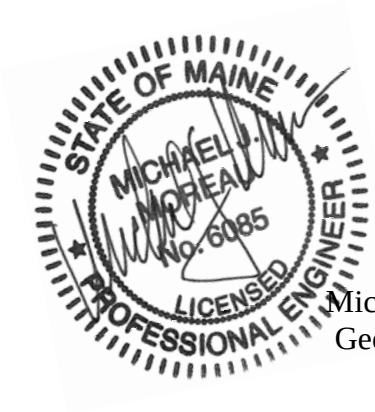
MAINE DEPARTMENT OF TRANSPORTATION
BRIDGE PROGRAM
GEOTECHNICAL SECTION
AUGUSTA, MAINE

GEOTECHNICAL DATA REPORT

For:

PENOBSCOT RIVER BRIDGE
ROUTES 6 AND 155 OVER PENOBSCOT RIVER
HOWLAND-ENFIELD, MAINE



Prepared by:

Michael J. Moreau, P.E.
Geotechnical Engineer

Reviewed by:

Laura Krusinski, P.E.
Senior Geotechnical Engineer

Penobscot County
PIN 16705.00

Soils Report 2010-37
Bridge No. 2660

Fed No. BH-1670(500)X
December 30, 2010

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1.0 INTRODUCTION

We show the Penobscot River Bridge that carries Routes 6 and 155 over the Penobscot River between Howland and Enfield, Maine, on Sheet 1, Site Location Map found at the end of this data report. The purpose of our subsurface investigation is to provide subsurface condition data along the existing bridge alignment to help assess feasibility and alternatives for bridge replacement along that alignment.

The existing simply supported five-span steel through truss was originally built in 1896, re-built in 1934, and widened and replaced in 1941. The original granite masonry abutments were founded on steep sloping bedrock at the banks. The 1941 bridge replacement plans indicate that the original abutments were underpinned and the concrete abutment footing extensions were founded on bedrock. The piers are founded on timber crib footings bearing on native soil. The original stone piers were extended at both ends with concrete founded on timber cribbing in 1941. Riprap was placed in front of the abutments and around the pier widening.

A 1995 scour assessment noted scattered riprap and partial footing exposure at piers 1 and 2, and missing riprap at piers 3 and 4. MaineDOT performed an underwater inspection in 2001 and found partial foundation exposure at piers 1, 2, and 3. Scour studies have indicated that pier 2 may be totally undermined during a 100 year storm event.

2.0 GEOLOGIC SETTING

The Maine Geologic Survey "Surficial Geology of Passadumkeag Quadrangle, Maine, Open-file No. 81-4" (1981) indicates that surficial soils in the vicinity of the Penobscot River Bridge consist primarily of stream alluvium deposits with nearby glacial-marine and glacial till soil unit contacts. The stream alluvium unit is typically made up of sand, gravel and silt. Glacial-marine deposits generally consist of silt, clay, and sand, commonly a clayey silt, but sand is abundant at the surface in some places. The glacial till is typically a heterogeneous mixture of sand, silt, clay, and stones.

According to the Maine Geologic Survey Bedrock Geologic Map of Maine (1985), the bedrock at the Penobscot River Bridge site consists of Silurian-Ordovician, calcareous sandstone, interbedded sandstone and impure limestone. Locally the bedrock has been identified as phyllite and metasiltstone and is part of the Vassalboro Formation.

3.0 SUBSURFACE INVESTIGATION PROGRAM

We investigated subsurface conditions in the vicinity of the existing bridge by drilling five test borings, BB-HEPR-101 through BB-HEPR-105. The approximate boring locations and coordinates are shown on Sheet 2 and Sheet 3, Boring Location Plan, found at the end of this report. We terminated all of the borings with bedrock cores. The Maine Department of Transportation (MaineDOT) drill rig and crew and the contract drill crew, Northern Test

Borings of Gorham, Maine, conducted the borings on August 16 through August 19, 2010. We present the details and sampling methods used, field data obtained, and soil and groundwater conditions encountered in the boring logs in Appendix A provided at the end of this report.

The MaineDOT geotechnical team member selected the boring locations and drilling methods, designated the type and depth of sampling techniques, and identified field and laboratory testing requirements. A consultant inspector or a MaineDOT NETTCP Certified Subsurface Inspector logged the subsurface conditions in the borings. The MaineDOT survey crew determined the boring location coordinates in the field after the borings were completed. The survey coordinates are based on the NAVD 88 datum.

The borings were drilled using solid stem auger and cased wash boring techniques. Soil samples were obtained, where possible, at 5-foot intervals using Standard Penetration Test (SPT) methods. The standard penetration resistances, or N-values, discussed in this report are corrected for average hammer energy transfer. We compute the corrected or, N_{60}-values, by applying an average hammer energy transfer factor of 0.84 and 0.678 to the raw field N-values obtained with the MaineDOT and Northern Test Boring drill rigs, respectively. Bedrock was cored using an NQ-2 core barrel producing a 2.0-inch diameter rock core.

4.0 LABORATORY TESTING PROGRAM

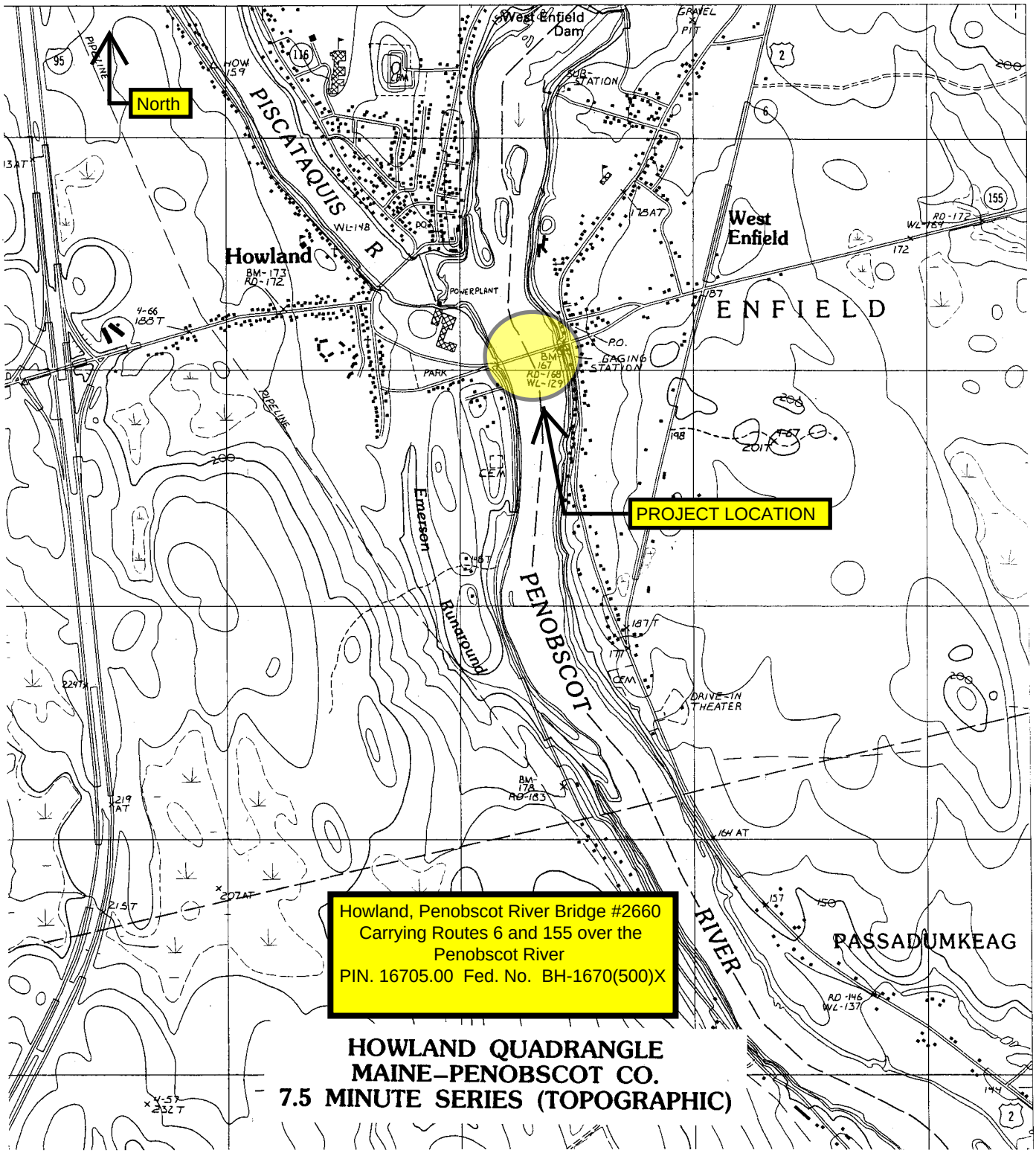
We conducted a laboratory soil testing program on selected samples recovered from the test borings to evaluate soil classification and soil properties. We performed the soil laboratory testing at the AASHTO accredited MaineDOT Soils Laboratory in Bangor, Maine. Laboratory testing consisted of 21 standard grain size analyses with natural water content, one with hydrometer analysis, and one Atterberg Limits test. We present the results of the laboratory testing in Appendix B, Laboratory Test Data. The AASHTO and Unified Soil Classification System (USCS) soil classification and water content data are also presented on the boring logs in Appendix A.

5.0 CLOSURE

This Geotechnical Data Report has been prepared for use by the MaineDOT Bridge Program for specific application to the replacement feasibility study for the Penobscot River Bridge carrying Routes 6 and 155 over the Penobscot River in Howland-Enfield, Maine. We have prepared the report in accordance with generally accepted soil and foundation engineering practices. No other intended use or warranty is expressed or implied.

The Department conducted a limited number of soil explorations at discrete locations near the existing bridge and a limited number of laboratory soil tests. The Department shall not be responsible for any bidder’s or contractor’s interpretations of, or estimates or conclusions drawn from, the geotechnical information. Data provided may not be representative of the subsurface conditions between the boring locations.

Sheets



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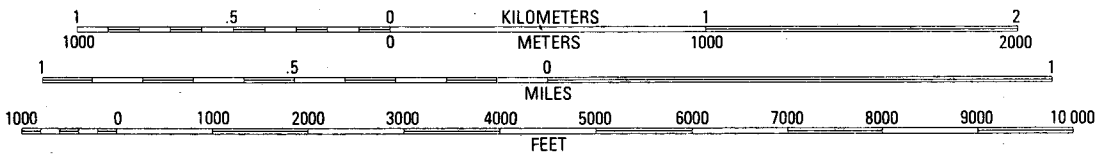

CONTOUR INTERVAL 10 FEET

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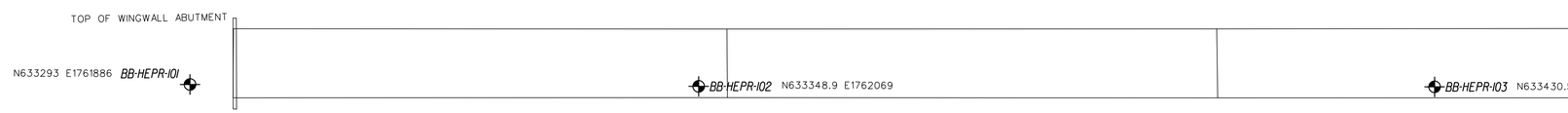


PROFILE

LEGEND

CASED WASH BORING NAVD88 GRID COORDINATES

PROJ. MANAGER		BY	DATE
DESIGN-DETAILED	M.MOREAU	T.WHITE	DEC 2010
CHECKED-REVIEWED			
DESIGN2-DETAILED2			
DESIGN3-DETAILED3			
REVISIONS 1			
REVISIONS 2			
REVISIONS 3			
REVISIONS 4			
FIELD CHANGES			

SIGNATURE

P.E. NUMBER

DATE

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

BH-1670(500)X

PIN 16705.00

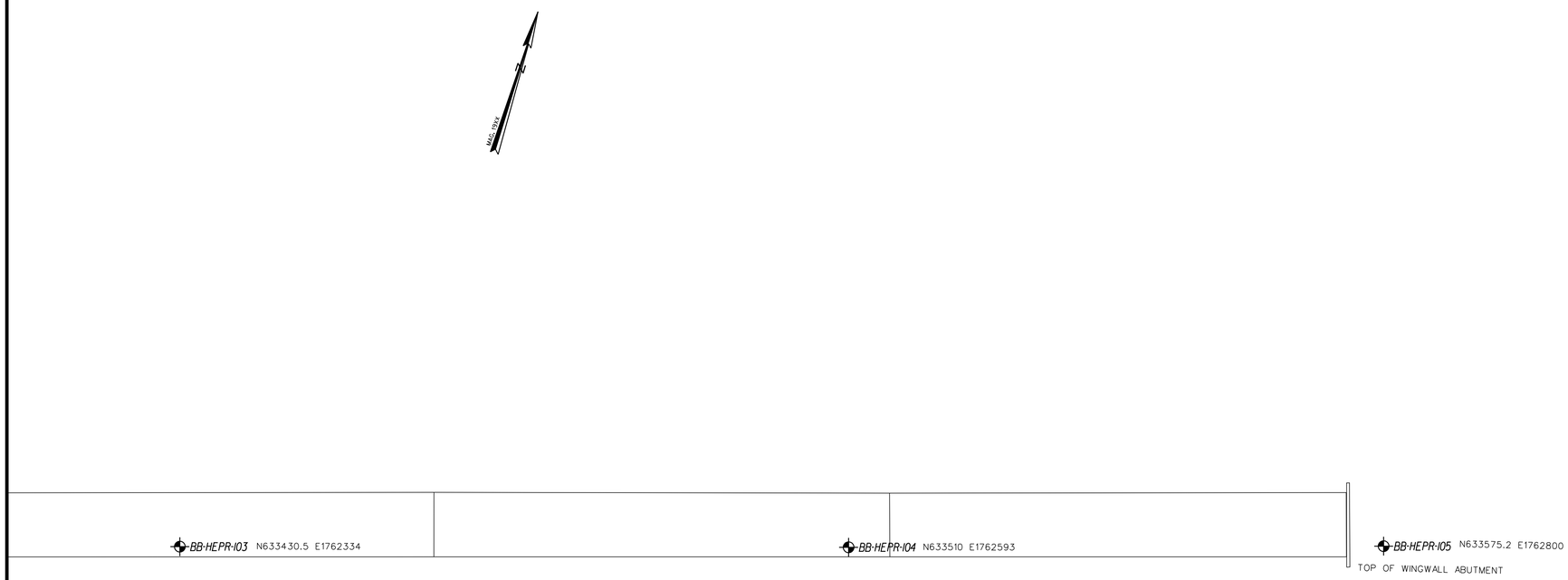
BRIDGE NO. 2860 BRIDGE PLANS

PENOBSCOT RIVER BRIDGE
PENOBSCOT RIVER
HOWLAND PENOBSCOT COUNTY

BORING LOCATION PLAN

SHEET NUMBER
2
OF 3

Filename: ...\00\geotech\msto\007_BLP2.dgn Division: GEOTECH Username: terry.white Date:12/21/2010



LEGEND

CASED WASH BORING NAD88 GRID COORDINATES

PROFILE

HORIZ 25 0 25 50

VERT 5 0 5 10

SCALE

PROJ. MANAGER	----------	BY	DATE
DESIGN-DETAILED	M.MOREAU	T.WHITE	DEC 2010
CHECKED-REVIEWED	------	------	------
DESIGN2-DETAILED2	------	------	------
DESIGN3-DETAILED3	------	------	------
REVISIONS 1	------	------	------
REVISIONS 2	------	------	------
REVISIONS 3	------	------	------
REVISIONS 4	------	------	------
FIELD CHANGES	------	------	------

SIGNATURE

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DATE

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

BH-1670(500)X

PIN
16705.00

BRIDGE NO. 2860 BRIDGE PLANS

PENOBSCOT RIVER BRIDGE
PENOBSCOT RIVER
HOWLAND PENOBSCOT COUNTY

BORING LOCATION PLAN

SHEET NUMBER

3

OF 3

Appendix A

Boring Logs

UNIFIED SOIL CLASSIFICATION SYSTEM

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

Desired Soil Observations: (in this order)

Color (Munsell color chart)
Moisture (dry, damp, moist, wet, saturated)
Density/Consistency (from above right hand side)
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., if applicable)
Cementation (weak, moderate, or strong, if applicable, ASTM D 2488)
Geologic Origin (till, marine clay, alluvium, etc.)
Unified Soil Classification Designation
Groundwater level

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. Consistency is rated according to standard penetration resistance.

Modified Burmister System

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

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 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 thumbnai
Hard	>30	over 4000	Indented by thumbnail with difficulty

Rock Quality Designation (RQD):

$$RQD = \frac{\text{sum of the lengths of intact pieces of core* > 100 mm}}{\text{length of core advance}}$$

*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)

Color (Munsell color chart)
Texture (aphanitic, fine-grained, etc.)
Lithology (igneous, sedimentary, metamorphic, 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, low angle - 5-35, mod. dipping - 35-55, steep - 55-85, vertical - 85-90)
- -spacing (very close - <5 cm, close - 5-30 cm, mod. close 30-100 cm, wide - 1-3 m, very wide >3 m)
- -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: AASHTO Standard Specification for Highway Bridges 17th Ed. Table 4.4.8.1.2A
Recovery

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

Sample Container Labeling Requirements:

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

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Penobscot River Bridge #2660 carries Route 155 over Penobscot River
Location: Howland-Enfield, Maine

Boring No.: BB-HEPR-101
PIN: 16705.00

Driller:	Northern Test Boring	**Elevation (ft.)**	157.5	**Auger ID/OD:**	5" Solid Stem
Operator:	Mike Nadeau/Ty Whitworth	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	Diedrich D-50 Track	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	8/16/10; 10:30-16:30	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2"
Boring Location:	N633293 E1761886	**Casing ID/OD:**	HW	**Water Level*:**	19.0 ft bgs.
Hammer Efficiency Factor:	0.678	**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 = Insitu Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Insitu 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 = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane Shear Strength (psf)
WC = water content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0							SSA	157.10	PAVEMENT. 0.40	
	1D	24/19	1.00 - 3.00	15/13/13/12	26	29			Brown, damp, medium dense, fine to coarse SAND, some gravel, trace silt, (Fill).	G#237550 A-1-b, SW-SM WC=3.9%
5	2D	24/20	5.00 - 7.00	16/31/36/32	67	76		151.50	6.00	
									Black, damp, very dense, fine to coarse SAND, little gravel, trace silt, (Fill).	
								149.00	8.50	
10	3D	24/15	10.00 - 12.00	3/3/2/2	5	6	20		Light brown to orange, wet, loose, fine to medium SAND, trace gravel and coarse sand, little silt (Fill).	
							26			
							26			
							35			
							25			
15	4D	24/16	15.00 - 17.00	3/3/2/2	5	6	11		Similar to above.	G#207064 A-2-4, SM WC=21.8%
							16			
							27			
							30			
							31			
20	5D	24/12	20.00 - 22.00	11/9/8/10	17	19	52	137.50	20.00	
							320		Brown, wet, medium dense, fine to coarse SAND, little gravel, some silt, trace organics, with brick pieces, (Fill).	
							55			
							72	134.50	23.00	
25							94			

Remarks:

Auto Hammer #283

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: Penobscot River Bridge #2660 carries Route 155 over Penobscot River
Location: Howland-Enfield, Maine

Boring No.: BB-HEPR-101
PIN: 16705.00

Driller:	Northern Test Boring	**Elevation (ft.)**	157.5	**Auger ID/OD:**	5" Solid Stem
Operator:	Mike Nadeau/Ty Whitworth	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	Diedrich D-50 Track	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	8/16/10; 10:30-16:30	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2"
Boring Location:	N633293 E1761886	**Casing ID/OD:**	HW	**Water Level*:**	19.0 ft bgs.
Hammer Efficiency Factor:	0.678	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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MV = Unsuccessful Insitu 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 = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane 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.
25	6D	9.6/7	25.00 - 25.80	23/50(3.6")	---		60			Light brown, wet, very dense, fine to coarse SAND, some gravel and silt, (Till). Cobble from 25.8-26.0 ft bgs. Roller Coned ahead to 30.3 ft bgs.	G#207066 A-2-4, SM WC=9.7%
							89				
							60	129.70		27.80 Very dense from 27.8-30.3 ft bgs., Weathered Rock?	
30	7D R1	3.6/3.6 36/23	30.00 - 30.30 30.30 - 33.30	50(3.6") RQD = 16%	---		NQ-2	127.20		30.30 Top of Intack Bedrock at Elev. 127.2 ft. Bedrock: Grey, fine-grained, moderately hard, slightly weathered, highly fractured, PHYLLITE, thin, steep bedding planes, joints very close, minor silt in-filling and iron staining. Rock Mass Quality is Very Poor [Vassalboro Formation] R1:Core Times (min:sec) 30.3-31.3 ft (6:00) 31.3-32.3 ft (5:15) 32.3-33.3 ft (6:45) 64% Recovery Core Blocked	
35	R2	42/42	33.30 - 36.80	RQD = 0%						R2:CoreTimes (min:sec) 33.3-34.3 ft (4:20) 34.3-35.3 ft (3:16) 35.3-36.3 ft (4:30) 36.3-36.8 ft (5:00) 100% Recovery Core Blocked	
40	R3	36/36	36.80 - 39.80	RQD = 0%				117.70		R3:CoreTimes (min:sec) 36.8-37.8 ft (5:00) 37.8-38.8 ft (6:30) 38.8-39.8 ft (6:45) 100% Recovery Core Blocked 39.80 **Bottom of Exploration at 39.80 feet below ground surface.**	
45											
50											

Remarks:

Auto Hammer #283

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: Penobscot River Bridge #2660 carries Route 155 over Penobscot River
Location: Howland-Enfield, Maine

Boring No.: BB-HEPR-102
PIN: 16705.00

Driller:	MaineDOT	**Elevation (ft.)**	126.8	**Auger ID/OD:**	N/A
Operator:	Giguere/Giles/Daggett	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Schonewald	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	8/16/10-8/17/10	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2"
Boring Location:	N633348.9 E1762069	**Casing ID/OD:**	HW & NW	**Water Level*:**	River Boring
Hammer Efficiency Factor:	0.84	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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WC = water content, percent
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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.)	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/5	0.00 - 2.00	1/2/11/10	13	18			Brown-grey, medium dense, fine to coarse sandy GRAVEL, trace silt, (Alluvium).	G#207067 A-1-a, GP WC=10.2%
							67			
							78			
							76			
							129	122.80	4.00	
5							118			
	2D	24/11	6.00 - 8.00	22/14/12/11	26	36	72		Grey, dense, fine to medium SAND, some gravel, little to some silt, trace coarse sand, (Alluvium).	
							71			
							64			
							76			
10							82			
	3D	24/9	11.00 - 13.00	14/19/17/20	36	50	73		Grey, dense, fine to coarse SAND, some gravel, little to some silt, (Alluvium).	
							93			
							125			
							134			
15							168			
	4D	24/12	16.00 - 18.00	16/36/33/34	69	97	123		Grey, very dense, fine to coarse SAND, some gravel, little silt, (Alluvium).	G#207068 A-1-b, SW-SM WC=11.7%
							194			
							252			
							270			
20							432			
	5D	9.6/3	21.00 - 21.80	21/50(3.6")	---				Brownish-grey, very dense, fine to coarse sandy GRAVEL, trace to little silt, (Alluvium).	
	R1	45.6/32	22.00 - 25.80	RQD = 11%			NQ-2	104.80	Attempt to roller cone ahead, solid at 21.8 ft bgs. Telescoped NW Casing, drive and washout to 22.0 ft bgs.	
								103.90	22.00 R1: Top 0.9 ft. Boulder underlain by Gravel.	
									22.90 Top of Bedrock at Elev. 103.9 ft. R1:Bedrock: Grey, fine-grained, medium hard, fresh to slightly	
25										

Remarks:

Bridge Deck to mudline, 33.1 ft. Bridge Deck Core 9 in, no asphalt.

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

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Boring No.: BB-HEPR-102

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Penobscot River Bridge #2660 carries Route 155 over Penobscot River
Location: Howland-Enfield, Maine

Boring No.: BB-HEPR-102
PIN: 16705.00

Driller:	MaineDOT	**Elevation (ft.)**	126.8	**Auger ID/OD:**	N/A
Operator:	Giguere/Giles/Daggett	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Schonewald	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	8/16/10-8/17/10	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2"
Boring Location:	N633348.9 E1762069	**Casing ID/OD:**	HW & NW	**Water Level*:**	River Boring
Hammer Efficiency Factor:	0.84	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
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MU = Unsuccessful Thin Wall Tube Sample attempt
V = Insitu Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Insitu 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 = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane 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.
25	R2	22.8/20	25.80 - 27.70	RQD = 0%						weathered, thinly bedded, calcereous muscovite PHYLLITE. Bedding high angle to vertical, highly undulating on small scale. Close, high angle, planar to undulating, smooth to rough, fresh to discolored, tight to open, breaks along bedding. Mud seam at 23.1 to 23.4 ft. Highly fractured at 24.8 ft. Rock Mass Quality is Very Poor. [Vassalboro Formation] R1:Core Times (min:sec) 22.0-23.0 ft (2:10) 23.0-24.0 ft (2:10) 24.0-25.0 ft (3:55) 25.0-25.8 ft (8:15) 70% Recovery R2:Bedrock: Same as R1, except fresh, highly fractured entire run. 80% Recovery. Core Times not recorded.	
	R3	60/60	27.70 - 32.70	RQD = 50%							
30											
								94.10		R3:Bedrock: Grey, fine-grained, medium hard, fresh, thinly bedded, calcareous muscovite PHYLLITE. Bedding high angle to vertical, highly undulating on small scale. Close to moderate, high angle upper and lower run and low angle middle run, undulating, smooth to rough, fresh, tight breaks along bedding. Highly fractured at 32.4 ft. Rock Mass Quality is Poor. [Vassalboro Formation] R3:Core Times (min:sec) 28.0-29.0 ft (2:40) 29.0-30.0 ft (2:30) 30.0-31.0 ft (2:25) 31.0-32.7 ft (2:45) 100% Recovery	
35											
40											
45											
50											

32.70

Bottom of Exploration at 32.70 feet below ground surface.

Remarks:

Bridge Deck to mudline, 33.1 ft. Bridge Deck Core 9 in, no asphalt.

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Penobscot River Bridge #2660 carries Route 155 over Penobscot River
Location: Howland-Enfield, Maine

Boring No.: BB-HEPR-103
PIN: 16705.00

Driller:	Northern Test Boring	**Elevation (ft.)**	127.0	**Auger ID/OD:**	5" Solid Stem
Operator:	Mike Nadeau/Ty Whitworth	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	Diedrich D-50 Track	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	8/17/10; 08:00-16:00	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2"
Boring Location:	N633430.5 E1762334	**Casing ID/OD:**	HW	**Water Level*:**	River Boring
Hammer Efficiency Factor:	0.678	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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MV = Unsuccessful Insitu 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 = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane Shear Strength (psf)
WC = water content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/8	0.00 - 2.00	6/9/17/10	26	29	32		Grey-brown, saturated, medium dense, fine to coarse sandy GRAVEL, trace silt, (Alluvium).	G#207069 A-1-a, GW WC=9.9%
							105			
							204			
	2D	24/13	3.50 - 5.50	26/31/20/18	51	58	152		Grey, saturated, very dense, GRAVEL, some fine to coarse sand, trace silt, (Alluvium). Roller Coned ahead from 3.5-8.5 ft bgs.	G#207070 A-1-a, GW WC=7.7%
							125			
5							88			
							84			
							91			
	3D	24/5	8.50 - 10.50	10/5/3/6	8	9	58		Similar to above, except loose.	
							55			
10							67			
							97			
							88			
	4D	24/4	13.50 - 15.50	5/7/8/7	15	17	51		Similar to above, except medium dense.	
							62			
15							76			
							92	110.00	17.00	
							174			
	5D	24/15	18.50 - 20.50	12/21/32/33	53	60	70		Grey, wet, very dense, fine to coarse SAND, some gravel, trace silt, (Alluvium). Roller Coned ahead to 23.5 ft bgs.	G#207071 A-1-b, SW-SM WC=11.5%
							41			
20							38			
							61	105.00	22.00	
							143			
	6D	24/17	23.50 - 25.50	29/45/33/50	78	88	136		Similar to above but gravelly. Roller Coned ahead to 28.5 ft bgs.	
25							92			

Remarks:

Auto Hammer #283
36.2 ft from Bridge Deck to Ground.

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Penobscot River Bridge #2660 carries Route 155 over Penobscot River
Location: Howland-Enfield, Maine

Boring No.: BB-HEPR-103
PIN: 16705.00

Driller:	Northern Test Boring	**Elevation (ft.)**	127.0	**Auger ID/OD:**	5" Solid Stem
Operator:	Mike Nadeau/Ty Whitworth	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	Diedrich D-50 Track	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	8/17/10; 08:00-16:00	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2"
Boring Location:	N633430.5 E1762334	**Casing ID/OD:**	HW	**Water Level*:**	River Boring
Hammer Efficiency Factor:	0.678	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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SSA = Solid Stem Auger
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RC = Roller Cone
WOH = weight of 140lb. hammer
WOR/C = weight of rods or casing
WO1P = Weight of one person
S_u = Insitu Field Vane Shear Strength (psf)
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N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane 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.)	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25							148			
							250	100.00	27.00	
							422			
	7D	18/16	28.50 - 30.00	22/33/50	83	94	350		Similar to 5D. Roller Coned ahead to 33.5 ft bgs.	G#207072 A-1-a, SW WC=10.1%
							131			
30							112			
							222			
							315			
	8D	16.8/14	33.50 - 34.90	31/39/56(4.8")	---		242		Similar to 5D. Roller Coned ahead to 38.5 ft bgs.	
							139			
35							225			
							232			
							OPEN HOLE	89.40	Open Hole, used 2 cups ACCU-VIS drilling mud. 37.60	
	9D	9.6/8	38.50 - 39.30	40/50(3.6")	---				Grey, wet, very dense, SILT, some fine to coarse sand, little gravel, (Till). Roller Coned ahead to 43.5 ft bgs.	
40										
	10D	15.6/12	43.50 - 44.80	23/43/50(3.6")	---				Similar to above. Roller Coned ahead to 49.0 ft bgs.	G#207073 A-4, SM WC=7.9%
45										
									Cobble from 48.5-48.9 ft bgs. Similar to above.	
50	11D	13.2/7	49.00 - 50.10	15/40/30 (1.2")	---				Roller Coned ahead to 50.1 ft bgs.	

Remarks:

Auto Hammer #283
36.2 ft from Bridge Deck to Ground.

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Penobscot River Bridge #2660 carries Route 155 over Penobscot River
Location: Howland-Enfield, Maine

Boring No.: BB-HEPR-103
PIN: 16705.00

Driller:	Northern Test Boring	**Elevation (ft.)**	127.0	**Auger ID/OD:**	5" Solid Stem
Operator:	Mike Nadeau/Ty Whitworth	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	Diedrich D-50 Track	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	8/17/10; 08:00-16:00	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2"
Boring Location:	N633430.5 E1762334	**Casing ID/OD:**	HW	**Water Level*:**	River Boring
Hammer Efficiency Factor:	0.678	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = weight of 140lb. hammer
WOR/C = weight of rods or casing
WO1P = Weight of one person
S_u = Insitu Field Vane Shear Strength (psf)
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q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane Shear Strength (psf)
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PL = Plastic Limit
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Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
50								76.90		50.10	
	R1	60/60	51.10 - 56.10	RQD = 93%			NQ-2			Top of Bedrock at Elev. 76.9 ft. Roller Coned ahead into Bedrock to 51.1 ft bgs. Bedrock: Grey, fine-grained, moderately hard, fresh, PHYLLITE, thin, steep bedding planes, joints close to moderatrely close except R2 is a weathered zone, otherwise minor silt in-filling, no iron staining. Rock Mass Quality is Good in R1 and R3, and Very Poor in R2. [Vassalboro Formation] R1:Core Times (min:sec) 51.1-52.1 ft (4:10) 52.1-53.1 ft (5:30) 53.1-54.1 ft (5:00) 54.1-55.1 ft (5:10) 55.1-56.1 ft (5:30) 100% Recovery	
55	R2	15.6/12	56.10 - 57.40	RQD = 0%						R2:Core Times (min:sec) 56.1-57.1 ft (5:45) 57.1-57.4 ft (4:00) 80% Recovery Core Blocked	
	R3	48/48	57.40 - 61.40	RQD = 90%						R3:Core Times not recorded. 100% Recovery	
60								65.60		61.40	
										Bottom of Exploration at 61.40 feet below ground surface.	
65											
70											
75											

Remarks:

Auto Hammer #283
36.2 ft from Bridge Deck to Ground.

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Penobscot River Bridge #2660 carries Route 155 over Penobscot River
Location: Howland-Enfield, Maine

Boring No.: BB-HEPR-104
PIN: 16705.00

Driller:	MaineDOT	**Elevation (ft.)**	123.4	**Auger ID/OD:**	N/A
Operator:	Giguere/Giles/Daggett	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Schonewald	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	8/17/10-8/18/10	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2"
Boring Location:	N633510 E1762593	**Casing ID/OD:**	HW & NW	**Water Level*:**	River Boring
Hammer Efficiency Factor:	0.84	**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 = Insitu Field Vane Shear Strength (psf)
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N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane Shear Strength (psf)
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LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/3	0.00 - 2.00	6/4/8/14	12	17	16		Brown, medium dense, GRAVEL, some fine to coarse sand, trace silt, (River Alluvium).	G#207074 A-1-a, GP WC=10.1%
							52			
							62			
							94			
							131	118.90	4.50	
5							86			
							144			
	2D	16/4	7.00 - 8.33	38/47/50(4")	---		196		Grey, very dense, fine to coarse SAND, some gravel and silt, (Alluvium). [a]Washed Ahead of casing from 8.0-22.0 ft bgs.	G#207075 A-1-b, SM WC=8.3%
							[a]WA			
10										
	3D	24/11	12.00 - 14.00	15/19/31/32	50	70			Greyish brown, very dense, fine to coarse SAND, little gravel, trace silt, (Alluvium).	G#239827 A-1-b, SP-SM WC=15.1%
15										
	4D	24/4	17.00 - 19.00	20/19/19/20	38	53			Brown, very dense, gravelly, fine to coarse SAND, trace silt, (Alluvium).	
									Switch to NW Casing at 19.0 ft bgs.	
20										
	5D	24/13	22.00 - 24.00	22/23/32/21	55	77	45		Greyish brown, very dense, gravelly, fine to coarse SAND, trace silt, (Alluvium).	G#239828 A-1-a, SW-SM WC=10.3%
							81			
25							108			

Remarks:

Bridge Deck to mudline, 42.3 ft. Bridge Deck Core lost through deck.
Deck to waterline 38.2 ft.

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Boring No.: BB-HEPR-104

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Penobscot River Bridge #2660 carries Route 155 over Penobscot River
Location: Howland-Enfield, Maine

Boring No.: BB-HEPR-104
PIN: 16705.00

Driller:	MaineDOT	**Elevation (ft.)**	123.4	**Auger ID/OD:**	N/A
Operator:	Giguere/Giles/Daggett	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Schonewald	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	8/17/10-8/18/10	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2"
Boring Location:	N633510 E1762593	**Casing ID/OD:**	HW & NW	**Water Level*:**	River Boring
Hammer Efficiency Factor:	0.84	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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WC = water content, percent
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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.
25							176				
							162				
	6D	8.4/5	27.00 - 27.70	40/50(2.4")	---		WASH			Greyish brown, very dense, gravelly, fine to coarse SAND, trace silt, (Alluvium).	
							67	95.40		Roller Cone refusal at 27.8 ft bgs. Attempt rock core. Dropped through boulder at 28.3 ft bgs.	
							126			28.00	
30							153				
							166				
	7D	24/17	32.00 - 34.00	44/40/48/48	88	123	[a]WA			Grey, very dense, SILT, some fine to coarse sand, trace gravel, (Till). [a]Washed Ahead of casing from 32.0-47.0 ft bgs.	G#239829 A-4, ML WC=11.6%
35											
	8D	9.6/1	37.00 - 37.80	59/56(3.6")	---					Same as above.	
40								83.40		40.00	
	9D	9.6/5	42.00 - 42.80	48/50(3.6")	---					Grey, very dense, fine to coarse sandy SILT, trace gravel, (Till) .	
45											
	10D	21.6/20	47.00 - 48.80	35/46/49/50(3.6)	95	133	[a]WA			Grey, very dense, fine to coarse sandy SILT, trace gravel, (Till). [a] Washed ahead to 52.0 ft bgs.	G#239830 A-4, SM WC=8.4%
50											

Remarks:

Bridge Deck to mudline, 42.3 ft. Bridge Deck Core lost through deck.
Deck to waterline 38.2 ft.

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Penobscot River Bridge #2660 carries Route 155 over Penobscot River
Location: Howland-Enfield, Maine

Boring No.: BB-HEPR-104
PIN: 16705.00

Driller:	MaineDOT	**Elevation (ft.)**	123.4	**Auger ID/OD:**	N/A
Operator:	Giguere/Giles/Daggett	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Schonewald	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	8/17/10-8/18/10	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2"
Boring Location:	N633510 E1762593	**Casing ID/OD:**	HW & NW	**Water Level*:**	River Boring
Hammer Efficiency Factor:	0.84	**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 = Insitu Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Insitu 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 = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane 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.
50										Casing and Roller Cone Refusal at 52.0 ft bgs.	
								71.40		52.00	
	R1	60/54	52.00 - 57.00	RQD = 62%			NQ-2			Top of Bedrock at Elev. 71.4 ft.	
55										R1:Bedrock: Grey, fine-grained, hard, fresh, thinly bedded calcereous muscovite PHYLLITE. Bedding high angle, highly undulating on smaller scale. Moderately spaced, high angle and one low angle, planar to undulating, rough, fresh, tight breaks along bedding. Upper foot more fractured, (close spacing). Rock Mass Quality is Fair. [Vassalboro Formation]	
	R2	60/60	57.00 - 62.00	RQD = 52%						R1:Core Times (min:sec) 52.0-53.0 ft (3:30) 53.0-54.0 ft (2:50) 54.0-55.0 ft (2:40) 55.0-56.0 ft (-:--) (Core Time not recorded) 56.0-57.0 ft (2:35) 90% Recovery	
60										R2:Bedrock: Grey, fine-grained, hard, fresh, thinly bedded calcereous muscovite PHYLLITE. Bedding high angle, highly undulating on small scale. Close, high angle, undulating to stepped, rough, fresh, tight to open breaks along bedding. Fractured at 57.0 to 57.5 ft and 58.8 to 60.0 ft. Rock Mass Quality is Fair. [Vassalboro Formation]	
								61.40		R2:Core Times (min:sec) 57.0-58.0 ft (3:00) 58.0-59.0 ft (3:30) 59.0-60.0 ft (4:30) 60.0-61.0 ft (4:00) 61.0-62.0 ft (3:40) 100% Recovery	
65										62.00	
										Bottom of Exploration at 62.00 feet below ground surface.	
70											
75											

Remarks:

Bridge Deck to mudline, 42.3 ft. Bridge Deck Core lost through deck.
Deck to waterline 38.2 ft.

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: Penobscot River Bridge #2660 carries Route 155 over Penobscot River
Location: Howland-Enfield, Maine

Boring No.: BB-HEPR-105
PIN: 16705.00

Driller:	Northern Test Boring	**Elevation (ft.)**	167.4	**Auger ID/OD:**	5" Solid Stem
Operator:	Mike Nadeau/Ty Whitworth	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Schonewald	**Rig Type:**	Diedrich D-50 Track	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	8/19/10; 08:00-14:15	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2"
Boring Location:	N633575.2 E1762800	**Casing ID/OD:**	HW	**Water Level*:**	None Observed
Hammer Efficiency Factor:	0.678	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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SSA = Solid Stem Auger
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RC = Roller Cone
WOH = weight of 140lb. hammer
WOR/C = weight of rods or casing
WO1P = Weight of one person
S_u = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane Shear Strength (psf)
WC = water content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0							SSA	166.60	ASPHALT. 0.80	
	1D	24/6	1.00 - 3.00	17/14/15/15	29	33			Brown, damp, dense, fine to coarse SAND, some gravel, trace silt, (Fill).	G#239831 A-1-b, SW-SM WC=2.7%
5	2D	24/2	5.00 - 7.00	8/8/9/8	17	19			Brown, dry, medium dense, gravelly fine to coarse SAND, trace silt, piece of gravel in tip of spoon, (Fill).	
10	3D	24/16	10.00 - 12.00	6/10/7/5	17	19	62		Brown, damp, medium dense, fine to coarse SAND, some gravel, trace silt, (Fill).	G#239832 A-1-b, SW-SM WC=7.5%
							81			
							136			
							126		Possible old asphalt layer at 13.0 ft based on wash water.	
							148			
15	4D/AB	24/12	15.00 - 17.00	8/5/6/7	11	12	38	152.40 / 152.20	15.00 4D/A (15.0-15.2) Brown, moist, CLAY-SILT mixed with fill. 15.20	G#239833 A-6, CL WC=24.1% LL=33 PL=21 PI=12
							45		4D/B (15.2-17.0) Brown, moist, stiff, CLAY-SILT, trace fine to medium sand, mottled, (Glaciomarine).	
							66			
							81			
							72	148.40	19.00 Driller notes material change at 19.0 ft bgs.	
20	5D	24/10	20.00 - 22.00	2/2/2/3	4	5	40		Dark brown and black, moist, loose, fine to medium SAND, little silt, (Glaciomarine).	G#239834 A-2-4, SM WC=18.5%
							44			
							53			
							60			
25							68			

Remarks:

Auto Hammer #283

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Penobscot River Bridge #2660 carries Route 155 over Penobscot River
Location: Howland-Enfield, Maine

Boring No.: BB-HEPR-105
PIN: 16705.00

Driller:	Northern Test Boring	**Elevation (ft.)**	167.4	**Auger ID/OD:**	5" Solid Stem
Operator:	Mike Nadeau/Ty Whitworth	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Schonewald	**Rig Type:**	Diedrich D-50 Track	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	8/19/10; 08:00-14:15	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2"
Boring Location:	N633575.2 E1762800	**Casing ID/OD:**	HW	**Water Level*:**	None Observed
Hammer Efficiency Factor:	0.678	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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WOH = weight of 140lb. hammer
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WO1P = Weight of one person
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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.
25	6D	24/7	25.00 - 27.00	3/4/4/5	8	9	45			Same as above.	
							59				
							82				
							99	138.80		28.60	
							194			Drilling behavior suggests material change at 28.6 ft, boney material.	
30	7D	24/7	30.00 - 32.00	11/15/17/18	32	36	74			Brown, dense, gravelly fine to coarse SAND, some silt, (Till).	
							104				
							208				
							338				
							286				
35	8D	24/12	35.00 - 37.00	39/21/38/36	59	67	[a]WA			Brown, very dense, gravelly, fine to coarse SAND, litle silt, (Till). [a]Washed Ahead to 39.8 ft bgs.	G#239835 A-1-b, SM WC=9.1%
	R1	60/54	39.80 - 44.80	RQD = 35%			NQ-2	127.60		39.80	
40										Top of Bedrock at Elev. 127.6 ft.	
										R1:Bedrock: Grey, fine-grained, hard, fresh to sliightly weathered, calcereous METASILTSTONE. Original bedding highly disturbed to not discernible. Quartz inclusions, close to moderately spaced, moderately dipping and low angle, undulating, rough, discolored, open fractures. Rock Mass Quality is Poor. [Vassalboro Formation]	
	R2	42/38	44.80 - 48.30	RQD = 86%						R1:Core Times (min:sec) 39.8-40.8 ft (4:00) 40.8-41.8 ft (6:30) 41.58-42.8 ft (7:40) 42.8-43.8 ft (6:40) 43.8-44.8 ft (8:30) 90% Recovery	
45											
	R3	24/22	48.30 - 50.30	RQD = 71%						R2:Bedrock: Same as R1, except original bedding not discernible, more quartz inclusions, and fractures are fresh to discolored, two drill breaks at 47.15 and 47.65 ft. Rock Mass Quality is Good. 90% Recovery	
50										R3:Bedrock: Same as R2, one drill break at 49.6 ft. Rock Mass Quality	

Remarks:

Auto Hammer #283

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Penobscot River Bridge #2660 carries Route 155 over Penobscot River
Location: Howland-Enfield, Maine

Boring No.: BB-HEPR-105
PIN: 16705.00

Driller:	Northern Test Boring	**Elevation (ft.)**	167.4	**Auger ID/OD:**	5" Solid Stem
Operator:	Mike Nadeau/Ty Whitworth	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Schonewald	**Rig Type:**	Diedrich D-50 Track	**Hammer Wt./Fall:**	140#/30"
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Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
50								117.10		is Fair. 50.30	
										Bottom of Exploration at 50.30 feet below ground surface.	
55											
60											
65											
70											
75											

Remarks:

Auto Hammer #283

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Appendix B

Laboratory Test Data

State of Maine - Department of Transportation

Laboratory Testing Summary Sheet

Town(s): Howland-Enfield Project Number: 16705.00

Boring & Sample Identification Number	Northing	Easting	Depth (Feet)	Reference Number	G.S.D.C. Sheet	W.C. %	L.L.	P.I.	Classification		
	NAVD88								Unified	AASHTO	Frost
BB-HEPR-101, 1D	633293	1761886	1.0-3.0	237550	1	3.9			SW-SM	A-1-b	0
BB-HEPR-101, 4D	633293	1761886	15.0-17.0	207064	1	21.8			SM	A-2-4	II
BB-HEPR-101, 6D	633293	1761886	25.0-25.8	207066	1	9.7			SM	A-2-4	II
BB-HEPR-102, 1D	633348.9	1762069	0.0-2.0	207067	1	10.2			GP	A-1-a	0
BB-HEPR-102, 4D	633348.9	1762069	16.0-18.0	207068	1	11.7			SW-SM	A-1-b	0
BB-HEPR-103, 1D	633430.5	1762334	0.0-2.0	207069	2	9.9			GW	A-1-a	0
BB-HEPR-103, 2D	633430.5	1762334	3.5-5.5	207070	2	7.7			GW	A-1-a	0
BB-HEPR-103, 5D	633430.5	1762334	18.5-20.5	207071	2	11.5			SW-SM	A-1-b	0
BB-HEPR-103, 7D	633430.5	1762334	28.5-30.0	207072	2	10.1			SW	A-1-a	0
BB-HEPR-103, 10D	633430.5	1762334	43.5-44.8	207073	2	7.9			SM	A-4	IV
BB-HEPR-104, 1D	633510	1762593	0.0-2.0	207074	3	10.1			GP	A-1-a	0
BB-HEPR-104, 2D	633510	1762593	7.0-8.33	207075	3	8.3			SM	A-1-b	II
BB-HEPR-104, 3D	633510	1762593	12.0-14.0	239827	3	15.1			SP-SM	A-1-b	0
BB-HEPR-104, 5D	633510	1762593	22.0-24.0	239828	3	10.3			SW-SM	A-1-a	0
BB-HEPR-104, 7D	633510	1762593	32.0-34.0	239829	3	11.6			ML	A-4	IV
BB-HEPR-104, 10D	633510	1762593	47.0-48.8	239830	3	8.4			SM	A-4	IV
BB-HEPR-105, 1D	633575.2	1762800	1.0-3.0	239831	4	2.7			SW-SM	A-1-b	0
BB-HEPR-105, 3D	633575.2	1762800	10.0-12.0	239832	4	7.5			SW-SM	A-1-b	0
BB-HEPR-105, 4D/B	633575.2	1762800	15.0-17.0	239833	4	24.1	33	12	CL	A-6	III
BB-HEPR-105, 5D	633575.2	1762800	20.0-22.0	239834	4	18.5			SM	A-2-4	II
BB-HEPR-105, 8D	633575.2	1762800	35.0-37.0	239835	4	9.1			SM	A-1-b	II

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

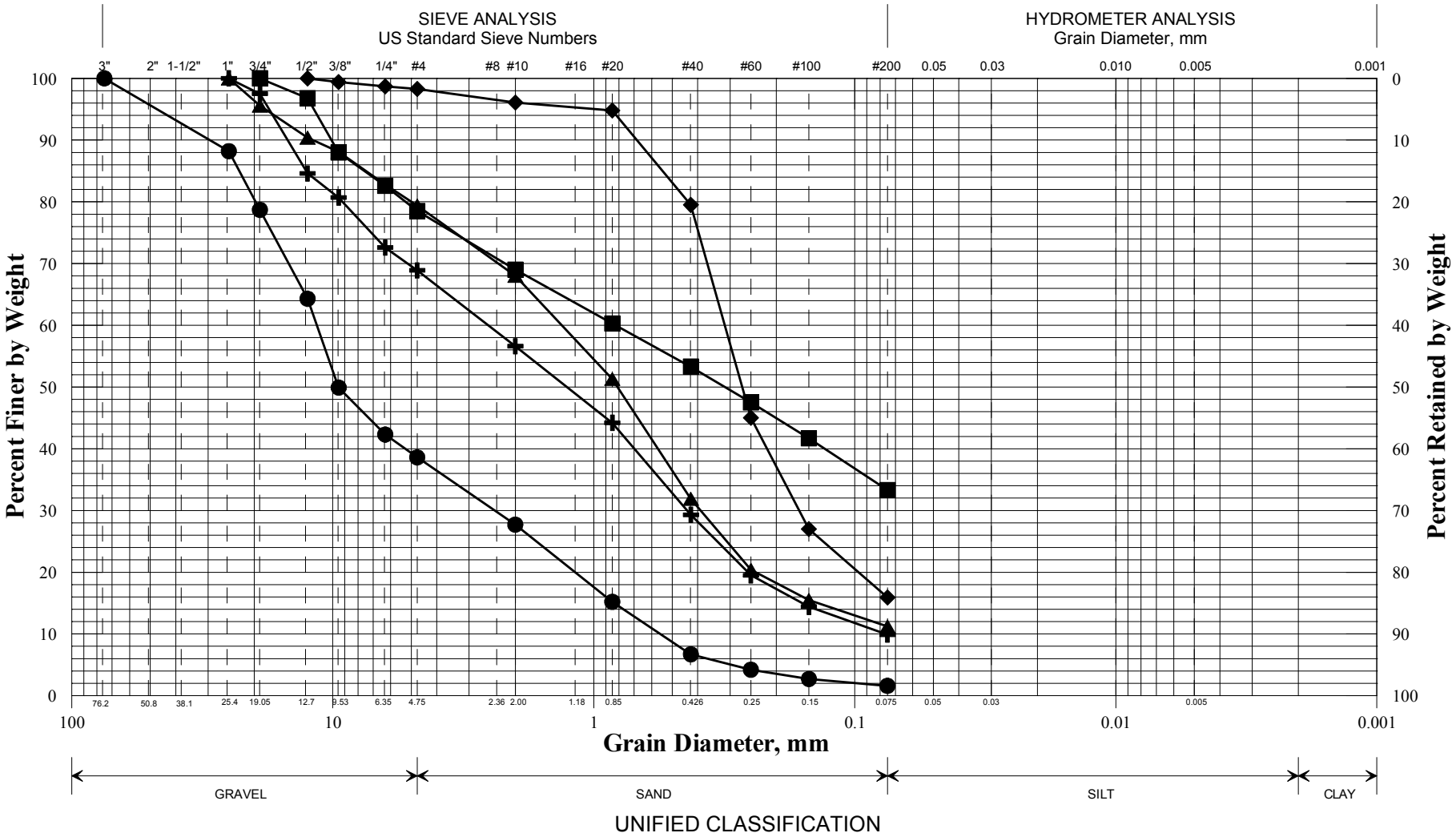
GSDC = Grain Size Distribution Curve as determined by AASHTO T 88-93 (1996) and/or ASTM D 422-63 (Reapproved 1998)

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

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

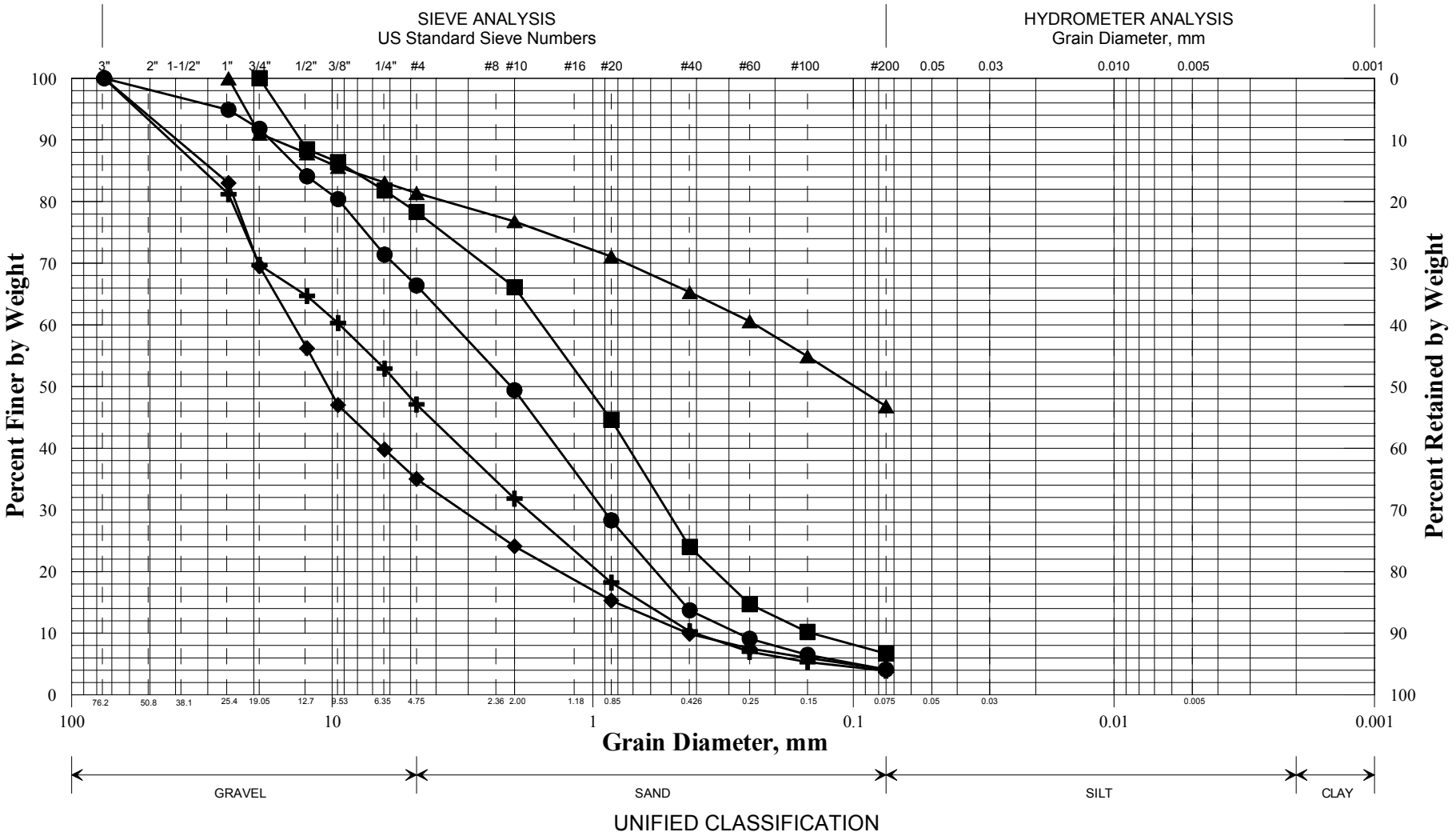
State of Maine Department of Transportation
GRAIN SIZE DISTRIBUTION CURVE



	Boring/Sample No.	Northing	Easting	Depth, ft	Description	W, %	LL	PL	PI
✚	BB-HEPR-101/1D	633293	1761886	1.0-3.0	SAND, some gravel, trace silt.	3.9			
◆	BB-HEPR-101/4D	633293	1761886	15.0-17.0	SAND, little silt, trace gravel.	21.8			
■	BB-HEPR-101/6D	633293	1761886	25.0-25.8	SAND, some silt, some gravel.	9.7			
●	BB-HEPR-102/1D	633348.9	1762069	0.0-2.0	Sandy GRAVEL, trace silt.	10.2			
▲	BB-HEPR-102/4D	633348.9	1762069	16.0-18.0	SAND, some gravel, little silt.	11.7			
✖									

PIN
016705.00
Town
Howland,Enfield
Reported by/Date
WHITE, TERRY A 9/29/2010

State of Maine Department of Transportation
GRAIN SIZE DISTRIBUTION CURVE



UNIFIED CLASSIFICATION

	Boring/Sample No.	Northing	Easting	Depth, ft	Description	W, %	LL	PL	PI
✚	BB-HEPR-103/1D	633430.5	1762334	0.0-2.0	Sandy GRAVEL, trace silt.	9.9			
◆	BB-HEPR-103/2D	633430.5	1762334	3.5-5.5	GRAVEL, some sand, trace silt.	7.7			
■	BB-HEPR-103/5D	633430.5	1762334	18.5-20.5	SAND, some gravel, trace silt.	11.5			
●	BB-HEPR-103/7D	633430.5	1762334	28.5-30.0	SAND, some gravel, trace silt.	10.1			
▲	BB-HEPR-103/10D	633430.5	1762334	43.5-44.8	SILT, some sand, little gravel.	7.9			
✖									

PIN
016705.00
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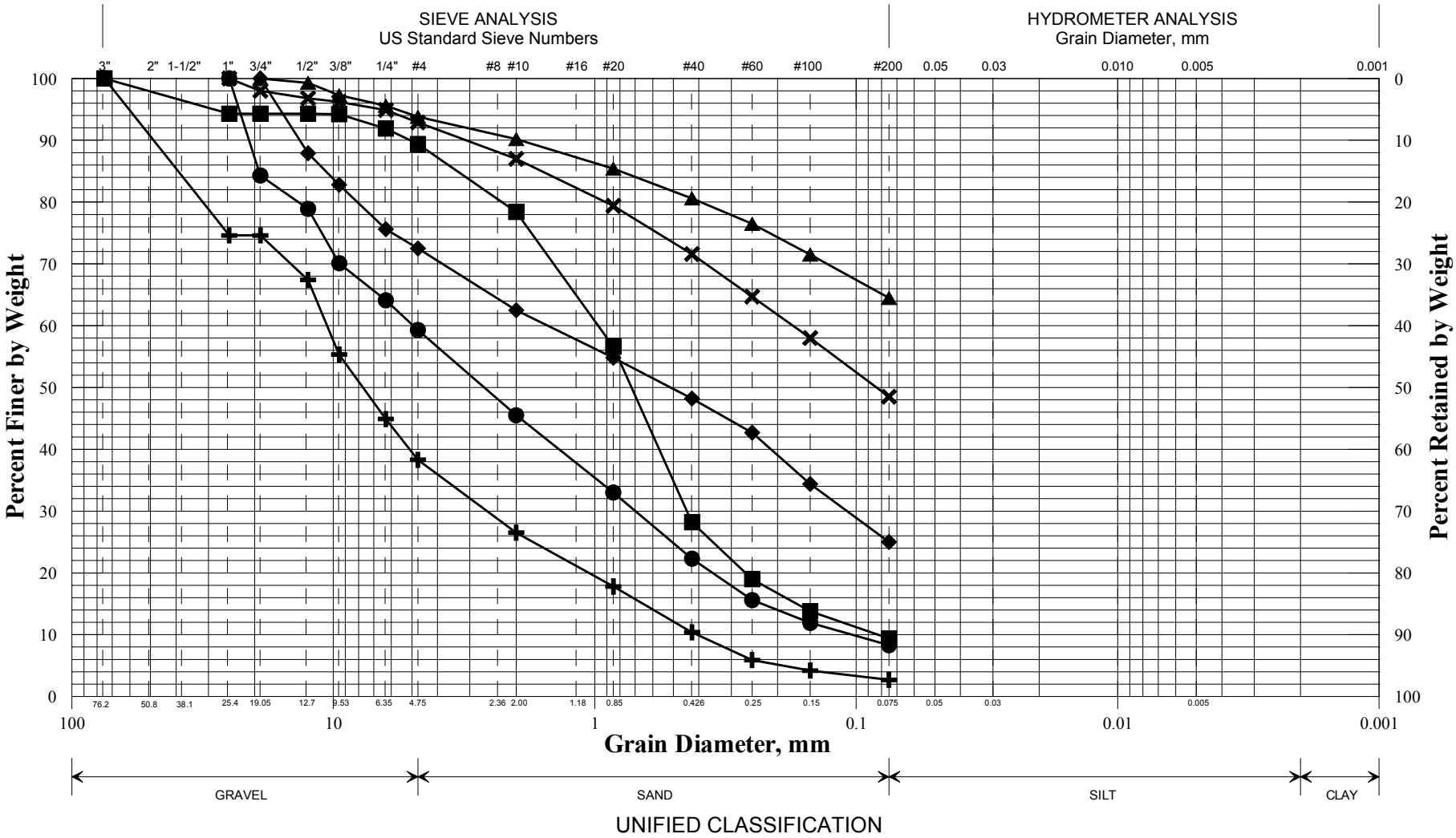
State of Maine Department of Transportation
GRAIN SIZE DISTRIBUTION CURVE



UNIFIED CLASSIFICATION

	Boring/Sample No.	Northing	Easting	Depth, ft	Description	W, %	LL	PL	PI
✚	BB-HEPR-104/1D	633510	1762593	0.0-2.0	GRAVEL, some sand, trace silt.	10.1			
◆	BB-HEPR-104/2D	633510	1762593	7.0-8.3	SAND, some gravel, some silt.	8.3			
■	BB-HEPR-104/3D	633510	1762593	12.0-14.0	SAND, little gravel, trace silt.	15.1			
●	BB-HEPR-104/5D	633510	1762593	22.0-24.0	Gravelly SAND, trace silt.	10.3			
▲	BB-HEPR-104/7D	633510	1762593	32.0-34.0	SILT, some sand, trace gravel.	11.6			
✖	BB-HEPR-104/10D	633510	1762593	47.0-48.8	Sandy SILT, trace gravel.	8.4			

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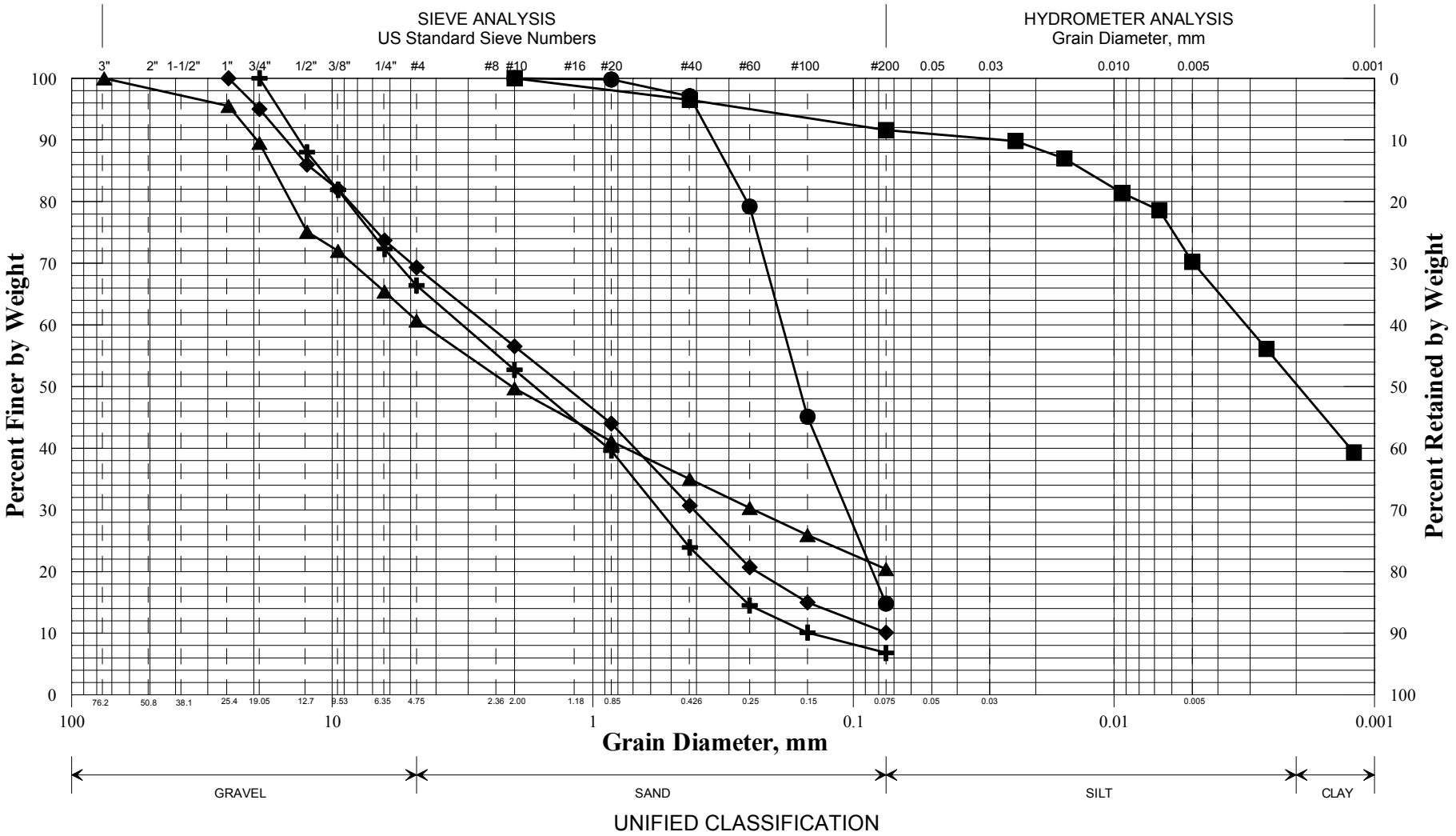
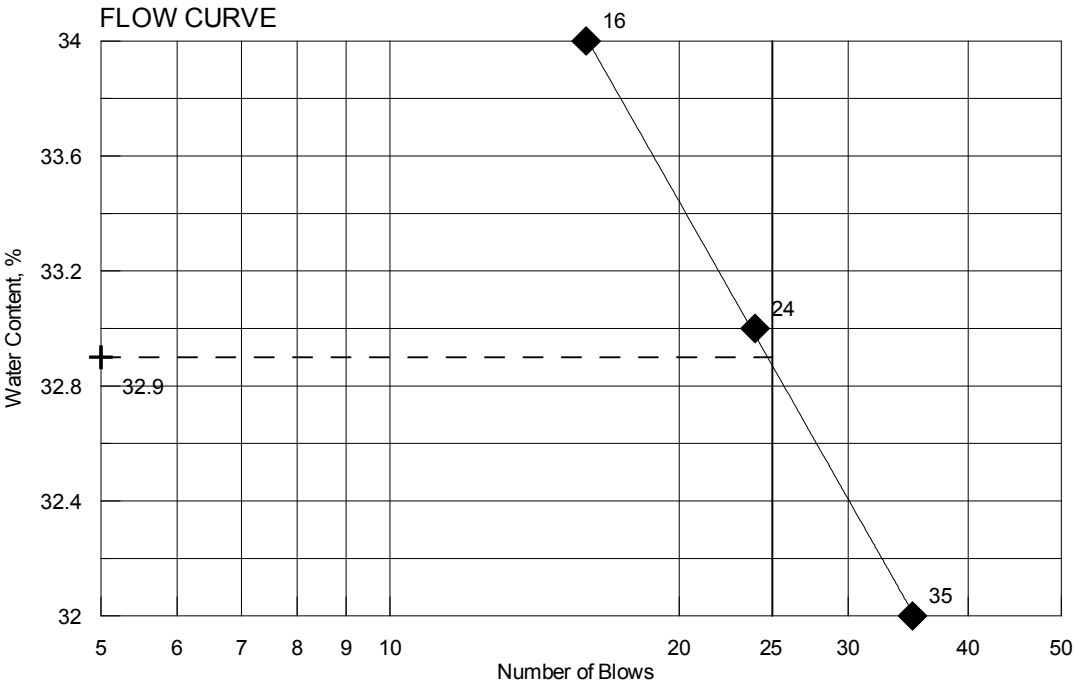
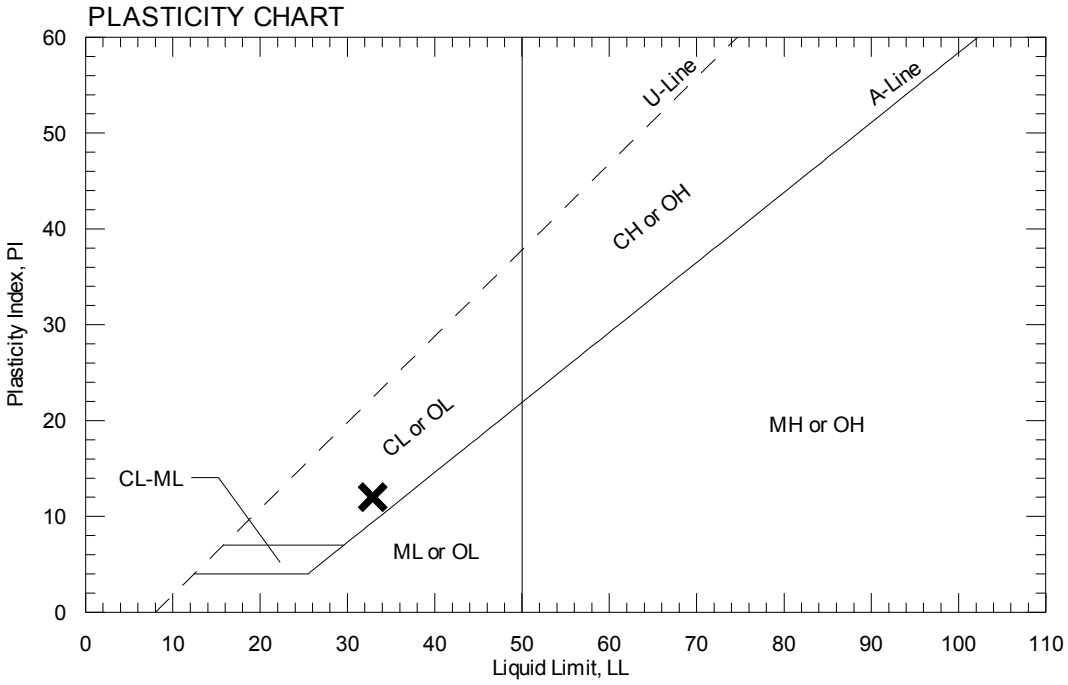


UNIFIED CLASSIFICATION

	Boring/Sample No.	Northing	Easting	Depth, ft	Description	W, %	LL	PL	PI
✚	BB-HEPR-105/1D	633575.2	1762800	1.0-3.0	SAND, some gravel, trace silt.	2.7			
◆	BB-HEPR-105/3D	633575.2	1762800	10.0-12.0	SAND, some gravel, trace silt.	7.5			
■	BB-HEPR-105/4DB	633575.2	1762800	15.2-17.0	CLAY-SILT, trace sand.	24.1	33	21	12
●	BB-HEPR-105/5D	633575.2	1762800	20.0-22.0	SAND, little silt.	18.5			
▲	BB-HEPR-105/8D	633575.2	1762800	35.0-37.0	Gravelly SAND, little silt.	9.1			
✖									

PIN
016705.00
Town
Howland,Enfield
Reported by/Date
WHITE, TERRY A 10/20/2010

TOWN	Howland,Enfield	Reference No.	239833
PIN	016705.00	Water Content, %	24.1
Sampled	8/19/2010	Plastic Limit	21
Boring No./Sample No.	BB-HEPR-105/4DB	Liquid Limit	33
Station		Plasticity Index	12
Depth	15.2-17.0	Tested By	BBURR