MAINE DEPARTMENT OF TRANSPORTATION
HIGHWAY PROGRAM
GEOTECHNICAL SECTION
AUGUSTA, MAINE

GEOTECHNICAL DESIGN REPORT

For the Construction of:

RIVER GLEN BRIDGE
ROUTE 194
WHITEFIELD, MAINE

Prepared by:
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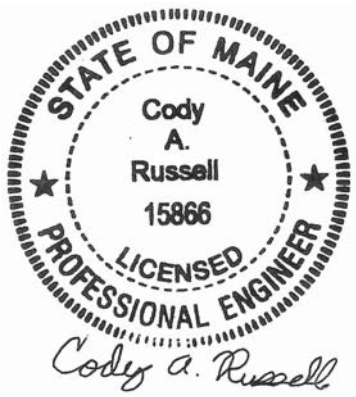

Reviewed by:
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Lincoln County
WIN 23032.00

Soils Report 2021-03
Bridge No. 6629

January 25, 2021

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Appendices

1.0 INTRODUCTION

The purpose of this Geotechnical Design Report is to present subsurface information and make geotechnical recommendations for the replacement of an existing large culvert (#46459) on Route 194 in Whitefield, Maine. A subsurface investigation has been completed at the site to evaluate subsurface conditions and to develop geotechnical design and construction recommendations for the replacement structure. This report presents the subsurface information obtained during the subsurface investigation and soil laboratory testing programs and provides design and construction recommendations and geotechnical design parameters for the culvert replacement.

The existing structure consists of twin, approximately 48-inch diameter, 110-foot long corrugated metal pipe (CMP) culverts on a skew of approximately 11 degrees to the roadway centerline. The CMPs are in poor condition. Route 194 is a Highway Corridor Priority 4 road.

The proposed replacement structure will be a 10-foot diameter, 120-foot long polymer coated corrugated steel pipe culvert on a skew of approximately 7 degrees to the roadway centerline. To facilitate fish passage, Habitat Connectivity Design elements will be used inside the polymer coated corrugate steel pipe culvert as shown on the Streambed Details Sheets in the Plans. The invert of the proposed culvert is approximately 23 feet below the existing road grade at the roadway centerline. The roadway embankment slopes at the proposed culvert inlet shall be 3H:1V from the roadway edge and will break to a 2H:1V slope 2-feet above the culvert end. The 2H:1V slope at the culvert inlet shall be protected with 18 inches of plan riprap to protect against erosion. The roadway embankment slope at the proposed culvert outlet shall be 2H:1V from the roadway edge and will break to a 1.5H:1V slope 2-feet above the culvert end. The 1.5H:1V slope shall be protected with 3 feet of plain riprap to protect against erosion.

2.0 GEOLOGIC SETTING

The existing culvert carries an unnamed stream under Route 194 in Whitefield and is located approximately 0.73 of a mile south of Jewett Lane as shown on Sheet 1 – Location Map.

According to the Maine Geological Survey (MGS) map titled Surficial Geology North Whitefield Quadrangle, Maine, Open File 09-11 (2009) the surficial soils at the site consist of Stream Alluvium. Stream Alluvium consists of sand, gravel, and silt.

According to the map titled Bedrock Geologic Map of Maine (1985) published by the MGS, the bedrock in the vicinity of the site consists of interbedded pelite and sandstone of the Cape Elizabeth Formation.

3.0 SUBSURFACE INVESTIGATION

One (1) boring (HB-WHI-101) and one (1) probe (HB-WHI-102) were drilled on opposite, diagonal corners of the existing structure on August 8, 2018 by the MaineDOT drill crew using a trailer mounted drill rig. Exploration locations are shown on Sheet 2 – Boring Location Plan &

Interpretive Subsurface Profile. Details and sampling methods used, field data obtained, and soil and groundwater conditions encountered are presented on the Boring Logs in Appendix A.

Boring HB-WHI-101 was drilled using solid stem auger, cased wash boring, and rock core drilling techniques. Soil samples were obtained in boring HB-WHI-101 at 5-foot intervals using Standard Penetration Test (SPT) methods. The MaineDOT drill rig is equipped with an automatic hammer to drive the split spoon. The MaineDOT calibrated automatic hammer delivers approximately 54 percent more energy during driving than the standard rope and cathead system. All N-values discussed in this report are corrected values (N_{60}) computed by applying an average energy transfer factor of 0.928 to the raw field N-values. Bedrock was cored in boring HB-WHI-101 using an NQ 2-inch core barrel and the Rock Quality Designation (RQD) of the core was calculated. Probe HB-WHI-102 was drilled using solid stem auger techniques. No soil samples were obtained in the probe.

The MaineDOT Geotechnical Team member selected the boring and probe locations, drilling methods, designated type and depth of sampling, reviewed field logs for accuracy and identified field and laboratory testing requirements. A NorthEast Transportation Training and Certification (NETTCP) certified Subsurface Investigator logged the subsurface conditions encountered in the boring and probe. The boring and probe were located in the field by taping to surveyed site features after completion of the drilling program.

4.0 LABORATORY TESTING

A laboratory testing program was conducted to assist in soil classification, evaluation of engineering properties of the soils and geologic assessment of the project site. Laboratory testing consisted of six (6) standard grain size analysis with natural water content and one (1) standard grain size analysis with hydrometer and natural water content. The results of the laboratory testing program are discussed in the following section and are included in Appendix B – Laboratory Test Results. Laboratory test information is also shown on the Boring Logs in Appendix A.

5.0 SUBSURFACE CONDITIONS

Subsurface conditions encountered at the test boring and probe generally consisted fill sand, gravelly sand, and sandy gravel; underlain by native silt and sand. An interpretive subsurface profile depicting the generalized soil stratigraphy at the boring location is shown on Sheet 2 – Boring Location Plan & Interpretive Subsurface Profile.

Boring HB-WHI-101 was drilled to a depth of approximately 37.0 feet below ground surface (bgs), including a 5-foot bedrock core. Probe HB-WHI-102 was drilled to a depth of approximately 35.0 feet bgs and did not encounter a refusal surface.

The table below summarizes the field and laboratory information obtained in boring HB-WHI-101:

Approx. Depth BGS[1] (feet)	Soil Description	AASHTO[2] Classification	USCS[3]	WC%[4]
0.0 – 0.4	Pavement	--	--	--
0.4 – 19.0	Fill – Brown, damp, fine to coarse sand, little to some gravel, little to some silt. Brown, wet, fine to coarse sandy gravel, trace silt. Brown, wet, gravelly fine to coarse sand, little silt.	 A-1-a or A-2-4 A-1-a A-1-b	 SM GP SM	 3.6 to 12.4 9.1 10.9
19.0 – 25.0	Native Silt – Grey, wet, silt, some fine to coarse sand, little clay, trace gravel.	A-4	CL	25.2
25.0 – 30.4	Native Sand – Grey, wet, fine to coarse sand, little to some silt, trace to little gravel.	A-2-4	SP-SM or SM	9.2 to 19.5
30.4 – 37.0	Bedrock – Interbedded pelite and sandstone of the Cape Elizabeth Formation.	--	--	--

[1]BGS = below ground surface
[2]AASHTO = American Association of State Highway and Transportation Officials
[3]USCS = Unified Soil Classification System
[4]WC% = Water content in percent

Four (4) corrected N-values obtained in the fill ranged from 9 to 131 blows per foot (bpf) indicating that the fill is loose to very dense in consistency. One (1) corrected N-value obtained in the native silt was 11 bpf indicating that the native silt is stiff in consistency. One (1) corrected N-value obtained in the native sand was 22 bpf indicating that the native sand is medium dense in consistency.

In boring HB-WHI-101 bedrock was encountered at a depth of approximately 30.4 feet bgs (approximate elevation 49.1 feet). The Rock Quality Designation (RQD) of the bedrock was determined to be 47 percent in boring HB-WHI-101, which correlates to a Rock Quality of poor.

Groundwater was not observed in the boring or probe. Groundwater level was not recorded in the probe. Groundwater levels can be expected to fluctuate subject to seasonal variations, local soil conditions, topography, precipitation, and construction activity.

6.0 GEOTECHNICAL DESIGN AND CONSTRUCTION RECOMMENDATIONS

The proposed replacement structure will consist of a 10-foot diameter, 120-foot long polymer coated corrugated steel pipe culvert on a skew of approximately 7 degrees to the roadway

centerline. The proposed structure inlet and outlet slopes shall be constructed with slopes no steeper than 2H:1V with 18 inches of riprap at the culvert inlet and no steeper than 1.5H:1V with 3-feet of riprap at the culvert outlet to protect against erosion. The following sections discuss geotechnical recommendations for the design and construction of the proposed culvert.

6.1 Polymer Coated Corrugated Steel Pipe Culvert Design and Construction

The proposed replacement structure will consist of a 10-foot diameter, 120-foot long polymer coated corrugated steel pipe culvert on a skew of approximately 7 degrees to the roadway centerline. The proposed culvert shall be designed and constructed in accordance with MaineDOT Standard Specification 603.

The invert elevation of the proposed polymer coated corrugated steel pipe arch culvert ranges from approximately 58.2 feet at the inlet end to approximately 57.3 feet at the outlet end with an approximately 0.7 percent slope. To facilitate fish passage, Habitat Connectivity Design elements will be used inside the polymer coated corrugated steel pipe culvert as shown on the Streambed Details Sheets in the Plans.

The full nature of the culvert bearing surface will not become evident until the culvert excavation is made. Any cobbles or boulders in excess of 6 inches encountered at the bedding elevation shall be removed and replaced with compacted Granular Borrow Material for Underwater Backfill or Crushed Stone ¾-Inch. Any disturbed soils at the bedding elevation resulting from excavation activities should be removed by hand prior to placement of the bedding material. The prepared subgrade shall be proofrolled using a static roller to visually confirm the prepared subgrade is firm and stable. The exposed subgrade shall be free of ponded water so that bedding material placement and compaction can be completed in the dry.

The proposed structure shall be bedded on a 1-foot thick layer of Granular Borrow, Material for Underwater Backfill meeting the requirements of MaineDOT Standard Specification 703.19. The soil envelope and backfill shall consist of Standard Specification 703.19 - Granular Borrow with a maximum particle size of 4 inches. The Granular Borrow bedding and backfill material shall be placed in lifts of 6 to 8 inches loose measure and compacted to the manufacturer's specifications or, in the absence of manufacturer's specifications, the bedding and backfill soil shall be compacted to at least 92 percent of the AASHTO T-180 maximum dry density.

6.2 Settlement

No settlement issues are anticipated at the site. The proposed structure is larger than the existing culverts and will result in a net unloading of the site soils at the structure location. Placement of fill soils at the location of the existing structure is not anticipated to exceed the past loading condition of the site soils. Any settlement due to elastic compression of the subgrade soils and bedding material will be immediate and negligible.

6.3 Scour and Riprap

Both the inlet and outlet of the polymer coated corrugated steel pipe culvert shall be protected against scour with riprap conforming to MaineDOT Standard Specification Section 703.26 Plain and Hand Laid Riprap. The proposed structure slopes shall be constructed with slopes no steeper than 2H:1V with 18 inches of riprap at the culvert inlet and no steeper than 1.5H:1V with 3-feet of riprap at the culvert outlet to protect against erosion. No specific scour protection recommendations are needed other than armoring with riprap. The riprap on the slopes shall be underlain by a non-woven, Class 1 Erosion Control Geotextile meeting the requirements of MaineDOT Standard Specification 722.03 that is underlain by a 1-foot layer of protective aggregate cushion consisting of Granular Borrow Material for Underwater Backfill (703.19). The toe of the riprap sections shall be keyed into the existing soils 1 foot below the streambed elevation.

6.4 Seismic Design Considerations

In conformance with LRFD Article 3.10.1, seismic analysis is not required for buried structures, except where they cross active faults. There are no known active faults in Maine; therefore, seismic analysis is not required.

6.5 Construction Considerations

Construction activities may include construction of cofferdams and earth support systems to control stream flow during construction. Construction activities will also include common earth excavation. Construction of the proposed polymer coated corrugated steel pipe culvert will require deep soil excavation. Earth support systems shall be implemented if laying back slopes is not feasible. It is likely that the use of complex (four-sided) braced excavations with dewatering will be necessary due to the depth of the excavation. If this is the case, adequate embedment into native silts will be necessary to allow for the excavation and maintenance of a stable excavation bottom. All earth support systems shall be designed by a Professional Engineer licensed in the State of Maine. Regardless of the method of excavation, all excavations and earth support systems shall meet all applicable OSHA regulations.

The Contractor shall control groundwater and surface water infiltration using temporary ditches, sumps, granular drainage blankets, stone ditch protection or hand-laid riprap with geotextile underlayment to divert groundwater and surface water as needed to maintain a stable excavation and allow work in the dry.

Using the excavated native soils as backfill around the culvert shall not be permitted. The native soils may only be used as common borrow in accordance with MaineDOT Standard Specifications 203 and 703.

The Contractor will have to excavate the existing subbase and subgrade fill soils in the vicinity of the culvert. These materials should not be used to re-base the roadway. Excavated subbase sand and gravel may be used as fill below roadway subgrade level in fill areas provided all other requirements of MaineDOT Standard Specifications 203 and 703 are met.

7.0 CLOSURE

This report has been prepared for the use of the MaineDOT Highway Program for specific application to the proposed replacement of an existing large culvert (#46459) under Route 194 in Whitefield, Maine in accordance with generally accepted geotechnical and foundation engineering practices. No other intended use or warranty is expressed or implied.

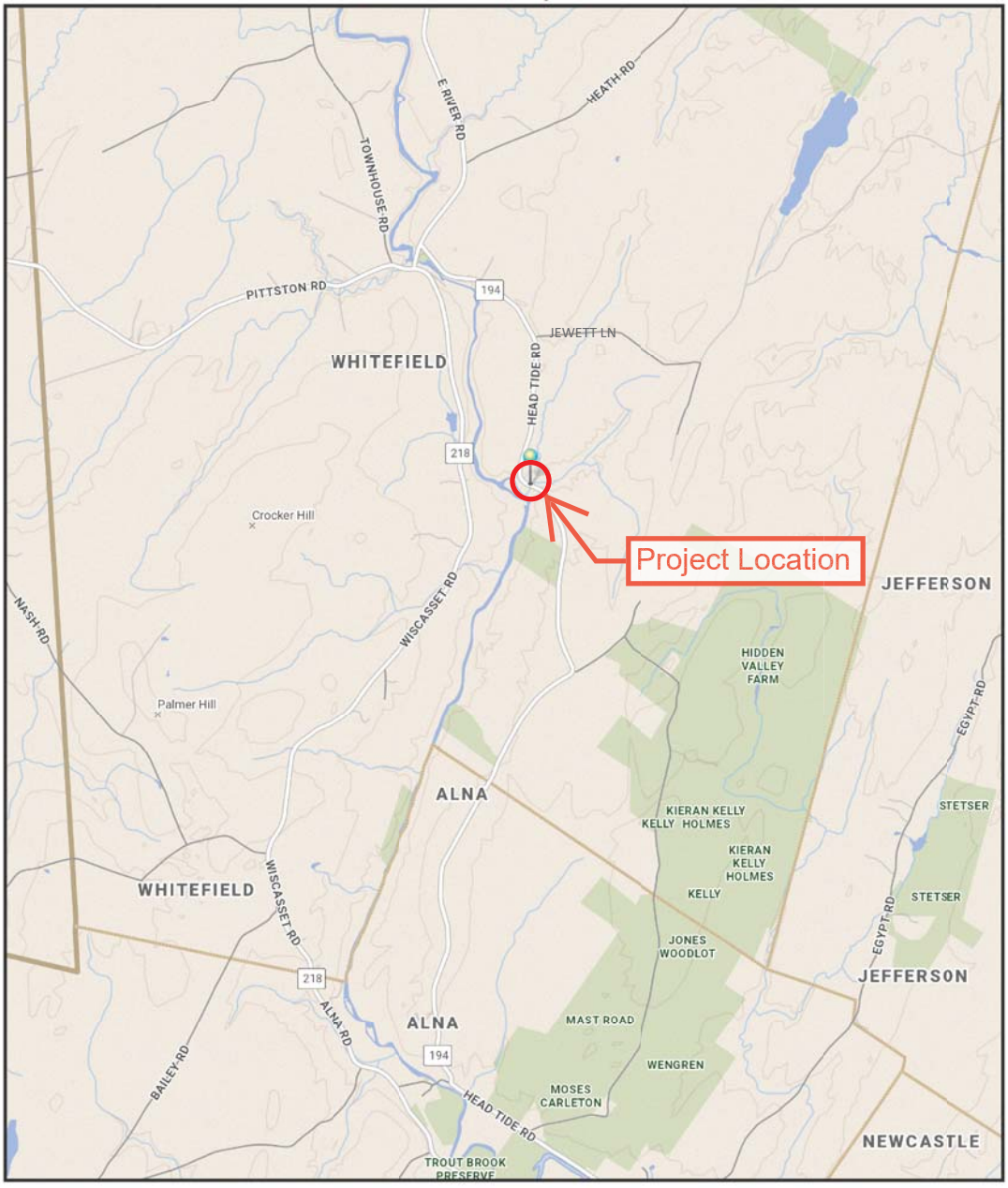
In the event that any changes in the nature, design, or location of the proposed project are planned, this report should be reviewed by a geotechnical engineer to assess the appropriateness of the conclusions and recommendations and to modify the recommendations as appropriate to reflect the changes in design. These analyses and recommendations are based in part upon a limited subsurface investigation at discrete exploratory location completed at the site. If variations from the conditions encountered during the investigation appear evident during construction, it may also become necessary to re-evaluate the recommendations made in this report.

It is recommended that a geotechnical engineer be provided the opportunity for a review of the design and specifications in order that the earthwork and foundation recommendations and construction considerations presented in this report are properly interpreted and implemented in the design and specifications.

Sheets

Username: Terry.White Division: GEOTECH Date:1/25/2021

WHITEFIELD, MAINE



The Maine Department of Transportation provides this publication for information only. Reliance upon this information is at user risk. It is subject to revision and may be incomplete depending upon changing conditions. The Department assumes no liability if injuries or damages result from this information. This map is not intended to support emergency dispatch.

0.75 Miles

1 inch = 0.81 miles

Date: 1/25/2021
Time: 9:07:49 AM

SHEET NUMBER 1 OF 2	WHITEFIELD ROUTE 194 LOCATION MAP	STATE OF MAINE DEPARTMENT OF TRANSPORTATION 23032.00 WIN 23032.00 HIGHWAY PLANS

CURVE DATA #1
PI = 11+88.65
D = 17°54'17.8"
Δ = 40°40'53.0" Lt.
R = 320.00'
L = 227.21'
T = 118.63'
E = 21.28'

PCC = STA. 12+97.23
N: 2392778.7344
E: 1511980.8721

PT = STA. 14+34.46
N: 2392225.4960
E: 1512107.3106

BEGIN PROJECT
END TRANSITION
STA. 13+25.00

BEGIN TRANSITION
STA. 13+00.00

CURVE #1

12+00

13+00

CURVE #2
SKEW
6°47'49"

14+00

S69°37'22.90"E

15+00

ROUTE 194

16+00

HB-WHI-101

HB-WHI-102

END PROJECT
BEGIN TRANSITION
STA. 14+25.00

END TRANSITION
STA. 14+50.00

5' GRAVEL SHOULDER (TYP.)

PLAIN
RIPRAI
STATIC
13+64
13+79

SLOPE
STATION
13+50

LIMITS OF WORK
STA. 15+17.04

LOCATION OI

PROPOSED 10' DIAMETER X 120'
LENGTH POLYMER COATED
CORRUGATED STEEL PIPE- STATE
SUPPLIED.
EXISTING 2 48" PIPES TO BE
REMOVED

PLAIN RIPRAP (TYP.)

PC = STA. 15+17.46

CURVE DATA
PI = 16+28.
D = 9°57'
Δ = 21°53'0
R = 575.00'
L = 219.62'
T = 111.16'
E = 10.65'

TH

506.1301

H

506.1304

RADIUS
25'

PLAN

25 0 25 50
Scale of Feet

LEGEND
CASED WASH BORING
PROBE

T AS DIRECTED BY
VTAL STAFF.
IE APPROPRIATE

12+00 13+00 14+00 15+00 16+00

STA. 13+00
BEGIN TRANSITION

25.0'
TRANS.

100.0'
PROJECT

25.0'
TRANS.

PROFILE GRADE

4" HMA

EXISTING
GROUND

STA. 13+25
END TRANSITION
BEGIN PROJECT

STA. 14+50
END TRANSITION

STA. 14+25
BEGIN TRANSITION
END PROJECT

LOW POINT = STA. 13+52.46
ELEV. = 80.2'

20" AGGREGATE SUBBASE
COURSE GRAVEL

Brown, damp to wet, loose to very dense, fine to coarse SAND, little to some gravel, little to some silt; fine to coarse Sandy GRAVEL, trace silt; and Gravelly fine to coarse SAND, little silt. (Fill).

CONTRACTOR'S METHOD OF
EXCAVATION IN ACCORDANCE WITH
OSHA REQUIREMENTS BACKFILL WITH
SUITABLE EXCAVATED MATERIAL
(TYP.)

LIMITS OF GRANULAR BORROW

10' DIAMETER X 120' LENGTH POLYMER CORRUGATE STEEL PIPE- STATE SUPPLIED

Grey, wet, stiff, SILT, some fine to coarse sand, little clay, trace gravel.

Grey, wet, medium dense, fine to coarse SAND, little to some silt, trace to little gravel.

EL. 49.1

RI: Bedrock: Interbedded PELITE and SANDSTONE. [Cape Elizabeth Formation]. Rock Quality = Poor

RQD=47%

NR

BOE

90 85 80 75 70 65 60 55 50 45 40

12+00 13+00 14+00 15+00 16+00

Weathered Bedrock, if applicable
Approximate Top of Bedrock
Boring No.
Offset, if shown
Pavement Thickness, if applicable
RQD= Rock Quality Designation of Bedrock Core Sample
BOE= Bottom of Exploration

LEGEND

No Refusal
NR
Refusal
R

PROFILE

HORIZ 25 0 25 50
VERT 5 0 5 10
SCALE

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

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

23032.00

WIN
23032.00

HIGHWAY PLANS

	BY	DATE
PROJ. MANAGER	----------	----------
DESIGN-DETAILED	C.RUSSELL	DEC 2020
CHECKED-REVIEWED	-----	-----
DESIGN2-DETAILED2	----------	----------
DESIGN3-DETAILED3	----------	----------
REVISIONS 1	T.WHITE	-----
REVISIONS 2	----------	----------
REVISIONS 3	----------	----------
REVISIONS 4	----------	----------
FIELD CHANGES	----------	----------

SIGNATURE

P.E. NUMBER

DATE

WHITEFIELD
ROUTE 194

BORING LOCATION PLAN &
INTERPRETIVE SUBSURFACE PROFILE

SHEET NUMBER

2

OF 2

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, if applicable):

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

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

MODIFIED BURMISTER SYSTEM

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

TERMS DESCRIBING DENSITY/CONSISTENCY

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

Density of Cohesionless Soils	Standard Penetration Resistance N-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):

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

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

Rock Quality Based on RQD

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

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

Color (Munsell color chart)
Texture (aphanitic, fine-grained, etc.)
Rock Type (granite, schist, sandstone, etc.)
Hardness (very hard, hard, mod. hard, etc.)
Weathering (fresh, very slight, slight, moderate, mod. severe, severe, etc.)
Geologic discontinuities/jointing:
-dip (horiz - 0-5 deg., low angle - 5-35 deg., mod. dipping - 35-55 deg., steep - 55-85 deg., vertical - 85-90 deg.)
-spacing (very close - <2 inch, close - 2-12 inch, mod. close - 1-3 feet, wide - 3-10 feet, very wide >10 feet)
-tightness (tight, open, or healed)
-infilling (grain size, color, etc.)
Formation (Waterville, Ellsworth, Cape Elizabeth, etc.)
RQD and correlation to rock quality (very poor, poor, etc.)
ref: ASTM D6032 and FHWA NHI-16-072 GEC 5 - Geotechnical Site Characterization, Table 4-12
Recovery (inch/inch and percentage)
Rock Core Rate (X.X ft - Y.Y ft (min:sec))

Sample Container Labeling Requirements:

WIN
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: Large Culvert Replacement on Route 194
Location: Whitefield, Maine

Boring No.: HB-WHI-101
WIN: 23032.00

Driller:	MaineDOT	**Elevation (ft.)**	79.5	**Auger ID/OD:**	5" Solid Stem
Operator:	Daggett/Niles/Kyle	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	C. Russell	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	8/8/2018; 08:25-12:55	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2"
Boring Location:	13+69.6, 8.3 ft Lt.	**Casing ID/OD:**	NW-3"	**Water Level*:**	None Observed
Hammer Efficiency Factor: 0.928		**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	79.1		5" HMA. 0.4	
	1D	24/9	1.00 - 3.00	8/9/10/9	19	29				Brown, damp, medium dense, fine to coarse SAND, some gravel, little silt, (Fill).	G#296560 A-1-a, SM WC=3.6%
5	2D	24/14	5.00 - 7.00	6/3/3/4	6	9	30			Brown, damp, loose, fine to coarse SAND, some silt, little gravel, (Fill).	G#296561 A-2-4, SM WC=12.4%
							19				
							14				
							11				
							25				
10	3D	24/4	10.00 - 12.00	7/8/7/10	15	23	5			Brown, wet, medium dense, fine to coarse Sandy GRAVEL, trace silt, (Fill).	G#296562 A-1-a, GP WC=9.1%
							35				
							44				
							88				
							191				
15	4D	24/8	15.40 - 17.40	17/49/36/18	85	131	25			Cobble from 15.0-15.4 ft bgs. Brown, wet, very dense, Gravelly fine to coarse SAND, little silt, (Fill).	G#296563 A-1-b, SM WC=10.9%
							69				
							141				
							63				
							39	60.5		19.0	
20	5D	24/20	20.00 - 22.00	2/3/4/4	7	11	34			Grey, wet, stiff, SILT, some fine to coarse sand, little clay, trace gravel.	G#296564 A-4, CL WC=25.2%
							35				
							45				
							37				
25							43				

Remarks:

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: Large Culvert Replacement on Route 194
Location: Whitefield, Maine

Boring No.: HB-WHI-101
WIN: 23032.00

Driller:	MaineDOT	**Elevation (ft.)**	79.5	**Auger ID/OD:**	5" Solid Stem
Operator:	Daggett/Niles/Kyle	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	C. Russell	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	8/8/2018; 08:25-12:55	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2"
Boring Location:	13+69.6, 8.3 ft Lt.	**Casing ID/OD:**	NW-3"	**Water Level*:**	None Observed
Hammer Efficiency Factor:	0.928	**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	6D	24/18	25.00 - 27.00	3/5/9/17	14	22	36	54.5		25.0 Grey, wet, medium dense, fine to coarse SAND, little silt, trace gravel.	G#296565 A-2-4, SP-SM WC=19.5%
							42				
							60				
							52				
							56				
30	7D	4.8/2	30.00 - 30.40	34(4.8")	---		RC	49.1		Grey, wet, fine to coarse SAND, some silt, little gravel. Spoon REFUSAL at 30.4 ft bgs. 30.4	G#296566 A-2-4, SM WC=9.2%
										Top of Bedrock at Elev. 49.1 ft. Roller Coned ahead to 32.0 ft bgs.	
	R1	60/60	32.00 - 37.00	RQD = 47%			NQ-2			R1: Bedrock: Interbedded PELITE and SANDSTONE [Cape Elizabeth Formation]. Rock Quality = Poor. R1: Core Times (min:sec) 32.0-33.0 ft (0:34) 33.0-34.0 ft (3:08) 34.0-35.0 ft (3:15) 35.0-36.0 ft (5:16) 36.0-37.0 ft (2:41) 100% Recovery	
35								42.5		37.0 **Bottom of Exploration at 37.0 feet below ground surface.**	
40											
45											
50											

Remarks:

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: Large Culvert Replacement on Route 194
Location: Whitefield, Maine

Boring No.: HB-WHI-102
WIN: 23032.00

Drilling Contractor:	MaineDOT	**Elevation (ft.)**	80.6	**Auger ID/OD:**	5" Dia.
Operator:	Daggett/Niles/Kyle	**Datum:**	NAVD88	**Sampler:**	N/A
Logged By:	C. Russell	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	N/A
Date Start/Finish:	8/8/2018; 13:00-13:35	**Drilling Method:**	Solid Stem Auger	**Core Barrel:**	N/A
Boring Location:	14+05.2, 5.7 ft Rt.	**Casing ID/OD:**	N/A	**Water Level*:**	None Observed

Definitions: D = Spilt Spoon Sample; S = Sample off Auger Flights; B = Bucket Sample off Auger Flights; MD = Unsuccessful Split Spoon Sample Attempt; U = Thin Wall Tube Sample; MV = Unsuccessful Field Vane Shear Test Attempt; V = Field Vane Shear Test, PP= Pocket Penetrometer; MU = Unsuccessful Thin Wall Tube Sample 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 1 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-value = Raw Field SPT N-value; T_v = Pocket Torvane Shear Strength (psf); WC = Water Content, percent ≅ = Similar or Equal too; 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-value	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0						SSA			Probe, no soil samples taken.	
5										
10										
15										
20										
25										

Remarks:

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: Large Culvert Replacement on Route 194
Location: Whitefield, Maine

Boring No.: HB-WHI-102
WIN: 23032.00

Drilling Contractor:	MaineDOT	**Elevation (ft.)**	80.6	**Auger ID/OD:**	5" Dia.
Operator:	Daggett/Niles/Kyle	**Datum:**	NAVD88	**Sampler:**	N/A
Logged By:	C. Russell	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	N/A
Date Start/Finish:	8/8/2018; 13:00-13:35	**Drilling Method:**	Solid Stem Auger	**Core Barrel:**	N/A
Boring Location:	14+05.2, 5.7 ft Rt.	**Casing ID/OD:**	N/A	**Water Level*:**	None Observed

Definitions:
D = Spilt Spoon Sample
S = Sample off Auger Flights
B = Bucket Sample off Auger Flights
MD = Unsuccessful Split Spoon Sample Attempt
U = Thin Wall Tube Sample
MV = Unsuccessful Field Vane Shear Test Attempt
V = Field Vane Shear Test, PP= Pocket Penetrometer
MU = Unsuccessful Thin Wall Tube Sample Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140lb. Hammer
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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-value = Raw Field SPT N-value
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WC = Water Content, percent ≅ = Similar or Equal too
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-value	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25										
30										
35							45.6		**Bottom of Exploration at 35.0 feet below ground surface.** 35.0 NO REFUSAL	
40										
45										
50										

Remarks:

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.

Appendix B

Laboratory Test Results

State of Maine - Department of Transportation

Laboratory Testing Summary Sheet

Town(s): Whitefield Work Number: 23032.00

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-WHI-101, 1D	13+69.6	8.3 Lt.	1.0-3.0	296560	1	3.6			SM	A-1-a	II
HB-WHI-101, 2D	13+69.6	8.3 Lt.	5.0-7.0	296561	1	12.4			SM	A-2-4	II
HB-WHI-101, 3D	13+69.6	8.3 Lt.	10.0-12.0	296562	1	9.1			GP	A-1-a	0
HB-WHI-101, 4D	13+69.6	8.3 Lt.	15.4-17.4	296563	1	10.9			SM	A-1-b	II
HB-WHI-101, 5D	13+69.6	8.3 Lt.	20.0-22.0	296564	2	25.2			CL	A-4	IV
HB-WHI-101, 6D	13+69.6	8.3 Lt.	25.0-27.0	296565	2	19.5			SP-SM	A-2-4	0
HB-WHI-101, 7D	13+69.6	8.3 Lt.	30.0-30.4	296566	2	9.2			SM	A-2-4	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.

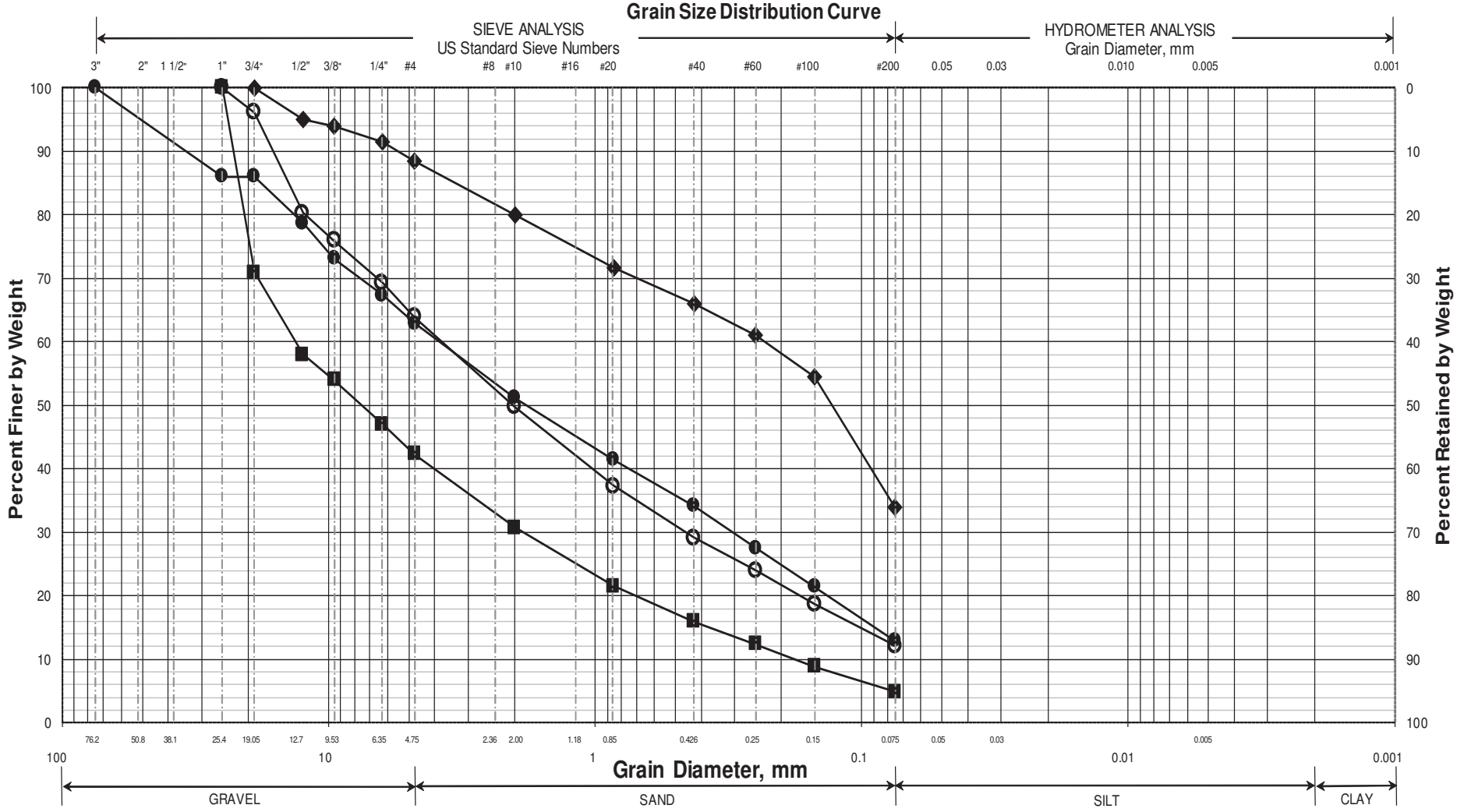
GSDC = Grain Size Distribution Curve as determined by AASHTO T 88-93 (1996) and/or ASTM D 422-63 (Reapproved 1998)

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 NP = Non Plastic

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

Maine Department of Transportation
Grain Size Distribution Curve

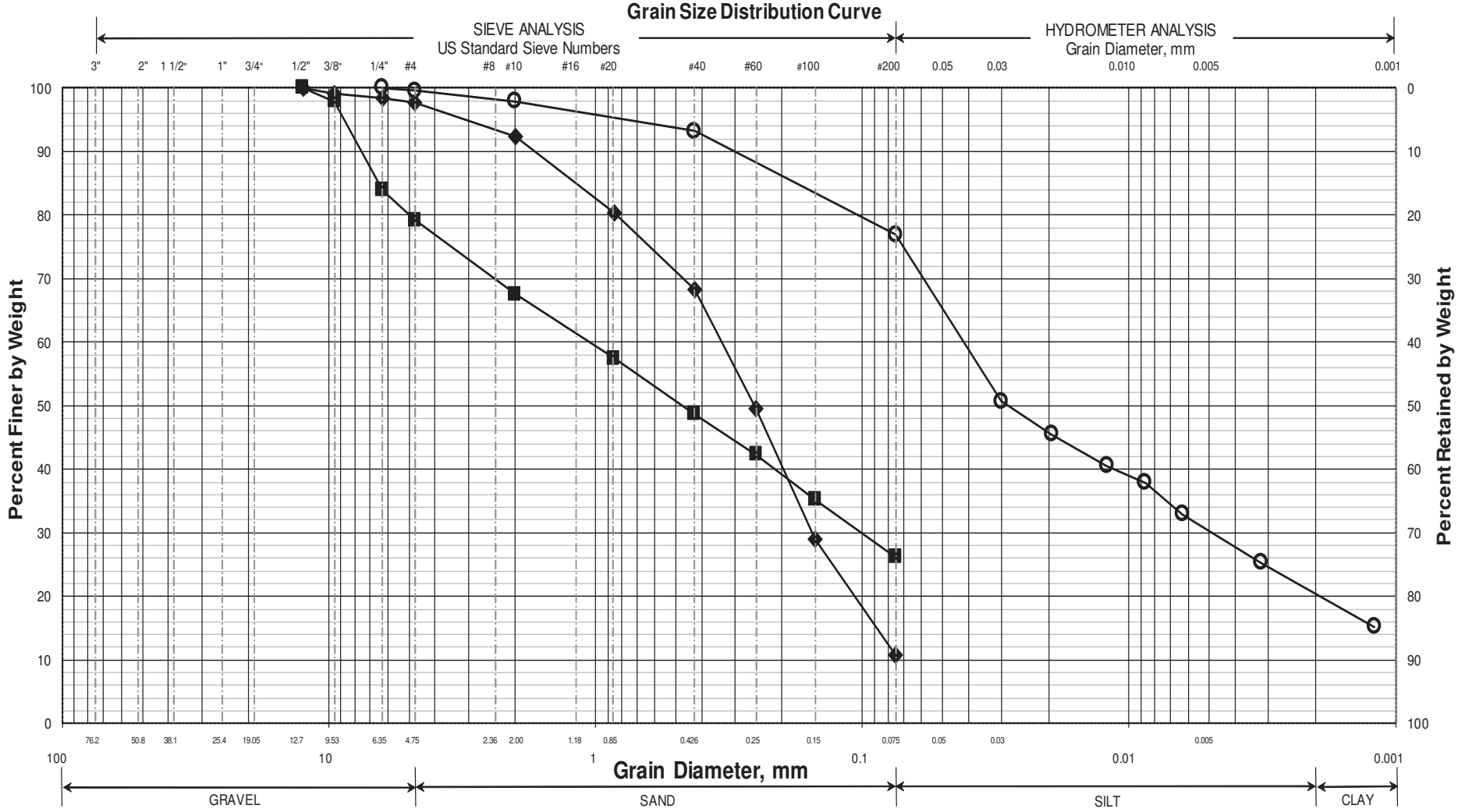


UNIFIED CLASSIFICATION

	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	WC, %	LL	PL	PI
○	HB-WHI-101/1D	13+69.6	8.3 LT	1.0-3.0	SAND, some gravel, little silt.	3.6			
◆	HB-WHI-101/2D	13+69.6	8.3 LT	5.0-7.0	SAND, some silt, little gravel.	12.4			
■	HB-WHI-101/3D	13+69.6	8.3 LT	10.0-12.0	Sandy GRAVEL, trace silt.	9.1			
●	HB-WHI-101/4D	13+69.6	8.3 LT	15.4-17.4	Gravelly SAND, little silt.	10.9			
▲									
×									

WIN
023032.00
Town
Whitefield
Reported by/Date
WHITE, TERRY A 12/15/2020

Maine Department of Transportation
Grain Size Distribution Curve



UNIFIED CLASSIFICATION

	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	WC, %	LL	PL	PI
○	HB-WHI-101/5D	13+69.6	8.3 LT	20.0-22.0	SILT, some sand, little clay, trace gravel.	25.2			
◆	HB-WHI-101/6D	13+69.6	8.3 LT	25.0-27.0	SAND, little silt, trace gravel.	19.5			
■	HB-WHI-101/7D	13+69.6	8.3 LT	30.0-30.4	SAND, some silt, little gravel.	9.2			
●									
▲									
×									

WIN
023032.00
Town
Whitefield
Reported by/Date
WHITE, TERRY A 12/16/2020