC	**Elevation (ft.)**	Not Surveyed	**Auger ID/OD:**	5 inch Solid-Stem Auger
Operator:	J. Lee	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	T. Demers	**Rig Type:**	CME 850	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	02-13-2018 / 02-14-2018	**Drilling Method:**	Cased Wash	**Core Barrel:**	N/A
Boring Location:	Sta. 239+81.4, 33.1 feet Rt; I-295 NB	**Casing ID/OD:**	HW 4/4.5 inch	**Water Level*:**	Not Observed
Hammer Efficiency Factor: 0.813		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Sample Information

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0							SSA				
	1D	24/19	2.00 - 4.00	3/5/6/5	11	15				Brown, moist, medium dense, SAND, trace silt, trace gravel, (Fill).	
5	2D	24/18	5.00 - 7.00	3/2/1/2	3	4				2D(A) Dark brown, moist, loose, SAND, some silt, trace gravel, (Fill).	
										6.0	
										2D(B) Dark brown, wet, medium stiff, Sandy SILT, trace organics (rootlets).	
10										10.0	
	3D	24/16	10.00 - 12.00	3/6/8/13	14	19	48			Grey-brown, wet, medium dense, Silty SAND, trace gravel, (Glacial Till).	
							102				
							111				
							144				
							121				
15	4D	24/12	15.00 - 17.00	12/9/8/8	17	23	57			Grey, wet, medium dense, Silty SAND, little gravel, (Glacial Till).	
							59				
							148				
							230				
							OPEN				
20	MD	0/0	20.00 - 20.00	25-0"	- -					20.0	
										Bottom of Exploration at 20.0 feet below ground surface. Refusal.	
25											

Remarks:

-Autohammer SN 295792
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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Interstate 295, Exit 22 Light Pole Structures
Location: Freeport, ME

Boring No.: HB-FREE-105
WIN: 022871.00

Driller:	S. W. Cole Explorations, LLC	**Elevation (ft.)**	Not Surveyed	**Auger ID/OD:**	5 inch Solid-Stem Auger
Operator:	J. Lee	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	T. Demers	**Rig Type:**	CME 850	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	02-14-2018 / 02-14-2018	**Drilling Method:**	Cased Wash	**Core Barrel:**	N/A
Boring Location:	Sta. 242+72.9, 27.0 feet Rt; I-295 NB	**Casing ID/OD:**	HW 4/4.5 inch	**Water Level*:**	Not Observed
Hammer Efficiency Factor: 0.813		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Depth (ft.)	Sample Information: Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0							SSA				
	1D	24/8	2.00 - 4.00	7/9/9/10	18	24				Brown, damp, medium dense, SAND, some gravel, little silt, (Fill).	
5	2D	24/2	5.00 - 7.00	1/2/7/10	9	12				Grey, moist, medium dense, SAND, some silt, trace gravel, (Fill).	
10	3D	24/18	10.00 - 12.00	1/1/1/1	2	3	12			10.0 Grey, wet, medium stiff, Silty CLAY, trace sand.	
							13				
							19				
							20				
							21				
15	MD	24/0	15.00 - 17.00	WOH-24"	- -		34			No recovery.	
							33				
							43			18.0	
							90				
							97				
20	4D	24/16	20.00 - 22.00	18/18/23/33	41	56	145			Brown, wet, very dense, SAND, some silt, trace gravel, (Glacial Till).	
							217				
							OPEN				
25											

Remarks:

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

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Interstate 295, Exit 22 Light Pole Structures
Location: Freeport, ME

Boring No.: HB-FREE-105
WIN: 022871.00

Driller:	S. W. Cole Explorations, LLC	**Elevation (ft.)**	Not Surveyed	**Auger ID/OD:**	5 inch Solid-Stem Auger
Operator:	J. Lee	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	T. Demers	**Rig Type:**	CME 850	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	02-14-2018 / 02-14-2018	**Drilling Method:**	Cased Wash	**Core Barrel:**	N/A
Boring Location:	Sta. 242+72.9, 27.0 feet Rt; I-295 NB	**Casing ID/OD:**	HW 4/4.5 inch	**Water Level*:**	Not Observed
Hammer Efficiency Factor:	0.813	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample Information: Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25	5D	24/12	25.00 - 27.00	13/14/19/40	33	45				Brown, wet, dense, Silty SAND, little gravel, (Glacial Till).	
										27.0	
										Bottom of Exploration at 27.0 feet below ground surface. No Refusal.	
30											
35											
40											
45											
50											

Remarks:

-Autohammer SN 295792
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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Interstate 295, Exit 22 Light Pole Structures
Location: Freeport, ME

Boring No.: HB-FREE-106
WIN: 022871.00

Driller:	S. W. Cole Explorations, LLC	**Elevation (ft.)**	Not Surveyed	**Auger ID/OD:**	5 inch Solid-Stem Auger
Operator:	J. Lee	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	T. Demers	**Rig Type:**	CME 850	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	02-13-2018 / 02-13-2018	**Drilling Method:**	Cased Wash	**Core Barrel:**	NQ2 2 inch
Boring Location:	Sta. 212+99.2, 23.5 feet Lt; I-295 SB	**Casing ID/OD:**	HW 4/4.5 inch	**Water Level*:**	Not Observed
Hammer Efficiency Factor: 0.813		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Depth (ft.)	Sample Information: Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0							SSA			7" Pavement	
										0.6	
	1D	24/12	2.00 - 4.00	20/27/19/10	46	62				Brown, damp, very dense, SAND, little gravel, trace silt, (Fill).	
5										5.0	
	2D	24/24	5.00 - 7.00	4/6/6/7	12	16				Grey, moist, very stiff, Silty CLAY, trace sand. PP=4.0-5.0 ksf	
10										10.0	
	R1	60/60	10.00 - 15.00	RQD = 54%			NQ2			Top of Bedrock R1:Bedrock: Light grey, fine- to medium-grained, biotite SCHIST with quartz zoning, hard, slight to moderate weathering, fractures are horizontal to steep, very close to close, and open, (Richmond Corner Formation). Rock Mass Quality = Fair R1:Core Times (min:sec) 10.0-11.0 feet (3:14) 11.0-12.0 feet (4:02) 12.0-13.0 feet (3:46) 13.0-14.0 feet (5:08) 14.0-15.0 feet (3:51) 100% Recovery	
15										15.0	
										Bottom of Exploration at 15.0 feet below ground surface.	
20											
25											

Remarks:

-Autohammer SN 295792
-bgs = below ground surface.
±3 ft of frost at time of exploration.

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

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Interstate 295, Exit 22 Light Pole Structures
Location: Freeport, ME

Boring No.: HB-FREE-107
WIN: 022871.00

Driller:	S. W. Cole Explorations, LLC	**Elevation (ft.)**	Not Surveyed	**Auger ID/OD:**	5 inch Solid-Stem Auger
Operator:	J. Lee	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	T. Demers	**Rig Type:**	CME 850	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	02-12-2018 / 02-13-2018	**Drilling Method:**	Cased Wash	**Core Barrel:**	N/A
Boring Location:	Sta. 215+99, 23.8 feet Lt; I-295 SB	**Casing ID/OD:**	HW 4/4.5 inch	**Water Level*:**	Not Observed
Hammer Efficiency Factor: 0.813		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0							SSA			5" Pavement	
										0.4	
	1D	24/14	2.00 - 4.00	11/35/15/12	50	68				Brown, damp, very dense, SAND, some gravel, trace silt, (Fill).	
5										5.0	
	2D		5.00 - 7.00	2/2/7/9	9	12				Brown-grey, moist, stiff, Clayey SILT, little sand, trace gravel, trace organics (rootlets).	
										6.5	
										Grey, damp, stiff, Silty CLAY, little sand.	
10	3D	24/24	10.00 - 12.00	6/11/13/16	24	33	86			Similar to above, except hard.	
							105				
							107				
							108				
							127				
15	MD	24/0	15.00 - 17.00	4/4/6/9	10	14	97			No recovery.	
							103				
							105				
							126			18.0	
							157				
20	4D	19/12	20.00 - 21.58	58/19/20/50-1"	39	53				Brown-grey, wet, dense, Silty SAND, little gravel, (Glacial Till).	
										21.6	
										Bottom of Exploration at 21.6 feet below ground surface. Refusal.	
25											

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Interstate 295, Exit 22 Light Pole Structures
Location: Freeport, ME

Boring No.: HB-FREE-108
WIN: 022871.00

Driller:	S. W. Cole Explorations, LLC	**Elevation (ft.)**	Not Surveyed	**Auger ID/OD:**	5 inch Solid-Stem Auger
Operator:	J. Lee	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	T. Demers	**Rig Type:**	CME 850	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	02-15-2018 / 02-16-2018	**Drilling Method:**	Cased Wash	**Core Barrel:**	N/A
Boring Location:	Sta. 13+97.4, 11.3 feet Rt; Ramp A	**Casing ID/OD:**	HW 4/4.5 inch	**Water Level*:**	Not Observed
Hammer Efficiency Factor: 0.813		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0							SSA			5" Pavement	
										0.4	
	1D	24/10	2.00 - 4.00	7/13/10/10	23	31				Brown, damp, dense, SAND, little gravel, trace silt, (Fill).	
5	2D	24/16	5.00 - 7.00	2/5/9/9	14	19				Similar to above, except medium dense.	
10	3D	24/12	10.00 - 12.00	4/4/3/3	7	9	46			Grey-brown, moist, loose, Silty SAND, little gravel, trace clay, (Fill).	
							46				
							46				
							87				
							105				
15	4D	24/24	15.00 - 17.00	4/5/7/8	12	16	72			15.0	
							82			Grey-brown, moist, very stiff, Silty CLAY, trace sand. PP=5.0-5.5 ksf	
							97				
							124				
							128				
20	5D	24/24	20.00 - 22.00	1/2/1/5	3	4	96			Similar to above except, wet and medium stiff.	
							104				
							126				
							116				
25							110				

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Interstate 295, Exit 22 Light Pole Structures
Location: Freeport, ME

Boring No.: HB-FREE-108
WIN: 022871.00

Driller:	S. W. Cole Explorations, LLC	**Elevation (ft.)**	Not Surveyed	**Auger ID/OD:**	5 inch Solid-Stem Auger
Operator:	J. Lee	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	T. Demers	**Rig Type:**	CME 850	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	02-15-2018 / 02-16-2018	**Drilling Method:**	Cased Wash	**Core Barrel:**	N/A
Boring Location:	Sta. 13+97.4, 11.3 feet Rt; Ramp A	**Casing ID/OD:**	HW 4/4.5 inch	**Water Level*:**	Not Observed
Hammer Efficiency Factor:	0.813	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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SSA = Solid Stem Auger
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WOH = Weight of 140 lb. Hammer
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WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
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Depth (ft.)	Sample Information: Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25	6D	15/2	25.00 - 26.25	9/13/50-3"	- -					25.0 Grey, wet, very dense, Silty SAND, little gravel, (Glacial Till). 26.3 **Bottom of Exploration at 26.3 feet below ground surface.** Refusal.	
30											
35											
40											
45											
50											

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Interstate 295, Exit 22 Light Pole Structures
Location: Freeport, ME

Boring No.: HB-FREE-109
WIN: 022871.00

Driller:	S. W. Cole Explorations, LLC	**Elevation (ft.)**	Not Surveyed	**Auger ID/OD:**	5 inch Solid-Stem Auger
Operator:	J. Lee	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	T. Demers	**Rig Type:**	CME 850	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	02-15-2018 / 02-15-2018	**Drilling Method:**	Cased Wash	**Core Barrel:**	N/A
Boring Location:	Sta. 3+34.9, 27.4 feet Lt; Ramp B	**Casing ID/OD:**	HW 4/4.5 inch	**Water Level*:**	Not Observed
Hammer Efficiency Factor: 0.813		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
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$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
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C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/12	0.00 - 2.00	3/5/4/4	9	12	SSA			4" Topsoil (0.3) Brown, damp, stiff, Sandy SILT, trace gravel, trace organics (rootlets), (Fill).	
5	2D	24/14	5.00 - 7.00	10/11/9/10	20	27				Brown, damp, medium dense, SAND, little silt, trace gravel, (Fill).	
10	3D	24/14	10.00 - 12.00	6/10/10/11	20	27	75			(10.0) Grey-brown, damp, very stiff, Silty CLAY, trace sand. PP=8.0-9.0 ksf	
							96				
							102				
							111				
							107				
15	4D	24/24	15.00 - 17.00	6/6/10/9	16	22	75			Similar to above, except moist and stiff. PP=5.0-6.5 ksf	
							120				
							125				
							140				
							137				
20	MV/5D	24/24	20.00 - 22.00	1/1/3/3	4	5	130			Failed 25.4x50.8 mm Vane Attempt. No Penetration. Similar to above, except wet and medium stiff.	
							145				
							138				
							142				
25							146				

Remarks:

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Interstate 295, Exit 22 Light Pole Structures
Location: Freeport, ME

Boring No.: HB-FREE-109
WIN: 022871.00

Driller:	S. W. Cole Explorations, LLC	**Elevation (ft.)**	Not Surveyed	**Auger ID/OD:**	5 inch Solid-Stem Auger
Operator:	J. Lee	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	T. Demers	**Rig Type:**	CME 850	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	02-15-2018 / 02-15-2018	**Drilling Method:**	Cased Wash	**Core Barrel:**	N/A
Boring Location:	Sta. 3+34.9, 27.4 feet Lt; Ramp B	**Casing ID/OD:**	HW 4/4.5 inch	**Water Level*:**	Not Observed
Hammer Efficiency Factor: 0.813		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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N-uncorrected = Raw Field SPT N-value
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Depth (ft.)	Sample Information: Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25	6D	24/24	25.00 - 27.00	1/1/1/1	2	3	82			Similar to above.	
							133				
							138				
							136				
							140				
30	7D	24/24	30.00 - 32.00	1/1/1/1	2	3	139			Grey, wet, medium stiff, Silty CLAY.	
							PROBE			Advanced by rod probe from 32 to 46 ft bgs.	
35											
40											
45										46.0	
										Bottom of Exploration at 46.0 feet below ground surface. No Refusal.	
50											

Remarks:

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Interstate 295, Exit 22 Light Pole Structures
Location: Freeport, ME

Boring No.: HB-FREE-110
WIN: 022871.00

Driller:	S. W. Cole Explorations, LLC	**Elevation (ft.)**	Not Surveyed	**Auger ID/OD:**	5 inch Solid-Stem Auger
Operator:	J. Lee	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	T. Demers	**Rig Type:**	CME 850	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	02-13-2018 / 02-14-2018	**Drilling Method:**	Cased Wash	**Core Barrel:**	N/A
Boring Location:	Sta. 21+14.9, 13.5 feet Lt; Mallet Dr.	**Casing ID/OD:**	HW 4/4.5 inch	**Water Level*:**	Not Observed
Hammer Efficiency Factor: 0.813		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0							SSA			5" Pavement	
										0.4	
	1D	24/16	2.00 - 4.00	18/47/44/25	91	123				Brown, damp, very dense, SAND, little silt, little gravel, (Fill).	
5	2D	24/12	5.00 - 7.00	2/2/3/4	3	4				Similar to above except, loose.	
10	3D	24/24	10.00 - 12.00	11/6/6/10	12	16	72			Brown, damp, medium dense, SAND, little silt, trace gravel, (Fill).	
							107				
							161				
							182				
15							93				
	4D	24/10	15.00 - 17.00	10/7/26/23	33	45	32			Brown, moist, dense, SAND, some gravel, little silt, (Fill).	
							156				
							147				
							178				
							139				
20	MD	2/0	20.00 - 20.17	50-2"	- -		OPEN			No recovery.	
										20.2	
										Bottom of Exploration at 20.2 feet below ground surface. Refusal.	
25											

Remarks:

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Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Interstate 295, Exit 22 Light Pole Structures
Location: Freeport, ME

Boring No.: HB-FREE-111
WIN: 022871.00

Driller:	S. W. Cole Explorations, LLC	**Elevation (ft.)**	Not Surveyed	**Auger ID/OD:**	5 inch Solid-Stem Auger
Operator:	J. Lee	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	T. Demers	**Rig Type:**	CME 850	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	02-15-2018 / 02-15-2018	**Drilling Method:**	Cased Wash	**Core Barrel:**	N/A
Boring Location:	Sta. 28+87.7, 20.6 feet Rt; Mallet Dr.	**Casing ID/OD:**	HW 4/4.5 inch	**Water Level*:**	Not Observed
Hammer Efficiency Factor: 0.813		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0							SSA			5" Pavement	
										0.4	
	1D	24/16	2.00 - 4.00	12/11/12/11	23	31				Brown, damp, dense, SAND, little gravel, trace silt, (Fill).	
5	2D	24/22	5.00 - 7.00	5/5/6/9	11	15				Brown, damp, medium dense, SAND, some silt, trace gravel, (Fill).	
10	3D	24/16	10.00 - 12.00	2/2/5/6	7	9	33			10.0 Grey-brown, moist, stiff, Silty CLAY, trace sand. PP=3.0-5.0 ksf	
							57				
							75				
							100				
							95				
15	4D	24/12	15.00 - 17.00	4/4/5/5	9	12	73			Similar to above. PP=6.0-7.0 ksf	
							75				
							78				
							93				
							87				
20	5D	24/10	20.00 - 22.00	2/3/2/3	5	7	83			Similar to above. PP=3.5-5.0 ksf	
							106				
							121				
							153				
25							149				

Remarks:

-Autohammer SN 295792
-bgs = below ground surface.

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

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

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Interstate 295, Exit 22 Light Pole Structures
Location: Freeport, ME

Boring No.: HB-FREE-111
WIN: 022871.00

Driller:	S. W. Cole Explorations, LLC	**Elevation (ft.)**	Not Surveyed	**Auger ID/OD:**	5 inch Solid-Stem Auger
Operator:	J. Lee	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	T. Demers	**Rig Type:**	CME 850	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	02-15-2018 / 02-15-2018	**Drilling Method:**	Cased Wash	**Core Barrel:**	N/A
Boring Location:	Sta. 28+87.7, 20.6 feet Rt; Mallet Dr.	**Casing ID/OD:**	HW 4/4.5 inch	**Water Level*:**	Not Observed
Hammer Efficiency Factor: 0.813		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Depth (ft.)	Sample Information: Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25	5D	24/16	25.00 - 27.00	8/11/14/17	25	34				Similar to above, except hard. PP=9.0 ksf	
										27.0 **Bottom of Exploration at 27.0 feet below ground surface.** No refusal.	
30											
35											
40											
45											
50											

Remarks:

-Autohammer SN 295792
-bgs = below ground surface.

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

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

S.W.COLE ENGINEERING, INC.

APPENDIX D

Evaluations

Estimated Frost Penetration Depth

Based on MaineDOT Bridge Design Guide Section 5.2.1

Site Location:
Freeport, Maine

Soil Conditions:
Sand Fill
Silty CLAY

Step 1. From Figure 5-1:
Design Freezing Index = ±1300 freezing degree-days

Step 2. Assume w = 10% (worse case)

Step 3. From Table 5-1 for coarse-grained soils (worse case)

Depth of frost penetration = 76.3 inches = 6.4 feet

Calculated by / Date: MAS / 03-22-2018
Checked by / Date: EJB / 03-26-2018

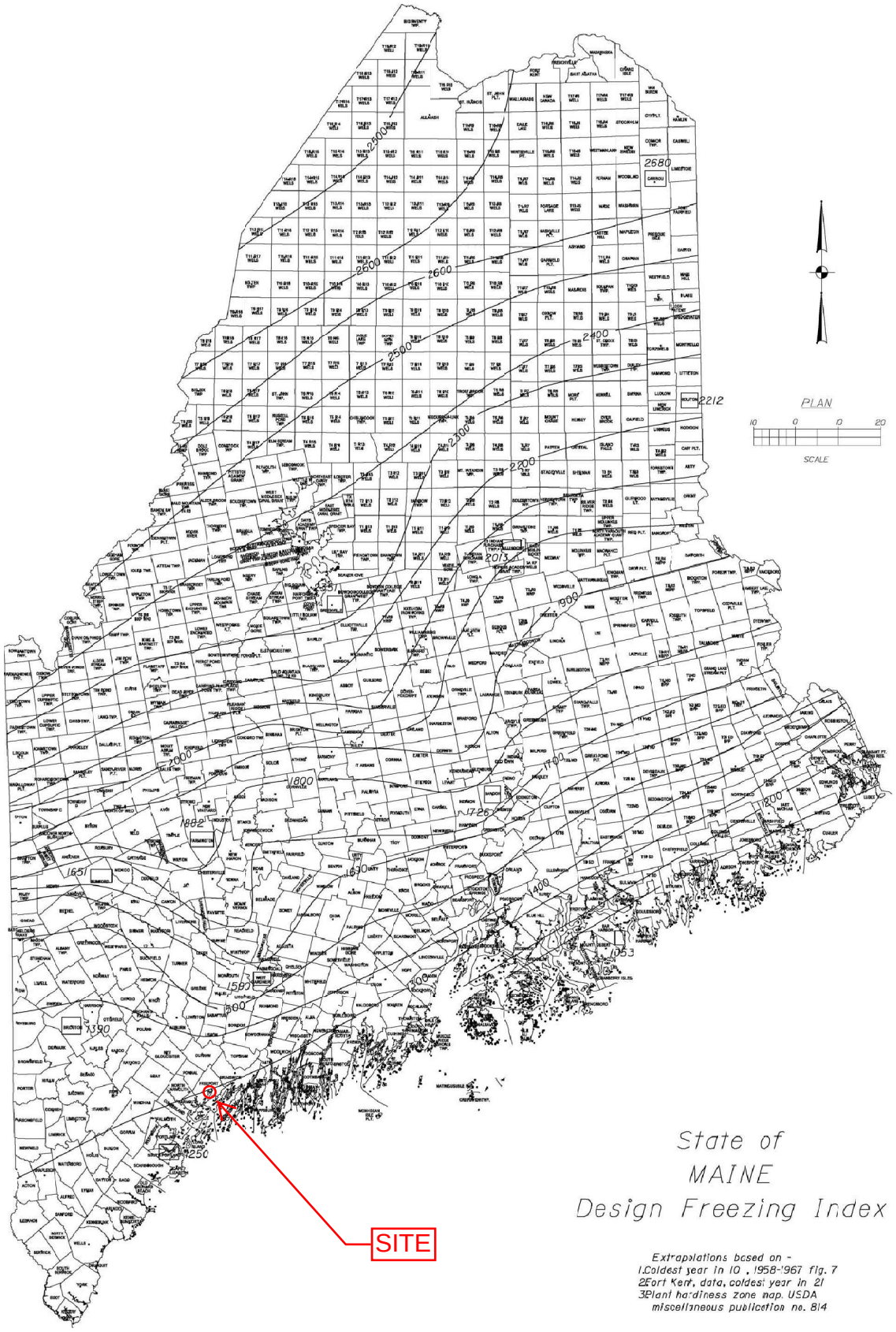


Figure 5-1 Maine Design Freezing Index Map

5.2 General

5.2.1 Frost

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

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

Table 5-1 Depth of Frost Penetration

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

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

S.W.COLE ENGINEERING, INC.

SPT BLOW COUNT CONVERSION AND FRICTION ANGLE CORRELATION FOR GRANULAR SOILS

Project Name: Light Pole Structures - WIN 22871
Project No.: 17-1515
Evaluated By/Date: MAS / 03-18-2018
Reviewed By/Date: EJB / 03-26-2018

81 Hammer Efficiency
u = 5 Depth to Water *Assumed*

		BORING		HB-FREE-101			Correction Factors							
Soil Layer	Stratum	Sample No.	Top of Sample Depth (ft)	Field N-Value N_m	Total Stress at Sample Depth (psf)	Effective Stress at Sample Depth (psf)	Overburden Stress[1] C_N	Hammer Efficiency C_E	Borehole Diameter[2] C_B	Rod Length[2] C_R	Sampler[2] C_S	N_{60}	$(N1)_{60}$	Friction Angle[3] (degrees)
1	Fill	1D	2	6	250	250	1.70	1.35	1.0	0.75	1.0	7	12	29
2	Silty Clay	2D	5	5	620	620	1.39	1.35	1.0	0.75	1.0	6	9	29
2	Silty Clay	3D	10	8	1220	908	1.27	1.35	1.0	0.75	1.0	9	12	30
3	Till	4D	15	25	1835	1211	1.17	1.35	1.0	0.85	1.0	29	34	35

1. Determination of overburden stress correction factor (CN) based on Peck, Hanson and Thornburn (1974) and guidance from AASHTO LRFD Section 10.4.6.2.4 (AASHTO LRFD 8th Ed., 2017).
2. Determination of correction factors (CB, CR, CS) based on guidance from Seed et al. (1985) and Skempton (1986) as presented in Das (2014) Principles of Foundation Engineering, 8th Ed. Table 3.5.
3. Estimated friction angle based on guidance from Peck, Hanson and Thornburn (1974)

S.W.COLE ENGINEERING, INC.

SPT BLOW COUNT CONVERSION AND FRICTION ANGLE CORRELATION FOR GRANULAR SOILS

Project Name: Light Pole Structures - WIN 22871
Project No.: 17-1515
Evaluated By/Date: MAS / 03-18-2018
Reviewed By/Date: EJB / 03-26-2018

81 Hammer Efficiency
u = 5 Depth to Water *Assumed*

		BORING		HB-FREE-102			Correction Factors							
Soil Layer	Stratum	Sample No.	Top of Sample Depth (ft)	Field N-Value N_m	Total Stress at Sample Depth (psf)	Effective Stress at Sample Depth (psf)	Overburden Stress[1] C_N	Hammer Efficiency C_E	Borehole Diameter[2] C_B	Rod Length[2] C_R	Sampler[2] C_S	N_{60}	$(N1)_{60}$	Friction Angle[3] (degrees)
1	Silty Clay	1D	0	5	0	0	2.00	1.35	1.0	0.75	1.0	6	12	29
2	Till	2D	5	27	615	615	1.40	1.35	1.0	0.75	1.0	28	40	35

1. Determination of overburden stress correction factor (CN) based on Peck, Hanson and Thornburn (1974) and guidance from AASHTO LRFD Section 10.4.6.2.4 (AASHTO LRFD 8th Ed., 2017).
2. Determination of correction factors (CB, CR, CS) based on guidance from Seed et al. (1985) and Skempton (1986) as presented in Das (2014) Principles of Foundation Engineering, 8th Ed. Table 3.5.
3. Estimated friction angle based on guidance from Peck, Hanson and Thornburn (1974)

S.W.COLE ENGINEERING, INC.

SPT BLOW COUNT CONVERSION AND FRICTION ANGLE CORRELATION FOR GRANULAR SOILS

Project Name: Light Pole Structures - WIN 22871
Project No.: 17-1515
Evaluated By/Date: MAS / 03-18-2018
Reviewed By/Date: EJB / 03-26-2018

81 Hammer Efficiency
u = 5.5 Depth to Water *Assumed*

		BORING		HB-FREE-103			Correction Factors							
Soil Layer	Stratum	Sample No.	Top of Sample Depth (ft)	Field N-Value N_m	Total Stress at Sample Depth (psf)	Effective Stress at Sample Depth (psf)	Overburden Stress[1] C_N	Hammer Efficiency C_E	Borehole Diameter[2] C_B	Rod Length[2] C_R	Sampler[2] C_S	N_{60}	$(N1)_{60}$	Friction Angle[3] (degrees)
1	Fill	1D	2	3	250	250	1.70	1.35	1.0	0.75	1.0	4	7	28
2	Silty Clay	2D	7	13	865	771	1.32	1.35	1.0	0.75	1.0	14	19	31
2	Silty Clay	3D	10	19	1225	944	1.25	1.35	1.0	0.75	1.0	20	26	33
3	Bedrock	4D	15	17	1870	1277	1.15	1.35	1.0	0.85	1.0	20	24	33
3	Bedrock	5D	20	-	2695	1790	1.04	1.35	1.0	0.95	1.0			

1. Determination of overburden stress correction factor (CN) based on Peck, Hanson and Thornburn (1974) and guidance from AASHTO LRFD Section 10.4.6.2.4 (AASHTO LRFD 8th Ed., 2017).
2. Determination of correction factors (CB, CR, CS) based on guidance from Seed et al. (1985) and Skempton (1986) as presented in Das (2014) Principles of Foundation Engineering, 8th Ed. Table 3.5.
3. Estimated friction angle based on guidance from Peck, Hanson and Thornburn (1974)

S.W.COLE ENGINEERING, INC.

SPT BLOW COUNT CONVERSION AND FRICTION ANGLE CORRELATION FOR GRANULAR SOILS

Project Name: Light Pole Structures - WIN 22871
Project No.: 17-1515
Evaluated By/Date: MAS / 03-18-2018
Reviewed By/Date: EJB / 03-26-2018

81 Hammer Efficiency
u = 6 Depth to Water *Assumed*

		BORING		HB-FREE-104			Correction Factors							
Soil Layer	Stratum	Sample No.	Top of Sample Depth (ft)	Field N-Value N_m	Total Stress at Sample Depth (psf)	Effective Stress at Sample Depth (psf)	Overburden Stress[1] C_N	Hammer Efficiency C_E	Borehole Diameter[2] C_B	Rod Length[2] C_R	Sampler[2] C_S	N_{60}	$(N1)_{60}$	Friction Angle[3] (degrees)
1	Fill	1D	2	11	250	250	1.70	1.35	1.0	0.75	1.0	12	21	31
1	Fill	2D	5	3	625	625	1.39	1.35	1.0	0.75	1.0	4	6	28
3	Till	3D	10	14	1240	990	1.24	1.35	1.0	0.75	1.0	15	19	31
3	Till	4D	15	17	1915	1353	1.13	1.35	1.0	0.85	1.0	20	23	33
3	Till	MD	20											

1. Determination of overburden stress correction factor (CN) based on Peck, Hanson and Thornburn (1974) and guidance from AASHTO LRFD Section 10.4.6.2.4 (AASHTO LRFD 8th Ed., 2017).
2. Determination of correction factors (CB, CR, CS) based on guidance from Seed et al. (1985) and Skempton (1986) as presented in Das (2014) Principles of Foundation Engineering, 8th Ed. Table 3.5.
3. Estimated friction angle based on guidance from Peck, Hanson and Thornburn (1974)

S.W.COLE ENGINEERING, INC.

SPT BLOW COUNT CONVERSION AND FRICTION ANGLE CORRELATION FOR GRANULAR SOILS

Project Name: Light Pole Structures - WIN 22871
Project No.: 17-1515
Evaluated By/Date: MAS / 03-18-2018
Reviewed By/Date: EJB / 03-26-2018

81 Hammer Efficiency
u = 10 Depth to Water *Assumed*

		BORING		HB-FREE-105			Correction Factors							
Soil Layer	Stratum	Sample No.	Top of Sample Depth (ft)	Field N-Value N_m	Total Stress at Sample Depth (psf)	Effective Stress at Sample Depth (psf)	Overburden Stress[1] C_N	Hammer Efficiency C_E	Borehole Diameter[2] C_B	Rod Length[2] C_R	Sampler[2] C_S	N_{60}	$(N1)_{60}$	Friction Angle[3] (degrees)
1	Fill	1D	2	18	250	250	1.70	1.35	1.0	0.75	1.0	19	33	33
1	Fill	2D	5	9	625	625	1.39	1.35	1.0	0.75	1.0	10	14	30
2	Silty Clay	3D	10	2	1245	1245	1.16	1.35	1.0	0.75	1.0	3	4	28
2	Silty Clay	MD	15											
3	Till	4D	20	41	2490	1866	1.02	1.35	1.0	0.95	1.0	53	55	41

1. Determination of overburden stress correction factor (CN) based on Peck, Hanson and Thornburn (1974) and guidance from AASHTO LRFD Section 10.4.6.2.4 (AASHTO LRFD 8th Ed., 2017).
2. Determination of correction factors (CB, CR, CS) based on guidance from Seed et al. (1985) and Skempton (1986) as presented in Das (2014) Principles of Foundation Engineering, 8th Ed. Table 3.5.
3. Estimated friction angle based on guidance from Peck, Hanson and Thornburn (1974)

S.W.COLE ENGINEERING, INC.

SPT BLOW COUNT CONVERSION AND FRICTION ANGLE CORRELATION FOR GRANULAR SOILS

Project Name: Light Pole Structures - WIN 22871
Project No.: 17-1515
Evaluated By/Date: MAS / 03-18-2018
Reviewed By/Date: EJB / 03-26-2018

81 Hammer Efficiency
u = 5 Depth to Water *Assumed*

		BORING		HB-FREE-106			Correction Factors							
Soil Layer	Stratum	Sample No.	Top of Sample Depth (ft)	Field N-Value N_m	Total Stress at Sample Depth (psf)	Effective Stress at Sample Depth (psf)	Overburden Stress[1] C_N	Hammer Efficiency C_E	Borehole Diameter[2] C_B	Rod Length[2] C_R	Sampler[2] C_S	N_{60}	$(N1)_{60}$	Friction Angle[3] (degrees)
1	Fill	1D	2	46	250	250	1.70	1.35	1.0	0.75	1.0	47	80	40
2	Silty Clay	2D	5	12	620	620	1.39	1.35	1.0	0.75	1.0	13	19	31

1. Determination of overburden stress correction factor (CN) based on Peck, Hanson and Thornburn (1974) and guidance from AASHTO LRFD Section 10.4.6.2.4 (AASHTO LRFD 8th Ed., 2017).
2. Determination of correction factors (CB, CR, CS) based on guidance from Seed et al. (1985) and Skempton (1986) as presented in Das (2014) Principles of Foundation Engineering, 8th Ed. Table 3.5.
3. Estimated friction angle based on guidance from Peck, Hanson and Thornburn (1974)

S.W.COLE ENGINEERING, INC.

SPT BLOW COUNT CONVERSION AND FRICTION ANGLE CORRELATION FOR GRANULAR SOILS

Project Name: Light Pole Structures - WIN 22871
Project No.: 17-1515
Evaluated By/Date: MAS / 03-18-2018
Reviewed By/Date: EJB / 03-26-2018

81 Hammer Efficiency
u = 5 Depth to Water *Assumed*

BORING **HB-FREE-107**

Soil Layer	Stratum	Sample No.	Top of Sample Depth (ft)	Field N-Value N_m	Total Stress at Sample Depth (psf)	Effective Stress at Sample Depth (psf)	Correction Factors: Overburden Stress[1] C_N	Hammer Efficiency C_E	Borehole Diameter[2] C_B	Rod Length[2] C_R	Sampler[2] C_S	N_{60}	$(N1)_{60}$	Friction Angle[3] (degrees)
1	Fill	1D	2	50	250	250	1.70	1.35	1.0	0.75	1.0	51	87	41
1	Fill	2D	5	9	625	625	1.39	1.35	1.0	0.75	1.0	10	14	30
2	Silty Clay	3D	10	24	1230	918	1.26	1.35	1.0	0.75	1.0	25	32	34
2	Silty Clay	MD	15	10	1830	1206	1.17	1.35	1.0	0.85	1.0	12	15	31
3	Till	4D	20	39	2475	1539	1.09	1.35	1.0	0.95	1.0	51	56	41

1. Determination of overburden stress correction factor (CN) based on Peck, Hanson and Thornburn (1974) and guidance from AASHTO LRFD Section 10.4.6.2.4 (AASHTO LRFD 8th Ed., 2017).
2. Determination of correction factors (CB, CR, CS) based on guidance from Seed et al. (1985) and Skempton (1986) as presented in Das (2014) Principles of Foundation Engineering, 8th Ed. Table 3.5.
3. Estimated friction angle based on guidance from Peck, Hanson and Thornburn (1974)

S.W.COLE ENGINEERING, INC.

SPT BLOW COUNT CONVERSION AND FRICTION ANGLE CORRELATION FOR GRANULAR SOILS

Project Name: Light Pole Structures - WIN 22871
Project No.: 17-1515
Evaluated By/Date: MAS / 03-18-2018
Reviewed By/Date: EJB / 03-26-2018

81 Hammer Efficiency
u = 5 Depth to Water *Assumed*

		BORING		HB-FREE-108			Correction Factors							
Soil Layer	Stratum	Sample No.	Top of Sample Depth (ft)	Field N-Value N_m	Total Stress at Sample Depth (psf)	Effective Stress at Sample Depth (psf)	Overburden Stress[1] C_N	Hammer Efficiency C_E	Borehole Diameter[2] C_B	Rod Length[2] C_R	Sampler[2] C_S	N_{60}	$(N1)_{60}$	Friction Angle[3] (degrees)
1	Fill	1D	2	23	250	250	1.70	1.35	1.0	0.75	1.0	24	41	34
1	Fill	2D	5	14	625	625	1.39	1.35	1.0	0.75	1.0	15	21	31
1	Fill	3D	10	7	1250	938	1.25	1.35	1.0	0.75	1.0	8	11	29
2	Silty Clay	4D	15	12	1870	1246	1.16	1.35	1.0	0.85	1.0	14	17	31
2	Silty Clay	5D	20	3	2470	1534	1.09	1.35	1.0	0.95	1.0	4	5	28
3	Till	6D	25											

1. Determination of overburden stress correction factor (CN) based on Peck, Hanson and Thornburn (1974) and guidance from AASHTO LRFD Section 10.4.6.2.4 (AASHTO LRFD 8th Ed., 2017).
2. Determination of correction factors (CB, CR, CS) based on guidance from Seed et al. (1985) and Skempton (1986) as presented in Das (2014) Principles of Foundation Engineering, 8th Ed. Table 3.5.
3. Estimated friction angle based on guidance from Peck, Hanson and Thornburn (1974)

S.W.COLE ENGINEERING, INC.

SPT BLOW COUNT CONVERSION AND FRICTION ANGLE CORRELATION FOR GRANULAR SOILS

Project Name: Light Pole Structures - WIN 22871
Project No.: 17-1515
Evaluated By/Date: MAS / 03-18-2018
Reviewed By/Date: EJB / 03-26-2018

81 Hammer Efficiency
u = 10 Depth to Water *Assumed*

BORING **HB-FREE-109**

Soil Layer	Stratum	Sample No.	Top of Sample Depth (ft)	Field N-Value N_m	Total Stress at Sample Depth (psf)	Effective Stress at Sample Depth (psf)	Correction Factors: Overburden Stress[1] C_N	Hammer Efficiency C_E	Borehole Diameter[2] C_B	Rod Length[2] C_R	Sampler[2] C_S	N_{60}	$(N1)_{60}$	Friction Angle[3] (degrees)
1	Fill	1D	2	9	250	250	1.70	1.35	1.0	0.75	1.0	10	17	30
1	Fill	2D	5	20	625	625	1.39	1.35	1.0	0.75	1.0	21	30	33
2	Silty Clay	3D	10	20	1245	1245	1.16	1.35	1.0	0.75	1.0	21	25	33
2	Silty Clay	4D	15	16	1845	1533	1.09	1.35	1.0	0.85	1.0	19	21	33
2	Silty Clay	5D	20	4	2445	1821	1.03	1.35	1.0	0.95	1.0	6	7	29
2	Silty Clay	6D	25	2	3045	2109	0.98	1.35	1.0	0.95	1.0	3	3	28
2	Silty Clay	7D	30	2	3645	2397	0.94	1.35	1.0	0.95	1.0	3	3	28

1. Determination of overburden stress correction factor (CN) based on Peck, Hanson and Thornburn (1974) and guidance from AASHTO LRFD Section 10.4.6.2.4 (AASHTO LRFD 8th Ed., 2017).
2. Determination of correction factors (CB, CR, CS) based on guidance from Seed et al. (1985) and Skempton (1986) as presented in Das (2014) Principles of Foundation Engineering, 8th Ed. Table 3.5.
3. Estimated friction angle based on guidance from Peck, Hanson and Thornburn (1974)

S.W.COLE ENGINEERING, INC.

SPT BLOW COUNT CONVERSION AND FRICTION ANGLE CORRELATION FOR GRANULAR SOILS

Project Name: Light Pole Structures - WIN 22871
Project No.: 17-1515
Evaluated By/Date: MAS / 03-18-2018
Reviewed By/Date: EJB / 03-26-2018

81 Hammer Efficiency
u = 15 Depth to Water *Assumed*

		BORING		HB-FREE-110			Correction Factors							
Soil Layer	Stratum	Sample No.	Top of Sample Depth (ft)	Field N-Value N_m	Total Stress at Sample Depth (psf)	Effective Stress at Sample Depth (psf)	Overburden Stress[1] C_N	Hammer Efficiency C_E	Borehole Diameter[2] C_B	Rod Length[2] C_R	Sampler[2] C_S	N_{60}	$(N1)_{60}$	Friction Angle[3] (degrees)
1	Fill	1D	2	91	250	250	1.70	1.35	1.0	0.75	1.0	93	158	50
1	Fill	2D	5	3	625	625	1.39	1.35	1.0	0.75	1.0	4	6	28
1	Fill	3D	10	12	1250	1250	1.16	1.35	1.0	0.75	1.0	13	16	31
1	Fill	4D	15	33	1875	1875	1.02	1.35	1.0	0.85	1.0	38	39	38
1	Fill	MD	20											

1. Determination of overburden stress correction factor (CN) based on Peck, Hanson and Thornburn (1974) and guidance from AASHTO LRFD Section 10.4.6.2.4 (AASHTO LRFD 8th Ed., 2017).
2. Determination of correction factors (CB, CR, CS) based on guidance from Seed et al. (1985) and Skempton (1986) as presented in Das (2014) Principles of Foundation Engineering, 8th Ed. Table 3.5.
3. Estimated friction angle based on guidance from Peck, Hanson and Thornburn (1974)

S.W.COLE ENGINEERING, INC.

SPT BLOW COUNT CONVERSION AND FRICTION ANGLE CORRELATION FOR GRANULAR SOILS

Project Name: Light Pole Structures - WIN 22871
Project No.: 17-1515
Evaluated By/Date: MAS / 03-18-2018
Reviewed By/Date: EJB / 03-26-2018

81 Hammer Efficiency
u = 15 Depth to Water *Assumed*

BORING **HB-FREE-111**

Soil Layer	Stratum	Sample No.	Top of Sample Depth (ft)	Field N-Value N_m	Total Stress at Sample Depth (psf)	Effective Stress at Sample Depth (psf)	Correction Factors: Overburden Stress[1] C_N	Hammer Efficiency C_E	Borehole Diameter[2] C_B	Rod Length[2] C_R	Sampler[2] C_S	N_{60}	$(N1)_{60}$	Friction Angle[3] (degrees)
1	Fill	1D	2	23	250	250	1.70	1.35	1.0	0.75	1.0	24	41	34
1	Fill	2D	5	11	625	625	1.39	1.35	1.0	0.75	1.0	12	17	31
2	Silty Clay	3D	10	7	1245	1245	1.16	1.35	1.0	0.75	1.0	8	10	29
2	Silty Clay	4D	15	9	1845	1845	1.03	1.35	1.0	0.85	1.0	11	12	30
2	Silty Clay	5D	20	5	2445	2133	0.98	1.35	1.0	0.95	1.0	7	7	29
2	Silty Clay	6D	25	25	3045	2421	0.94	1.35	1.0	0.95	1.0	33	31	36

1. Determination of overburden stress correction factor (CN) based on Peck, Hanson and Thornburn (1974) and guidance from AASHTO LRFD Section 10.4.6.2.4 (AASHTO LRFD 8th Ed., 2017).
2. Determination of correction factors (CB, CR, CS) based on guidance from Seed et al. (1985) and Skempton (1986) as presented in Das (2014) Principles of Foundation Engineering, 8th Ed. Table 3.5.
3. Estimated friction angle based on guidance from Peck, Hanson and Thornburn (1974)

GEOTECHNICAL DESIGN REPORT

17-1516

April 9, 2018

Explorations and Geotechnical Engineering Services

Light Pole Structures
I-95, Exit 227
T2R8, Maine
WIN 023014.00

PREPARED FOR:
Maine Department of Transportation
Attention: Kate Maguire, P.E.
State House Station 16
Augusta, ME 04333-0016

PREPARED BY:
S. W. Cole Engineering, Inc.
26 Coles Crossing Drive
Sidney, ME 04330
T: (207) 626-0600

S.W.COLE ENGINEERING, INC.

- *Geotechnical Engineering*
- *Construction Materials Testing and Special Inspections*
- *GeoEnvironmental Services*
- *Test Boring Explorations*

www.swcole.com

TABLE OF CONTENTS

17-1516

April 9, 2018

Maine Department of Transportation
Attention: Kate Maguire, P.E.
State House Station 16
Augusta, ME 04333-0016

Subject: Geotechnical Design Report
Explorations and Geotechnical Engineering Services
Light Pole Structures
I-95, Exit 227
T2R8, Maine
WIN 023014.00

Dear Kate:

In accordance with our Proposal dated December 28, 2017, and project Assignment Letter #5 dated January 3, 2018, we have made the requested subsurface explorations for the subject project. The purpose of our services was to obtain subsurface information in order to provide geotechnical parameters and recommendations to assist design of new mast pole luminaire structures. The services provided by S. W. Cole Engineering, Inc. (S.W.COLE) were conducted in accordance with our Multi-PIN Agreement with the Maine Department of Transportation (MaineDOT), No. 20150720000000000085, dated July 20, 2015. The contents of this report are subject to the limitations in Appendix A.

1.0 INTRODUCTION

1.1 Site and Proposed Construction

The project is located along I-95 near Exit 227 in T2R8, Maine. The project location is shown on the *Site Location Map* attached as Appendix B.

Based on the provided Preliminary Plans, we understand the proposed construction includes ten new mast pole luminaire (light poles) structures. We understand the poles will be 80 to 90 feet high supported on drilled shaft foundations that may extend up to 20 feet below ground surface, based on MaineDOT Standard Details 626.

2.0 EXPLORATIONS AND TESTING

2.1 Explorations

Eleven test borings (HB-T2R8-101 through HB-T2R8-110 and HB-T2R8-109A) were made at the site from January 24 through February 5, 2018 by S. W. Cole Explorations, LLC using a Diedrich D-50 drill rig. The exploration locations were selected and established in the field by S.W.COLE using taped measurements from existing site features. The approximate exploration locations are shown on the *Boring Location Plans* attached as Appendix B. Logs of the test borings and a Key to Soil and Rock Descriptions and Terms used on the logs are attached as Appendix C. Approximate station and offset at exploration locations are provided on individual boring logs and summarized in the table below.

Structure Number	Boring Number	Approximate Station & Location
1	HB-T2R8-101	Sta. 2+13.5, 36.8 ft Rt. Ramp C
2	HB-T2R8-102	Sta. 5+79, 40.3 ft Rt. Ramp C
3	HB-T2R8-103	Sta. 14+90.1, 48.0 ft Rt. Ramp D
4	HB-T2R8-104	Sta. 10+70.2, 40.0 ft Rt. Ramp D
5	HB-T2R8-105	Sta. 2+48.9, 52.0 ft Rt. Ramp B
6	HB-T2R8-106	Sta. 6+05.2, 56.1 ft Rt. Ramp B
7	HB-T2R8-107	Sta. 16+71, 46.5 ft Rt. Ramp A
8	HB-T2R8-108	Sta. 20+51, 52.3 ft Rt. Ramp A
9	HB-T2R8-109	Sta. 58+03.8, 57.0 ft Lt. Access Road
	HB-T2R8-109A	Sta. 58+08.2, 55.1 ft Lt. Access Road
10	HB-T2R8-110	Sta. 45+65.6, 11.2 ft Lt. Access Road

2.2 Testing

The test borings were drilled using a combination of solid-stem auger and cased-wash boring drilling techniques. The soils were sampled at 2 to 5-foot intervals using a split-spoon sampler and Standard Penetration Testing (SPT) methods. Upon encountering bedrock, boring HB-T2R8-104 was advanced about 5 feet into bedrock using NQ2 rock coring techniques. Upon encountering boulders and cobbles, boring HB-T2R8-106 was advanced about 5 feet into glacial till soils, using NQ2 rock coring techniques. The hammer efficiency factor (0.790), uncorrected SPT blow counts, raw field N-values, corrected N-values (N_{60}) and rock core intervals are shown on the logs in Appendix C. The drill rig was equipped with a calibrated automatic hammer to drive the split-spoon. Corrected N-values in this report were computed by applying an average energy transfer

of 0.790 for the calibrated automatic hammer to the raw field N-values. Pocket penetrometer tests were performed on disturbed samples of stiffer cohesive soils where encountered.

Soils samples recovered from the test borings were visually classified in our laboratory and transported to the MaineDOT Laboratory in Bangor, Maine for testing. Laboratory testing was performed on disturbed SPT samples obtained during the explorations. Laboratory testing was performed by the MaineDOT Materials Testing and Exploration Central Laboratory in Bangor, Maine in accordance with applicable American Association of State Highway and Transportation Officials (AASHTO) testing procedures. Laboratory testing included three (3) natural water content tests and three (3) grain size analyses. Results of the laboratory testing are noted on the logs and provided in Appendix D.

3.0 SUBSURFACE CONDITIONS

3.1 Surficial and Bedrock Geology

According to the Maine Geological Survey (MGS) mapping of the Lincoln Quadrangle (Open-File 80-12), mapped surficial geology units within the site vicinity consist of:

- Glacial-Marine deposit of silt, clay and sand; and
- Glacial Till deposit consisting of sand, silt, clay and stones (gravel, cobbles and boulders).

The subsurface conditions encountered were generally consistent with the mapped surficial geology; however, the explorations also encountered fill soils from previous site development in borings HB-T2R8-105, -106, -109, -109A and -110.

Bedrock in the site vicinity is mapped as calcareous quartzite with lime-silicate minerals (Bedrock Geology Map of Maine, MGS 1985). The bedrock cored at HB-T2R8-104 was composed of fine-grained, hard, slightly weathered quartzite and is generally consistent with the mapped bedrock geology.

3.2 Soil and Bedrock

The test borings encountered a soils profile generally consisting of a surface layer of topsoil or pavement overlying fill overlying glacial till or glaciomarine deposits overlying glacial till. The principal strata encountered in the explorations are summarized below; refer to the attached logs for more detailed subsurface information.

Topsoil: Topsoil was encountered in borings HB-T2R8-101 through HB-T2R8-109 and HB-T2R8-109A to a depth of about 0.5 to 1.8 feet below ground surface (bgs). The topsoil generally consisted of brown silty sand, sandy silt or sand with some silt, and organics.

Pavement: Bituminous concrete pavement was encountered at the ground surface in boring HB-T2R8-110, made adjacent to the guardrail. The bituminous concrete pavement thickness was about 8 inches.

Fill: Below the topsoil, borings HB-T2R8-105, -106, -109 and -109A encountered fill soils extending to depths of about 5 to 5.5 feet bgs. A relic topsoil layer was encountered at HB-T2R8-106 from about 5.5 to 6 feet bgs. Below the pavement, boring HB-T2R8-110 encountered fill soils extending to a depth of about 25 feet bgs. The fill soils generally consisted of sand with varying amounts of gravel and silt

The fill was generally loose to very dense with SPT N_{60} values ranging from 8 to 100 blows per foot (bpf).

Glaciomarine Silt and Clay: Below the topsoil or fill, the borings HB-T2R8-103, HB-T2R8-105, HB-T2R8-106, HB-T2R8-109 and HB-T2R8-110 encountered glaciomarine silt and clay extending to depths of about 6 to 35 feet bgs. In general, the deposit consisted of brown to grey, silty clay.

The glaciomarine silt and clay was generally stiff to very stiff with SPT N_{60} values ranging from 13 to 30 bpf. Pocket penetrometer test results performed on disturbed soil samples ranged from about 3,000 to 9,000 psf, correlating to approximate shear strengths of about 1,500 to 4,500 psf..

Glacial Till: Below the topsoil, fill soils, or glaciomarine silt and clay, the borings encountered glacial till generally consisting of brown and grey, silt and sand with varying amounts of gravel and occasional cobbles and boulders.

The glacial till was generally medium dense to very dense with SPT N_{60} values ranging from 25 bpf to refusal (e.g. greater than 100 blows per 6 inch increment of drive). At borings where refusal surfaces or bedrock were not encountered, the borings were terminated in glacial till at depths of about 25 to 37 feet bgs.

Refusal: A refusal surface was encountered in borings HB-T2R8-103 and HB-T2R8-105 at depths of about 25 and 21.3 feet bgs, respectively. The nature of the refusal surface

encountered in HB-T2R8-103 and HB-T2R8-105 was not determined. Bedrock was encountered and sampled in boring HB-T2R8-104. The top of bedrock at HB-T2R8-104 was encountered at about 11.3 feet bgs and consisted of light grey, hard, slightly weathered, fine grained, quartzite of the Madrid Formation. Joints were generally steep to vertical, close to very close and tight with remobilized quartz calcite.

Rock quality designation (RQD) value for the bedrock was 14 percent correlating to a Rock Mass Quality (RMQ) of very poor.

3.3 Groundwater

The soils encountered at the test borings were damp to wet from the ground surface. Five borings were generally performed at or near the low point of drainage swales. As a result, perched water was encountered at or above the ground surface at borings HB-T2R8-101, HB-T2R8-102, HB-T2R8-104, HB-T2R8-107 and HB-T2R8-108. The measured water level in the remaining five borings was observed immediately after drilling, and ranging from about 2.5 to 14 feet bgs. Long term groundwater information is not available. It should be anticipated that groundwater levels will fluctuate seasonally, particularly in response to periods of snowmelt and precipitation, changes in site use and the water level of adjacent waterways or wet areas.

4.0 EVALUATION AND RECOMMENDATIONS

4.1 General Findings

The soils encountered in the explorations included a surficial layer topsoil or pavement underlain by fill, glaciomarine clay and glacial till. Based on the subsurface findings, the native site soils appear suitable for supporting the proposed light pole structures on drilled shaft foundations. Rock anchors or bedrock removal may be required at Structure 4 due to the thin overburden soils and low RQD bedrock encountered in HB-T2R8-104.

4.2 Frost Considerations

Based on the Maine Design Freezing Index Map[1], the design freezing index for the T2R8 Township, Maine area is approximately 1,900 freezing degree-days. Based on Section 5.2.1 of the MaineDOT BDG and subsurface findings, the maximum seasonal frost

[1] Maine Department of Transportation, Bridge Design Guide (BDG), August 2003, with Revisions through 2014, Figure 5-1.

penetration is estimated to be on the order of about 7.7 feet. Considering this, we recommend foundations have at least 7.7 feet of soil cover to provide frost protection.

4.3 Design Soil Parameters

Three soil units were generally encountered in the borings:

- Loose to very dense, sand with varying amounts of gravel and silt (Fill);
- Stiff to very stiff, silty clay (Glaciomarine Clay); and
- Medium dense to very dense, Glacial Till

Site specific soil parameters were evaluated in accordance with AASHTO LRFD Section 10.4.6.2.4 and MaineDOT BDG Table 3.3. Site-specific structural design of the foundations should be completed in accordance with based on MaineDOT Standard Details Section 626, using the following soil parameters:

Design Soil Parameters				
Strata	**Structures**	**Unit Weight (pcf)**	**Friction Angle, ϕ (degrees)**	**Shear Strength, s_u (psf)**
Fill	10	125	30	
Glaciomarine Clay	3, 5, 6, 9	120		1,200
Glacial Till	1, 2, 4, 7, 8	135	34	

The design of drilled shafts should be in accordance with AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals (2015, 6th Ed.), MaineDOT Standard Detail Items 626, provided site-specific soils parameters and structural loads. Structural design should consider both geotechnical lateral and axial resistance, although lateral resistance will likely control.

Based on the very poor RQD of the bedrock sampled, we anticipate doweling into bedrock will not be feasible and bedrock removal should be anticipated depending on the design drilled shaft length. Dowel reinforcing into competent rock, if needed, shall be completed in accordance with MaineDOT Standard Detail 626.36.

4.4 Construction Considerations

Drilled shafts shall be uncased (concrete cast against soil) below the frost zone. Temporary casing used during construction shall be removed following placement of concrete. The level of concrete shall be at least 5 feet above the bottom of casing at all

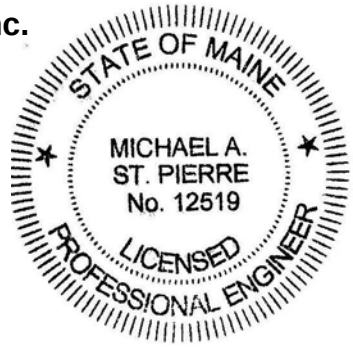
times during casing removal. Backfill used to repair disturbed areas around the drilled shafts should consist of MaineDOT Specification 703.19 “Granular Borrow for Embankment Construction” and grading adjacent to the shafts should direct surface water runoff away from the structure.

5.0 CLOSURE

We trust this information meets your present needs. Please contact us if you have any questions or need further assistance.

Sincerely,

S. W. Cole Engineering, Inc.



Michael A. St. Pierre, P.E.
Geotechnical Engineer

NDS-MAS:tjb

S.W.COLE ENGINEERING, INC.

APPENDIX A

Limitations

This report has been prepared for the exclusive use of the Maine Department of Transportation for specific application to the proposed Light Pole Structures along I-95 at Exit 227 (MaineDOT WIN 023014.00) in T2R8, Maine. S. W. Cole Engineering, Inc. (S.W.COLE) has endeavored to conduct our services in accordance with generally accepted soil and foundation engineering practices. No warranty, expressed or implied, is made.

The soil profiles described in the report are intended to convey general trends in subsurface conditions. The boundaries between strata are approximate and are based upon interpretation of exploration data and samples.

The analyses performed during this investigation and recommendations presented in this report are based in part upon the data obtained from subsurface explorations made at the site. Variations in subsurface conditions may occur between explorations and may not become evident until construction. If variations in subsurface conditions become evident after submission of this report, it will be necessary to evaluate their nature and to review the recommendations of this report.

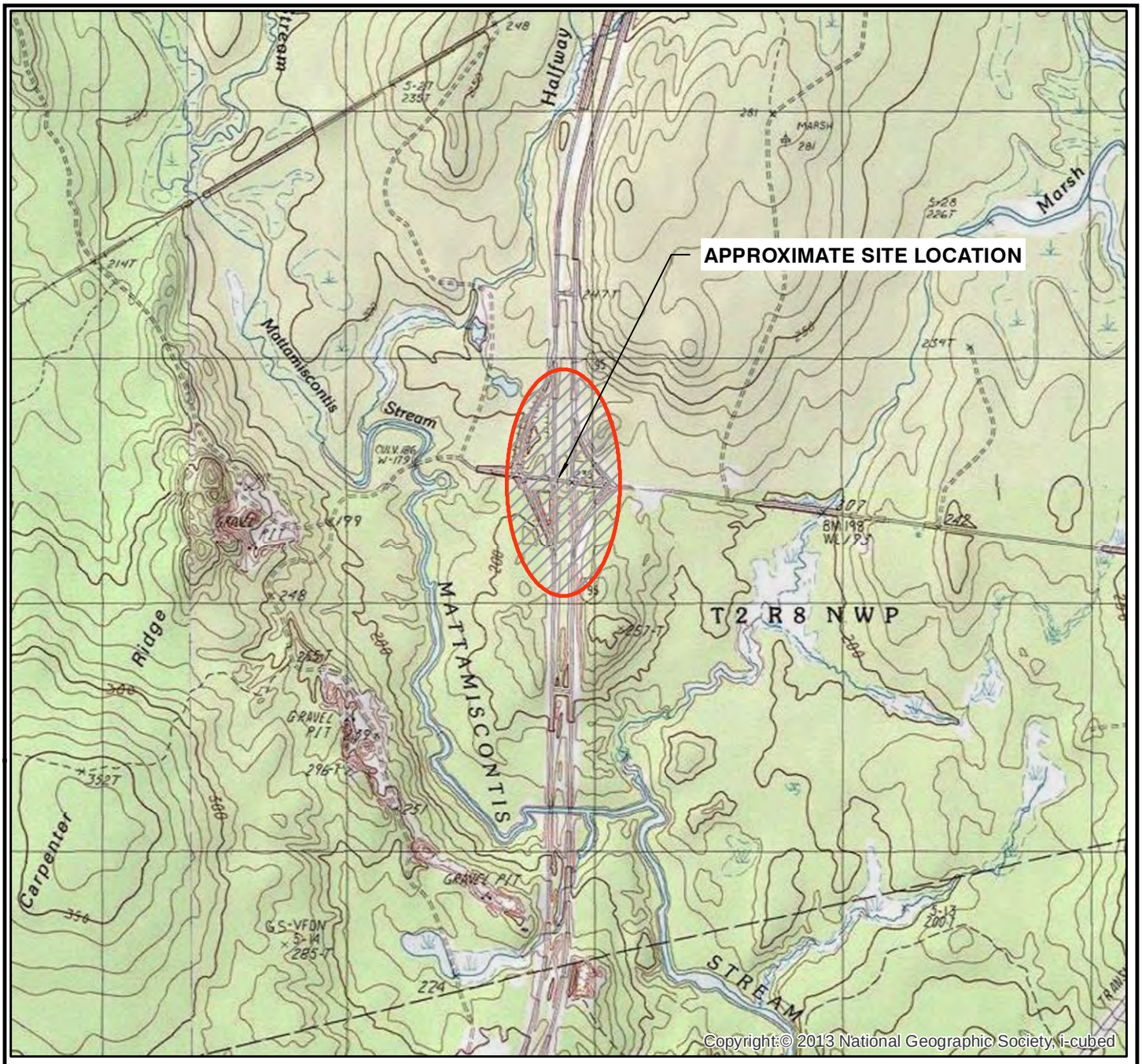
Observations have been made during exploration work to assess site groundwater levels. Fluctuations in water levels will occur due to variations in rainfall, temperature, and other factors.

Recommendations contained in this report are based substantially upon information provided by others regarding the proposed project. In the event that any changes are made in the design, nature, or location of the proposed project, S.W.COLE should review such changes as they relate to analyses associated with this report. Recommendations contained in this report shall not be considered valid unless the changes are reviewed by S.W.COLE.

S.W.COLE ENGINEERING, INC.

APPENDIX B

Figures



N
W E
S

2,000 0 2,000 4,000

Scale in Feet

NOTE:
SITE LOCATION MAP PREPARED FROM ESRI ArcGIS ONLINE AND DATA PARTNERS INCLUDING USGS AND © 2007 NATIONAL GEOGRAPHIC SOCIETY.

S.W.COLE ENGINEERING, INC.

MAINE DEPARTMENT OF TRANSPORTATION

SITE LOCATION MAP

WIN 023014.00
LIGHT POLE STRUCTURES
I-95, EXIT 227
T2R8, MAINE

Job No.	17-1516	Scale	1:24000
Date:	04/03/2018	Sheet	1

R:\2017\17-1516\GIS\MXDs\17-1516 SLM.mxd, 4/3/2018 12:37:44 PM, 1:24,000,

N

8
Sta 20+50
44' Rt
Ramp A
Luminaire A
90' High Mast
Pole

HB-T2R8-108

REMOVE POLE
AND FOUNDATION

REMOVE POLE
AND FOUNDATION

7
Sta 16+70
44' Rt
Ramp A
Luminaire A
90' High Mast
Pole

HB-T2R8-107

RAMP A

PT 11+98.54

To Bangor

I-95 SOUTHBOUND

SMALL GAP IN TREES.
NO CLEARING NECESSARY

I-95 NORTHBOUND

HB-T2R8-101

HB-T2R8-102

RAMP C

REMOVE POLE
AND FOUNDATION

REMOVE POLE
AND FOUNDATION

PC 6+67.62

1
Sta 2+15
48' Rt
Ramp C
Luminaire A
90' High Mast
Pole

2
Sta 5+80
48' Rt
Ramp C
Luminaire A
90' High Mast
Pole

LEGEND
CASED WASH BORING

LEGEND for LIGHTING

- Control Cabinet and Service
- Proposed Conduit
- Existing Conduit
- Pull Box (Precast Concrete Junction Box)
- Existing Junction Box
- High Mast Pole, Luminaires and Foundation. Height as Noted (Direction of Luminaire)
- Directional Bore
- Existing Light Fixture, Pole and Foundation (Approximate Location, To Be Removed)

SCALE

50 0 50 100

Scale of Feet

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

2301400

WIN
23014.00

HIGHWAY PLANS

	BY	DATE
PROJ. MANAGER	---	---
DESIGN-DETAILED	---	---
CHECKED-REVIEWED	-----	-----
DESIGN2-DETAILED2	M.ST.PIERRE	FEB 2018
DESIGN3-DETAILED3	-----	-----
REVISIONS 1	-----	-----
REVISIONS 2	-----	-----
REVISIONS 3	-----	-----
REVISIONS 4	-----	-----
FIELD CHANGES	-----	-----

SIGNATURE

P.E. NUMBER

DATE

T2R8
INTERSTATE EXIT 227

BORING LOCATION PLAN

SHEET NUMBER

1

OF 5

Sta 45+62,
32' Lt, 5' Behind GR
Access Rd
Luminaire A
90' High Mast
Pole

REMOVE POLE AND FOUNDATION.
REMOVE AND RESET GUARDRAIL AS DIRECTED FOR INSTALLATION OF NEW POLE AND REMOVAL OF EXISTING POLE.

RUN CONDUIT WITHIN
10' OF FACE OF GR.

N

SCALE

50 0 50 100

Scale of Feet

RAMP A

I-95 SOUTHBOUND

I-95 NORTHBOUND

ACCESS ROAD

RAMP C

RAMP D

REMOVE POLE
AND FOUNDATION

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

2301400

WIN
23014.00

HIGHWAY PLANS

SIGNATURE

P.E. NUMBER

DATE

	BY	DATE
PROJ. MANAGER	----------	--
DESIGN-DETAILED	----------	-----
CHECKED-REVIEWED	----------	-----
DESIGN2-DETAILED2	M.ST.PIERRE	FEB 2018
DESIGN3-DETAILED3	----------	-----
REVISIONS 1	----------	------
REVISIONS 2	----------	------
REVISIONS 3	----------	------
REVISIONS 4	----------	------
FIELD CHANGES	----------	------

T2R8
INTERSTATE EXIT 227

BORING LOCATION PLAN

SHEET NUMBER

2

OF 5

Filename: ...\00\geotech\vmsto\002_BLP2.dgn Division: GEOTECH Username: Terry.White Date:2/27/2018

RAMP B

N

PT 13+70.72

PC 13+52.56

I-95 SOUTHBOUND

REMOVE FOUNDATION

6
Sta 6+10
40' Rt
Ramp B
Luminaire A
90' High Mast Pole

PC 6+42.56

HB-T2R8-106

REMOVE POLE AND FOUNDATION

HB-T2R8-105

5
Sta 2+50
40' Rt
Ramp B
Luminaire A
90' High Mast Pole

CLEARING NEEDED UNLESS HORIZONTALLY BORED

I-95 NORTHBOUND

To Houlton

RAMP D

PT 10+96.48

HB-T2R8-103

3
Sta 14+90
45' Rt
Ramp D
Luminaire A
90' High Mast Pole

HB-T2R8-104

4
Sta 18+70
40' Rt
Ramp D
Luminaire A
90' High Mast Pole

REMOVE POLE AND FOUNDATION

REMOVE POLE AND FOUNDATION

SCALE

50 0 50 100

Scale of Feet

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

2301400

WIN
23014.00

HIGHWAY PLANS

SIGNATURE

P.E. NUMBER

DATE

	BY	DATE
PROJ. MANAGER	---	---
DESIGN-DETAILED	---	---
CHECKED-REVIEWED	---	---
DESIGN2-DETAILED2	M.ST.PIERRE	FEB 2018
DESIGN3-DETAILED3	---	---
REVISIONS 1	---	---
REVISIONS 2	---	---
REVISIONS 3	---	---
REVISIONS 4	---	---
FIELD CHANGES	---	---

T2R8
INTERSTATE EXIT 227

BORING LOCATION PLAN

SHEET NUMBER

3

OF 5

ACCESS ROAD

RAMP A

RAMP B

HB-T2R8-II0

10
Sta 45+62,
32' Lt, 5' Behind GR
Access Rd
Luminaire A
90' High Mast
Pole

REMOVE POLE AND FOUNDATION.
REMOVE AND RESET GUARDRAIL AS DIRECTED FOR INSTALLATION OF NEW POLE AND REMOVAL OF EXISTING POLE.

RUN CONDUIT WITHIN 10' OF FACE OF GR.

N

SCALE

50 0 50 100

Scale of Feet

I-95 SOUTHBOUND

I-95 NORTHBOUND

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

2301400

WIN
23014.00

HIGHWAY PLANS

	BY	DATE
PROJ. MANAGER	------	------
DESIGN-DETAILED	------	------
CHECKED-REVIEWED	-----	-----
DESIGN2-DETAILED2	M.ST.PIERRE	FEB 2018
DESIGN3-DETAILED3	------	------
REVISIONS 1	------	------
REVISIONS 2	------	------
REVISIONS 3	------	------
REVISIONS 4	------	------
FIELD CHANGES	------	------

SIGNATURE

P.E. NUMBER

DATE

T2R8
INTERSTATE EXIT 227

BORING LOCATION PLAN

SHEET NUMBER

4

OF 5

I-95 NORTHBOUND

ACCESS ROAD

RAMP C

RAMP D

REMOVE POLE
AND FOUNDATION

REMOVE POLE
AND FOUNDATION

REMOVE EXISTING CONTROL
CABINET AND POLE

INSTALL CONTROL CABINET
AND SERVICE, STA 60+50
50' RT.

POWER SOURCE

HB-T2R8-109

HB-T2R8-109A

9
Sta 58+12
52' Lt,
Access Rd
Luminaire A
90' High Mast
Pole

To Lincoln

N

SCALE

50 0 50 100

Scale of Feet

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

2301400

WIN
23014.00

HIGHWAY PLANS

	BY	DATE
PROJ. MANAGER	------	---
DESIGN-DETAILED	------	-----
CHECKED-REVIEWED	-----	-----
DESIGN2-DETAILED2	M.ST.PIERRE	FEB 2018
DESIGN3-DETAILED3	------	-----
REVISIONS 1	------	-----
REVISIONS 2	------	-----
REVISIONS 3	------	-----
REVISIONS 4	------	-----
FIELD CHANGES	------	-----

SIGNATURE

P.E. NUMBER

DATE

T2R8
INTERSTATE EXIT 227

BORING LOCATION PLAN

SHEET NUMBER

5

OF 5

S.W.COLE ENGINEERING, INC.

APPENDIX C

Boring Logs & Key to Soil and Rock Descriptions and Terms

UNIFIED SOIL CLASSIFICATION SYSTEM

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

Desired Soil Observations (in this order, if applicable):

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

MODIFIED BURMISTER SYSTEM

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

TERMS DESCRIBING DENSITY/CONSISTENCY

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

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

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

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

Rock Quality Designation (RQD):

RQD (%) = sum of the lengths of intact pieces of core* > 4 inches / length of core advance

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

Correlation of RQD to Rock Mass Quality

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

Desired Rock Observations (in this order, if applicable):

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

Formation (Waterville, Ellsworth, Cape Elizabeth, etc.)
RQD and correlation to rock mass quality (very poor, poor, etc.)
ref: ASTM D6032 and AASHTO Standard Specification for Highway Bridges, 17th Ed. Table 4.4.8.1.2A
Recovery (inch/inch and percentage)
Rock Core Rate (X.X ft - Y.Y ft (min:sec))

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

Sample Container Labeling Requirements:

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

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Interstate 95, Exit 227 Light Pole Structures
Location: T2R8 NWP, Maine

Boring No.: HB-T2R8-101
WIN: 023014.00

Driller:	S. W. Cole Explorations, LLC	**Elevation (ft.)**	not surveyed	**Auger ID/OD:**	5 inch Solid Stem Auger
Operator:	K. Hanscom	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	N. Strout	**Rig Type:**	Diedrich D50	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	01/24/2018 - 01/24/2018	**Drilling Method:**	Cased Wash	**Core Barrel:**	N/A
Boring Location:	Sta. 2+13.5, 36.8 ft Rt. Ramp C	**Casing ID/OD:**	HW 4/4.5 inch	**Water Level*:**	Perched water at surface.
Hammer Efficiency Factor: 0.79		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Depth (ft.)	Sample Information: Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/6	0.00 - 2.00	1/1/3/10	4	5	SSA			Dark brown, moist, Silty SAND, some organics, (Topsoil).	
										1.8	
	2D	24/19	2.00 - 4.00	25/51/42/37	93	122				Grey, moist, very dense, Sandy SILT, little gravel, (Glacial Till).	
5	3D	24/22	5.00 - 7.00	20/25/51/52	76	100				Similar to above.	
							102				
							133				
10	4D	24/16	10.00 - 12.00	17/17/19/18	36	47	112			Similar to above, except dense.	
							147				
							225			Cobble from 12.5 to 13.5 ft bgs.	
							OPEN			Advance by roller-cone from 12.5 to 14 ft bgs.	
							225				
15	5D	11/7	15.00 - 15.92	58/100-5"	- -		257			Grey, moist, very dense, Silty SAND, some gravel, occasional cobbles, (Glacial Till).	
							OPEN				
20	6D	12/12	20.00 - 21.00	51/110	- -					Similar to above.	
25											

Remarks:

-Autohammer SN367
-bgs = below existing ground surface.

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

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

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Interstate 95, Exit 227 Light Pole Structures
Location: T2R8 NWP, Maine

Boring No.: HB-T2R8-101
WIN: 023014.00

Driller:	S. W. Cole Explorations, LLC	**Elevation (ft.)**	not surveyed	**Auger ID/OD:**	5 inch Solid Stem Auger
Operator:	K. Hanscom	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	N. Strout	**Rig Type:**	Diedrich D50	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	01/24/2018 - 01/24/2018	**Drilling Method:**	Cased Wash	**Core Barrel:**	N/A
Boring Location:	Sta. 2+13.5, 36.8 ft Rt. Ramp C	**Casing ID/OD:**	HW 4/4.5 inch	**Water Level*:**	Perched water at surface.
Hammer Efficiency Factor:	0.79	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Depth (ft.)	Sample Information: Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25	7D	11/11	25.00 - 25.92	50/100-5"	- -					Similar to above.	
										25.9	
										Bottom of Exploration at 25.9 feet below ground surface. No Refusal.	
30											
35											
40											
45											
50											

Remarks:

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Interstate 95, Exit 227 Light Pole Structures
Location: T2R8 NWP, Maine

Boring No.: HB-T2R8-102
WIN: 023014.00

Driller:	S. W. Cole Explorations, LLC	**Elevation (ft.)**	not surveyed	**Auger ID/OD:**	5 inch Solid Stem Auger
Operator:	K. Hanscom	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	N. Strout	**Rig Type:**	Diedrich D50	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	01/24/2018 - 01/25/2018	**Drilling Method:**	Cased Wash	**Core Barrel:**	N/A
Boring Location:	Sta. 5+79, 40.3 ft Rt. Ramp C	**Casing ID/OD:**	HW 4/4.5 inch	**Water Level*:**	Perched water at surface.
Hammer Efficiency Factor: 0.79		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/11	0.00 - 2.00	1/2/5/12	7	9	SSA			Brown, wet, loose, Silty SAND, some organics, (Topsoil).	
										1.0	
	2D	24/22	2.00 - 4.00	13/14/18/21	32	42				Brown, moist, dense, Sandy SILT, trace gravel, (Glacial Till).	
5	3D	24/17	5.00 - 7.00	16/28/37/38	65	86				Similar to above, except very dense.	G#303126 A-4, SM WC=8.7%
10	4D	24/14	10.00 - 12.00	18/26/32/41	58	76	89			Similar to above, except wet.	
							126				
							235				
							283				
							167				
15	5D	10/5	15.00 - 15.83	42/100-4"	- -		OPEN			Brown, wet, very dense, Silty SAND, some gravel, occasional cobbles, (Glacial Till).	
20	6D	11/10	20.00 - 20.92	53/100-5"	- -					Similar to above. Boulder from 21 to 23.5 ft bgs.	
25											

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Interstate 95, Exit 227 Light Pole Structures
Location: T2R8 NWP, Maine

Boring No.: HB-T2R8-102
WIN: 023014.00

Driller:	S. W. Cole Explorations, LLC	**Elevation (ft.)**	not surveyed	**Auger ID/OD:**	5 inch Solid Stem Auger
Operator:	K. Hanscom	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	N. Strout	**Rig Type:**	Diedrich D50	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	01/24/2018 - 01/25/2018	**Drilling Method:**	Cased Wash	**Core Barrel:**	N/A
Boring Location:	Sta. 5+79, 40.3 ft Rt. Ramp C	**Casing ID/OD:**	HW 4/4.5 inch	**Water Level*:**	Perched water at surface.
Hammer Efficiency Factor:	0.79	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Depth (ft.)	Sample Information: Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25	7D	2/2	25.00 - 25.17	75-2"	- -					Similar to above, except grey. 25.2	
										Bottom of Exploration at 25.2 feet below ground surface. No Refusal.	
30											
35											
40											
45											
50											

Remarks:

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Interstate 95, Exit 227 Light Pole Structures
Location: T2R8 NWP, Maine

Boring No.: HB-T2R8-103
WIN: 023014.00

Driller:	S. W. Cole Explorations, LLC	**Elevation (ft.)**	not surveyed	**Auger ID/OD:**	5 inch Solid Stem Auger
Operator:	K. Hanscom	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	N. Strout	**Rig Type:**	Diedrich D50	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	01/30/2018 - 01/30/2018	**Drilling Method:**	Cased Wash	**Core Barrel:**	N/A
Boring Location:	Sta. 14+90.1, 48.0 ft Rt. Ramp D	**Casing ID/OD:**	HW 4/4.5 inch	**Water Level*:**	2.5 feet (after drilling)
Hammer Efficiency Factor: 0.79		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Depth (ft.)	Sample Information: Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/22	0.00 - 2.00	1/2/4/4	6	8	SSA			1D(A) Brown, wet, loose, Silty SAND, with organics, (Topsoil).	
										0.5	
										1D(B) Brown, moist, medium stiff, Silty CLAY.	
	2D	24/24	2.00 - 4.00	6/7/8/9	15	20				Similar to above, except very stiff. PP=8-9 ksf	
5	3D	24/19	5.00 - 7.00	5/7/12/15	19	25				3D(A) Similar to above, except stiff. PP=3-4 ksf	
										6.0	
										3D(B) Brown, moist, medium dense, Silty SAND, some gravel, (Glacial Till).	
10	4D	24/12	10.00 - 12.00	10/9/10/12	19	25	34			Similar to above, except wet.	
							47				
							54				
							66				
							71				
15	5D	24/8	15.00 - 17.00	22/23/19/17	42	55	58			Similar to above, except very dense.	
							75				
							79				
							89				
							122				
20	6D	24/18	20.00 - 22.00	12/9/13/51	22	29	OPEN			6D(A) Brown, wet, medium dense, Silty SAND, some gravel, (Glacial Till).	
										6D(B) Similar to above with weathered bedrock fragments.	
25											

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Interstate 95, Exit 227 Light Pole Structures
Location: T2R8 NWP, Maine

Boring No.: HB-T2R8-103
WIN: 023014.00

Driller:	S. W. Cole Explorations, LLC	**Elevation (ft.)**	not surveyed	**Auger ID/OD:**	5 inch Solid Stem Auger
Operator:	K. Hanscom	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	N. Strout	**Rig Type:**	Diedrich D50	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	01/30/2018 - 01/30/2018	**Drilling Method:**	Cased Wash	**Core Barrel:**	N/A
Boring Location:	Sta. 14+90.1, 48.0 ft Rt. Ramp D	**Casing ID/OD:**	HW 4/4.5 inch	**Water Level*:**	2.5 feet (after drilling)
Hammer Efficiency Factor:	0.79	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample Attempt
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WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample Information: Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25	MD	0/0	25.00 - 25.00	50-0"	- -					No penetration. 25.0	
										Bottom of Exploration at 25.0 feet below ground surface. Refusal.	
30											
35											
40											
45											
50											

Remarks:

-Autohammer SN367
-bgs = below existing ground surface.

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

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Interstate 95, Exit 227 Light Pole Structures
Location: T2R8 NWP, Maine

Boring No.: HB-T2R8-104
WIN: 023014.00

Driller:	S. W. Cole Explorations, LLC	**Elevation (ft.)**	not surveyed	**Auger ID/OD:**	5 inch Solid Stem Auger
Operator:	K. Hanscom	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	N. Strout	**Rig Type:**	Diedrich D50	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	01/30/2018 - 01/31/2018	**Drilling Method:**	Cased Wash	**Core Barrel:**	NQ2 2 inch
Boring Location:	Sta. 10+70.2, 40.0 ft Rt. Ramp D	**Casing ID/OD:**	HW 4/4.5 inch	**Water Level*:**	Perched water at surface.
Hammer Efficiency Factor: 0.79		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Sample Information

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/15	0.00 - 2.00	1/11/16/12	27	36	SSA			1D(A) Dark brown, wet, medium dense, Silty SAND, some organics, (Topsoil).	
										0.5	
										1D(B) Brown, wet, Sandy SILT, trace gravel, (Glacial Till).	
	2D	24/16	2.00 - 4.00	8/10/10/11	20	26				Brown, wet, Sandy SILT, little gravel, (Glacial Till).	
5	3D	24/18	5.00 - 7.00	8/11/12/12	23	30				Brown, wet, Sandy SILT, some gravel, (Glacial Till).	
10	4D	17/12	10.00 - 11.42	15/15/100-5"	- -		OPEN			Similar to above.	
	R1	60/60	11.80 - 16.80	RQD = 14%			NQ2			11.3	
										Top of Bedrock Advanced by rollercone to 11.8 ft bgs. R1: Bedrock: Light grey, fine-grained, QUARZITE, hard, slight weathering with remobilized quartz calcite on joints, joints are steep to vertical, close to very close and tight, (Madrid Formation). Rock Mass Quality = Very Poor R1: Core Times (min:sec) 11.8-12.8 feet (6:10) 12.8-13.8 feet (5:06) 13.8-14.8 feet (4:49) 14.8-15.8 feet (4:51) 15.8-16.8 feet (5:06) 100% Recovery	
15										16.8	
										Bottom of Exploration at 16.8 feet below ground surface.	
20											
25											

Remarks:

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-bgs = below existing ground surface.

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

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Interstate 95, Exit 227 Light Pole Structures
Location: T2R8 NWP, Maine

Boring No.: HB-T2R8-105
WIN: 023014.00

Driller:	S. W. Cole Explorations, LLC	**Elevation (ft.)**	not surveyed	**Auger ID/OD:**	5 inch Solid Stem Auger
Operator:	K. Hanscom	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	N. Strout	**Rig Type:**	Diedrich D50	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	02/01/2018 - 02/05/2018	**Drilling Method:**	Cased Wash	**Core Barrel:**	N/A
Boring Location:	Sta. 2+48.9, 52.0 ft Rt. Ramp B	**Casing ID/OD:**	HW 4/4.5 inch	**Water Level*:**	9 ft bgs (on 02/05/18)
Hammer Efficiency Factor: 0.79		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Sample Information

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/18	0.00 - 2.00	2/4/3/4	7	9	SSA			1D(A) Brown, moist, Silty SAND, with organics, (Topsoil).	
										0.5	
										1D(B) Brown, moist, loose, Silty SAND, trace gravel, (Fill).	
	2D	24/9	2.00 - 4.00	10/6/3/5	9	12				Similar to above, except medium dense.	
5										5.0	
	3D	24/20	5.00 - 7.00	6/8/14/16	22	29				Brown, moist, very stiff, Silty CLAY.	
										9.5	
10	4D	24/18	10.00 - 12.00	8/12/28/23	40	53	273			Brown, wet, very dense, Silty SAND, little gravel, occasional cobbles, (Glacial Till).	
							322				
							151				
							119				
							110				
15	5D	24/17	15.00 - 17.00	13/13/13/12	26	34	18			Similar to above, except dense.	
							74				
							74				
							359			Advance by rollercone through cobble.	
							OPEN				
20	6D	4/4	20.00 - 20.33	100-4"	- -					Similar to above, with weathered bedrock fragments.	
										21.3	
										Bottom of Exploration at 21.3 feet below ground surface. Refusal.	
25											

Remarks:

-Autohammer SN367
-bgs = below existing ground surface.
-Sampled to 10 ft bgs and drove casing to 15 ft bgs on 02/01/2018.
-Water level ±9 feet bgs on 02/05/2018 with casing down to 15 feet bgs.

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Interstate 95, Exit 227 Light Pole Structures
Location: T2R8 NWP, Maine

Boring No.: HB-T2R8-106
WIN: 023014.00

Driller:	S. W. Cole Explorations, LLC	**Elevation (ft.)**	not surveyed	**Auger ID/OD:**	5 inch Solid Stem Auger
Operator:	K. Hanscom	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	N. Strout	**Rig Type:**	Diedrich D50	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	02/05/2018 - 02/05/2018	**Drilling Method:**	Cased Wash	**Core Barrel:**	NQ2 2 inch
Boring Location:	Sta. 6+05.2, 56.1 ft Rt. Ramp B	**Casing ID/OD:**	HW 4/4.5 inch	**Water Level*:**	Not Observed
Hammer Efficiency Factor: 0.79		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
				Sample Information							
0	1D	24/11	0.00 - 2.00	1/6/26/6	32	42	SSA			1D(A) Brown, moist, Silty SAND, with organics, (Topsoil).	
										0.5	
										1D(B) Brown, moist, SAND, little silt, little gravel, (Fill).	
	2D	24/12	2.00 - 4.00	4/6/7/9	13	17				Brown, moist, SAND, some silt, little gravel, (Fill).	
5	3D	24/18	5.00 - 7.00	1/2/7/9	9	12				5.5	
										3D(A) Dark brown, moist, Sandy SILT, with organics, (Relic Topsoil Layer).	
										6.0	
										3D(B) Brown, moist, stiff, Silty CLAY. PP=9+ ksf	
10	4D	24/20	10.00 - 12.00	14/16/16/16	32	42	138			10.0	
							155			Brown, moist, dense, Sandy SILT, little gravel, (Glacial Till).	
							204				
							192				
							181				
15	5D	24/21	15.00 - 17.00	15/14/12/10	26	34	84			Similar to above, except wet.	
							86				
							190				
							230				
							OPEN				
20	R1	60/18	20.00 - 25.00				NQ2			Advanced by rock core.	
										Boulder from 18.9 to 21.6 feet bgs.	
25											

Remarks:

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Interstate 95, Exit 227 Light Pole Structures
Location: T2R8 NWP, Maine

Boring No.: HB-T2R8-106
WIN: 023014.00

Driller:	S. W. Cole Explorations, LLC	**Elevation (ft.)**	not surveyed	**Auger ID/OD:**	5 inch Solid Stem Auger
Operator:	K. Hanscom	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	N. Strout	**Rig Type:**	Diedrich D50	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	02/05/2018 - 02/05/2018	**Drilling Method:**	Cased Wash	**Core Barrel:**	NQ2 2 inch
Boring Location:	Sta. 6+05.2, 56.1 ft Rt. Ramp B	**Casing ID/OD:**	HW 4/4.5 inch	**Water Level*:**	Not Observed
Hammer Efficiency Factor:	0.79	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Depth (ft.)	Sample Information: Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25							OPEN			25.6	
										Bottom of Exploration at 25.6 feet below ground surface. No Refusal.	
30											
35											
40											
45											
50											

Remarks:

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Interstate 95, Exit 227 Light Pole Structures
Location: T2R8 NWP, Maine

Boring No.: HB-T2R8-107
WIN: 023014.00

Driller:	S. W. Cole Explorations, LLC	**Elevation (ft.)**	not surveyed	**Auger ID/OD:**	5 inch Solid Stem Auger
Operator:	K. Hanscom	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	N. Strout	**Rig Type:**	Diedrich D50	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	01/31/2018 - 01/31/2018	**Drilling Method:**	Cased Wash	**Core Barrel:**	N/A
Boring Location:	Sta. 16+71, 46.5 ft Rt. Ramp A	**Casing ID/OD:**	HW 4/4.5 inch	**Water Level*:**	Perched water at surface.
Hammer Efficiency Factor: 0.79		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/15	0.00 - 2.00	1/11/15/12	26	34	SSA			1D(A) Brown, wet, SAND, some silt, with organics, (Topsoil). 0.5	
										1D(B) Brown, wet, medium dense, SAND, little silt, little gravel, (Glacial Till).	
	2D	24/18	2.00 - 4.00	12/10/11/10	21	28				Similar to above.	
5	3D	24/16	5.00 - 7.00	8/9/12/14	21	28				Brown, wet, medium dense, Sandy SILT, trace gravel, (Glacial Till).	G#303127 A-4, SM WC=10.8%
10	4D	20/5	10.00 - 11.67	13/12/48/100-2"	60	79	62			Similar to above, except very dense.	
							250				
							OPEN			Advanced by rollercone through cobble from 11.8 to 12.4 feet bgs.	
15	5D	24/6	15.00 - 17.00	14/13/12/12	25	33	65			Similar to above, except grey and dense.	
							97				
							132				
							169				
							230				
20	6D	24/18	20.00 - 22.00	15/24/23/28	47	62	OPEN			Grey, wet, very dense, SAND, some silt, some gravel, occasional cobbles, (Glacial Till).	
25											

Remarks:

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Interstate 95, Exit 227 Light Pole Structures
Location: T2R8 NWP, Maine

Boring No.: HB-T2R8-107
WIN: 023014.00

Driller:	S. W. Cole Explorations, LLC	**Elevation (ft.)**	not surveyed	**Auger ID/OD:**	5 inch Solid Stem Auger
Operator:	K. Hanscom	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	N. Strout	**Rig Type:**	Diedrich D50	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	01/31/2018 - 01/31/2018	**Drilling Method:**	Cased Wash	**Core Barrel:**	N/A
Boring Location:	Sta. 16+71, 46.5 ft Rt. Ramp A	**Casing ID/OD:**	HW 4/4.5 inch	**Water Level*:**	Perched water at surface.
Hammer Efficiency Factor:	0.79	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Depth (ft.)	Sample Information: Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25	7D	24/13	25.00 - 27.00	17/23/37/39	60	79				Similar to above.	
										27.0	
										Bottom of Exploration at 27.0 feet below ground surface. No Refusal.	
30											
35											
40											
45											
50											

Remarks:

-Autohammer SN367
-bgs = below existing ground surface.

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Interstate 95, Exit 227 Light Pole Structures
Location: T2R8 NWP, Maine

Boring No.: HB-T2R8-108
WIN: 023014.00

Driller:	S. W. Cole Explorations, LLC	**Elevation (ft.)**	not surveyed	**Auger ID/OD:**	5 inch Solid Stem Auger
Operator:	K. Hanscom	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	N. Strout	**Rig Type:**	Diedrich D50	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	01/31/2018 - 02/01/2018	**Drilling Method:**	Cased Wash	**Core Barrel:**	N/A
Boring Location:	Sta. 20+51, 52.3 ft Rt. Ramp A	**Casing ID/OD:**	HW 4/4.5 inch	**Water Level*:**	Perched water at surface.
Hammer Efficiency Factor: 0.79		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/8	0.00 - 2.00	WOH/WOH/4/10	- -		SSA			1D(A) Brown, wet, Sandy SILT, with organics, (Topsoil).	
										1.0	
										1D(B) Brown, wet, medium dense, SAND, some gravel, little silt, (Glacial Till).	
	2D	24/14	2.00 - 4.00	9/13/9/10	22	29				Similar to above.	
5	3D	24/11	5.00 - 7.00	11/9/10/10	19	25				Similar to above.	
10	4D	24/15	10.00 - 12.00	11/19/26/23	45	59	70			Brown, wet, very dense, Silty SAND, little gravel, (Glacial Till).	
							127				
							173				
							167				
							183				
15	5D	24/16	15.00 - 17.00	9/11/10/13	21	28	53			Grey, wet, medium dense, SILT, some sand, little gravel, (Glacial Till).	
							75				
							103				
							388				
							OPEN				
20	MD	24/0	20.00 - 22.00	13/14/16/15	30	40	110			No recovery.	
							107				
							145				
							237				
25							296				

Remarks:

-Autohammer SN367
-bgs = below existing ground surface.

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

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

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Interstate 95, Exit 227 Light Pole Structures
Location: T2R8 NWP, Maine

Boring No.: HB-T2R8-108
WIN: 023014.00

Driller:	S. W. Cole Explorations, LLC	**Elevation (ft.)**	not surveyed	**Auger ID/OD:**	5 inch Solid Stem Auger
Operator:	K. Hanscom	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	N. Strout	**Rig Type:**	Diedrich D50	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	01/31/2018 - 02/01/2018	**Drilling Method:**	Cased Wash	**Core Barrel:**	N/A
Boring Location:	Sta. 20+51, 52.3 ft Rt. Ramp A	**Casing ID/OD:**	HW 4/4.5 inch	**Water Level*:**	Perched water at surface.
Hammer Efficiency Factor:	0.79	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Depth (ft.)	Sample Information: Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25	6D	24/1	25.00 - 27.00	12/13/21/19	34	45	OPEN			Grey, wet, dense, SAND, some gravel, some silt, occasional cobbles, (Glacial Till).	
30	7D	24/18	30.00 - 32.00	27/49/39/49	88	116				Similar to above, except very dense.	
										32.0	
										Bottom of Exploration at 32.0 feet below ground surface. No Refusal.	
35											
40											
45											
50											

Remarks:

-Autohammer SN367
-bgs = below existing ground surface.

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

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

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Interstate 95, Exit 227 Light Pole Structures
Location: T2R8 NWP, Maine

Boring No.: HB-T2R8-109
WIN: 023014.00

Driller:	S. W. Cole Explorations, LLC	**Elevation (ft.)**	not surveyed	**Auger ID/OD:**	5 inch Solid Stem Auger
Operator:	K. Hanscom	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	N. Strout	**Rig Type:**	Diedrich D50	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	01/26/2018 - 01/26/2018	**Drilling Method:**	Cased Wash	**Core Barrel:**	N/A
Boring Location:	Sta. 58+03.8, 57.0 ft Lt. Access Road	**Casing ID/OD:**	HW 4/4.5 inch	**Water Level*:**	8 feet bgs (after drilling)
Hammer Efficiency Factor: 0.79		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/13	0.00 - 2.00	1/4/4/4	8	11	SSA			1D(A) Brown, moist, Sandy SILT, with organics, (Topsoil).	
										0.5	
										1D(B) Brown, moist, medium dense, SAND, some silt, little gravel, trace organics, (Fill).	
	2D	24/4	2.00 - 4.00	5/4/2/2	6	8				Brown, wet, loose, SAND, little silt, little gravel, (Fill).	
5										5.0	
	3D	24/14	5.00 - 7.00	3/4/6/9	10	13				Brown, moist, stiff, Silty CLAY. PP=9+ ksf	
10	4D	24/20	10.00 - 12.00	3/4/6/6	10	13	98			Olive, moist, stiff, Silty CLAY. PP=4-5 ksf	
							102				
							111				
							115				
							120				
15	5D	24/13	15.00 - 17.00	20/28/44/28	72	95	78			15.0 Brown, wet, very dense, Silty SAND, little gravel, (Glacial Till).	
							159				
							363			Casing broke driving to 18 ft bgs. Abandon boring.	
										18.0 **Bottom of Exploration at 18.0 feet below ground surface.** No Refusal.	
20											
25											

Remarks:

-Autohammer SN367
-bgs = below existing ground surface.

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

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

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Interstate 95, Exit 227 Light Pole Structures
Location: T2R8 NWP, Maine

Boring No.: HB-T2R8-109A
WIN: 023014.00

Driller:	S. W. Cole Explorations, LLC	**Elevation (ft.)**	not surveyed	**Auger ID/OD:**	5 inch Solid Stem Auger
Operator:	K. Hanscom	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	N. Strout	**Rig Type:**	Diedrich D50	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	01/26/2018 - 01/26/2018	**Drilling Method:**	Cased Wash	**Core Barrel:**	N/A
Boring Location:	Sta. 58+08.2, 55.1 ft Lt. Access Road	**Casing ID/OD:**	HW 4/4.5 inch	**Water Level*:**	8 feet bgs (after drilling)
Hammer Efficiency Factor: 0.79		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Sample Information

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0							SSA			Augered to 10 feet bgs and set HW casing. Soil samples not retrieved. Soils similar to boring HB-T2R8-109 from 0 to 18 feet bgs.	
										0.5	
										Probable Fill.	
5										5.0	
										Probably Silty Clay.	
10							OPEN				
										13.3	
										Probable Glacial Till.	
15											
										Cobble.	
20	1D	24/17	20.00 - 22.00	17/20/21/30	41	54				Brown, wet, very dense, Silty SAND, little gravel, occasional cobbles, (Glacial Till).	
25											

Remarks:

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-bgs = below existing ground surface.

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

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

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Interstate 95, Exit 227 Light Pole Structures
Location: T2R8 NWP, Maine

Boring No.: HB-T2R8-109A

WIN: 023014.00

Driller:	S. W. Cole Explorations, LLC	**Elevation (ft.)**	not surveyed	**Auger ID/OD:**	5 inch Solid Stem Auger
Operator:	K. Hanscom	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	N. Strout	**Rig Type:**	Diedrich D50	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	01/26/2018 - 01/26/2018	**Drilling Method:**	Cased Wash	**Core Barrel:**	N/A
Boring Location:	Sta. 58+08.2, 55.1 ft Lt. Access Road	**Casing ID/OD:**	HW 4/4.5 inch	**Water Level*:**	8 feet bgs (after drilling)
Hammer Efficiency Factor:	0.79	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

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

Remarks:

-Autohammer SN367
-bgs = below existing ground surface.

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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.

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Interstate 95, Exit 227 Light Pole Structures
Location: T2R8 NWP, Maine

Boring No.: HB-T2R8-110
WIN: 023014.00

Driller:	S. W. Cole Explorations, LLC	**Elevation (ft.)**	not surveyed	**Auger ID/OD:**	5 inch Solid Stem Auger
Operator:	K. Hanscom	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	N. Strout	**Rig Type:**	Diedrich D50	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	01/25/2018 - 01/25/2018	**Drilling Method:**	Cased Wash	**Core Barrel:**	N/A
Boring Location:	Sta. 45+65.6, 11.2 ft Lt. Access Road	**Casing ID/OD:**	HW 4/4.5 inch	**Water Level*:**	14 feet bgs (after drilling)
Hammer Efficiency Factor: 0.79		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Depth (ft.)	Sample Information: Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	4/4	0.70 - 1.03	100-4"	- -		SSA			8 inches Pavement	
										0.7	
										Brown, frozen, SAND, some gravel, trace silt, (Fill).	
	2D	24/24	2.00 - 4.00	61/51/38/25	89	117				Similar to above.	
5	3D	24/14	5.00 - 7.00	24/54/42/35	96	126				Brown, moist, very dense, SAND, some gravel, some silt, (Fill).	
10	4D	24/20	10.00 - 12.00	31/22/15/15	37	49	172			Brown, moist, dense, Silty SAND, little gravel, (Fill).	G#303128 A-4, ML WC=6.7%
							138				
							367				
							196				
							203				
15	5D	24/18	15.00 - 17.00	30/38/38/52	76	100	136			Brown, wet, very dense, SAND, some silt, little gravel, (Fill).	
							248				
							233				
							154				
							167				
20	6D	24/9	20.00 - 22.00	7/3/3/3	6	8	77			Grey, wet, loose, SAND, little silt, trace gravel, (Probable Fill).	
							71				
							88				
							97				
25							93				

Remarks:

-Autohammer SN367
-bgs = below existing ground surface. -Soils frozen to ±3.5 feet bgs.

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

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

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Interstate 95, Exit 227 Light Pole Structures
Location: T2R8 NWP, Maine

Boring No.: HB-T2R8-110
WIN: 023014.00

Driller:	S. W. Cole Explorations, LLC	**Elevation (ft.)**	not surveyed	**Auger ID/OD:**	5 inch Solid Stem Auger
Operator:	K. Hanscom	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	N. Strout	**Rig Type:**	Diedrich D50	**Hammer Wt./Fall:**	140 lbs/30 inches
Date Start/Finish:	01/25/2018 - 01/25/2018	**Drilling Method:**	Cased Wash	**Core Barrel:**	N/A
Boring Location:	Sta. 45+65.6, 11.2 ft Lt. Access Road	**Casing ID/OD:**	HW 4/4.5 inch	**Water Level*:**	14 feet bgs (after drilling)
Hammer Efficiency Factor: 0.79		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25	7D	24/18	25.00 - 27.00	6/9/14/16	23	30	119			25.0 — Brown mottled grey, wet, very stiff, Silty CLAY.	
							218			PP = 9 ksf	
							331				
							271				
							202				
30	8D	24/22	30.00 - 32.00	5/5/7/7	12	16	163			Grey, wet, stiff, Silty CLAY. PP=4.5-5 ksf	
							171				
							156				
							152				
							161				
35	9D	24/10	35.00 - 37.00	12/23/19/23	42	55				35.0 — Grey, wet, Silty SAND, little gravel, (Glacial Till).	
										37.0 — **Bottom of Exploration at 37.0 feet below ground surface.** No Refusal.	
40											
45											
50											

Remarks:

-Autohammer SN367
-bgs = below existing ground surface. -Soils frozen to ±3.5 feet bgs.

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

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

S.W.COLE ENGINEERING, INC.

APPENDIX D

Laboratory Test Results

State of Maine - Department of Transportation

Laboratory Testing Summary Sheet

Town(s): T2R8 NWP Work Number: 23014.00

Boring & Sample Identification Number	Station (Feet)	Offset (Feet)	Depth (Feet)	Reference Number	G.S.D.C. Sheet	W.C. %	L.L.	P.I.	Classification		
									Unified	AASHTO	Frost
HB-T2R8-102, 3D	5+79 RC	40.3 Rt.	5.0-7.0	303126	1	8.7			SM	A-4	III
HB-T2R8-107, 3D	16+71 RA	46.5 Rt.	5.0-7.0	303127	1	10.8			SM	A-4	III
HB-T2R8-110, 4D	45+65.6 AR	11.2 Lt.	10.0-12.0	303128	1	6.7			ML	A-4	IV
RA= RAMP A, RC =RAMP C, AR=ACCESS ROAD											

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

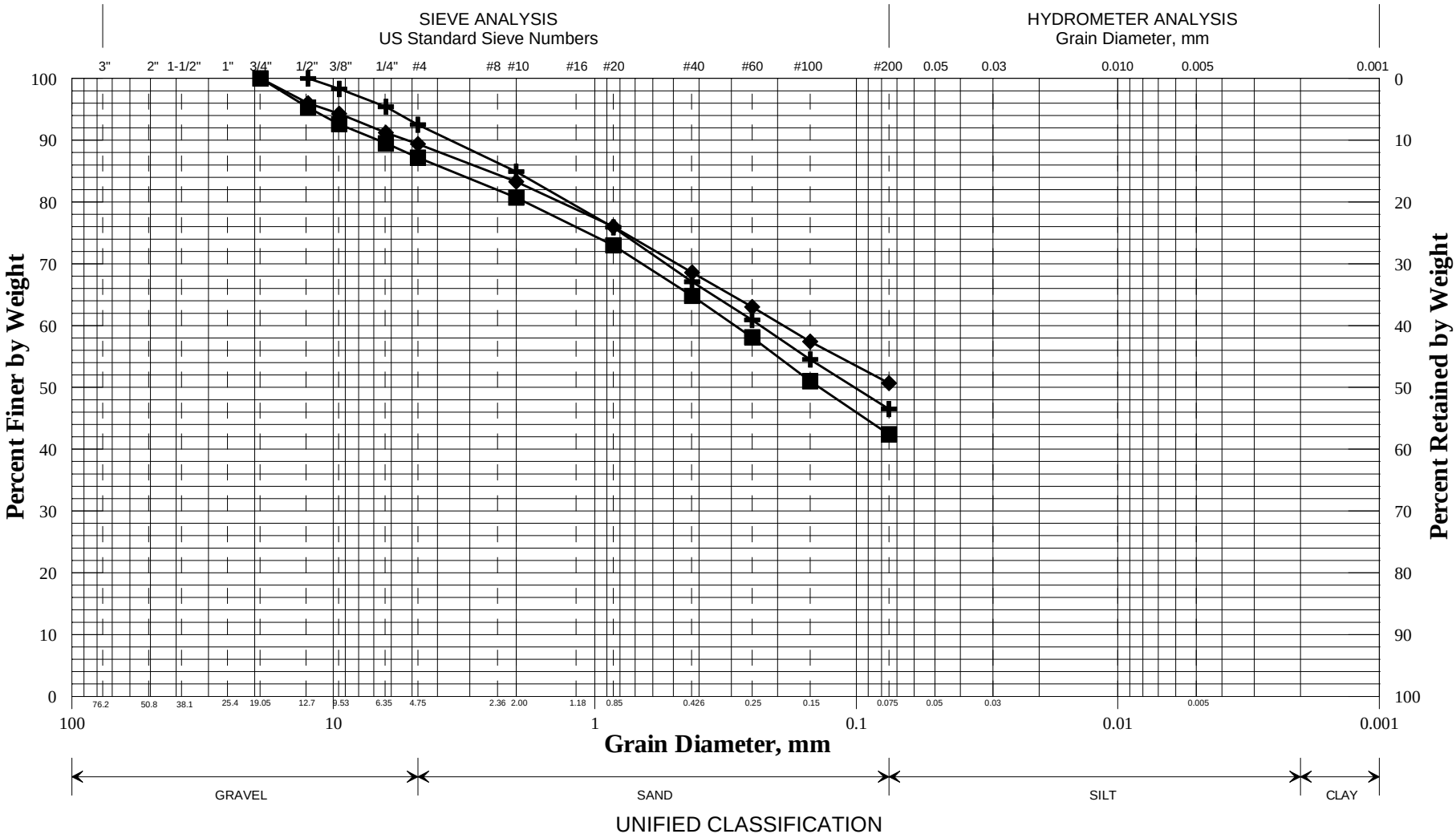
GSDC = Grain Size Distribution Curve as determined by AASHTO T 88-93 (1996) and/or ASTM D 422-63 (Reapproved 1998)

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

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

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

State of Maine Department of Transportation
GRAIN SIZE DISTRIBUTION CURVE



	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
✚	HB-T2R8-102/3D	5+79 RC	40.3 RT	5.0-7.0	Sandy SILT, trace gravel.	8.7			
◆	HB-T2R8-107/3D	16+71 RA	46.5 RT	5.0-7.0	Sandy SILT, trace gravel.	10.8			
■	HB-T2R8-110/4D	45+65.6 AR	11.2 LT	10.0-12.0	Silty SAND, little gravel.	6.7			
●									
▲									
✖									

WIN
023014.00
Town
T2 R8 NWP
Reported by/Date
WHITE, TERRY A 2/28/2018

S.W.COLE ENGINEERING, INC.

APPENDIX E

Evaluations

Estimated Frost Penetration Depth

Based on MaineDOT Bridge Design Guide Section 5.2.1

Site Location:
T2R8, Maine

Soil Conditions:
SILT, some to little sand, some to little gravel to SAND, little silt, little gravel (Glacial Till)
Silty CLAY
Silty SAND, trace gravel to SAND, some to little gravel, little to trace silt (Fill)

Step 1. From Figure 5-1:
Design Freezing Index = ±1900 freezing degree-days

Step 2. From laboratory test results:
natural soil water contents = 8.7%, 10.8% and 6.7%
average = 8.7% Use w=10%

Step 3. From Table 5-1:
Worse-case for coarse-grained soils
Depth of frost penetration = 92.6 inches = 7.7 feet

Calculated by / Date: MAS / 03-08-2018
Checked by / Date: EJB / 03-13-2018

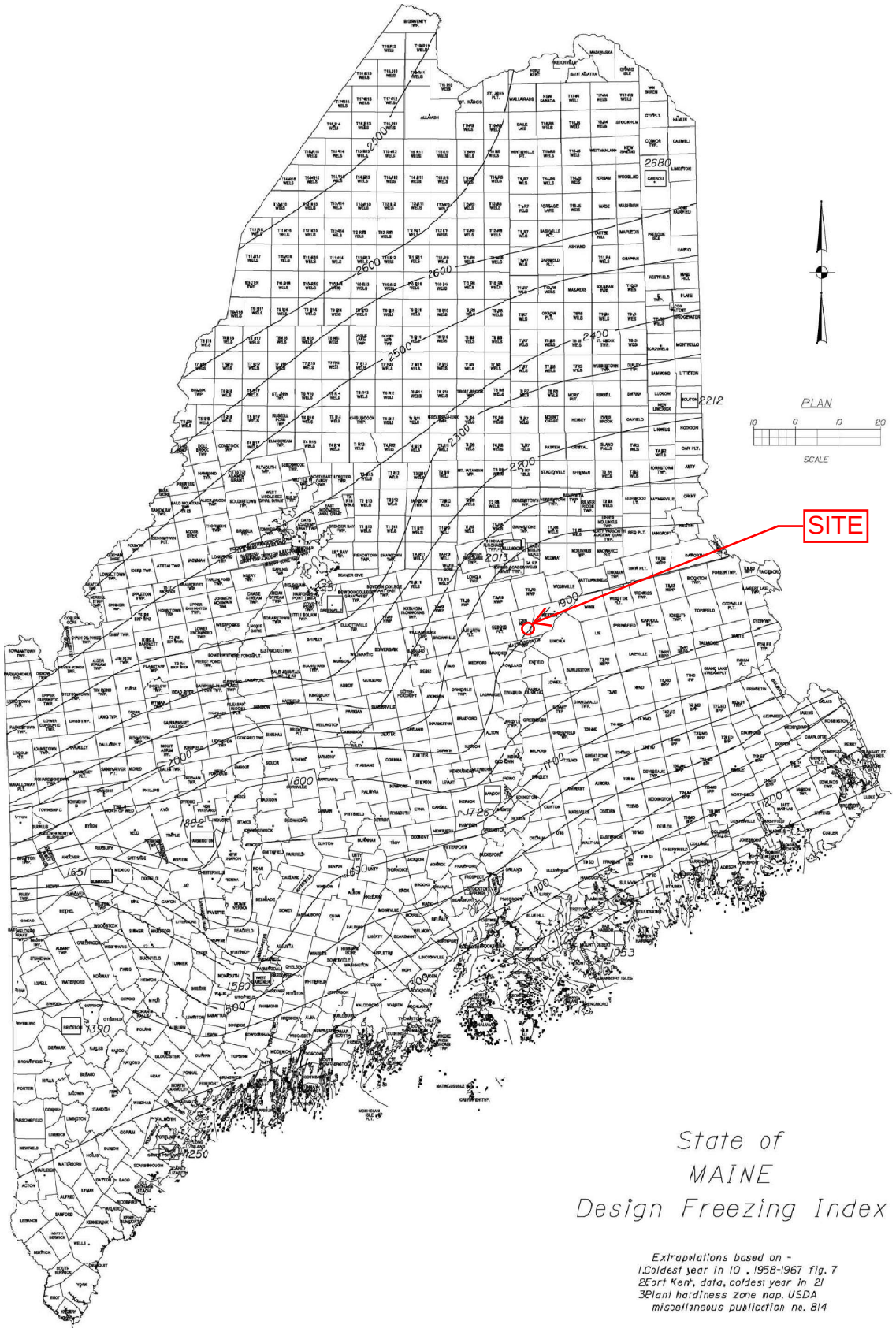


Figure 5-1 Maine Design Freezing Index Map

5.2 General

5.2.1 Frost

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

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

Table 5-1 Depth of Frost Penetration

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

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

S.W.COLE ENGINEERING, INC.

SPT BLOW COUNT CONVERSION AND FRICTION ANGLE CORRELATION FOR GRANULAR SOILS

Project Name: Light Pole Structures - WIN 23014
Project No.: 17-1516
Evaluated By/Date: MAS / 03/02/2018
Reviewed By/Date: EJB / 03/13/2018

79 Hammer Efficiency
u = N/A Depth to Water

		BORING	HB-T2R8-101				Correction Factors							
Soil Layer	Stratum	Sample No.	Top of Sample Depth (ft)	Field N-Value N_m	Total Stress at Sample Depth (psf)	Effective Stress at Sample Depth (psf)	Overburden Stress[1] C_N	Hammer Efficiency C_E	Borehole Diameter[2] C_B	Rod Length[2] C_R	Sampler[2] C_S	N_{60}	$(N1)_{60}$	Friction Angle[3] (degrees)
1	Topsoil	1D	0	4	0	0	2.00	1.32	1.0	0.75	1.0	4	8	28
2	Glacial Till	2D	2	93	250	250	1.70	1.32	1.0	0.75	1.0	92	157	50
2	Glacial Till	3D	5	76	655	655	1.38	1.32	1.0	0.75	1.0	76	105	47
2	Glacial Till	4D	10	36	1330	1330	1.14	1.32	1.0	0.75	1.0	36	41	37
2	Glacial Till	5D	15	-	2005	2005	1.00	1.32	1.0	0.85	1.0			
2	Glacial Till	6D	20	-	2680	2680	0.90	1.32	1.0	0.95	1.0			
2	Glacial Till	7D	25	-	3355	3355	0.83	1.32	1.0	0.95	1.0			

1. Determination of overburden stress correction factor (CN) based on Peck, Hanson and Thornburn (1974) and guidance from AASHTO LRFD Section 10.4.6.2.4 (AASHTO LRFD 8th Ed., 2017).
2. Determination of correction factors (CB, CR, CS) based on guidance from Seed et al. (1985) and Skempton (1986) as presented in Das (2014) Principles of Foundation Engineering, 8th Ed. Table 3.5.
3. Estimated friction angle based on guidance from Peck, Hanson and Thornburn (1974)

S.W.COLE ENGINEERING, INC.

SPT BLOW COUNT CONVERSION AND FRICTION ANGLE CORRELATION FOR GRANULAR SOILS

Project Name: Light Pole Structures - WIN 23014
Project No.: 17-1516
Evaluated By/Date: MAS / 03/02/2018
Reviewed By/Date: EJB / 03/13/2018

79 Hammer Efficiency
u = N/A Depth to Water

		BORING	HB-T2R8-102				Correction Factors							
Soil Layer	Stratum	Sample No.	Top of Sample Depth (ft)	Field N-Value N_m	Total Stress at Sample Depth (psf)	Effective Stress at Sample Depth (psf)	Overburden Stress[1] C_N	Hammer Efficiency C_E	Borehole Diameter[2] C_B	Rod Length[2] C_R	Sampler[2] C_S	N_{60}	$(N1)_{60}$	Friction Angle[3] (degrees)
1	Topsoil	1D	0	7	0	0	2.00	1.32	1.0	0.75	1.0	7	14	29
2	Glacial Till	2D	2	32	270	270	1.67	1.32	1.0	0.75	1.0	32	54	36
2	Glacial Till	3D	5	86	675	675	1.37	1.32	1.0	0.75	1.0	85	117	49
2	Glacial Till	4D	10	76	1350	1350	1.13	1.32	1.0	0.75	1.0	76	87	47
2	Glacial Till	5D	15	-	2025	2025	1.00	1.32	1.0	0.85	1.0			
2	Glacial Till	6D	20	-	2700	2700	0.90	1.32	1.0	0.95	1.0			
2	Glacial Till	7D	25	-	3375	3375	0.83	1.32	1.0	0.95	1.0			

1. Determination of overburden stress correction factor (CN) based on Peck, Hanson and Thornburn (1974) and guidance from AASHTO LRFD Section 10.4.6.2.4 (AASHTO LRFD 8th Ed., 2017).
2. Determination of correction factors (CB, CR, CS) based on guidance from Seed et al. (1985) and Skempton (1986) as presented in Das (2014) Principles of Foundation Engineering, 8th Ed. Table 3.5.
3. Estimated friction angle based on guidance from Peck, Hanson and Thornburn (1974)

S.W.COLE ENGINEERING, INC.

SPT BLOW COUNT CONVERSION AND FRICTION ANGLE CORRELATION FOR GRANULAR SOILS

Project Name: Light Pole Structures - WIN 23014
Project No.: 17-1516
Evaluated By/Date: MAS / 03/02/2018
Reviewed By/Date: EJB / 03/13/2018

79 Hammer Efficiency
u = 2.5 Depth to Water

		BORING		HB-T2R8-103			Correction Factors							
Soil Layer	Stratum	Sample No.	Top of Sample Depth (ft)	Field N-Value N_m	Total Stress at Sample Depth (psf)	Effective Stress at Sample Depth (psf)	Overburden Stress[1] C_N	Hammer Efficiency C_E	Borehole Diameter[2] C_B	Rod Length[2] C_R	Sampler[2] C_S	N_{60}	$(N1)_{60}$	Friction Angle[3] (degrees)
1	Topsoil	1D	0	6	0	0	2.00	1.32	1.0	0.75	1.0	6	12	29
2	Marine Clay	2D	2	15	235	235	1.72	1.32	1.0	0.75	1.0	15	26	31
2	Marine Clay	3D	5	19	595	439	1.51	1.32	1.0	0.75	1.0	19	29	33
3	Glacial Till	4D	10	19	1255	787	1.31	1.32	1.0	0.75	1.0	19	25	33
3	Glacial Till	5D	15	42	1930	1150	1.19	1.32	1.0	0.85	1.0	48	57	40
3	Glacial Till	6D	20	22	2605	1513	1.10	1.32	1.0	0.95	1.0	28	31	35
3	Glacial Till	7D	25	-	3280	1876	1.02	1.32	1.0	0.95	1.0			

1. Determination of overburden stress correction factor (CN) based on Peck, Hanson and Thornburn (1974) and guidance from AASHTO LRFD Section 10.4.6.2.4 (AASHTO LRFD 8th Ed., 2017).
2. Determination of correction factors (CB, CR, CS) based on guidance from Seed et al. (1985) and Skempton (1986) as presented in Das (2014) Principles of Foundation Engineering, 8th Ed. Table 3.5.
3. Estimated friction angle based on guidance from Peck, Hanson and Thornburn (1974)

S.W.COLE ENGINEERING, INC.

SPT BLOW COUNT CONVERSION AND FRICTION ANGLE CORRELATION FOR GRANULAR SOILS

Project Name: Light Pole Structures - WIN 23014
Project No.: 17-1516
Evaluated By/Date: MAS / 03/02/2018
Reviewed By/Date: EJB / 03/13/2018

79 Hammer Efficiency
u = N/A Depth to Water

		BORING	HB-T2R8-104				Correction Factors							
Soil Layer	Stratum	Sample No.	Top of Sample Depth (ft)	Field N-Value N_m	Total Stress at Sample Depth (psf)	Effective Stress at Sample Depth (psf)	Overburden Stress[1] C_N	Hammer Efficiency C_E	Borehole Diameter[2] C_B	Rod Length[2] C_R	Sampler[2] C_S	N_{60}	$(N1)_{60}$	Friction Angle[3] (degrees)
1	Topsoil	1D	0	27	0	0	2.00	1.32	1.0	0.75	1.0	27	54	35
2	Glacial Till	2D	2	20	250	250	1.70	1.32	1.0	0.75	1.0	20	34	33
2	Glacial Till	3D	5	23	655	655	1.38	1.32	1.0	0.75	1.0	23	32	34
2	Glacial Till	4D	10	-	1330	1330	1.14	1.32	1.0	0.75	1.0			

1. Determination of overburden stress correction factor (CN) based on Peck, Hanson and Thornburn (1974) and guidance from AASHTO LRFD Section 10.4.6.2.4 (AASHTO LRFD 8th Ed., 2017).
2. Determination of correction factors (CB, CR, CS) based on guidance from Seed et al. (1985) and Skempton (1986) as presented in Das (2014) Principles of Foundation Engineering, 8th Ed. Table 3.5.
3. Estimated friction angle based on guidance from Peck, Hanson and Thornburn (1974)

S.W.COLE ENGINEERING, INC.

SPT BLOW COUNT CONVERSION AND FRICTION ANGLE CORRELATION FOR GRANULAR SOILS

Project Name: Light Pole Structures - WIN 23014
Project No.: 17-1516
Evaluated By/Date: MAS / 03/02/2018
Reviewed By/Date: EJB / 03/13/2018

79 Hammer Efficiency
u = N/A Depth to Water

		BORING	HB-T2R8-105				Correction Factors							
Soil Layer	Stratum	Sample No.	Top of Sample Depth (ft)	Field N-Value N_m	Total Stress at Sample Depth (psf)	Effective Stress at Sample Depth (psf)	Overburden Stress[1] C_N	Hammer Efficiency C_E	Borehole Diameter[2] C_B	Rod Length[2] C_R	Sampler[2] C_S	N_{60}	$(N1)_{60}$	Friction Angle[3] (degrees)
1	Topsoil	1D	0	7	0	0	2.00	1.32	1.0	0.75	1.0	7	14	29
2	Fill	2D	2	9	240	240	1.71	1.32	1.0	0.75	1.0	9	16	30
3	Marine Clay	3D	5	22	615	615	1.40	1.32	1.0	0.75	1.0	22	31	33
4	Glacial Till	4D	10	40	1215	1215	1.17	1.32	1.0	0.75	1.0	40	47	38
4	Glacial Till	5D	15	26	1890	1890	1.02	1.32	1.0	0.85	1.0	30	31	36
4	Glacial Till	6D	20	-	2565	2565	0.92	1.32	1.0	0.95	1.0			

1. Determination of overburden stress correction factor (CN) based on Peck, Hanson and Thornburn (1974) and guidance from AASHTO LRFD Section 10.4.6.2.4 (AASHTO LRFD 8th Ed., 2017).
2. Determination of correction factors (CB, CR, CS) based on guidance from Seed et al. (1985) and Skempton (1986) as presented in Das (2014) Principles of Foundation Engineering, 8th Ed. Table 3.5.
3. Estimated friction angle based on guidance from Peck, Hanson and Thornburn (1974)

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SPT BLOW COUNT CONVERSION AND FRICTION ANGLE CORRELATION FOR GRANULAR SOILS

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Evaluated By/Date: MAS / 03/02/2018
Reviewed By/Date: EJB / 03/13/2018

79 Hammer Efficiency
u = N/A Depth to Water

		BORING	HB-T2R8-106				Correction Factors							
Soil Layer	Stratum	Sample No.	Top of Sample Depth (ft)	Field N-Value N_m	Total Stress at Sample Depth (psf)	Effective Stress at Sample Depth (psf)	Overburden Stress[1] C_N	Hammer Efficiency C_E	Borehole Diameter[2] C_B	Rod Length[2] C_R	Sampler[2] C_S	N_{60}	$(N1)_{60}$	Friction Angle[3] (degrees)
1	Topsoil	1D	0	32	0	0	2.00	1.32	1.0	0.75	1.0	32	64	36
2	Fill	2D	2	13	250	250	1.70	1.32	1.0	0.75	1.0	13	23	31
3	Marine Clay	3D	5	9	620	620	1.39	1.32	1.0	0.75	1.0	9	13	30
4	Glacial Till	4D	10	32	1235	1235	1.16	1.32	1.0	0.75	1.0	32	38	36
4	Glacial Till	5D	15	26	1910	1910	1.02	1.32	1.0	0.85	1.0	30	31	36

1. Determination of overburden stress correction factor (CN) based on Peck, Hanson and Thornburn (1974) and guidance from AASHTO LRFD Section 10.4.6.2.4 (AASHTO LRFD 8th Ed., 2017).
2. Determination of correction factors (CB, CR, CS) based on guidance from Seed et al. (1985) and Skempton (1986) as presented in Das (2014) Principles of Foundation Engineering, 8th Ed. Table 3.5.
3. Estimated friction angle based on guidance from Peck, Hanson and Thornburn (1974)

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SPT BLOW COUNT CONVERSION AND FRICTION ANGLE CORRELATION FOR GRANULAR SOILS

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79 Hammer Efficiency
u = N/A Depth to Water

		BORING	HB-T2R8-107				Correction Factors							
Soil Layer	Stratum	Sample No.	Top of Sample Depth (ft)	Field N-Value N_m	Total Stress at Sample Depth (psf)	Effective Stress at Sample Depth (psf)	Overburden Stress[1] C_N	Hammer Efficiency C_E	Borehole Diameter[2] C_B	Rod Length[2] C_R	Sampler[2] C_S	N_{60}	$(N1)_{60}$	Friction Angle[3] (degrees)
1	Topsoil	1D	0	26	0	0	2.00	1.32	1.0	0.75	1.0	26	52	35
2	Glacial Till	2D	2	21	270	270	1.67	1.32	1.0	0.75	1.0	21	36	33
2	Glacial Till	3D	5	21	675	675	1.37	1.32	1.0	0.75	1.0	21	29	33
2	Glacial Till	4D	10	60	1350	1350	1.13	1.32	1.0	0.75	1.0	60	68	43
2	Glacial Till	5D	15	24	2025	2025	1.00	1.32	1.0	0.85	1.0	27	27	35
2	Glacial Till	6D	20	47	2700	2700	0.90	1.32	1.0	0.95	1.0	59	54	43
2	Glacial Till	7D	25	60	3375	3375	0.83	1.32	1.0	0.95	1.0	76	63	47

1. Determination of overburden stress correction factor (CN) based on Peck, Hanson and Thornburn (1974) and guidance from AASHTO LRFD Section 10.4.6.2.4 (AASHTO LRFD 8th Ed., 2017).
2. Determination of correction factors (CB, CR, CS) based on guidance from Seed et al. (1985) and Skempton (1986) as presented in Das (2014) Principles of Foundation Engineering, 8th Ed. Table 3.5.
3. Estimated friction angle based on guidance from Peck, Hanson and Thornburn (1974)

S.W.COLE ENGINEERING, INC.

SPT BLOW COUNT CONVERSION AND FRICTION ANGLE CORRELATION FOR GRANULAR SOILS

Project Name: Light Pole Structures - WIN 23014
Project No.: 17-1516
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Reviewed By/Date: EJB / 03/13/2018

79 Hammer Efficiency
u = 0 Depth to Water

		BORING		HB-T2R8-108			Correction Factors							
Soil Layer	Stratum	Sample No.	Top of Sample Depth (ft)	Field N-Value N_m	Total Stress at Sample Depth (psf)	Effective Stress at Sample Depth (psf)	Overburden Stress[1] C_N	Hammer Efficiency C_E	Borehole Diameter[2] C_B	Rod Length[2] C_R	Sampler[2] C_S	N_{60}	$(N1)_{60}$	Friction Angle[3] (degrees)
1	Topsoil	1D	0	-	0	0	2.00	1.32	1.0	0.75	1.0			
2	Glacial Till	2D	2	22	250	125	1.93	1.32	1.0	0.75	1.0	22	43	33
2	Glacial Till	3D	5	19	655	343	1.59	1.32	1.0	0.75	1.0	19	31	33
2	Glacial Till	4D	10	45	1330	706	1.35	1.32	1.0	0.75	1.0	45	61	40
2	Glacial Till	5D	15	21	2005	1069	1.21	1.32	1.0	0.85	1.0	24	30	34
2	Glacial Till	MD	20	30	2680	1432	1.11	1.32	1.0	0.95	1.0	38	43	38
2	Glacial Till	6D	25	34	3355	1795	1.04	1.32	1.0	0.95	1.0	43	45	39
2	Glacial Till	7D	30	88	4030	2158	0.98	1.32	1.0	0.95	1.0	111	109	54

1. Determination of overburden stress correction factor (CN) based on Peck, Hanson and Thornburn (1974) and guidance from AASHTO LRFD Section 10.4.6.2.4 (AASHTO LRFD 8th Ed., 2017).
2. Determination of correction factors (CB, CR, CS) based on guidance from Seed et al. (1985) and Skempton (1986) as presented in Das (2014) Principles of Foundation Engineering, 8th Ed. Table 3.5.
3. Estimated friction angle based on guidance from Peck, Hanson and Thornburn (1974)

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SPT BLOW COUNT CONVERSION AND FRICTION ANGLE CORRELATION FOR GRANULAR SOILS

Project Name: Light Pole Structures - WIN 23014
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79 Hammer Efficiency
u = 8 Depth to Water

		BORING		HB-T2R8-109/109A			Correction Factors							
Soil Layer	Stratum	Sample No.	Top of Sample Depth (ft)	Field N-Value N_m	Total Stress at Sample Depth (psf)	Effective Stress at Sample Depth (psf)	Overburden Stress[1] C_N	Hammer Efficiency C_E	Borehole Diameter[2] C_B	Rod Length[2] C_R	Sampler[2] C_S	N_{60}	$(N1)_{60}$	Friction Angle[3] (degrees)
1	Topsoil	1D	0	8	0	0	2.00	1.32	1.0	0.75	1.0	8	16	29
2	Fill	2D	2	6	240	240	1.71	1.32	1.0	0.75	1.0	6	11	29
3	Marine Clay	3D	5	10	615	615	1.40	1.32	1.0	0.75	1.0	10	14	30
3	Marine Clay	4D	10	10	1215	1090	1.20	1.32	1.0	0.75	1.0	10	13	30
4	Glacial Till	5D	15	72	1845	1408	1.12	1.32	1.0	0.85	1.0	81	91	48
4	Glacial Till	1D	20	41	2520	1771	1.04	1.32	1.0	0.95	1.0	52	55	41

1. Determination of overburden stress correction factor (CN) based on Peck, Hanson and Thornburn (1974) and guidance from AASHTO LRFD Section 10.4.6.2.4 (AASHTO LRFD 8th Ed., 2017).
2. Determination of correction factors (CB, CR, CS) based on guidance from Seed et al. (1985) and Skempton (1986) as presented in Das (2014) Principles of Foundation Engineering, 8th Ed. Table 3.5.
3. Estimated friction angle based on guidance from Peck, Hanson and Thornburn (1974)

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SPT BLOW COUNT CONVERSION AND FRICTION ANGLE CORRELATION FOR GRANULAR SOILS

Project Name: Light Pole Structures - WIN 23014
Project No.: 17-1516
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79 Hammer Efficiency
u = 14 Depth to Water

		BORING		HB-T2R8-110			Correction Factors							
Soil Layer	Stratum	Sample No.	Top of Sample Depth (ft)	Field N-Value N_m	Total Stress at Sample Depth (psf)	Effective Stress at Sample Depth (psf)	Overburden Stress[1] C_N	Hammer Efficiency C_E	Borehole Diameter[2] C_B	Rod Length[2] C_R	Sampler[2] C_S	N_{60}	$(N1)_{60}$	Friction Angle[3] (degrees)
1	Fill	1D	0	-	0	0	2.00	1.32	1.0	0.75	1.0			
1	Fill	2D	2	89	250	250	1.70	1.32	1.0	0.75	1.0	88	150	49
1	Fill	3D	5	96	625	625	1.39	1.32	1.0	0.75	1.0	95	133	51
1	Fill	4D	10	37	1250	1250	1.16	1.32	1.0	0.75	1.0	37	43	37
1	Fill	5D	15	76	1875	1813	1.03	1.32	1.0	0.85	1.0	86	89	49
1	Fill	6D	20	6	2500	2126	0.98	1.32	1.0	0.95	1.0	8	8	29
2	Marine Clay	7D	25	23	3125	2439	0.94	1.32	1.0	0.95	1.0	29	28	35
2	Marine Clay	8D	30	12	3725	2727	0.90	1.32	1.0	0.95	1.0	16	15	32
3	Glacial Till	9D	35	42	4325	3015	0.86	1.32	1.0	1.00	1.0	56	49	42

1. Determination of overburden stress correction factor (CN) based on Peck, Hanson and Thornburn (1974) and guidance from AASHTO LRFD Section 10.4.6.2.4 (AASHTO LRFD 8th Ed., 2017).
2. Determination of correction factors (CB, CR, CS) based on guidance from Seed et al. (1985) and Skempton (1986) as presented in Das (2014) Principles of Foundation Engineering, 8th Ed. Table 3.5.
3. Estimated friction angle based on guidance from Peck, Hanson and Thornburn (1974)