

**MAINE DEPARTMENT OF TRANSPORTATION
HIGHWAY PROGRAM
GEOTECHNICAL SECTION
AUGUSTA, MAINE**

GEOTECHNICAL DATA REPORT

For the Rehabilitation of:
**RIVER ROAD
WINDHAM, MAINE**

Prepared by:
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Assistant Geotechnical Engineer



Reviewed by:
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Senior Geotechnical Engineer

Cumberland County
WIN 11219.20

Soils Report 2019-11
Federal No. STP-1121(920)X

April 12, 2019

INTRODUCTION

The purpose of this data report is to document subsurface information collected and make geotechnical and construction recommendations for the rehabilitation of an approximately 3.15-mile portion of River Road in Windham. The project is needed to improve the roadway structure and wearing surface, address geometric deficiencies, and address drainage issues. This report presents the results of a limited geotechnical investigation performed along the project alignment and the results of a limited laboratory testing program conducted on soils recovered during the geotechnical investigation. River Road is a Highway Corridor Priority 3 road.

GEOLOGIC SETTING

The project begins at the Westbrook town line and extends northerly approximately 3.15 miles to Chute/Depot Road as shown on Sheet 1 – Location Map.

According to the Maine Geologic Survey (MGS) map titled Surficial Geology, Gorham Quadrangle, Maine, Open-File No. 99-84 (1999) the surficial soils along the project consist of Presumpscot Formation silt, clay, and sand; End Moraine Complex coarse gravel, sand, silt, and till; and sand, silt, and gravel Till. End Moraine Complex and Till typically overlay shallow bedrock.

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 calcareous sandstone and interbedded sandstone and impure limestone of the Vassalboro Formation.

SUBSURFACE INVESTIGATION

Subsurface conditions along the project were explored by drilling thirty-five (35) test borings in June 2005 and February 2015 and eighty-seven (87) probes in June 2005 and April 2007. One (1) additional boring was drilled outside the project limits. The borings and probes were drilled by the MaineDOT drill crew using a trailer mounted drill rig and solid stem auger techniques. The exploration depths ranged from approximately 1.5 to 10.0 feet below ground surface (bgs) in the borings and approximately 1.2 feet to 10.2 feet bgs in the probes. Twelve (12) of the borings and seventy-two (72) of the probes encountered a shallow refusal surface. The exact nature of the refusal surface was not determined in the explorations. Soil samples were obtained off the auger flights in all borings. No soil samples were obtained in the probes. Boring and probe locations are shown on Sheets 2 through 27 – Boring Location Plans. Details on sampling methods used, field data obtained, and soil conditions encountered are presented in the boring logs provided in the attached Boring Logs. Information relating to the probes is summarized in the attached Probe Summary Sheets.

A Northeast Transportation Training and Certification Program (NETTCP) Certified Subsurface Inspector logged the subsurface conditions encountered in the borings. 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 laboratory testing requirements. The borings and probes were located in the field by taping to site features after completion of the drilling program.

LABORATORY TESTING

A laboratory testing program was conducted on select soil samples obtained in the borings to assist in soil classification. Laboratory testing consisted of twenty-four (24) standard grain size analyses with natural water content. The results of the laboratory tests are summarized in the attached Laboratory Testing Summary Sheet. Laboratory test results for the samples obtained in the borings are also summarized on the attached boring logs.

GEOTECHNICAL RECOMMENDATIONS

Shallow Refusals

Shallow refusals are an area of geotechnical concern on this project. Based on the results of the borings and probes, rock removal will be necessary near the following stations where shallow refusal surfaces were encountered:

Approximate Stations	Range of Approximate Depths to Refusal (feet bgs)
854+01 to 858+51	2.1 to 9.6
865+01	1.5
879+01 to 880+51	7.5 to 10.2
892+51 to 894+01	1.6 to 3.5
1941+51 to 1947+51	1.2 to 9.5

Rock excavation for the proposed drainage system will be necessary near these stations. Additional shallow rock may be encountered during construction of the drainage system at other locations. No rock cores were taken along the project and the actual nature of the refusal surface was not determined. The nature, slope and degree of fracturing in the rock surface will not be evident until the excavations are made and rock is exposed.

It should be anticipated that if shallow rock is encountered during excavation work, removal will be necessary. Machinery capable of removing intact rock, such as heavy-duty backhoes with rock ripping teeth, hydraulic thumbs or pneumatic rock breaking equipment, should be anticipated for this work. There is also a possibility that rock excavation will require blasting. Construction activities should not be permitted to disturb the rock mass or to create any rock falls or any open fissures.

Blasting should be conducted in accordance with MaineDOT Standard Specification Sections 105.2.7 and 203. The Contractor is required to conduct pre-blast surveys as well as blast vibration monitoring at any nearby structures in accordance with industry standards at the time of the blast. Pre-blast surveys shall be provided to the Resident prior to blasting at the site. Strict measures should be implemented to control flyrock. The method of flyrock control shall

be subject to approval by the Department. Such approval will not relieve the Contractor from adequately protecting adjacent property and work areas.

CLOSURE

This Geotechnical Data Report has been prepared for the use of the MaineDOT Highway Program for specific application to the proposed rehabilitation of River Road in Windham, Maine in accordance with generally accepted geotechnical and foundation engineering practices. No other intended use or warranty is expressed or implied.

MaineDOT conducted a limited number of soil explorations at discrete locations along the project and a limited number of laboratory tests. MaineDOT shall not be responsible for the Bidder's or Contractor's interpretations, estimates, or conclusions derived from the geotechnical information. Data provided may not be representative of the subsurface conditions between boring locations.

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 locations 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.

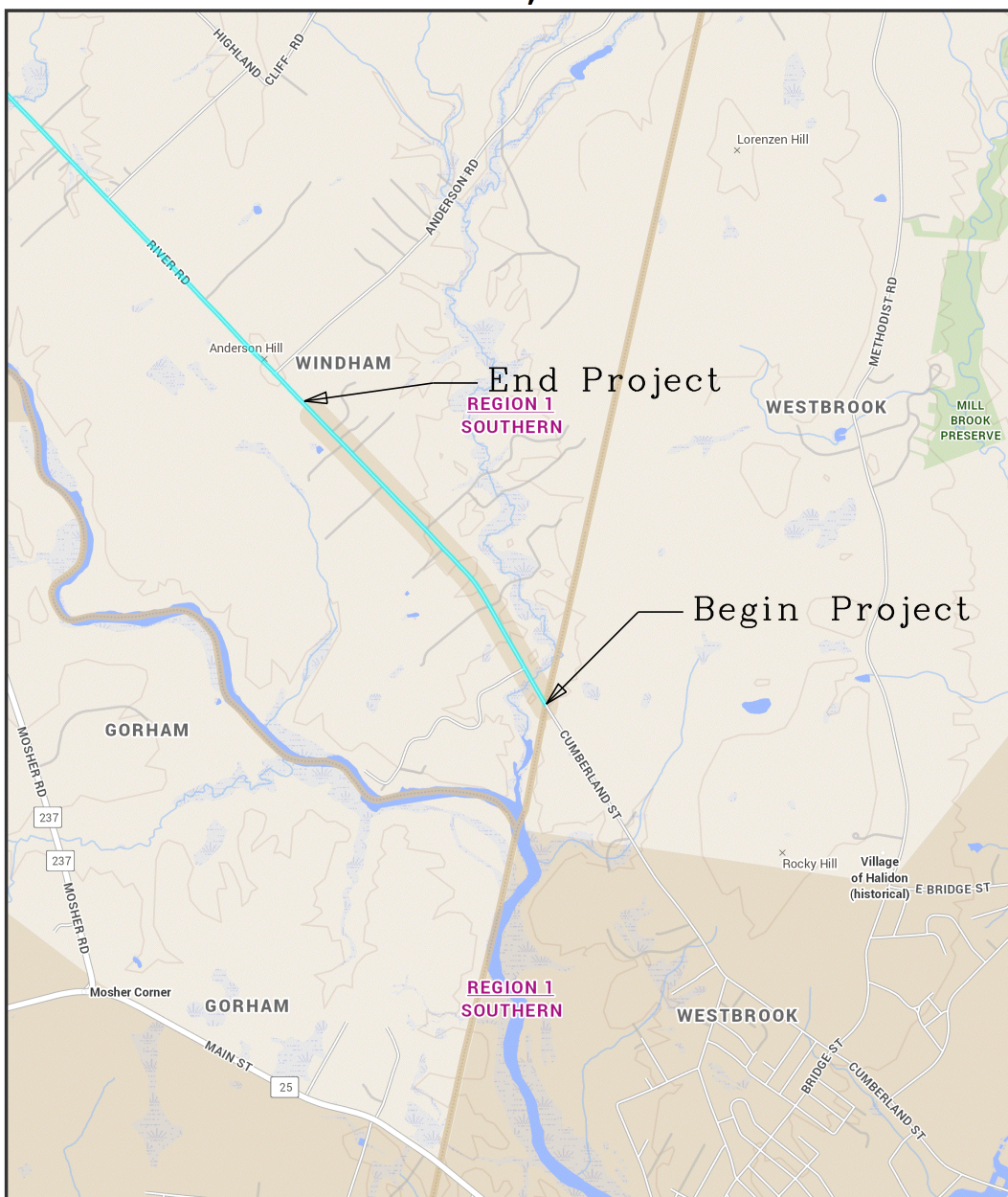
It is recommended that a geotechnical engineer be provided the opportunity for a review of the design and specifications in order that the earthwork and foundation recommendations and construction considerations presented in this report are properly interpreted and implemented in the design and specifications.

Attachments:

Location Map
Boring Location Plans
Key to Soil and Rock Descriptions and Terms
Boring Logs
Probe Summary Sheets
Laboratory Testing Summary Sheet
Grain Size Distribution Curves



WINDHAM, MAINE

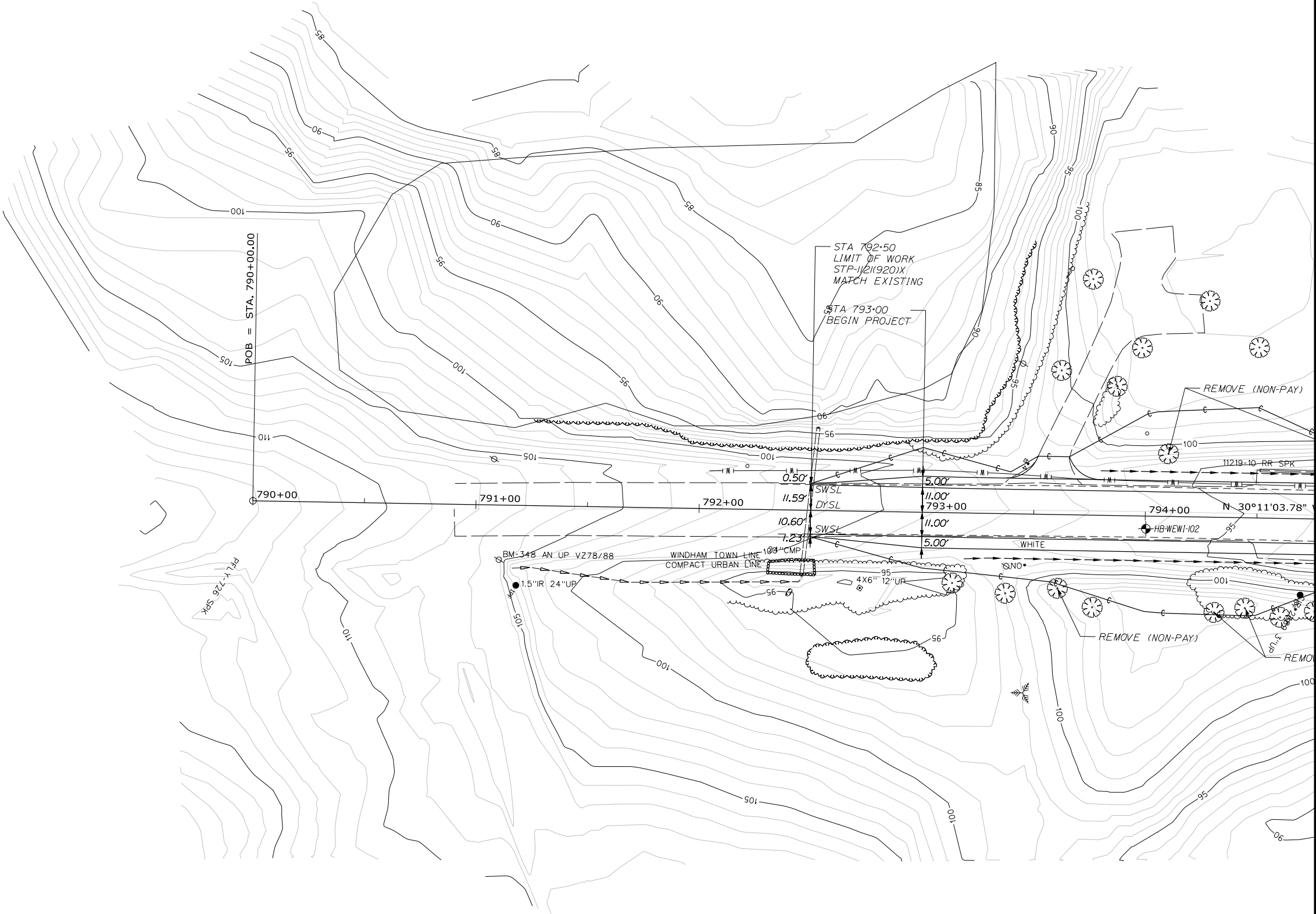
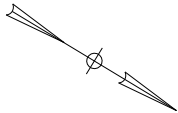


The Maine Department of Transportation provides this publication for information only. Reliance upon this information is at user risk. It is subject to revision and may be incomplete depending upon changing conditions. The Department assumes no liability if injuries or damages result from this information.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

0.45
Miles
1 inch = 0.48 miles

Date: 3/14/2019
Time: 7:16:09 AM

SHEET NUMBER 1 OF 27	WINDHAM RIVER ROAD LOCATION MAP	STATE OF MAINE DEPARTMENT OF TRANSPORTATION 011219.20 WIN 11219.20 HIGHWAY PLANS
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LEGEND

HB- SOLID STEM AUGER W/DESCRIPTIONS

P- PROBE

KEY

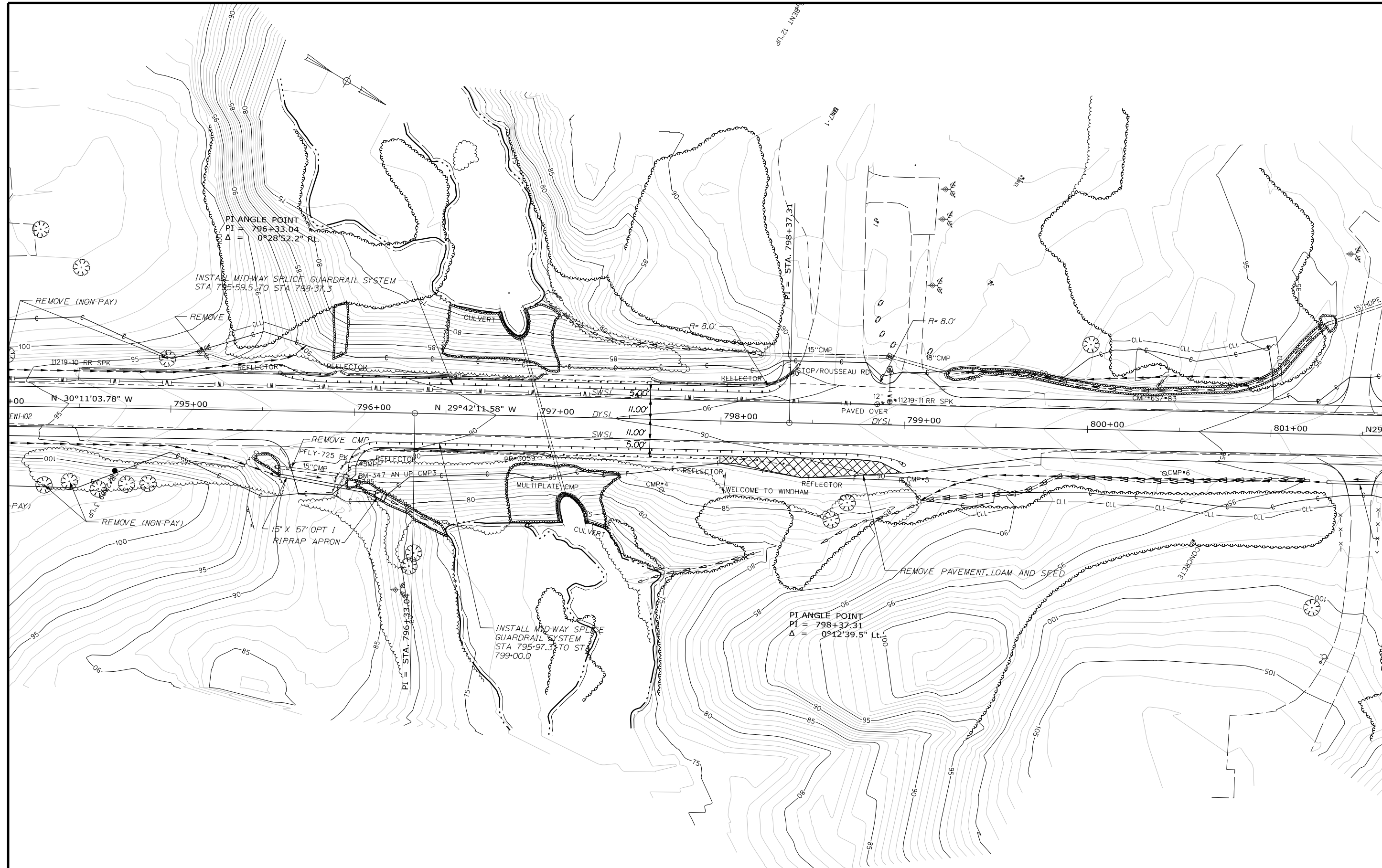
R - Refusal of augers (actual nature of refusal surface unknown)

NR - No Refusal surface encountered

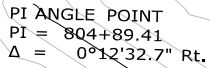
W - Weathered Rock, top of

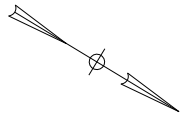
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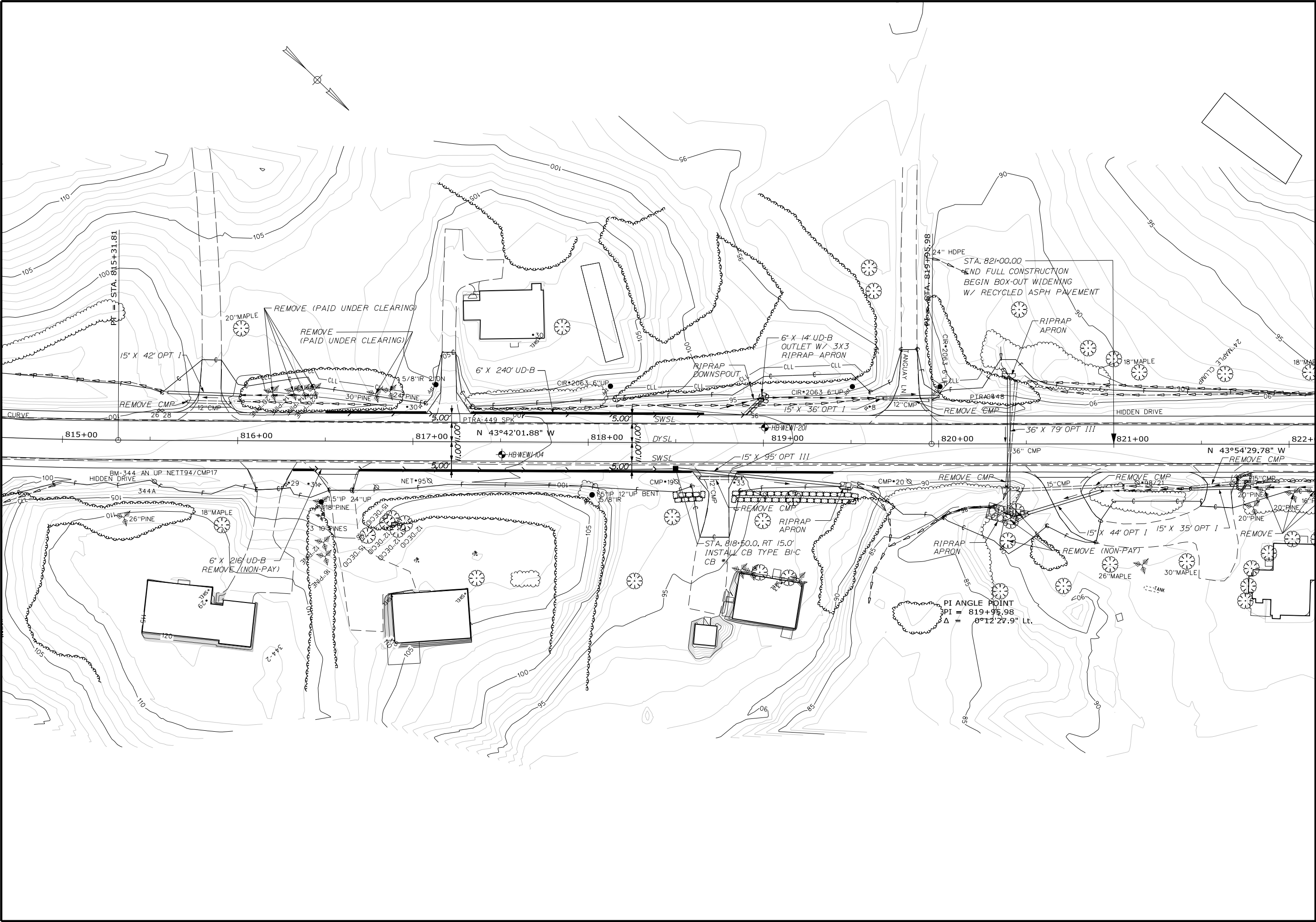


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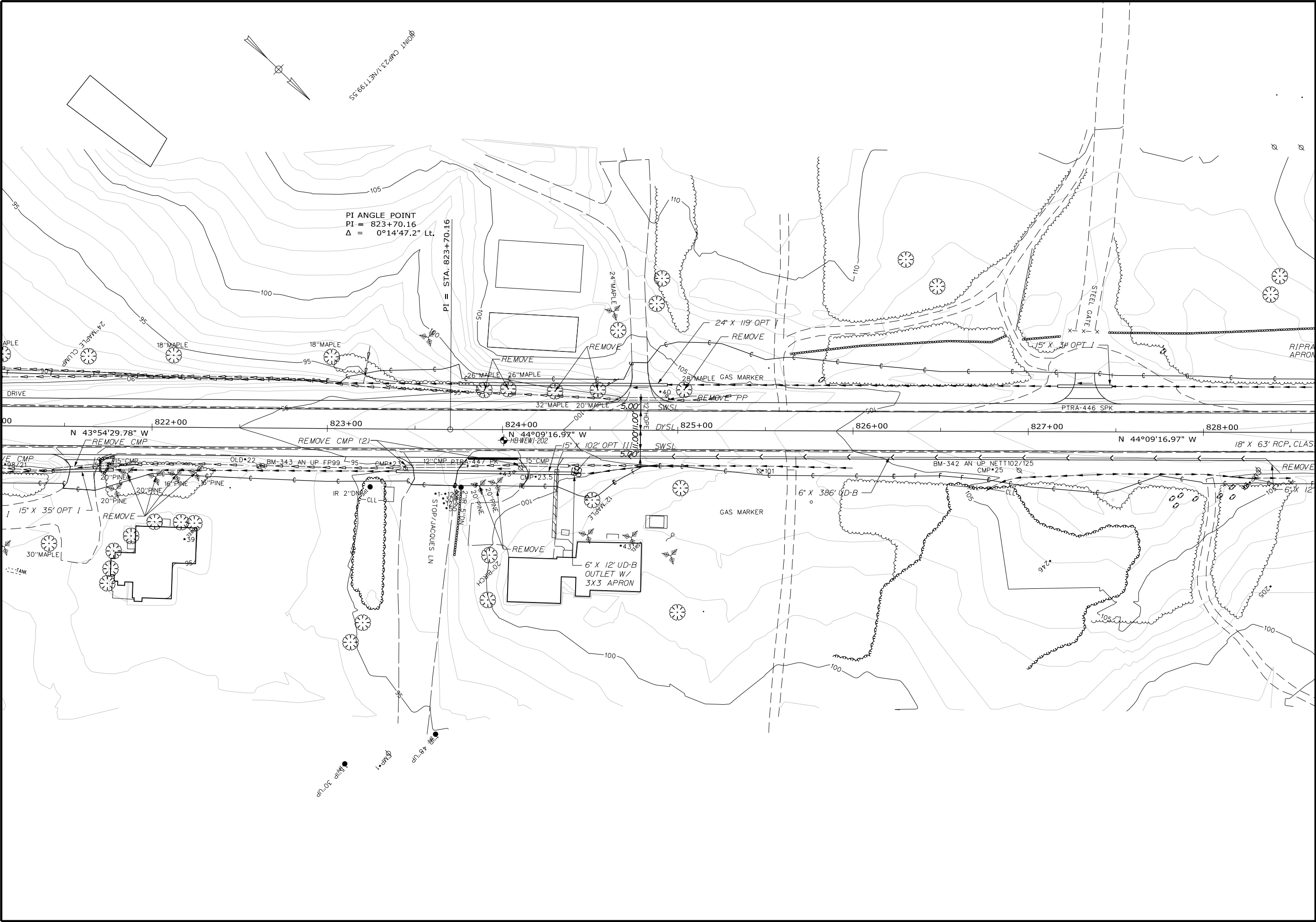
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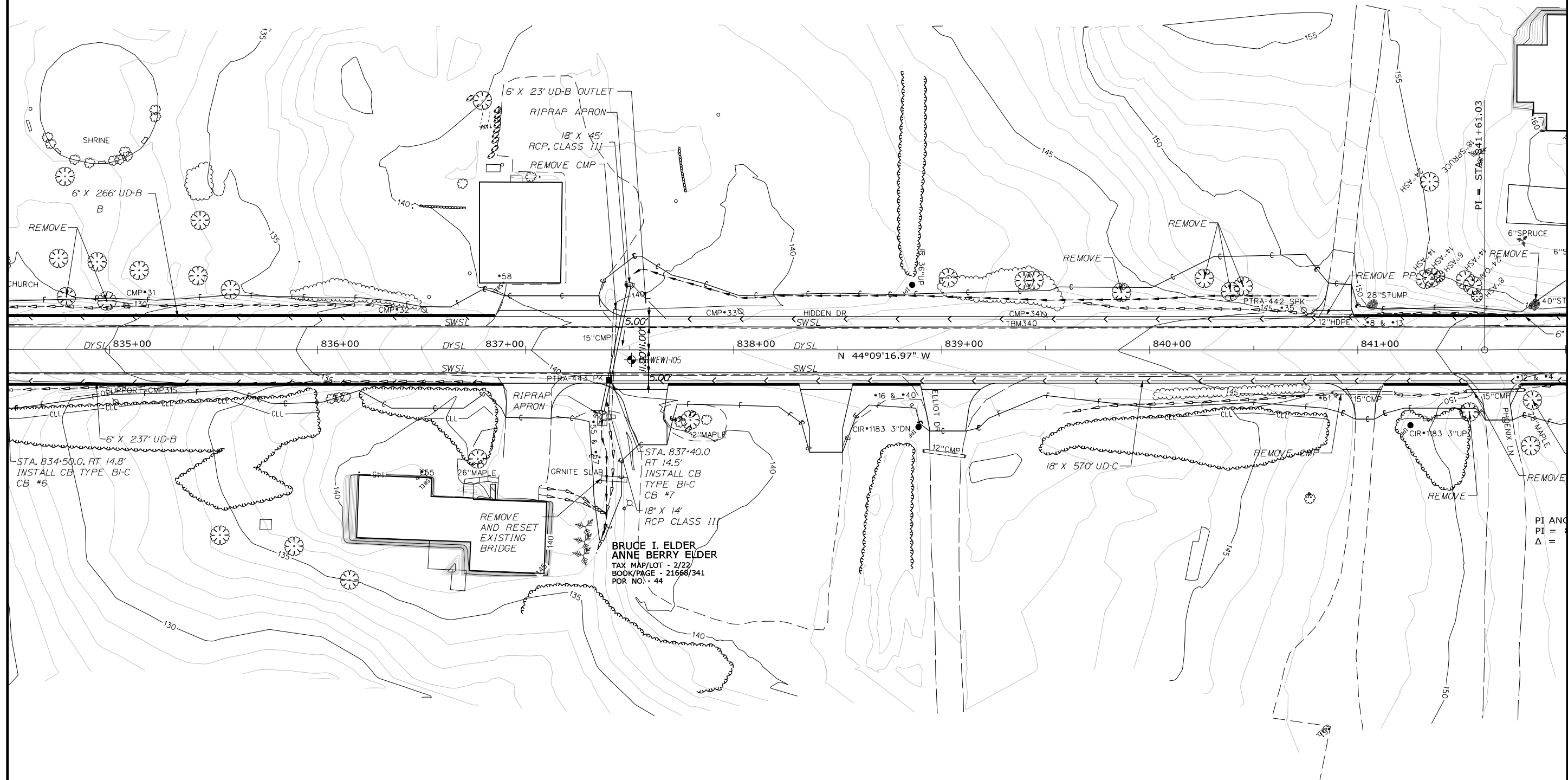
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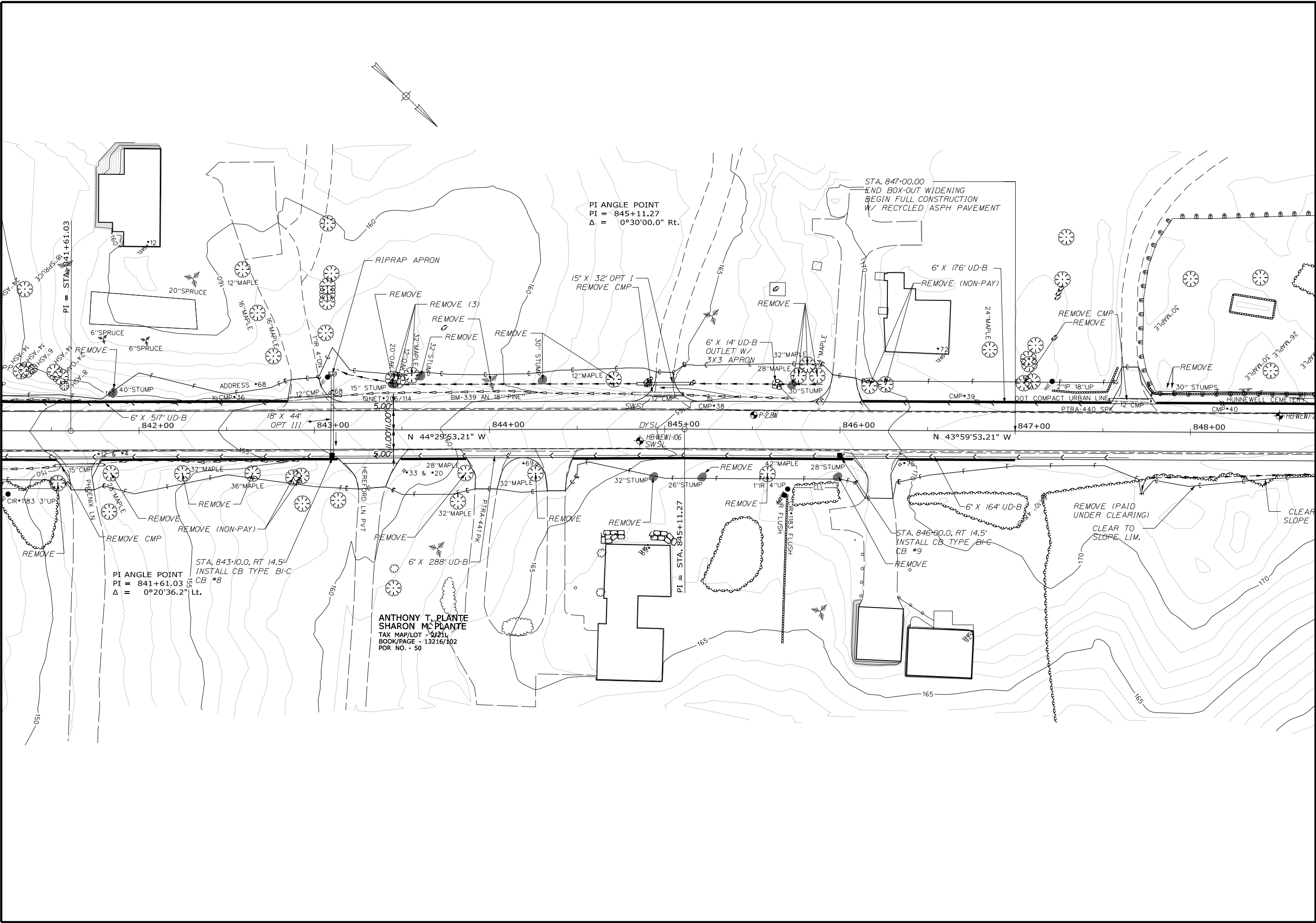


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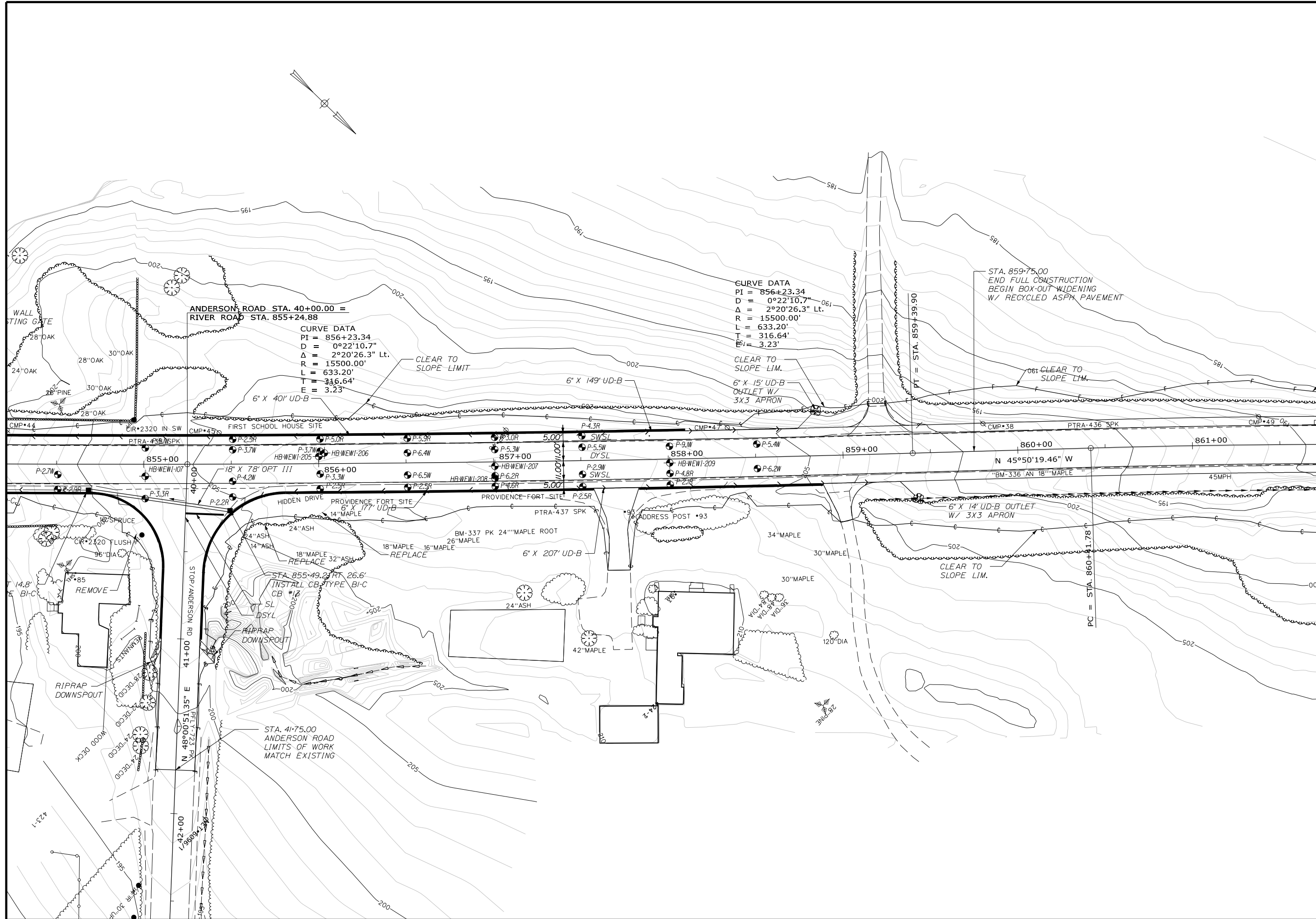


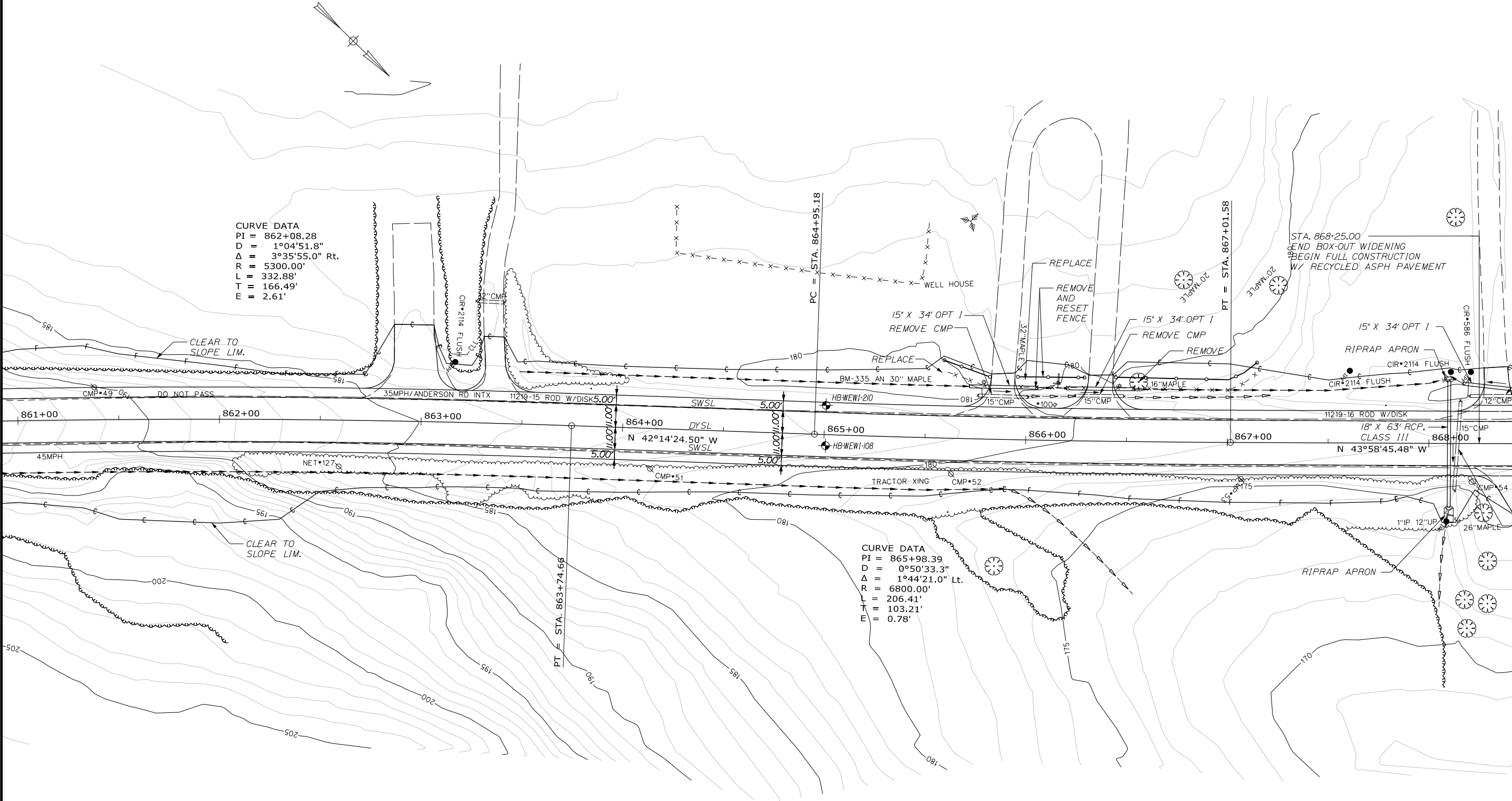
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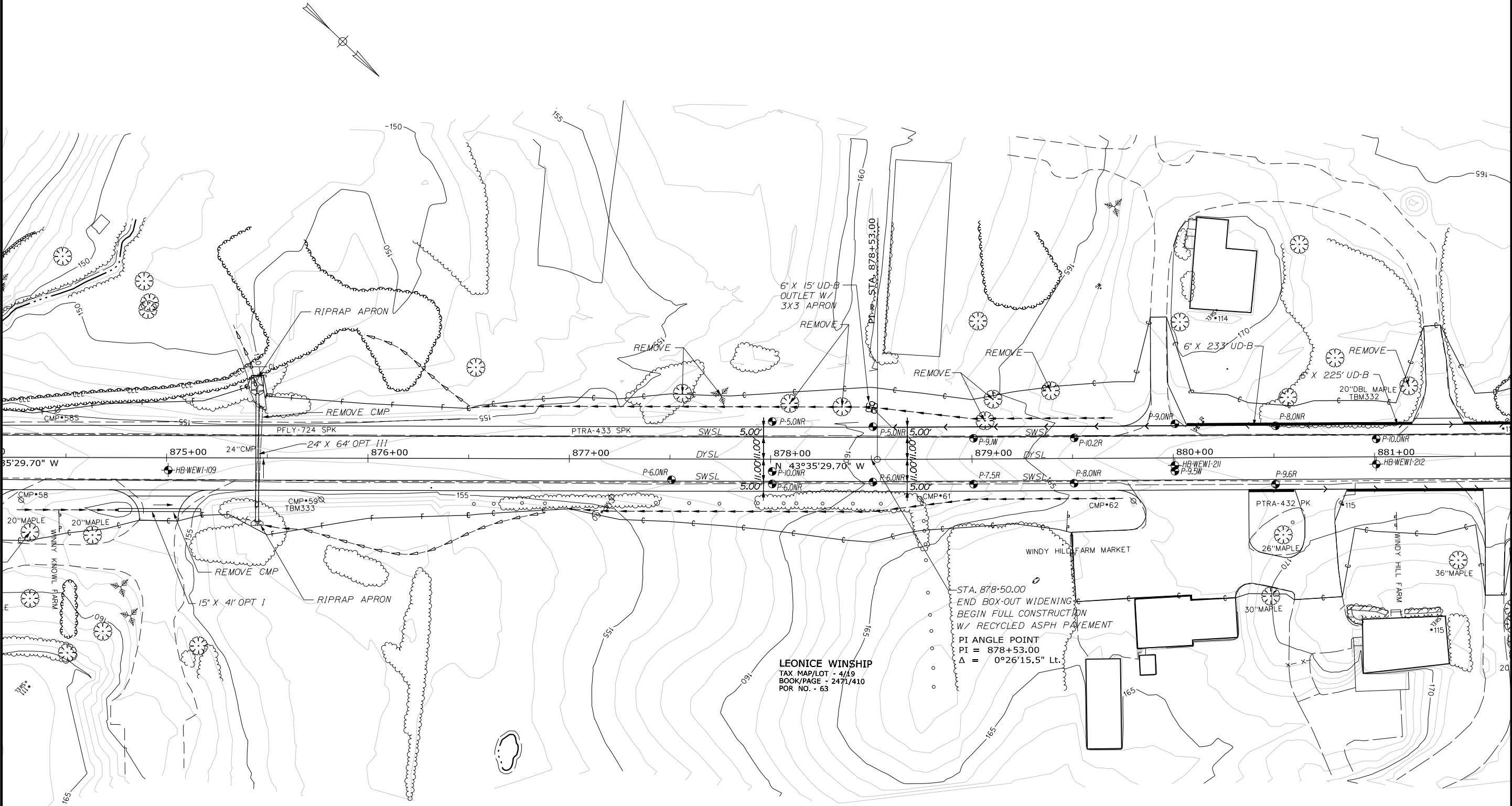
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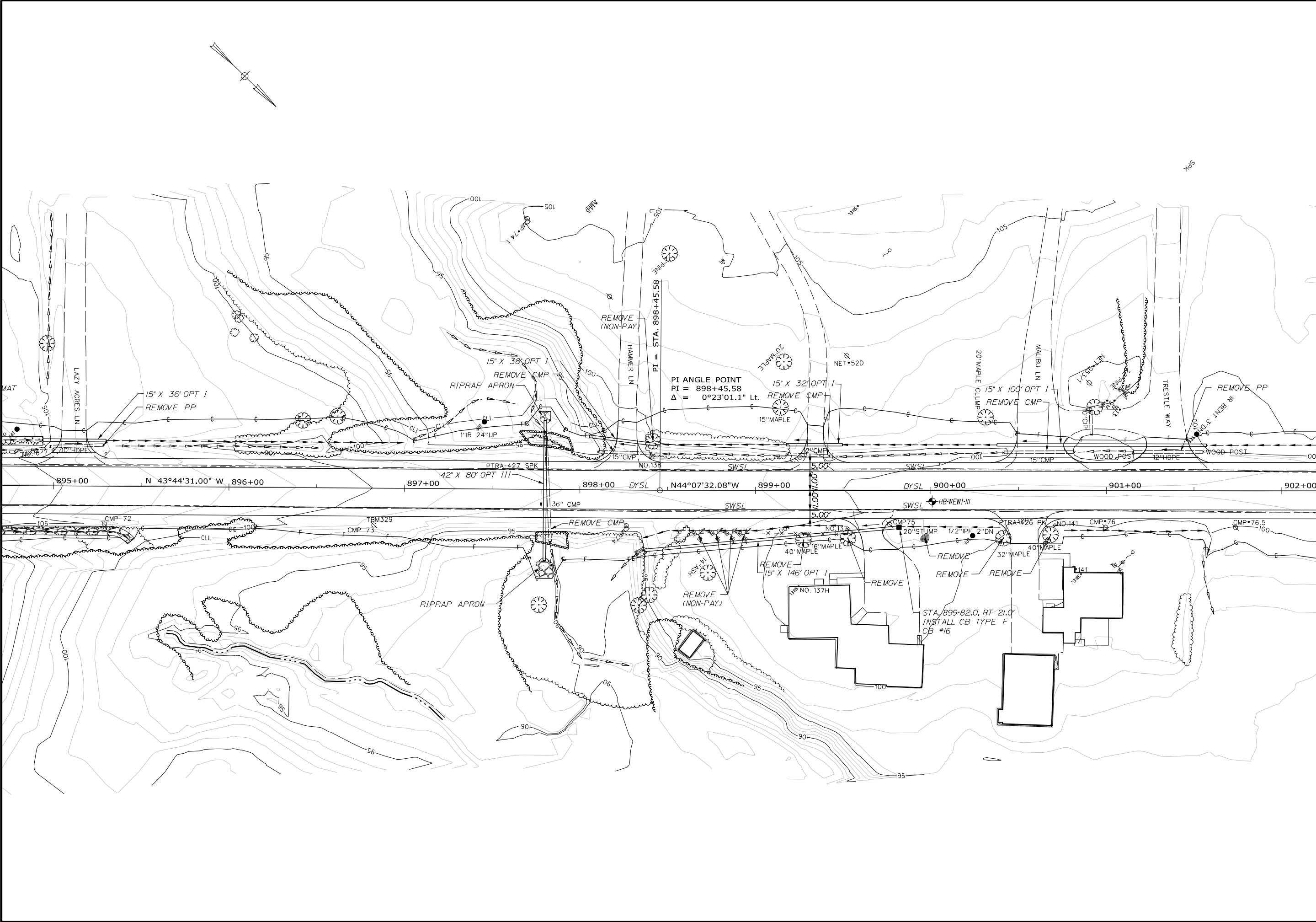
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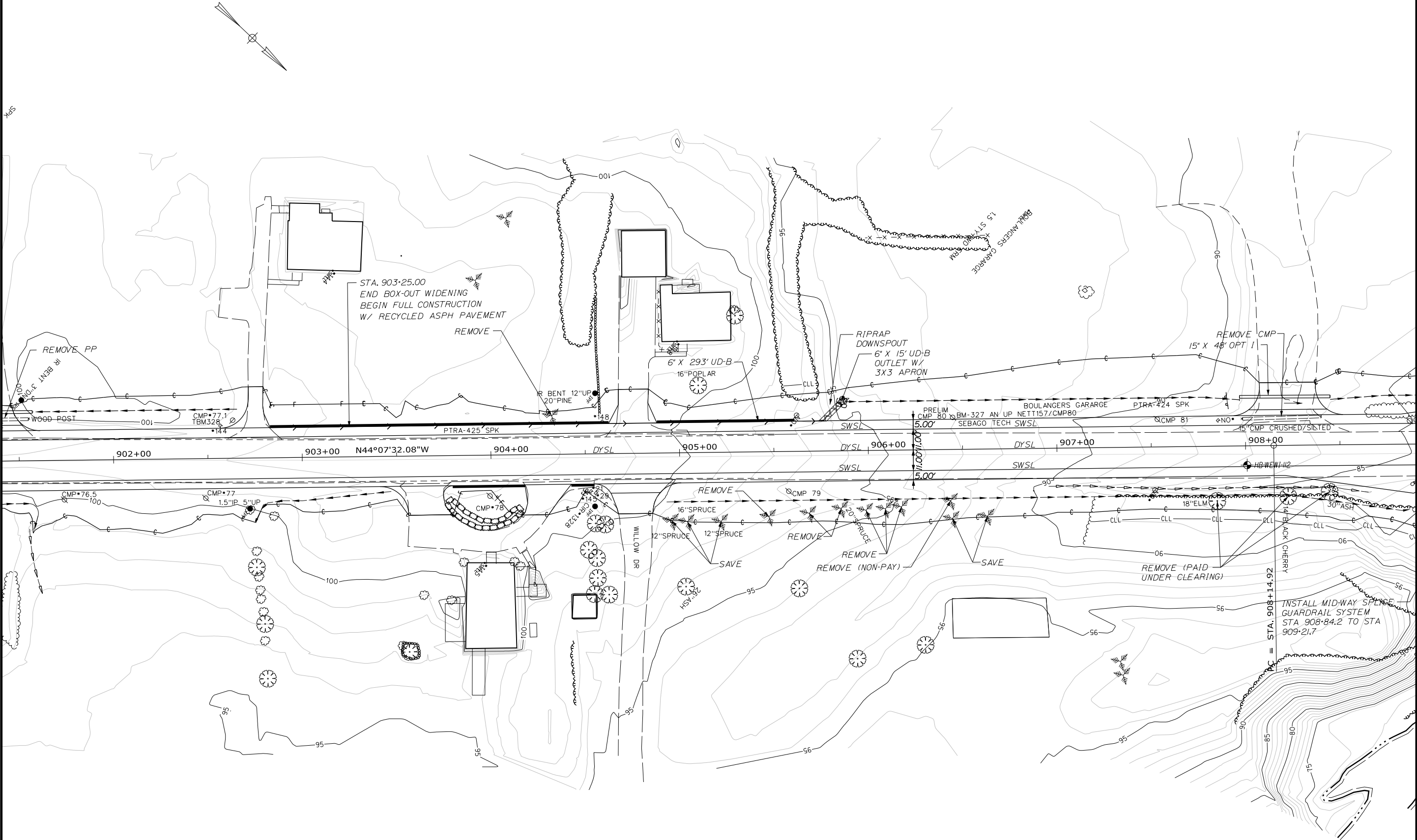
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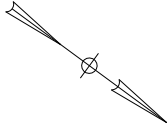
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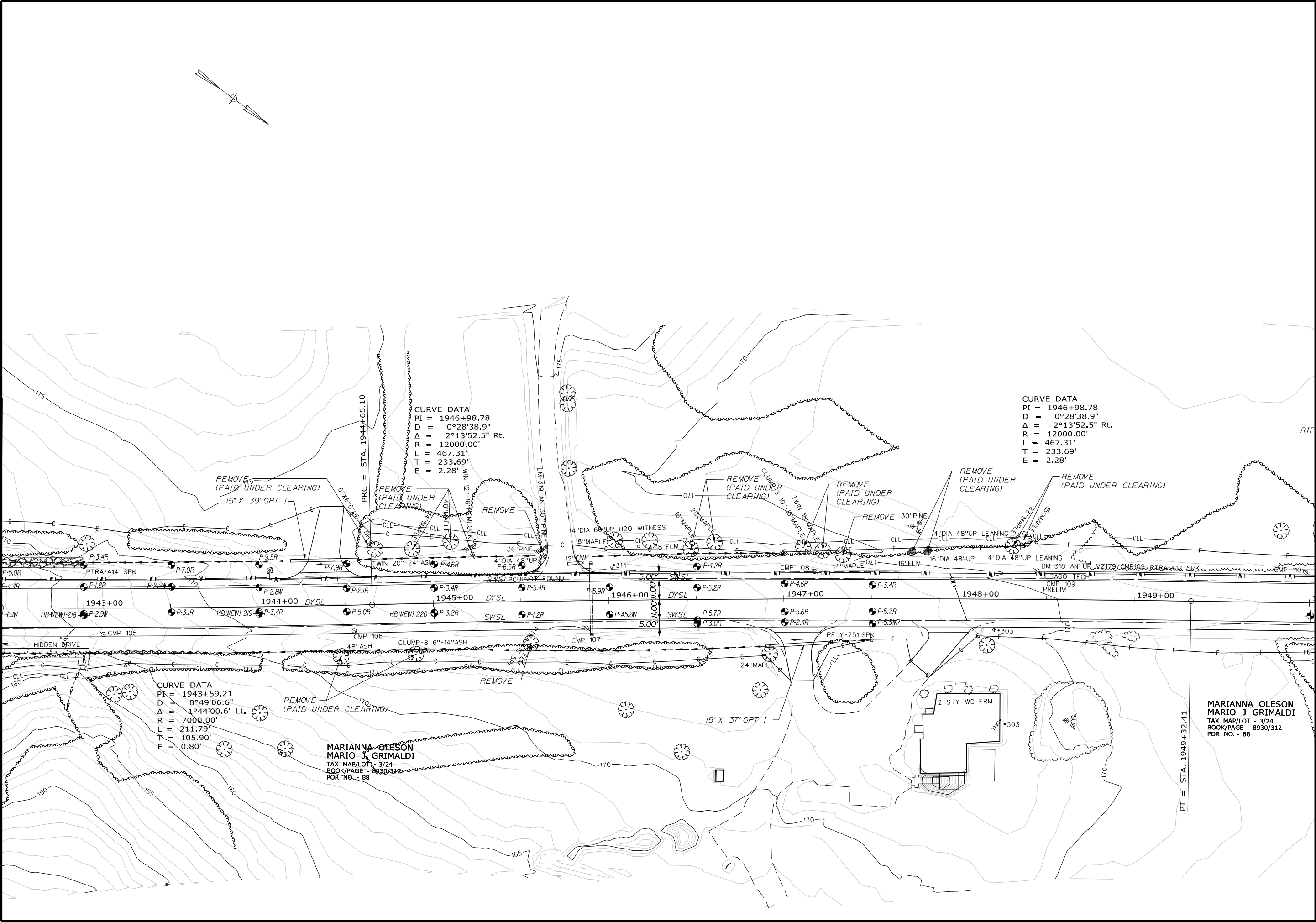
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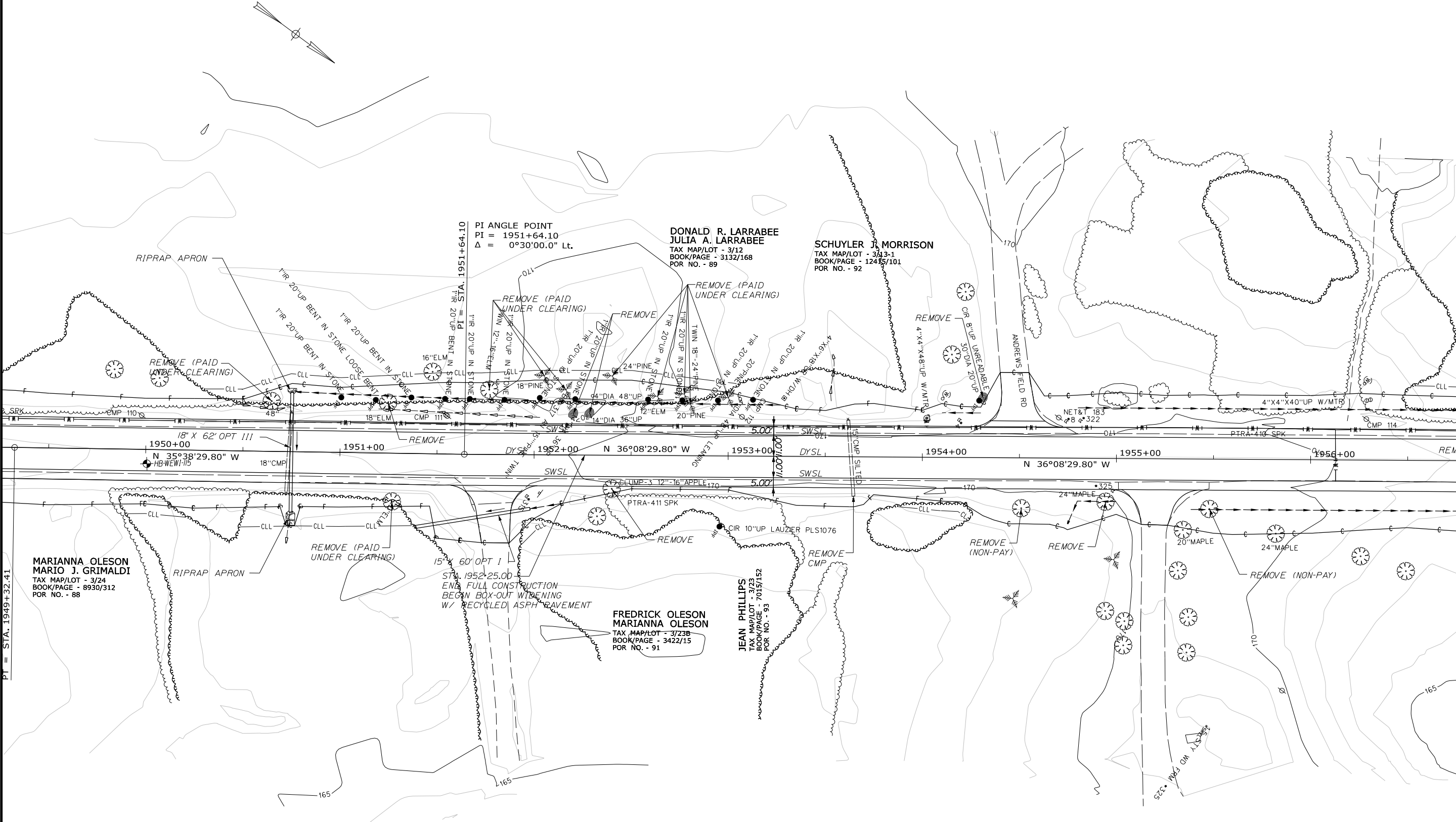
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UNIFIED SOIL CLASSIFICATION SYSTEM					MODIFIED BURMISTER SYSTEM										
MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES											
COARSE-GRAINED SOILS (more than half of material is larger than No. 200 sieve size)	GRAVELS (more than half of coarse fraction is larger than No. 4 sieve size)	CLEAN GRAVELS	GW	Well-graded gravels, gravel-sand mixtures, little or no fines.	Descriptive Term		Portion of Total (%)								
		(little or no fines)	GP	Poorly-graded gravels, gravel sand mixtures, little or no fines.	trace	0 - 10									
					little	11 - 20									
					some	21 - 35									
					adjective (e.g. sandy, clayey)	36 - 50									
	SANDS (more than half of coarse fraction is smaller than No. 4 sieve size)	CLEAN SANDS	SW	Well-graded sands, gravelly sands, little or no fines	TERMS DESCRIBING DENSITY/CONSISTENCY										
		(little or no fines)	SP	Poorly-graded sands, gravelly sand, little or no fines.											
		SANDS WITH FINES (Appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures.	<u>Coarse-grained soils</u> (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).										
			GC	Clayey gravels, gravel-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.	Density of Cohesionless Soils		Standard Penetration Resistance N-Value (blows per foot)						
CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.	Very loose			0 - 4										
OL	Organic silts and organic silty clays of low plasticity.	Loose			5 - 10										
SILTS AND CLAYS (liquid limit greater than 50)	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.	Medium Dense		11 - 30										
	CH	Inorganic clays of high plasticity, fat clays.	Dense		31 - 50										
	OH	Organic clays of medium to high plasticity, organic silts.	Very Dense	> 50											
HIGHLY ORGANIC SOILS	Pt	Peat and other highly organic soils.	<u>Fine-grained soils</u> (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.												
<u>Desired Soil Observations (in this order, if applicable):</u> 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					<u>Approximate Undrained Shear Strength (psf)</u> <u>Consistency of Cohesive soils</u> Very Soft Soft Medium Stiff Stiff Very Stiff Hard										
					<u>SPT N-Value (blows per foot)</u> WOH, WOR, WOP, <2 2 - 4 5 - 8 9 - 15 16 - 30 >30										
<u>Desired Rock Observations (in this order, if applicable):</u> Color (Munsell color chart) Texture (aphanitic, fine-grained, etc.) Rock Type (granite, schist, sandstone, etc.) Hardness (very hard, hard, mod. hard, etc.) Weathering (fresh, very slight, slight, moderate, mod. severe, severe, etc.) Geologic discontinuities/jointing: -dip (horiz - 0-5 deg., low angle - 5-35 deg., mod. dipping - 35-55 deg., steep - 55-85 deg., vertical - 85-90 deg.) -spacing (very close - <2 inch, close - 2-12 inch, mod. close - 1-3 feet, wide - 3-10 feet, very wide >10 feet) -tightness (tight, open, or healed) -infilling (grain size, color, etc.) Formation (Waterville, Ellsworth, Cape Elizabeth, etc.) RQD and correlation to rock mass quality (very poor, poor, etc.) ref: ASTM D6032 and AASHTO Standard Specification for Highway Bridges, 17th Ed. Table 4.4.8.1.2A Recovery (inch/inch and percentage) Rock Core Rate (X.X ft - Y.Y ft (min:sec))					<u>Field Guidelines</u> Fist easily penetrates Thumb easily penetrates Thumb penetrates with moderate effort Indented by thumb with great effort Indented by thumbnail Indented by thumbnail with difficulty										
					<u>Rock Quality Designation (RQD):</u> RQD (%) = $\frac{\text{sum of the lengths of intact pieces of core} * > 4 \text{ inches}}{\text{length of core advance}}$ *Minimum NQ rock core (1.88 in. OD of core) Correlation of RQD to Rock Mass Quality <table><tr><th>Rock Mass Quality</th><th>RQD (%)</th></tr><tr><td>Very Poor</td><td>≤25</td></tr><tr><td>Poor</td><td>26 - 50</td></tr><tr><td>Fair</td><td>51 - 75</td></tr><tr><td>Good</td><td>76 - 90</td></tr><tr><td>Excellent</td><td>91 - 100</td></tr></table>				Rock Mass Quality	RQD (%)	Very Poor	≤25	Poor	26 - 50	Fair
Rock Mass Quality	RQD (%)														
Very Poor	≤25														
Poor	26 - 50														
Fair	51 - 75														
Good	76 - 90														
Excellent	91 - 100														
Maine Department of Transportation Geotechnical Section Key to Soil and Rock Descriptions and Terms Field Identification Information					<u>Sample Container Labeling Requirements:</u> WIN Bridge Name / Town Boring Number Sample Number Sample Depth Blow Counts Sample Recovery Date Personnel Initials										

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Maine Department of Transportation

Soil/Rock Exploration Log

US CUSTOMARY UNITS

Project: River Road

Location: Windham, Maine

Boring No.: HB-WEWI-102

WIN: 11219.20

Drilling Contractor: MaineDOT

Operator: E.Giguere

Logged By: G.Lidstone

Date Start/Finish: 6/7/05, 09:45-09:55

Boring Location: 794+00.3, 5.7 ft Rt.

Elevation (ft.) 96.1

Datum: NAVD 88

Rig Type: CME 45C

Drilling Method: Soil Stem Auger

Casing ID/OD: N/A

Auger ID/OD: 5"

Sampler: Off Flights

Hammer Wt./Fall: N/A

Core Barrel: N/A

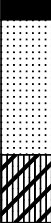
Water Level*: None Observed

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							Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows					
0						SSA	95.6		PAVEMENT.	G#180893 A-4, CL-ML WC=32.5%	
									Brown, damp, fine to coarse SAND, little gravel, little silt.		
	S3		3.50 - 5.00				92.6		Brown, moist, Clayey SILT, trace sand, trace gravel.		
5							91.1		Bottom of Exploration at 5.0 feet below ground surface. NO REFUSAL		
10											
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.

Page 1 of 1

Boring No.: HB-WEWI-102

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS						Project: River Road				Boring No.: HB-WEWI-103																																																																																																																																																																																																																																																																																																																																																																																																																									
						Location: Windham, Maine				WIN: 11219.20																																																																																																																																																																																																																																																																																																																																																																																																																									
Drilling Contractor: MaineDOT						Elevation (ft.) 114.7				Auger ID/OD: 5"																																																																																																																																																																																																																																																																																																																																																																																																																									
Operator: E.Giguere						Datum: NAVD 88				Sampler: Off Flights																																																																																																																																																																																																																																																																																																																																																																																																																									
Logged By: G.Lidstone						Rig Type: CME 45C				Hammer Wt./Fall: N/A																																																																																																																																																																																																																																																																																																																																																																																																																									
Date Start/Finish: 6/7/05, 10:00-10:10						Drilling Method: Soild Stem Auger				Core Barrel: N/A																																																																																																																																																																																																																																																																																																																																																																																																																									
Boring Location: 807+50.4, 7.2 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 Su = Peak/Remolded Field Vane Undrained Shear Strength (psf) Su(lab) = Lab Vane Undrained Shear Strength (psf) qp = Unconfined Compressive Strength (ksf) N-value = Raw Field SPT N-value Tv = 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																																																																																																																																																																																																																																																																																																																																																																																																																																			
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Brown, damp, fine to coarse SAND, little gravel, little silt.</td><td>-0.4</td><td rowspan="10">G#180905 A-4, SM WC=12.4%</td></tr><tr><td></td><td>S4</td><td></td><td>2.10 - 3.40</td><td></td><td></td><td></td><td>112.6</td><td></td><td>Brown, moist, Silty fine to coarse SAND, trace gravel.</td><td>-2.1</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>111.3</td><td></td><td>Grey, moist, SILT, some sand, trace gravel.</td><td>-3.4</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>110.6</td><td></td><td>Brown, moist, Clayey SILT, trace sand, trace gravel.</td><td>-4.1</td></tr><tr><td>5</td><td></td><td></td><td></td><td></td><td></td><td></td><td>109.7</td><td></td><td>Bottom of Exploration at 5.0 feet below ground surface. NO REFUSAL</td><td>-5.0</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>10</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>20</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>25</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>														Depth (ft.)	Sample Information								Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Graphic Log	0						SSA	114.3		PAVEMENT. Brown, damp, fine to coarse SAND, little gravel, little silt.	-0.4	G#180905 A-4, SM WC=12.4%		S4		2.10 - 3.40				112.6		Brown, moist, Silty fine to coarse SAND, trace gravel.	-2.1								111.3		Grey, moist, SILT, some sand, trace gravel.	-3.4								110.6		Brown, moist, Clayey SILT, trace sand, trace gravel.	-4.1	5							109.7		Bottom of Exploration at 5.0 feet below ground surface. 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Maine Department of Transportation

Soil/Rock Exploration Log

US CUSTOMARY UNITS

Project: River Road

Location: Windham, Maine

Boring No.: HB-WEWI-106

WIN: 11219.20

Drilling Contractor: MaineDOT

Elevation (ft.) 164.6

Auger ID/OD: 5"

Operator: E.Giguere

Datum: NAVD 88

Sampler: Off Flights

Logged By: G.Lidstone

Rig Type: CME 45C

Hammer Wt./Fall: N/A

Date Start/Finish: 6/7/05, 11:10-11:20

Drilling Method: Soil Stem Auger

Core Barrel: N/A

Boring Location: 844+85.9, 6.6 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
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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						Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows				
0						SSA	164.2		PAVEMENT.	
							163.3		Dark brown, damp, fine to coarse SAND, little gravel, trace silt.	0.4
									Brown, damp, fine to coarse SAND, little gravel, little silt.	1.3
	S7		2.80 - 5.00				161.8		Brown, damp, stiff Clayey SILT.	2.8
5						↓	159.6		Bottom of Exploration at 5.0 feet below ground surface. NO REFUSAL	5.0
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.

Page 1 of 1

Boring No.: HB-WEWI-106

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS						Project: River Road							Boring No.: HB-WEWI-107																
						Location: Windham, Maine							WIN: 11219.20																
Drilling Contractor: MaineDOT						Elevation (ft.) 202.8							Auger ID/OD: 5"																
Operator: E.Giguere						Datum: NAVD 88							Sampler: Off Flights																
Logged By: G.Lidstone						Rig Type: CME 45C							Hammer Wt./Fall: N/A																
Date Start/Finish: 6/7/05, 11:25-11:35						Drilling Method: Soild Stem Auger							Core Barrel: N/A																
Boring Location: 855+00.8, 6.9 ft Rt.						Casing ID/OD: N/A							Water Level*: None Observed																
Definitions: D = Spilt Spoon SampleMU = Unsuccessful Thin Wall Tube Sample AttemptWO1P = Weight of 1 PersonS _p = Peak/Remolded Field Vane Undrained Shear Strength (psf) S = Sample off Auger FlightsR = Rock Core SampleS _{u(lab)} = Lab Vane Undrained Shear Strength (psf)LL = Liquid Limit B = Bucket Sample off Auger FlightsSSA = Solid Stem Augerq _p = Unconfined Compressive Strength (ksf)PL = Plastic LimitMD = Unsuccessful Split Spoon Sample AttemptHSA = Hollow Stem AugerN-value = Raw Field SPT N-valuedG = Grain Size AnalysisU = Thin Wall Tube SampleRC = Roller ConeT _v = Pocket Torvane Shear Strength (psf)PI = Plasticity IndexMV = Unsuccessful Field Vane Shear Test AttemptWOH = Weight of 140lb. HammerWC = Water Content, percent ≈ = Similar or Equal tooV = Field Vane Shear TestPP= Pocket PenetrometerWOR/C = Weight of Rods or CasingC = Consolidation Test																													
Sample Information <table><tr><td rowspan="2">Depth (ft.)</td><td rowspan="2">Sample No.</td><td rowspan="2">Pen./Rec. (in.)</td><td rowspan="2">Sample Depth (ft.)</td><td rowspan="2">Blows (/6 in.) Shear Strength (psf) or RQD (%)</td><td rowspan="2">N-value</td><td rowspan="2">Casing Blows</td><td rowspan="2">Elevation (ft.)</td><td rowspan="2">Graphic Log</td><td rowspan="2">Visual Description and Remarks</td><td rowspan="2">Laboratory Testing Results/ AASHTO Unified Class.</td></tr><tr></tr></table>																			Depth (ft.)	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 Unified Class.
Depth (ft.)	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 Unified Class.																			
PAVEMENT. -0.4 G#180881 A-4, SM WC=4.8% Brown, damp, fine to medium SAND, some silt, little gravel. Augered in Rock. -3.2 Bottom of Exploration at 4.2 feet below ground surface. REFUSAL -4.2																													
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: River Road Location: Windham, Maine		Boring No.: HB-WEWI-108 WIN: 11219.20			
Drilling Contractor: MaineDOT			Elevation (ft.) 181.6		Auger ID/OD: 5"				
Operator: E.Giguere			Datum: NAVD 88		Sampler: Off Flights				
Logged By: G.Lidstone			Rig Type: CME 45C		Hammer Wt./Fall: N/A				
Date Start/Finish: 6/8/05, 11:05-11:15			Drilling Method: Soil Stem Auger		Core Barrel: N/A				
Boring Location: 865+00.8, 5.5 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							Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)		
0	S15		0.50 - 1.80			SSA	181.1	PAVEMENT. Dark brown, damp, fine to coarse SAND, little gravel, trace silt, (Fill). Brown, damp, Silty fine to coarse SAND, some gravel, (Fill). Grey, moist, Silty fine SAND.	0.5-1.8-3.0
	S16		1.80 - 3.00				179.8		
							178.6		
	S17		3.00 - 5.00						
5							176.6	Bottom of Exploration at 5.0 feet below ground surface. NO REFUSAL	5.0
25									
Remarks:									
Stratification lines represent approximate boundaries between soil types; transitions may be gradual.								Page 1 of 1	
* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.								Boring No.: HB-WEWI-108	

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Maine Department of Transportation

Soil/Rock Exploration Log

US CUSTOMARY UNITS

Project: River Road

Location: Windham, Maine

Boring No.: HB-WEWI-111

WIN: 11219.20

Drilling Contractor: MaineDOT

Elevation (ft.) 100.6

Auger ID/OD: 5"

Operator: E.Giguere

Datum: NAVD 88

Sampler: Off Flights

Logged By: G.Lidstone

Rig Type: CME 45C

Hammer Wt./Fall: N/A

Date Start/Finish: 6/7/05, 13:25-13:35

Drilling Method: Soil Stem Auger

Core Barrel: N/A

Boring Location: 900+00.8, 6.3 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

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SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140lb. Hammer
WOR/C = Weight of Rods or Casing

WO1P = Weight of 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						Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows				
0						SSA	100.2		PAVEMENT.	G#180891 A-4, CL-ML WC=23.8%
	S9		1.80 - 5.00				98.8		Brown, damp, fine to coarse SAND, little gravel, trace silt.	
									Brown, moist, stiff, Clayey SILT, trace sand, trace gravel.	
5							95.6		Bottom of Exploration at 5.0 feet below ground surface. NO REFUSAL	
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.

Page 1 of 1

Boring No.: HB-WEWI-111

[illegible]

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: River Road Location: Windham, Maine				Boring No.: HB-WEWI-113 WIN: 11219.20																																																																																																																															
Drilling Contractor: MaineDOT				Elevation (ft.): 99.6				Auger ID/OD: 5"																																																																																																																															
Operator: E.Giguere				Datum: NAVD 88				Sampler: Off Flights																																																																																																																															
Logged By: G.Lidstone				Rig Type: CME 45C				Hammer Wt./Fall: N/A																																																																																																																															
Date Start/Finish: 6/7/05, 14:15-14:25				Drilling Method: Soild Stem Auger				Core Barrel: N/A																																																																																																																															
Boring Location: 917+51.1, 6.7 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																																																																																																																																							
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Page 1 of 1										Boring No.: HB-WEWI-113																																																																																																																													

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS						Project: River Road Location: Windham, Maine							Boring No.: HB-WEWI-114 WIN: 11219.20							
Drilling Contractor: MaineDOT						Elevation (ft.) 97.5							Auger ID/OD: 5"							
Operator: E.Giguere						Datum: NAVD 88							Sampler: Off Flights							
Logged By: G.Lidstone						Rig Type: CME 45C							Hammer Wt./Fall: N/A							
Date Start/Finish: 6/7/05, 14:30-14:45						Drilling Method: Soild Stem Auger							Core Barrel: N/A							
Boring Location: 1925+00.5, 7.1 ft Rt.						Casing ID/OD: N/A							Water Level*: None Observed							
Definitions: D = Spilt Spoon SampleMU = Unsuccessful Thin Wall Tube Sample AttemptWO1P = Weight of 1 PersonS = Sample off Auger FlightsR = Rock Core SampleSu = Peak/Remolded Field Vane Undrained Shear Strength (psf)B = Bucket Sample off Auger FlightsSSA = Solid Stem AugerSu(lab) = Lab Vane Undrained Shear Strength (psf)MD = Unsuccessful Split Spoon Sample AttemptHSA = Hollow Stem Augerqp = Unconfined Compressive Strength (ksf)U = Thin Wall Tube SampleRC = Roller ConeN-value = Raw Field SPT N-valueMV = Unsuccessful Field Vane Shear TestWOH = Weight of 140lb. HammerTy = Pocket Torvane Shear Strength (psf)V = Field Vane Shear TestPP= Pocket PenetrometerWOR/C = Weight of Rods or CasingWC = Water Content, percent ≡ Similar or Equal tooLL = Liquid LimitPL = Plastic LimitPI = Plasticity IndexG = Grain Size AnalysisC = Consolidation Test																				
Sample Information																				
Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or ROD (%)	N-value	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks									Laboratory Testing Results/ AASHTO Unified Class.		
0	S13		0.40 - 2.00			SSA	97.1		PAVEMENT. Brown, damp, fine to coarse SAND, some gravel, trace silt, (Fill).									G#180900 A-1-b, SW-SM WC=5.2%		
							95.5		----- Brown gravel, moist, SILT, some sand, trace gravel, (Fill). -----									G#180901 A-4, ML WC=17.5%		
	S14		2.00 - 3.30				94.2		Grey, moist, SILT, some sand, trace gravel.											
							92.5		Bottom of Exploration at 5.0 feet below ground surface. NO REFUSAL											
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.

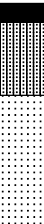
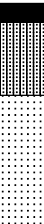
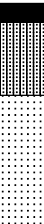
Page 1 of 1

Boring No.: HB-WEWI-114

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: River Road Location: Windham, Maine				Boring No.: HB-WEWI-115 WIN: 11219.20																																																																																																																													
Drilling Contractor: MaineDOT				Elevation (ft.): 168.8				Auger ID/OD: 5"																																																																																																																													
Operator: E.Giguere				Datum: NAVD 88				Sampler: Off Flights																																																																																																																													
Logged By: G.Lidstone				Rig Type: CME 45C				Hammer Wt./Fall: N/A																																																																																																																													
Date Start/Finish: 6/9/05, 11:05-11:20				Drilling Method: Soild Stem Auger				Core Barrel: N/A																																																																																																																													
Boring Location: 1950+00.6, 7.4 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																																																																																																																																					
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5								163.8		Bottom of Exploration at 5.0 feet below ground surface. NO REFUSAL																																																																																																																											
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Boring No.: HB-WEWI-115																																																																																																																																					

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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: River Road Location: Windham, Maine				Boring No.: HB-WEWI-202 WIN: 11219.20			
Drilling Contractor: MaineDOT				Elevation (ft.): 98.5				Auger ID/OD: 5" Dia.			
Operator: Giles/Daggett				Datum: NAVD 88				Sampler: Off Flights			
Logged By: B. Wilder				Rig Type: CME 45C				Hammer Wt./Fall: N/A			
Date Start/Finish: 2/11/2015-2/11/2015				Drilling Method: Soil Stem Auger				Core Barrel: N/A			
Boring Location: 824+00.7, 6.0 ft Rt.				Casing ID/OD: N/A				Water Level*: None Observed			
Definitions: D = Spilt Spoon Sample MU = Unsuccessful Thin Wall Tube Sample Attempt WO1P = Weight of 1 Person S = Sample off Auger Flights R = Rock Core Sample S _u = Peak/Remolded Field Vane Undrained Shear Strength (psf) B = Bucket Sample off Auger Flights SSA = Solid Stem Auger S _{u(lab)} = Lab Vane Undrained Shear Strength (psf) MD = Unsuccessful Split Spoon Sample Attempt HSA = Hollow Stem Auger q _p = Unconfined Compressive Strength (ksf) U = Thin Wall Tube Sample RC = Roller Cone N-value = Raw Field SPT N-value MV = Unsuccessful Field Vane Shear Test Attempt WOH = Weight of 140lb. Hammer T _v = Pocket Torvane Shear Strength (psf) V = Field Vane Shear Test, PP= Pocket Penetrometer WOR/C = Weight of Rods or Casing 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							Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows					
0	S3		0.38 - 2.00			SSA	98.1		4½" PAVEMENT.	G#266617 A-2-4, SM WC=12.5%	
							96.5		Brown, moist, fine to coarse SAND, little silt, little gravel		
	S4		2.00 - 5.00							Brown, wet, fine to medium SAND, trace silt.	
5							93.5				
10											
15											
20											
25											
Remarks: Note: 826+00, under High Power Lines, did not drill.											
Stratification lines represent approximate boundaries between soil types; transitions may be gradual.										Page 1 of 1	
* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.										Boring No.: HB-WEWI-202	

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: River Road Location: Windham, Maine				Boring No.: HB-WEWI-203 WIN: 11219.20																																																																																																																			
Drilling Contractor: MaineDOT				Elevation (ft.): 114.4				Auger ID/OD: 5" Dia.																																																																																																																			
Operator: Giles/Daggett				Datum: NAVD 88				Sampler: Off Flights																																																																																																																			
Logged By: B. Wilder				Rig Type: CME 45C				Hammer Wt./Fall: N/A																																																																																																																			
Date Start/Finish: 2/11/2015-2/11/2015				Drilling Method: Soild Stem Auger				Core Barrel: N/A																																																																																																																			
Boring Location: 831+50.7, 10.1 ft Lt.				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																																																																																																																											
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* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.										Boring No.: HB-WEWI-203																																																																																																																	

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: River Road Location: Windham, Maine		Boring No.: HB-WEWI-204 WIN: 11219.20				
Drilling Contractor: MaineDOT			Elevation (ft.): 170.6		Auger ID/OD: 5" Dia.					
Operator: Giles/Daggett			Datum: NAVD 88		Sampler: Off Flights					
Logged By: B. Wilder			Rig Type: CME 45C		Hammer Wt./Fall: N/A					
Date Start/Finish: 2/11/2015-2/11/2015			Drilling Method: Soil Stem Auger		Core Barrel: N/A					
Boring Location: 848+50.7, 9.6 ft Lt.			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						Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows				
0	S7		0.33 - 1.60			SSA	170.3		4" PAVEMENT.	G#266620 A-2-4, SM WC=9.8% G#266619 A-4, SM WC=10.3%
	S8		1.60 - 8.70				169.0		Brown, moist, fine to coarse SAND, some silt, trace gravel.	
									Light brown, moist, Silty fine to coarse SAND, trace gravel.	
5										
10							160.6		Light brown, moist, Silty fine to coarse SAND, some gravel.	
									Bottom of Exploration at 10.0 feet below ground surface. NO REFUSAL	
25										
Remarks:										
Stratification lines represent approximate boundaries between soil types; transitions may be gradual.									Page 1 of 1	
* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.									Boring No.: HB-WEWI-204	

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: River Road Location: Windham, Maine				Boring No.: HB-WEWI-205 WIN: 11219.20																																																																																																																									
Drilling Contractor: MaineDOT				Elevation (ft.): 207.8				Auger ID/OD: 5" Dia.																																																																																																																									
Operator: Giles/Daggett				Datum: NAVD 88				Sampler: Off Flights																																																																																																																									
Logged By: B. Wilder				Rig Type: CME 45C				Hammer Wt./Fall: N/A																																																																																																																									
Date Start/Finish: 2/11/2015-2/11/2015				Drilling Method: Soild Stem Auger				Core Barrel: N/A																																																																																																																									
Boring Location: 856+00.1, 4.1 ft Lt.				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																																																																																																																																	
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Page 1 of 1																																																																																																																																	
Boring No.: HB-WEWI-205																																																																																																																																	

[illegible]

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: River Road Location: Windham, Maine				Boring No.: HB-WEWI-207 WIN: 11219.20			
Drilling Contractor: MaineDOT				Elevation (ft.): 209.0				Auger ID/OD: 5" Dia.			
Operator: Giles/Daggett				Datum: NAVD 88				Sampler: Off Flights			
Logged By: B. Wilder				Rig Type: CME 45C				Hammer Wt./Fall: N/A			
Date Start/Finish: 2/11/2015-2/11/2015				Drilling Method: Soil Stem Auger				Core Barrel: N/A			
Boring Location: 857+00.8, 2.4 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							Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.		
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)				
0	S11		0.42 - 2.00			SSA	208.6	5" PAVEMENT.	G#266621 A-1-b, SM WC=4.8%		
								Brown, moist, fine to coarse SAND, little silt, trace gravel.			
	S12		2.00 - 6.60				207.0	Light grey, damp, fine to medium SAND, trace silt.			
5											
6.6								Bottom of Exploration at 6.6 feet below ground surface. REFUSAL			
10											
15											
20											
25											
Remarks:											
Stratification lines represent approximate boundaries between soil types; transitions may be gradual.								Page 1 of 1			
* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.								Boring No.: HB-WEWI-207			

[illegible]

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS								Project: River Road						Boring No.: HB-WEWI-209									
								Location: Windham, Maine						WIN: 11219.20									
Drilling Contractor: MaineDOT								Elevation (ft.) 208.9						Auger ID/OD: 5" Dia.									
Operator: Giles/Daggett								Datum: NAVD 88						Sampler: Off Flights									
Logged By: B. Wilder								Rig Type: CME 45C						Hammer Wt./Fall: N/A									
Date Start/Finish: 2/11/2015-2/11/2015								Drilling Method: Soild Stem Auger						Core Barrel: N/A									
Boring Location: 858+00.8, 2.2 ft Rt.								Casing ID/OD: N/A						Water Level*: None Observed									
Definitions: D = Spilt Spoon SampleMU = Unsuccessful Thin Wall Tube Sample AttemptWO1P = Weight of 1 PersonS = Sample off Auger FlightsR = Rock Core SampleSu = Peak/Remolded Field Vane Undrained Shear Strength (psf)B = Bucket Sample off Auger FlightsSSA = Solid Stem AugerSu(lab) = Lab Vane Undrained Shear Strength (psf)MD = Unsuccessful Split Spoon Sample AttemptHSA = Hollow Stem Augerqp = Unconfined Compressive Strength (ksf)U = Thin Wall Tube SampleRC = Roller ConeN-value = Raw Field SPT N-valueMV = Unsuccessful Field Vane Shear Test AttemptWOH = Weight of 140lb. HammerTy = Pocket Torvane Shear Strength (psf)V = Field Vane Shear TestPP= Pocket PenetrometerWOR/C = Weight of Rods or CasingWC = Water Content, percent ≈ = Similar or Equal tooLL = Liquid LimitPL = Plastic LimitPI = Plasticity IndexG = Grain Size AnalysisC = Consolidation Test																							
Sample Information											Visual Description and Remarks											Laboratory Testing Results/ AASHTO and Unified Class.	
Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	Graphic Log															
0	S14		0.33 - 2.20			SSA	208.6	[Pattern]	4" PAVEMENT. Brown, moist, fine to coarse SAND, trace silt.											-0.3			
	S15		2.20 - 5.90				206.7	[Pattern]	Brown, moist, fine to medium SAND, little silt.											-2.2			
5						V	203.0	[Pattern]	Bottom of Exploration at 5.9 feet below ground surface. REFUSAL											-5.9			
10																							
15																							
20																							
25																							
Remarks:																							
Stratification lines represent approximate boundaries between soil types; transitions may be gradual.																							
Page 1 of 1																							
Boring No.: HB-WEWI-209																							

Maine Department of Transportation

Soil/Rock Exploration Log

US CUSTOMARY UNITS

Project: River Road

Location: Windham, Maine

Boring No.: HB-WEWI-210

WIN: 11219.20

Drilling Contractor: MaineDOT

Operator: Giles/Daggett

Logged By: B. Wilder

Date Start/Finish: 2/11/2015-2/11/2015

Boring Location: 865+00.5, 14.5 ft Lt.

Elevation (ft.) 181.4

Datum: NAVD 88

Rig Type: CME 45C

Drilling Method: Soild Stem Auger

Casing ID/OD: N/A

Auger ID/OD: 5" Dia.

Sampler: Off Flights

Hammer Wt./Fall: N/A

Core Barrel: 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							Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.	
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows						
0							SSA	179.9		Brown, moist, fine to coarse SAND, trace silt.		
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.

Page 1 of 1

Boring No.: HB-WEWI-210

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: River Road Location: Windham, Maine		Boring No.: HB-WEWI-211 WIN: 11219.20				
Drilling Contractor: MaineDOT			Elevation (ft.): 168.0		Auger ID/OD: 5" Dia.					
Operator: Giles/Daggett			Datum: NAVD 88		Sampler: Off Flights					
Logged By: B. Wilder			Rig Type: CME 45C		Hammer Wt./Fall: N/A					
Date Start/Finish: 2/11/2015-2/11/2015			Drilling Method: Soil Stem Auger		Core Barrel: N/A					
Boring Location: 880+00.7, 3.7 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							Laboratory Testing Results/ AASHTO and Unified Class.		
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)			
0	S16		0.33 - 2.20			SSA	167.7	4" PAVEMENT. Brown, moist, fine to coarse SAND, some silt, little gravel.	0.3- 2.2-	G#266622 A-1-b, SM WC=4.3%
	S17		2.20 - 9.50				165.8			
5										
10							158.5	Bottom of Exploration at 9.5 feet below ground surface. NO REFUSAL	9.5-	
15										
20										
25										
Remarks:										
Stratification lines represent approximate boundaries between soil types; transitions may be gradual.								Page 1 of 1		
* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.								Boring No.: HB-WEWI-211		

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: River Road Location: Windham, Maine		Boring No.: HB-WEWI-212 WIN: 11219.20		
Drilling Contractor: MaineDOT			Elevation (ft.): 168.8		Auger ID/OD: 5" Dia.			
Operator: Giles/Daggett			Datum: NAVD 88		Sampler: Off Flights			
Logged By: B. Wilder			Rig Type: CME 45C		Hammer Wt./Fall: N/A			
Date Start/Finish: 2/11/2015-2/11/2015			Drilling Method: Soil Stem Auger		Core Barrel: N/A			
Boring Location: 881+00.8, 3.7 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							Laboratory Testing Results/ AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)	
0						SSA	168.4	Visual Description and Remarks 4½" PAVEMENT. Brown, moist, fine to coarse SAND, trace silt. Olive, moist, Clayey SILT, trace fine sand. Bottom of Exploration at 7.0 feet below ground surface. NO REFUSAL
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: River Road Location: Windham, Maine		Boring No.: HB-WEWI-213 WIN: 11219.20				
Drilling Contractor: MaineDOT			Elevation (ft.): 130.0		Auger ID/OD: 5" Dia.					
Operator: Giles/Daggett			Datum: NAVD 88		Sampler: Off Flights					
Logged By: B. Wilder			Rig Type: CME 45C		Hammer Wt./Fall: N/A					
Date Start/Finish: 2/11/2015-2/11/2015			Drilling Method: Soil Stem Auger		Core Barrel: N/A					
Boring Location: 891+00.7, 10.1 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						Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows				
0	S18		0.33 - 2.20			SSA	129.7		4" PAVEMENT.	
									Brown, wet, fine to coarse SAND, trace silt.	0.3
	S19		2.20 - 5.00				127.8		Light brown, moist, fine to medium SAND, little silt, trace gravel.	2.2
5							125.0			
10										
20										
25										
Remarks:										
Stratification lines represent approximate boundaries between soil types; transitions may be gradual.								Page 1 of 1		
* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.								Boring No.: HB-WEWI-213		

[illegible]

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: River Road Location: Windham, Maine				Boring No.: HB-WEWI-215 WIN: 11219.20																																																																																																																							
Drilling Contractor: MaineDOT				Elevation (ft.): 98.2				Auger ID/OD: 5" Dia.																																																																																																																							
Operator: Giles/Daggett				Datum: NAVD 88				Sampler: Off Flights																																																																																																																							
Logged By: B. Wilder				Rig Type: CME 45C				Hammer Wt./Fall: N/A																																																																																																																							
Date Start/Finish: 2/11/2015-2/11/2015				Drilling Method: Soild Stem Auger				Core Barrel: N/A																																																																																																																							
Boring Location: 1928+00.5, 10.8 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																																																																																																																															
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Boring No.: HB-WEWI-215																																																																																																																															

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: River Road Location: Windham, Maine				Boring No.: HB-WEWI-216 WIN: 11219.20			
Drilling Contractor: MaineDOT				Elevation (ft.): 100.4				Auger ID/OD: 5" Dia.			
Operator: Giles/Daggett				Datum: NAVD 88				Sampler: Off Flights			
Logged By: B. Wilder				Rig Type: CME 45C				Hammer Wt./Fall: N/A			
Date Start/Finish: 2/11/2015-2/11/2015				Drilling Method: Soil Stem Auger				Core Barrel: N/A			
Boring Location: 1931+00.5, 6.8 ft Lt.				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											
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	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-value	Casing Blows	Elevation (ft.)				
0							100.1	4" PAVEMENT.			
	S22		1.60 - 5.00				98.8	Brown, moist, fine to coarse SAND, some gravel, trace silt.	0.3		
								Olive, wet, Clayey SILT, trace fine sand.	1.6		
5							95.4	Bottom of Exploration at 5.0 feet below ground surface. NO REFUSAL	5.0		
10											
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20											
25											
Remarks:											
Stratification lines represent approximate boundaries between soil types; transitions may be gradual.								Page 1 of 1			
* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.								Boring No.: HB-WEWI-216			

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: River Road Location: Windham, Maine				Boring No.: HB-WEWI-217 WIN: 11219.20																																																																																																																						
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS								Project: River Road						Boring No.: HB-WEWI-218																																																																																																																																																																																																																																																																																																																																																																																																						
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: River Road Location: Windham, Maine		Boring No.: HB-WEWI-221 WIN: 11219.20				
Drilling Contractor: MaineDOT			Elevation (ft.): 166.4		Auger ID/OD: 5" Dia.					
Operator: Giles/Daggett			Datum: NAVD 88		Sampler: Off Flights					
Logged By: B. Wilder			Rig Type: CME 45C		Hammer Wt./Fall: N/A					
Date Start/Finish: 2/11/2015-2/11/2015			Drilling Method: Soil Stem Auger		Core Barrel: N/A					
Boring Location: 1959+00.5, 10.8 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										
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0	S26		0.33 - 2.20			SSA	166.1		4" PAVEMENT.	G#266624 A-1-b, SM WC=6.5%
							164.2		Brown, damp, fine to coarse SAND, some gravel, trace silt.	
	S27		2.20 - 5.00						Grey, very wet, Clayey SILT, trace fine sand.	
5							161.4		Bottom of Exploration at 5.0 feet below ground surface. NO REFUSAL	
10										
15										
20										
25										
Remarks:										
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* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.									Boring No.: HB-WEWI-221	

State of Maine - Department of Transportation

Probe Summary Sheet

Town(s): Windham

Work Number: 11219.20

Station (Feet)	Offset (Feet)	Weathered Rock (Feet)	Weathered Rock Elevation	Refusal (Feet)	No Refusal (Feet)	Bottom of Probe Elevation	Comments 11/15/2017
845+50.8	8.3 Lt.	2.8	163.9			163.9	
854+00.9	15.9 Lt.			3.5		190.4	
854+50.9	5.8 Rt.	2.7	196.0	3.2		195.5	
854+50.7	14.5 Rt.			2.9		195.3	
855+00.9	9.3 Lt.	5.1	197.6	5.9		196.8	
855+00.7	19.7 Rt.			3.3		199.0	
855+50.7	8.2 Lt.	3.7	202.2	5.0		200.9	
855+50.8	9.8 Rt.	4.2	201.5	5.0		200.7	
855+50.8	14.2 Lt.			2.5		203.3	
855+50.8	18.8 Rt.			2.2		202.7	
856+00.8	7.1 Lt.	3.7	204.0	5.0		202.7	
856+00.8	5.9 Rt.	3.3	204.7	4.1		203.9	
856+00.8	14.1 Lt.			5.0		202.4	
856+00.8	14.4 Rt.			2.5		205.2	
856+50.8	5.8 Lt.	6.4	202.0	6.7		201.7	
856+50.8	6.9 Rt.	6.5	202.1	7.1		201.5	
856+50.8	14.1 Lt.			5.9		202.1	
856+50.8	13.9 Rt.			2.5		206.0	
857+00.8	7.0 Lt.	5.3	203.4	5.7		203.0	
857+00.8	7.9 Rt.			6.2		202.8	
857+00.8	14.0 Lt.			3.0		205.4	
857+00.8	13.9 Rt.			4.6		204.2	
857+50.8	7.7 Lt.	5.5	203.3	6.3		202.5	
857+50.8	7.9 Rt.	2.9	206.6	3.3		206.2	
857+50.8	14.2 Lt.			4.3		203.8	
857+50.8	14.8 Rt.			2.5		206.6	
858+00.8	7.3 Lt.	9.1	199.1	9.6		198.6	
858+00.9	8.3 Rt.			4.8		204.0	
858+00.9	14.7 Rt.			2.1		206.6	
858+50.8	7.5 Lt.	5.4	200.7	5.7		200.4	
858+50.9	6.5 Rt.	6.2	200.4	7.1		199.5	
869+00.9	7.2 Rt.				5.0	171.7	
877+50.8	10.3 Rt.				6.0	151.2	
878+00.8	6.1 Rt.				10.0	148.6	
878+00.8	18.7 Lt.				5.0	153.0	
878+00.8	12.3 Rt.				6.0	152.4	
878+50.7	16.2 Lt.				5.0	156.0	
878+50.8	11.2 Rt.				6.0	154.2	
879+00.8	10.2 Lt.	9.1	154.0	9.3		153.8	
879+00.7	12.5 Rt.			7.5		155.1	
879+50.9	10.1 Lt.			10.2		155.8	
879+50.7	12.3 Rt.				8.0	157.5	
880+00.8	6.6 Rt.	9.5	158.3	9.8		158.2	
880+00.9	16.9 Lt.				9.0	158.7	
880+50.8	15.7 Lt.				8.0	160.0	
880+50.8	13.3 Rt.			9.6		158.4	

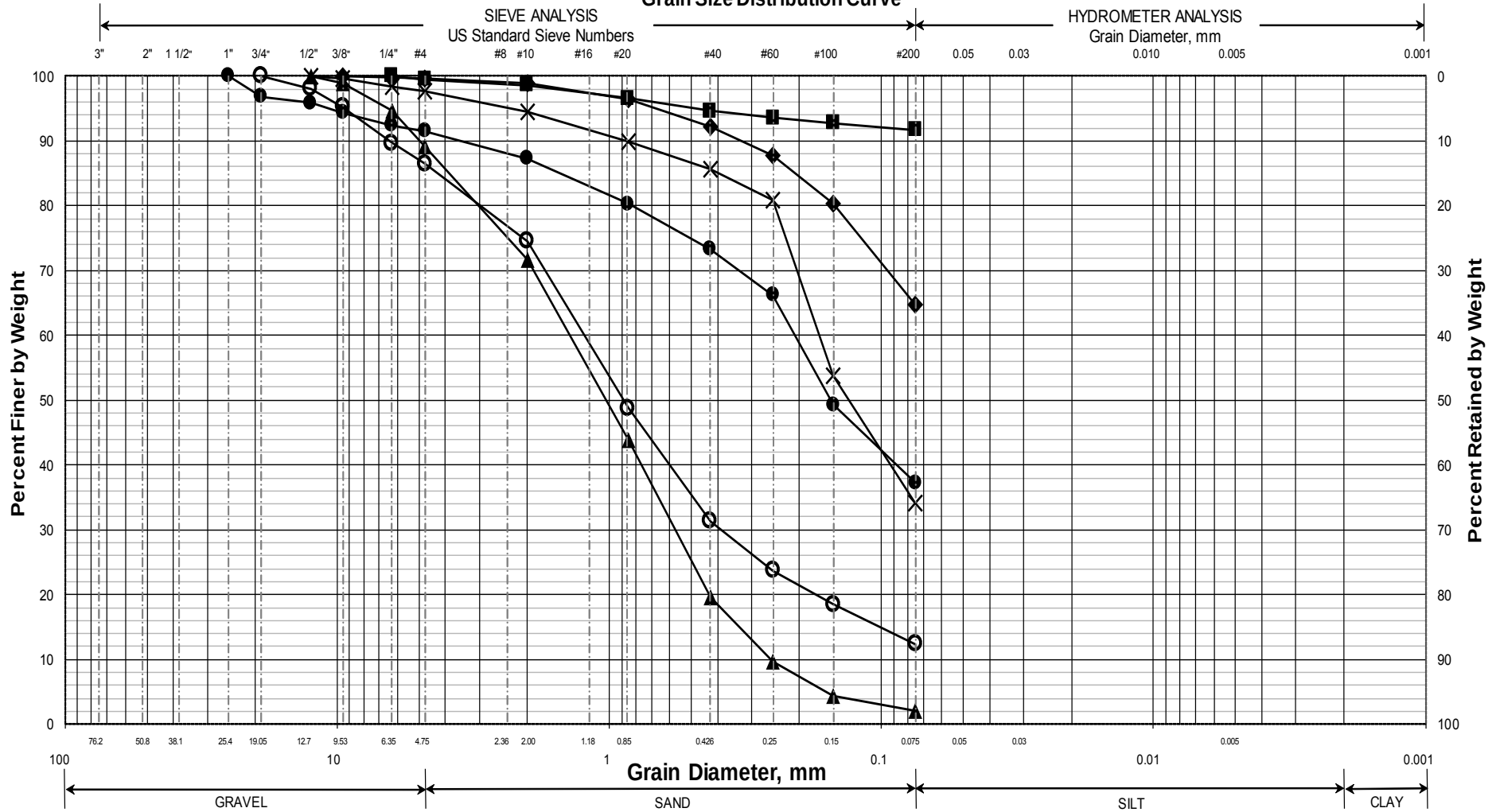
State of Maine - Department of Transportation

Probe Summary Sheet**Town(s): Windham****Work Number: 11219.20**

Station (Feet)	Offset (Feet)	Weathered Rock (Feet)	Weathered Rock Elevation	Refusal (Feet)	No Refusal (Feet)	Bottom of Probe Elevation	Comments 11/15/2017
881+00.9	8.8 Lt.				10.0	158.5	
882+00.6	7.5 Rt.				10.0	157.4	
883+00.9	8.4 Rt.				10.0	151.7	
1941+50.5	11.7 Lt.	7.4	146.1	7.7		145.8	
1941+50.6	4.4 Rt.	8.2	145.1	8.4		144.9	
1942+00.4	11.5 Lt.			5.2		152.8	
1942+00.6	4.0 Rt.	5.3	152.6	5.5		152.4	
1942+00.4	20.9 Lt.			6.0		151.7	
1942+50.4	12.2 Lt.			4.4		158.1	
1942+50.5	3.7 Rt.	6.1	156.2	6.3		156.0	
1942+50.4	22.3 Lt.			5.0		157.9	
1943+00.5	12.1 Lt.			1.8		164.5	
1943+00.6	3.2 Rt.	2.9	163.1	3.2		162.8	
1943+00.5	24.5 Lt.			3.4		164.4	
1943+50.6	12.0 Lt.	2.2	167.0	2.7		166.5	
1943+50.5	2.6 Rt.			3.1		165.7	
1943+50.7	24.4 Lt.			7.0		162.4	
1944+00.6	11.0 Lt.	2.8	168.3	3.1		168.0	
1944+00.5	2.9 Rt.			3.4		167.4	
1944+00.8	24.0 Lt.			9.5		163.4	
1944+50.7	9.8 Lt.			2.1		170.6	
1944+50.4	3.8 Rt.			5.0		167.4	
1944+51	23.8 Lt.			7.9		166.1	
1945+00.7	8.9 Lt.			3.4		170.2	
1945+00.5	5.4 Rt.			3.2		170.5	
1945+01	22.3 Lt.			4.6		168.5	
1945+50.7	8.1 Lt.			5.4		169.1	
1945+50.5	7.4 Rt.			1.2		173.4	
1945+50.9	20.5 Lt.			6.5		166.7	
1946+00.6	7.5 Lt.			5.9		168.5	
1946+00.5	8.0 Rt.	5.6	168.9	6.1		168.4	
1946+50.6	6.8 Lt.			5.2		168.4	
1946+50.5	11.6 Rt.	5.2	168.6	5.7		168.1	
1946+50.7	18.7 Lt.			4.2		168.1	
1946+50.5	13.7 Rt.			3.0		170.9	
1947+00.5	8.7 Lt.			4.6		168.0	
1947+00.6	7.3 Rt.			5.6		167.2	
1947+00.6	13.3 Rt.			2.4		170.4	
1947+50.6	7.8 Lt.			3.4		168.1	
1947+50.7	7.1 Rt.			5.2		166.5	
1947+50.6	14.1 Rt.				5.5	166.2	

Project Number: 11219.20PI = Plasticity Index as determined by AASHTO 90-96 and/or ASTM D4318-98

Maine Department of Transportation Grain Size Distribution Curve

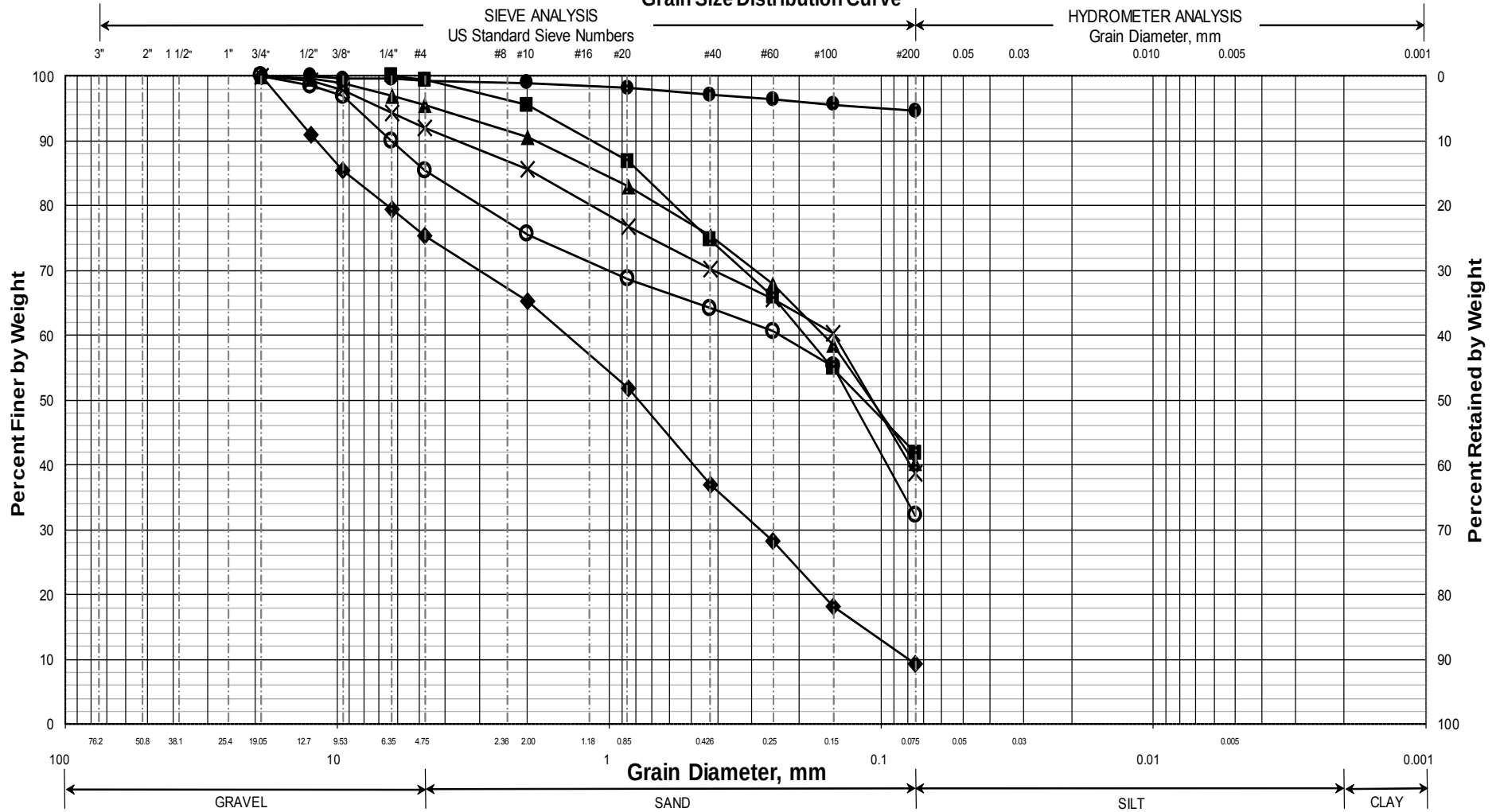


UNIFIED CLASSIFICATION

	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	WC, %	LL	PL	PI
O	HB-WEWI-101/S1	Off Project	--- RT	0.45-3.4	SAND, little gravel, little silt.	5.1			
◆	HB-WEWI-101/S2	Off Project	--- RT	3.4-5.0	SILT, some sand, trace gravel.	22.6			
■	HB-WEWI-102/S3	794+00.3	5.7 RT	3.5-5.0	SILT with clay, trace sand, trace gravel.	32.5			
●	HB-WEWI-103/S4	807+50.4	7.2 RT	2.1-3.4	Silty SAND, trace gravel.	12.4			
▲	HB-WEWI-104/S5	817+50.8	7.3 RT	0.50-1.2	SAND, little gravel, trace silt.	5.4			
X	HB-WEWI-104/S6	817+50.8	7.3 RT	2.6-4.1	SAND, some silt, trace gravel.	18.0			

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Windham
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WHITE, TERRY A 4/5/2019

Maine Department of Transportation Grain Size Distribution Curve

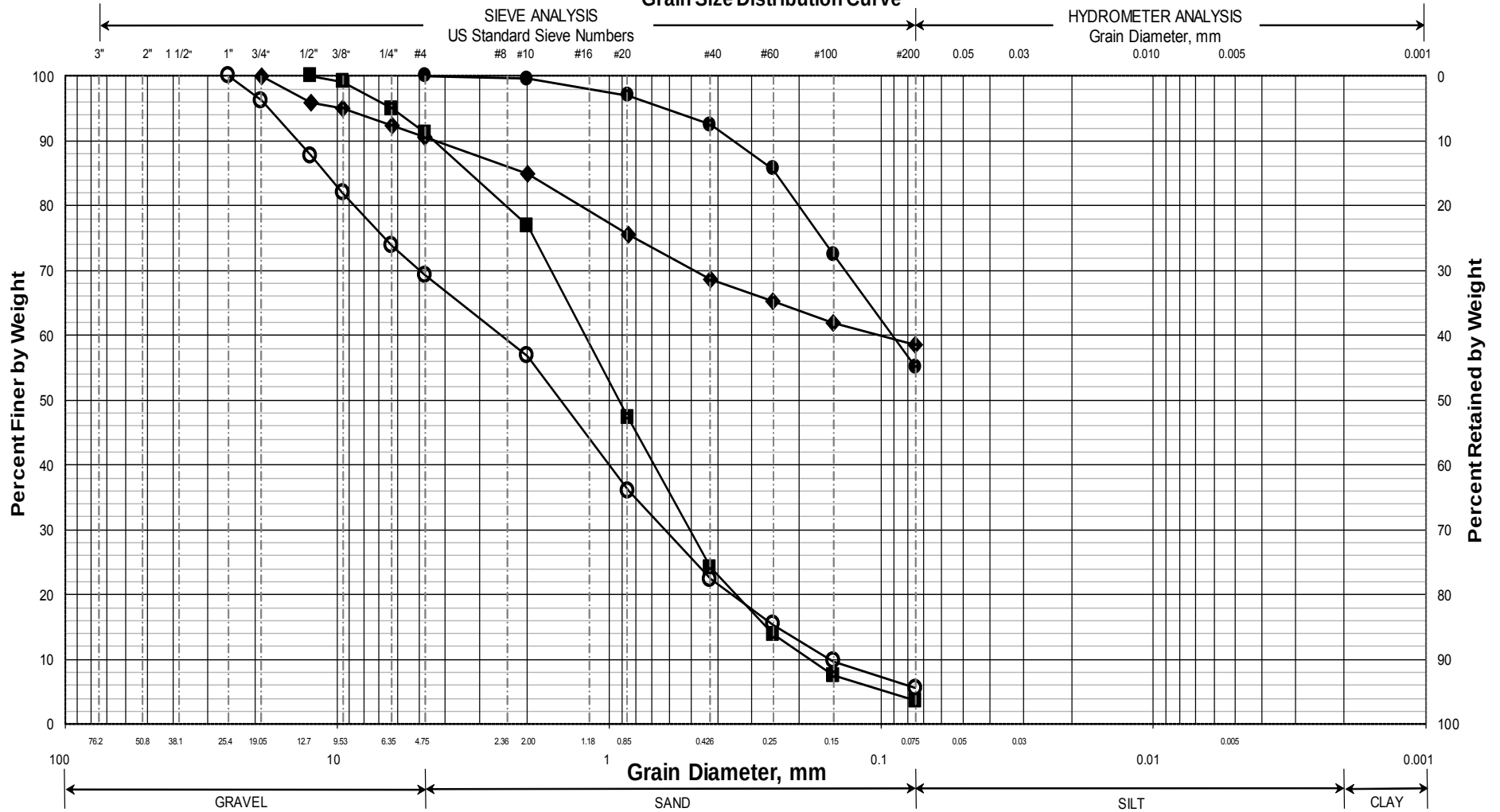


UNIFIED CLASSIFICATION

	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	WC, %	LL	PL	PI
O	HB-WEWI-107/S8	855+00.8	6.9 RT	0.40-3.2	SAND, some silt, little gravel.	4.8			
♦	HB-WEWI-109/S18	875+00.8	6.2 RT	1.0-3.7	SAND, some gravel, trace silt.	4.7			
■	HB-WEWI-109/S19	875+00.8	6.2 RT	3.7-5.0	Silty SAND, trace gravel.	21.4			
●	HB-WEWI-111/S9	900+00.8	6.3 RT	1.8-5.0	SILT with clay, trace sand, trace gravel.	23.8			
▲	HB-WEWI-112/S10	908+00.8	10.3 RT	1.3-2.8	Silty SAND, trace gravel.	27.1			
X	HB-WEWI-112/S11	908+00.8	10.3 RT	2.8-5.0	Silty SAND, trace gravel.	13.7			

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Maine Department of Transportation Grain Size Distribution Curve

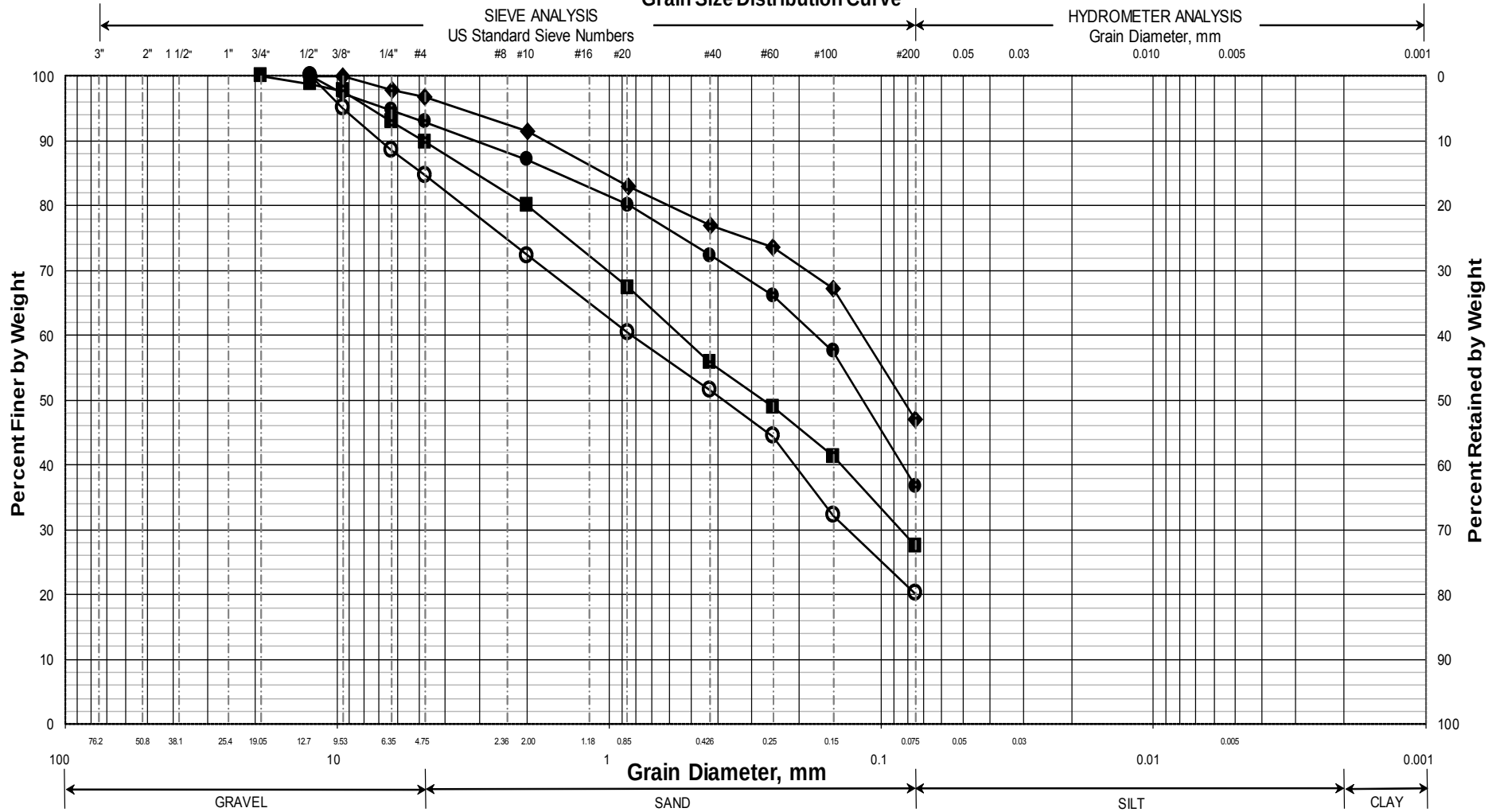


UNIFIED CLASSIFICATION

	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	WC, %	LL	PL	PI
○	HB-WEWI-114/S13	1925+00.5	7.1 RT	0.40-2.0	SAND, some gravel, trace silt.	5.2			
◆	HB-WEWI-114/S14	1925+00.5	7.1 RT	2.0-3.3	SILT, some sand, trace gravel.	17.5			
■	HB-WEWI-115/S20	1950+00.6	7.4 RT	0.40-1.6	SAND, trace gravel, trace silt.	4.2			
●	HB-WEWI-115/S22	1950+00.6	7.4 RT	2.5-5.0	Sandy SILT.	42.5	33	22	11
▲									
X									

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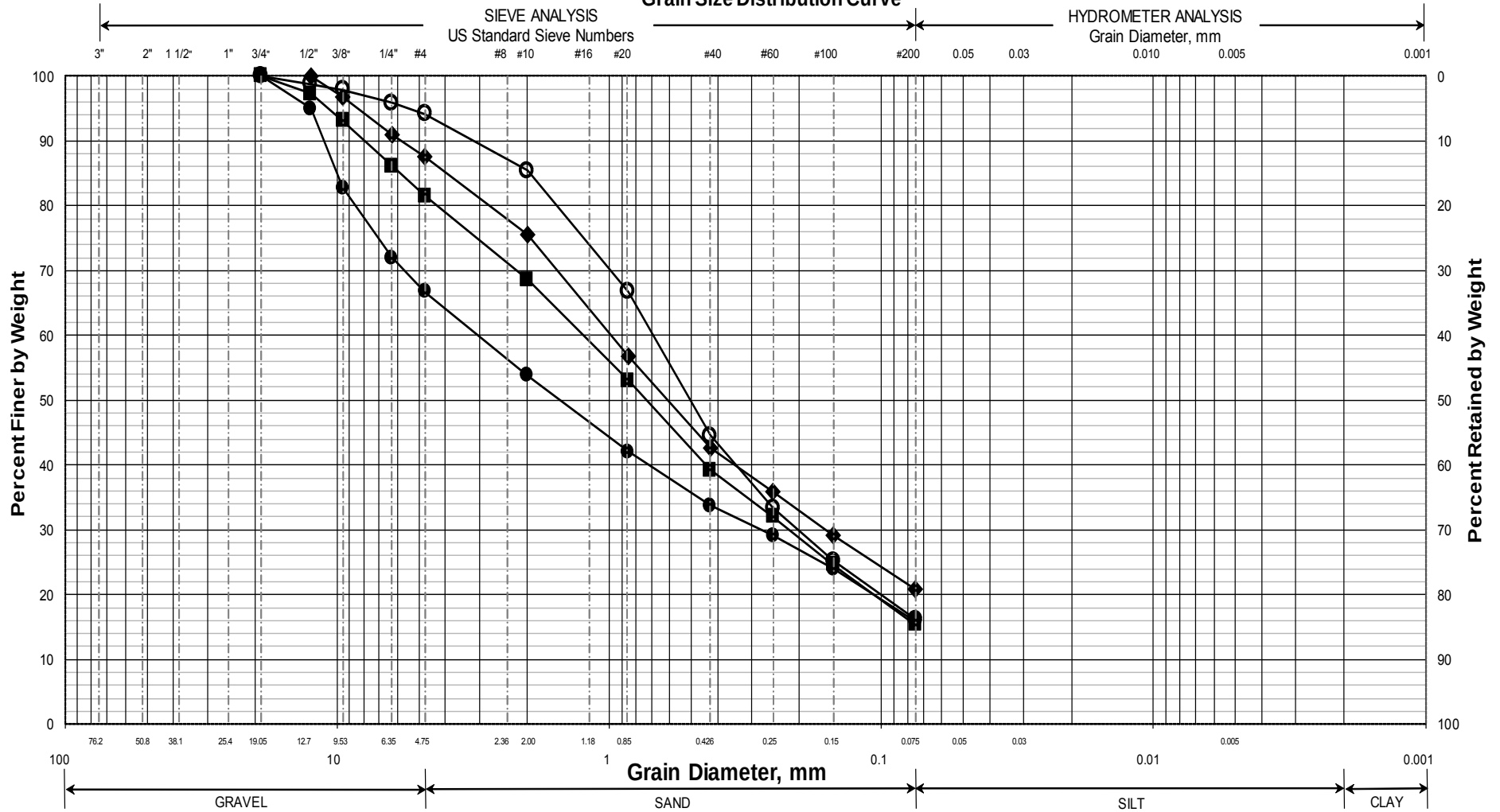


UNIFIED CLASSIFICATION

	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	WC, %	LL	PL	PI
○	HB-WEWI-202/S3	824+00.7	6.0 RT	0.38-2.0	SAND, little silt, little gravel.	12.5			
◆	HB-WEWI-203/S5	831+50.7	10.1 LT	0.38-2.0	Silty SAND, trace gravel.	18.7			
■	HB-WEWI-204/S7	848+50.7	9.6 LT	0.33-1.6	SAND, some silt, trace gravel.	9.8			
●	HB-WEWI-204/S8	848+50.7	9.6 LT	1.6-8.7	Silty SAND, trace gravel.	10.3			
▲									
X									

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Town
Windham
Reported by/Date
WHITE, TERRY A 4/5/2019

Maine Department of Transportation Grain Size Distribution Curve



UNIFIED CLASSIFICATION

	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	WC, %	LL	PL	PI
○	HB-WEWI-207/S11	857+00.8	2.4 RT	0.42-2.0	SAND, little silt, trace gravel.	4.8			
◆	HB-WEWI-211/S16	880+00.7	3.7 RT	0.33-2.2	SAND, some silt, little gravel.	4.3			
■	HB-WEWI-218/S24	1943+00.5	4.2 RT	0.33-2.6	SAND, little gravel, little silt.	4.0			
●	HB-WEWI-221/S26	1959+00.5	10.8 RT	0.33-2.2	SAND, some gravel, little silt.	6.5			
▲									
X									

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GEOTECHNICAL DESIGN REPORT

16-0443

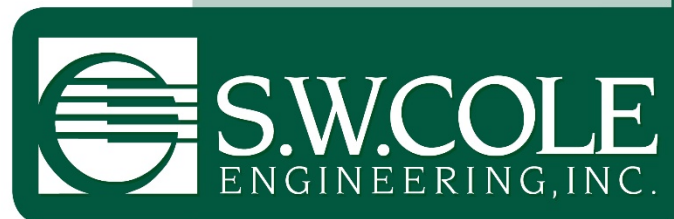
March 21, 2019

Explorations and Geotechnical Engineering Services

Doles Bridge #5061 Replacement
River Road over Colley Wright Brook
Windham, Maine
WIN 021924.00

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

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



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

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TABLE OF CONTENTS

1.0 INTRODUCTION	1
1.1 Site Conditions.....	1
1.2 Proposed Construction	2
2.0 EXPLORATIONS AND TESTING	2
2.1 Explorations.....	2
2.1.1 Preliminary Phase Explorations	2
2.1.2 Design Phase Explorations	2
2.2 Testing.....	3
3.0 SUBSURFACE CONDITIONS	3
3.1 Surficial and Bedrock Geology.....	3
3.2 Subsurface Conditions.....	4
3.3 Groundwater Conditions	7
4.0 PRELIMINARY GEOTECHNICAL EVALUATION	7
4.1 Foundation Options and Discussion	7
4.2 Settlement	8
4.3 Global Stability.....	9
4.4 Integral Abutment H-Piles	10
4.4.1 Strength Limit State Design.....	10
4.4.2 Service and Extreme Limit State Design	12
4.4.3 Downdrag.....	14
4.4.4 Lateral Pile Resistance	14
4.4.5 Driven Pile Resistance and Pile Quality Control.....	15
4.5 Integral Abutment Design	16
4.6 Frost Considerations.....	18
4.7 Seismic Design Considerations	18
4.8 Recommendations for Scour Evaluation.....	19
4.9 Construction Considerations.....	20
5.0 CLOSURE.....	20

Appendix A	Limitations
Appendix B	Figures
	Site Location Map
	Boring Location Plan
	Interpretive Subsurface Profile
	Boring Log Plan Sheets
Appendix C	Logs and Key to Soil and Rock Descriptions and Terms
Appendix D	Laboratory Test Results
Appendix E	Calculations
Appendix F	Historical Bridge Plans

16-0443

March 21, 2019

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

Subject: Geotechnical Design Report
Explorations and Geotechnical Engineering Services
Doles Bridge #5061 Replacement
River Road over Colley Wright Brook
Windham, Maine
WIN 021924.00

Dear Laura:

In accordance with our Proposals, dated May 6, 2016 and December 18, 2018, and project specific Assignment Letters #1 and #2, dated May 9, 2016 and January 7, 2019, we have made the requested subsurface explorations for the subject project. The purpose of our services was to obtain subsurface information in order to provide geotechnical parameters and recommendations for foundations and earthwork associated with the proposed construction.

The services provided by S. W. Cole Engineering, Inc. (S.W.COLE) were conducted in accordance with our Multi-PIN Agreement with the Maine Department of Transportation (MaineDOT), No. 20150720000000000085, dated July 20, 2015. The contents of this report are subject to the limitations in Attachment A.

1.0 INTRODUCTION

1.1 Site Conditions

The site is Doles Bridge (MaineDOT Bridge #5061) carrying River Road over Colley Wright Brook in Windham, Maine. The site location is shown on the "Site Location Map" attached in Appendix B. Based on the historic bridge plans provided by MaineDOT, we understand the existing bridge was originally constructed in 1930. The bridge structure

was raised and widened in 1983. The existing bridge is a 21-foot long by ± 26.8 -foot wide (out-to-out) single-span structure with a cast-in-place concrete deck. The existing clear span is 15 feet. The 1930 historic bridge plans indicate the existing bridge is supported on 15-ton timber pile foundations; however, historic subsurface information is unavailable. Historic Bridge Plans are attached in Appendix B.

1.2 Proposed Construction

Based on the Preliminary Design Report (PDR) prepared by CHA Consulting, Inc. (CHA), we understand the project is scoped for bridge replacement. We understand the replacement structure will be a 70-foot single-span, integral abutment structure founded on H-piles. The proposed abutments will be constructed behind the existing abutments requiring removal of the existing abutments to about Elevation (EI) 68 feet.

We understand the bridge will be widened about 16 feet (out-to-out) and the new alignment will be shifted about 4 feet west (left of existing centerline) requiring new approach fills. We understand the vertical profile will be raised about 2 feet to provide additional freeboard. We understand 1.75:1 (H:V) riprap slopes will be placed in front of the new integral abutments for scour protection and new approach slopes will be constructed with 2H:1V, or flatter, sideslopes.

2.0 EXPLORATIONS AND TESTING

2.1 Explorations

2.1.1 Preliminary Phase Explorations

Five test borings (BB-WCWB-101 through BB-WCWB-104 and BB-WCWB-102A) were made at the site on May 16 through May 18, 2016 by S. W. Cole Explorations, LLC. These exploration locations were selected and established in the field by S.W.COLE. The ground surface elevations of the test borings were provided by MaineDOT. The “as-drilled” exploration locations are shown on the “Boring Location Plan” attached in Appendix B. Logs of these test borings and a Key to Soil and Rock Descriptions and Terms used on the logs are attached as Appendix C.

2.1.2 Design Phase Explorations

Two test borings (BB-WCWB-201 and BB-WCWB-202) were made at the site on January 14 and 15, 2019 by S. W. Cole Explorations, LLC. These exploration locations

were selected and established in the field by S.W.COLE. The ground surface elevations of the test borings were provided by MaineDOT. The “as-drilled” exploration locations are shown on the “Boring Location Plan” attached in Appendix B. Logs of these test borings and a Key to Soil and Rock Descriptions and Terms used on the logs are attached as Appendix C.

2.2 Testing

The test borings were drilled using a combination of solid-stem auger, hollow-stem augers, cased wash boring, and NQ2 rock core drilling techniques. The soils were sampled at 2 to 5-foot intervals using a split-spoon sampler and Standard Penetration Testing (SPT) techniques using a calibrated automatic hammer. Shelby tube sampling and Vane Shear Testing (VST), using the MaineDOT Geonor vane kit, were performed where softer cohesive soils were encountered. Upon encountering refusal on bedrock, borings BB-WCWB-102, BB-WCWB-102A, BB-WCWB-103, BB-WCWB-201 and BB-WCWB-202 were advanced up to 10 feet into bedrock using NQ2 rock coring. The uncorrected SPT blow counts, uncorrected and corrected SPT N-values, VST and rock core intervals are shown on the logs.

Soils and rock core samples recovered from the test borings were visually classified in our laboratory and transported to the MaineDOT Laboratory in Bangor, Maine for testing to assist soil classification and identification. Laboratory testing was performed on disturbed SPT and undisturbed Shelby Tube samples obtained during the explorations. Laboratory testing was performed by the MaineDOT Materials Testing and Exploration Central Laboratory in Bangor, Maine in accordance with applicable American Association of State Highway and Transportation Officials (AASHTO) testing procedures. Laboratory testing included 23 natural water content tests, 14 grain size analyses (with and without hydrometer), eight Atterberg limits, and two consolidation tests. A summary and results of the laboratory testing are provided in Appendix D.

3.0 SUBSURFACE CONDITIONS

3.1 Surficial and Bedrock Geology

According to the Maine Geological Survey’s (MGS’s) mapping of the North Windham Quadrangle, Maine (Open-File No. 97-41, MGS 1997), surficial geologic units within the site vicinity consist of Presumpscot Formation (marine silt, clay and sand) and Glacial

Till. The surficial geologic units encountered were consistent with the mapped geology; however, the explorations also encountered Fill soils from previous site development.

Bedrock in the site vicinity is mapped as Late Ordovician or Silurian age material of the Hutchins Corner Formation (Open-File No. 98-1, MGS 1998). This material is generally composed of metamorphic biotite-quartz-plagioclase granofels with thin inter-beds of calc-silicate granofels and occasional schist layers. Quartz-biotite-plagioclase granofels was encountered in the explorations where sampled. The observed bedrock is generally consistent with the mapped bedrock geology. There are no mapped faults within the site vicinity.

3.2 Soil and Bedrock

The test borings encountered a soils profile generally consisting of a surface layer of pavement overlying fill overlying marine sand, silt and clay overlying glacial till mantling bedrock. The principal strata encountered in the explorations are summarized below. An Interpretive Subsurface Profile is attached as in Appendix B. Refer to the attached logs for more detailed descriptions of the subsurface findings at the exploration locations.

Fill: Below an approximate 8 to 10 inch layer of pavement, the borings encountered fill extending to depths of about 11.3 to 18.8 feet below ground surface (bgs) corresponding to Elevation (El.) 73 to 65.2 feet. The fill generally consisted of:

- Brown, moist, SAND, varying amounts of gravel, some to trace silt;
- Brown, moist, silty SAND, little to trace gravel;
- Brown, moist, sandy SILT, varying amounts of clay; and
- Brown to grey, moist to wet, clayey SILT, some to trace sand, trace gravel.

Occasional organics (rootlets) were encountered within the fill. Wood debris was encountered at a depth of about 15 feet bgs (El. 69 feet) in BB-WCWB-103.

The fill was generally loose to very dense with SPT N_{60} values ranging from 3 to 65 blows per foot (bpf).

Marine Clay: Below the fill, the borings encountered marine clays to a depth of about 19 to 37 feet bgs (El. 64.9 to 47.2 feet). The marine clay sampled consisted of:

- Brown, wet, clayey SILT, some sand;
- Grey, wet, silty CLAY, trace sand; trace gravel; and
- Grey, wet, silty CLAY, trace sand.

The thickness of the marine clay generally increased from south to north. In general, the deposit consisted of grey, silty clay with sand layers towards the bottom of the deposit.

Vane shear tests completed in the marine clay measured undisturbed undrained shear strengths ranging from about 700 to 1,100 pounds per square foot (psf), indicating the marine clay is medium stiff to stiff in consistency. The remolded shear strengths ranged from about 80 to 140 psf. Based on the ratio of peak (undisturbed) to remolded shear strength, the marine clay has a sensitivity ranging from about 5 to 10 and classified as moderately to highly sensitive.

Atterberg Limits tests were conducted on seven samples of the marine clay. Results of the Atterberg Limits testing on the marine clay are summarized in the following table:

Boring No.	Sample No.	USCS Classification	Water Content (%)	Atterberg Limits			Liquidity Index (LI)
				LL	PL	PI	
BB-WCWB-101	7D	CL	23.1	33	23	10	0.0
BB-WCWB-101	8D	CL	43.4	40	22	18	1.2
BB-WCWB-102	1U	CL	40.8	37	21	16	1.2
BB-WCWB-102	2U	CL	39.1	35	21	14	1.3
BB-WCWB-103	10D	-	40.5	NA	NA	NP	NA
BB-WCWB-103	11D	CL	38.8	35	20	15	1.3
BB-WCWB-104	5D	CL	43.2	33	21	12	1.9

Six of the samples where Atterberg Limits were completed indicated the marine clay is plastic. The plasticity indices (PI) of these samples ranged from 10 to 18 indicating the soils generally have a low to medium plasticity. The natural water contents for these samples ranged from about 23 to 43 percent and liquid limits (LL) ranged from 33 to 40. The liquidity indices (LI) ranged from 0 to 1.9. Interpretation of these results indicate the soils with a LI of 1 or less are normally or heavily consolidated while those with LI in excess of 1 are on the verge of being a viscous liquid as the natural water content exceeds the LL. Soils with LI in excess of 1 have a high liquefaction potential and loss

of strength and structure when disturbed. LI values greater than or equal to 1 are also indicative of soils that are unconsolidated and are commonly referred to as “quick.”

Two one-dimensional consolidation tests were conducted on undisturbed Shelby Tube samples. The results of the tests are included in Appendix B and summarized in the following table:

Boring No.	Sample No.	Sample Elevation (ft)	Stress History			Compressibility		
			Existing Vertical Effective Stress (psf)	Maximum Previous Stress (psf)	OCR	C _R	R _R	C _v (ft ² /day)
BB-WCWB-102	1U	64.2	1,840	3,100	1.7	0.40	0.051	0.007 to 0.01
BB-WCWB-102	2U	54.2	2,300	4,100	1.8	0.52	0.076	

Based on the consolidation test results, the maximum previous stress (e.g. preconsolidation stress) within the marine clay is greater than the existing vertical effective stress (Overconsolidation Ratio, OCR = 1.7 to 1.8) indicating the marine clay deposit is slightly overconsolidated.

Glacial Till: Underlying the marine clay, the borings encountered glacial till to a depth of about 28.3 to 42.9 feet bgs (El. 55.6 to 41.5 feet). The glacial till generally consisted of:

- Grey, wet, SAND, varying amounts of gravel and silt, with occasional cobbles.

The glacial till was generally medium dense to very dense with SPT N₆₀ values ranging from 21 to 76 blows per foot (bpf).

Bedrock: Bedrock was encountered and sampled in borings BB-WCWB-102, BB-WCWB-102A, BB-WCWB-103, BB-WCWB-201 and BB-WCWB-202. The top of bedrock varied from about 28.3 to 42.9 feet bgs (El. 41.5 to 55.6 feet). The bedrock consisted of dark grey, hard, very slightly weathered quartz-biotite-plagioclase granofels of the Hutchins Corner Formation. Joints were generally low to moderate dipping, close and tight with quartz and calcite infilling.

The following table summarizes the approximate depths to bedrock, corresponding top of bedrock elevations and Rock Quality Designation (RQD) where encountered.

Boring Number (Substructure)	Approximate Depth to Bedrock (feet)	Approximate Bedrock Elevation (feet)	RQD (RMQ)
BB-WCWB-102 (Abutment No 2)	41.7	42.5	0 to 76% (Very Poor to Good)
BB-WCWB-102A (Abutment No 2)	41.6	42.6	84 to 91% (Good to Excellent)
BB-WCWB-103	35.2	48.8	56 to 93% (Fair to Excellent)
BB-WCWB-201 (Abutment No 1)	28.3	55.5	40 to 87% (Poor to Good)
BB-WCWB-202	42.9	41.5	48 to 70% (Poor to Fair)

Rock quality designation (RQD) values for the bedrock generally ranged from 40 to 93 percent corresponding to a Rock Mass Quality (RMQ) of poor to excellent. The RQD for a 6 inch core run from BB-WCWB-102 was 0 percent due to plugging of the core barrel. Detailed descriptions of the rock core and RQD values for each core run are shown on the exploration logs in Appendix C.

3.3 Groundwater

The soils encountered at the test borings were moist from the ground surface. Measured water levels made immediately after drilling ranged from 9 to 11.7 feet bgs. It should be noted that water was introduced during drilling; therefore, water levels indicated may not represent stabilized ground water conditions. Long term groundwater information is not available. It should be anticipated that groundwater levels will fluctuate seasonally, particularly in response to periods of snowmelt and precipitation, changes in site use and the water level of Colley Wright Brook.

4.0 PRELIMINARY GEOTECHNICAL EVALUATION

S.W.COLE conducted geotechnical engineering evaluations in accordance with 2017 AASHTO LRFD Bridge Design Specifications, 8th Edition (AASHTO) and the MaineDOT Bridge Design Guide, 2003 Edition with revisions through June 2018 (MaineDOT BDG) and offers the following:

4.1 Foundation Options and Discussion

During the preliminary design phase, bridge replacement alternatives evaluated included the following:

- Precast concrete box culvert (box culvert alternative)
- Precast concrete three-sided frame (three-sided frame alternative);

- Composite arch (composite arch option); and
- Integral Abutment Bridge (IAB alternative).

The PDR identifies the pile-supported IAB as the preferred replacement structure and driven piles as the preferred foundation option. The following sections provide preliminary geotechnical design considerations and recommendation for H-pile supported integral bridge abutments.

4.2 Settlement

We understand the current design development will shift the horizontal alignment north about 4 feet requiring new approach fills for embankment widening. Additionally, we understand the vertical profile will be raised about 2 feet. Based on the subsurface soil conditions encountered, placement of normal-weight fills will cause settlement of the underlying marine clay. We conducted settlement evaluations using Settle3D software to assess the feasibility of constructing the proposed embankment fill and widening.

As described above, the compressibility of the marine clay deposit is dependent upon stress history. Based on the laboratory consolidation test results, the maximum previous stress (e.g. preconsolidation stress) within the marine clay is greater than the existing vertical effective stress ($OCR = 1.7$ to 1.8) within the roadway embankment. We estimated the magnitude of stress increase within the marine clay deposit as a result of the anticipated fill placement and widening using normal-weight fills with a unit weight of 125 pounds per cubic foot (pcf). Since the combination of the existing vertical effective stress and estimated stress increase from the placement of about 10 feet of fill will be less than the maximum previous stress, the magnitude of consolidation settlement will be a function of the marine clays recompression ratio ($R_R = 0.051$ to 0.076).

Settlement evaluations were conservatively completed to model the approach embankment widening and 2 feet raise in grade using normal-weight fills. Settlement was evaluated for short-term (0.1 year), 1 year and 50 years after loading. Estimates of the magnitude of total ground surface settlement for each stage are summarized below. The evaluation shows that the estimated magnitude of total ground surface settlement due to embankment widening and grade raise will result in total settlements approaching $\frac{1}{2}$ inch at Abutment No. 1 and 1 inch at Abutment No 2. Model run output are provided in Appendix B.

Model	Range of Estimated Total Settlement (inches)			
	Stage 1 (0.1 year)	Stage 2 (1 year)	Stage 3 (50 years)	Net Change from Stage 2 and 3
Abutment 1/South Approach	$\frac{1}{8}$ to $\frac{1}{4}$	$\frac{1}{4}$ to $\frac{1}{2}$	$\frac{1}{4}$ to $\frac{1}{2}$	Negligible
Abutment 2/North Approach	$\frac{1}{8}$ to $\frac{3}{8}$	$\frac{1}{4}$ to $\frac{1}{2}$	$\frac{3}{4}$ to 1	$\frac{1}{2}$

As discussed above, the estimated settlement will occur as recompression since the combination of existing vertical stress and estimated stress increase within the marine clay layer is less than the maximum past pressure. As a result, we anticipate most of the settlement will occur during construction, as fill is placed and compacted.

4.3 Global Stability

We performed global stability evaluations for the existing north approach embankment at approximately Sta. 911+00 considering the embankment widening and 2 foot raise in roadway grade. Our slope stability analyses were made using SLOPE/W software.

We evaluated global stability considering the resistance factors outlined in AASHTO LRFD, Section 11.6.2.3 and guidance in Section C11.6.2.3 as follows:

Global Stability for Static Conditions

$FS \geq 1.3$ ($\phi = 0.75$) for slopes or walls supporting a structural element

Global Stability for Seismic Conditions

$FS \geq 1.0$ ($\phi = 1$)

In accordance with LRFD Article 11.6.5.2.2, the seismic condition includes a seismic load by incorporating a horizontal seismic coefficient, k_h of 0.114 g, equal to one-half of the calculated acceleration coefficient (A_s) of 0.227 g. Results of our global stability model runs are summarized in the following table and included in Appendix E.

Model	Safety Factor
Static Conditions Embankment widening and 2 foot raise in road grade – Rapid Drawdown	1.36
Seismic Conditions Embankment widening and 2 foot raise in road grade	1.06

Results of our global stability model runs indicated safety factors against global stability failure for the rapid drawdown during static conditions and seismic conditions are above the referenced safety factors per LRFD Section 11.6.2.3. Results are included as Appendix E.

4.4 Integral Abutment H-Piles

We understand abutments No. 1 (South) and No. 2 (North) will be integral abutments founded on a single row of steel H-piles. The piles shall be end bearing on or within bedrock and driven to the required resistance. Based on the MaineDOT BDG Section 5.4.2.1, piles may include HP 12x53, 12x74, 14x73 or 14x89. Additional pile sections may be considered depending on the factored design axial loads. S.W.COLE can provide additional input on pile size once pile loading has been developed for the proposed structure.

H-piles shall be 50 ksi, Grade A572 steel with cast driving points conforming to MaineDOT Standard Specification 711.10 to help reduce damage to the piles during driving and improve penetration. We recommend pile points consist of Associated Pile and Fitting, Rock Injector, HP-80500 Pile Points.

Based on the depths bedrock was encountered at the borings we estimate the following pile lengths:

Location	Approx. Bottom of Proposed Abutment	Approx. Top of Competent Bedrock	Estimated Pile Length (feet)
	Elevation (feet)		
Abutment No. 1	75.5	55.8	20
Abutment No. 2	75.5	42.2	34

The estimated pile lengths do not take into account locations where bedrock may be deeper or shallower than that encountered at the test borings, pile damaged, additional footage (5 feet) of pile required for dynamic testing instrumentation (per ASTM D4945), additional pile length needed to accommodate leads and driving equipment, or additional pile length needed for embedment in the abutment or pile cap.

4.4.1 Strength Limit State Design

Design of pile foundations bearing on or within bedrock at the strength limit state shall consider;

- Compressive axial geotechnical resistance of individual piles bearing on bedrock;
- Drivability resistance of individual piles driven to bedrock;
- Structural resistance of individual piles in axial compression, and;
- Structural resistance of individual piles in combined axial loading and flexure.

Pile groups should be designed to resist all lateral earth loads, vehicular loads, dead and live loads, and lateral forces transferred through the abutments. The pile group resistance after scour due to the design flood shall provide adequate foundation resistance using the resistance factors given in this section.

Per LRFD Article 6.5.4.2, at the strength limit state, the axial resistance factor $\phi_c = 0.50$, for severe driving conditions shall be applied to the structural compressive resistance of the pile. The H-piles will be subjected to lateral loading, therefore the piles shall be evaluated for resistance against combined axial compression and flexure in accordance with LRFD Articles 6.9.2.2 and 6.15.2.

Per LRFD Article 6.5.4.2, at the strength limit state, the axial resistance factor $\phi_c = 0.70$ and the flexural resistance factor $\phi_f = 1.0$ shall be applied to the combined axial and flexural resistance of the pile in the interaction equation (LRFD Eq. 6.9.2.2-1 or -2).

Abutment H-piles should be analyzed for determination of unbraced lengths and fixity using LPILE® 2016 (LPile) software. The calculated unbraced lengths should be used to analyze the piles in combined axial compression and flexure resistance provided in LRFD Articles 6.9.2.2 and 6.15.2.

Structural Resistance. The nominal axial compressive structural resistance (P_n) for piles loaded in compression shall be as specified in LRFD Article 6.9.4.1. The nominal axial structural compressive resistance (P_n) subject to the combined axial compression and flexure shall be evaluated based on unbraced lengths (l) and effective length factors (K) as determined from LPile once structural loads are available. The nominal axial structural resistance should be evaluated based on combined axial compression and flexure.

Preliminary estimates of the structural axial resistance for selected H-pile sections were calculated using a resistance factor, $\phi_c = 0.50$, for severe driving conditions. The unbraced pile lengths (l) and effective length factors (K) in these evaluations have been assumed. It is the responsibility of the structural engineer to calculate the nominal axial structural compressive resistance (P_n) based on unbraced lengths (l) and effective length factors (K) determined from LPile.

Geotechnical Resistance. The nominal axial geotechnical resistance in the strength limit state should be calculated using the guidance in LRFD Article 10.7.3.2.3 which states

the nominal bearing resistance of piles driven to point bearing on hard rock shall not exceed the structural pile resistances obtained from LRFD Article 6.9.4.1 with a resistance factor ϕ_c , of 0.50, for severe driving conditions. For non-displacement piles driven to end bearing on or within bedrock, it is our experience that this is generally not the controlling resistance.

Drivability Analyses. Drivability analyses shall be performed to determine the pile resistance that might be achieved considering available diesel hammers. The maximum driving stresses in the pile, assuming the use of 50 ksi steel, shall be less than 45 ksi. The drivability resistances shall be calculated using the resistance factor, ϕ_{dyn} , of 0.65, for a single pile in axial compression when a dynamic test is performed as specified in LRFD Table 10.5.5.2.3-1.

A summary of the calculated factored axial compressive structural, geotechnical, and drivability resistances of selected H-piles for the strength limit states are provided in the following table.

Factored Axial Pile Resistances at Strength Limit States				
Pile Section	Factored Axial Pile Resistance (kips)			
	Structural Resistance $\phi_c = 0.5$	Controlling Geotechnical Resistance $\phi = 0.5$	Drivability Resistance $\phi_{dyn} = 0.65$	Controlling Axial Pile Resistance
HP 12x53	387	387	273	273
HP 12x74	545	545	412	412
HP 14x73	535	535	410	410
HP 14x89	652	652	439	439

LRFD Article 10.7.3.2.3 states the nominal axial compressive resistance of piles driven to hard rock is typically controlled by the structural resistance with a resistance factor for severe driving conditions applied. However, the estimated factored axial pile resistance from the drivability analyses for the H-pile sections are less than the controlling factored axial structural resistance per LRFD Article 10.7.3.2.3. Therefore, drivability controls. The maximum applied factored axial pile load for the strength limit states should not exceed the controlling factored pile resistance shown in above table.

4.4.2 Service and Extreme Limit State Design

The design of H-piles at the service limit state shall consider tolerable transverse and longitudinal movement of piles and pile group movement considering changes in soil

conditions due to scour based on the design flood (Q_{100}). For the service limit state, resistance factors of $\phi = 1.0$ should be used in accordance with LRFD Article 10.5.5.1. The exception is the overall global stability of the foundation which should be investigated at the Service I load combination and a resistance factor, ϕ of 0.65.

Extreme limit state design shall include pile axial compressive resistance, overall global stability of the pile group, pile failure by uplift in tension, and structural failure. The extreme event load combinations are those related to seismic forces, ice loads, debris loads, and hydraulic events. Extreme limit state design shall also check that the nominal pile foundation resistance remaining after scour due to the check flood (Q_{500}) can support the extreme limit state loads. Resistance factors for extreme limit states, per LRFD Article 10.5.5.3, shall be taken as $\phi = 1.0$ with the exception of uplift of piles, for which the resistance factor, ϕ_{up} , shall be 0.80 or less per LRFD Article 10.5.5.3.2.

The nominal axial geotechnical pile resistance at the service and extreme limit state was calculated using the guidance in LRFD Article 10.7.3.2.3. A summary of the calculated factored axial structural, geotechnical, and drivability resistances of selected H-piles for the extreme and service limit states are provided in the following table.

Factored Axial Pile Resistances at Service and Extreme Limit States				
Pile Section	Factored Axial Pile Resistance (kips)			
	Structural Resistance $\phi_c = 1.0$	Controlling Geotechnical Resistance $\phi = 1.0$	Drivability Resistance $\phi_{dyn} = 1.0$	Controlling Axial Pile Resistance
HP 12x53	714	775	420	420
HP 12x74	1007	1090	634	634
HP 14x73	1012	1070	631	631
HP 14x89	1236	1305	675	675

LRFD Article 10.7.3.2.3 states that the nominal axial compressive resistance of piles driven to hard rock is typically controlled by the structural resistance with a resistance factor for severe driving conditions applied. However, the estimated factored axial pile resistances from the drivability analyses for the H-pile sections are less than the controlling factored axial structural resistance per LRFD Article 10.7.3.2.3 and the nominal structural resistances. The maximum applied factored axial pile load for the extreme and service limit states should not exceed the controlling factored pile resistance shown in above table.

4.4.3 Downdrag

As previously discussed, a total settlement of up to 1 inch was estimated at Abutment No. 2. The settlement is anticipated as recompression consolidation of the marine clay as a result of the embankment widening and raise in roadway grade. Therefore, we recommend sequencing construction to place the fills for embankment widening and raise in roadway grade prior to installation of piles. Additionally, the piles should be designed to resist downdrag loading.

Side friction contributing to downdrag loading was estimated using the β -method in NAVFAC DM-7.2¹. A summary of the calculated nominal downdrag load for the selected piles are provided in the following table. A load factor of 1.0 should be applied to the calculated downdrag load, which should be added to the maximum factored axial dead load.

Pile Section	Nominal Downdrag Load (kips)
HP 12x53	47.8
HP 12x74	42.2
HP 14x73	49.0
HP 14x89	49.5

4.4.4 Lateral Pile Resistance

In accordance with LRFD Article 6.15.1, the structural analysis of pile groups subjected to lateral loads shall include consideration of soil-structure interaction effects as specified in LRFD Article 10.7.3.9. Assumptions regarding a fixed or pinned condition at the pile tip should be also confirmed with soil-structure interaction analyses.

Lateral pile analyses were not completed by S.W.COLE as part of our evaluation. We recommend that lateral pile results be used to check that the combined axial and bending demand meet the LRFD structural requirements. We recommend lateral pile analysis be required to show the pile tips meet a pinned condition (no translation), if a fixed condition is not apparent. Geotechnical parameters for generation of soil-resistance (p-y) curves in lateral pile analyses using LPILE® software are shown in the following Table.

¹ Naval Facilities Engineering Command (NAVFAC), Design Manual (DM) 7.2, 1986, Page 7.2-211.

Recommended LPILE® Soil Parameters							
Elevation Range ^{1,2} (Depth Range)		Soil Layer ^{2,3} (Soil Model)	K _{static} (pci)	Soil Parameters			
Top	Bottom			Effective Unit Wt. γ', (pcf)	Cohesion c, (psf)	e ₅₀	Friction Angle φ', (deg)
Abutment 1 (Borings BB-WCWB-104 and 201)							
75.5 (0)	68.5 (7.0)	med dense Sand/Silt Fill (Sand-Reese)	60	57.6	-	-	30
68.5 (7.0)	63.0 (12.5)	medium stiff Marine Clay (Soft Clay-Matlock)	-	52.6	850	0.010	-
63.0 (12.5)	55.8 (19.7)	med dense/dense Glacial Till (Sand-Reese)	125	67.6	-	-	34
55.8 (19.7)	-	Bedrock ⁴ (Strong Rock – Vuggy Limestone)	-	102.6	-	-	-
Abutment 2 (Borings BB-WCWB-102 and 102A)							
75.5 (0)	68.0 (7.5)	medium dense Sand/Silt Fill (Sand-Reese)	60	57.6	-	-	30
68.0 (7.5)	48.1 (27.4)	medium stiff Marine Clay (Soft Clay-Matlock)	-	52.6	700	0.010	-
48.1 (27.4)	42.2 (33.3)	med dense/dense Glacial Till (Sand-Reese)	125	67.6	-	-	34
42.2 (33.3)	-	Bedrock ⁴ (Strong Rock – Vuggy Limestone)	-	102.6	-	-	-

Notes: 1. From preliminary plans bottom of pile cap at ±Elevation 75.5 feet.
2. Soil profiles based on subsurface conditions encountered in test borings BB-WCWB-104 and BB-WCWB-201 for Abutment 1 and BB-WCWB-102 and BB-WCWB-102A for Abutment 2.
3. Groundwater at El. 79.5 feet corresponding to Q₅₀.
4. Unconfined Compressive Strength (Q_u) assumed as 2,000 psi.

4.4.5 Driven Pile Resistance and Pile Quality Control

The contract documents shall require the contractor to perform a wave equation analysis for the proposed pile-hammer system and conduct dynamic pile load tests with signal matching. The first pile driven at each abutment should be dynamically tested to confirm nominal pile resistance and verify the stopping criteria developed by the contractor in the wave equation analysis. Minimum 24-hour restrrike tests will be required and should be noted on the plans. Additional dynamic tests may be required as part of the pile field quality control program if:

- Pile behavior vary radically between adjacent piles;
- Pile behavior indicates pile refusal on a boulder or in a cobble layer above bedrock;
- Pile tip is not firmly embedded in bedrock, or
- Pile is out of tolerance.

Piles should be driven to an acceptable penetration resistance based on the results of a wave equation analysis provided by the contractor and as approved by the design team. Pile load testing should be completed by PDA testing with signal matching including one pile at each abutment. Driving stresses in the pile determined in the drivability analysis and confirmed by PDA testing shall be less than 45 ksi, in accordance with LRFD Article 10.7.8. The pile hammer should be selected such that the required pile resistance when the penetration resistance for the final 3 to 6 inches is between 3 to 15 blows per inch (bpi). If an abrupt increase in driving resistance is encountered, the driving may be terminated when the penetration is less than 0.5-inch in 10 consecutive blows. Termination criteria shall be confirmed and evaluated for the selected pile hammer.

4.5 Integral Abutment Design

Integral abutment sections shall be designed for all relevant strength, service, and extreme limit states and load combinations specified in LRFD Articles 3.4.1 and 11.5.5. Stub abutments shall be designed to resist all lateral earth loads, vehicular loads, dead and live loads, and lateral forces transferred through the integral superstructure. The design of the integral abutment at the strength limit state shall consider reinforced-concrete structural design. Strength limit state design shall also consider changes in foundation conditions and foundation resistance after scour due to the design (Q_{100}) flood.

A resistance factor (ϕ) of 1.0 shall be used to assess abutment design at the service limit state, including: settlement, excessive horizontal movement, and movement resulting after scour due to the design (Q_{100}) flood. The overall stability of the foundation should be investigated at the Service I Load Combination and a resistance factor, ϕ , of 0.65.

Extreme limit state design of integral abutment supported on H-piles shall include pile structural resistance, pile geotechnical resistance, pile resistance in combined axial and flexure, and overall stability. Resistance factors for extreme limit state shall be taken as 1.0. Extreme limit state design shall also check that the nominal foundation resistance remaining after scour due to the check (Q_{500}) flood can support the extreme limit state loads with a resistance factor of 1.0.

The designer may assume Soil Type 4 (MaineDOT Bridge Design Guide (BDG) Section 3.6.1) for abutment backfill material soil properties. The backfill properties are as follows:

- Angle of internal friction (ϕ) of 32 degrees;
- Total unit weight (γ) of 125 pcf; and
- Soil-concrete interface friction angle (δ) of 20 degrees.

Integral abutment sections shall be designed to withstand a lateral earth load equal to the passive pressure state. Calculation of passive earth pressures should assume a Coulomb passive earth pressure coefficient, K_p , of 6.7. Developing full passive pressure assumes that the ratio of lateral abutment movement to abutment height (y/H) exceeds 0.005. If the calculated displacements are significantly less than that required to develop full passive pressure the designer may consider using the Rankine passive earth pressure coefficient of 3.3.

Additional lateral earth pressure due to live load surcharge is required per Section 3.6.8 of the MaineDOT BDG for abutments if an approach slab is not specified. When a structural approach slab is specified, reduction, not elimination, of the surcharge load is permitted per LRFD Article 3.11.6.5. The live load surcharge may be estimated as a uniform horizontal earth pressure due to an equivalent height of soil (h_{eq}) based on LRFD Table 3.11.6.4-1.

The abutment design shall include a drainage system behind the abutment to mitigate excessive hydrostatic pressures. Drainage behind the structure shall be in accordance with MaineDOT BDG Section 5.4.2.13.

Backfill within 10 feet of the abutments and side slope fill shall conform to MaineDOT Specification 703.19 "Granular Borrow for Underwater Backfill."

Slopes in front of the pile supported integral abutments should be constructed with riprap and erosion control geotextile. The riprap slopes should not exceed 1.75:1(H:V) in accordance with MaineDOT Standard Detail 610(03). The 1.75H:1V riprap slopes shall "toe-in" at least 1 foot below the streambed.

4.6 Frost Considerations

According to MaineDOT BDG Section 5.2.1, pile supported integral abutments shall be embedded a minimum of 4.0 feet for frost protection. Foundations bearing on soil should be designed with an appropriate embedment for frost protection. Based on the Maine Design Freezing Index Map², the design freezing index for the Windham, Maine area is approximately 1,300 freezing degree-days. Based on Section 5.2.1 of the MaineDOT BDG and subsurface soils encountered, the maximum seasonal frost penetration is estimated to be on the order of about 3.5 feet. Considering this, we recommend foundations should have at least 3.5 feet of soil cover to provide frost protection.

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

4.7 Seismic Design Considerations

Seismic site class was evaluated in accordance with AASHTO Section 3.10.3.1 Method B (average N-value method). AASHTO allows for an N-value of 100 to be used for bedrock in the upper 100 feet of the soil profile. Based on the subsurface information and an N-value of 100 for the bedrock, the average N-value fell between below 15 bpf corresponding to an AASHTO Site Class E as defined in AASHTO Table 3.10.3.1-1.

The United States Geological Survey (USGS) Seismic Design Parameters program (Version 2.1) was used to obtain the seismic design parameters for the site. Based on the assigned site class (AASHTO Site Class E) and site coordinates, the software provides the recommended AASHTO Response Spectrum for a 7 percent probability of exceedance in 75 years. The results for the project site are summarized below and program output are provided in Appendix E.

²Maine Department of Transportation, Bridge Design Guide (BDG), August 2003, with Revisions through 2014, Figure 5-1.

RECOMMENDED SEISMIC DESIGN PARAMETERS	
Site Class	E
PGA	0.091 g
S_s	0.180 g
S_1	0.046 g
F_{pga}	2.5
F_a	2.5
F_v	3.5
A_s	0.227 g
S_{DS}	0.449 g
S_{D1}	0.160 g
Seismic Zone (based on S_{D1})	Zone 1

NOTE: Site Coordinates: N43.726513, W70.406225

4.8 Recommendations for Scour Evaluation

Based on the laboratory grain size analyses test results, we estimated the average grain diameter corresponding to 50 percent passing by weight (D_{50}) for use in scour evaluations is 0.002 mm. Results of the grain size analyses tests are included in Appendix B and the estimated D_{50} for samples at the channel elevation are summarized in the following table:

Boring No.	Sample No.	Depth (ft)	Elevation (ft)	Estimated D_{50}
BB-WCWB-101	8D	20.0	64.3	0.002
BB-WCWB-102	1U	20.0	64.2	0.002

Design at the strength limit state should consider loss of lateral and vertical support due to scour. Design at the extreme limit state should check that the nominal foundation resistance due to the check flood (Q_{500}) event is no less than the extreme limit state loads. At the service limit state, the design shall limit movements and ensure overall stability considering scour at the design load.

For scour protection of the pile-supported abutments, the bridge and abutment slopes will be armored with riprap. In accordance with MaineDOT BDG Section 2.3.11.3, the top of the riprap shall be located at the Q_{50} elevation. The toe of the new riprap slopes should be keyed into the existing soils at least 2 feet.

Riprap shall conform to MaineDOT Standard Specification 703.26 "Plain and Hand Laid Riprap." The riprap section shall be underlain by a Class 1 nonwoven erosion control geotextile per MaineDOT Standard Specification 722.03.

4.9 Construction Considerations

Construction of the abutments will require pile driving. Temporary lateral earth support systems may be required for construction of driven pile foundations at the proposed abutment locations. The new integral abutments will be constructed behind the existing abutments avoiding placement of fills or cofferdams in the brook. Care should be taken to drive H-piles within allowable tolerances without damaging the H-piles.

Excavations for the proposed abutments may expose pockets of soft or unsuitable material. Soft or unsuitable shall be removed and replaced with compacted granular borrow or crushed stone.

Sloughing and instability of the soils due to runoff, traffic vibrations, and construction activity is likely. The contractor should monitor the stability of slopes, excavation, soils at the roadway grade and the temporary earth retaining systems during construction. The contractor should control groundwater, surface water infiltration and soil erosion. Water should be controlled by pumping from sumps.

5.0 CLOSURE

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

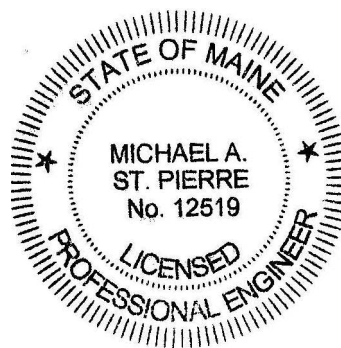
Sincerely,

S. W. Cole Engineering, Inc.

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



Timothy J. Boyce, P.E.
Senior Geotechnical Engineer



MAS/tjb-rec

APPENDIX A

Limitations

This report has been prepared for the exclusive use of the Maine Department of Transportation for specific application to the Proposed Doles Bridge (#5061) Replacement carrying River Road over Colley Wright Brook (MaineDOT WIN 021924.00) in Windham, Maine. S. W. Cole Engineering, Inc. (S.W.COLE) has endeavored to conduct our services in accordance with generally accepted soil and foundation engineering practices. No warranty, expressed or implied, is made.

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

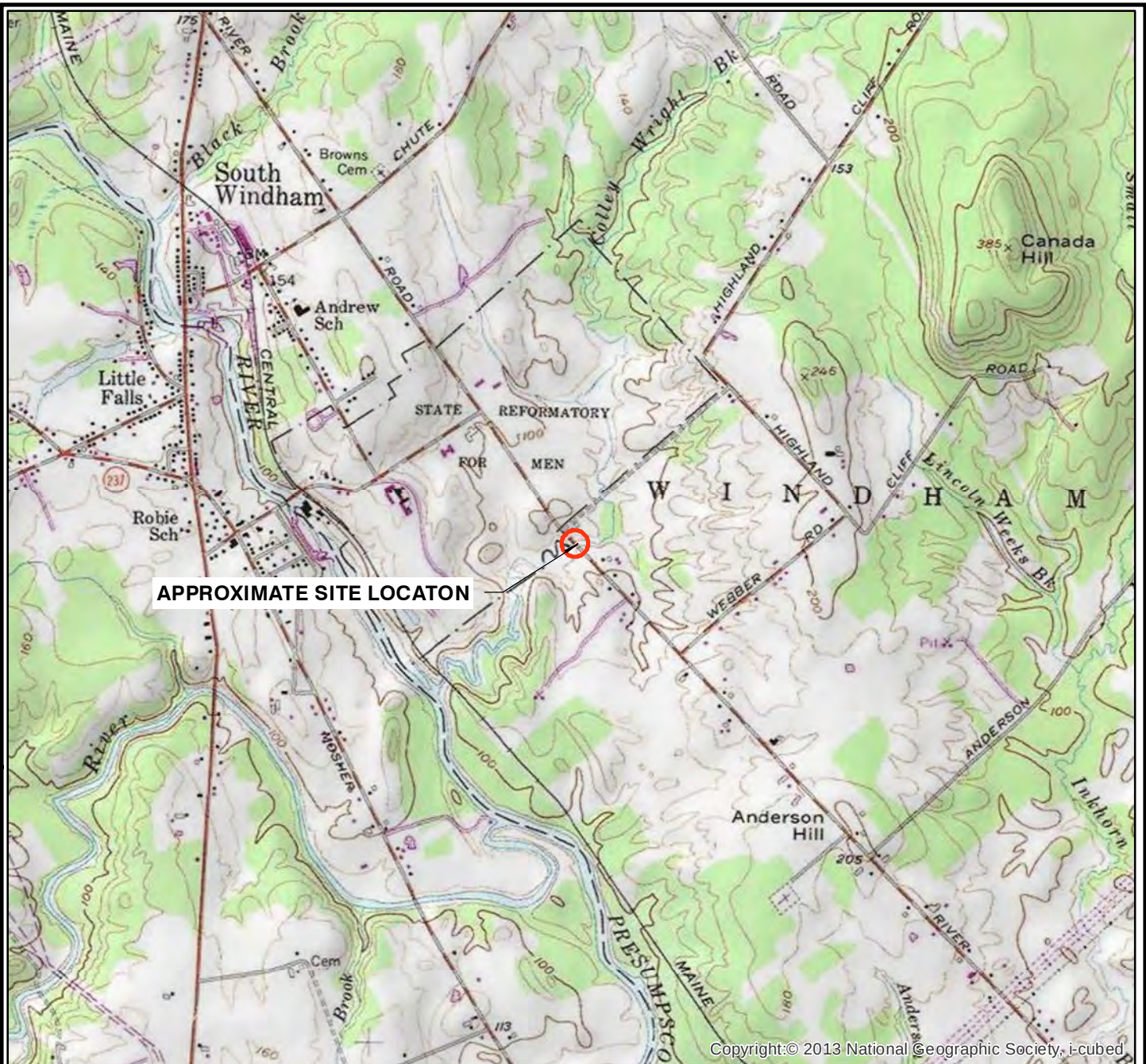
The analyses performed during this investigation and recommendations presented in this report are based in part upon the data obtained from subsurface explorations made at the site. Variations in subsurface conditions may occur between explorations and may not become evident until construction. If variations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

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

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

APPENDIX B

Figures



APPROXIMATE SITE LOCATION

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Scale in Feet



S.W.COLE
ENGINEERING, INC.

MAINE DEPARTMENT OF TRANSPORTATION

SITE LOCATION MAP

DOLES BRIDGE (#5061)

RIVER ROAD OVER COLLEY WRIGHT BROOK

WINDHAM, MAINE

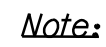
WIN 21924.00

NOTE:

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

Job No. 16-0443
Date: 07/08/2016

Scale 1:24000
Sheet 1

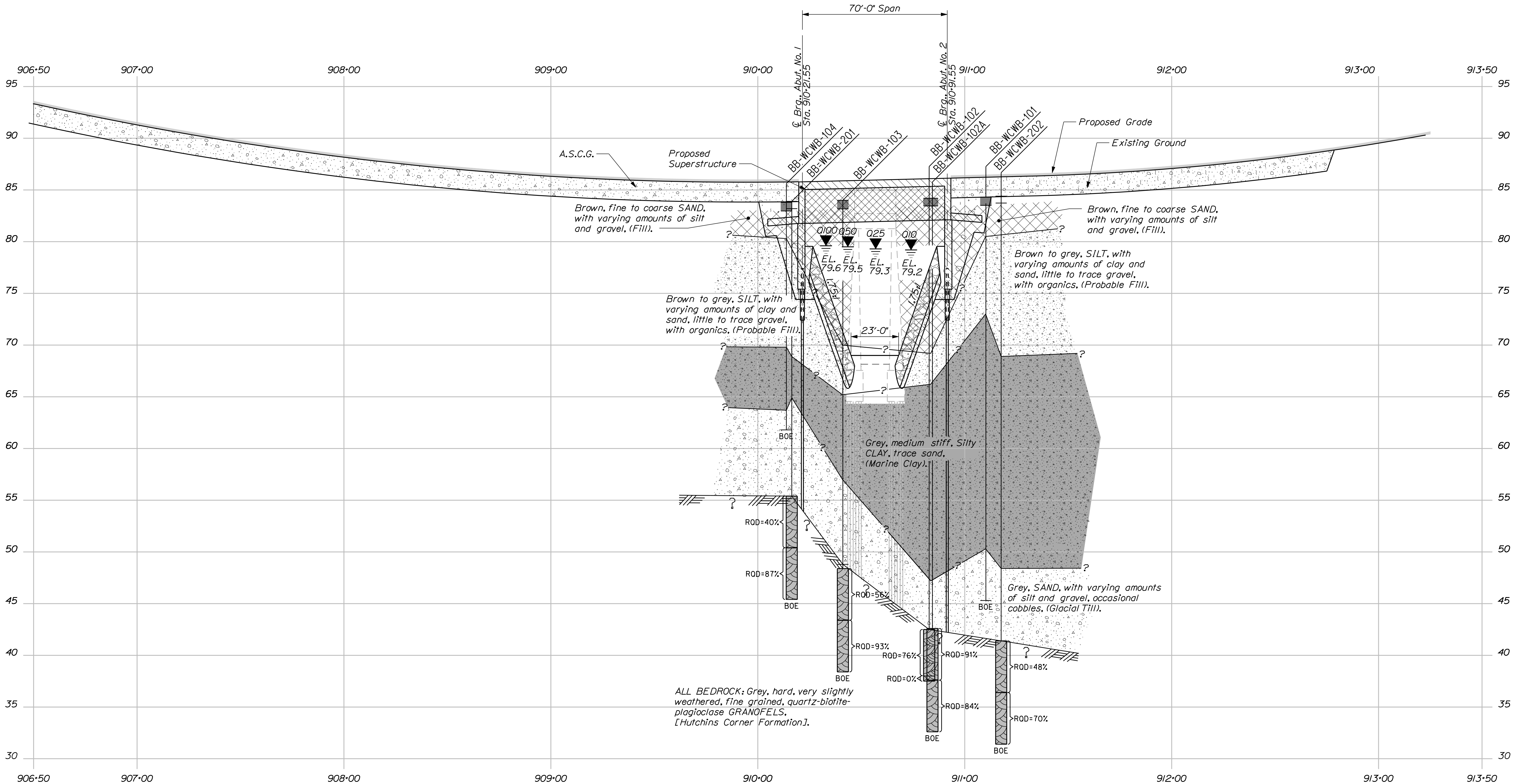


Date: 3/20/2019

Username: Terry.White

Division: GEOTECH

Filename: ...\\00\\geotech\\msta\\007_ISP1.dgn



STATE OF MAINE		DEPARTMENT OF TRANSPORTATION		BRIDGE NO. 5061		WIN		21924.00		BRIDGE PLANS	
DOLES BRIDGE		COLLEY WRIGHT BROOK		CUMBERLAND COUNTY		WINDHAM		INTERPRETIVE SUBSURFACE PROFILE		SHEET NUMBER	
PROJ. MANAGER		CHECKED-REVIEWED		DESIGNED-DETAILED		REVISIONS 1		REVISIONS 2		REVISIONS 3	
BY		DATE		SIGNATURE		P.E. NUMBER		DATE		FIELD CHANGES	
T. WHITE		JUN 2016		L. KRUSINSKI							
3		OF 5									

Maine Department of Transportation										Boring No.:		BB-WCWB-104	
Soil/Rock Exploration Log										Project:Doles Bridge # 5061 carries		River Road over Colley Wright	
US CUSTOMARY UNITS										Location: Windham, Maine		WIN: 21924.00	
Drillers:		S. W. Cole Explorations			Elevation (ft.):		83.8		Auger ID/OD:		2.174" ROTLOW STEEL		
Operator:		Kevin Hanson			Datum:		NAV088		Sampler:		Standard Split Spoon		
Logged By:		Nathan Strout			Rig Type:		Diachon D-50		Hammer Wt./Fall:		140W/30"		
Date Start/Finish:		5/17/2016			Drilling Method:		Cased Wash Boring		Core Barrel:		N/A		
Boring Location:		STA: 910+13.9, 11.3 ft Rt			Casing ID/OD:		HW 4"7/4.5"		Water Level#:		9.0' after completion		
Hammer Efficiency Factor: 0.9285		Hammer Type:		Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		Rope & Cathead ☐							
Test Notes: S = Split Spoon Sample MS = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MS = Unsuccessful Thin Wall Tube Sample Attempt V = Field Vane Shear Test W = Unsuccessful Field Vane Shear Test Attempt R = Pocket Penetrometer WMC = Weight of Rods or Casing N = SPT Unrecorded Corrected for Hammer Efficiency C = Grain Size Analysis N = Unsuccessful Field Vane Shear Test Attempt WMC = Weight of Rods or Casing N = SPT Unrecorded Corrected for Hammer Efficiency C = Grain Size Analysis										S = Test Results SSS = Solid Stem Auger MS = Unsuccessful Solid Stem Auger U = Thin Wall Tube Sample MS = Unsuccessful Thin Wall Tube Sample Attempt V = Field Vane Shear Test W = Unsuccessful Field Vane Shear Test Attempt R = Pocket Penetrometer WMC = Weight of Rods or Casing N = SPT Unrecorded Corrected for Hammer Efficiency C = Grain Size Analysis		S = Test Results SSS = Solid Stem Auger MS = Unsuccessful Solid Stem Auger U = Thin Wall Tube Sample MS = Unsuccessful Thin Wall Tube Sample Attempt V = Field Vane Shear Test W = Unsuccessful Field Vane Shear Test Attempt R = Pocket Penetrometer WMC = Weight of Rods or Casing N = SPT Unrecorded Corrected for Hammer Efficiency C = Grain Size Analysis	
Sample Information												Visual Description and Remarks	
Depth (ft.)	Sample No.	Pen./Ref. (in)	Sample Depth (ft.)	Blow / 6 in. (in)	Blow / 6 in. (in)	Blow / 6 in. (in)	Blow / 6 in. (in)	Blow / 6 in. (in)	Blow / 6 in. (in)	Blow / 6 in. (in)	Blow / 6 in. (in)	Laboratory Testing Results/ASTM and Unified Class	

[illegible][illegible]

APPENDIX C

Boring Logs & Key to Soil and Rock Descriptions and Terms

UNIFIED SOIL CLASSIFICATION SYSTEM					MODIFIED BURMISTER 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	GW	Well-graded gravels, gravel-sand mixtures, little or no fines.	Descriptive Term		Portion of Total (%)	
		(little or no fines)	GP	Poorly-graded gravels, gravel sand mixtures, little or no fines.	trace	0 - 10		
					little	11 - 20		
					some	21 - 35		
				adjective (e.g. sandy, clayey)	36 - 50			
						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)	
					Very Soft		WOH, WOR, WOP, <2	
					Soft		2 - 4	
					Medium Stiff		5 - 8	
					Stiff		9 - 15	
					Very Stiff		16 - 30	
					Hard		>30	
					Approximate Undrained Shear Strength (psf)		Field Guidelines	
					Very Soft		0 - 250	
					Soft		250 - 500	
					Medium Stiff		500 - 1000	
					Stiff		1000 - 2000	
					Very Stiff		2000 - 4000	
					Hard		over 4000	
					Rock Quality Designation (RQD):			
					RQD (%) = $\frac{\text{sum of the lengths of intact pieces of core} * > 4 \text{ inches}}{\text{length of core advance}}$			
					*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, if applicable):			
					Color (Munsell color chart)			
					Texture (aphanitic, fine-grained, etc.)			
					Rock Type (granite, schist, sandstone, etc.)			
					Hardness (very hard, hard, mod. hard, etc.)			
					Weathering (fresh, very slight, slight, moderate, mod. severe, severe, etc.)			
					Geologic discontinuities/jointing:			
					-dip (horiz - 0-5 deg., low angle - 5-35 deg., mod. dipping - 35-55 deg., steep - 55-85 deg., vertical - 85-90 deg.)			
					-spacing (very close - <2 inch, close - 2-12 inch, mod. close - 1-3 feet, wide - 3-10 feet, very wide >10 feet)			
					-tightness (tight, open, or healed)			
					-infilling (grain size, color, etc.)			
					Formation (Waterville, Ellsworth, Cape Elizabeth, etc.)			
					RQD and correlation to rock mass quality (very poor, poor, etc.)			
					ref: ASTM D6032 and AASHTO Standard Specification for Highway Bridges, 17th Ed. Table 4.4.8.1.2A			
					Recovery (inch/inch and percentage)			
					Rock Core Rate (X.X ft - Y.Y ft (min:sec))			
					Sample Container Labeling Requirements:			
					WIN		Blow Counts	
					Bridge Name / Town		Sample Recovery	
					Boring Number		Date	
					Sample Number		Personnel Initials	
					Sample Depth			
Maine Department of Transportation Geotechnical Section Key to Soil and Rock Descriptions and Terms Field Identification Information								

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS					Project: Doles Bridge # 5061 carries River Road over Colley Wright Brook Location: Windham, Maine			Boring No.: BB-WCWB-101 WIN: 21924.00	
Driller: S. W. Cole Explorations			Elevation (ft.) 84.3			Auger ID/OD: 2 1/4" Hollow Stem Augers			
Operator: Kevin Hanscom			Datum: NAVD88			Sampler: Standard Split Spoon			
Logged By: Nathan Strout			Rig Type: Diedrich D-50			Hammer Wt./Fall: 140#/30"			
Date Start/Finish: 5/17/2016			Drilling Method: Augers			Core Barrel: N/A			
Boring Location: STA. 911+10.2, 3.2 ft Lt			Casing ID/OD:			Water Level*: 9.0' after completion			
Hammer Efficiency Factor: 0.9285			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 $N_{60} = (\text{Hammer Efficiency Factor}/60\%) * N\text{-uncorrected}$ T_v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test									

Depth (ft.)	Sample Information							Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows				
0	1D	24/18	0.80 - 2.80	15/18/24/13	42	65	HSA	83.5		9.5" of Pavement.	G#242692 A-7-6, CL WC=39.8% LL=42 PI=21 PI=21
										Brown, moist, very dense, Gravelly SAND, trace silt, (Fill).	
	2D	24/14	2.80 - 4.80	11/10/8/6	18	28				2D(A) (2.8-3.8'): Similar to above.	
										2D(B): Brown, moist, loose, Clayey SILT, some fine sand, (Probable Fill).	
5	3D	24/24	4.80 - 6.80	1/1/2/2	3	5				Brown, moist, medium stiff, Clayey SILT, trace sand, trace gravel, (Probable Fill).	
										Brown, moist, medium dense, Clayey SILT, some fine sand, (Probable Fill).	
	4D	24/23	6.80 - 8.80	4/5/5/5	10	15					
										Brown, wet, medium dense, Clayey SILT, some fine sand, trace organics, (Probable Fill).	
	5D	24/23	8.80 - 10.80	4/5/4/4	9	14					
										Grey, wet, medium dense, Clayey SILT, some sand, trace organics, (Probable Fill).	
10	6D	24/20	10.80 - 12.80	3/2/1/WOH	3	5		73.0			
										Grey, wet, soft, Silty CLAY with fine silty sand layers, (Marine Clay).	
15	7D	24/24	15.00 - 17.00	1/1/1/2	2	3			Grey, wet, soft, Silty CLAY, medium plasticity, trace sand, trace gravel (Marine Clay).	G#242693 A-6, CL WC=23.1% LL=33 PL=23 PI=10	
20	8D	24/24	20.00 - 22.00	WOH-12"/1/1	1	2			Similar to above.	G#270897 A-7-6, CL WC=43.4% LL=40 PL=22 PI=18	
25											

Remarks:
 Auto hammer #562

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.

Page 1 of 2

Boring No.: BB-WCWB-101

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Doles Bridge # 5061 carries River Road over Colley Wright Brook Location: Windham, Maine				Boring No.: BB-WCWB-101 WIN: 21924.00																																																																																																																																																																																																																																																																																																																																																																		
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Doles Bridge # 5061 carries River Road over Colley Wright Brook Location: Windham, Maine				Boring No.: BB-WCWB-102 WIN: 21924.00				
Driller: S. W. Cole Explorations				Elevation (ft.) 84.2				Auger ID/OD: 5" Solid Stem Augers				
Operator: Kevin Hanscom				Datum: NAVD88				Sampler: Standard Split Spoon				
Logged By: Nathan Strout				Rig Type: Diedrich D-50				Hammer Wt./Fall: 140#/30"				
Date Start/Finish: 5/16/2016				Drilling Method: Cased Wash Boring				Core Barrel: NQ-2"				
Boring Location: STA. 910+82.8, 5.5 ft Lt				Casing ID/OD: HW 4"/4.5"				Water Level*: 10.5' after completion				
Hammer Efficiency Factor: 0.9285				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 $N_{60} = (\text{Hammer Efficiency Factor}/60\%) \cdot \text{N-uncorrected}$ T_v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test												
Depth (ft.)	Sample Information								Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows					
0	1D	24/10	0.90 - 2.90	14/18/11/9	29	45	SSA	83.5		9" of Pavement.		
										Brown, moist, medium dense, GRAVEL, some sand, little silt, trace clay, (Fill).	G#242694 A-1-b, GC-GM WC=2.5%	
	2D	24/17	2.90 - 4.90	6/6/8/4	14	22				Brown, moist, medium dense, Silty SAND, little gravel, (Fill).	G#242695 A-4, SM WC=11.3%	
5	3D	24/10	4.90 - 6.90	4/3/3/3	6	9				Brown, moist, loose, SILT, some clay, little sand, (Fill).		
	4D	18/11	6.90 - 8.40	3/2/15/100-0"	17	26				Brown, moist, medium dense, Sandy SILT, trace clay, trace gravel with organics, (Fill).	G#242696 A-4, CL WC=17.4%	
										Cobble (8.4-9.3') Hole caved, placed HW casing.		
10	5D	24/7	9.90 - 11.90	27/53/26/7	79	122	7			5D(A) (9.9-11.4'): Brown, wet, very dense, GRAVEL some silt and sand, (Fill).	G#242697 WC=14.8%	
										5D(B) (11.4-11.9'): Brown, wet, medium dense, SILT, some sand, (Probable Fill).	G#242699 WC=34.6%	
15	6D	24/5	15.00 - 17.00	3/6/3/1	9	14	46			Grey, wet, medium dense, medium SAND, little silt, trace gravel, trace wood at 16.5', (Probable Fill).	G#242699 WC=34.6%	
20	1U	24/23	20.00 - 22.00				26			Grey, wet, medium stiff, Clayey SILT, trace sand, trace gravel, (Marine Clay).	G#242700 A-6, CL WC=40.8% LL=37 PL=21 PI=16	
	V1		23.00 - 23.42	Su=714/137 psf			19			65x130 mm vane raw torque readings V1: 26/5 ft-lbs V2: 25.5/3 ft-lbs		
25	V2		24.00 - 24.42	Su=700/82 psf			21					
Remarks: Auto hammer #562												
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.										Page 1 of 2 Boring No.: BB-WCWB-102		

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Doles Bridge # 5061 carries River Road over Colley Wright Brook Location: Windham, Maine				Boring No.: BB-WCWB-102 WIN: 21924.00			
Driller: S. W. Cole Explorations				Elevation (ft.) 84.2				Auger ID/OD: 5" Solid Stem Augers			
Operator: Kevin Hanscom				Datum: NAVD88				Sampler: Standard Split Spoon			
Logged By: Nathan Strout				Rig Type: Diedrich D-50				Hammer Wt./Fall: 140#/30"			
Date Start/Finish: 5/16/2016				Drilling Method: Cased Wash Boring				Core Barrel: NQ-2"			
Boring Location: STA. 910+82.8, 5.5 ft Lt				Casing ID/OD: HW 4"/4.5"				Water Level*: 10.5' after completion			
Hammer Efficiency Factor: 0.9285				Hammer Type: Automatic ☒ Hydraulic ☐ Rope & Cathead ☐							
Definitions: D = Split Spoon Sample MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MU = Unsuccessful Thin Wall Tube Sample Attempt V = Field Vane Shear Test, PP = Pocket Penetrometer MV = Unsuccessful Field Vane Shear Test Attempt R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140 lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of One Person S _u = Peak/Remolded Field Vane Undrained Shear Strength (psf) S _{u(lab)} = Lab Vane Undrained Shear Strength (psf) q _p = Unconfined Compressive Strength (ksf) N-uncorrected = Raw Field SPT N-value Hammer Efficiency Factor = Rig Specific Annual Calibration Value N ₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency N ₆₀ = (Hammer Efficiency Factor/60%)*N-uncorrected T _v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test											
Depth (ft.)	Sample Information							Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows				
25	7D	24/24	25.00 - 27.00	WOH-18"/1	--		19			G#270884 A-4, CL WC=39.3%	
							21				
							21				
							21				
							25				
30	2U	24/23	30.00 - 32.00				23				
							21				
							23				
	8D V3	24/17	33.00 - 35.00 33.58 - 34.00	5/6/8/7 Su=1099/137 psf	--		22				
	MV		34.00 - 34.00				28				
35	9D	24/19	35.00 - 37.00	8/7/9/15	16	25	33				
							29				
							60				
							76				
							24				
40	10D	18/6	40.00 - 41.50	19/23/26/100-0	49	76					
	R1	54/52.8	41.70 - 46.20	RQD = 76%			NQ-2				
45											
	R2	6/2.4	46.20 - 46.70	RQD = 0%							
50											
Bottom of Exploration at 46.7 feet below ground surface.											
Remarks: Auto hammer #562											
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.										Page 2 of 2 Boring No.: BB-WCWB-102	

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Doles Bridge # 5061 carries River Road over Colley Wright Brook Location: Windham, Maine				Boring No.: BB-WCWB-102A WIN: 21924.00																																																																																																																																																											
Driller: S. W. Cole Explorations				Elevation (ft.) 84.2				Auger ID/OD: 5" Solid Stem Augers																																																																																																																																																											
Operator: Kevin Hanscom				Datum: NAVD88				Sampler: Standard Split Spoon																																																																																																																																																											
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Doles Bridge # 5061 carries River Road over Colley Wright Brook Location: Windham, Maine				Boring No.: BB-WCWB-102A							
								WIN: 21924.00							
Driller:		S. W. Cole Explorations		Elevation (ft.)		84.2		Auger ID/OD:		5" Solid Stem Augers					
Operator:		Kevin Hanscom		Datum:		NAVD88		Sampler:		Standard Split Spoon					
Logged By:		Nathan Strout		Rig Type:		Diedrich D-50		Hammer Wt./Fall:		140#/30"					
Date Start/Finish:		5/18/2016		Drilling Method:		Cased Wash Boring		Core Barrel:		NQ-2"					
Boring Location:		STA. 910+84.4, 4.0 ft Lt		Casing ID/OD:		HW 4"/4.5"		Water Level*:		9.5' after completion					
Hammer Efficiency Factor: 0.9285				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				Su = Peak/Remolded Field Vane Undrained Shear Strength (psf) Su(lab) = Lab Vane Undrained Shear Strength (psf) qp = Unconfined Compressive Strength (ksf) N-uncorrected = Raw Field SPT N-value Hammer Efficiency Factor = Rig Specific Annual Calibration Value N60 = SPT N-uncorrected Corrected for Hammer Efficiency N60 = (Hammer Efficiency Factor/60%)*N-uncorrected				Tv = Pocket Torvane Shear Strength (psf) WC = Water Content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test			
Sample Information															
Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N60	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.				
50								32.6		48.6-49.6 ft (2:25) 49.6-50.6 ft (2:18) 50.6-51.6 ft (2:29) Recovery = 100% Bottom of Exploration at 51.6 feet below ground surface.					
55															
60															
65															
70															
75															
Remarks: Auto hammer #562															
Stratification lines represent approximate boundaries between soil types; transitions may be gradual.										Page 3 of 3					
* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.										Boring No.: BB-WCWB-102A					

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS					Project: Doles Bridge # 5061 carries River Road over Colley Wright Brook Location: Windham, Maine			Boring No.: BB-WCWB-103 WIN: 21924.00				
Driller: S. W. Cole Explorations			Elevation (ft.) 84.0			Auger ID/OD: 2 1/4" Hollow Stem Augers						
Operator: Kevin Hanscom			Datum: NAVD88			Sampler: Standard Split Spoon						
Logged By: Nathan Strout			Rig Type: Diedrich D-50			Hammer Wt./Fall: 140#/30"						
Date Start/Finish: 5/17/2016			Drilling Method: Cased Wash Boring			Core Barrel: NQ-2"						
Boring Location: STA. 910+41.1, 10.4 ft Rt			Casing ID/OD: HW 4"/4.5"			Water Level*: 11.7" after completion						
Hammer Efficiency Factor: 0.9285			Hammer Type: Automatic ☒ Hydraulic ☐ Rope & Cathead ☐									
Definitions: D = Split Spoon Sample MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MU = Unsuccessful Thin Wall Tube Sample Attempt V = Field Vane Shear Test, PP = Pocket Penetrometer MV = Unsuccessful Field Vane Shear Test Attempt R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of One Person S _u = Peak/Remolded Field Vane Undrained Shear Strength (psf) S _u (lab) = Lab Vane Undrained Shear Strength (psf) q _p = Unconfined Compressive Strength (ksf) N-uncorrected = Raw Field SPT N-value Hammer Efficiency Factor = Rig Specific Annual Calibration Value N ₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency N ₆₀ = (Hammer Efficiency Factor/60%)*N-uncorrected T _v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test												
Depth (ft.)	Sample Information							Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.	
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows					
0	1D	24/11	0.80 - 2.80	22/12/11/8	23	36	HSA	83.2		10" of Pavement.		
										Brown, moist, medium dense, SAND, some gravel, some silt, trace clay, (Fill).	G#270886 A-1-b, SC-SM WC=2.9%	
	2D	24/16	2.80 - 4.80	8/16/7/4	23	36					Brown, moist, medium dense, fine Silty SAND, trace clay, trace gravel, (Fill).	G#270887 A-4, SC-SM WC=5.8%
											Similar to above.	
5	3D	24/14	4.80 - 6.80	5/4/4/4	8	12	V				Similar to above.	G#270888 WC=17.8%
											Similar to above.	
	4D	24/14	6.80 - 8.80	5/4/3/4	7	11						
	5D	24/15	8.80 - 10.80	6/5/3/6	8	12						
10	6D	24/4	10.80 - 12.80	4/3/2/2	5	8					Brown, wet, loose, SAND, some silt, little gravel, (Fill).	G#270889 A-2-4, SM WC=19.6%
	7D	24/22	12.80 - 14.80	5/3/2/2	5	8					Similar to above except with organics.	G#270890 A-2-4, SM WC=32.1%
15	8D	24/7	14.80 - 16.80	15/8/6/3	14	22					Grey, wet, medium dense, Silty SAND, some gravel with wood debris, (Probable Fill).	G#270891 WC=25.0%
	9D	24/5	16.80 - 18.80	5/1/1/2	2	3					Brown, wet, very loose, Silty SAND, some gravel, (Probable Fill).	
20	10D	24/17	18.80 - 20.80	1-12"/2/1	2	3		65.2			Grey, wet, soft, Silty CLAY, low plasticity (Marine Clay). Wood in wash water at 25 ft bgs.	G#270892 WC=40.5% NON PLASTIC
25												
Remarks: Auto hammer #562												
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.										Page 1 of 2 Boring No.: BB-WCWB-103		

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Doles Bridge # 5061 carries River Road over Colley Wright Brook Location: Windham, Maine				Boring No.: BB-WCWB-103 WIN: 21924.00			
Driller: S. W. Cole Explorations				Elevation (ft.) 84.0				Auger ID/OD: 2 1/4" Hollow Stem Augers			
Operator: Kevin Hanscom				Datum: NAVD88				Sampler: Standard Split Spoon			
Logged By: Nathan Strout				Rig Type: Diedrich D-50				Hammer Wt./Fall: 140#/30"			
Date Start/Finish: 5/17/2016				Drilling Method: Cased Wash Boring				Core Barrel: NQ-2"			
Boring Location: STA. 910+41.1, 10.4 ft Rt				Casing ID/OD: HW 4"/4.5"				Water Level*: 11.7' after completion			
Hammer Efficiency Factor: 0.9285				Hammer Type: Automatic ☒ Hydraulic ☐ Rope & Cathead ☐							
Definitions: D = Split Spoon Sample MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MU = Unsuccessful Thin Wall Tube Sample Attempt V = Field Vane Shear Test, PP = Pocket Penetrometer MV = Unsuccessful Field Vane Shear Test Attempt R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140 lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of One Person S _u = Peak/Remolded Field Vane Undrained Shear Strength (psf) S _u (lab) = Lab Vane Undrained Shear Strength (psf) q _p = Unconfined Compressive Strength (ksf) N-uncorrected = Raw Field SPT N-value Hammer Efficiency Factor = Rig Specific Annual Calibration Value N ₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency N ₆₀ = (Hammer Efficiency Factor/60%)*N-uncorrected T _v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test											
Depth (ft.)	Sample Information							Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows				
25	11D	24/19	25.00 - 27.00	WOH/WOH/2/6	2	3	12		Grey, wet, soft, Silty CLAY, low plasticity (Marine Clay).	G#270893 A-6, CL WC=38.8% LL=35 PL=20 PI=15	
							18		Sand seam at 26.5 ft bgs		
							44		Wood in wash water to 30 ft bgs		
							116		Grey, wet, very dense, SAND, some gravel, some silt, occasional cobbles (Glacial Till).		
							168				
30	12D	18/4	30.60 - 32.10	10/16/31	47	73	30		Pushed cobble at 29.5 ft bgs Roller cone cobble to 30.6 ft bgs	G#270894 A-1-b, SM WC=9.1%	
							39		Grey, wet, very dense, SAND, some gravel, some silt, occasional cobbles, (Glacial Till).		
							43				
							35				
							24				
35	13D R1	2/1 60/54	35.00 - 35.17 35.60 - 40.60	100-2" RQD = 56%	--		NQ-2	48.8	Probable cobble.		
									Top of Bedrock Elev 48.8 feet		
									Advanced by roller cone to 35.6 ft bgs		
									R1: Dark grey, fine-grained, quartz-biotite-plagioclase		
									GRANOFELS, metamorphic, hard, very slight weathering, joints are low to moderate dipping, close, and tight with quartz and calcite infilling, (Hutchins Corner Formation).		
									Rock Mass Quality = Fair		
									R1:Core times (min:sec)		
									35.6-36.6 ft (3:05)		
									36.6-37.6 ft (1:30)		
									37.6-38.6 ft (1:50)		
									38.6-39.6 ft (2:37)		
									39.6-40.6 ft (2:39) Recovery = 90%		
									R2: Similar to R1		
									Rock Mass Quality = Excellent		
									R2:Core times (min:sec)		
									40.6-41.6 ft (2:30)		
									41.6-42.6 ft (2:13)		
									42.6-43.6 ft (2:27)		
									43.6-44.6 ft (2:20)		
									44.6-45.6 ft (1:55) Recovery = 100%		
									Bottom of Exploration at 45.6 feet below ground surface.		
45								38.4			
50											
Remarks: Auto hammer #562											
Stratification lines represent approximate boundaries between soil types; transitions may be gradual.										Page 2 of 2	
* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.										Boring No.: BB-WCWB-103	

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Doles Bridge # 5061 carries River Road over Colley Wright Brook Location: Windham, Maine				Boring No.: BB-WCWB-104 WIN: 21924.00																																																																																																																																																																																																																																																																																														
Driller: S. W. Cole Explorations				Elevation (ft.) 83.8				Auger ID/OD: 2 1/4" Hollow Stem Augers																																																																																																																																																																																																																																																																																														
Operator: Kevin Hanscom				Datum: NAVD88				Sampler: Standard Split Spoon																																																																																																																																																																																																																																																																																														
Logged By: Nathan Strout				Rig Type: Diedrich D-50				Hammer Wt./Fall: 140#/30"																																																																																																																																																																																																																																																																																														
Date Start/Finish: 5/17/2016				Drilling Method: Cased Wash Boring				Core Barrel: N/A																																																																																																																																																																																																																																																																																														
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Sample Information							Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows	0							SSA	82.8		10" of Pavement.	G#270895 A-4, CL WC=24.6%		1D	24/16	1.00 - 3.00	14/10/6/5	16	25			2" of Probable reclaim pavement.										Brown, moist, medium dense, Gravelly SAND, trace silt, (Fill).		2D	24/4	3.00 - 5.00	5/6/5/2	11	17			Similar to above with brick.										Brown, moist, medium dense, fine Sandy SILT, (Fill).	5									Similar to above except loose		3D	24/13	5.00 - 7.00	2/3/2/3	5	8																																		10	4D	24/22	10.00 - 12.00	3/2/2/2	4	6	20	69.8	Brown, wet, medium stiff, Clayey SILT, some sand, (Probable Fill).	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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Doles Bridge # 5061 carries River Road over Colley Wright Brook Location: Windham, Maine				Boring No.: BB-WCWB-201 WIN: 21924.00				
Driller: S. W. Cole Explorations				Elevation (ft.) 83.9				Auger ID/OD: 5" Solid Stem Auger				
Operator: Jeff Lee				Datum: NAVD88				Sampler: Standard Split Spoon				
Logged By: Nathan Strout				Rig Type: CME 850				Hammer Wt./Fall: 140#/30"				
Date Start/Finish: 1/14/2019				Drilling Method: Cased Wash Boring				Core Barrel: NQ-2"				
Boring Location: STA. 910+16.4, 1.6 ft Lt				Casing ID/OD: HW 4"/4.5"				Water Level*: 11.0' after completion				
Hammer Efficiency Factor: 0.749				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 N₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency N₆₀ = (Hammer Efficiency Factor/60%)*N-uncorrected T_v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test												
Depth (ft.)	Sample Information								Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows					
0							SSA	83.2		8.5" of Pavement		
	1D	24/19	1.00 - 3.00	20/13/10/7	23	29				Brown, frozen, medium dense, Gravelly SAND, trace silt, (Fill).		
	2D	24/20	3.00 - 5.00	7/7/10/9	17	21				Brown, moist, medium dense, SAND, little silt, trace gravel, (Fill).		
5	3D	24/22	5.00 - 7.00	5/6/8/6	14	17				Similar to above.		
	4D	24/18	7.00 - 9.00	4/3/3/3	6	7				Similar to above except loose.		
10												
	5D	24/24	10.00 - 12.00	1/1/2/1	3	4				Brown and grey, moist, very loose, Silty SAND, (Probable Fill).		
							24					
							24					
							30					
							65					
15	6D	24/24	15.00 - 17.00	WOH-24"	--		32	68.9	Grey, wet, very soft, Silty CLAY, low plasticity, (Marine Clay).			
							14					
							17					
							16					
							23					
20	7D	24/24	20.00 - 22.00	18/22/25/22	47	59	60	64.9	Brown, wet, very dense, SAND, some gravel, little silt, (Glacial Till).			
							87					
							80					
							60					
25							71					
Remarks: Auto hammer #295792 Casing driven with auto hammer. Water level measured after drilling with casing removed. bgs = below ground surface.												
Stratification lines represent approximate boundaries between soil types; transitions may be gradual. * Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.										Page 1 of 2 Boring No.: BB-WCWB-201		

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Doles Bridge # 5061 carries River Road over Colley Wright Brook Location: Windham, Maine				Boring No.: BB-WCWB-201 WIN: 21924.00			
Driller: S. W. Cole Explorations				Elevation (ft.) 83.9				Auger ID/OD: 5" Solid Stem Auger			
Operator: Jeff Lee				Datum: NAVD88				Sampler: Standard Split Spoon			
Logged By: Nathan Strout				Rig Type: CME 850				Hammer Wt./Fall: 140#/30"			
Date Start/Finish: 1/14/2019				Drilling Method: Cased Wash Boring				Core Barrel: NQ-2"			
Boring Location: STA. 910+16.4, 1.6 ft Lt				Casing ID/OD: HW 4"/4.5"				Water Level*: 11.0' after completion			
Hammer Efficiency Factor: 0.749				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 N₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency N₆₀ = (Hammer Efficiency Factor/60%)*N-uncorrected T_v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test											
Depth (ft.)	Sample Information							Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows				
25	MD	24/0	25.00 - 27.00	14/10/7/9	17	21	59	55.6		No recovery. Probable cobble. Top of Bedrock Elev 55.6 feet Advanced by roller cone to 28.5 ft bgs R1: Dark grey, fine-grained, quartz-biotite-plagioclase GRANOPELS, metamorphic, hard, very slight weathering, joints are low to moderate dipping, close, and tight with quartz and calcite infilling, (Hutchins Corner Formation). Rock Mass Quality = Poor R1:Core Times (min:sec) 28.5-29.5 ft (3:14) 29.5-30.5 ft (3:18) 30.5-31.5 ft (4:38) 31.5-32.5 ft (3:53) 32.5-33.5 ft (4:04) Recovery = 95% R2: Similar to R1 Rock Mass Quality = Good R2:Core times (min:sec) 33.5-34.5 ft (1:59) 34.5-35.5 ft (3:21) 35.5-36.5 ft (3:01) 36.7-37.5 ft (3:11) 37.5-38.5 ft (4:15) Recovery = 100%	
							69				
							41				
	R1	60/57	28.50 - 33.50	RQD = 40%			52				
							90/3"				
							NQ2				
30											
	R2	60/60	33.50 - 38.50	RQD = 87%							
35									Bottom of Exploration at 38.5 feet below ground surface.		
40											
45											
50											
Remarks: Auto hammer #295792 Casing driven with auto hammer. Water level measured after drilling with casing removed. bgs = below ground surface.											
Stratification lines represent approximate boundaries between soil types; transitions may be gradual.										Page 2 of 2	
* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.										Boring No.: BB-WCWB-201	

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Doles Bridge # 5061 carries River Road over Colley Wright Brook Location: Windham, Maine				Boring No.: BB-WCWB-202 WIN: 21924.00			
Driller: S. W. Cole Explorations				Elevation (ft.): 84.4				Auger ID/OD: 5" Solid Stem Auger			
Operator: Jeff Lee				Datum: NAVD88				Sampler: Standard Split Spoon			
Logged By: Nathan Strout				Rig Type: CME 850				Hammer Wt./Fall: 140#/30"			
Date Start/Finish: 1/14/2019 - 1/15/2019				Drilling Method: Cased Wash Boring				Core Barrel: NQ-2"			
Boring Location: STA. 911+17.6, 1.6 ft Lt				Casing ID/OD: HW 4"/4.5"				Water Level*: 11.5' after completion			
Hammer Efficiency Factor: 0.749				Hammer Type: Automatic ☒ Hydraulic ☐ Rope & Cathead ☐							
Definitions: D = Split Spoon Sample MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MU = Unsuccessful Thin Wall Tube Sample Attempt V = Field Vane Shear Test, PP = Pocket Penetrometer MV = Unsuccessful Field Vane Shear Test Attempt R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of One Person S _u = Peak/Remolded Field Vane Undrained Shear Strength (psf) S _u (lab) = Lab Vane Undrained Shear Strength (psf) q _p = Unconfined Compressive Strength (ksf) N-uncorrected = Raw Field SPT N-value Hammer Efficiency Factor = Rig Specific Annual Calibration Value N ₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency N ₆₀ = (Hammer Efficiency Factor/60%)*N-uncorrected T _v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test											

Depth (ft.)	Sample Information								Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows					
0							SSA	83.7		8" of Pavement.		
	1D	24/17	1.00 - 3.00	28/19/14/12	33	41				Brown, frozen, medium dense, Gravelly SAND, trace silt, (Fill).		
	2D	24/20	3.00 - 5.00	5/4/4/4	8	10				Brown, moist, medium dense, SILT, some sand, trace gravel, trace clay, (Fill).		
5												
	3D	24/16	5.00 - 7.00	3/5/4/6	9	11				Similar to above, except with trace organics.		
	4D	24/20	7.00 - 9.00	5/5/6/5	11	14				Similar to above, except little clay.		
10												
	5D	24/24	10.00 - 12.00	WOH/2/1-12"	2	2				Brown and grey, wet, very loose, fine SAND, some silt, trace clay, (Fill).		
15												
	6D	24/24	15.00 - 17.00	7/1/2/3	3	4	45	68.9		6D(A) Grey, wet, medium dense, SAND, some silt, little gravel, with wood debris, (Fill).		
20												
	7D	24/24	20.00 - 22.00	WOH-24"	-	-	36			Similar to above except medium stiff.		
	V1		20.58 - 21.00	Su = 909/115 psf						65x130 mm vane raw torque readings		
	V2		21.58 - 22.00	Su = 912/115 psf			31			V1: 33.1/4.2 ft-lbs		
										V2: 33.2/4.2 ft-lbs		
25												

Remarks:
 Auto hammer #295792
 Casing driven with auto hammer.
 Water level measured after drilling with casing removed.
 bgs = below ground surface.

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

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

Page 1 of 3

Boring No.: BB-WCWB-202

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Doles Bridge # 5061 carries River Road over Colley Wright Brook Location: Windham, Maine				Boring No.: BB-WCWB-202 WIN: 21924.00									
Driller: S. W. Cole Explorations				Elevation (ft.) 84.4				Auger ID/OD: 5" Solid Stem Auger									
Operator: Jeff Lee				Datum: NAVD88				Sampler: Standard Split Spoon									
Logged By: Nathan Strout				Rig Type: CME 850				Hammer Wt./Fall: 140#/30"									
Date Start/Finish: 1/14/2019 - 1/15/2019				Drilling Method: Cased Wash Boring				Core Barrel: NQ-2"									
Boring Location: STA. 911+17.6, 1.6 ft Lt				Casing ID/OD: HW 4"/4.5"				Water Level*: 11.5' after completion									
Hammer Efficiency Factor: 0.749				Hammer Type: Automatic ☒ Hydraulic ☐ Rope & Cathead ☐													
Definitions: D = Split Spoon Sample MD = Unsuccessful Split Spoon Sample Attempt U = Thin Wall Tube Sample MU = Unsuccessful Thin Wall Tube Sample Attempt V = Field Vane Shear Test, PP = Pocket Penetrometer MV = Unsuccessful Field Vane Shear Test Attempt R = Rock Core Sample SSA = Solid Stem Auger HSA = Hollow Stem Auger RC = Roller Cone WOH = Weight of 140 lb. Hammer WOR/C = Weight of Rods or Casing WO1P = Weight of One Person S _u = Peak/Remolded Field Vane Undrained Shear Strength (psf) S _u (lab) = Lab Vane Undrained Shear Strength (psf) q _p = Unconfined Compressive Strength (ksf) N-uncorrected = Raw Field SPT N-value Hammer Efficiency Factor = Rig Specific Annual Calibration Value N ₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency N ₆₀ = (Hammer Efficiency Factor/60%)*N-uncorrected T _v = Pocket Torvane Shear Strength (psf) WC = Water Content, percent LL = Liquid Limit PL = Plastic Limit PI = Plasticity Index G = Grain Size Analysis C = Consolidation Test																	
Depth (ft.)	Sample Information							Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.						
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows										
25	8D V3	24/24	25.00 - 27.00	WOR-18"/WOH Su = 917/99 psf	--		36		Similar to above. 65x130 mm vane raw torque readings V3: 33.4/3.6 ft-lbs Failed vane attempt. No rotation. Probable sand seam.								
	MV		25.58 - 26.00				35										
							40										
							35										
30							36					Similar to above. 65x130 mm vane raw torque readings V4: 29.5/4.0 ft-lbs V5: 28.5/4.1 ft-lbs					
	9D V4	24/24	30.00 - 32.00	WOR-18"/WOH Su = 810/110 psf	--		36										
	V5		31.58 - 32.00	Su = 783/113 psf			36										
							43										
35							44								Similar to above.		
							42										
	10D	24/24	35.00 - 37.00	1/1/4/4	5	6	42										
							40										
40							49		Grey, wet, medium dense, SAND, little silt, trace gravel, (Glacial Till).	36.0							
							48										
							55										
							72										
45	11D	24/7	40.00 - 42.00	12/10/7/9	17	21	76					Similar to above, except little gravel.					
							60										
							90/11										
							41.5										
50	R1	60/58	43.00 - 48.00	RQD = 48%			NQ2								Top of Bedrock Elev 41.5 feet. Advanced by roller cone to 43.0 ft bgs R1: Dark grey, fine-grained, quartz-biotite-plagioclase GRANOFELS, metamorphic, hard, very slight weathering, joints are low to moderate dipping, close, and tight with quartz and calcite infilling, (Hutchins Corner Formation). Rock Mass Quality = Poor R1: Core Times (min:sec) 43.0-44.0 ft (3:57) 44.0-45.0 ft (3:44) 45.0-46.0 ft (3:02) 46.0-47.0 ft (4:04) 47.0-48.0 ft (4:36) Recovery = 97%	42.9	
50	R2	60/60	48.00 - 53.00	RQD = 70%					R2: Similar to R1								
Remarks: Auto hammer #295792 Casing driven with auto hammer. Water level measured after drilling with casing removed. bgs = below ground surface.																	
Stratification lines represent approximate boundaries between soil types; transitions may be gradual.											Page 2 of 3						
* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.											Boring No.: BB-WCWB-202						

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS						Project: Doles Bridge # 5061 carries River Road over Colley Wright Brook Location: Windham, Maine				Boring No.: BB-WCWB-202																																																																																																																																																																																																			
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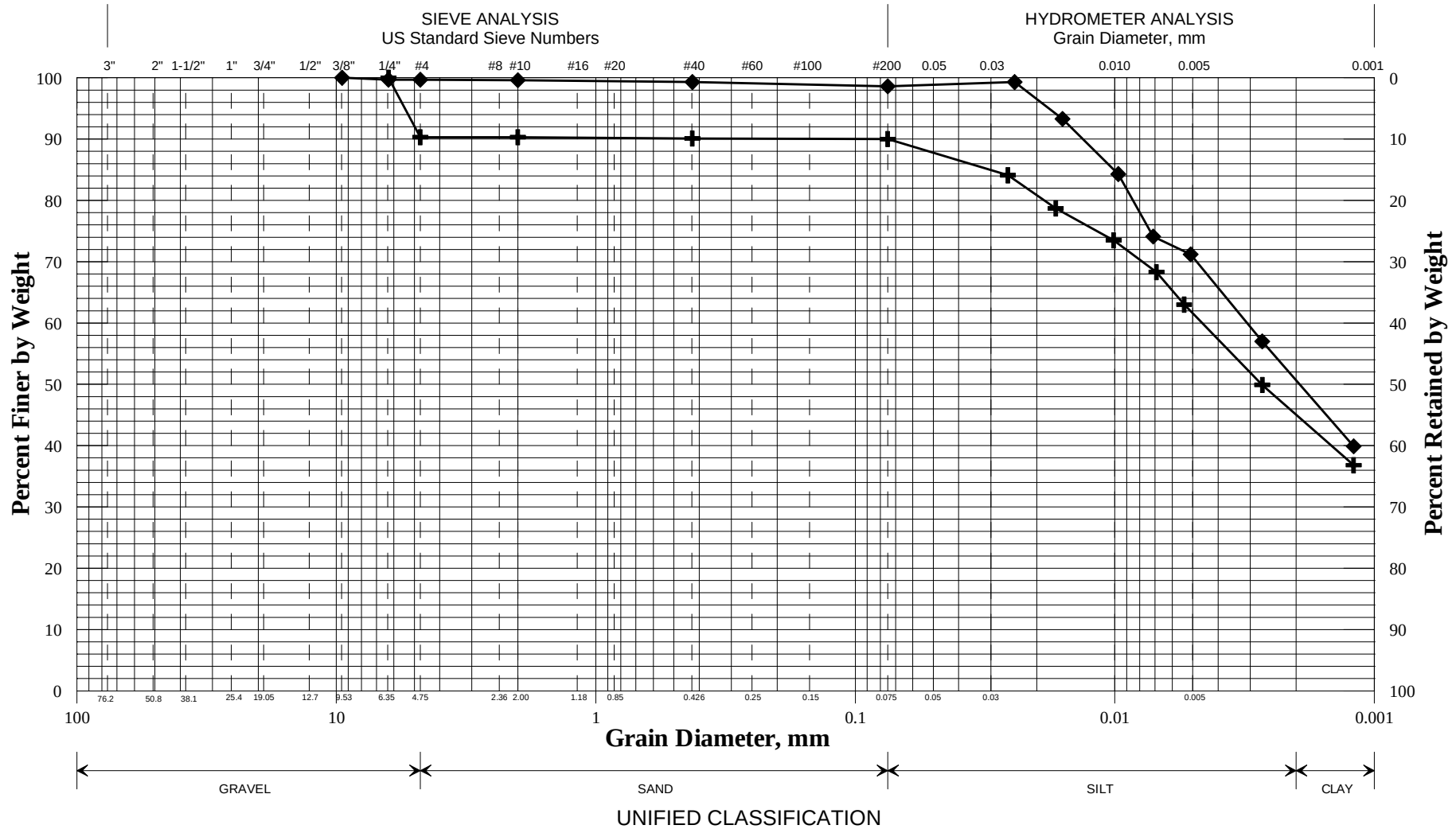
APPENDIX D

Laboratory Test Results

Work Number: 21924.00

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

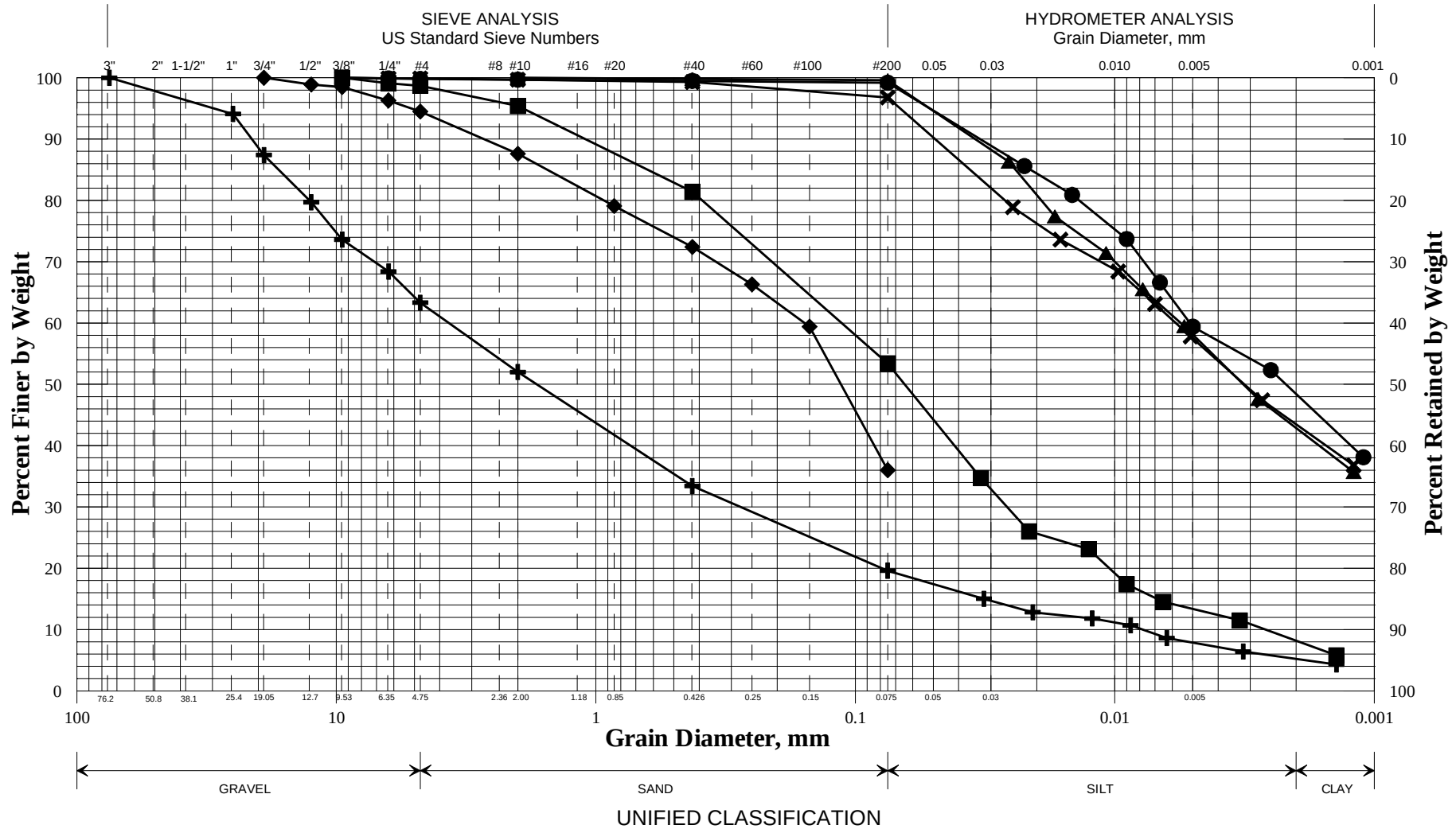
State of Maine Department of Transportation
GRAIN SIZE DISTRIBUTION CURVE



	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
+	BB-WCWB-101/3D	911+10.2	6.8 LT	4.8-6.8	Clayey SILT, trace sand, trace gravel.	39.8	42	21	21
◆	BB-WCWB-101/8D	911+10.2	6.8 LT	20.0-22.0	Silty CLAY, trace sand, trace gravel.	43.4	40	22	18
■									
●									
▲									
×									

WIN	
021924.00	
Town	
Windham	
Reported by/Date	
WHITE, TERRY A	6/13/2016

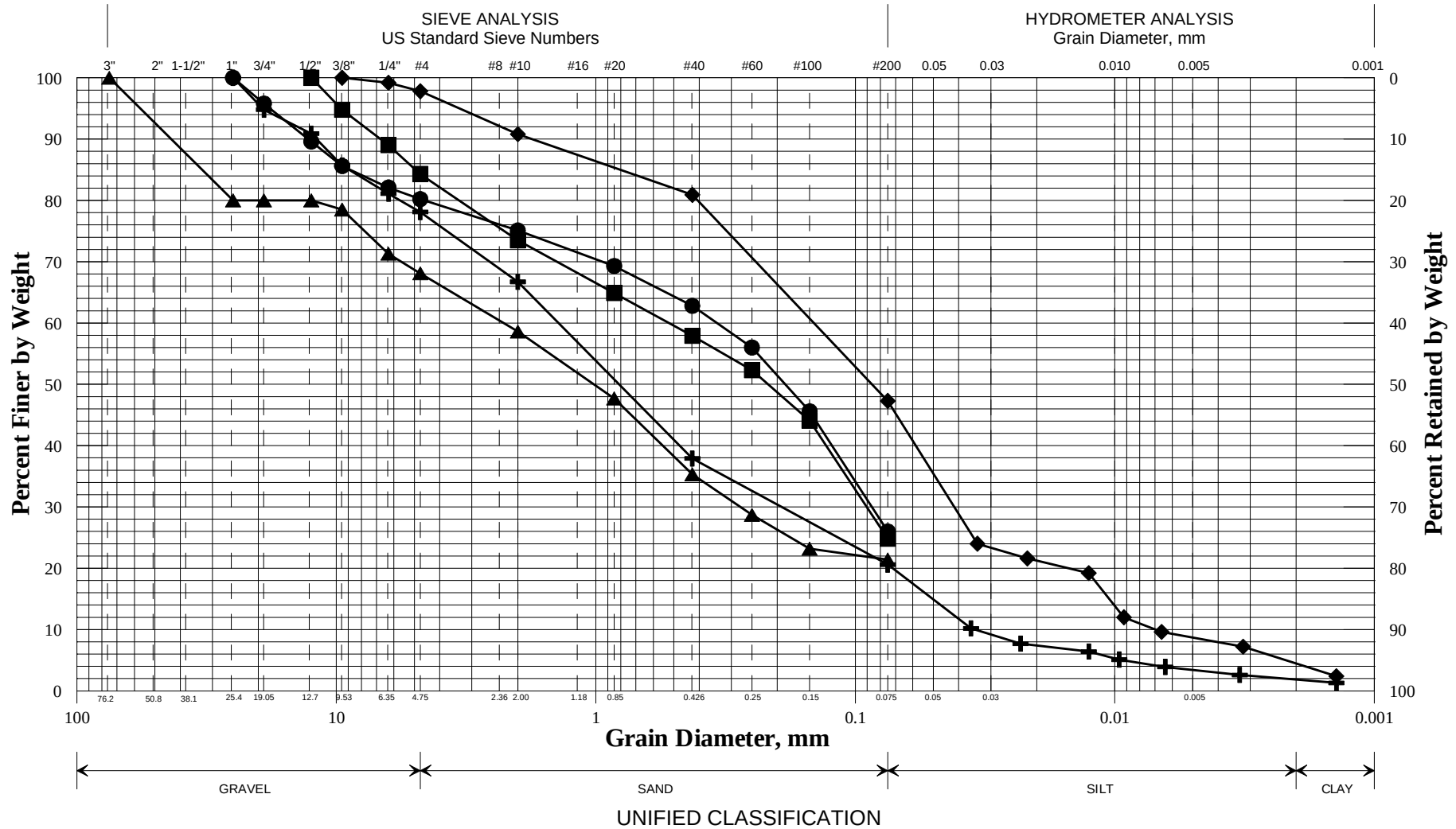
State of Maine Department of Transportation
GRAIN SIZE DISTRIBUTION CURVE



	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
+	BB-WCWB-102/1D	910+84.4	7.6 LT	0.9-2.9	GRAVEL, some sand, little silt, trace clay.	2.5			
◆	BB-WCWB-102/2D	910+84.4	7.6 LT	2.9-4.9	Silty SAND, little gravel.	11.3			
■	BB-WCWB-102/4D	910+84.4	7.6 LT	6.9-8.4	Sandy SILT, trace clay, trace gravel.	17.4			
●	BB-WCWB-102/1U	910+84.4	7.6 LT	20.0-22.0	Clayey SILT, trace sand, trace gravel.	40.8	37	21	16
▲	BB-WCWB-102/7D	910+84.4	7.6 LT	25.0-27.0	Clayey SILT, trace sand.	39.3			
×	BB-WCWB-102/2U	910+84.4	7.6 LT	30.0-32.0	Clayey SILT, trace sand, trace gravel.	39.1	35	21	14

WIN	
021924.00	
Town	
Windham	
Reported by/Date	
WHITE, TERRY A	7/11/2016

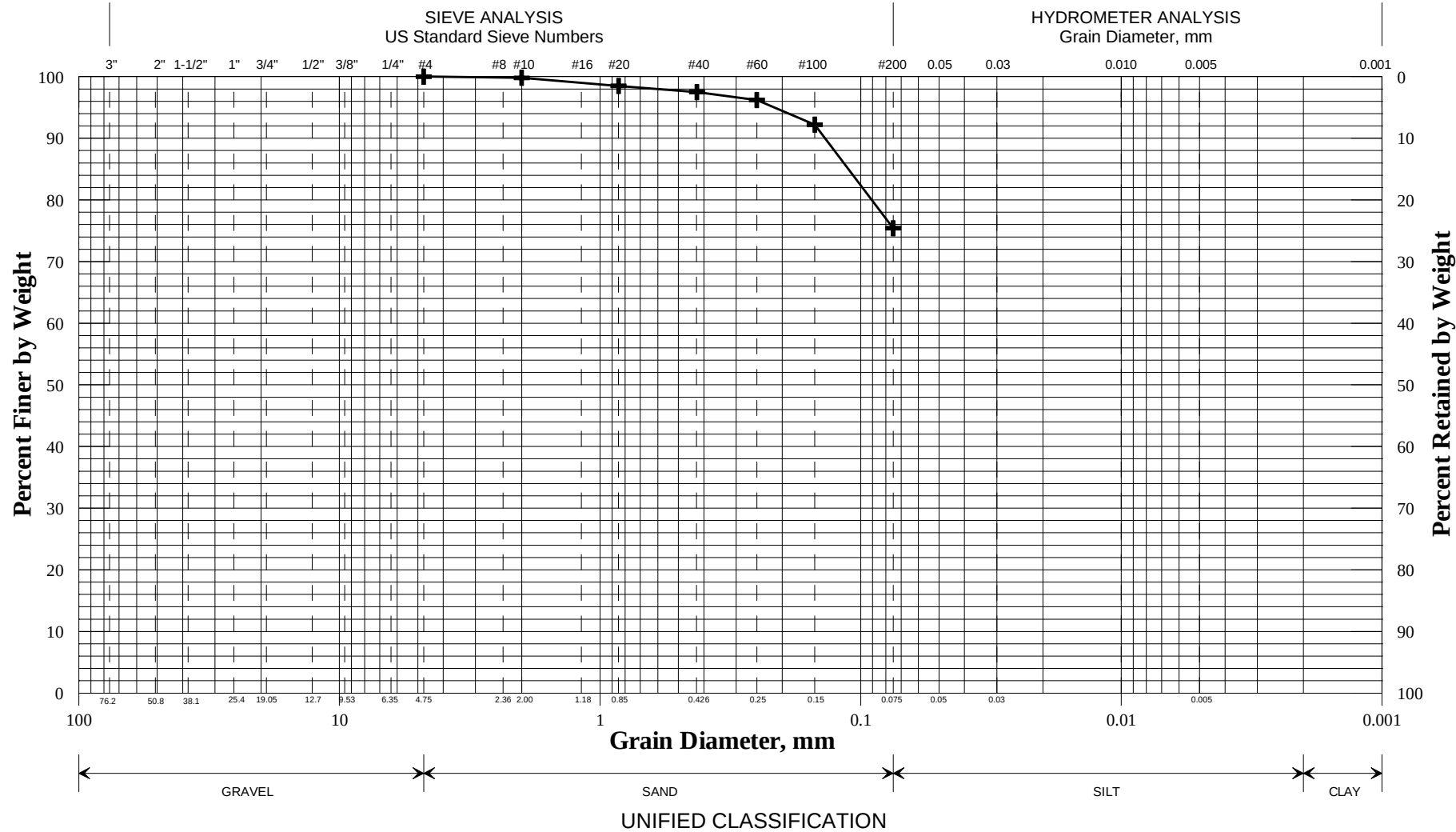
State of Maine Department of Transportation
GRAIN SIZE DISTRIBUTION CURVE



	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
+	BB-WCWB-103/1D	910+41	6.9 RT	0.8-2.8	SAND, some gravel, some silt, trace clay.	2.9			
◆	BB-WCWB-103/2D	910+41	6.9 RT	2.8-4.8	Silty SAND, trace clay, trace gravel.	5.8			
■	BB-WCWB-103/6D	910+41	6.9 RT	10.8-12.8	SAND, some silt, little gravel.	19.6			
●	BB-WCWB-103/7D	910+41	6.9 RT	12.8-14.8	SAND, some silt, little gravel.	32.1			
▲	BB-WCWB-103/12D	910+41	6.9 RT	30.6-32.1	SAND, some gravel, some silt.	9.1			
×									

WIN
021924.00
Town
Windham
Reported by/Date
WHITE, TERRY A 6/13/2016

State of Maine Department of Transportation
GRAIN SIZE DISTRIBUTION CURVE



	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
+	BB-WCWB-104/4D	910+13.8	7.7 RT	10.0-12.0	SILT, some sand.	24.6			
◆									
■									
●									
▲									
×									

WIN	
021924.00	
Town	
Windham	
Reported by/Date	
WHITE, TERRY A	6/13/2016



GEOTECHNICAL TEST REPORT

Central Laboratory

SAMPLE INFORMATION

Reference No. **242692** Boring No./Sample No. **BB-WCWB-101/3D** Sample Description **GEOTECHNICAL (DISTURBED)** Sampled **5/17/2016** Received **5/27/2016**

Sample Type: **GEOTECHNICAL** Location: Station: **911+10.2** Offset, ft: **6.8** LT Dbfg, ft: **4.8-6.8**

WIN/Town **021924.00 - WINDHAM** Sampler: **CONSULTANT SW COLE**

TEST RESULTS

Sieve Analysis (T 88)

Wash Method

SIEVE SIZE U.S. [SI]	% Passing
3 in. [75.0 mm]	
1 in. [25.0 mm]	
¾ in. [19.0 mm]	
½ in. [12.5 mm]	
⅜ in. [9.5 mm]	
¼ in. [6.3 mm]	100.0
No. 4 [4.75 mm]	90.3
No. 10 [2.00 mm]	90.3
No. 20 [0.850 mm]	
No. 40 [0.425 mm]	90.1
No. 60 [0.250 mm]	
No. 100 [0.150 mm]	
No. 200 [0.075 mm]	90.0
[0.0258 mm]	84.1
[0.0169 mm]	78.7
[0.0101 mm]	73.5
[0.0069 mm]	68.3
[0.0054 mm]	63.0
[0.0027 mm]	49.9
[0.0012 mm]	36.8

Miscellaneous Tests

Liquid Limit @ 25 blows (T 89), %	42
Plastic Limit (T 90), %	21
Plasticity Index (T 90), %	21
Specific Gravity, Corrected to 20°C (T 100)	2.72
Loss on Ignition, % (T 267)	
Water Content (T 265), %	39.8

Consolidation (T 216)

Trimming, Water Content, %

	Initial	Final		Void Ratio	% Strain
Water Content, %			Pmin		
Dry Density, lbs/ft³			Pp		
Void Ratio			Pmax		
Saturation, %			Cc/C'c		

Vane Shear Test on Shelby Tubes (Maine DOT)

Depth taken in tube, ft	3 In.		6 In.		Water Content, %	Description of Material Sampled at the Various Tube Depths
	U. Shear tons/ft²	Remold tons/ft²	U. Shear tons/ft²	Remold tons/ft²		

Comments:

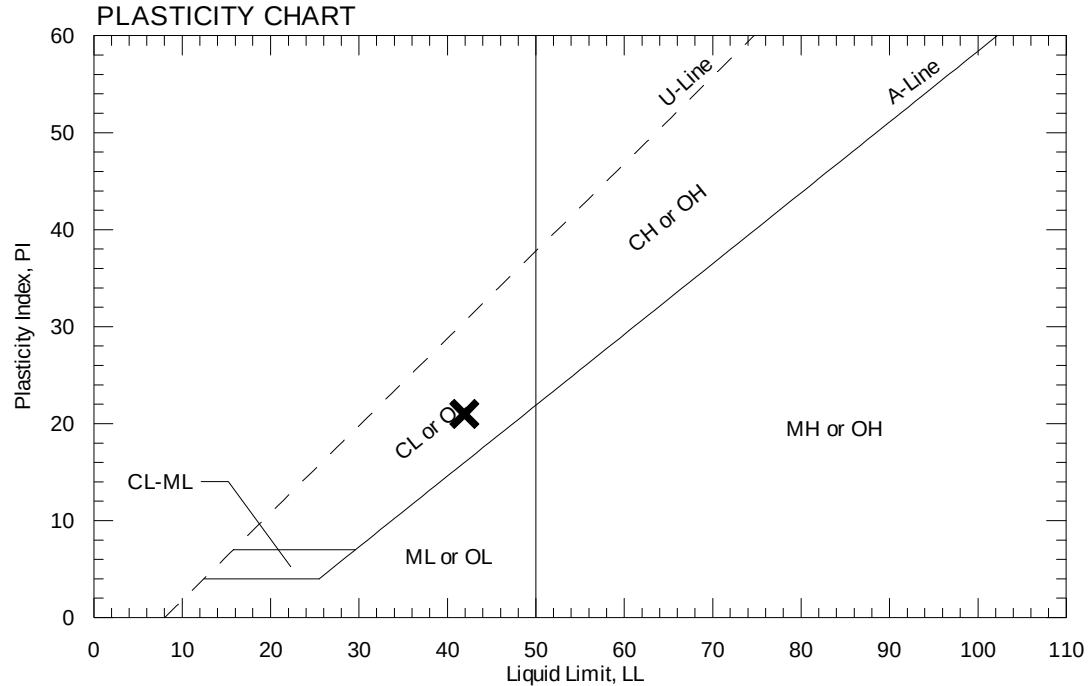
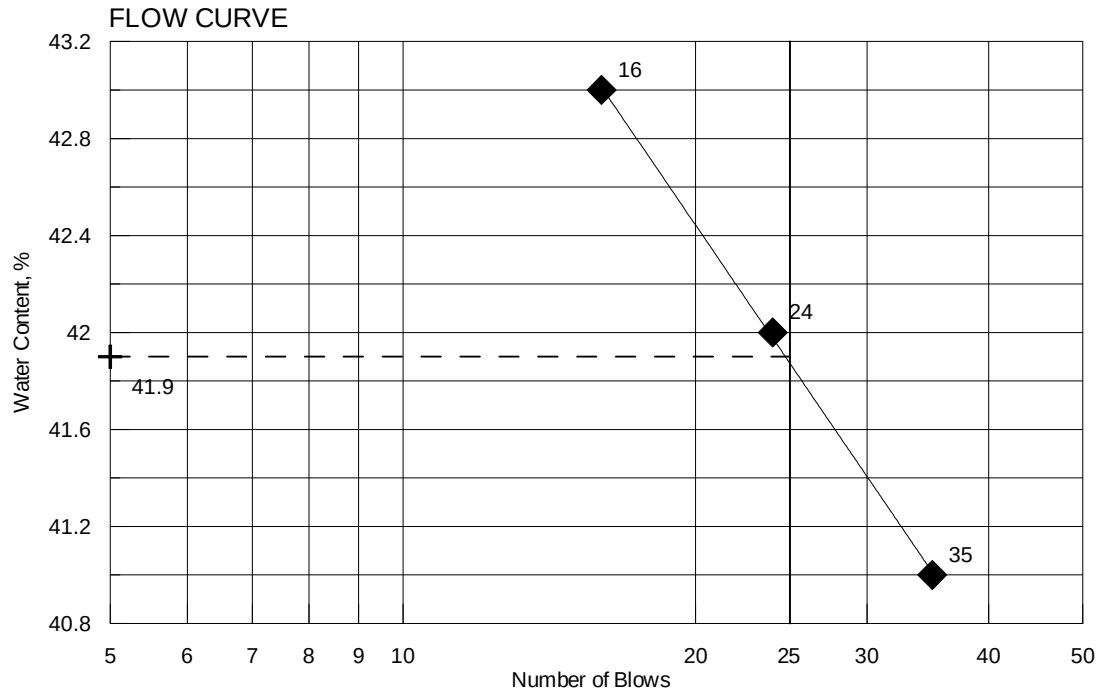
AUTHORIZATION AND DISTRIBUTION

Reported by: **GREGORY LIDSTONE**

Date Reported: **6/9/2016**

Paper Copy: Lab File; Project File; Geotech File

TOWN	Windham	Reference No.	242692
WIN	021924.00	Water Content, %	39.8
Sampled	5/17/2016	Liquid Limit @ 25 blows (T 89), %	42
Boring No./Sample No.	BB-WCWB-101/3D	Plastic Limit (T 90), %	21
Station	911+10.2	Plasticity Index (T 90), %	21
Depth	4.8-6.8	Tested By	BBURR





GEOTECHNICAL TEST REPORT

Central Laboratory

SAMPLE INFORMATION

Reference No. **242693** Boring No./Sample No. **BB-WCWB-101/7D** Sample Description **GEOTECHNICAL (DISTURBED)** Sampled **5/17/2016** Received **5/27/2016**

Sample Type: **GEOTECHNICAL** Location: Station: **911+10.2** Offset, ft: **6.8** LT Dbfg, ft: **15.0-17.0**

WIN/Town **021924.00 - WINDHAM** Sampler: **CONSULTANT SW COLE**

TEST RESULTS

Sieve Analysis (T 27)

Wash Method

SIEVE SIZE U.S. [SI]	% Passing
3 in. [75.0 mm]	
1 in. [25.0 mm]	
¾ in. [19.0 mm]	
½ in. [12.5 mm]	
⅜ in. [9.5 mm]	
¼ in. [6.3 mm]	
No. 4 [4.75 mm]	
No. 10 [2.00 mm]	
No. 20 [0.850 mm]	
No. 40 [0.425 mm]	
No. 60 [0.250 mm]	
No. 100 [0.150 mm]	
No. 200 [0.075 mm]	

Miscellaneous Tests

Liquid Limit @ 25 blows (T 89), %	33
Plastic Limit (T 90), %	23
Plasticity Index (T 90), %	10
Specific Gravity, Corrected to 20°C (T 100)	
Loss on Ignition, % (T 267)	
Water Content (T 265), %	23.1

Consolidation (T 216)

Trimming, Water Content, %					
	Initial	Final		Void Ratio	% Strain
Water Content, %			Pmin		
Dry Density, lbs/ft³			Pp		
Void Ratio			Pmax		
Saturation, %			Cc/C'c		

Vane Shear Test on Shelby Tubes (Maine DOT)

Depth taken in tube, ft	3 In.		6 In.		Water Content, %	Description of Material Sampled at the Various Tube Depths
	U. Shear	Remold	U. Shear	Remold		
	tons/ft²	tons/ft²	tons/ft²	tons/ft²		

Comments:

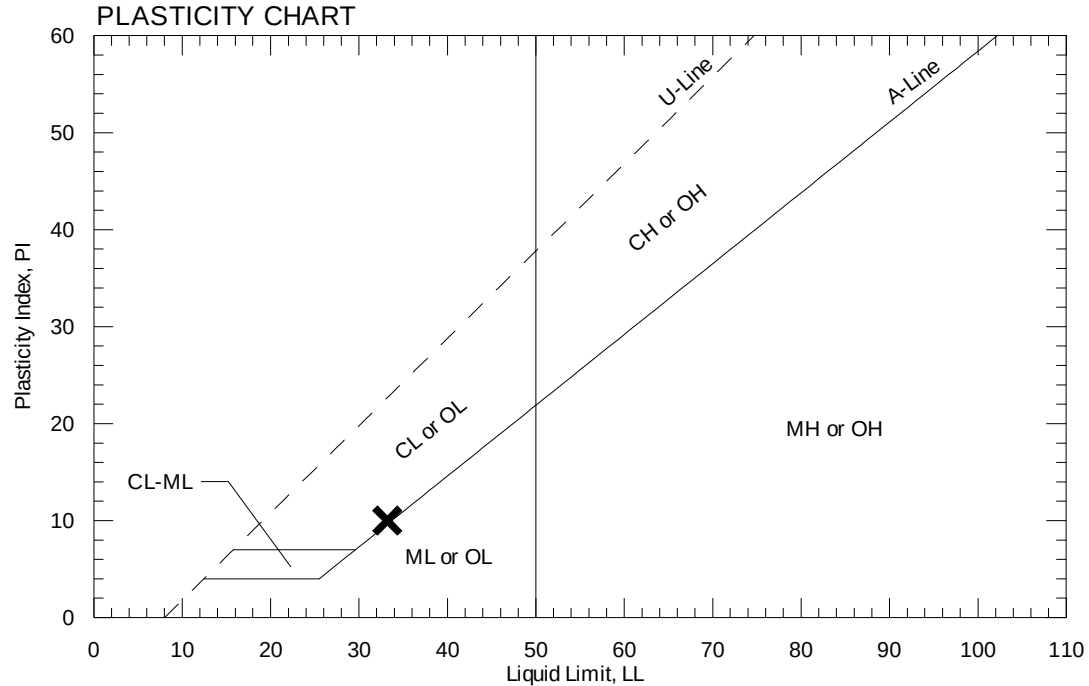
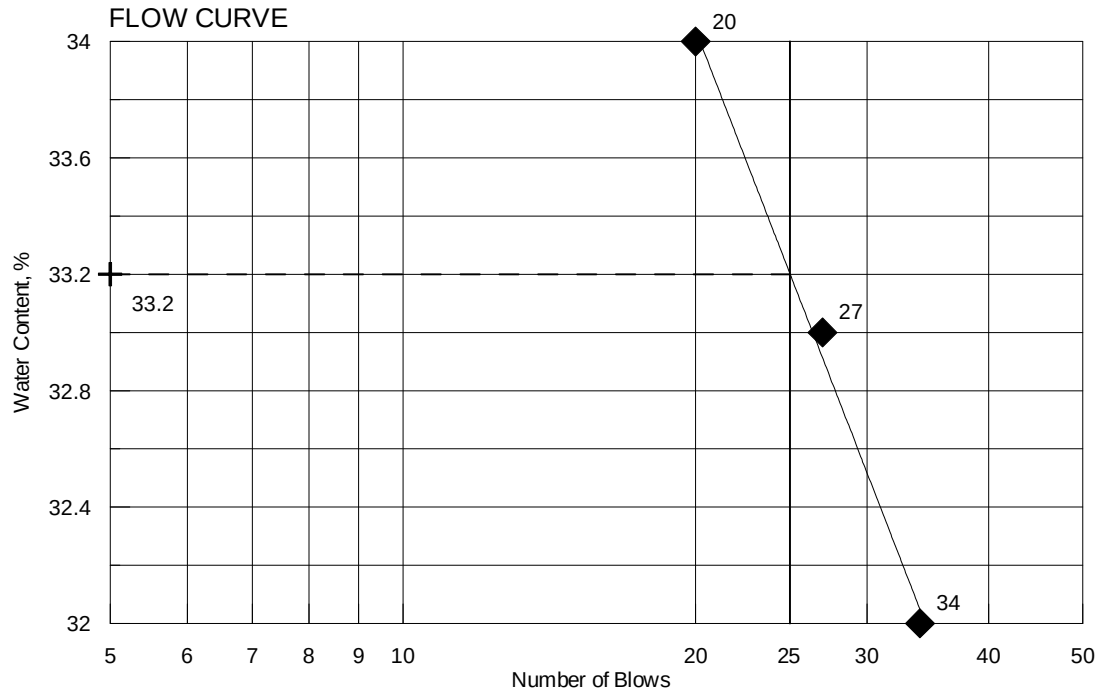
AUTHORIZATION AND DISTRIBUTION

Reported by: **GREGORY LIDSTONE**

Date Reported: **6/9/2016**

Paper Copy: Lab File; Project File; Geotech File

TOWN	Windham	Reference No.	242693
WIN	021924.00	Water Content, %	23.1
Sampled	5/17/2016	Liquid Limit @ 25 blows (T 89), %	33
Boring No./Sample No.	BB-WCWB-101/7D	Plastic Limit (T 90), %	23
Station	911+10.2	Plasticity Index (T 90), %	10
Depth	15.0-17.0	Tested By	BBURR





GEOTECHNICAL TEST REPORT

Central Laboratory

SAMPLE INFORMATION

Reference No. **270897** Boring No./Sample No. **BB-WCWB-101/8D** Sample Description **GEOTECHNICAL (DISTURBED)** Sampled **5/17/2016** Received **5/27/2016**

Sample Type: **GEOTECHNICAL** Location: Station: **911+10.2** Offset, ft: **6.8** LT Dbfg, ft: **20.0-22.0**

WIN/Town **021924.00 - WINDHAM** Sampler: **CONSULTANT SW COLE**

TEST RESULTS

Sieve Analysis (T 88)

Wash Method

SIEVE SIZE U.S. [SI]	% Passing
3 in. [75.0 mm]	
1 in. [25.0 mm]	
¾ in. [19.0 mm]	
½ in. [12.5 mm]	
⅜ in. [9.5 mm]	100.0
¼ in. [6.3 mm]	99.7
No. 4 [4.75 mm]	99.7
No. 10 [2.00 mm]	99.6
No. 20 [0.850 mm]	
No. 40 [0.425 mm]	99.3
No. 60 [0.250 mm]	
No. 100 [0.150 mm]	
No. 200 [0.075 mm]	98.6
[0.0243 mm]	99.3
[0.0159 mm]	93.3
[0.0097 mm]	84.3
[0.0071 mm]	74.1
[0.0051 mm]	71.2
[0.0027 mm]	57.0
[0.0012 mm]	39.9

Miscellaneous Tests

Liquid Limit @ 25 blows (T 89), %	40
Plastic Limit (T 90), %	22
Plasticity Index (T 90), %	18
Specific Gravity, Corrected to 20°C (T 100)	2.66
Loss on Ignition, % (T 267)	
Water Content (T 265), %	43.4

Consolidation (T 216)

Trimming, Water Content, %

	Initial	Final		Void Ratio	% Strain
Water Content, %			Pmin		
Dry Density, lbs/ft³			Pp		
Void Ratio			Pmax		
Saturation, %			Cc/C'c		

Vane Shear Test on Shelby Tubes (Maine DOT)

Depth taken in tube, ft	3 In.		6 In.		Water Content, %	Description of Material Sampled at the Various Tube Depths
	U. Shear tons/ft²	Remold tons/ft²	U. Shear tons/ft²	Remold tons/ft²		

Comments:

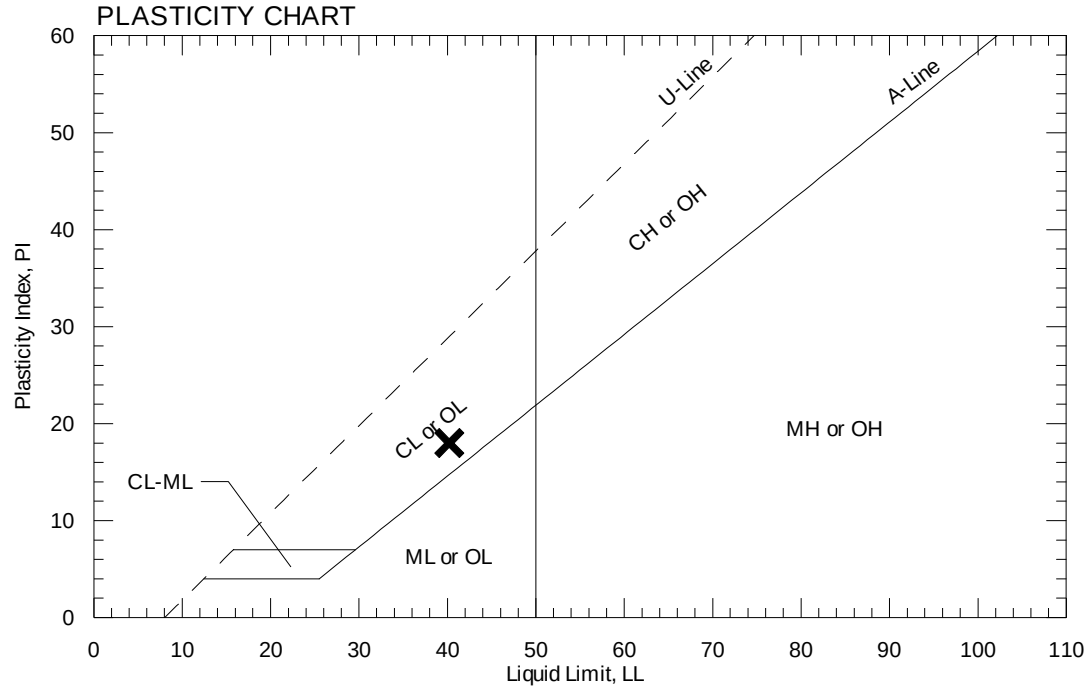
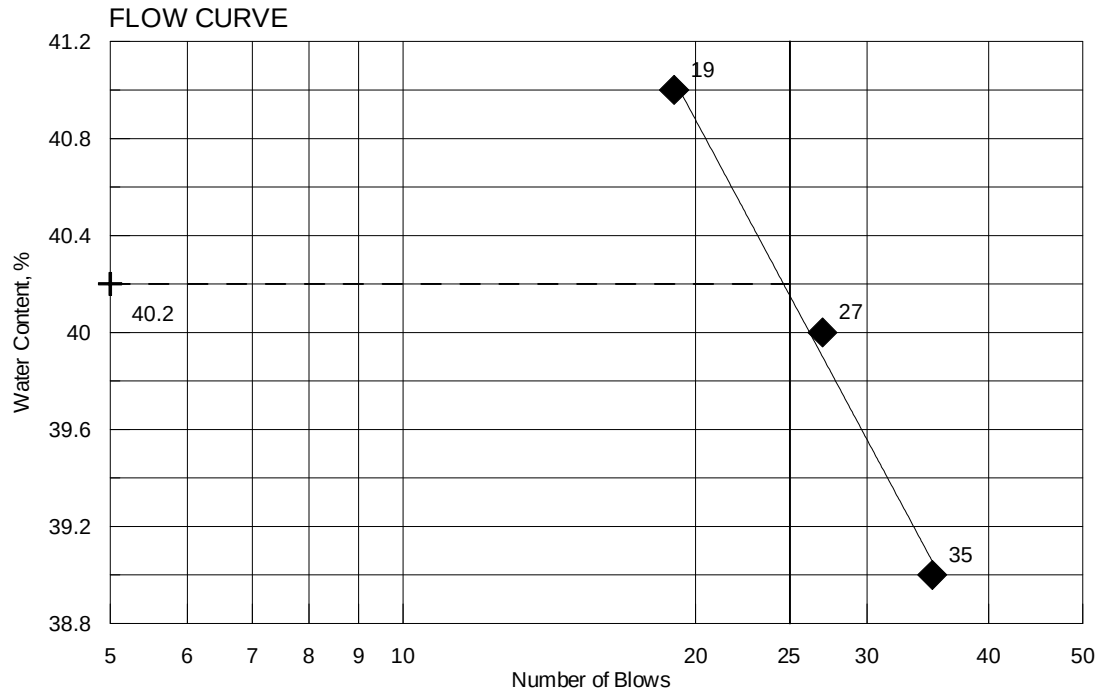
AUTHORIZATION AND DISTRIBUTION

Reported by: **GREGORY LIDSTONE**

Date Reported: **6/9/2016**

Paper Copy: Lab File; Project File; Geotech File

TOWN	Windham	Reference No.	270897
WIN	021924.00	Water Content, %	43.4
Sampled	5/17/2016	Liquid Limit @ 25 blows (T 89), %	40
Boring No./Sample No.	BB-WCWB-101/8D	Plastic Limit (T 90), %	22
Station	911+10.2	Plasticity Index (T 90), %	18
Depth	20.0-22.0	Tested By	BBURR





GEOTECHNICAL TEST REPORT

Central Laboratory

SAMPLE INFORMATION

Reference No. **242700** Boring No./Sample No. **BB-WCWB-102/1U** Sample Description **GEOTECHNICAL (UNDISTURBED)** Sampled **5/16/2016** Received **5/27/2016**

Sample Type: **GEOTECHNICAL** Location: Station: **910+84.4** Offset, ft: **7.6** LT Dbfg, ft: **20.0-22.0**

WIN/Town **021924.00 - WINDHAM** Sampler: **CONSULTANT SW COLE**

TEST RESULTS

Sieve Analysis (T 88)

Wash Method

SIEVE SIZE U.S. [SI]	% Passing
3 in. [75.0 mm]	
1 in. [25.0 mm]	
¾ in. [19.0 mm]	
½ in. [12.5 mm]	
⅜ in. [9.5 mm]	100.0
¼ in. [6.3 mm]	99.9
No. 4 [4.75 mm]	99.8
No. 10 [2.00 mm]	99.7
No. 20 [0.850 mm]	
No. 40 [0.425 mm]	99.5
No. 60 [0.250 mm]	
No. 100 [0.150 mm]	
No. 200 [0.075 mm]	99.2
[0.0223 mm]	85.6
[0.0146 mm]	80.9
[0.0090 mm]	73.7
[0.0067 mm]	66.6
[0.0050 mm]	59.4
[0.0025 mm]	52.3
[0.0011 mm]	38.1

Miscellaneous Tests

Liquid Limit @ 25 blows (T 89), %	37
Plastic Limit (T 90), %	21
Plasticity Index (T 90), %	16
Specific Gravity, Corrected to 20°C (T 100)	2.69
Loss on Ignition, % (T 267)	
Water Content (T 265), %	40.8

Consolidation (T 216)

Trimming, Water Content, %		37.6			
	Initial	Final		Void Ratio	% Strain
Water Content, %	38.15	27.15	Pmin		
Dry Density, lbs/ft³	79.98	97.055	Pp		
Void Ratio	1.1	0.73	Pmax		
Saturation, %	93.32	100	Cc/C'c		

Vane Shear Test on Shelby Tubes (Maine DOT)

Depth taken in tube, ft	3 In.		6 In.		Water Content, %	Description of Material Sampled at the Various Tube Depths
	U. Shear tons/ft²	Remold tons/ft²	U. Shear tons/ft²	Remold tons/ft²		
0-0.5	0.22	0.01	0.25	0.02	41.7	Alternating layers of light to dark gray clay, silt lines.
0.63-1.0	0.32	0.02	0.34	0.02	42.1	Alternating layers of light to dark gray clay, silt lines, sand lines at 0.8 and 1.0 ft.
1.0-1.5	0.25	0.01	0.28	0.01	40.7	Alt. layers of light to dark gray clay, silt lines, concretion at 1.1 ft, sand lines at 1.2ft and 1.3ft.
1.5-2.0	0.31	0.01	0.23	0.01	44.3	Alternating layers of light to dark gray clay, silt lines, sand line at 1.8ft.

Comments:

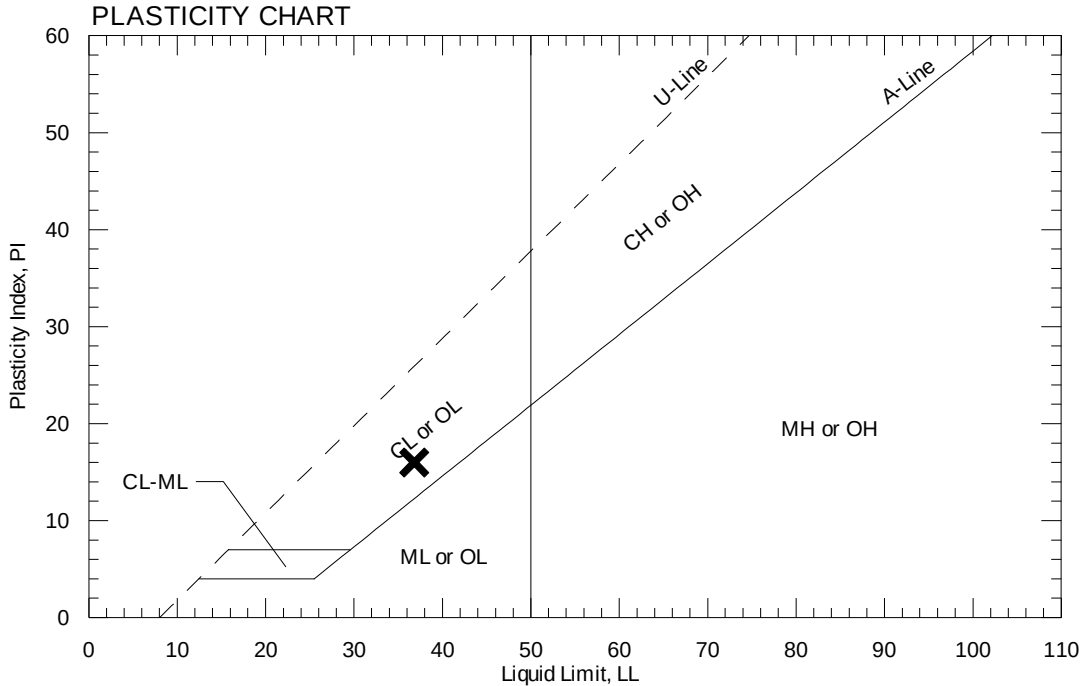
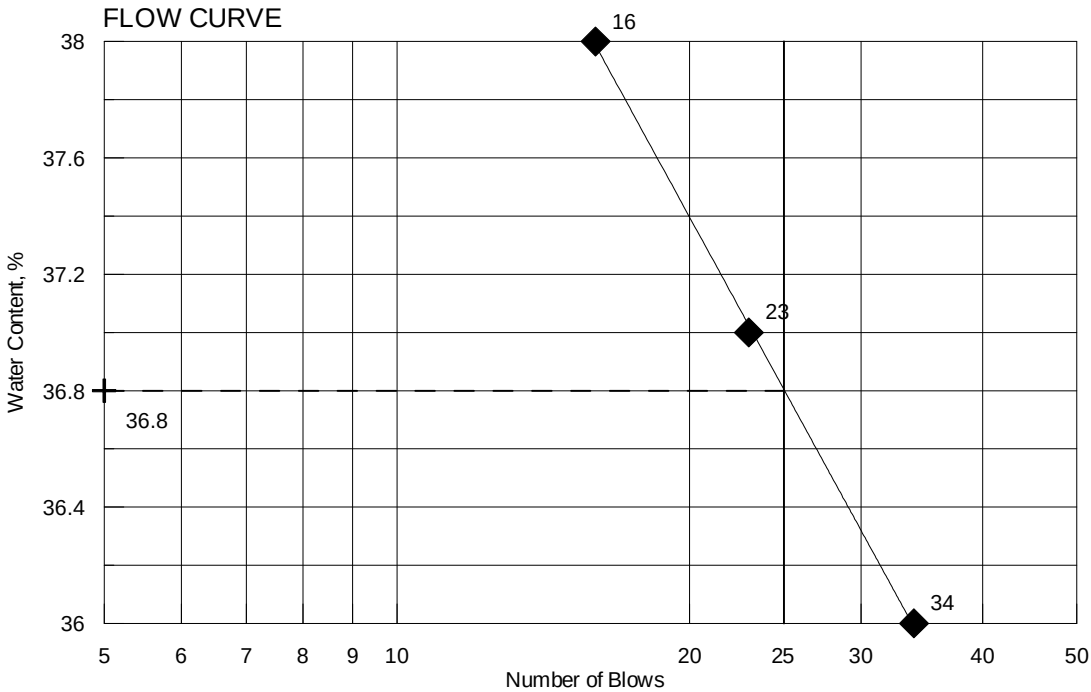
AUTHORIZATION AND DISTRIBUTION

Reported by: **GREGORY LIDSTONE**

Date Reported: **7/7/2016**

Paper Copy: Lab File; Project File; Geotech File

TOWN	Windham	Reference No.	242700
WIN	021924.00	Water Content, %	40.8
Sampled	5/16/2016	Liquid Limit @ 25 blows (T 89), %	37
Boring No./Sample No.	BB-WCWB-102/1U	Plastic Limit (T 90), %	21
Station	910+84.4	Plasticity Index (T 90), %	16
Depth	20.0-22.0	Tested By	BBURR





GEOTECHNICAL TEST REPORT

Central Laboratory

SAMPLE INFORMATION

Reference No. **270885** Boring No./Sample No. **BB-WCWB-102/2U** Sample Description **GEOTECHNICAL (UNDISTURBED)** Sampled **5/16/2016** Received **5/27/2016**

Sample Type: **GEOTECHNICAL** Location: Station: **910+84.4** Offset, ft: **7.6** LT Dbfg, ft: **30.0-32.0**

WIN/Town **021924.00 - WINDHAM** Sampler: **CONSULTANT SW COLE**

TEST RESULTS

Sieve Analysis (T 88)

Wash Method

SIEVE SIZE U.S. [SI]	% Passing
3 in. [75.0 mm]	
1 in. [25.0 mm]	
¾ in. [19.0 mm]	
½ in. [12.5 mm]	
⅜ in. [9.5 mm]	100.0
¼ in. [6.3 mm]	99.9
No. 4 [4.75 mm]	99.9
No. 10 [2.00 mm]	99.7
No. 20 [0.850 mm]	
No. 40 [0.425 mm]	99.3
No. 60 [0.250 mm]	
No. 100 [0.150 mm]	
No. 200 [0.075 mm]	96.8
[0.0247 mm]	78.9
[0.0162 mm]	73.6
[0.0097 mm]	68.4
[0.0070 mm]	63.1
[0.0051 mm]	57.8
[0.0027 mm]	47.4
[0.0012 mm]	36.8

Miscellaneous Tests

Liquid Limit @ 25 blows (T 89), %	35
Plastic Limit (T 90), %	21
Plasticity Index (T 90), %	14
Specific Gravity, Corrected to 20°C (T 100)	2.73
Loss on Ignition, % (T 267)	
Water Content (T 265), %	39.1

Consolidation (T 216)

Trimming, Water Content, %		36.0			
	Initial	Final		Void Ratio	% Strain
Water Content, %	39.61	28.64	Pmin		
Dry Density, lbs/ft³	77.729	95.64	Pp		
Void Ratio	1.19	0.782	Pmax		
Saturation, %	90.67	99.99	Cc/C'c		

Vane Shear Test on Shelby Tubes (Maine DOT)

Depth taken in tube, ft	3 In.		6 In.		Water Content, %	Description of Material Sampled at the Various Tube Depths
	U. Shear tons/ft²	Remold tons/ft²	U. Shear tons/ft²	Remold tons/ft²		
0-0.5	0.24	0	0.26	0.01	40.8	Alt. layers of light to dark gray clay, silt lines, sand lines at 0.05, 0.1, 0.18, 0.29, 0.33 ft. 3/8 inch stone at 0.33 ft.
0.63-1.0	0.26	0.01	0.25	0.02	42.3	Alternating layers of light to dark gray clay, silt lines.
1.0-1.5	0.19	0.02	0.18	0.01	36.4	Alternating layers of light to dark gray clay, silt lines, sand lines at 1.0 and 1.25 ft.
1.5-2.0	0.25	0.01	0.29	0.02	36.5	Alt. layers of light to dark gray clay, silt lines, sand lines at 1.55 and 1.9 ft. Flat stone at 2.0ft.

Comments:

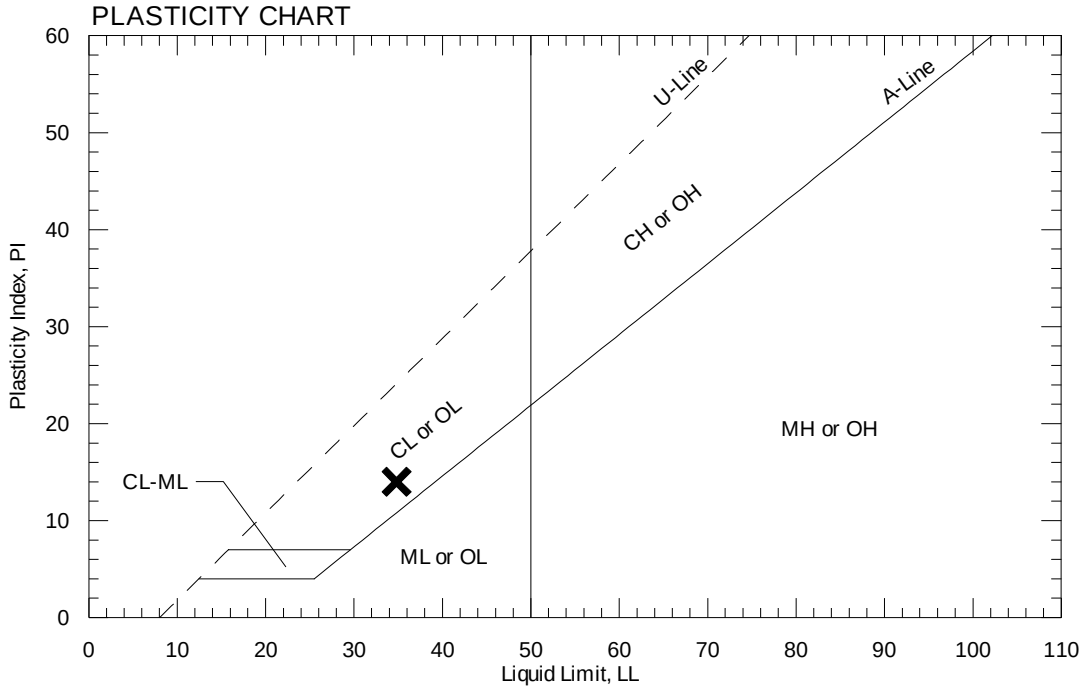
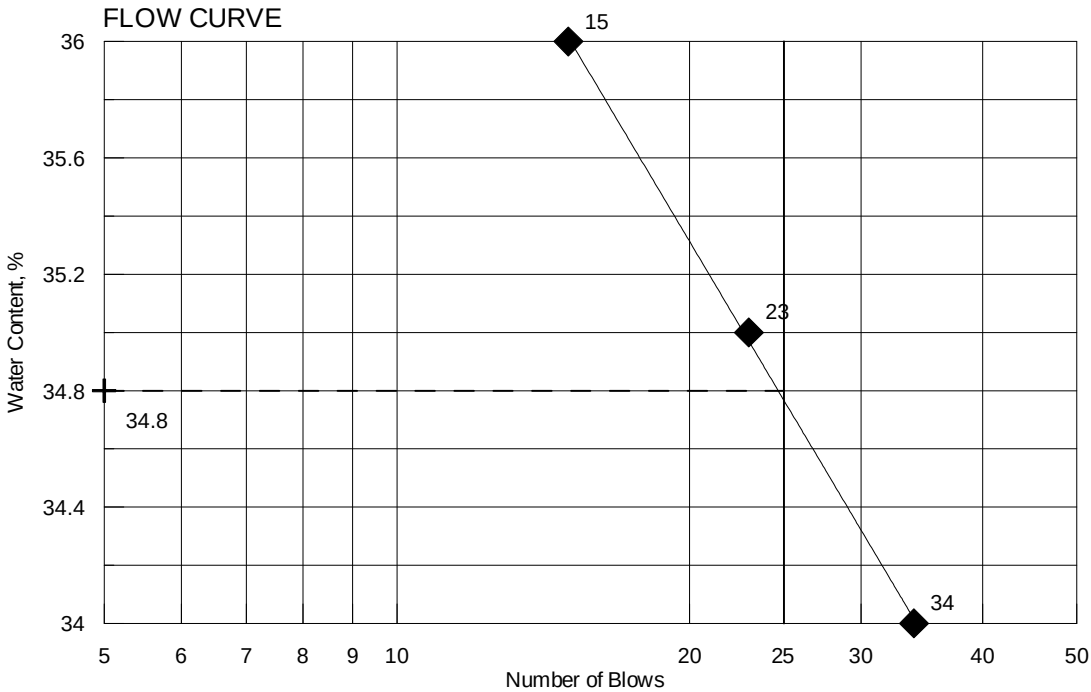
AUTHORIZATION AND DISTRIBUTION

Reported by: **GREGORY LIDSTONE**

Date Reported: **7/8/2016**

Paper Copy: Lab File; Project File; Geotech File

TOWN	Windham	Reference No.	270885
WIN	021924.00	Water Content, %	39.1
Sampled	5/16/2016	Liquid Limit @ 25 blows (T 89), %	35
Boring No./Sample No.	BB-WCWB-102/2U	Plastic Limit (T 90), %	21
Station	910+84.4	Plasticity Index (T 90), %	14
Depth	30.0-32.0	Tested By	BBURR





GEOTECHNICAL TEST REPORT

Central Laboratory

SAMPLE INFORMATION

Reference No. **270892** Boring No./Sample No. **BB-WCWB-103/10D** Sample Description **GEOTECHNICAL (DISTURBED)** Sampled **5/17/2016** Received **5/27/2016**

Sample Type: **GEOTECHNICAL** Location: Station: **910+41** Offset, ft: **6.9** RT Dbfg, ft: **18.8-20.8**

WIN/Town **021924.00 - WINDHAM** Sampler: **CONSULTANT SW COLE**

TEST RESULTS

Sieve Analysis (T 27)

Wash Method

SIEVE SIZE U.S. [SI]	% Passing
3 in. [75.0 mm]	
1 in. [25.0 mm]	
¾ in. [19.0 mm]	
½ in. [12.5 mm]	
⅜ in. [9.5 mm]	
¼ in. [6.3 mm]	
No. 4 [4.75 mm]	
No. 10 [2.00 mm]	
No. 20 [0.850 mm]	
No. 40 [0.425 mm]	
No. 60 [0.250 mm]	
No. 100 [0.150 mm]	
No. 200 [0.075 mm]	

Miscellaneous Tests

Liquid Limit @ 25 blows (T 89), %	
Plastic Limit (T 90), %	
Plasticity Index (T 90), %	NP
Specific Gravity, Corrected to 20°C (T 100)	
Loss on Ignition, % (T 267)	
Water Content (T 265), %	40.5

Consolidation (T 216)

Trimming, Water Content, %					
	Initial	Final		Void Ratio	% Strain
Water Content, %			Pmin		
Dry Density, lbs/ft³			Pp		
Void Ratio			Pmax		
Saturation, %			Cc/C'c		

Vane Shear Test on Shelby Tubes (Maine DOT)

Depth taken in tube, ft	3 In.		6 In.		Water Content, %	Description of Material Sampled at the Various Tube Depths
	U. Shear	Remold	U. Shear	Remold		
	tons/ft²	tons/ft²	tons/ft²	tons/ft²		

Comments:

AUTHORIZATION AND DISTRIBUTION

Reported by: **GREGORY LIDSTONE**

Date Reported: **6/9/2016**

Paper Copy: Lab File; Project File; Geotech File



GEOTECHNICAL TEST REPORT

Central Laboratory

SAMPLE INFORMATION

Reference No. **270893** Boring No./Sample No. **BB-WCWB-103/11D** Sample Description **GEOTECHNICAL (DISTURBED)** Sampled **5/17/2016** Received **5/27/2016**

Sample Type: **GEOTECHNICAL** Location: Station: **910+41** Offset, ft: **6.9** RT Dbfg, ft: **RT**

WIN/Town **021924.00 - WINDHAM** Sampler: **CONSULTANT SW COLE**

TEST RESULTS

Sieve Analysis (T 27)

Wash Method

SIEVE SIZE U.S. [SI]	% Passing
3 in. [75.0 mm]	
1 in. [25.0 mm]	
¾ in. [19.0 mm]	
½ in. [12.5 mm]	
⅜ in. [9.5 mm]	
¼ in. [6.3 mm]	
No. 4 [4.75 mm]	
No. 10 [2.00 mm]	
No. 20 [0.850 mm]	
No. 40 [0.425 mm]	
No. 60 [0.250 mm]	
No. 100 [0.150 mm]	
No. 200 [0.075 mm]	

Miscellaneous Tests

Liquid Limit @ 25 blows (T 89), %	35
Plastic Limit (T 90), %	20
Plasticity Index (T 90), %	15
Specific Gravity, Corrected to 20°C (T 100)	
Loss on Ignition, % (T 267)	
Water Content (T 265), %	38.8

Consolidation (T 216)

Trimming, Water Content, %					
	Initial	Final		Void Ratio	% Strain
Water Content, %			Pmin		
Dry Density, lbs/ft³			Pp		
Void Ratio			Pmax		
Saturation, %			Cc/C'c		

Vane Shear Test on Shelby Tubes (Maine DOT)

Depth taken in tube, ft	3 In.		6 In.		Water Content, %	Description of Material Sampled at the Various Tube Depths
	U. Shear	Remold	U. Shear	Remold		
	tons/ft²	tons/ft²	tons/ft²	tons/ft²		

Comments:

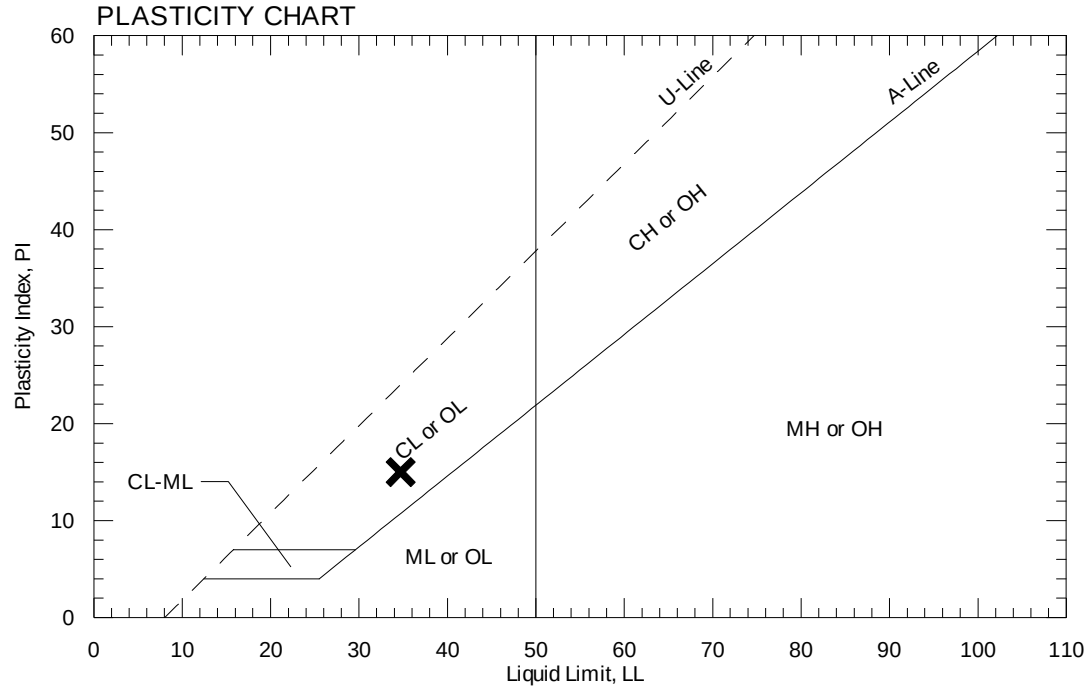
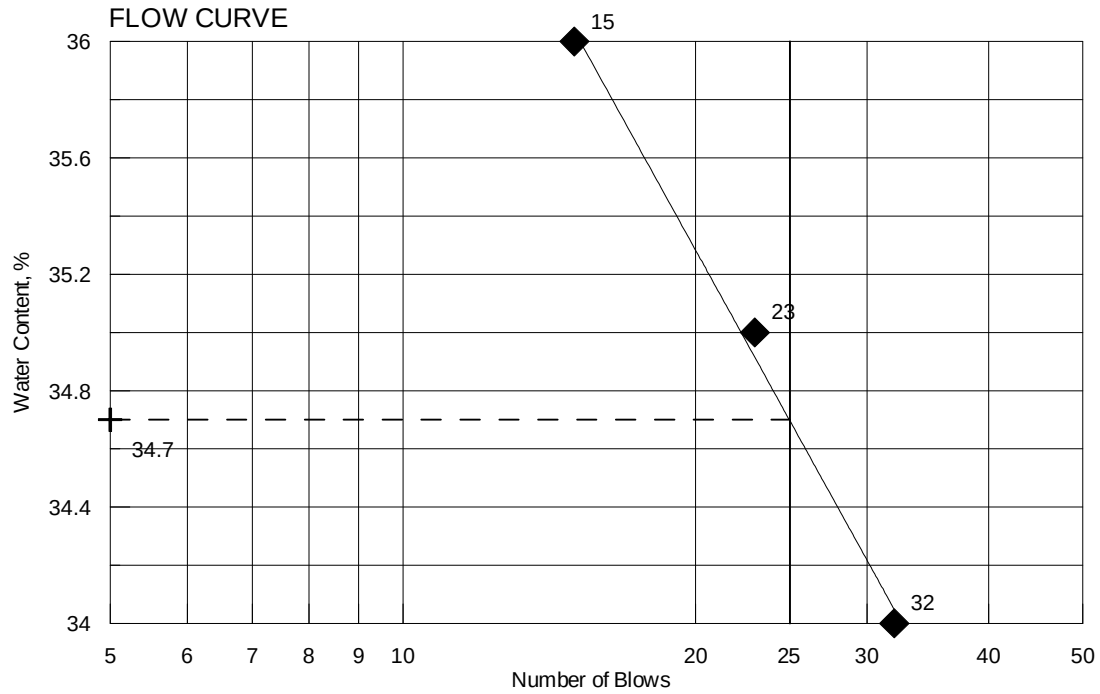
AUTHORIZATION AND DISTRIBUTION

Reported by: **GREGORY LIDSTONE**

Date Reported: **6/9/2016**

Paper Copy: Lab File; Project File; Geotech File

TOWN	Windham	Reference No.	270893
WIN	021924.00	Water Content, %	38.8
Sampled	5/17/2016	Liquid Limit @ 25 blows (T 89), %	35
Boring No./Sample No.	BB-WCWB-103/11D	Plastic Limit (T 90), %	20
Station	910+41	Plasticity Index (T 90), %	15
Depth		Tested By	BBURR





GEOTECHNICAL TEST REPORT

Central Laboratory

SAMPLE INFORMATION

Reference No. **270896** Boring No./Sample No. **BB-WCWB-104/5D** Sample Description **GEOTECHNICAL (DISTURBED)** Sampled **5/17/2016** Received **5/27/2016**

Sample Type: **GEOTECHNICAL** Location: Station: **910+13.8** Offset, ft: **7.7** RT Dbfg, ft: **18.0-20.0**

WIN/Town **021924.00 - WINDHAM** Sampler: **CONSULTANT SW COLE**

TEST RESULTS

Sieve Analysis (T 27)

Wash Method

SIEVE SIZE U.S. [SI]	% Passing
3 in. [75.0 mm]	
1 in. [25.0 mm]	
¾ in. [19.0 mm]	
½ in. [12.5 mm]	
⅜ in. [9.5 mm]	
¼ in. [6.3 mm]	
No. 4 [4.75 mm]	
No. 10 [2.00 mm]	
No. 20 [0.850 mm]	
No. 40 [0.425 mm]	
No. 60 [0.250 mm]	
No. 100 [0.150 mm]	
No. 200 [0.075 mm]	

Miscellaneous Tests

Liquid Limit @ 25 blows (T 89), %	33
Plastic Limit (T 90), %	21
Plasticity Index (T 90), %	12
Specific Gravity, Corrected to 20°C (T 100)	
Loss on Ignition, % (T 267)	
Water Content (T 265), %	43.2

Consolidation (T 216)

Trimming, Water Content, %					
	Initial	Final		Void Ratio	% Strain
Water Content, %			Pmin		
Dry Density, lbs/ft³			Pp		
Void Ratio			Pmax		
Saturation, %			Cc/C'c		

Vane Shear Test on Shelby Tubes (Maine DOT)

Depth taken in tube, ft	3 In.		6 In.		Water Content, %	Description of Material Sampled at the Various Tube Depths
	U. Shear	Remold	U. Shear	Remold		
	tons/ft²	tons/ft²	tons/ft²	tons/ft²		

Comments:

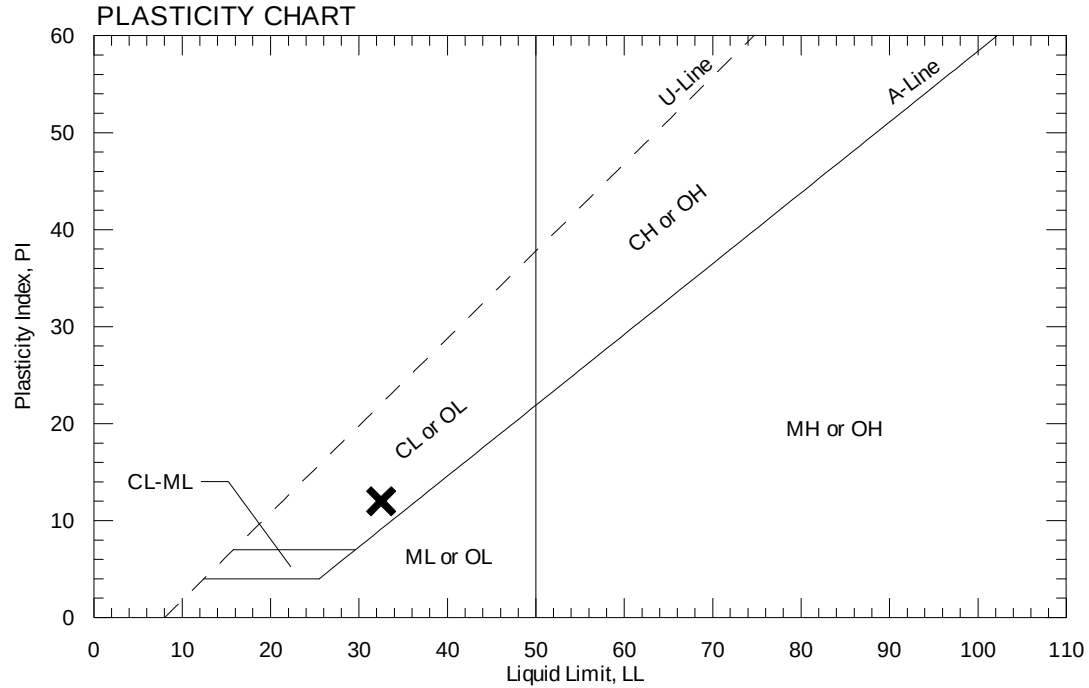
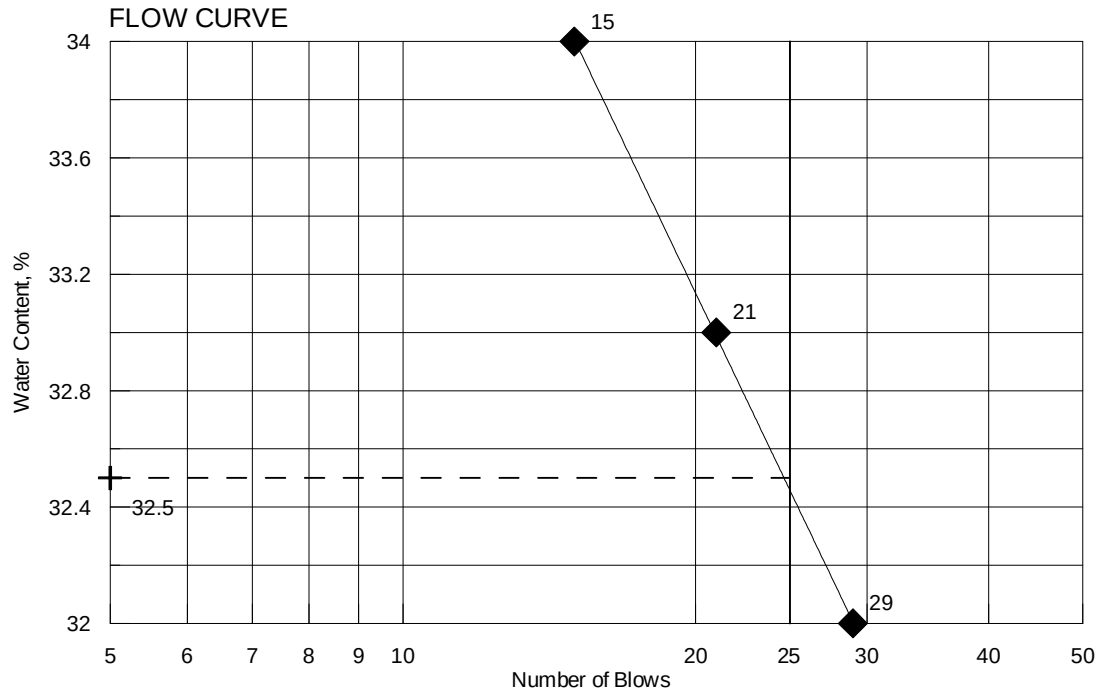
AUTHORIZATION AND DISTRIBUTION

Reported by: **GREGORY LIDSTONE**

Date Reported: **6/9/2016**

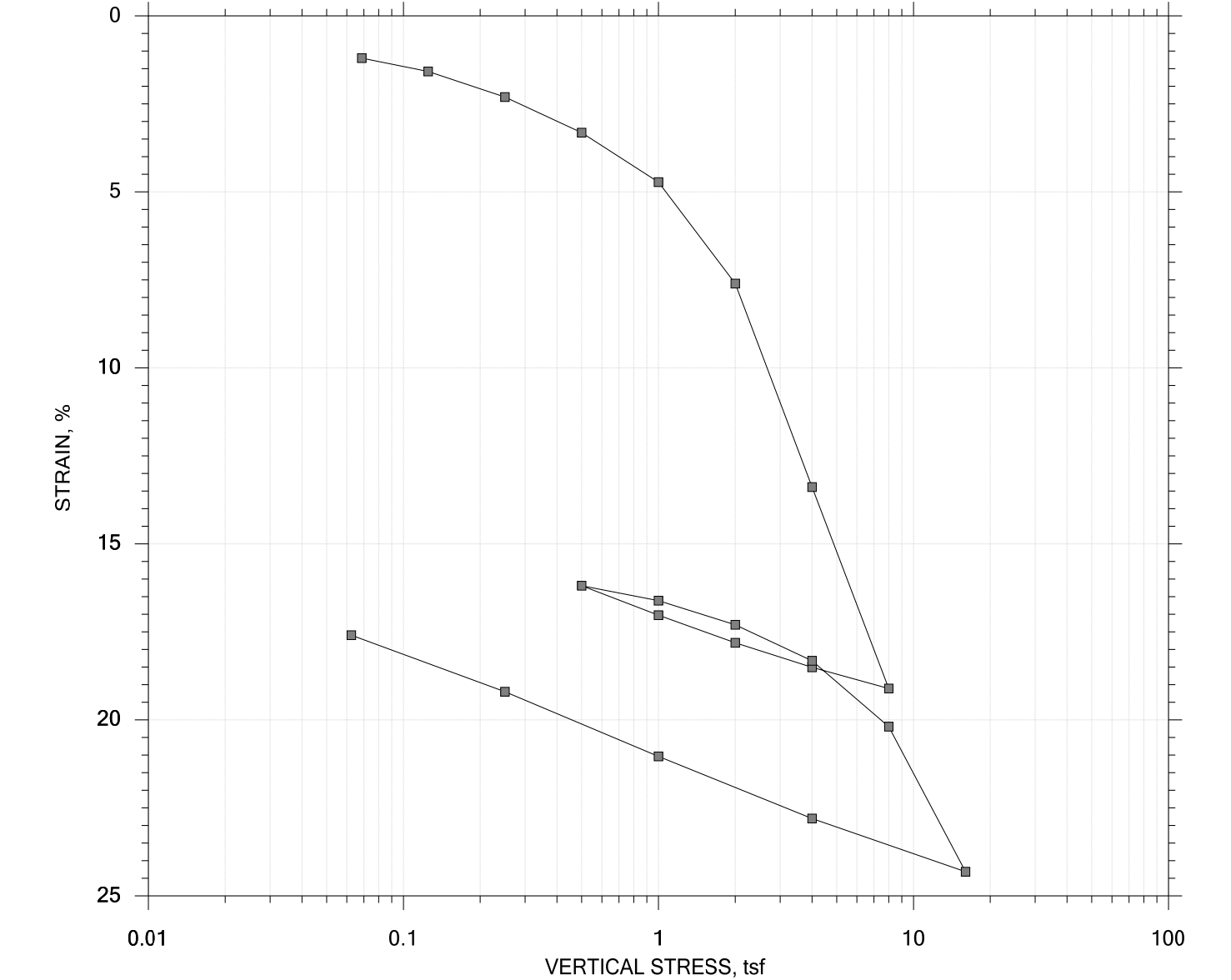
Paper Copy: Lab File; Project File; Geotech File

TOWN	Windham	Reference No.	270896
WIN	021924.00	Water Content, %	43.2
Sampled	5/17/2016	Liquid Limit @ 25 blows (T 89), %	33
Boring No./Sample No.	BB-WCWB-104/5D	Plastic Limit (T 90), %	21
Station	910+13.8	Plasticity Index (T 90), %	12
Depth	18.0-20.0	Tested By	BBURR



One-Dimensional Consolidation by ASTM D2435 - Method B

SUMMARY REPORT

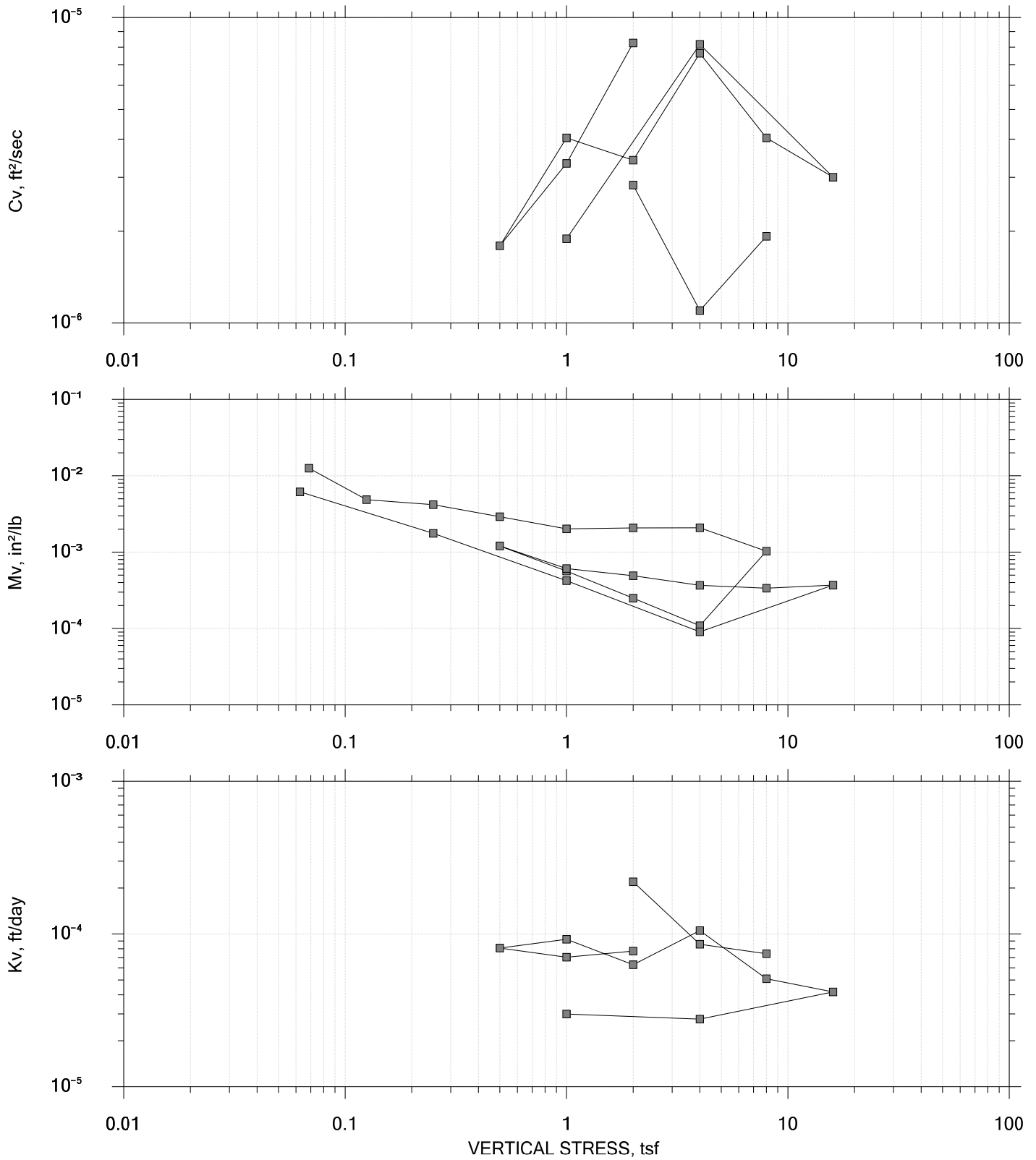


				Before Test	After Test	
Current Vertical Effective Stress: --- ±0.92 tsf				Water Content, %	38.15	27.15
Preconsolidation Stress: --- 1.55 tsf				Dry Unit Weight, pcf	79.98	97.055
Compression Ratio: --- 0.40				Saturation, %	93.32	100.00
Diameter: 2.5 in		Height: 1.016 in		Void Ratio	1.10	0.73
LL: --- 37	PL: --- 21	PI: --- 16	GS: 2.69			

	Project: WINDHAM	Location: -- Sta. 910+84.4; 7.6 LT	Project No.: 21924.00
	Boring No.: BB-WCWB-102	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 6/21/2016	Test No.: 242700
	Depth: 20.0-22.0 FT	Sample Type: intact	Elevation: – 64.2 ft
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

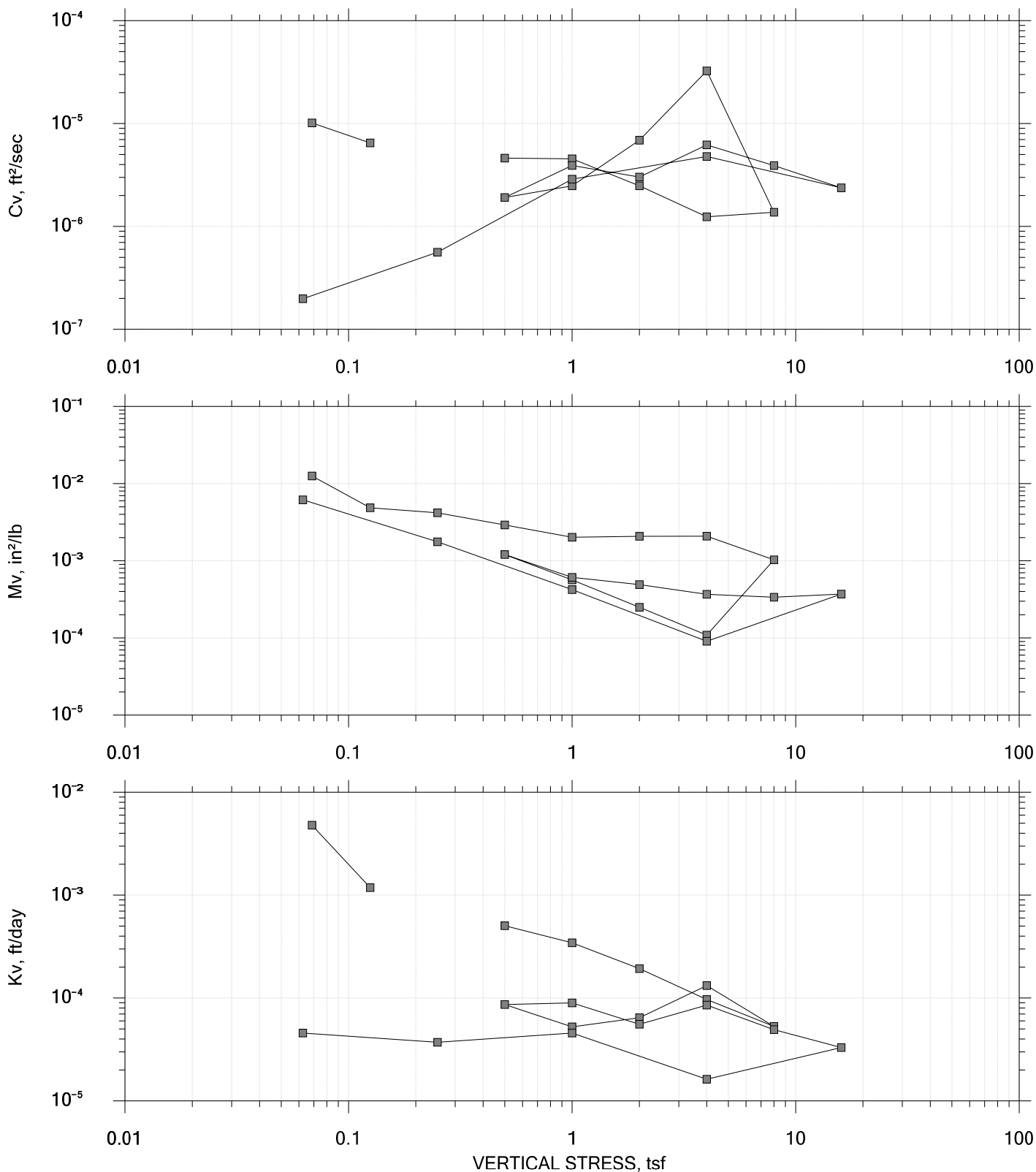
LOG of TIME COEFFICIENTS



	Project: WINDHAM	Location: --	Project No.: 21924.00
	Boring No.: BB-WCWB-102	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 6/21/2016	Test No.: 242700
	Depth: 20.0-22.0 FT	Sample Type: intact	Elevation: --
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

SQUARE ROOT of TIME COEFFICIENTS



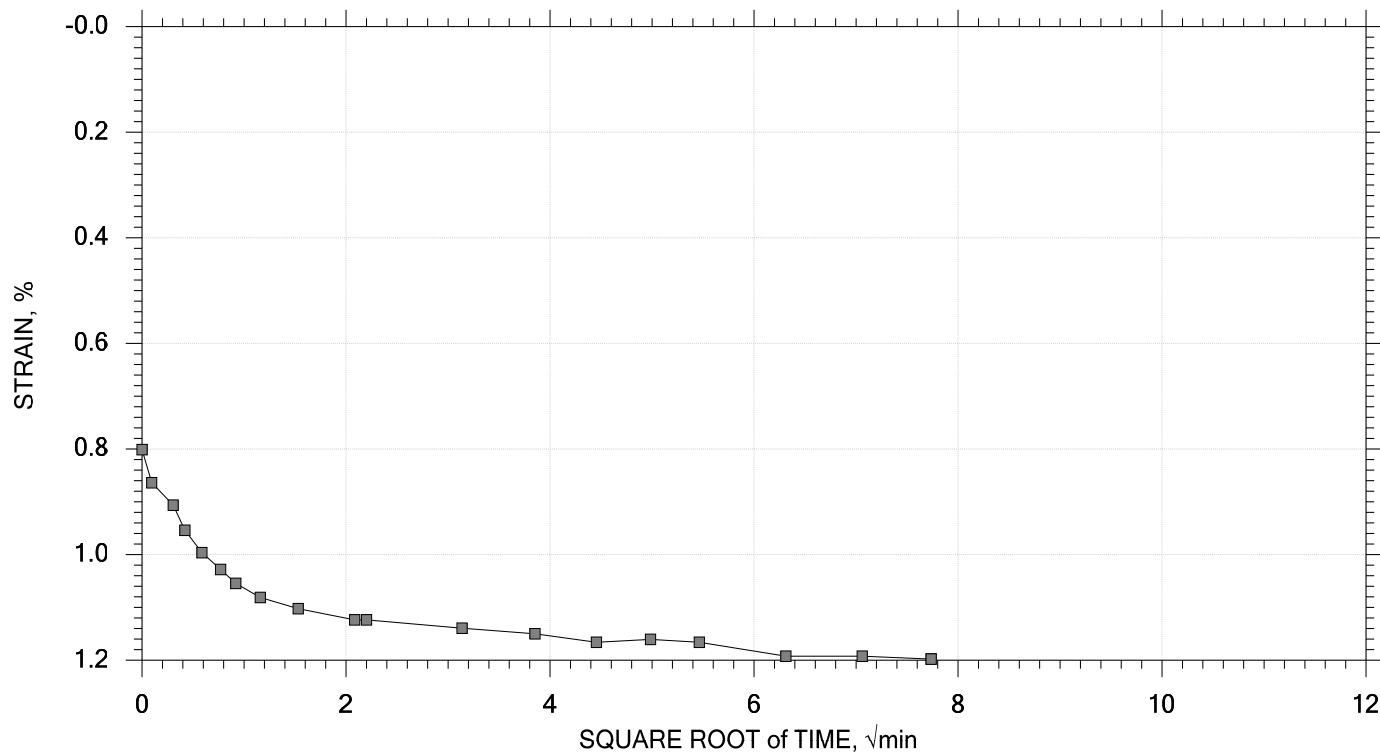
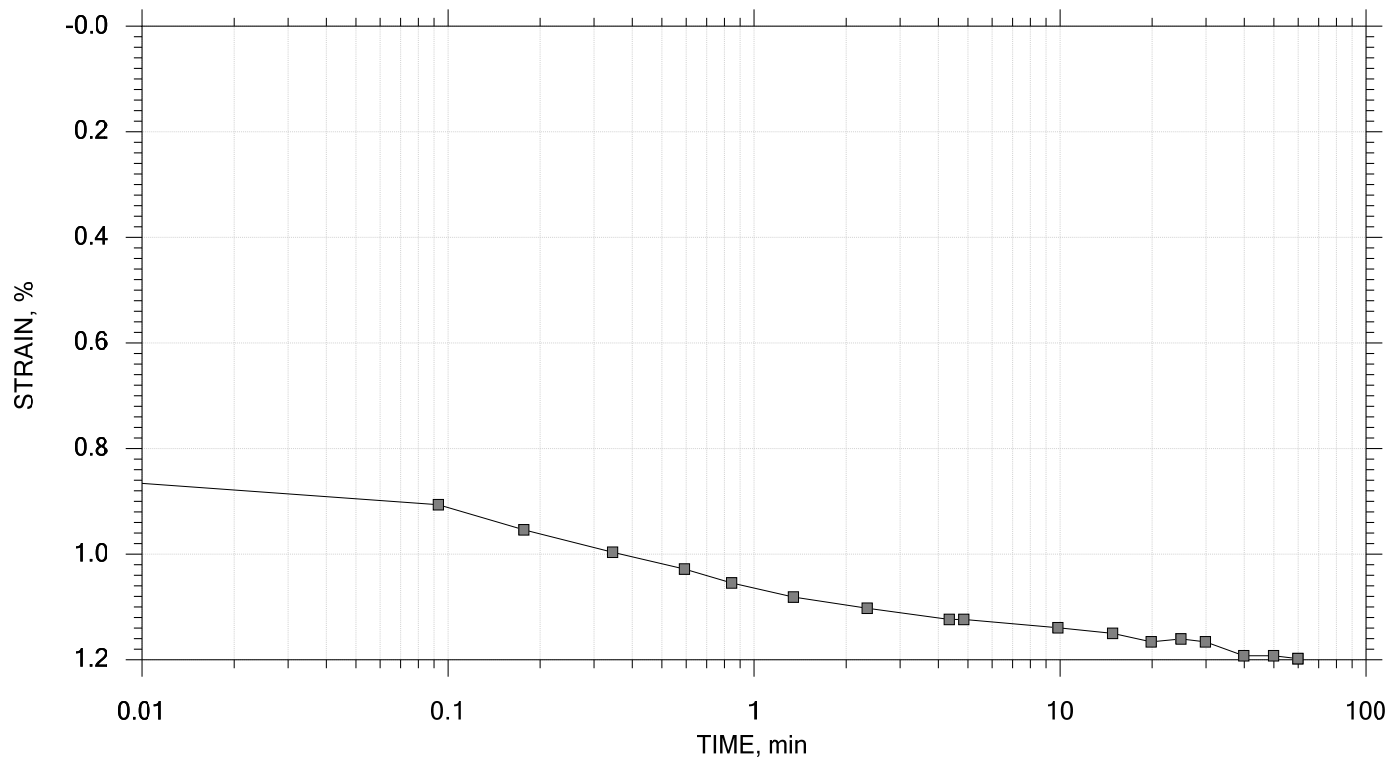
	Project: WINDHAM	Location: --	Project No.: 21924.00
	Boring No.: BB-WCWB-102	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 6/21/2016	Test No.: 242700
	Depth: 20.0-22.0 FT	Sample Type: intact	Elevation: --
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Volume Step 1 of 21

Stress: 0.068595 tsf



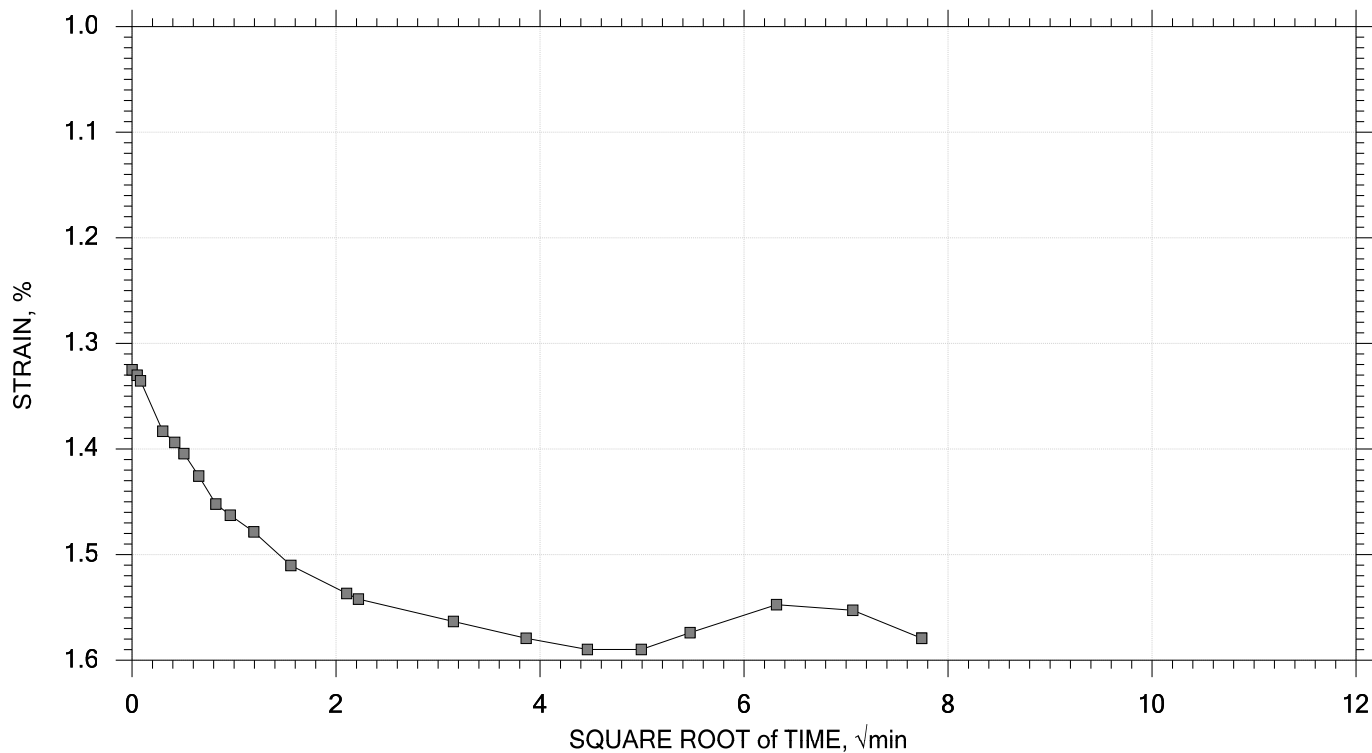
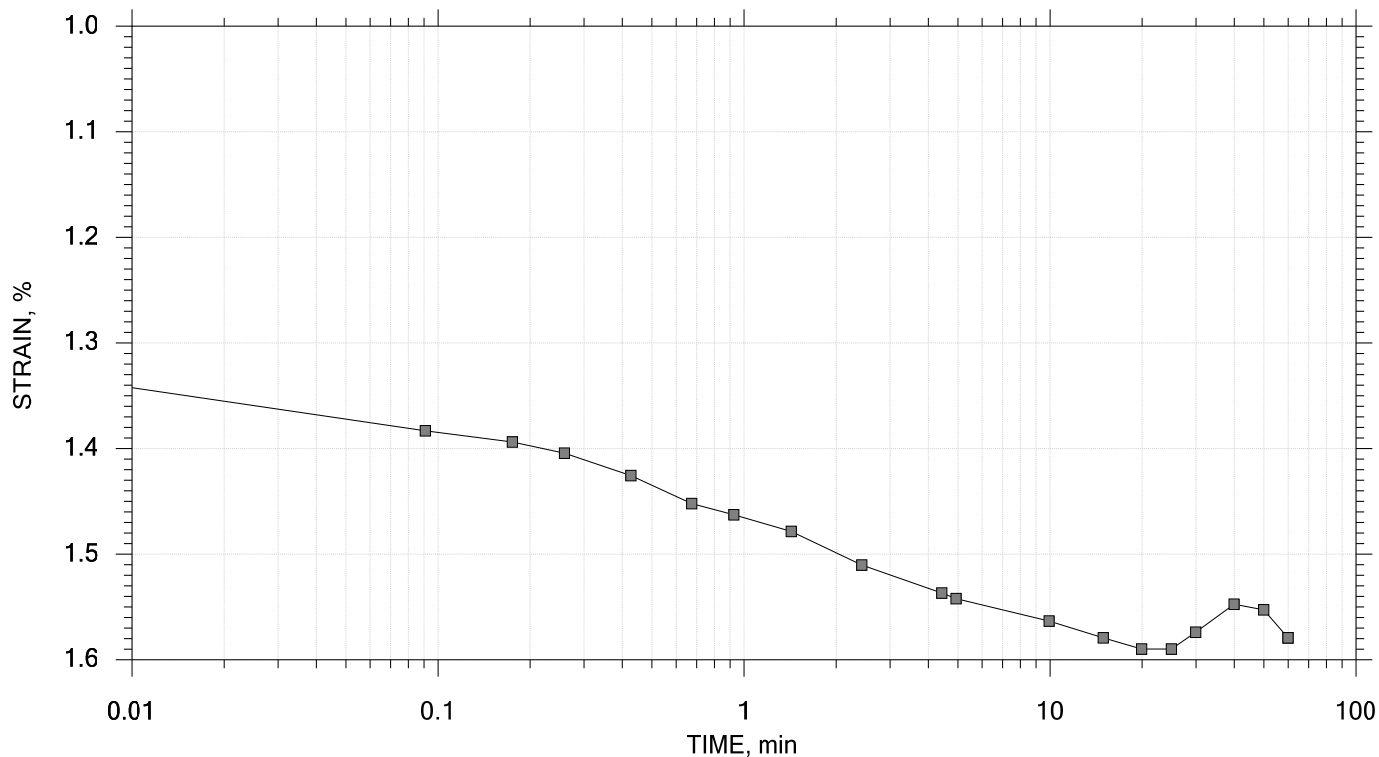
	Project: WINDHAM	Location: --	Project No.: 21924.00
	Boring No.: BB-WCWB-102	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 6/21/2016	Test No.: 242700
	Depth: 20.0-22.0 FT	Sample Type: intact	Elevation: --
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 2 of 21

Stress: 0.125 tsf



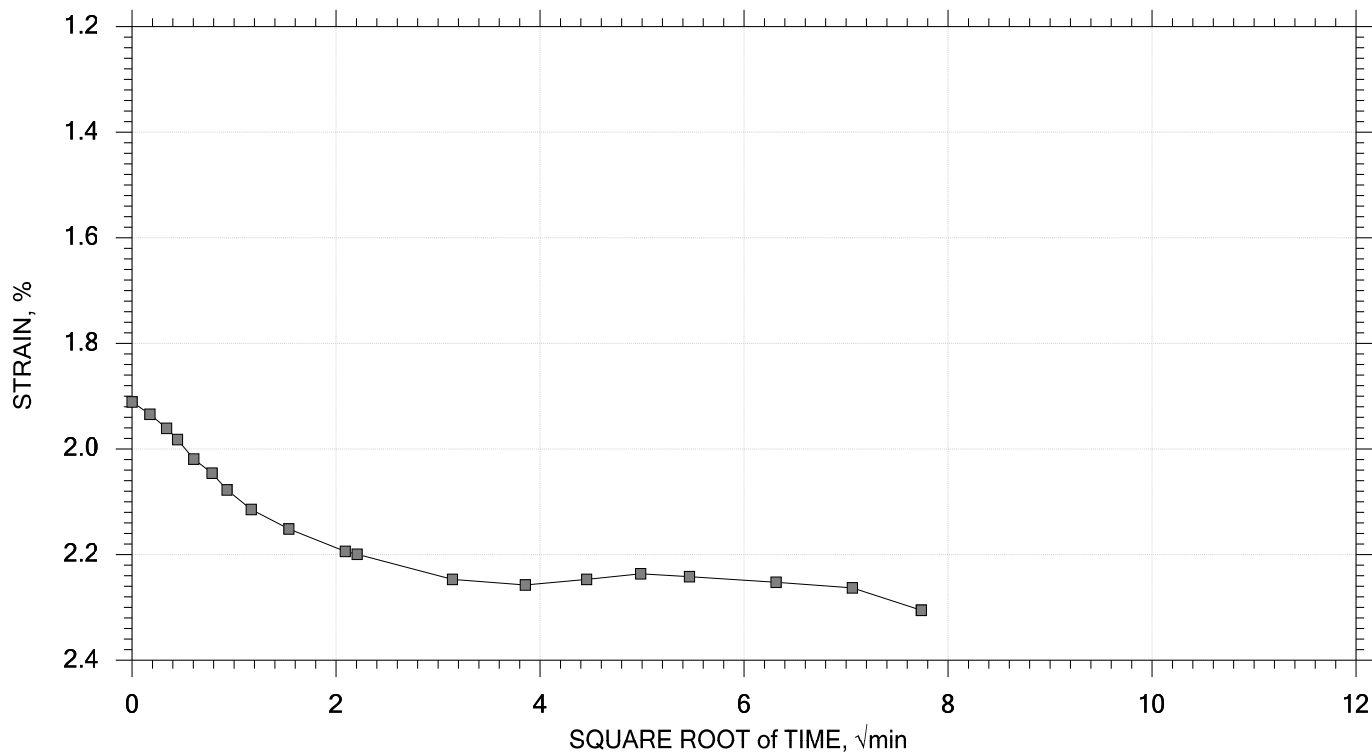
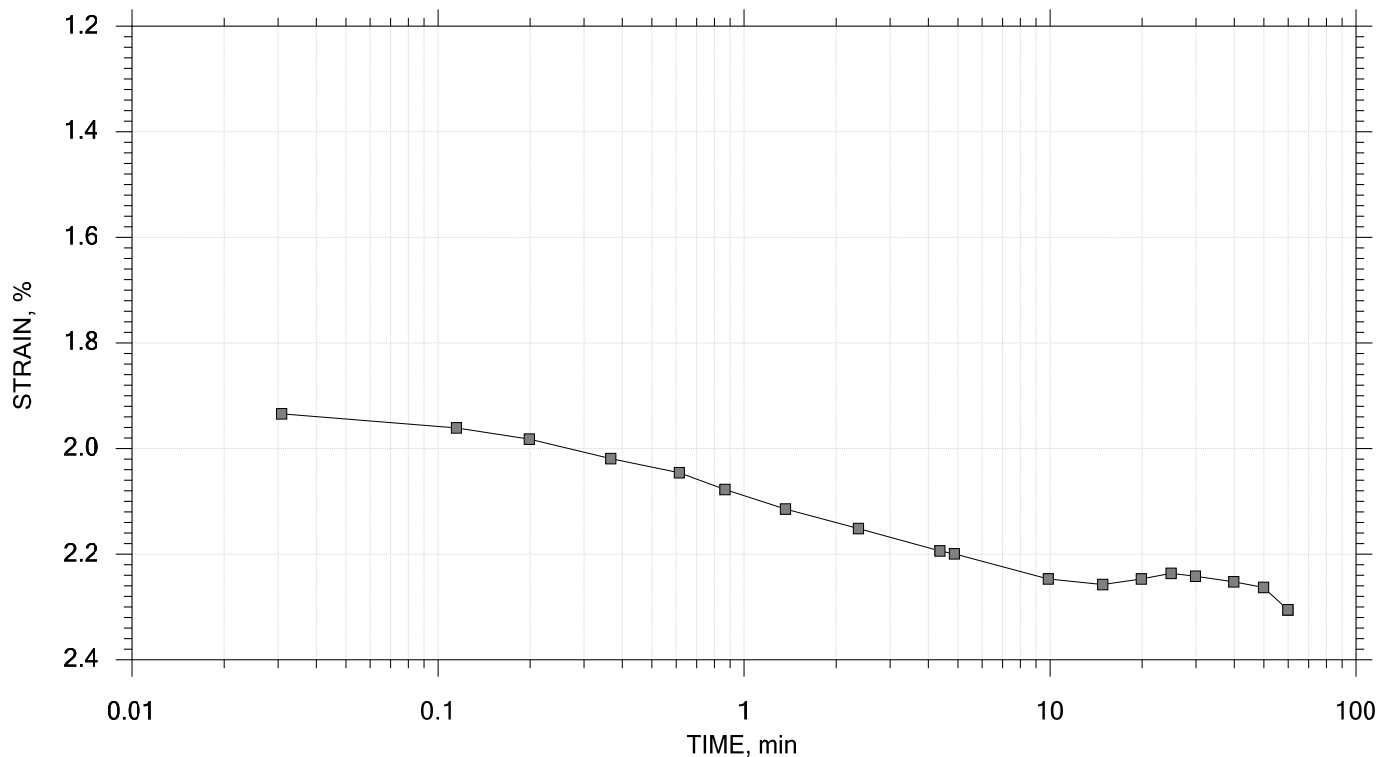
	Project: WINDHAM	Location: --	Project No.: 21924.00
	Boring No.: BB-WCWB-102	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 6/21/2016	Test No.: 242700
	Depth: 20.0-22.0 FT	Sample Type: intact	Elevation: --
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 3 of 21

Stress: 0.25 tsf



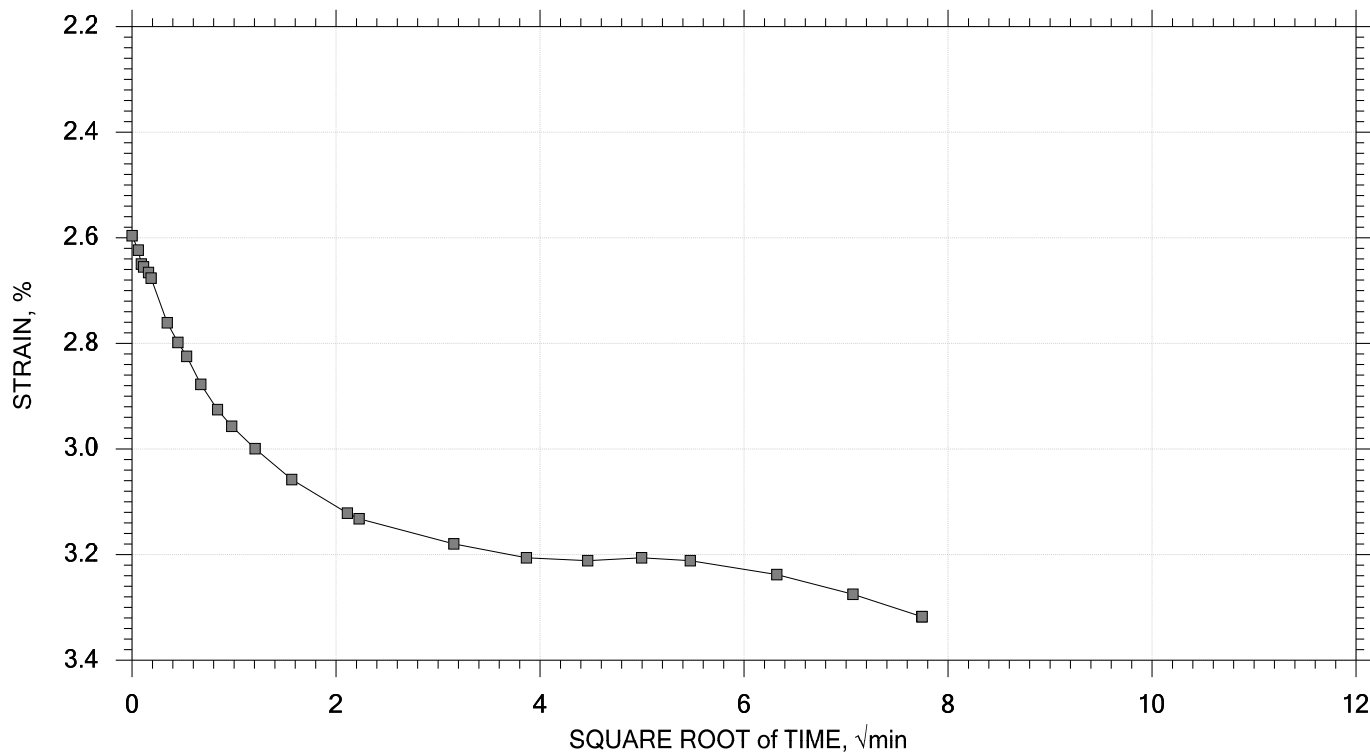
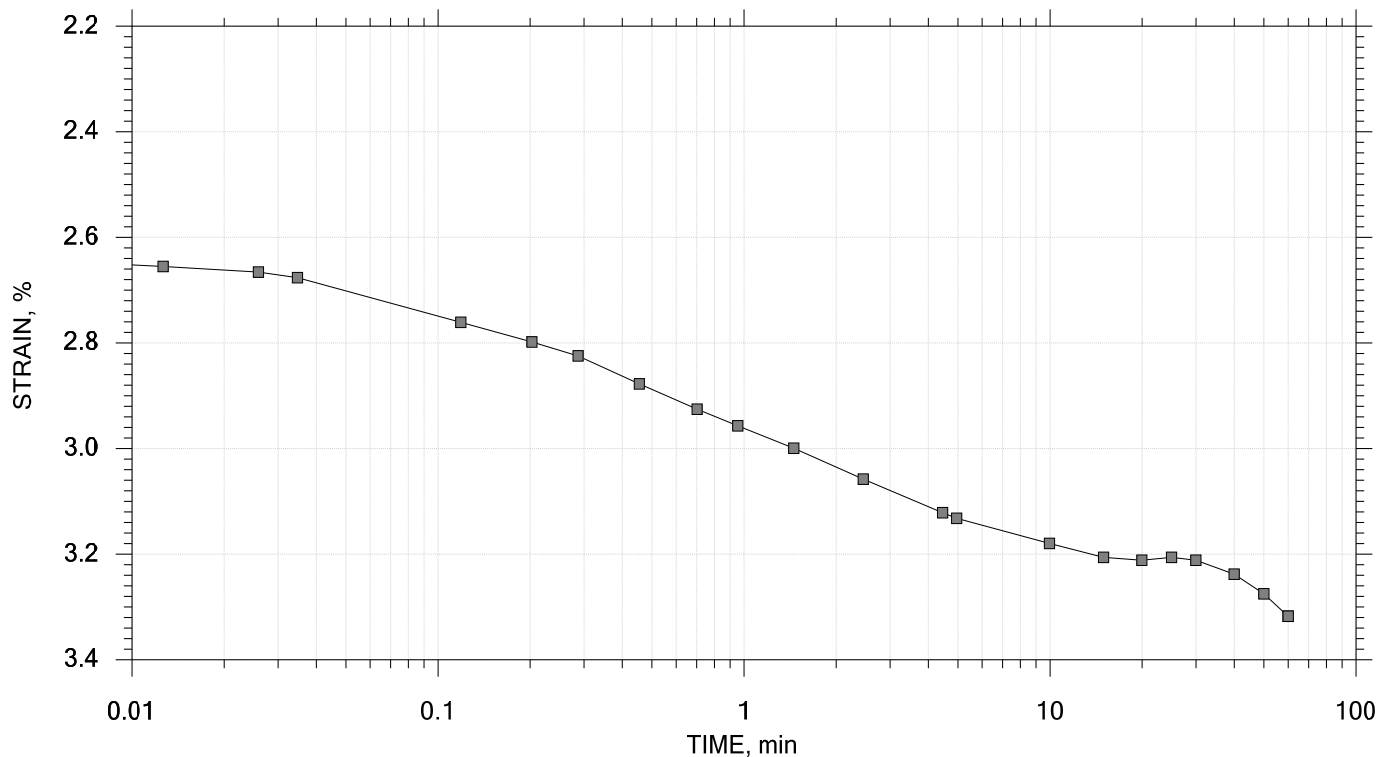
	Project: WINDHAM	Location: --	Project No.: 21924.00
	Boring No.: BB-WCWB-102	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 6/21/2016	Test No.: 242700
	Depth: 20.0-22.0 FT	Sample Type: intact	Elevation: --
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 4 of 21

Stress: 0.5 tsf



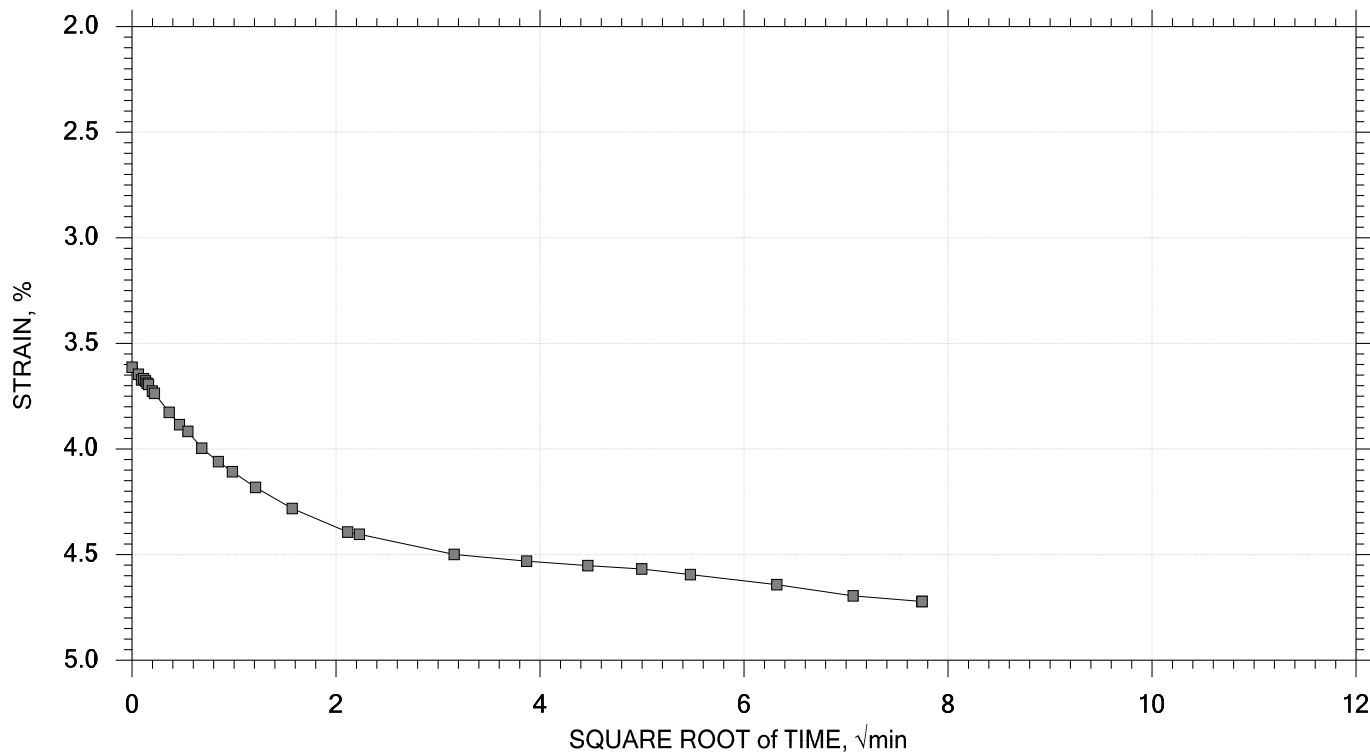
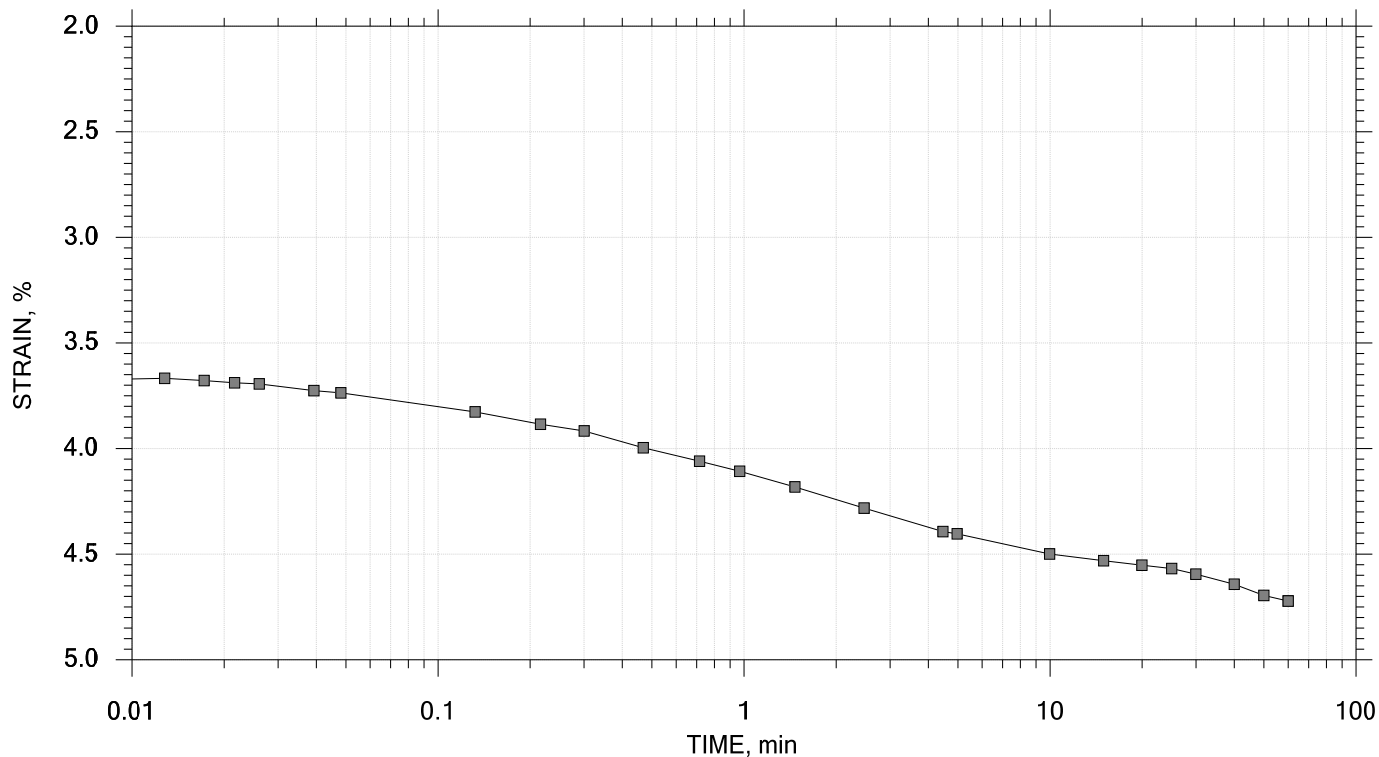
	Project: WINDHAM	Location: --	Project No.: 21924.00
	Boring No.: BB-WCWB-102	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 6/21/2016	Test No.: 242700
	Depth: 20.0-22.0 FT	Sample Type: intact	Elevation: --
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 5 of 21

Stress: 1 tsf



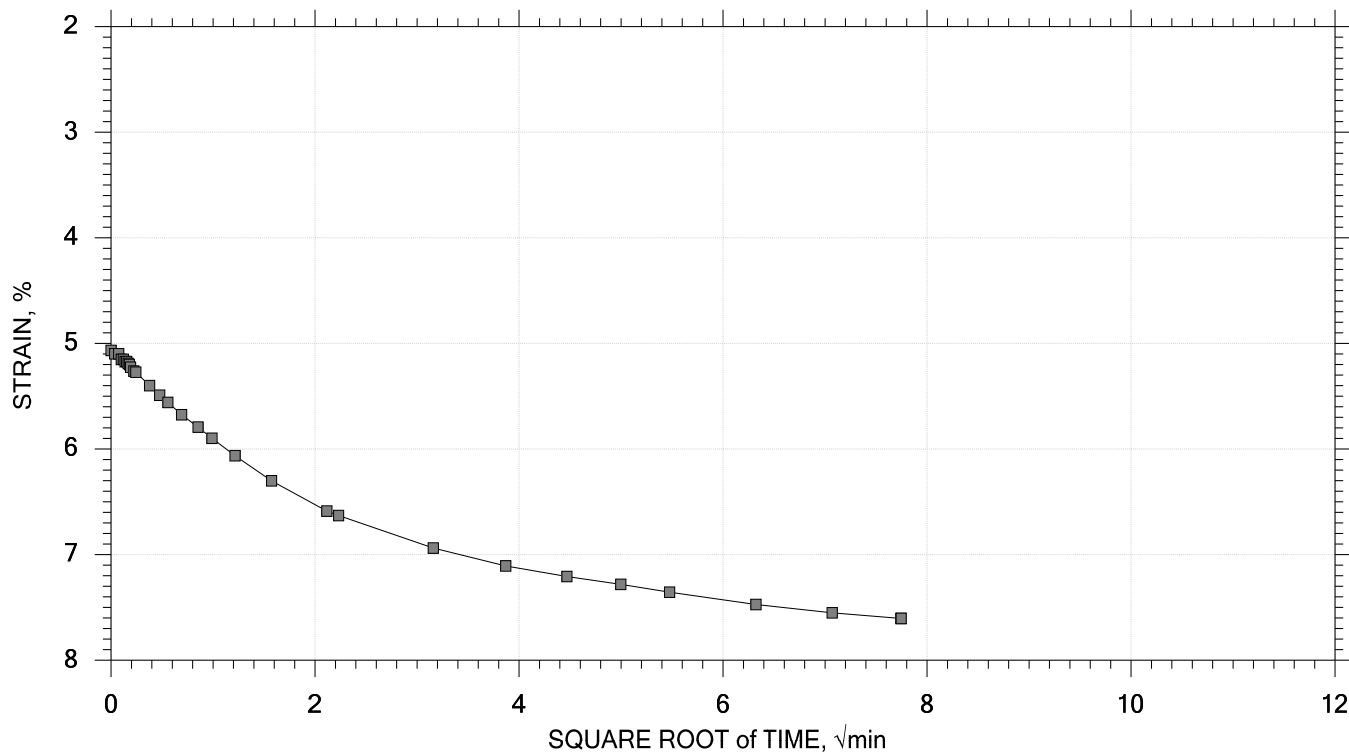
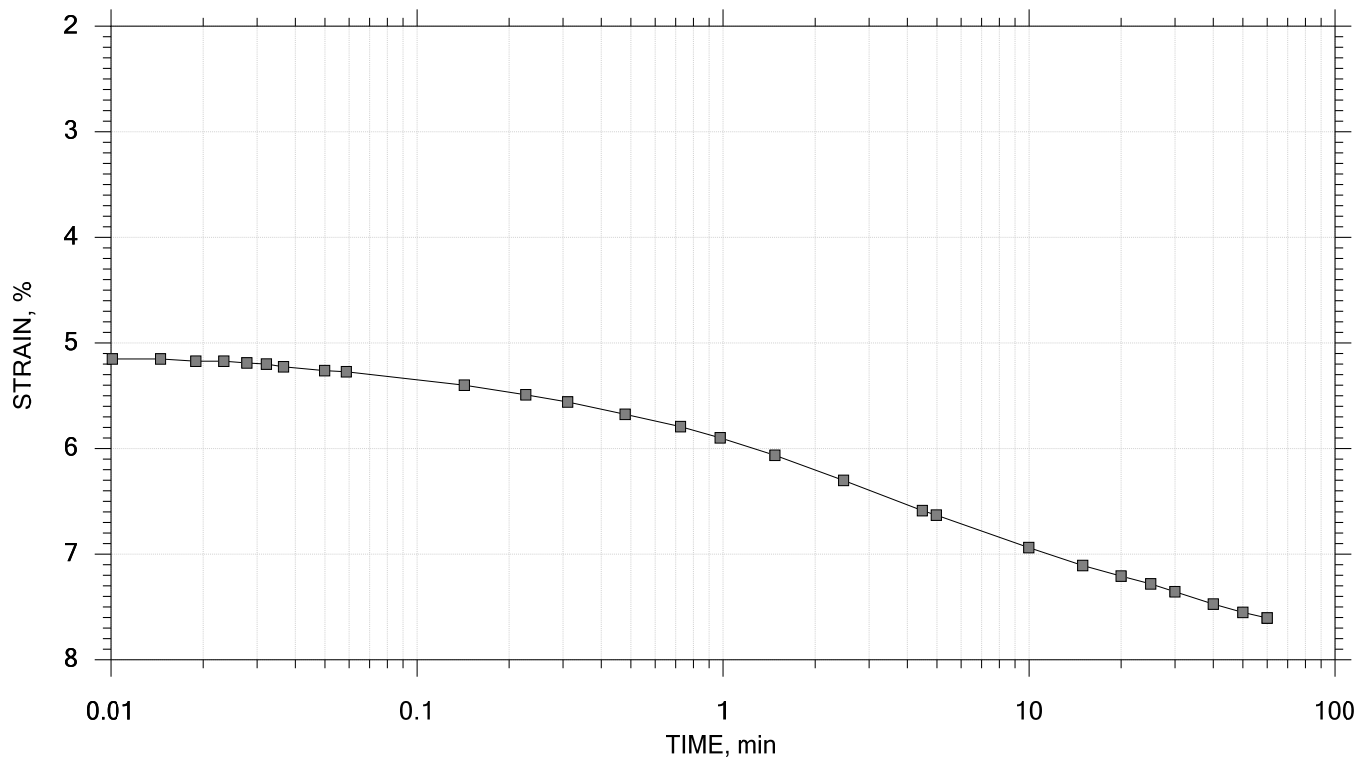
	Project: WINDHAM	Location: --	Project No.: 21924.00
	Boring No.: BB-WCWB-102	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 6/21/2016	Test No.: 242700
	Depth: 20.0-22.0 FT	Sample Type: intact	Elevation: --
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 6 of 21

Stress: 2 tsf



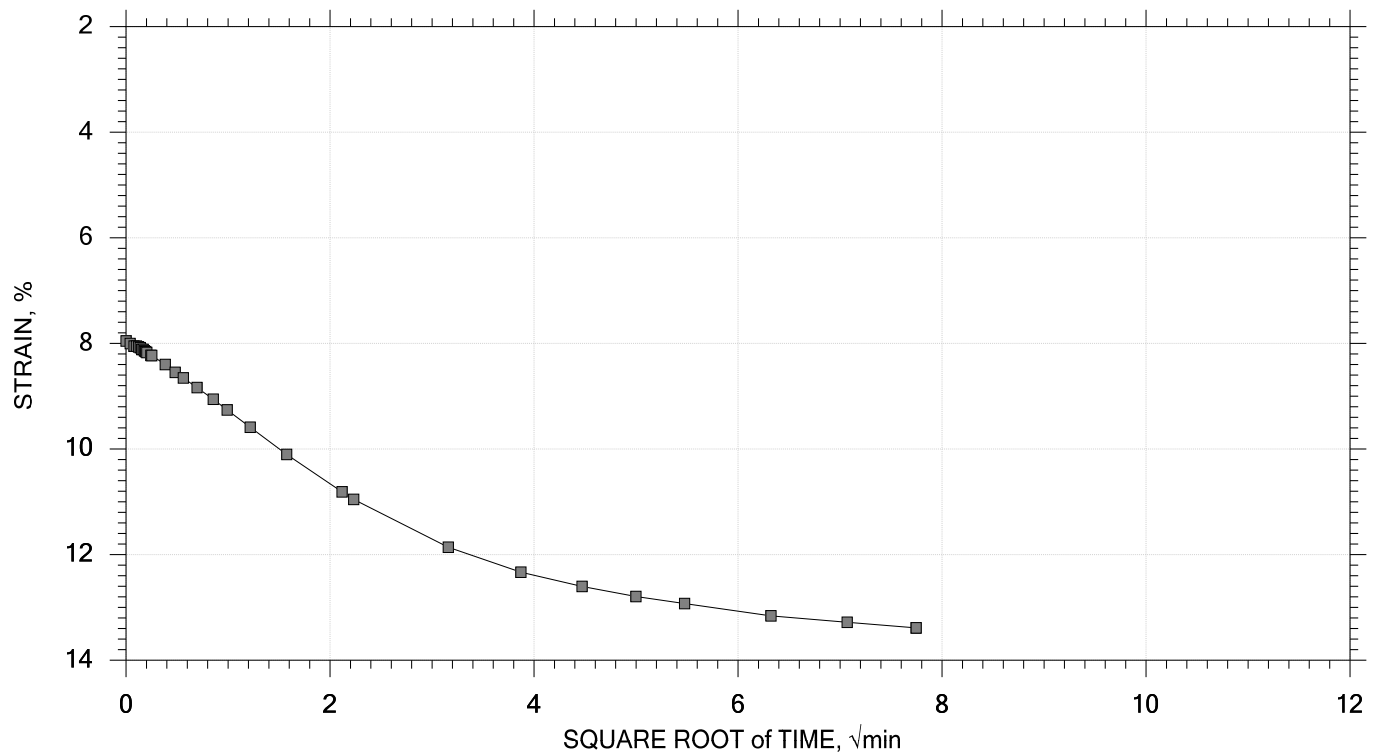
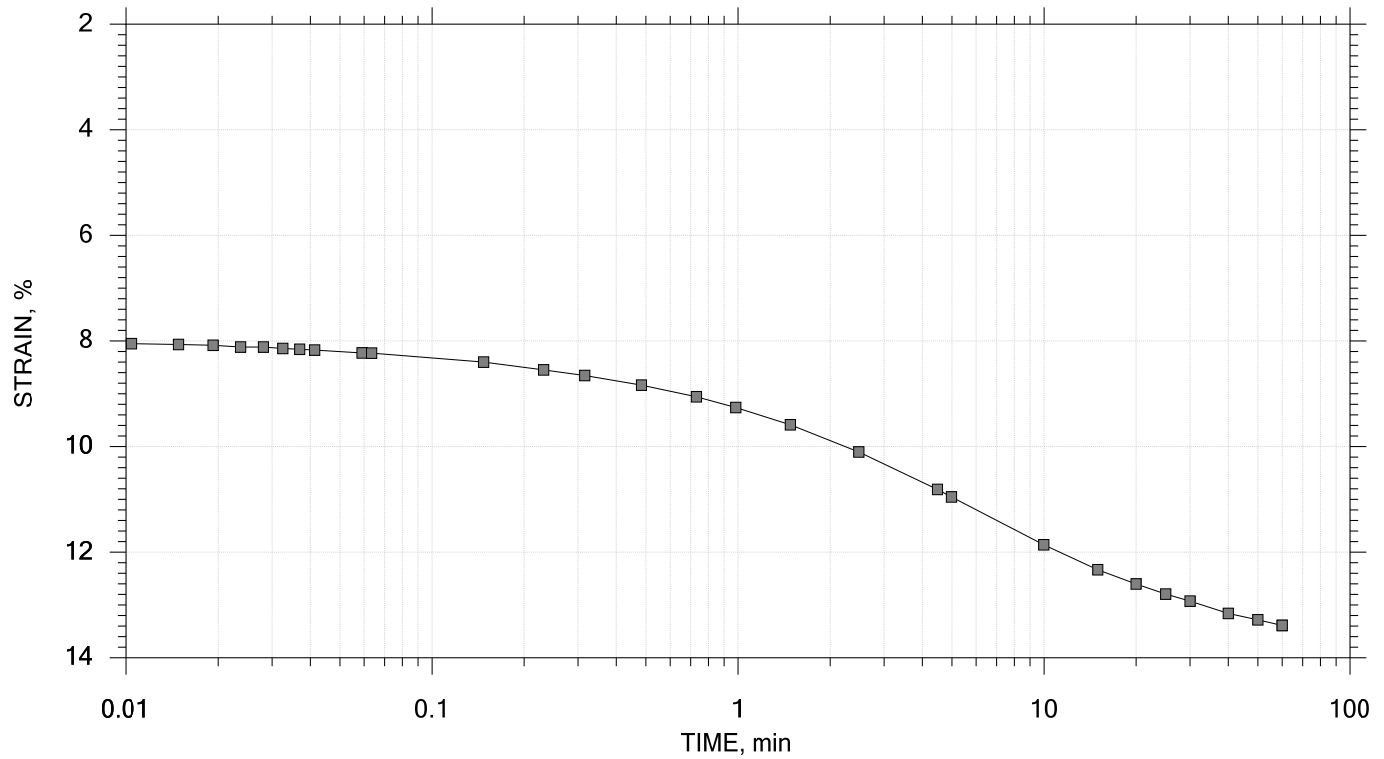
	Project: WINDHAM	Location: --	Project No.: 21924.00
	Boring No.: BB-WCWB-102	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 6/21/2016	Test No.: 242700
	Depth: 20.0-22.0 FT	Sample Type: intact	Elevation: --
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 7 of 21

Stress: 4 tsf



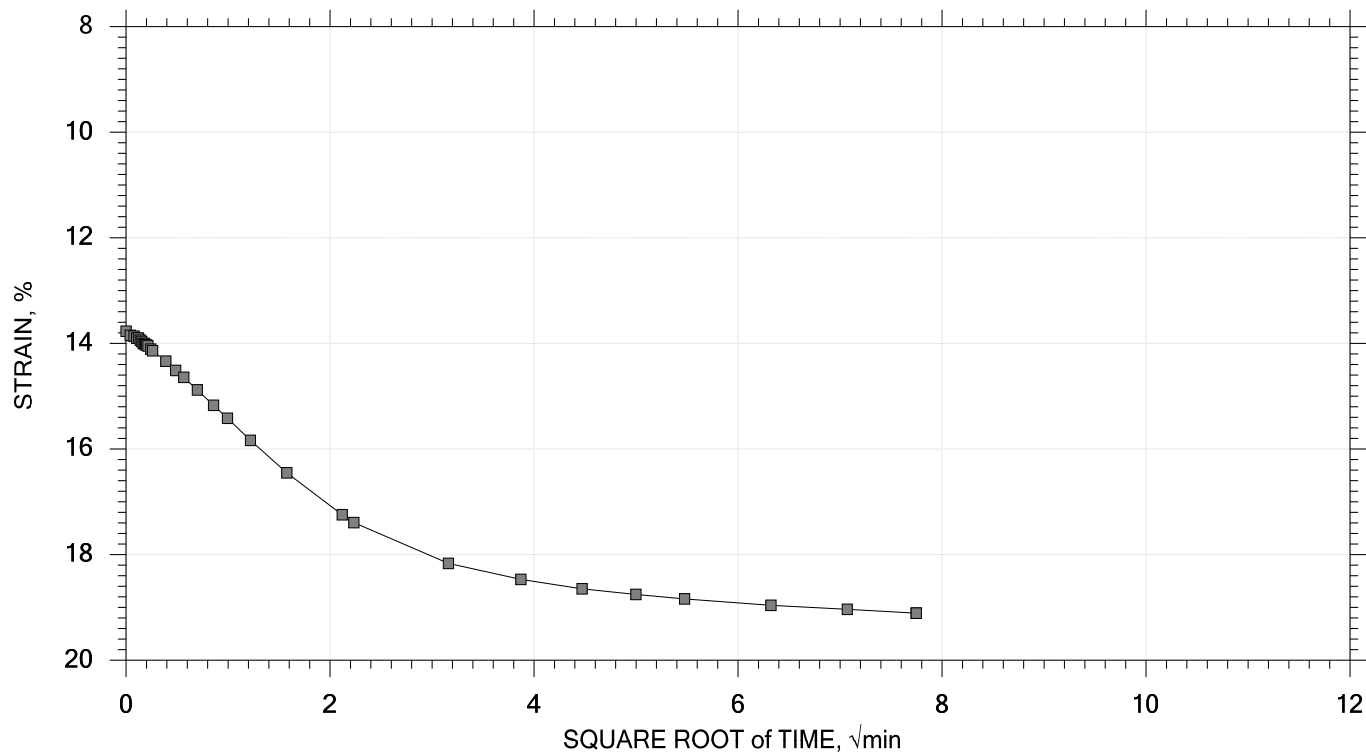
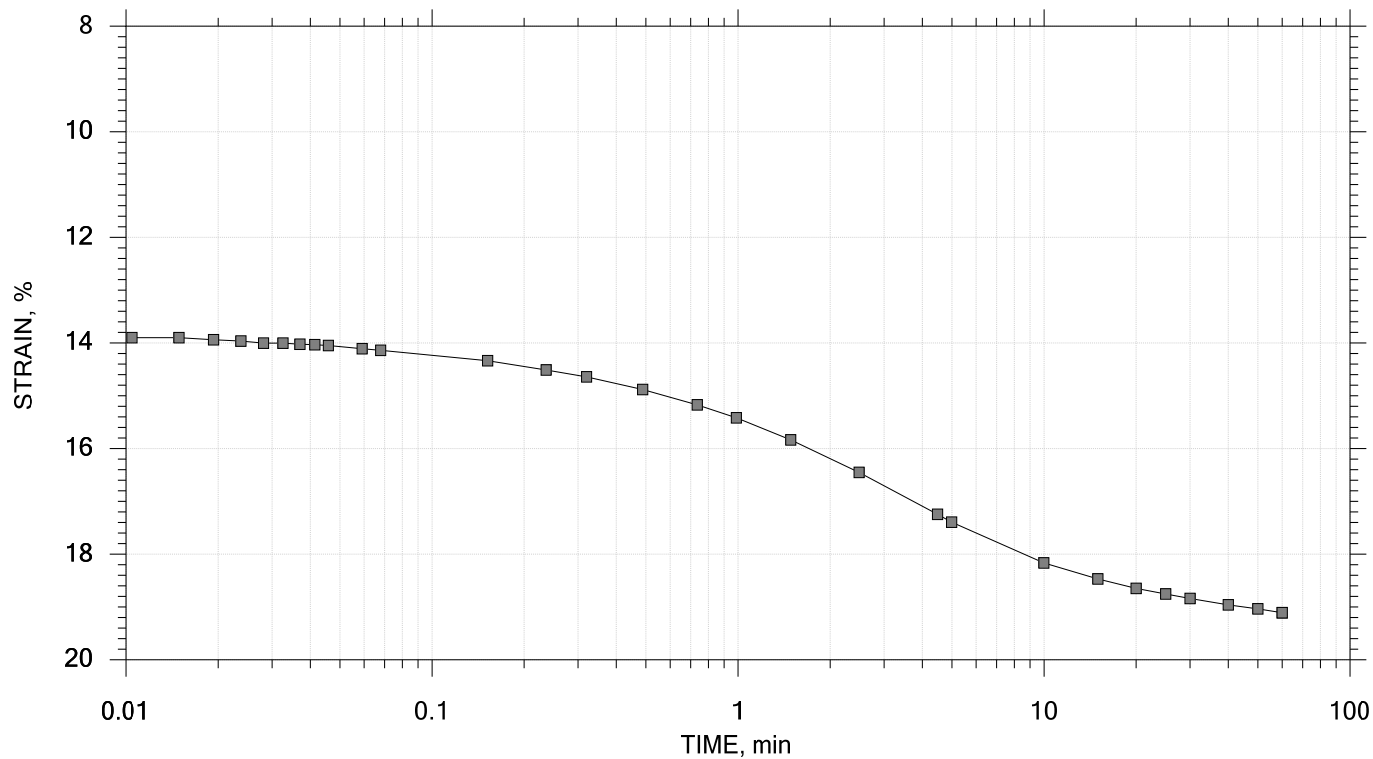
	Project: WINDHAM	Location: --	Project No.: 21924.00
	Boring No.: BB-WCWB-102	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 6/21/2016	Test No.: 242700
	Depth: 20.0-22.0 FT	Sample Type: intact	Elevation: --
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 8 of 21

Stress: 8 tsf



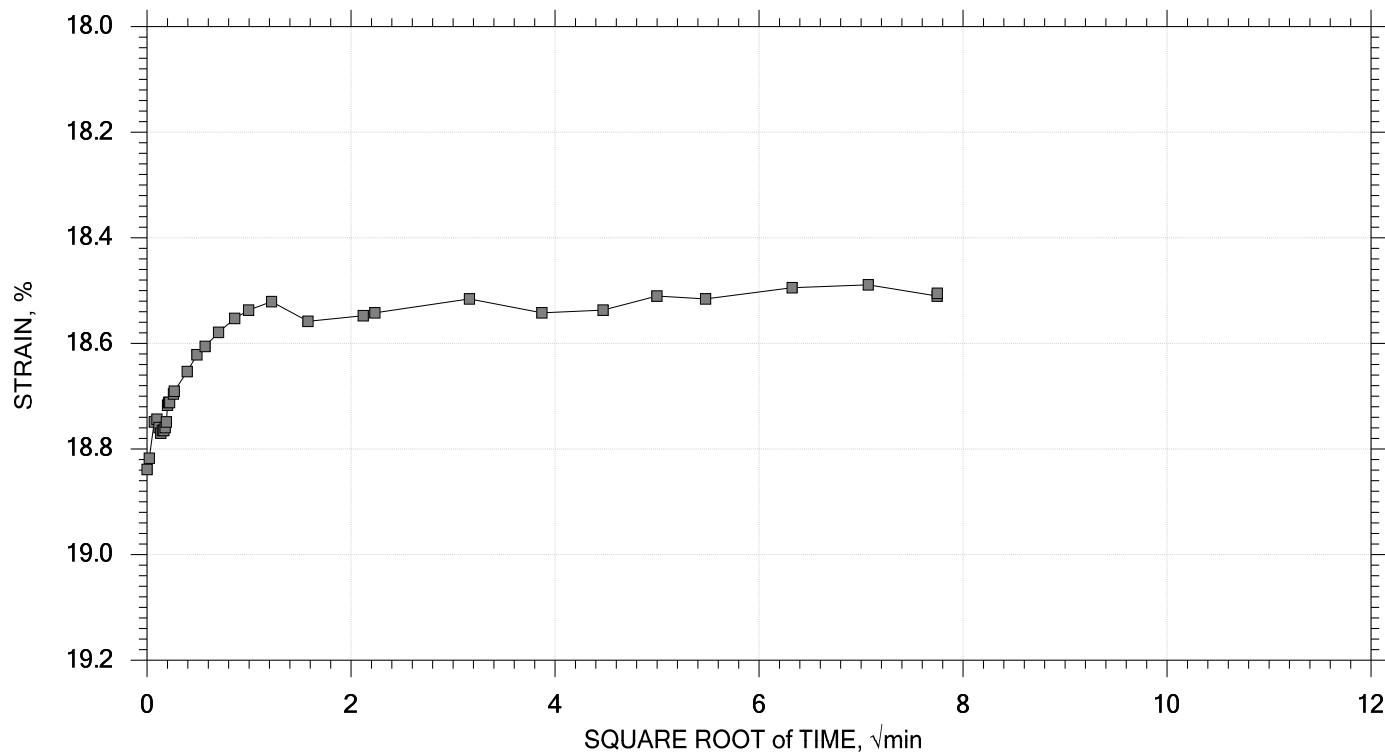
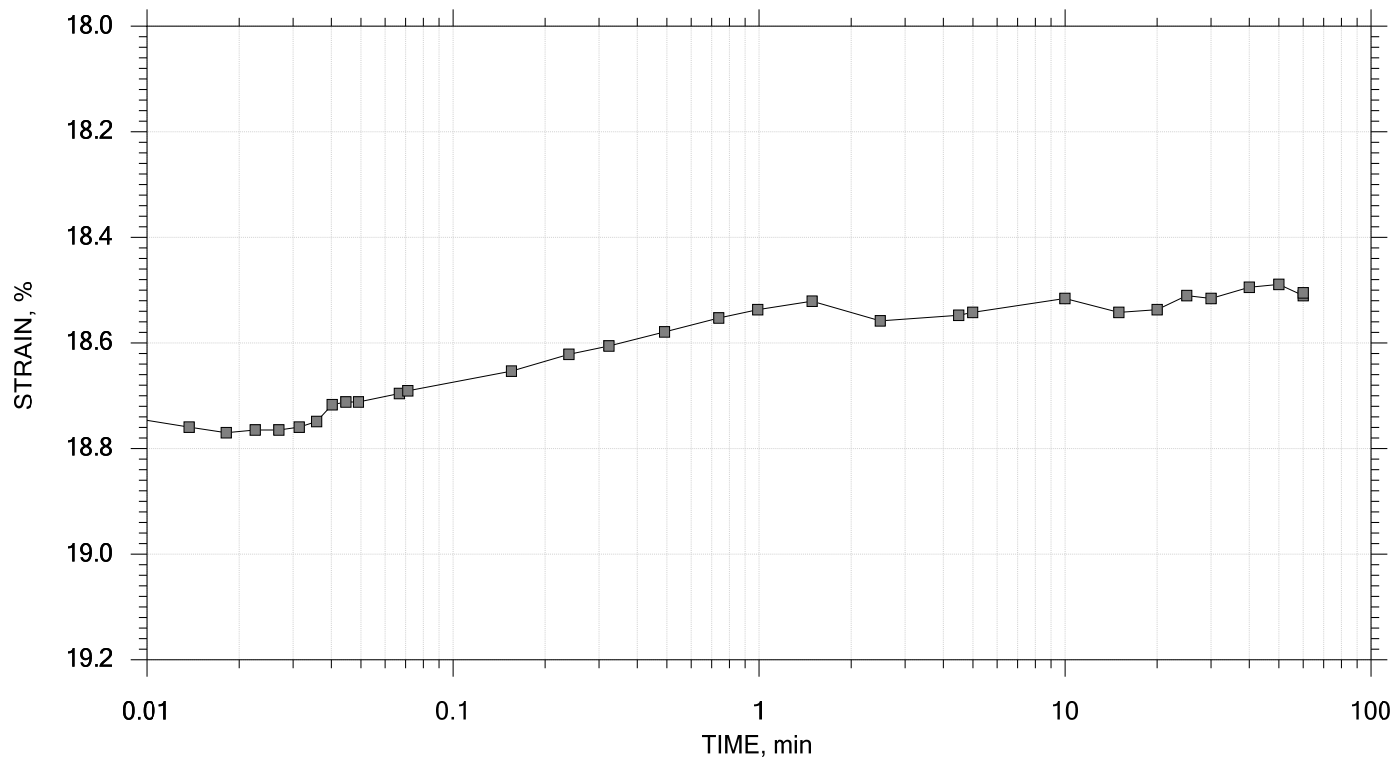
	Project: WINDHAM	Location: --	Project No.: 21924.00
	Boring No.: BB-WCWB-102	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 6/21/2016	Test No.: 242700
	Depth: 20.0-22.0 FT	Sample Type: intact	Elevation: --
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 9 of 21

Stress: 4 tsf



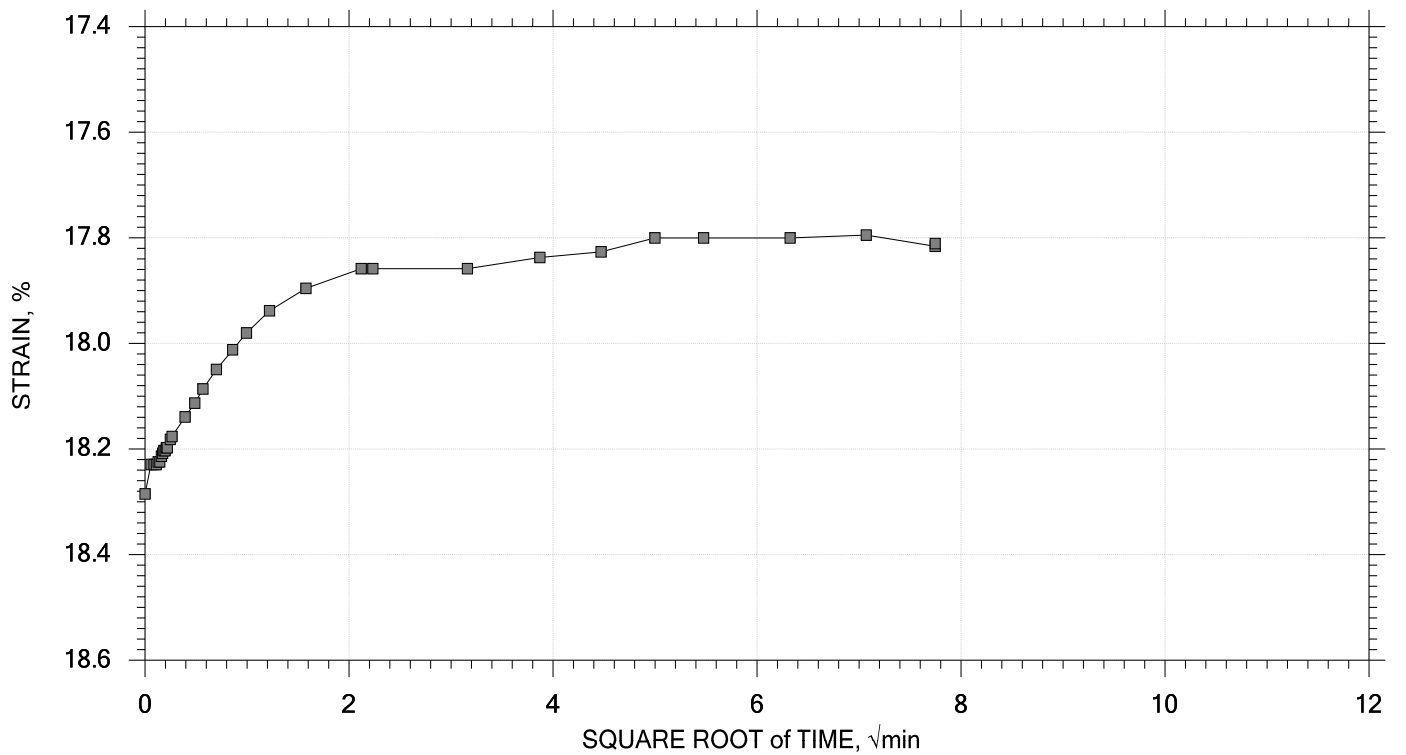
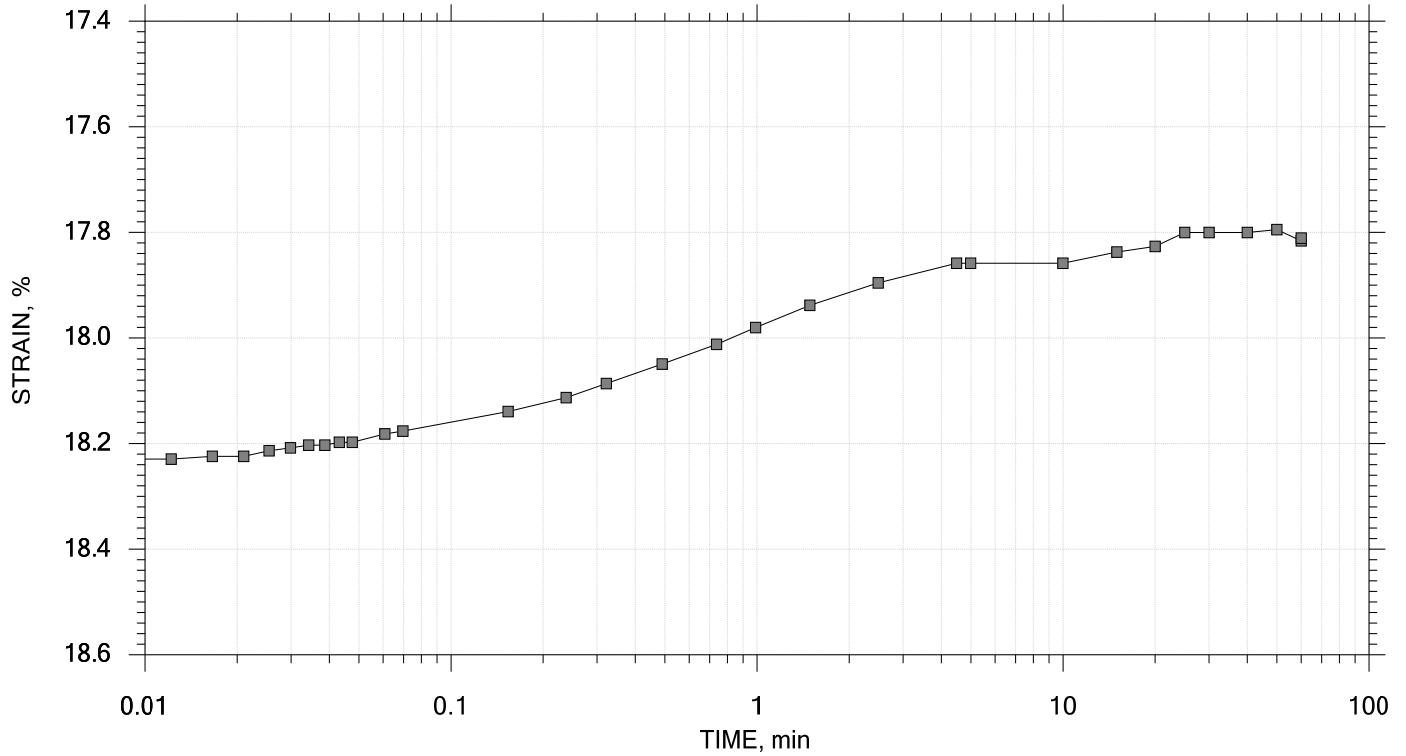
	Project: WINDHAM	Location: --	Project No.: 21924.00
	Boring No.: BB-WCWB-102	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 6/21/2016	Test No.: 242700
	Depth: 20.0-22.0 FT	Sample Type: intact	Elevation: --
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 10 of 21

Stress: 2 tsf



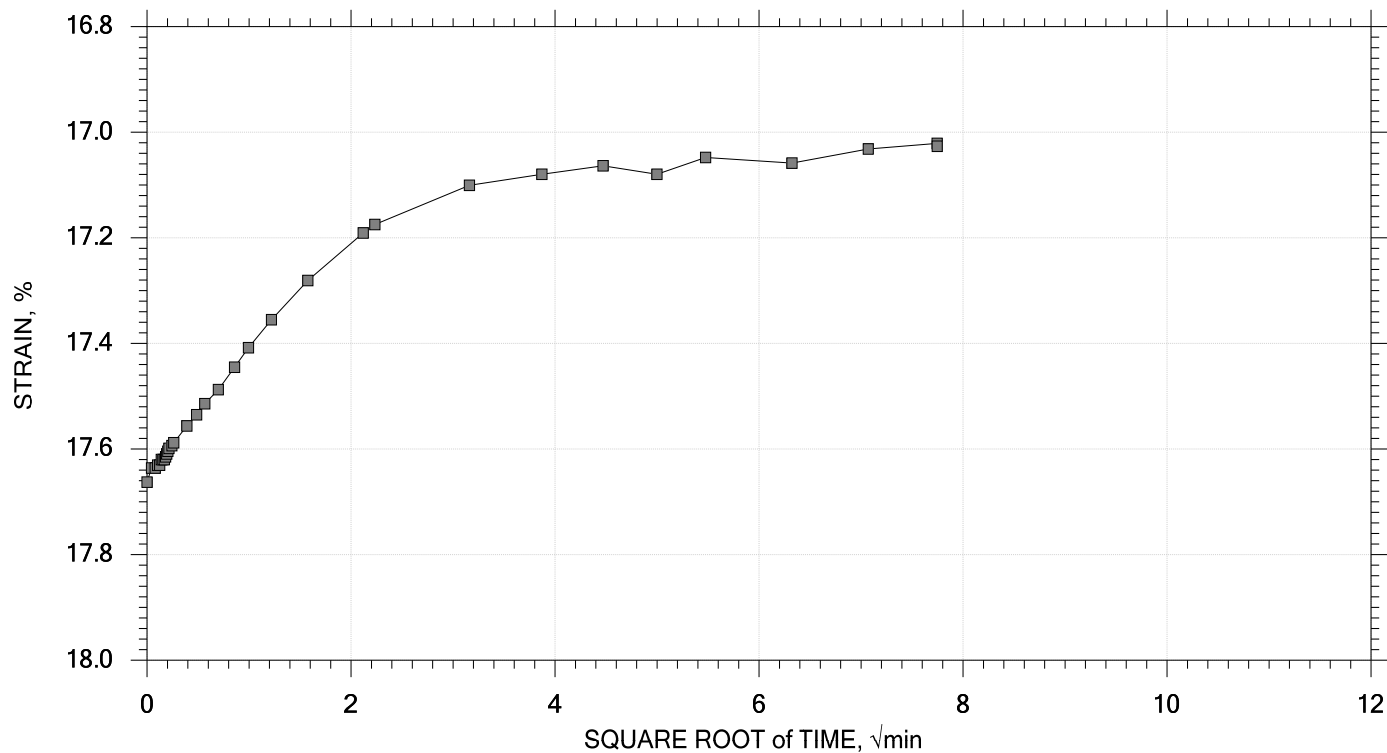
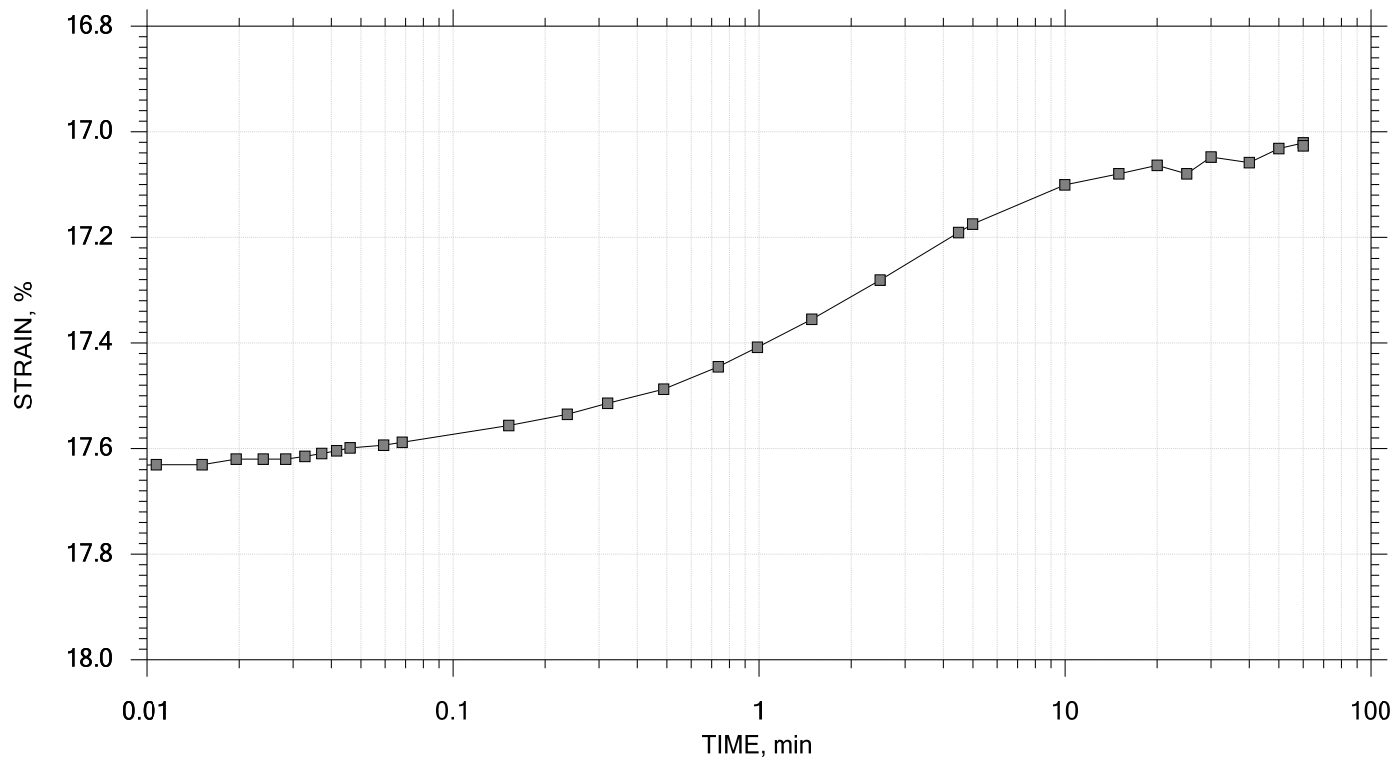
	Project: WINDHAM	Location: --	Project No.: 21924.00
	Boring No.: BB-WCWB-102	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 6/21/2016	Test No.: 242700
	Depth: 20.0-22.0 FT	Sample Type: intact	Elevation: --
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 11 of 21

Stress: 1 tsf



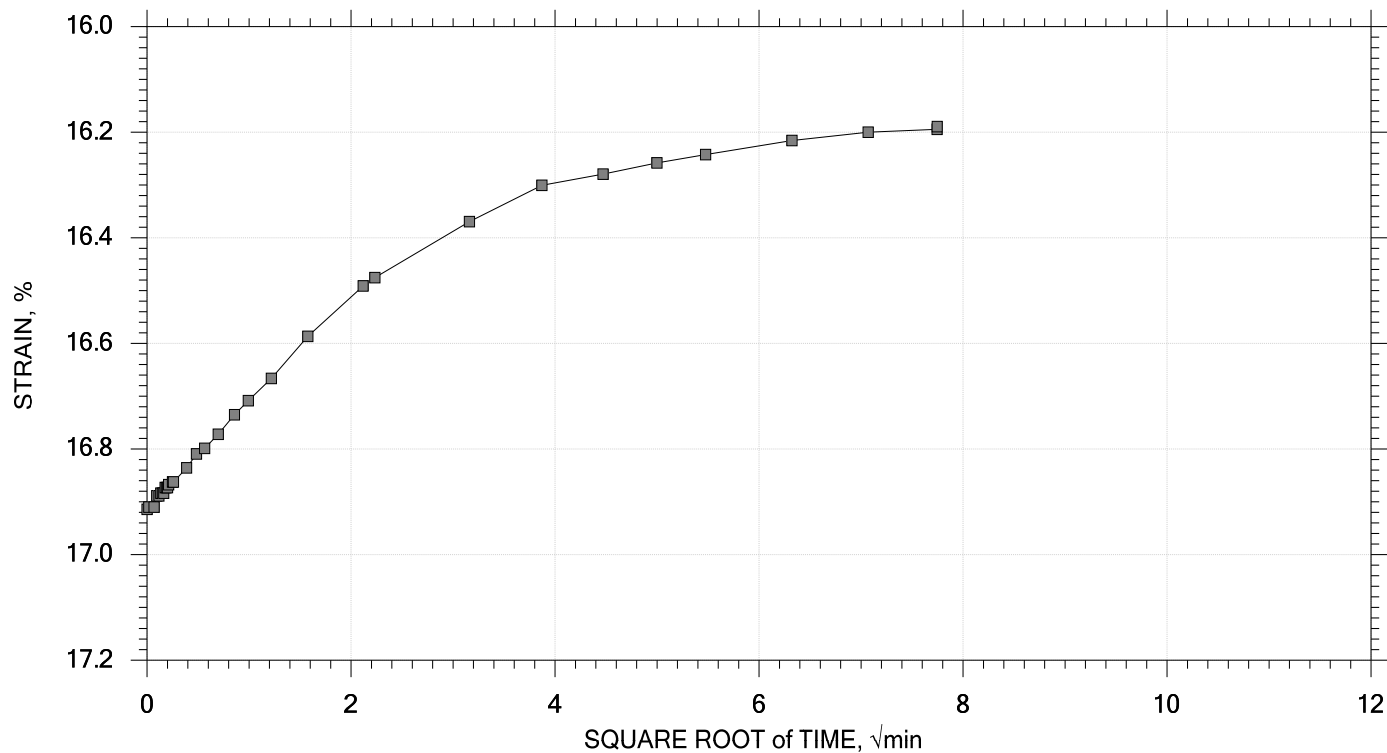
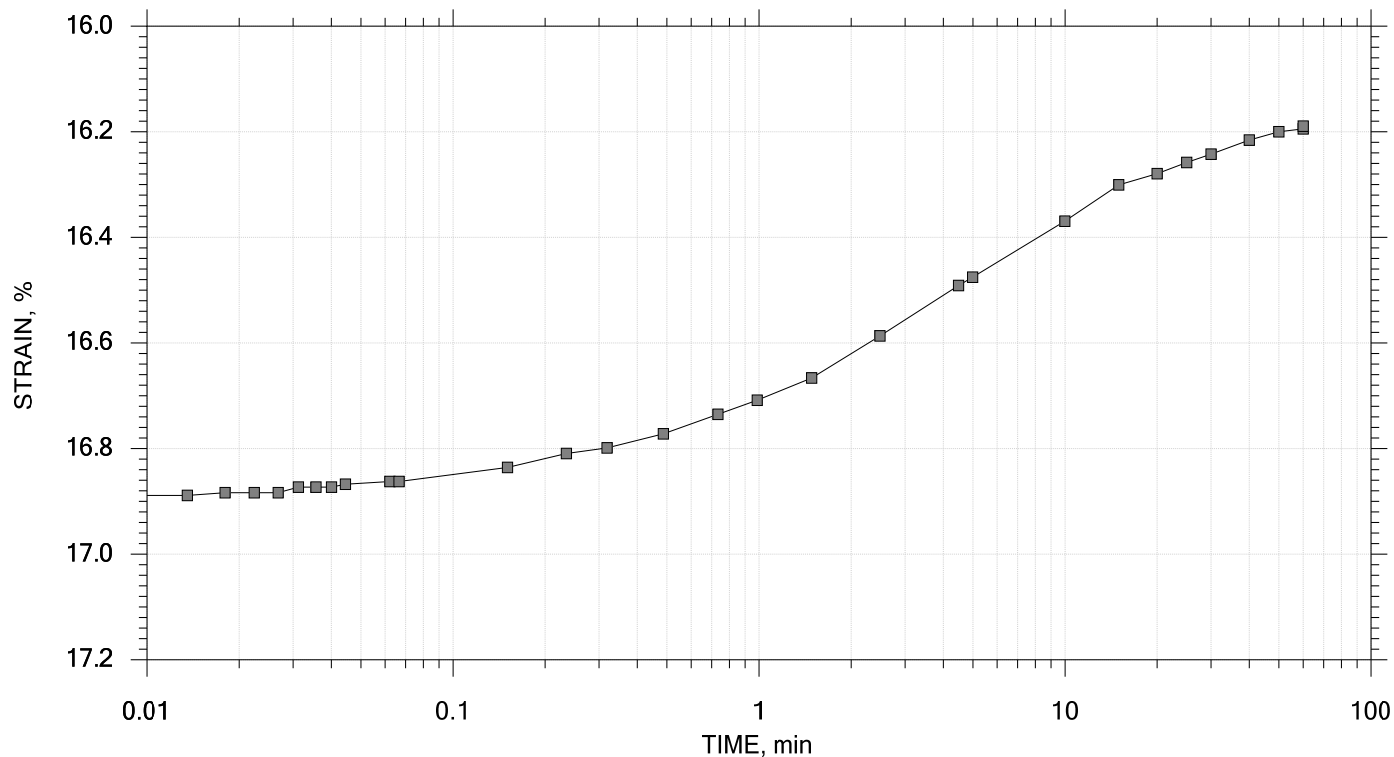
	Project: WINDHAM	Location: --	Project No.: 21924.00
	Boring No.: BB-WCWB-102	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 6/21/2016	Test No.: 242700
	Depth: 20.0-22.0 FT	Sample Type: intact	Elevation: --
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 12 of 21

Stress: 0.5 tsf



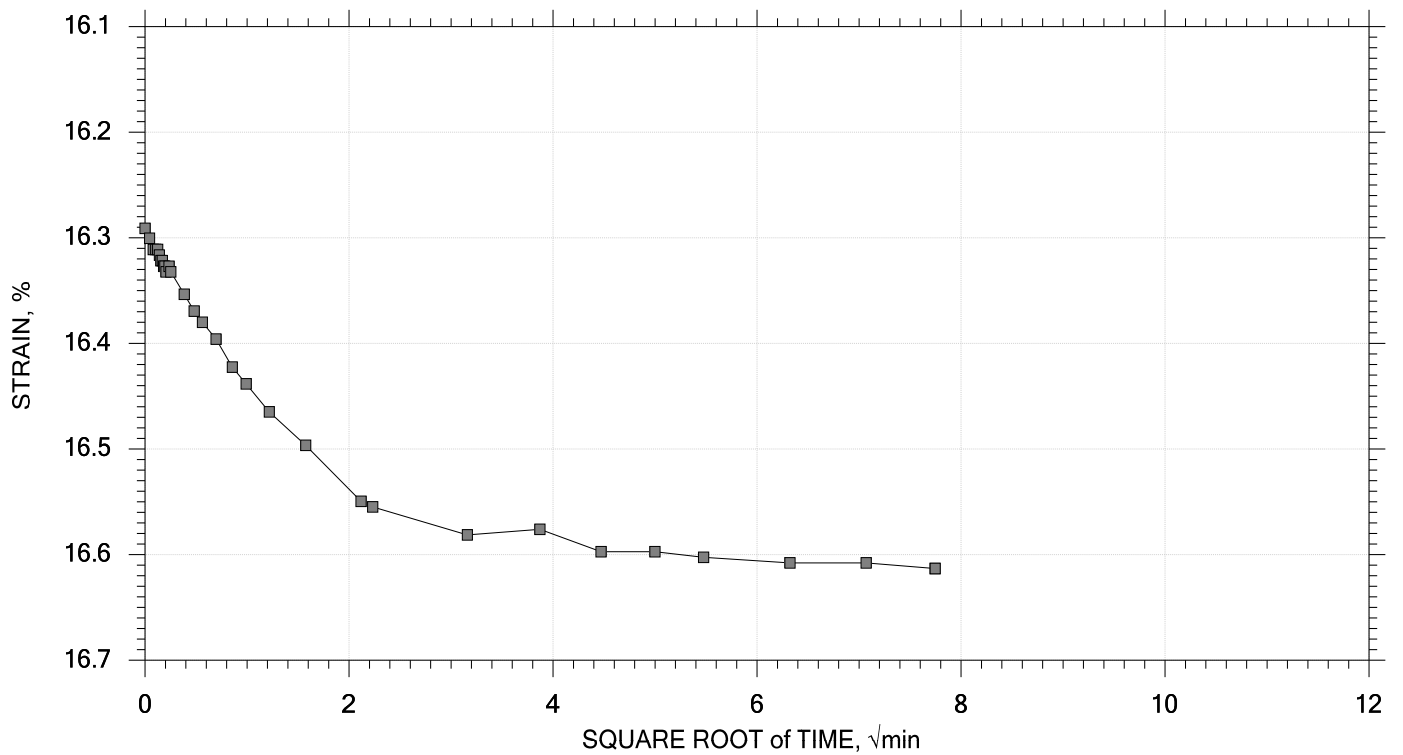
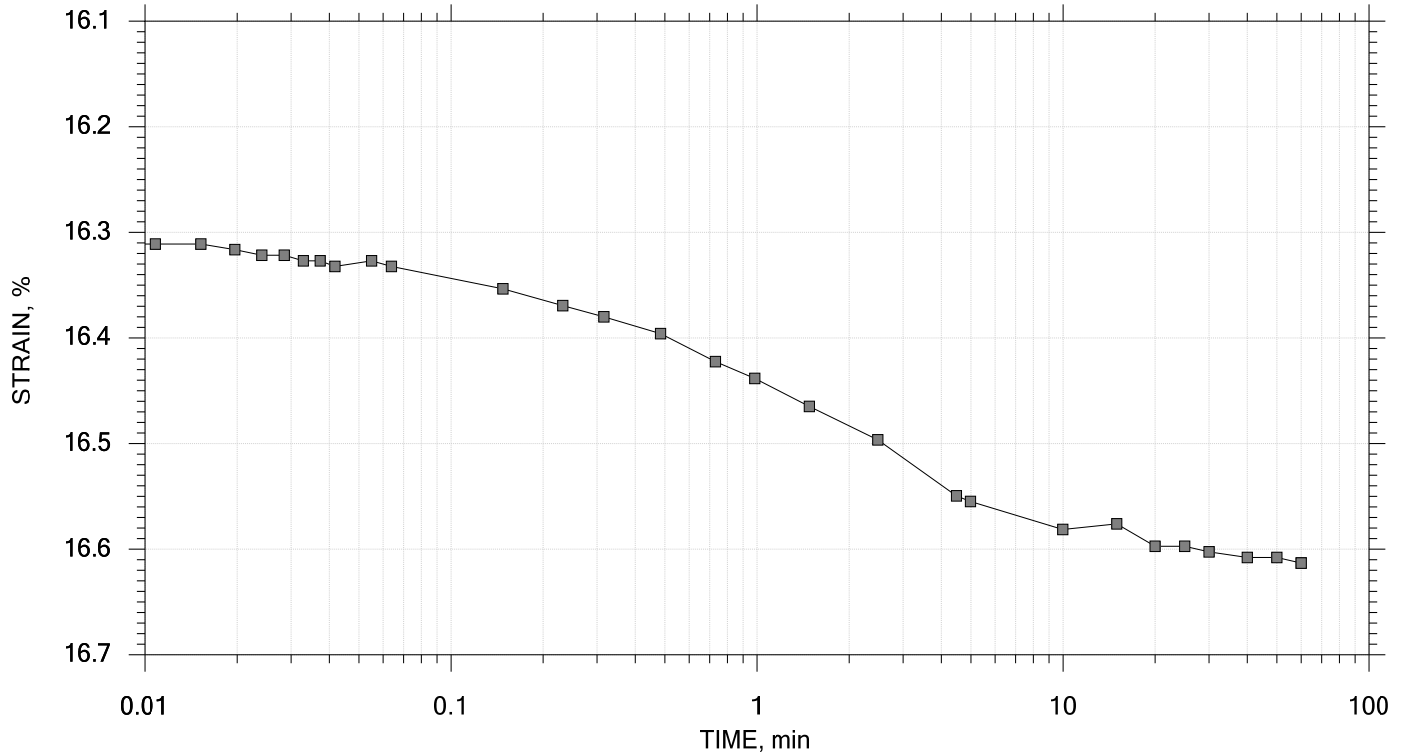
	Project: WINDHAM	Location: --	Project No.: 21924.00
	Boring No.: BB-WCWB-102	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 6/21/2016	Test No.: 242700
	Depth: 20.0-22.0 FT	Sample Type: intact	Elevation: --
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 13 of 21

Stress: 1 tsf



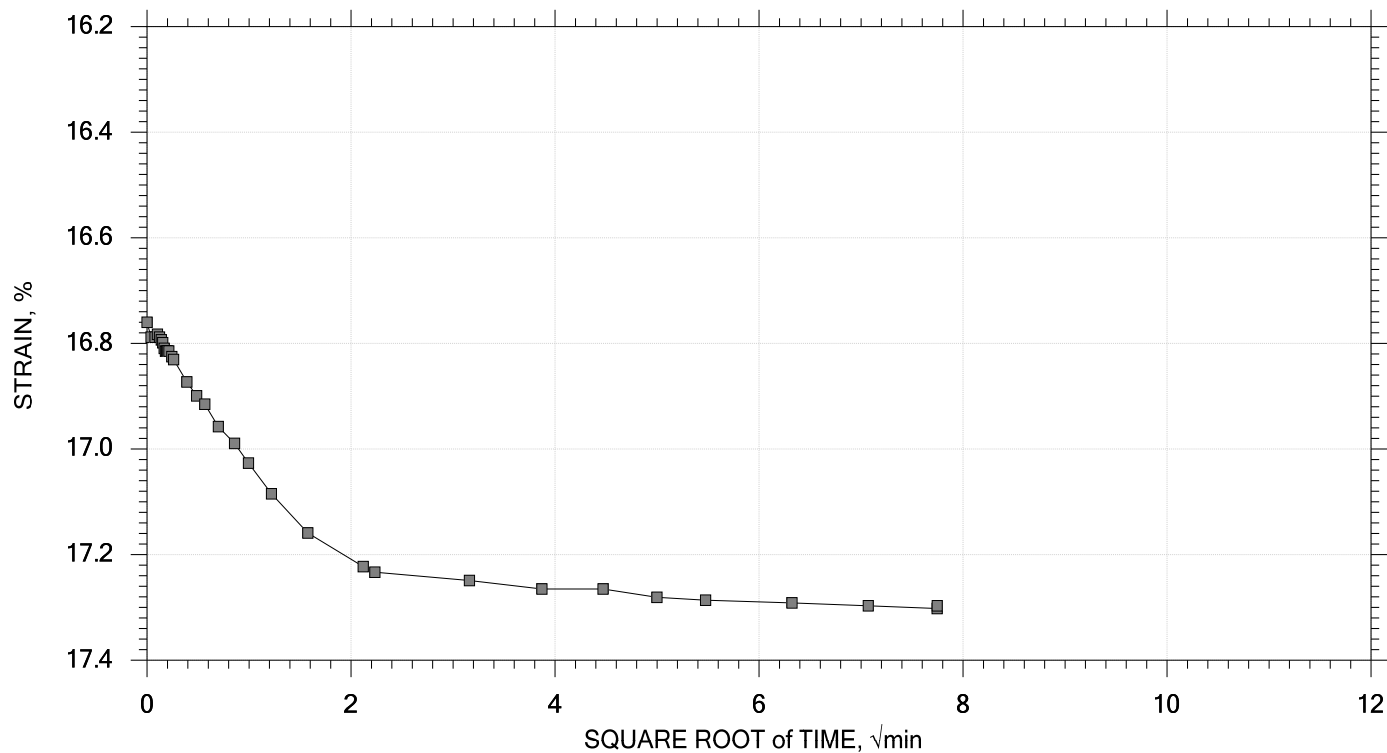
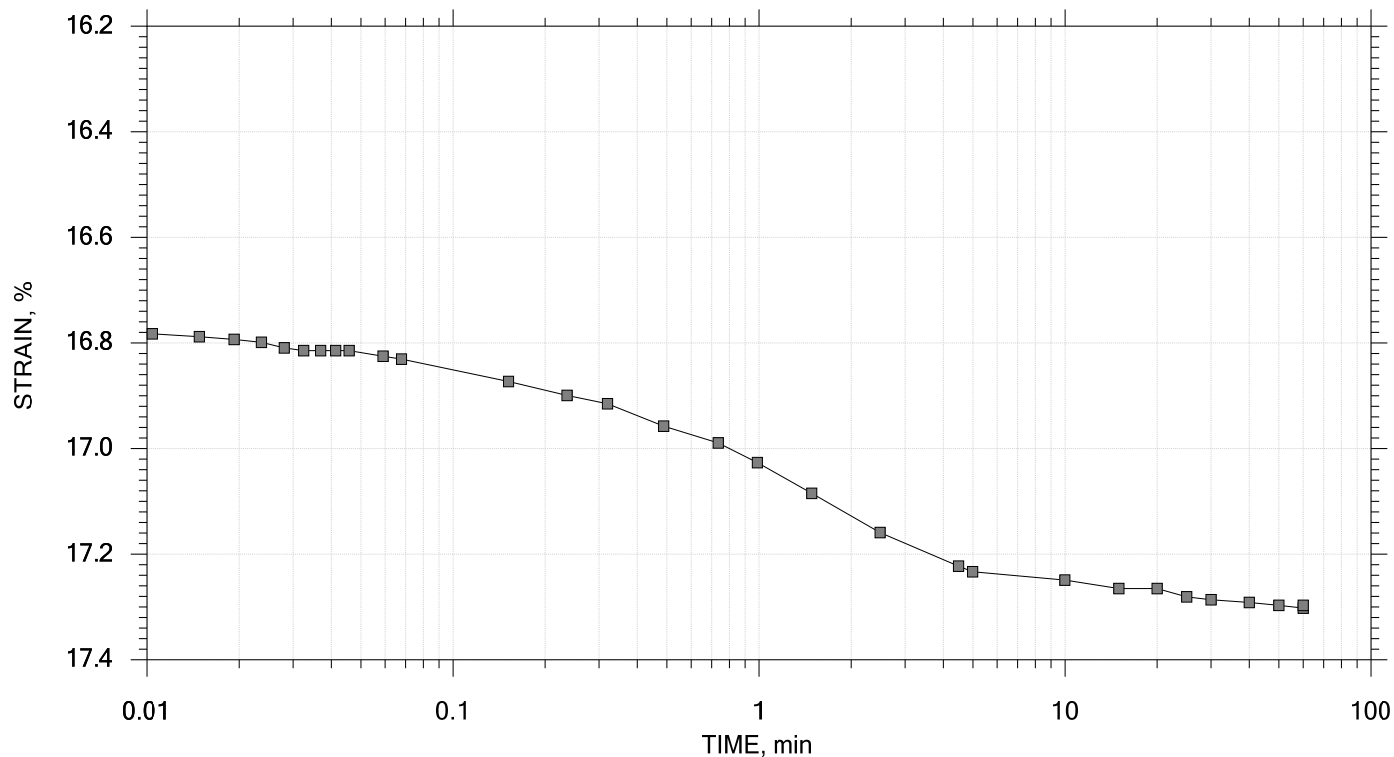
	Project: WINDHAM	Location: --	Project No.: 21924.00
	Boring No.: BB-WCWB-102	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 6/21/2016	Test No.: 242700
	Depth: 20.0-22.0 FT	Sample Type: intact	Elevation: --
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 14 of 21

Stress: 2 tsf



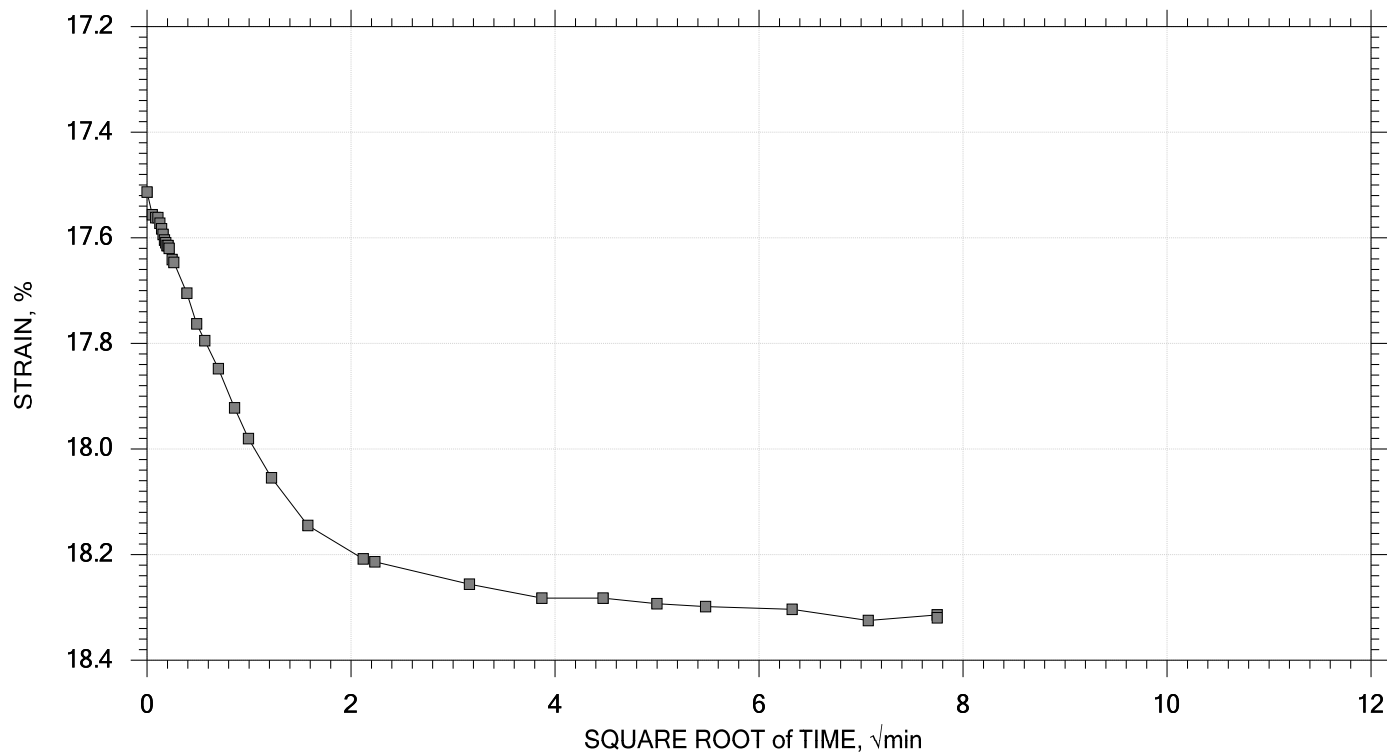
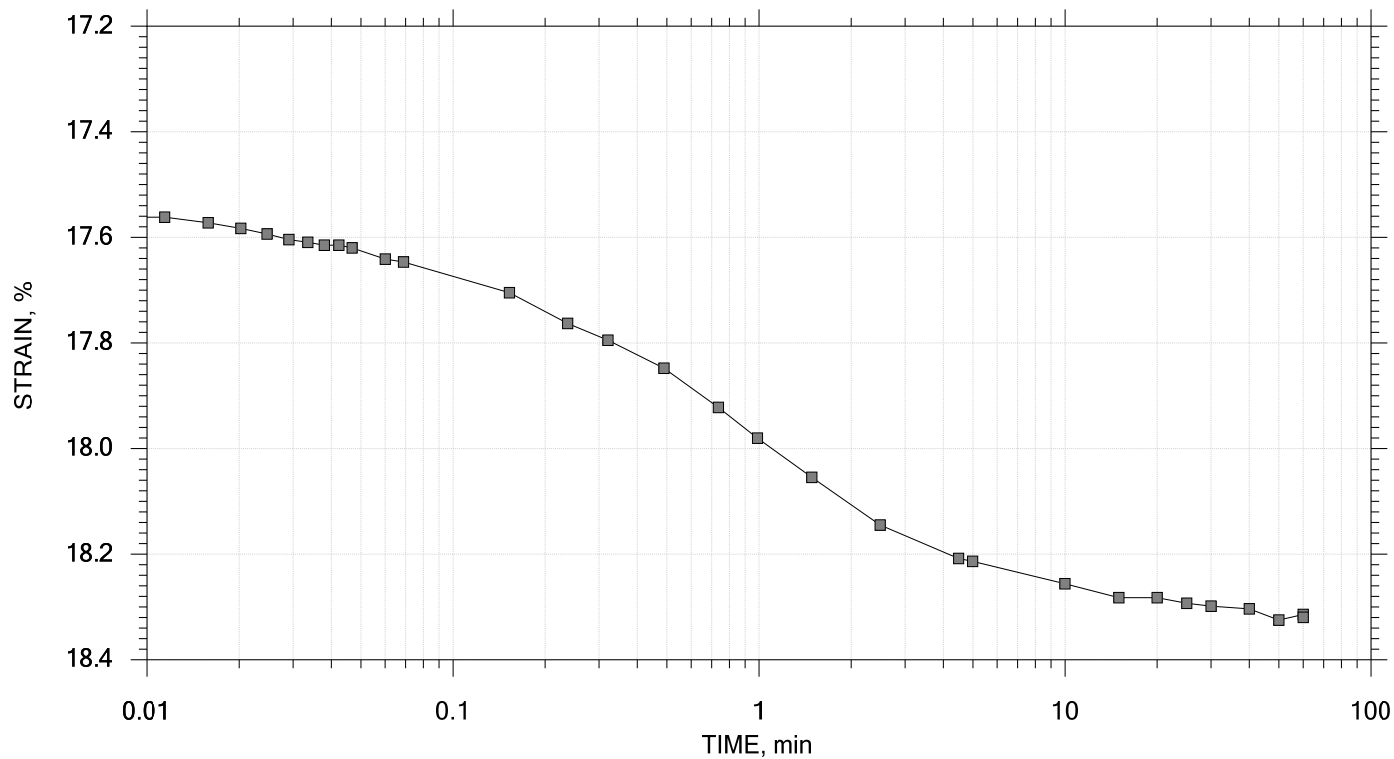
	Project: WINDHAM	Location: --	Project No.: 21924.00
	Boring No.: BB-WCWB-102	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 6/21/2016	Test No.: 242700
	Depth: 20.0-22.0 FT	Sample Type: intact	Elevation: --
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 15 of 21

Stress: 4 tsf



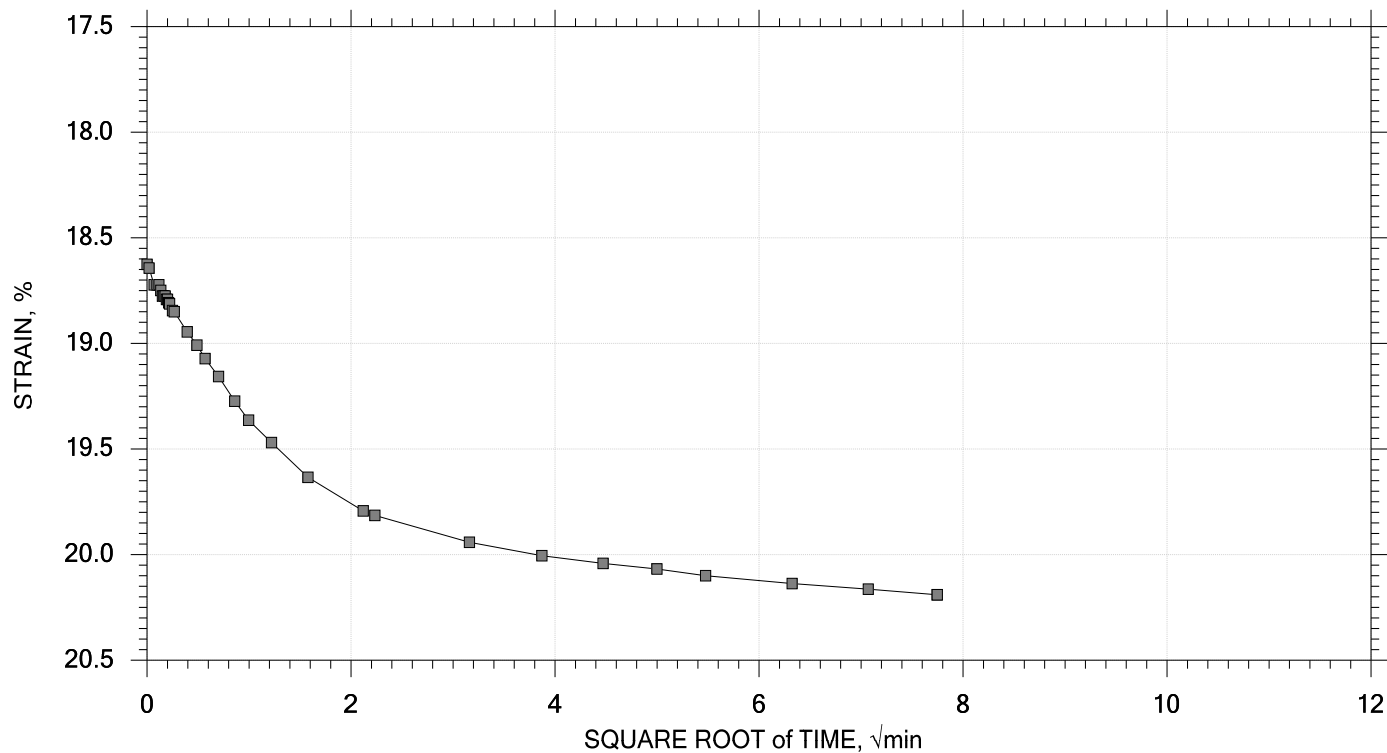
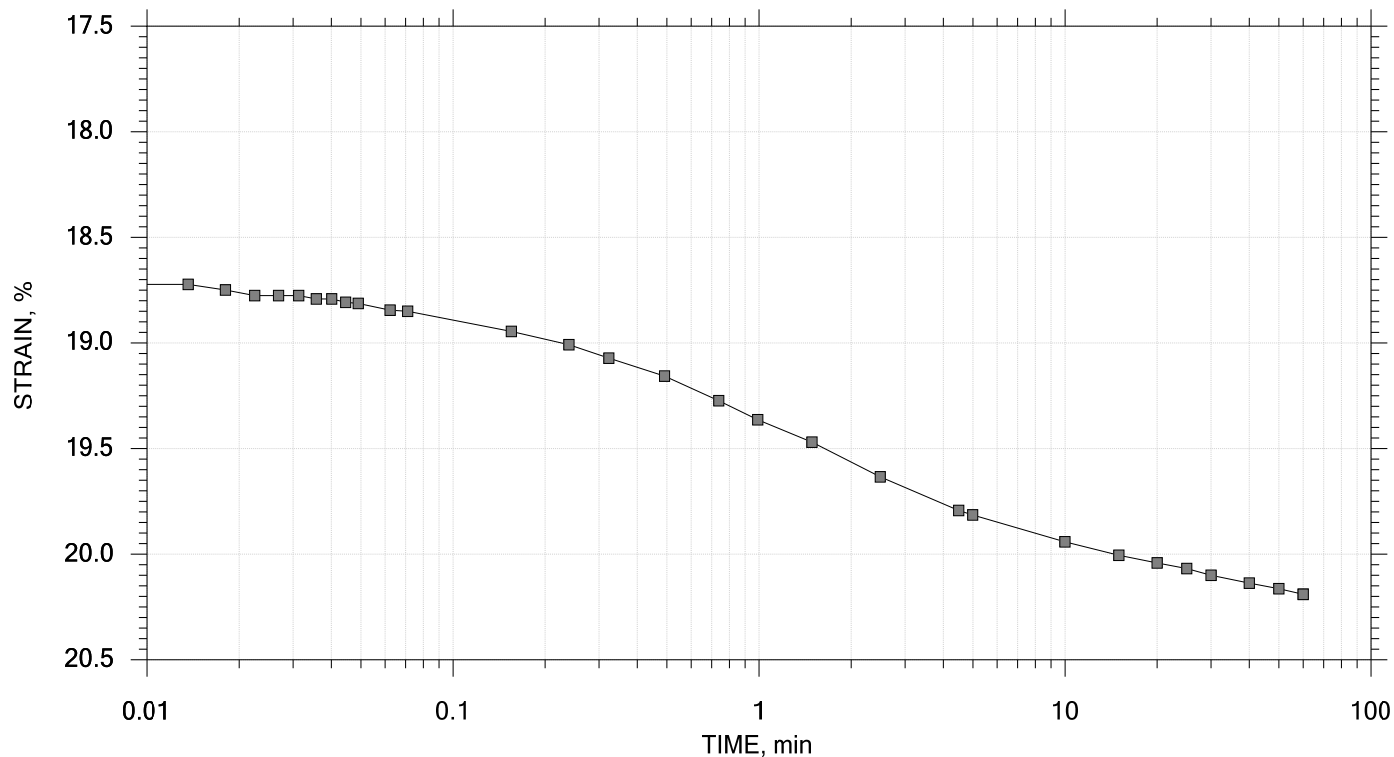
	Project: WINDHAM	Location: --	Project No.: 21924.00
	Boring No.: BB-WCWB-102	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 6/21/2016	Test No.: 242700
	Depth: 20.0-22.0 FT	Sample Type: intact	Elevation: --
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 16 of 21

Stress: 8 tsf



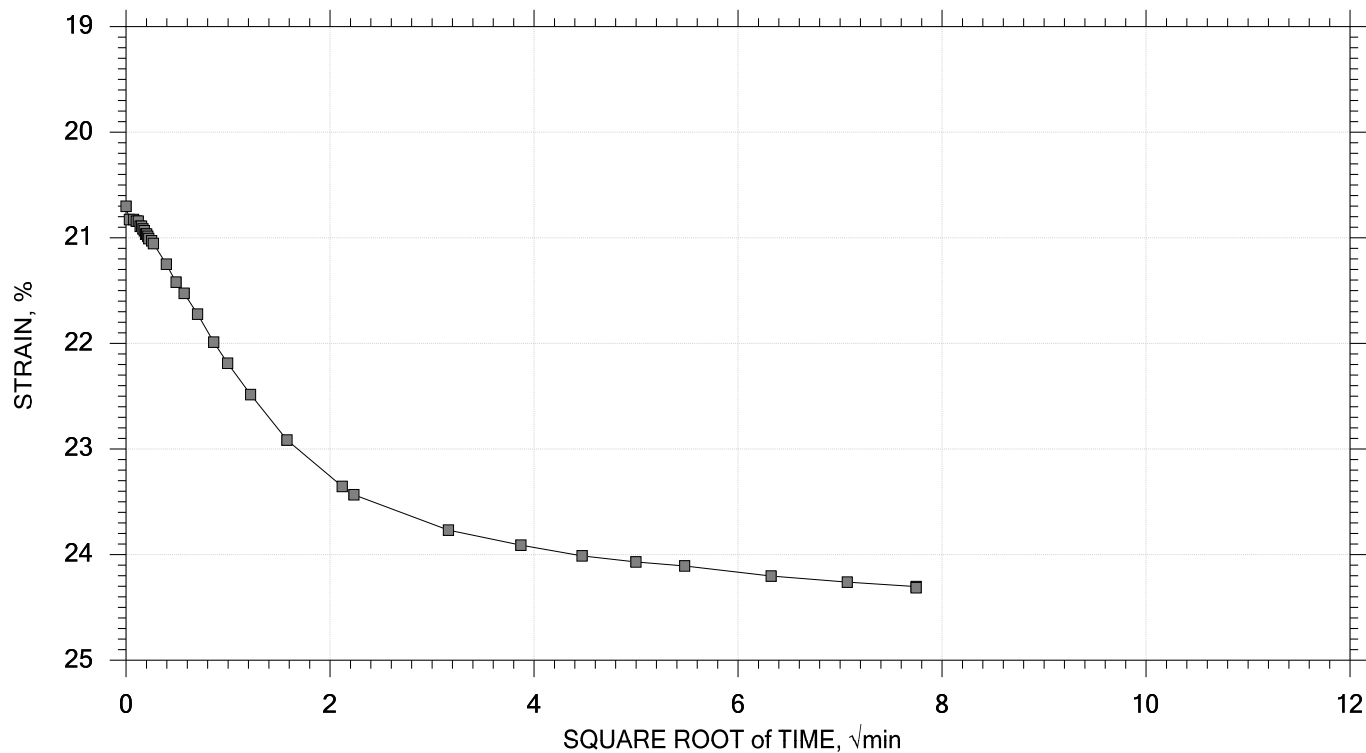
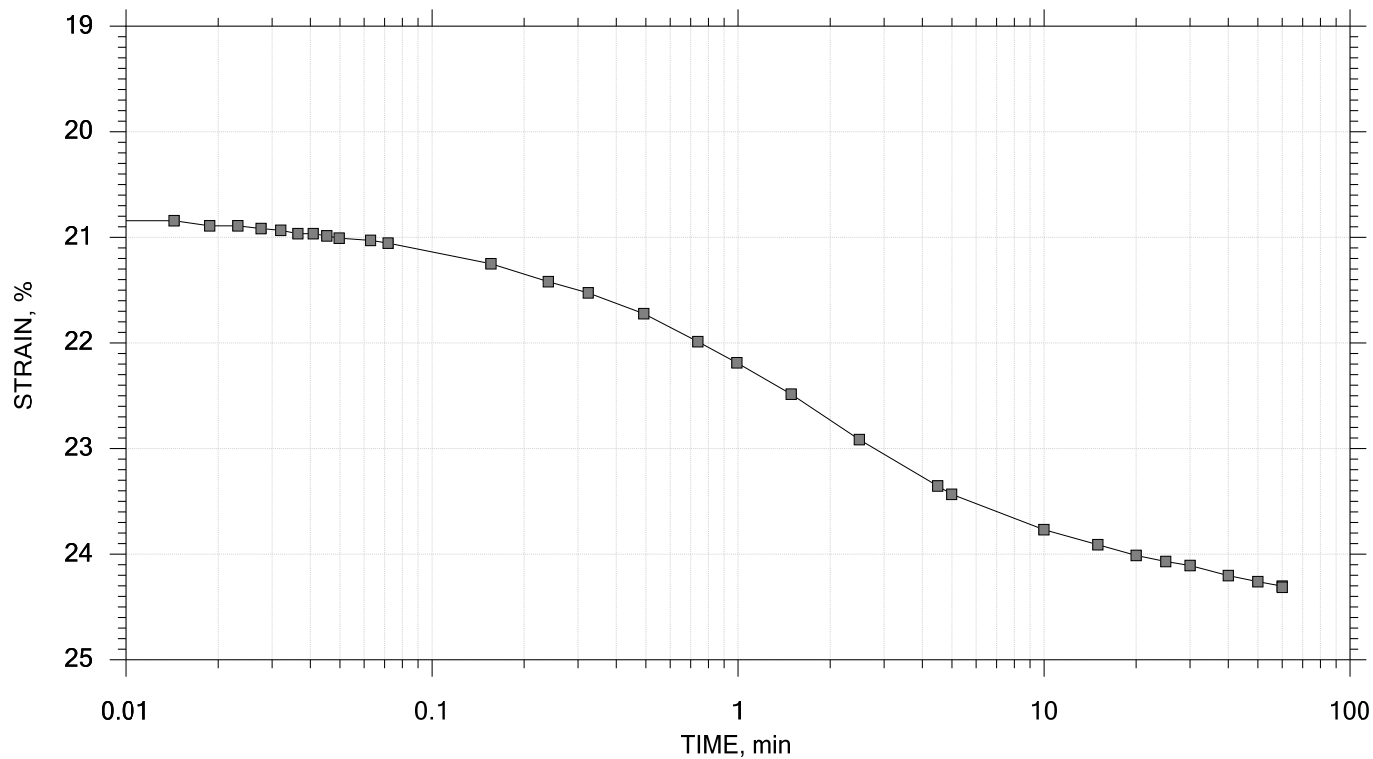
	Project: WINDHAM	Location: --	Project No.: 21924.00
	Boring No.: BB-WCWB-102	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 6/21/2016	Test No.: 242700
	Depth: 20.0-22.0 FT	Sample Type: intact	Elevation: --
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 17 of 21

Stress: 16 tsf



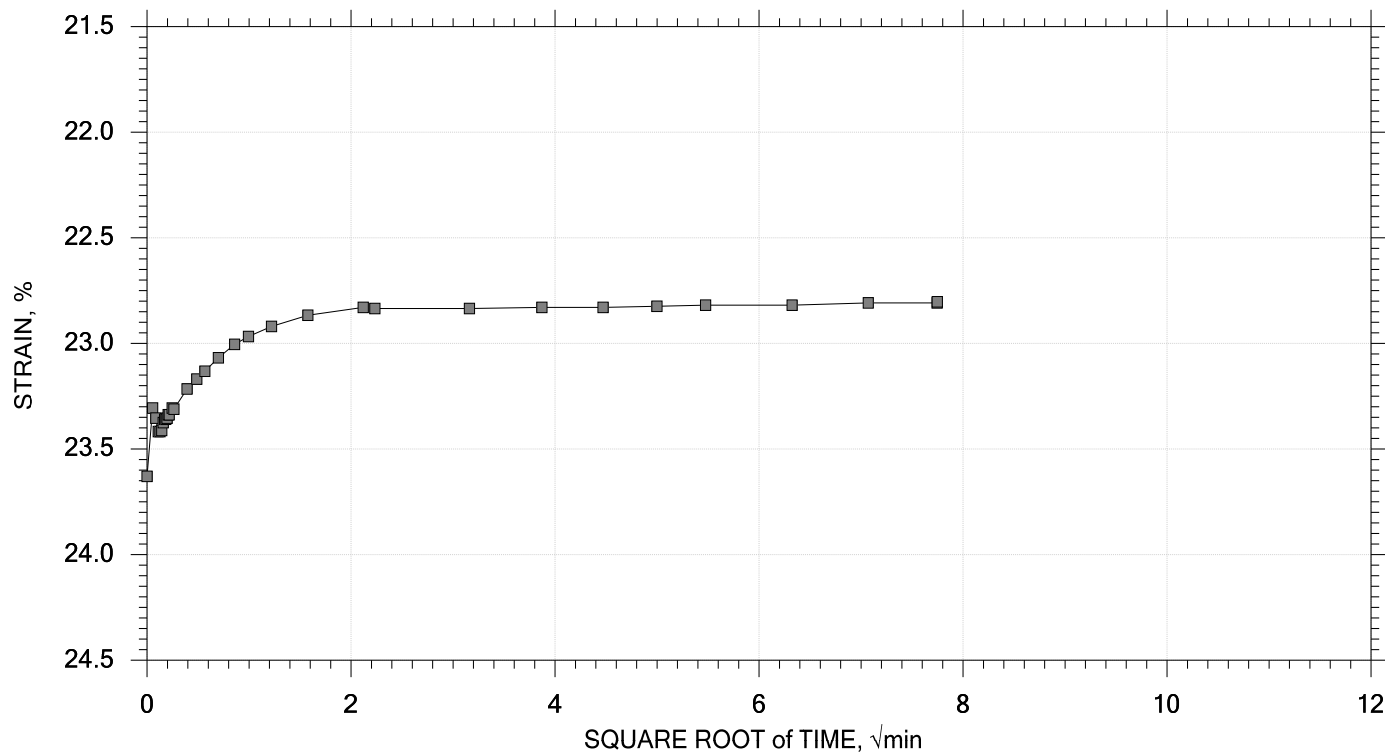
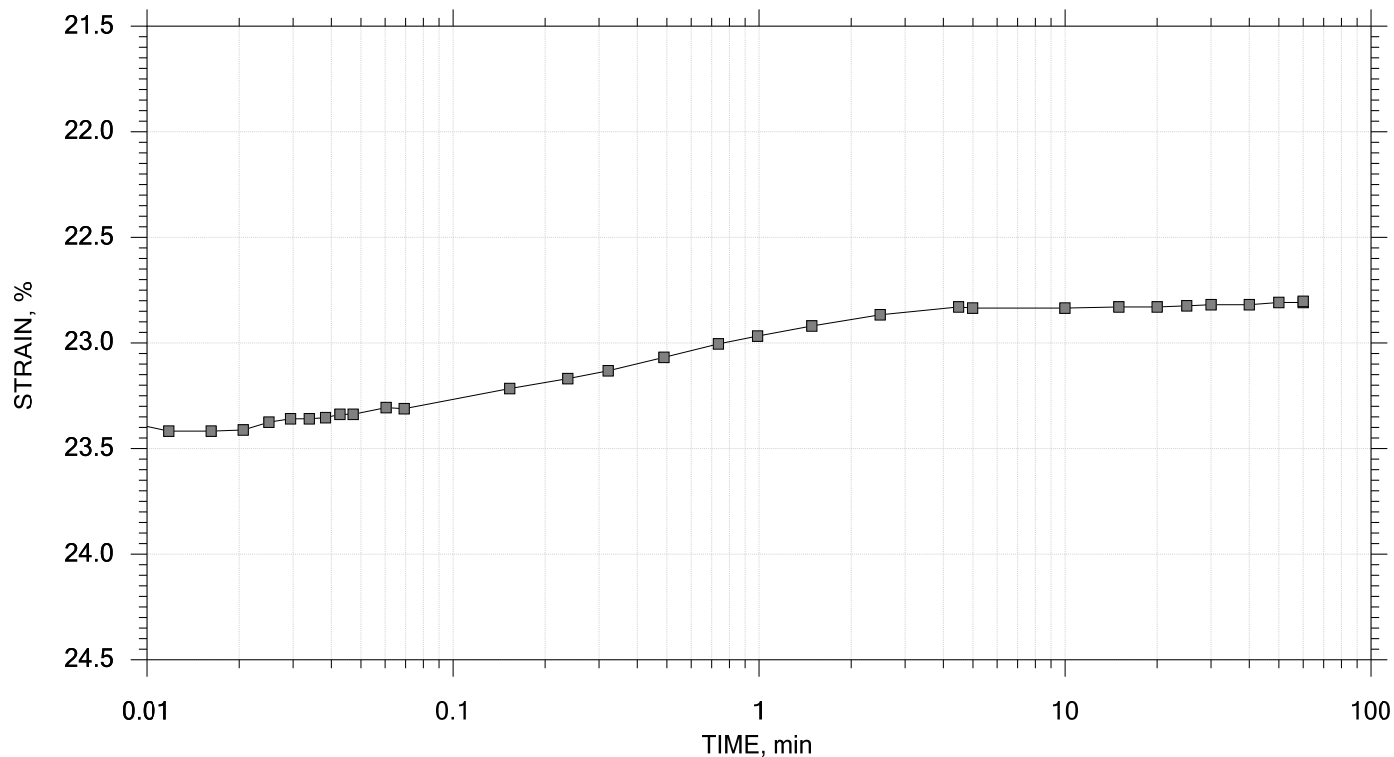
	Project: WINDHAM	Location: --	Project No.: 21924.00
	Boring No.: BB-WCWB-102	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 6/21/2016	Test No.: 242700
	Depth: 20.0-22.0 FT	Sample Type: intact	Elevation: --
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 18 of 21

Stress: 4 tsf



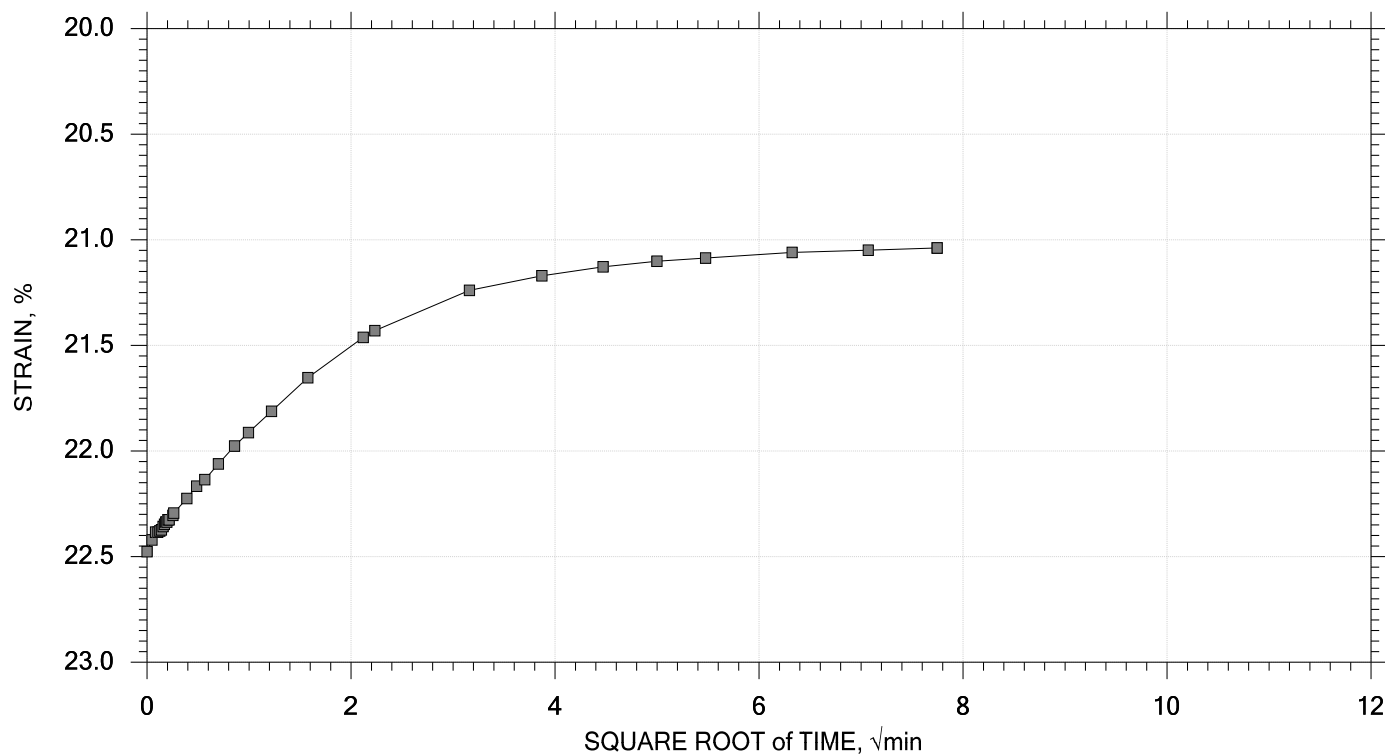
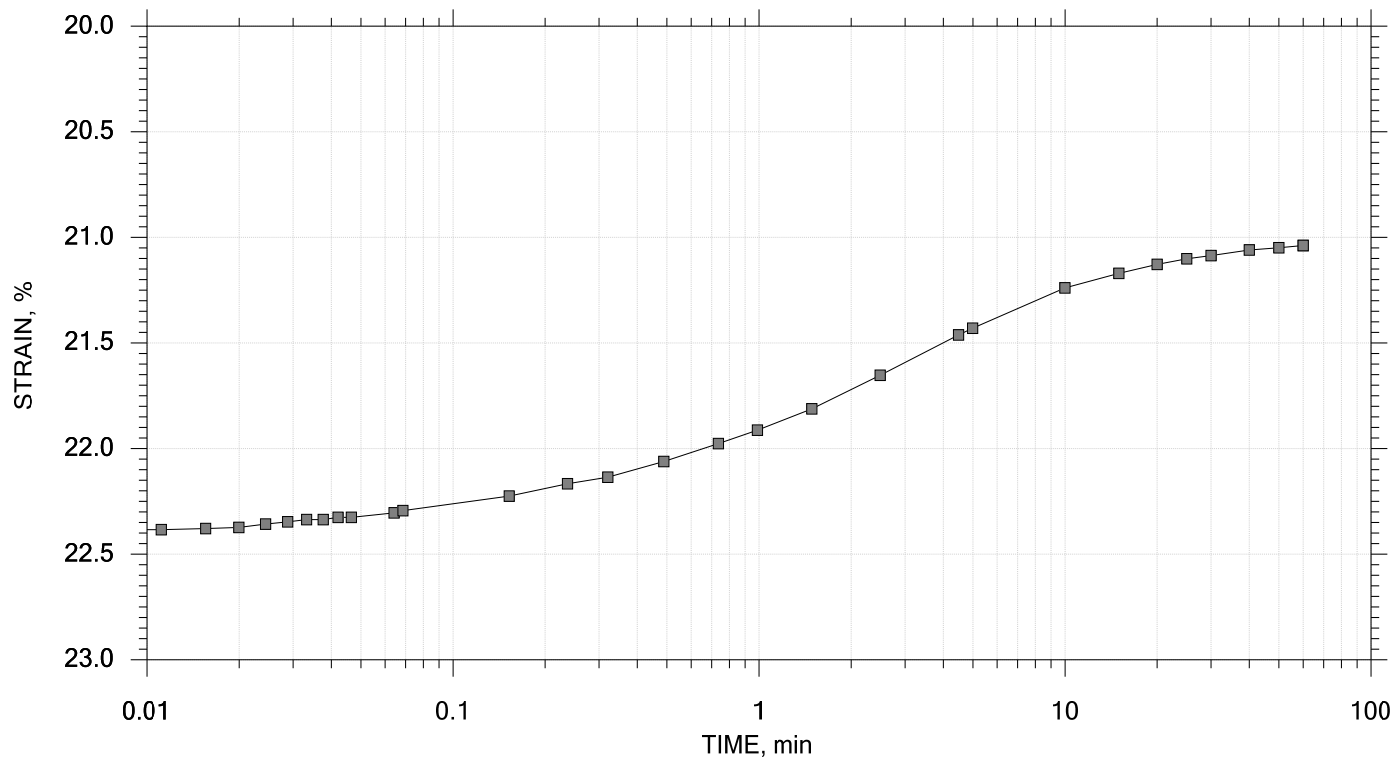
	Project: WINDHAM	Location: --	Project No.: 21924.00
	Boring No.: BB-WCWB-102	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 6/21/2016	Test No.: 242700
	Depth: 20.0-22.0 FT	Sample Type: intact	Elevation: --
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 19 of 21

Stress: 1 tsf



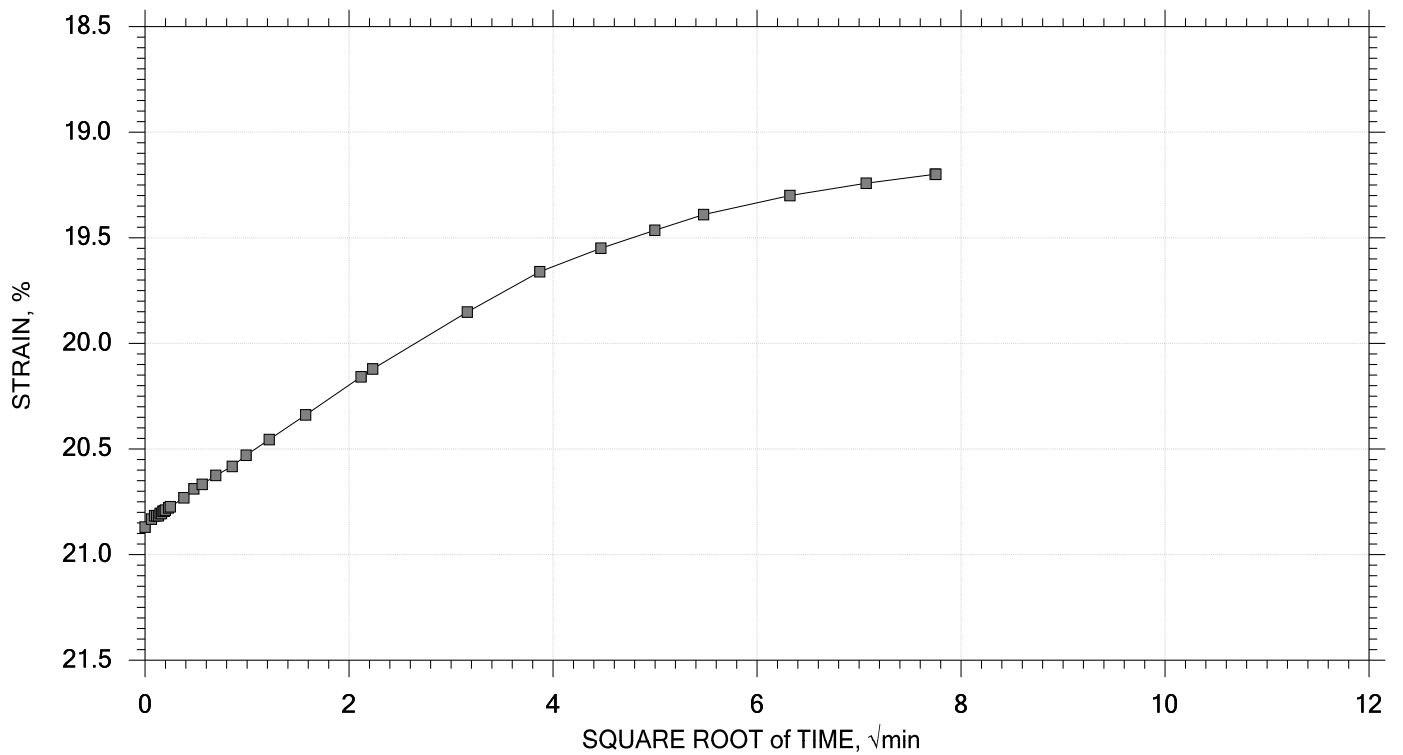
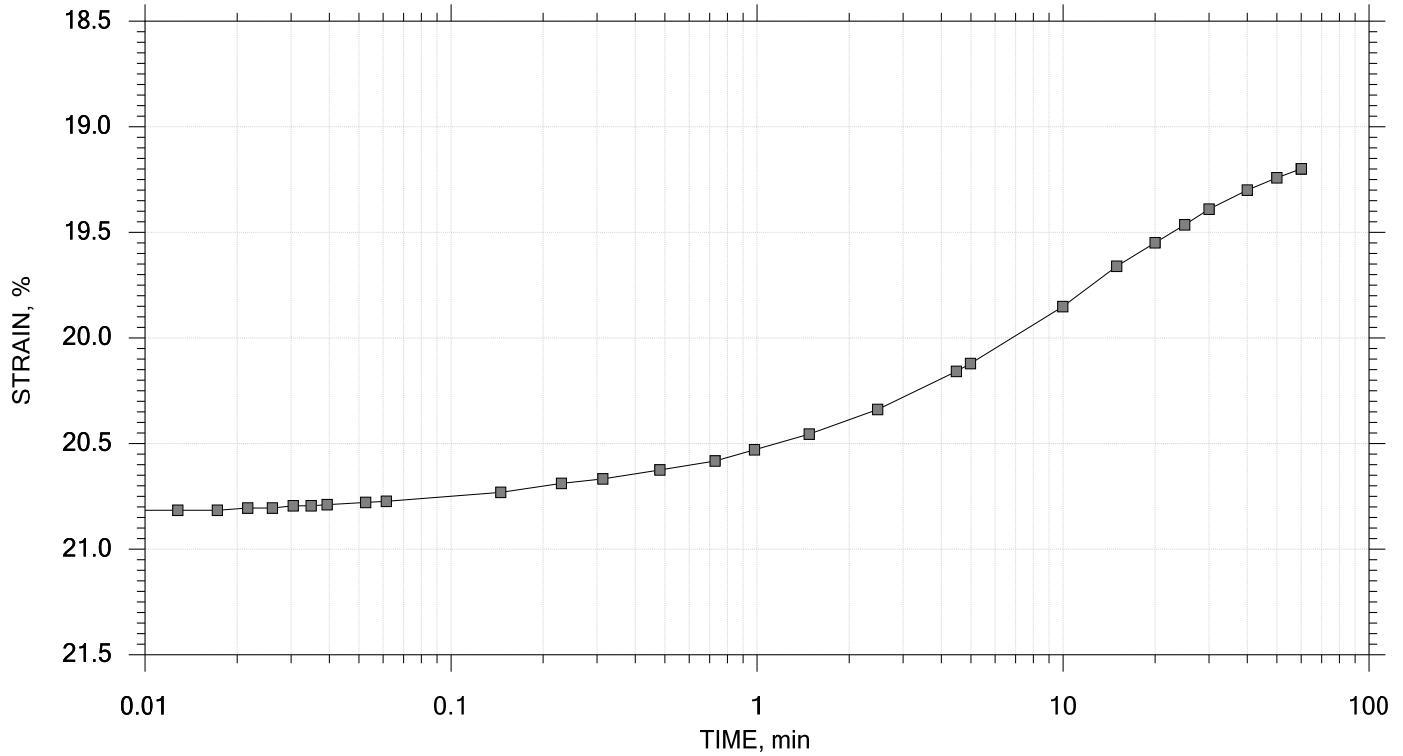
	Project: WINDHAM	Location: --	Project No.: 21924.00
	Boring No.: BB-WCWB-102	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 6/21/2016	Test No.: 242700
	Depth: 20.0-22.0 FT	Sample Type: intact	Elevation: --
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 20 of 21

Stress: 0.25 tsf



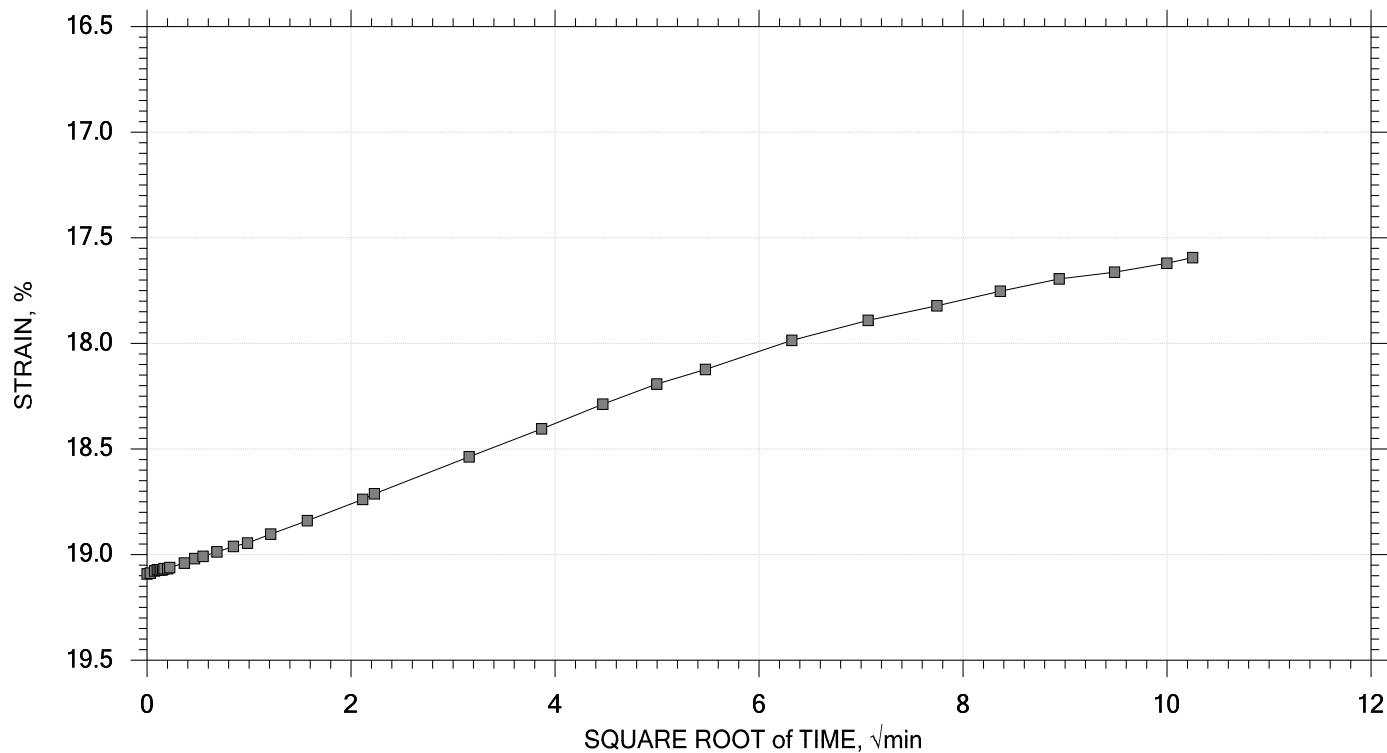
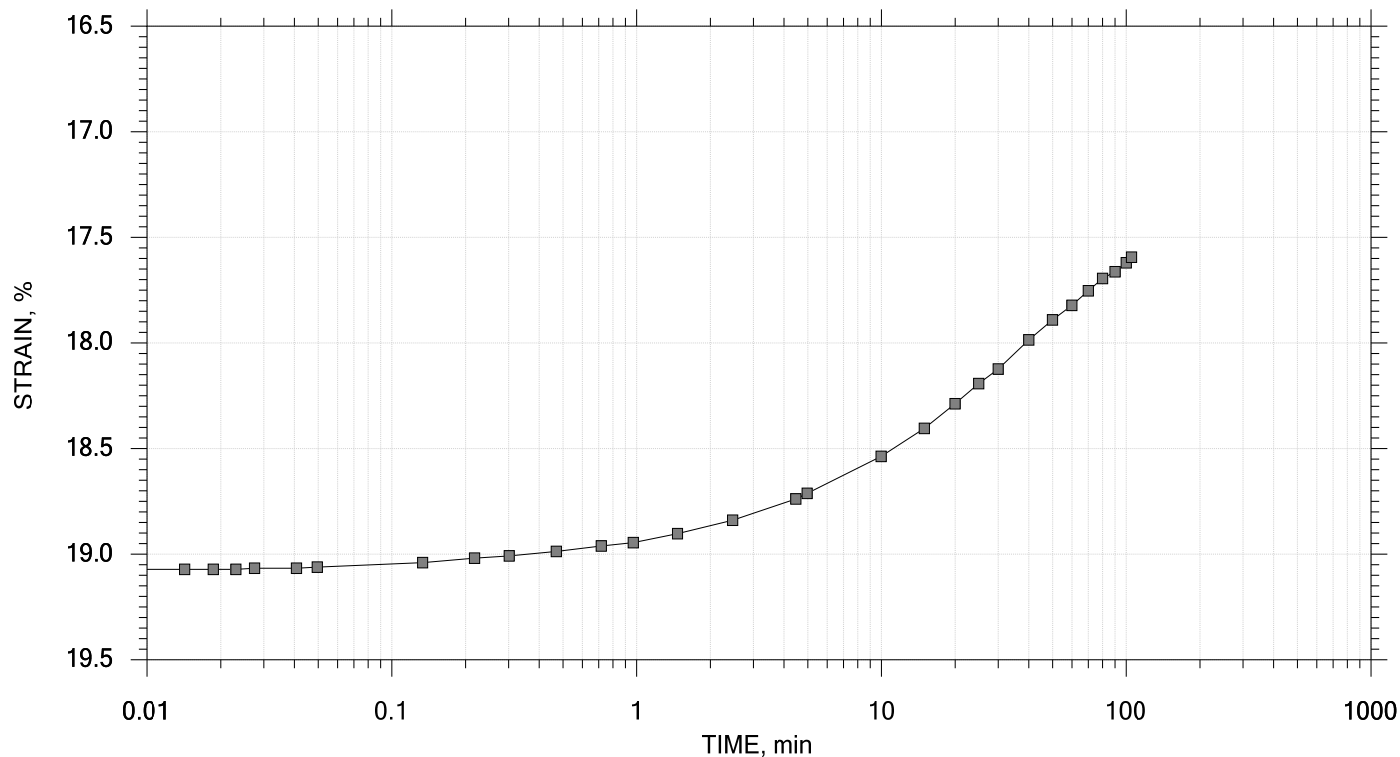
	Project: WINDHAM	Location: --	Project No.: 21924.00
	Boring No.: BB-WCWB-102	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 6/21/2016	Test No.: 242700
	Depth: 20.0-22.0 FT	Sample Type: intact	Elevation: --
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 21 of 21

Stress: 0.0625 tsf



	Project: WINDHAM	Location: --	Project No.: 21924.00
	Boring No.: BB-WCWB-102	Tested By: GSL	Checked By: --
	Sample No.: 1U	Test Date: 6/21/2016	Test No.: 242700
	Depth: 20.0-22.0 FT	Sample Type: intact	Elevation: --
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: WINDHAM
 Boring No.: BB-WCWB-102
 Sample No.: 1U
 Test No.: 242700

Location: --
 Tested By: GSL
 Test Date: 6/21/2016
 Sample Type: intact

Project No.: 21924.00
 Checked By: --
 Depth: 20.0-22.0 FT
 Elevation: --

Soil Description: GRAY CLAY

Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Measured Specific Gravity: 2.69
 Initial Void Ratio: 1.10
 Final Void Ratio: 0.730

Liquid Limit: ---
 Plastic Limit: ---
 Plasticity Index: ---

Specimen Diameter: 2.50 in
 Initial Height: 1.02 in
 Final Height: 0.84 in

Container ID	Before Consolidation		After Consolidation	
	Trimmings	Specimen+Ring	Specimen+Ring	Trimmings
	229	RING	RING	9
Wt. Container + Wet Soil, gm	181.05	406.81	395.29	180.83
Wt. Container + Dry Soil, gm	149.51	366.86	366.86	152.36
Wt. Container, gm	65.570	262.16	262.16	47.490
Wt. Dry Soil, gm	83.940	104.70	104.70	104.87
Water Content, %	37.57	38.15	27.15	27.15
Void Ratio	---	1.10	0.730	---
Degree of Saturation, %	---	93.32	100.00	---
Dry Unit Weight, pcf	---	79.980	97.055	---

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: WINDHAM
 Boring No.: BB-WCWB-102
 Sample No.: 1U
 Test No.: 242700

Location: --
 Tested By: GSL
 Test Date: 6/21/2016
 Sample Type: intact

Project No.: 21924.00
 Checked By: --
 Depth: 20.0-22.0 FT
 Elevation: --

Soil Description: GRAY CLAY

Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

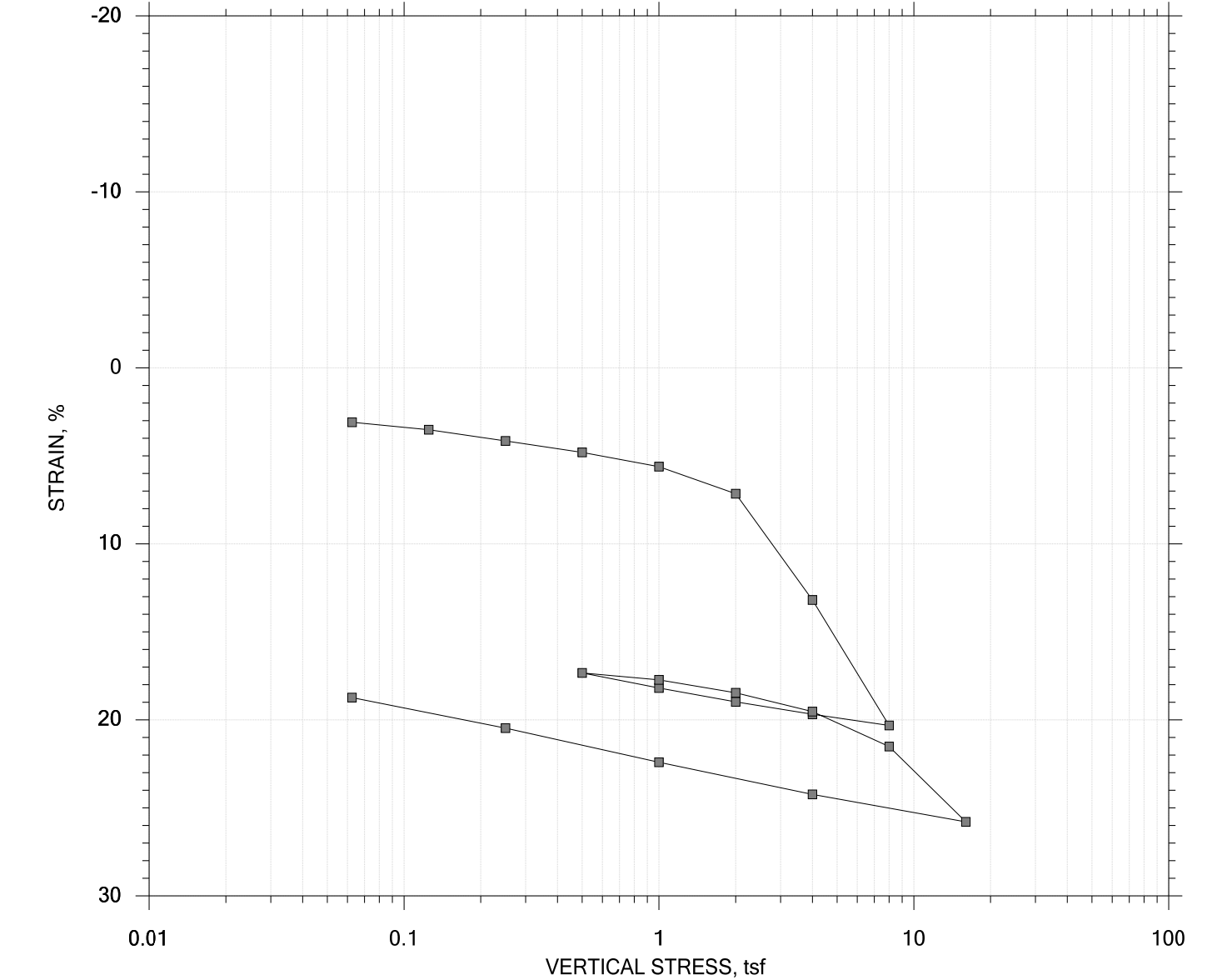
Displacement at End of Increment

	Applied Stress tsf	Final Displacement in	Void Ratio	Strain at End %	Sq.Rt T90 min	Cv ft ² /sec	Mv 1/tsf	k ft/day
1	0.0686	0.01217	1.07	1.20	2.465	1.02e-005	1.75e-001	4.78e-003
2	0.125	0.01604	1.07	1.58	3.797	6.49e-006	6.76e-002	1.18e-003
3	0.250	0.02342	1.05	2.31	0.000	0.00e+000	5.81e-002	0.00e+000
4	0.500	0.03370	1.03	3.32	5.180	4.62e-006	4.05e-002	5.04e-004
5	1.00	0.04797	1.00	4.72	5.133	4.55e-006	2.81e-002	3.44e-004
6	2.00	0.07726	0.940	7.60	8.976	2.48e-006	2.88e-002	1.93e-004
7	4.00	0.1360	0.819	13.4	16.358	1.24e-006	2.89e-002	9.67e-005
8	8.00	0.1941	0.698	19.1	12.929	1.37e-006	1.43e-002	5.30e-005
9	4.00	0.1880	0.711	18.5	0.514	3.25e-005	1.51e-003	1.32e-004
10	2.00	0.1810	0.726	17.8	2.465	6.88e-006	3.47e-003	6.44e-005
11	1.00	0.1730	0.742	17.0	6.959	2.48e-006	7.84e-003	5.25e-005
12	0.500	0.1645	0.760	16.2	9.209	1.91e-006	1.67e-002	8.64e-005
13	1.00	0.1688	0.751	16.6	4.518	3.92e-006	8.48e-003	8.96e-005
14	2.00	0.1757	0.736	17.3	5.789	3.02e-006	6.84e-003	5.56e-005
15	4.00	0.1861	0.715	18.3	2.762	6.20e-006	5.11e-003	8.54e-005
16	8.00	0.2051	0.676	20.2	4.226	3.91e-006	4.68e-003	4.93e-005
17	16.0	0.2470	0.589	24.3	6.441	2.38e-006	5.15e-003	3.30e-005
18	4.00	0.2317	0.621	22.8	3.094	4.78e-006	1.26e-003	1.62e-005
19	1.00	0.2137	0.658	21.0	5.366	2.88e-006	5.88e-003	4.57e-005
20	0.250	0.1951	0.697	19.2	28.811	5.61e-007	2.45e-002	3.71e-005
21	0.0625	0.1787	0.730	17.6	85.195	1.98e-007	8.56e-002	4.57e-005

	Applied Stress tsf	Final Displacement in	Void Ratio	Strain at End %	Log T50 min	Cv ft ² /sec	Mv 1/tsf	k ft/day	Ca %
1	0.0686	0.01217	1.07	1.20	0.000	0.00e+000	1.75e-001	0.00e+000	0.00e+000
2	0.125	0.01604	1.07	1.58	0.000	0.00e+000	6.76e-002	0.00e+000	0.00e+000
3	0.250	0.02342	1.05	2.31	0.000	0.00e+000	5.81e-002	0.00e+000	0.00e+000
4	0.500	0.03370	1.03	3.32	0.000	0.00e+000	4.05e-002	0.00e+000	0.00e+000
5	1.00	0.04797	1.00	4.72	0.000	0.00e+000	2.81e-002	0.00e+000	0.00e+000
6	2.00	0.07726	0.940	7.60	1.832	2.83e-006	2.88e-002	2.20e-004	0.00e+000
7	4.00	0.1360	0.819	13.4	4.290	1.10e-006	2.89e-002	8.57e-005	0.00e+000
8	8.00	0.1941	0.698	19.1	2.146	1.92e-006	1.43e-002	7.42e-005	0.00e+000
9	4.00	0.1880	0.711	18.5	0.000	0.00e+000	1.51e-003	0.00e+000	0.00e+000
10	2.00	0.1810	0.726	17.8	0.477	8.26e-006	3.47e-003	7.73e-005	0.00e+000
11	1.00	0.1730	0.742	17.0	1.205	3.33e-006	7.84e-003	7.05e-005	0.00e+000
12	0.500	0.1645	0.760	16.2	2.286	1.79e-006	1.67e-002	8.08e-005	0.00e+000
13	1.00	0.1688	0.751	16.6	1.018	4.04e-006	8.48e-003	9.23e-005	0.00e+000
14	2.00	0.1757	0.736	17.3	1.189	3.41e-006	6.84e-003	6.29e-005	0.00e+000
15	4.00	0.1861	0.715	18.3	0.520	7.64e-006	5.11e-003	1.05e-004	0.00e+000
16	8.00	0.2051	0.676	20.2	0.950	4.04e-006	4.68e-003	5.09e-005	0.00e+000
17	16.0	0.2470	0.589	24.3	1.184	3.00e-006	5.15e-003	4.17e-005	0.00e+000
18	4.00	0.2317	0.621	22.8	0.421	8.17e-006	1.26e-003	2.77e-005	0.00e+000
19	1.00	0.2137	0.658	21.0	1.900	1.89e-006	5.88e-003	3.00e-005	0.00e+000
20	0.250	0.1951	0.697	19.2	0.000	0.00e+000	2.45e-002	0.00e+000	0.00e+000
21	0.0625	0.1787	0.730	17.6	0.000	0.00e+000	8.56e-002	0.00e+000	0.00e+000

One-Dimensional Consolidation by ASTM D2435 - Method B

SUMMARY REPORT

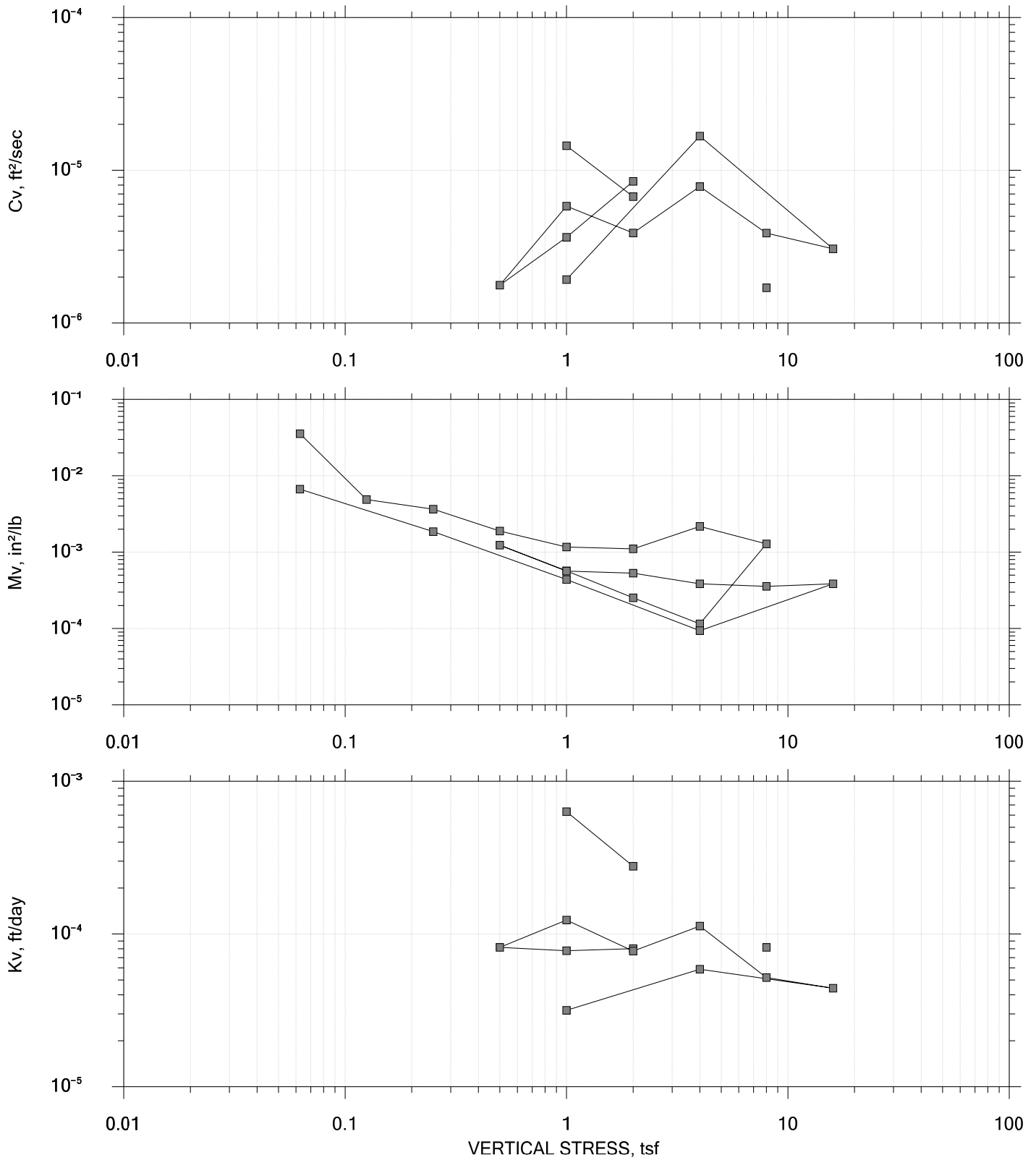


				Before Test	After Test
Current Vertical Effective Stress: --- ±1.15 tsf				Water Content, %	39.6128.64
Preconsolidation Stress: --- 2.05 tsf				Dry Unit Weight, pcf	77.72995.64
Compression Ratio: --- 0.52				Saturation, %	90.6799.99
Diameter: 2.5 in		Height: 1.043 in		Void Ratio	1.190.78
LL: --- 35	PL: --- 21	PI: --- 14	GS: 2.73		

	Project: WINDHAM		Location: -- Sta. 910+84.4; 7.6 LT	Project No.: 21924.00
	Boring No.: BB-WCWB-102		Tested By: GSL	Checked By: --
	Sample No.: 2U		Test Date: 6/25/16	Test No.: 270885
	Depth: 30.0-32.0 FT		Sample Type: INTACT	Elevation: -- 54.2 ft
	Description: GRAY CLAY			
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test			
	Displacement at End of Increment			

One-Dimensional Consolidation by ASTM D2435 - Method B

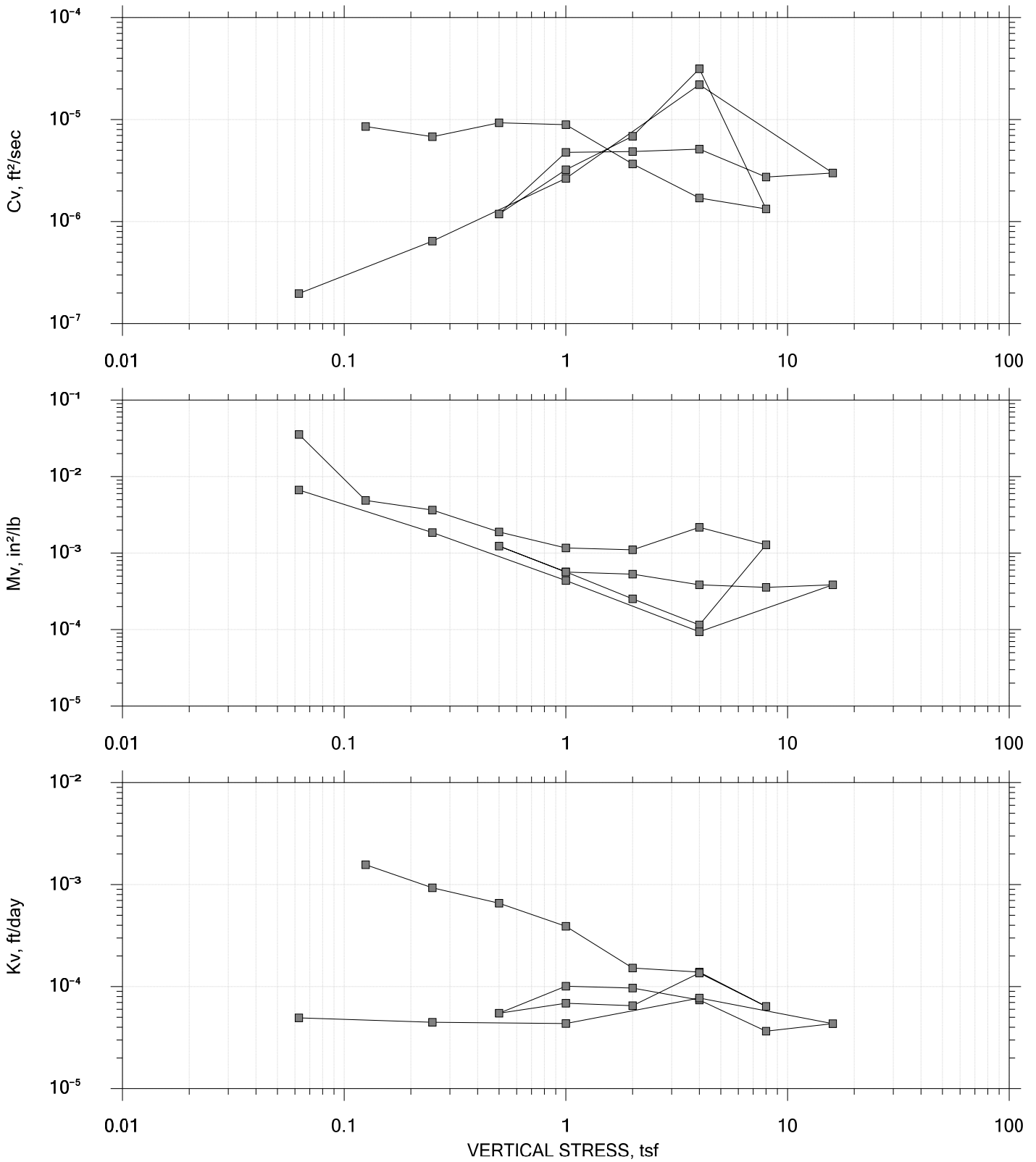
LOG of TIME COEFFICIENTS



	Project: WINDHAM	Location: -- Sta. 910+84.4; 7.6 LT	Project No.: 21924.00
	Boring No.: BB-WCWB-102	Tested By: GSL	Checked By: --
	Sample No.: 2U	Test Date: 6/25/16	Test No.: 270885
	Depth: 30.0-32.0 FT	Sample Type: INTACT	Elevation: -- 54.2 ft
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

SQUARE ROOT of TIME COEFFICIENTS



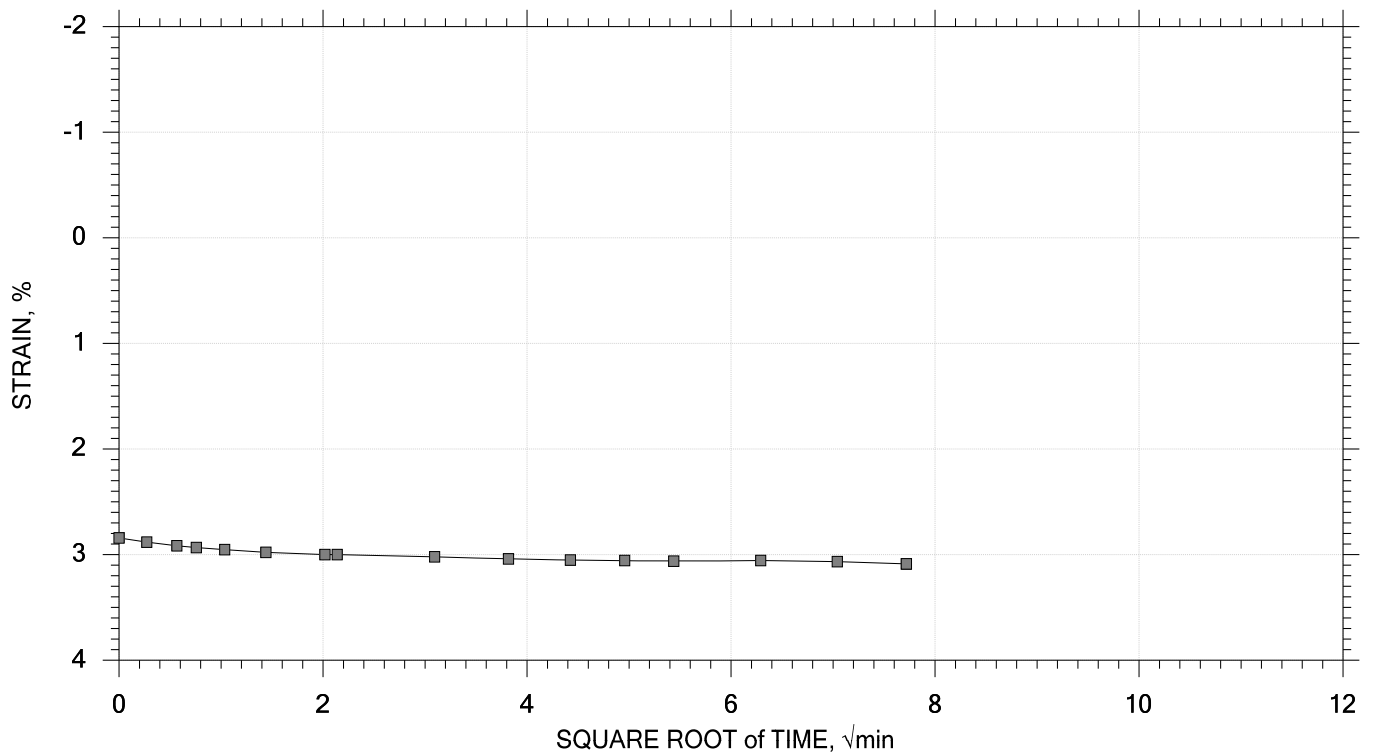
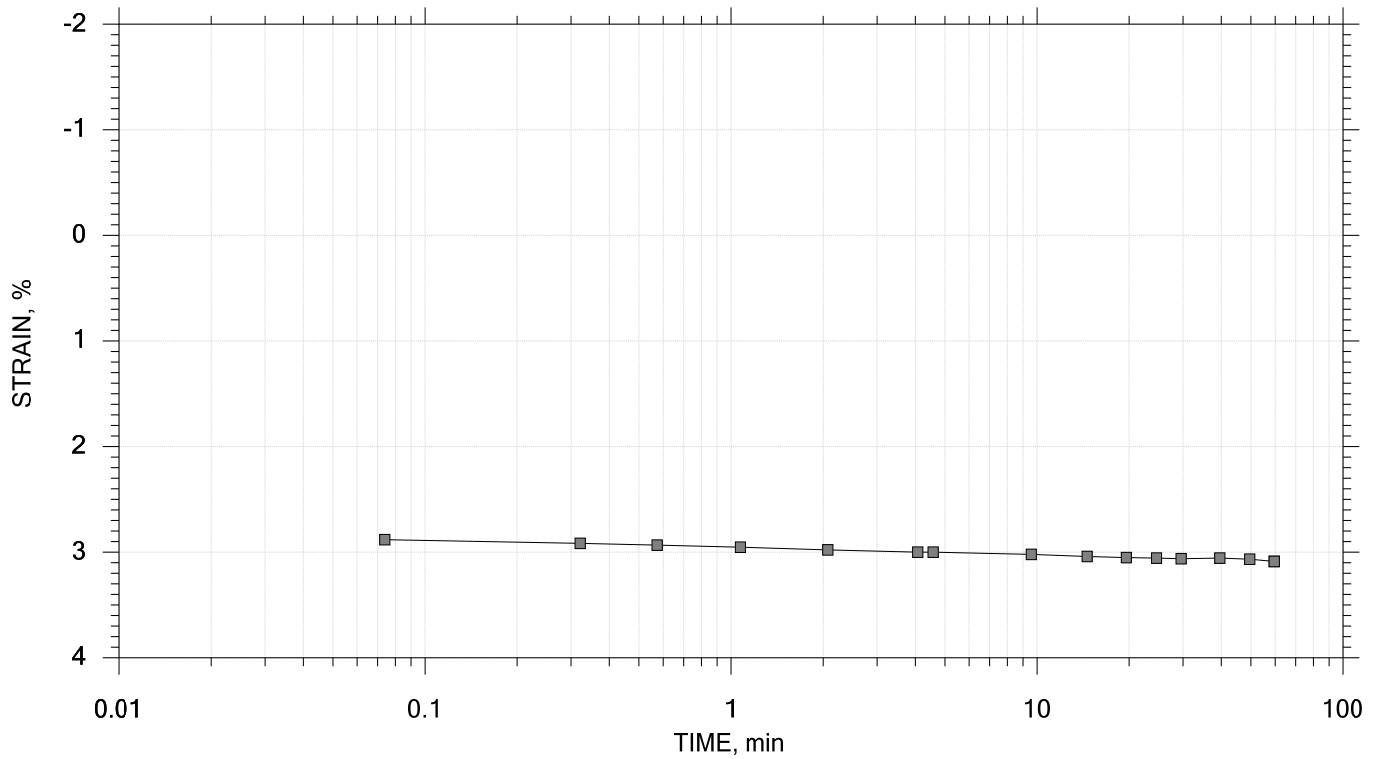
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	Boring No.: BB-WCWB-102	Tested By: GSL	Checked By: --
	Sample No.: 2U	Test Date: 6/25/16	Test No.: 270885
	Depth: 30.0-32.0 FT	Sample Type: INTACT	Elevation: --
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		
	Displacement at End of Increment		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Volume Step 1 of 21

Stress: 0.062572 tsf



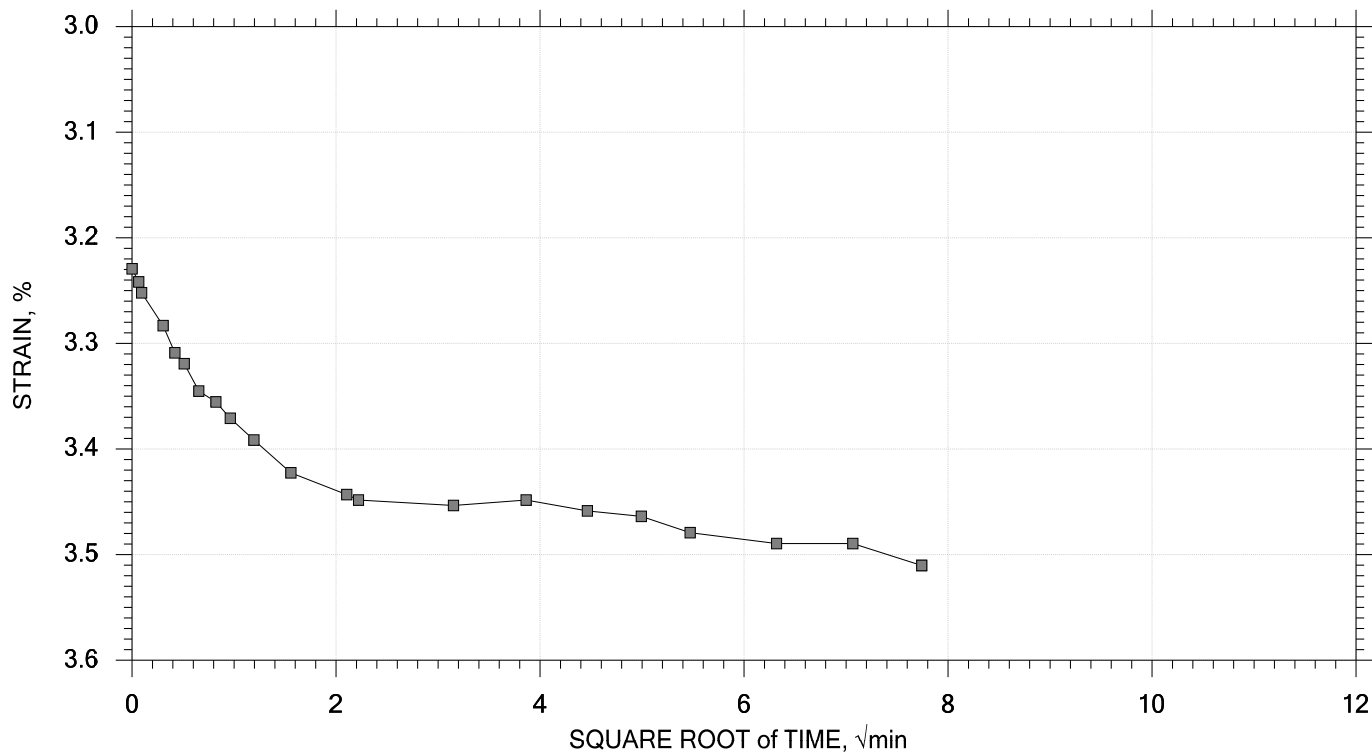
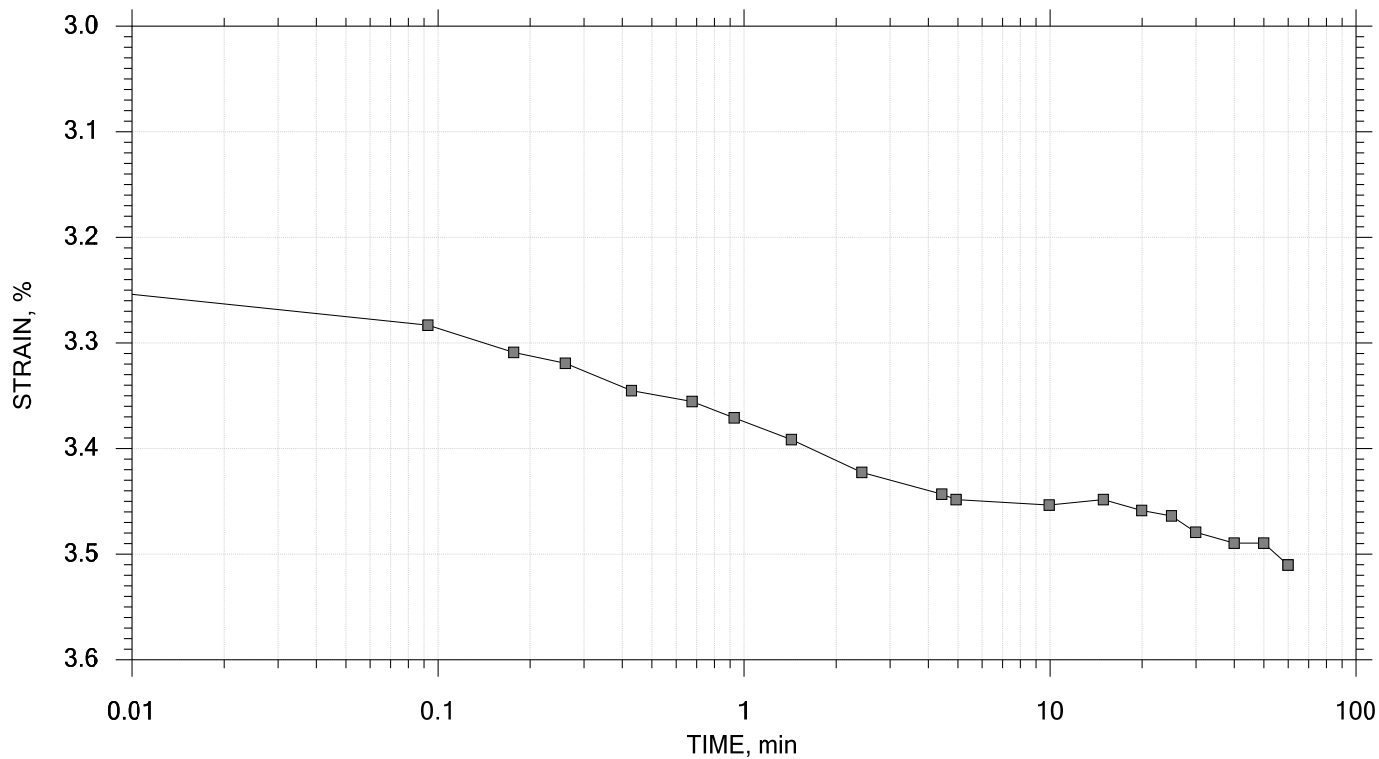
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	Sample No.: 2U	Test Date: 6/25/16	Test No.: 270885
	Depth: 30.0-32.0 FT	Sample Type: INTACT	Elevation: --
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 2 of 21

Stress: 0.125 tsf



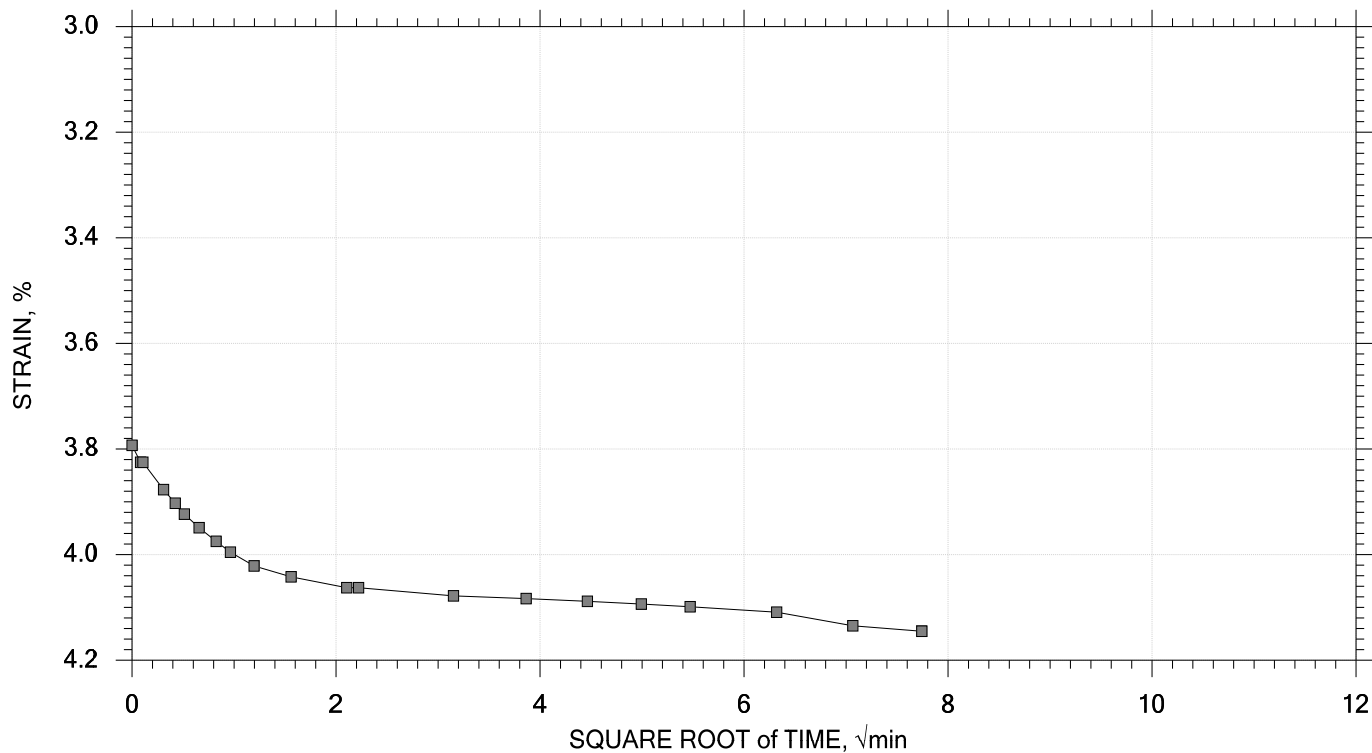
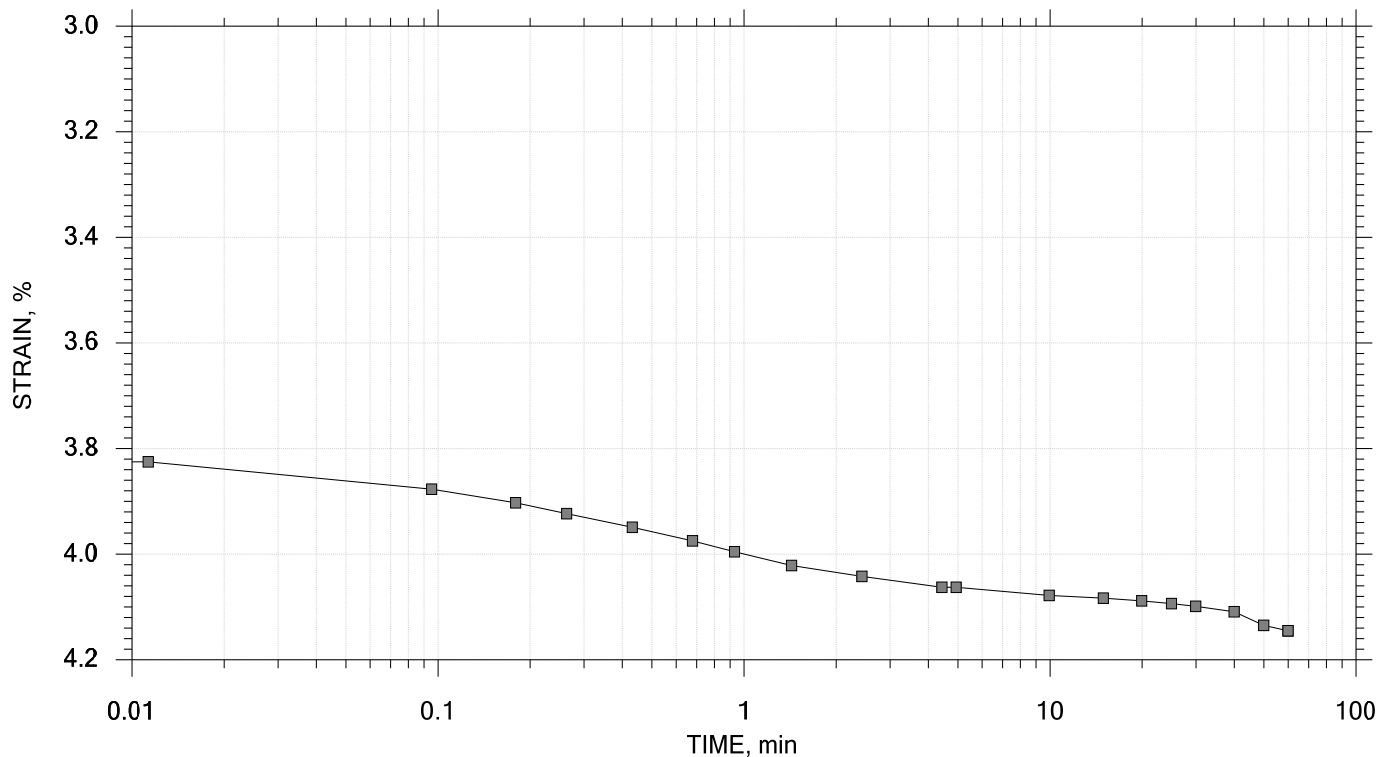
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	Boring No.: BB-WCWB-102	Tested By: GSL	Checked By: --
	Sample No.: 2U	Test Date: 6/25/16	Test No.: 270885
	Depth: 30.0-32.0 FT	Sample Type: INTACT	Elevation: --
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 3 of 21

Stress: 0.25 tsf



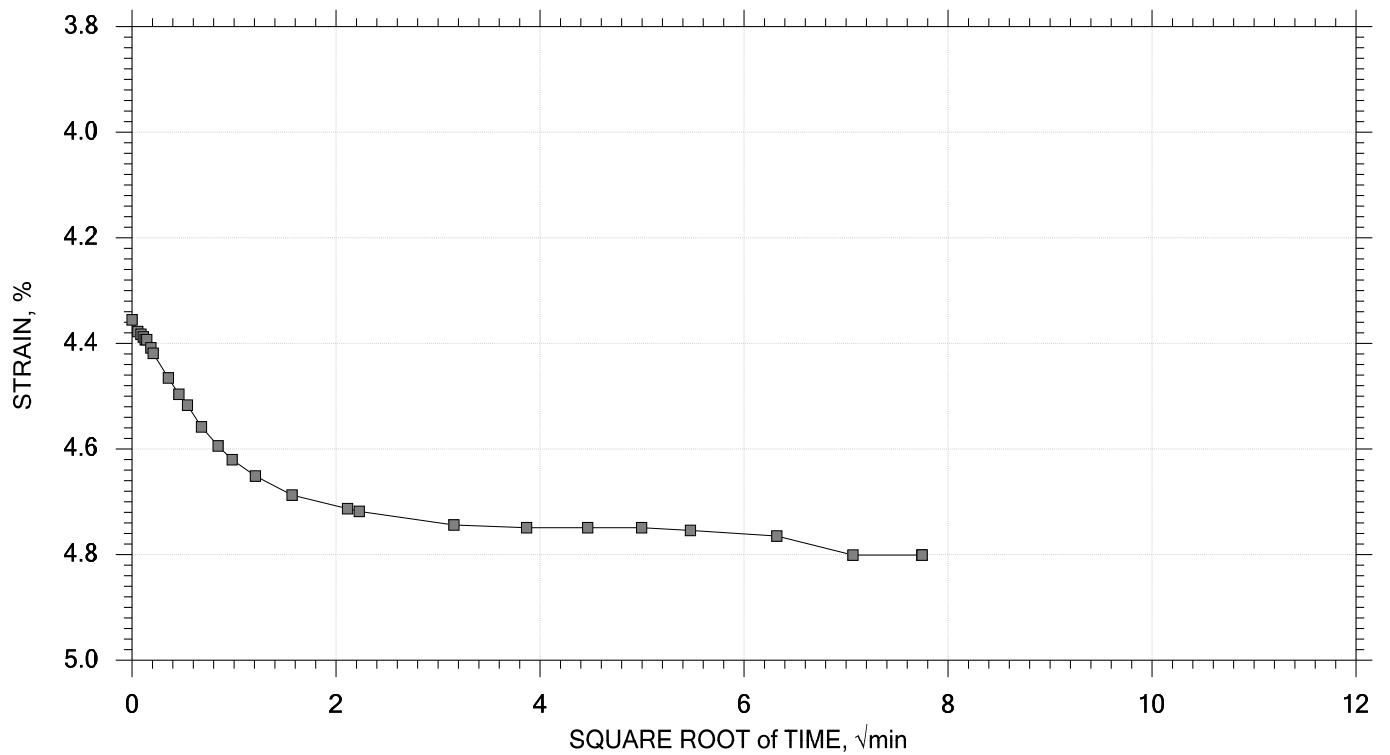
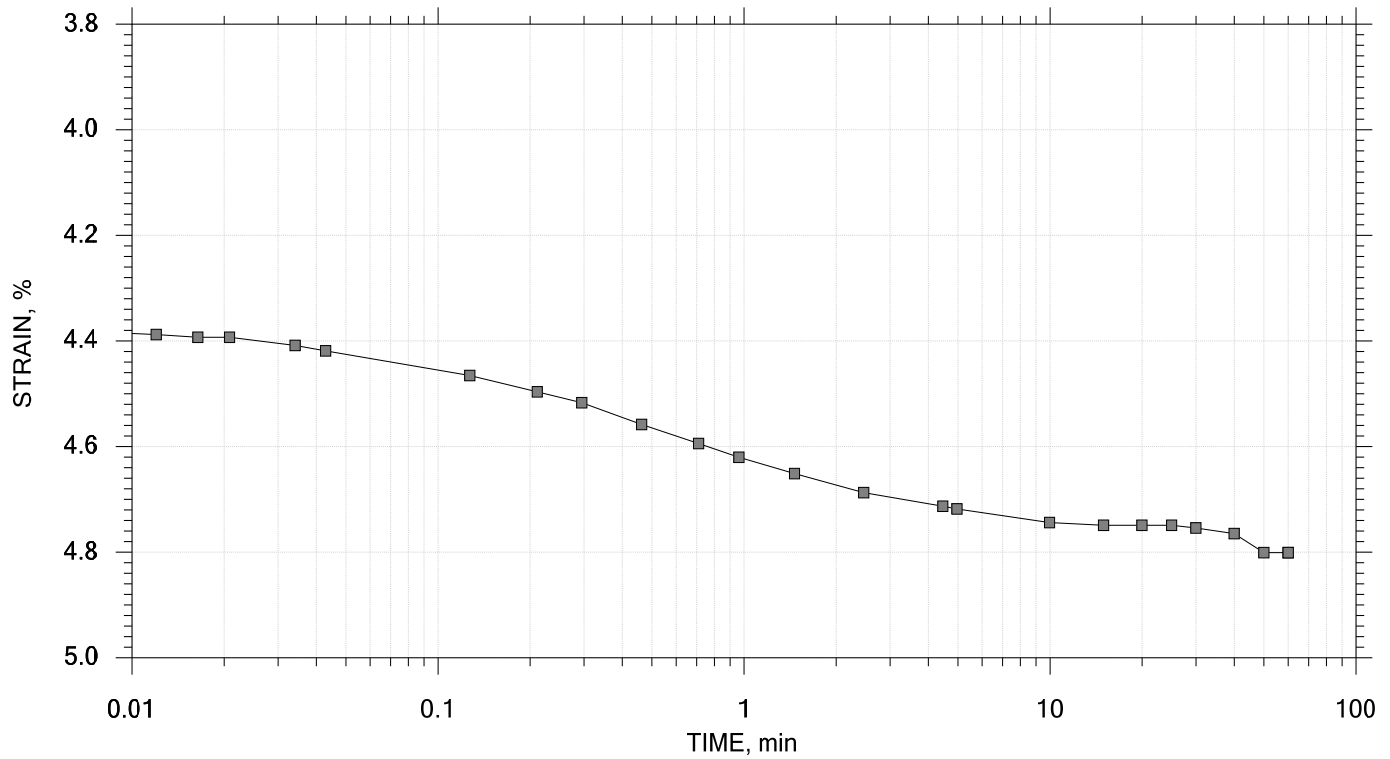
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	Boring No.: BB-WCWB-102	Tested By: GSL	Checked By: --
	Sample No.: 2U	Test Date: 6/25/16	Test No.: 270885
	Depth: 30.0-32.0 FT	Sample Type: INTACT	Elevation: --
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 4 of 21

Stress: 0.5 tsf



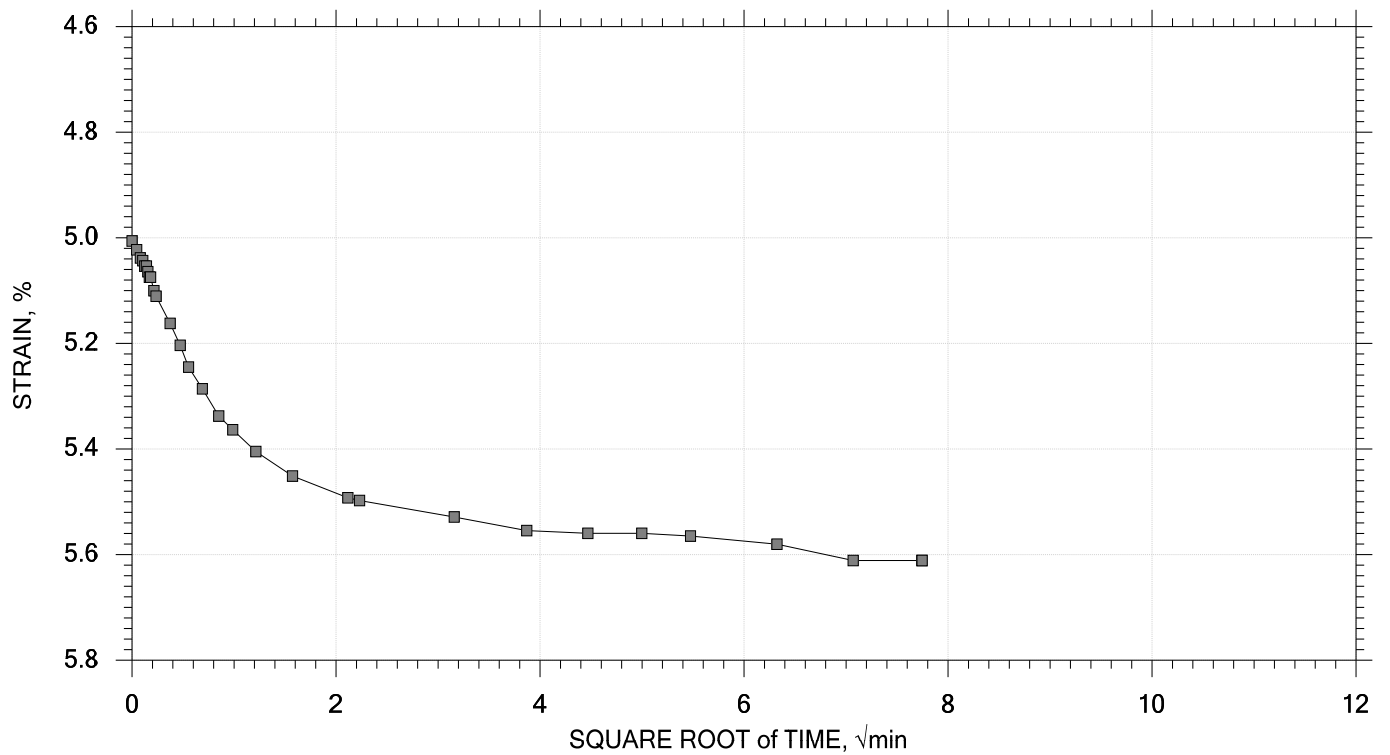
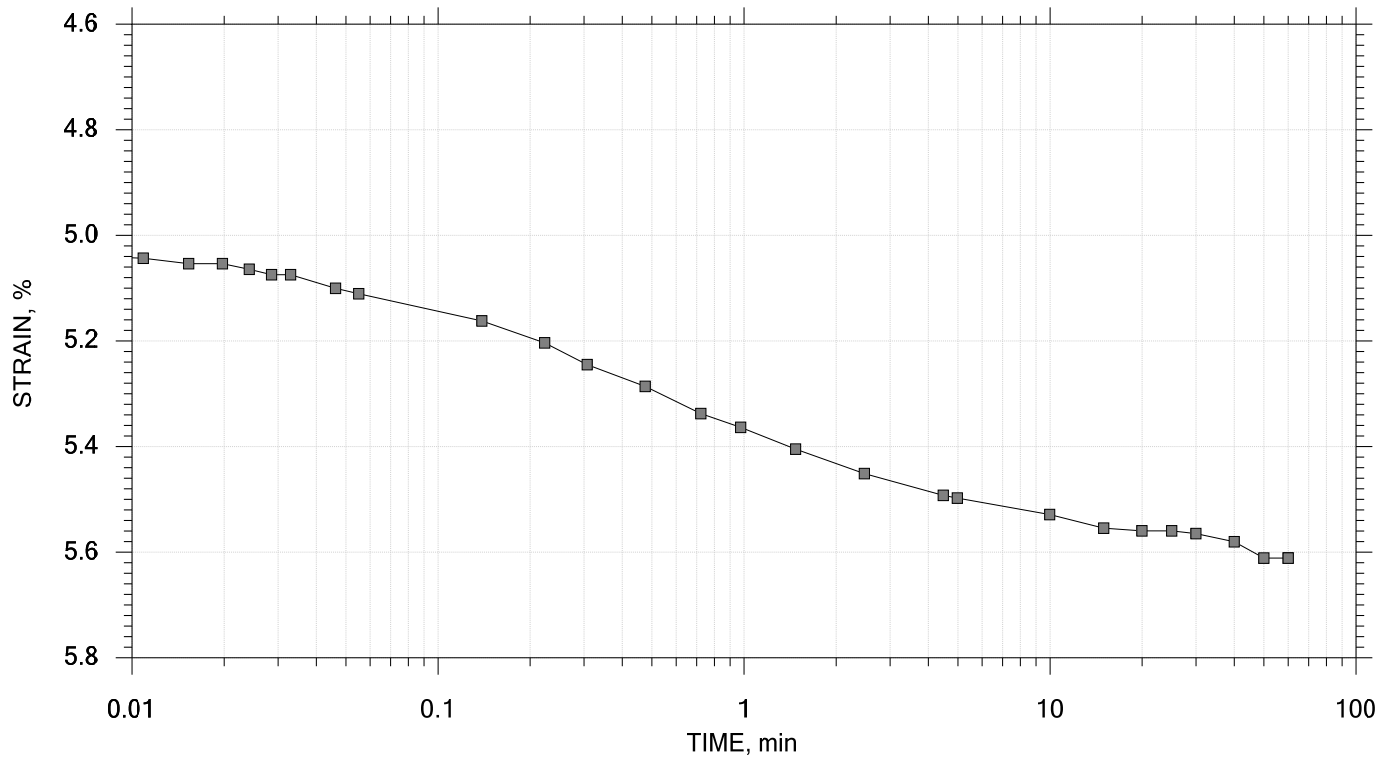
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	Boring No.: BB-WCWB-102	Tested By: GSL	Checked By: --
	Sample No.: 2U	Test Date: 6/25/16	Test No.: 270885
	Depth: 30.0-32.0 FT	Sample Type: INTACT	Elevation: --
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 5 of 21

Stress: 1 tsf



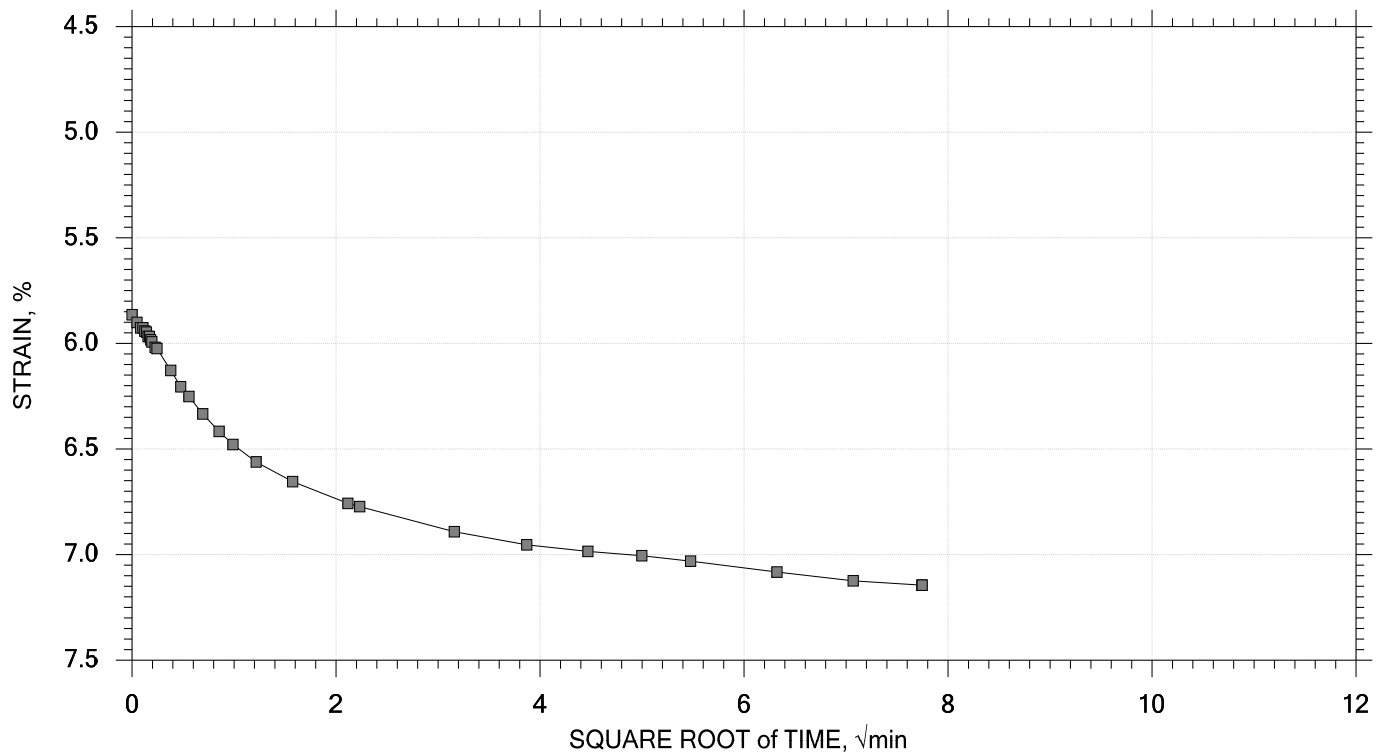
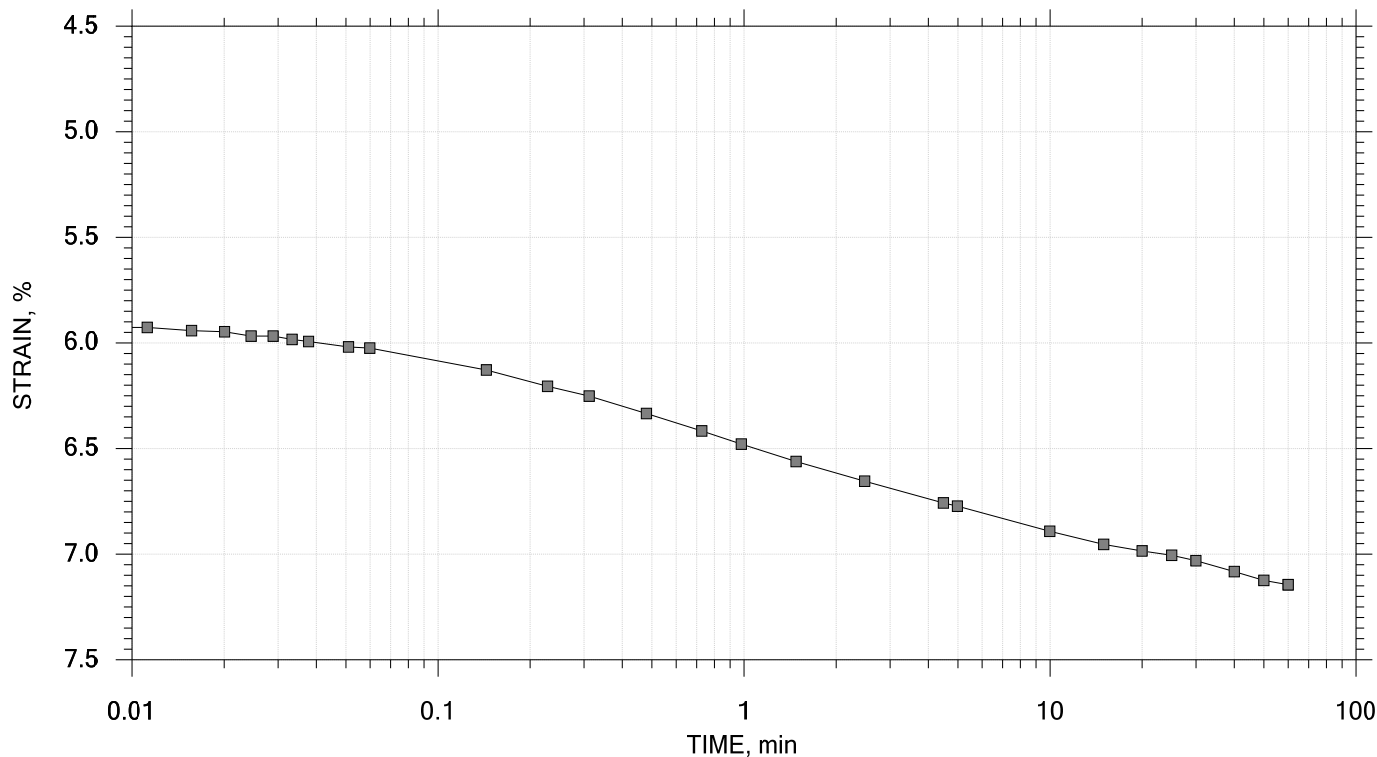
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	Boring No.: BB-WCWB-102	Tested By: GSL	Checked By: --
	Sample No.: 2U	Test Date: 6/25/16	Test No.: 270885
	Depth: 30.0-32.0 FT	Sample Type: INTACT	Elevation: --
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 6 of 21

Stress: 2 tsf



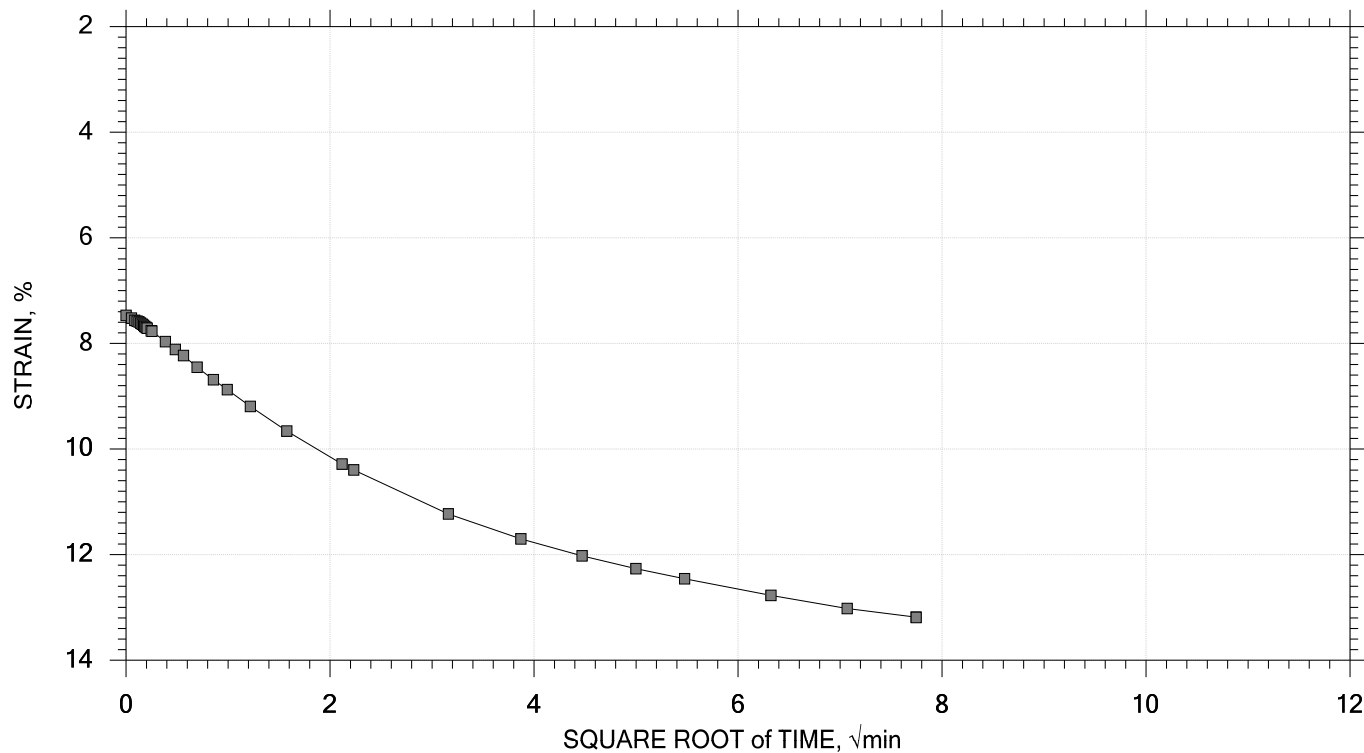
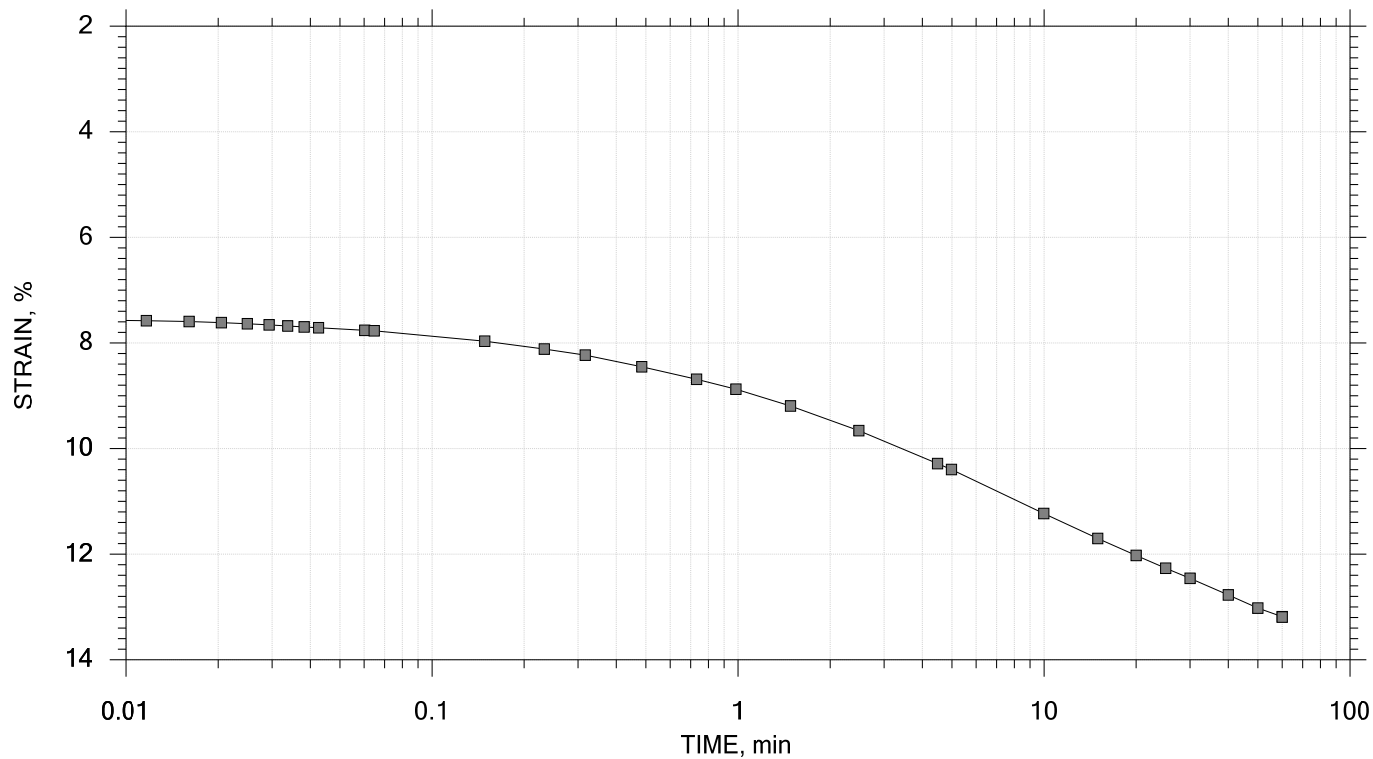
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	Depth: 30.0-32.0 FT	Sample Type: INTACT	Elevation: --
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 7 of 21

Stress: 4 tsf



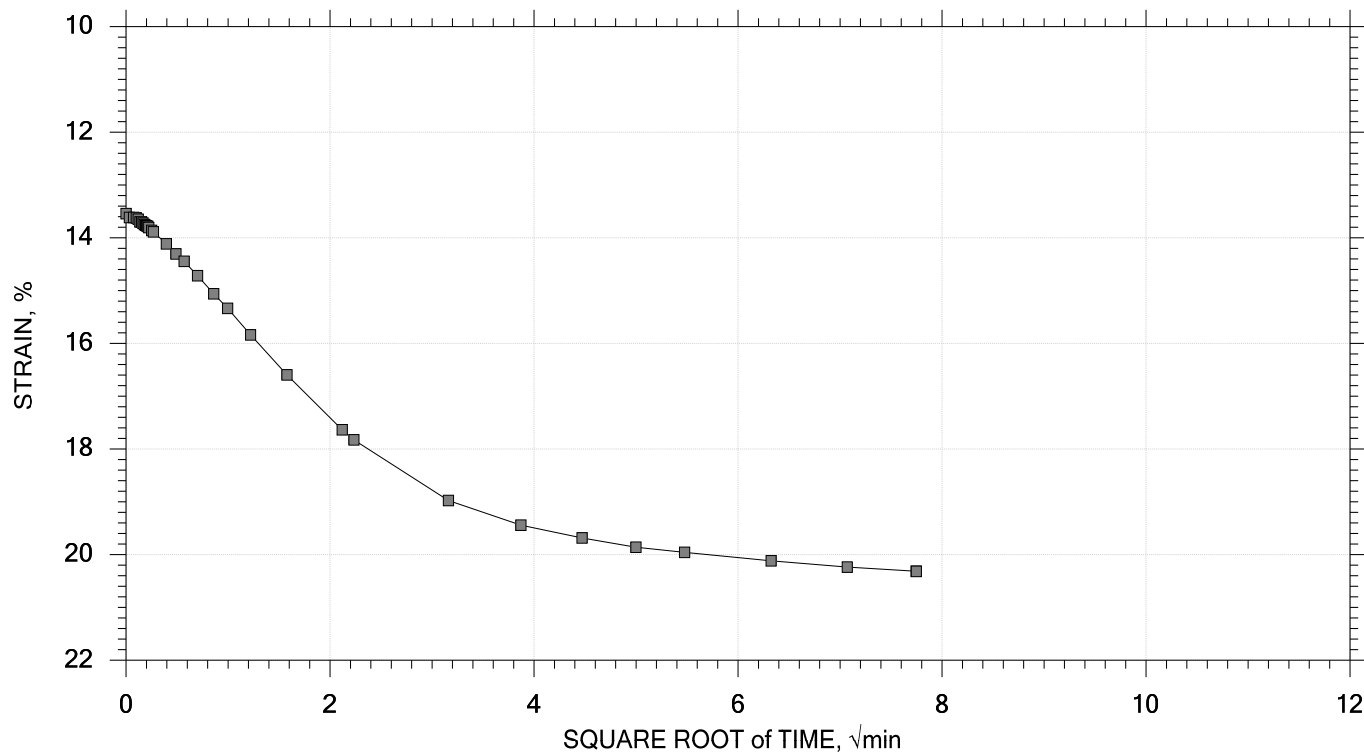
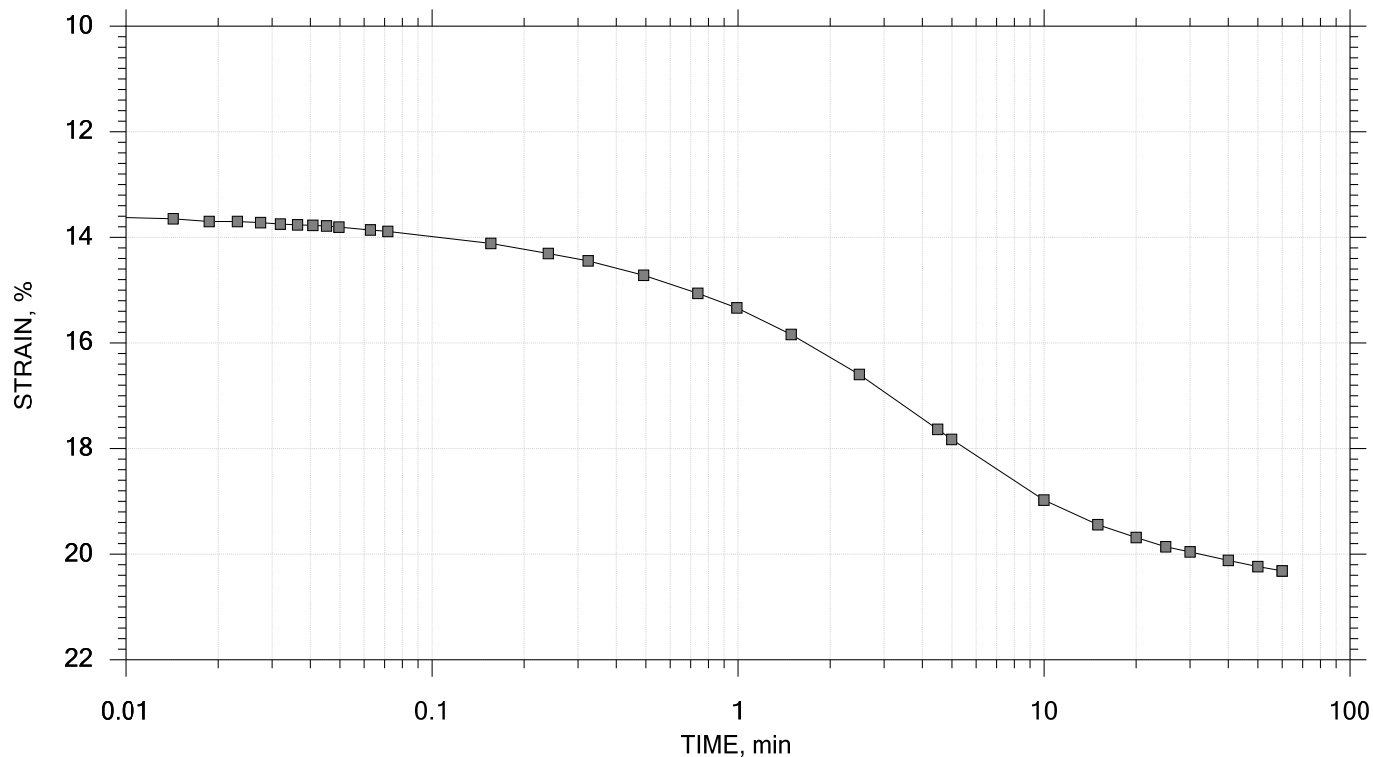
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	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 8 of 21

Stress: 8 tsf



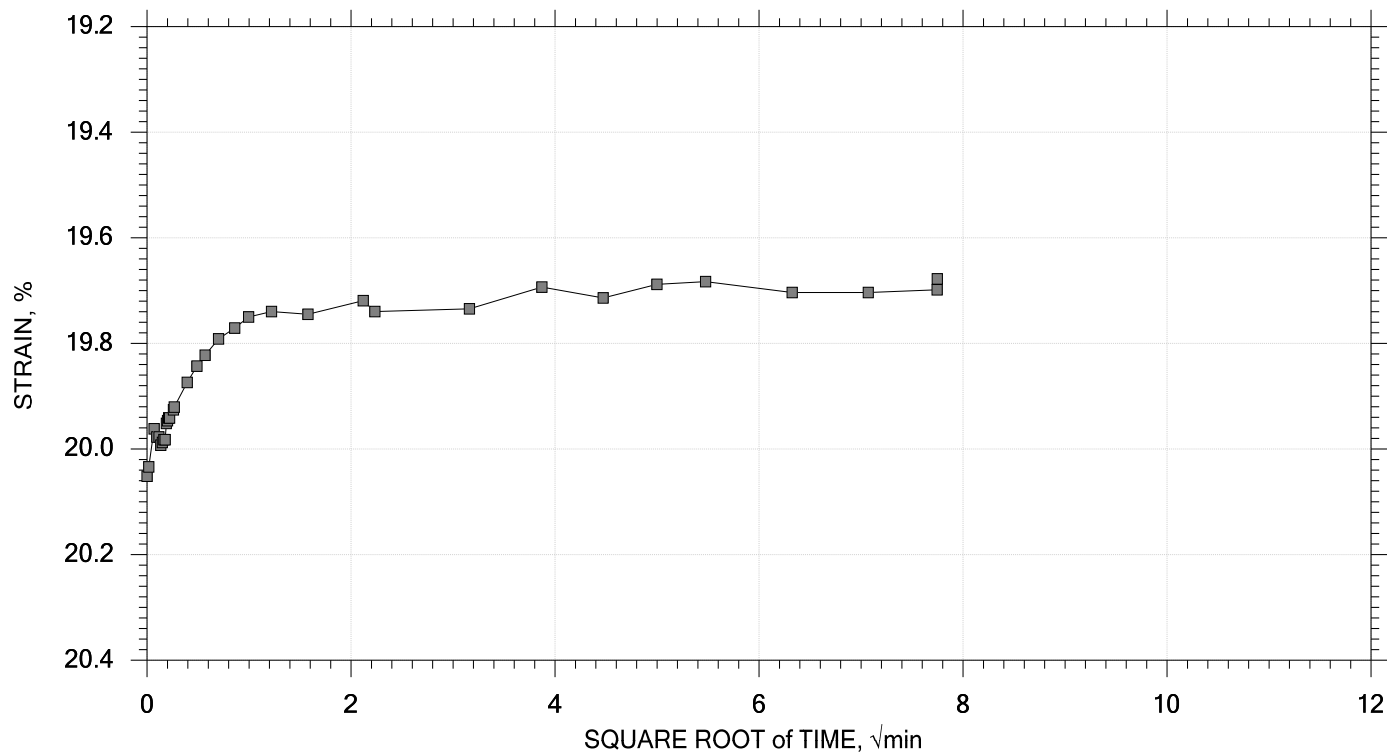
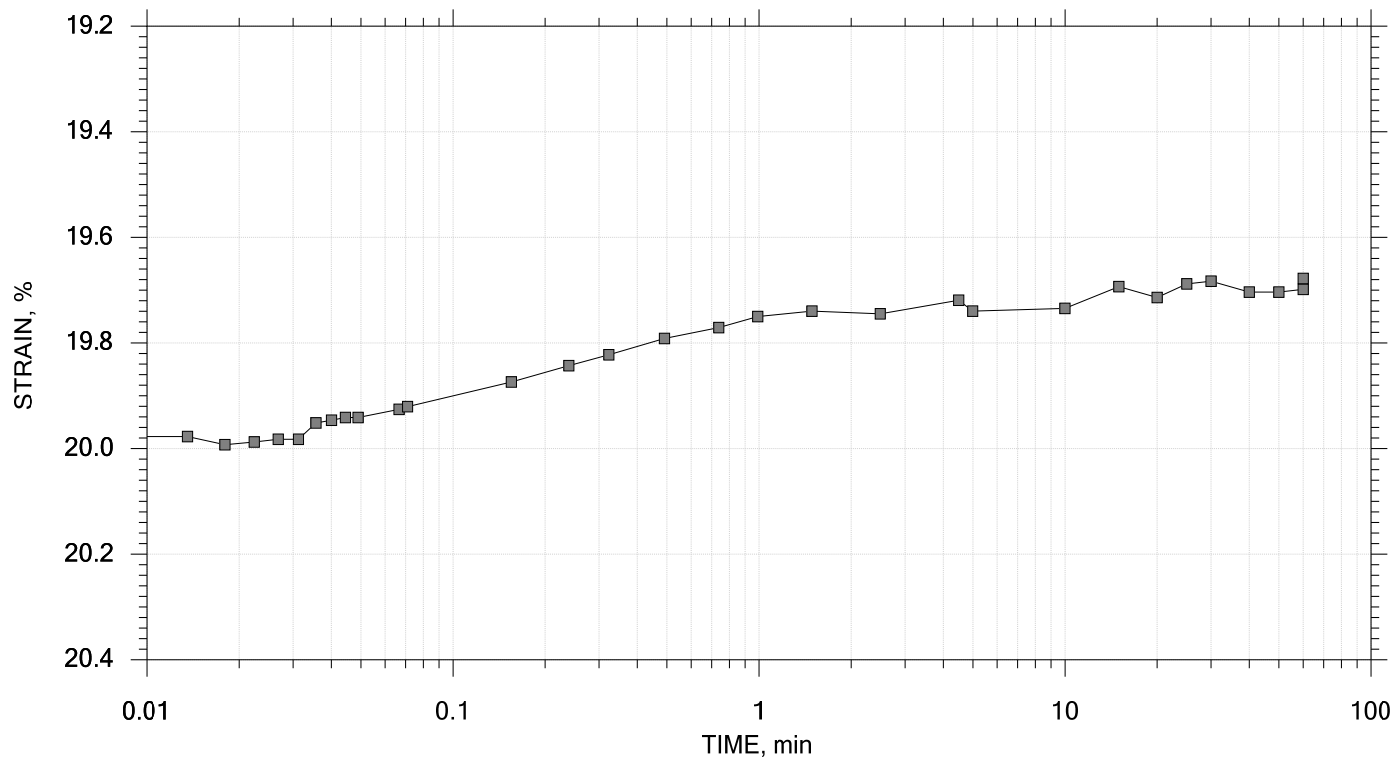
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	Depth: 30.0-32.0 FT	Sample Type: INTACT	Elevation: --
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 9 of 21

Stress: 4 tsf



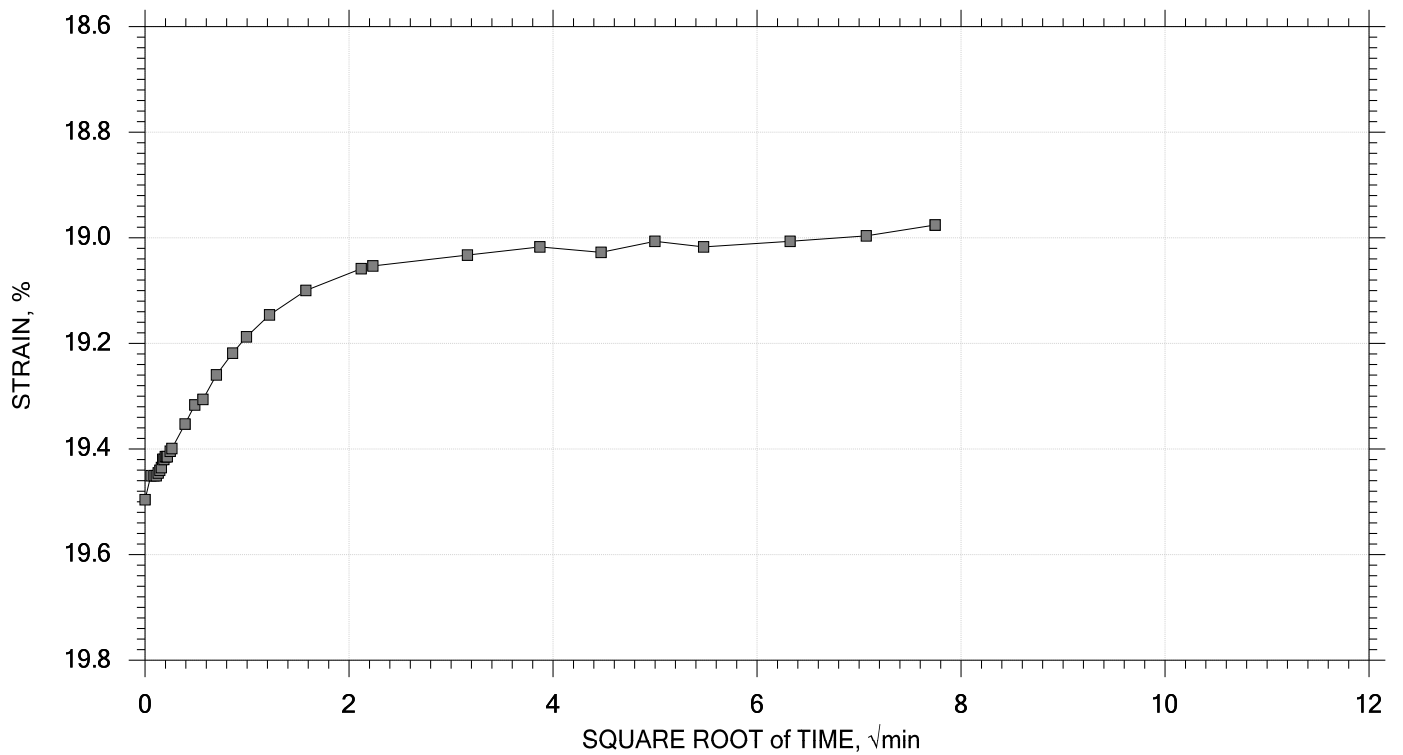
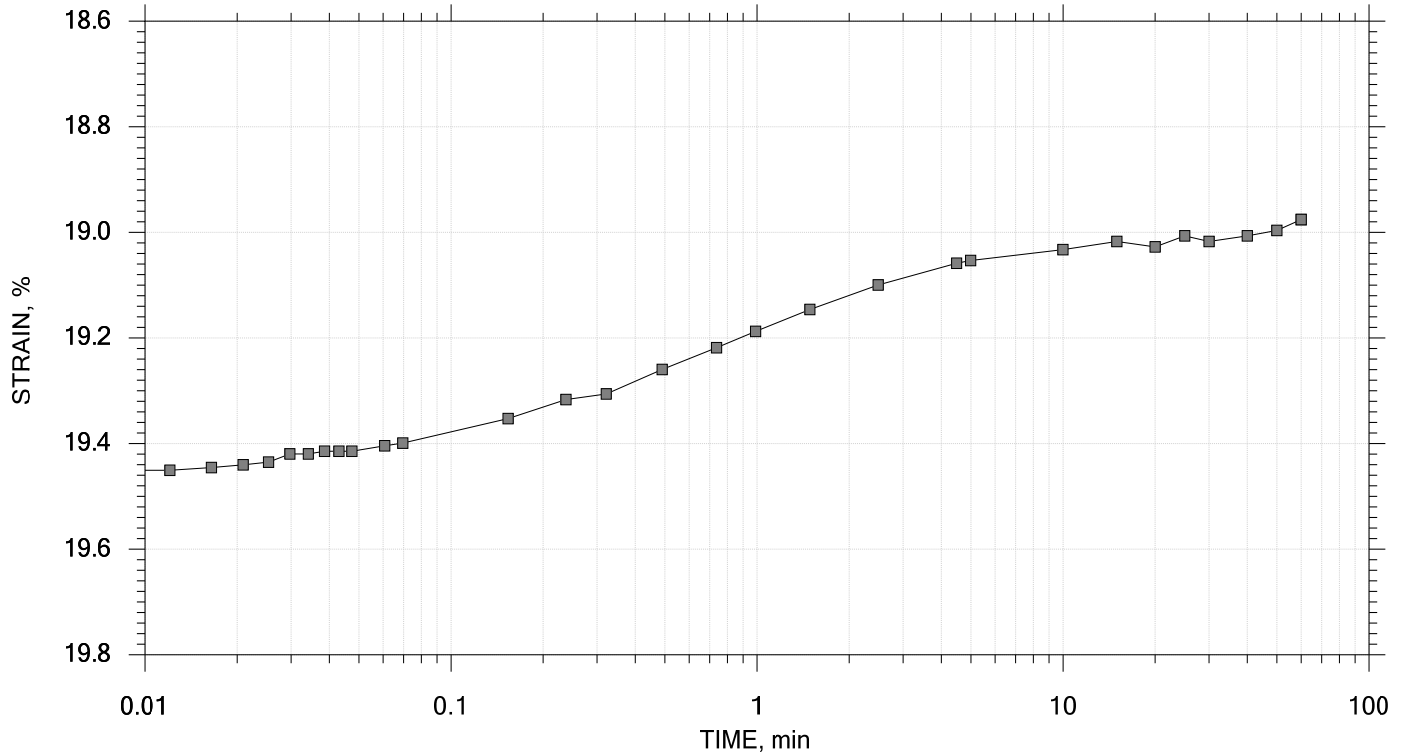
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	Sample No.: 2U	Test Date: 6/25/16	Test No.: 270885
	Depth: 30.0-32.0 FT	Sample Type: INTACT	Elevation: --
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 10 of 21

Stress: 2 tsf



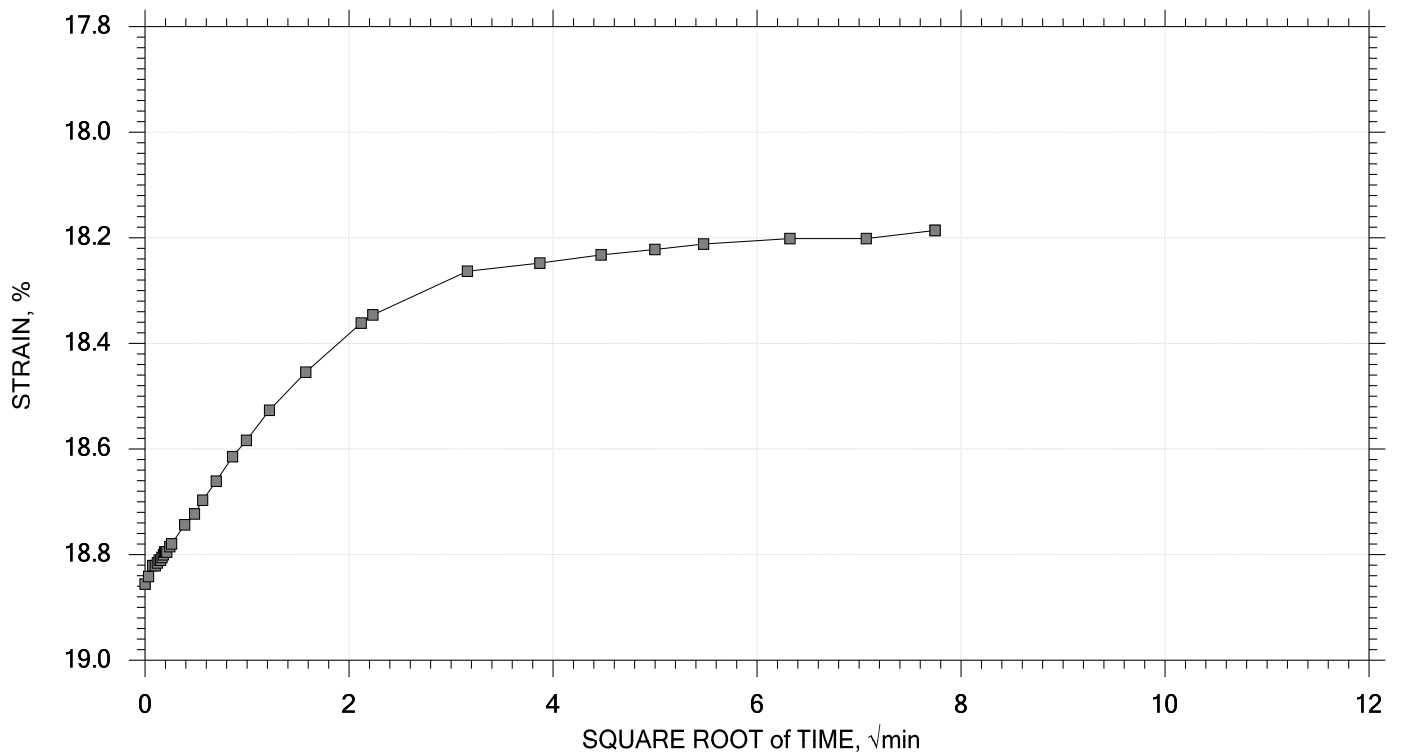
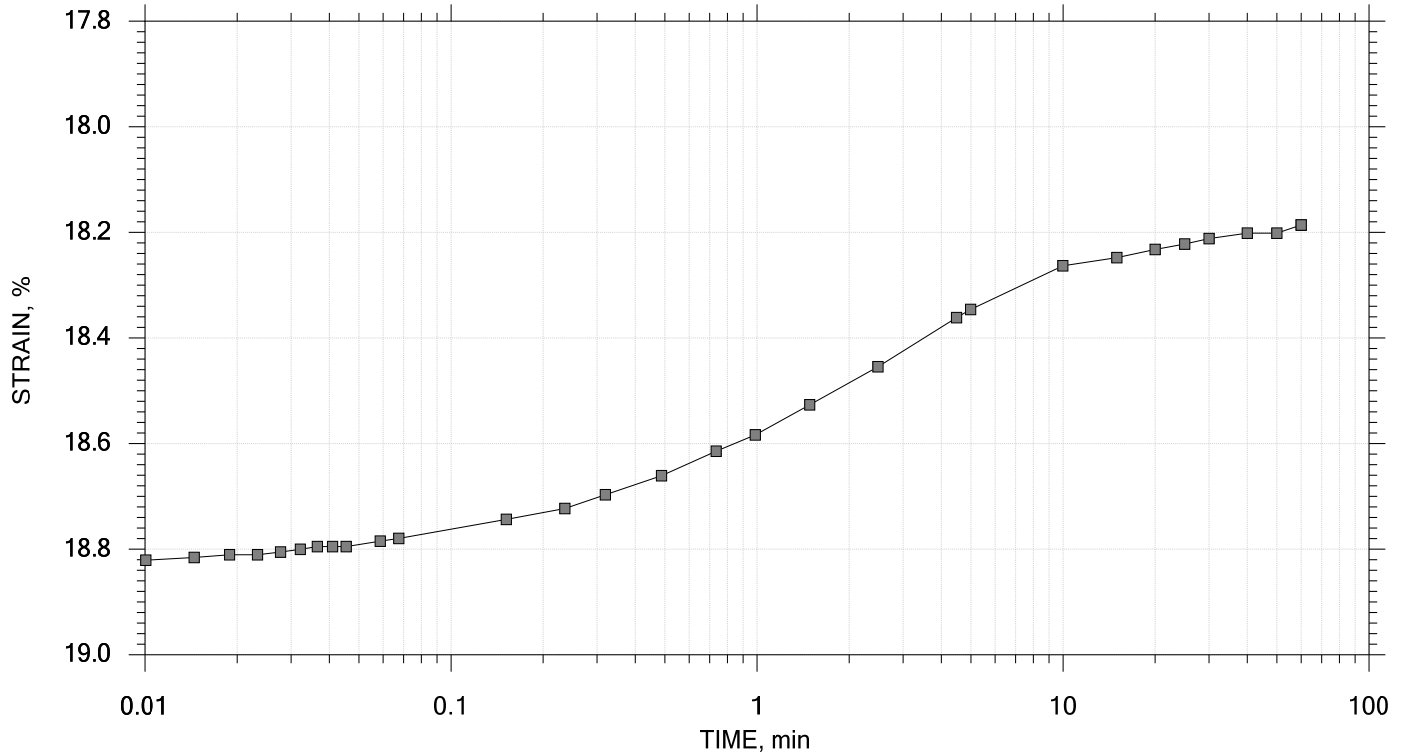
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	Sample No.: 2U	Test Date: 6/25/16	Test No.: 270885
	Depth: 30.0-32.0 FT	Sample Type: INTACT	Elevation: --
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 11 of 21

Stress: 1 tsf



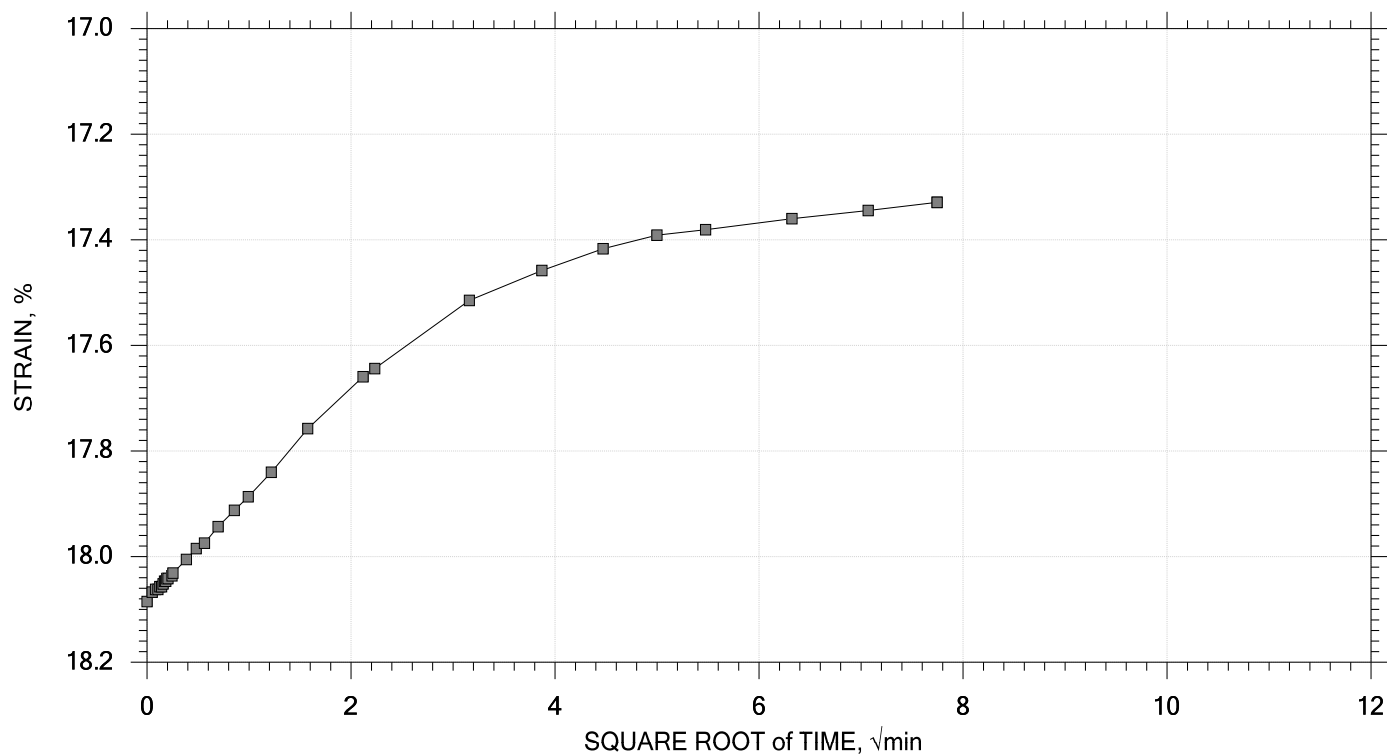
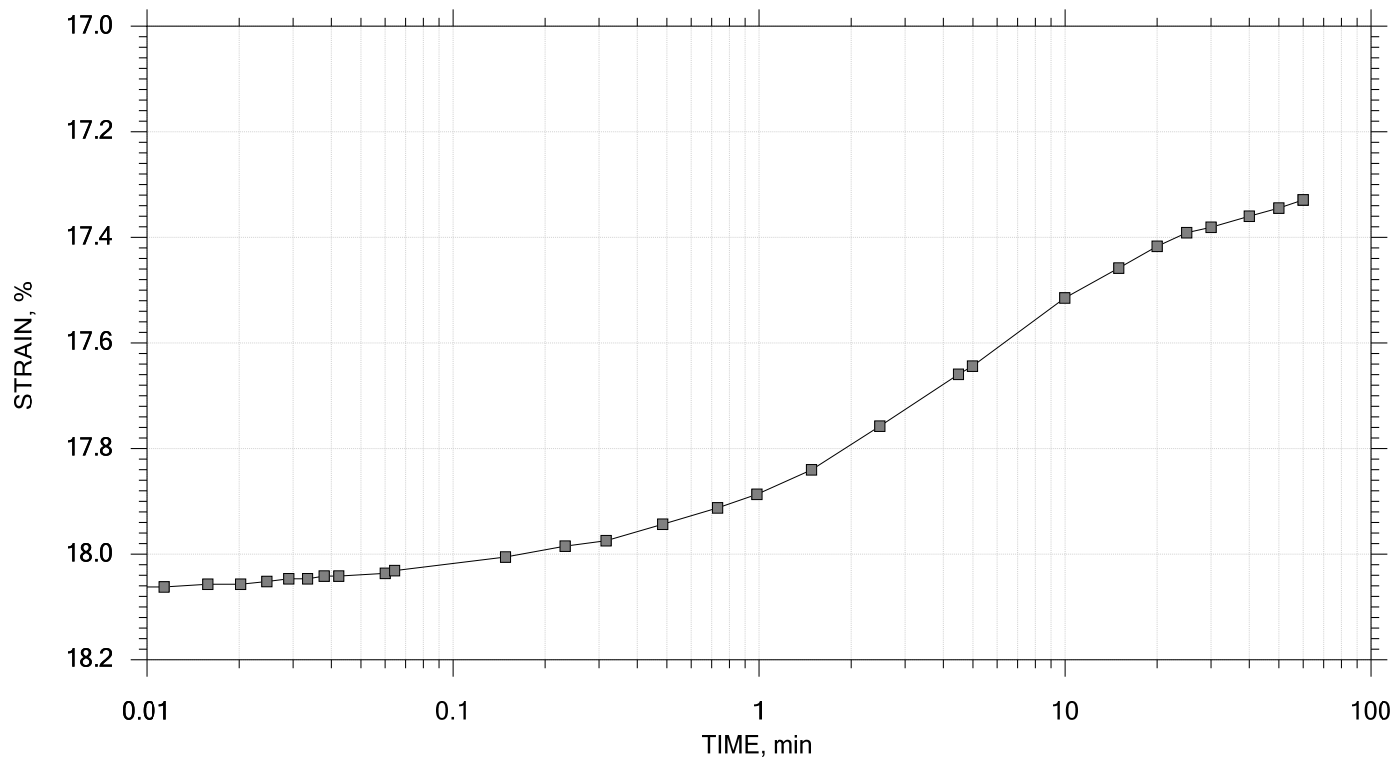
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	Depth: 30.0-32.0 FT	Sample Type: INTACT	Elevation: --
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 12 of 21

Stress: 0.5 tsf



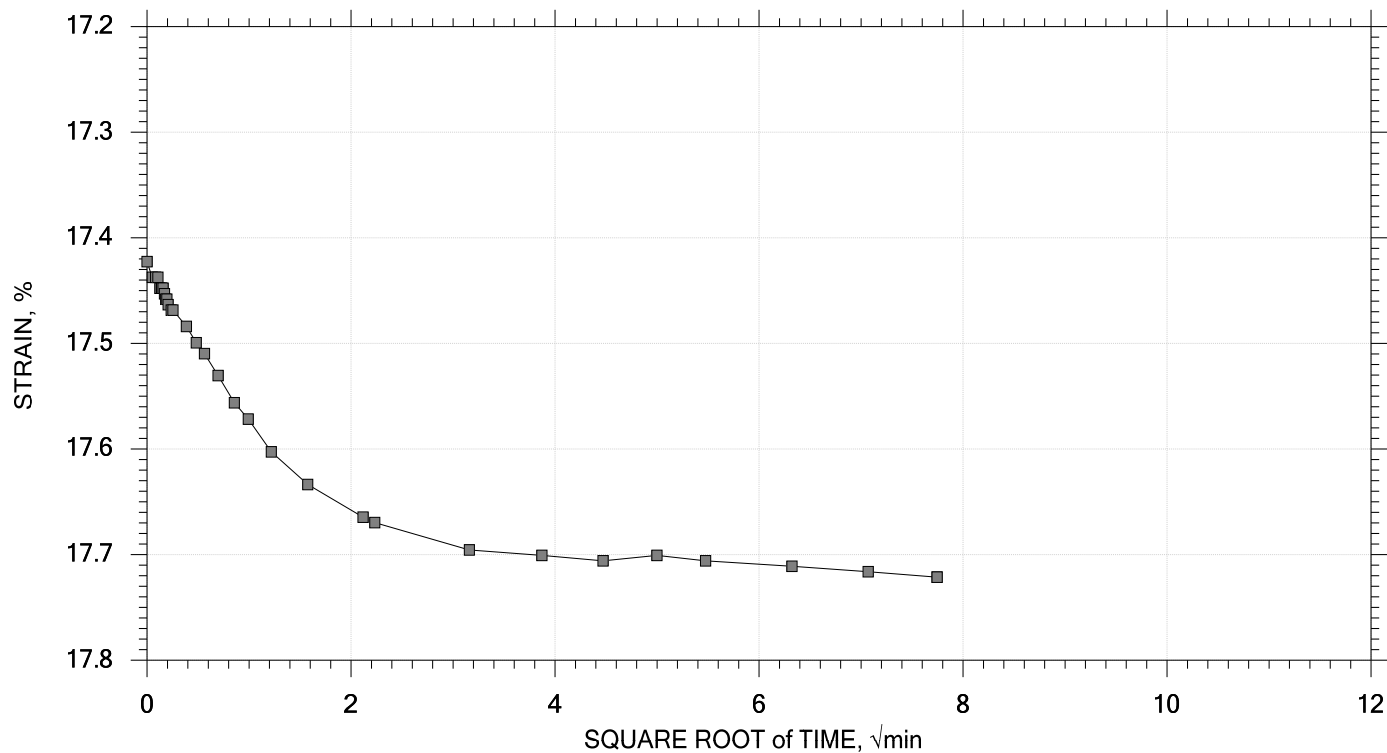
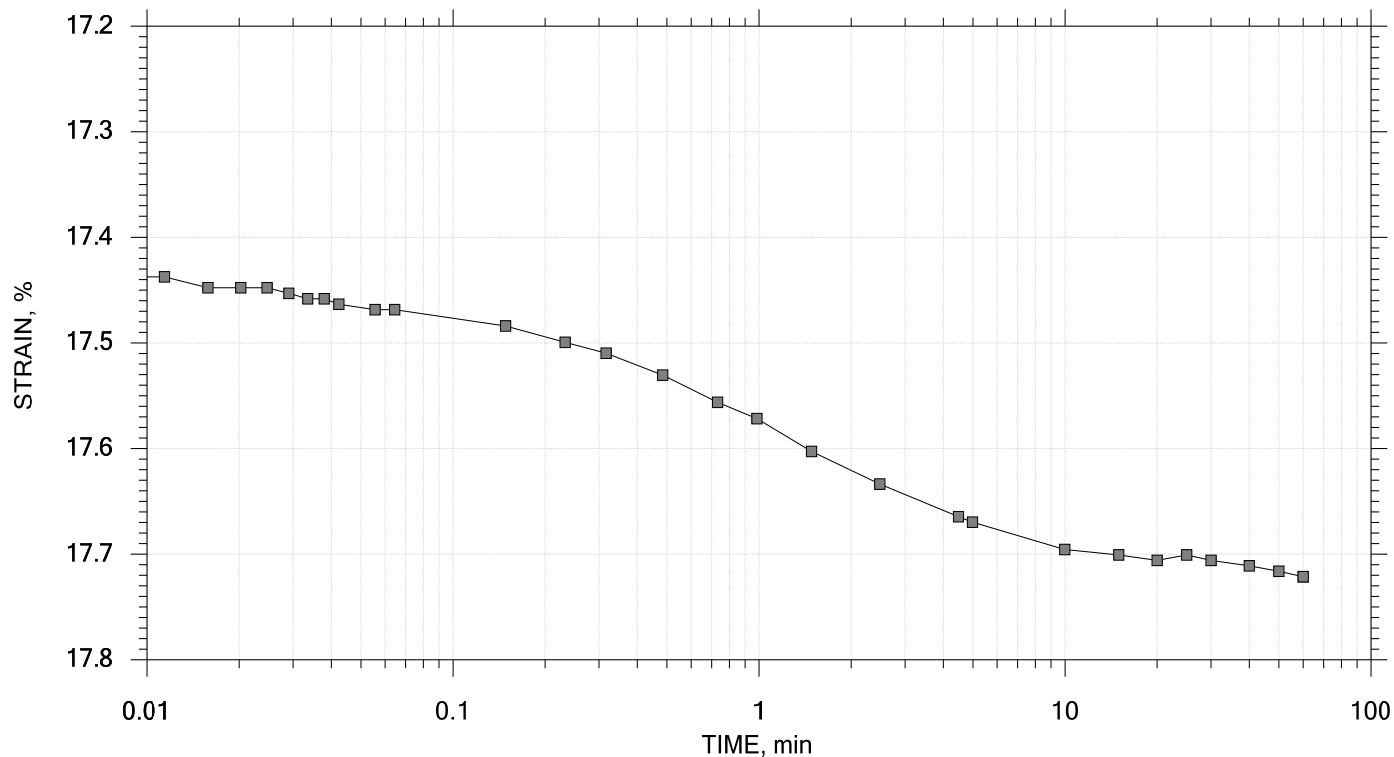
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	Sample No.: 2U	Test Date: 6/25/16	Test No.: 270885
	Depth: 30.0-32.0 FT	Sample Type: INTACT	Elevation: --
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 13 of 21

Stress: 1 tsf



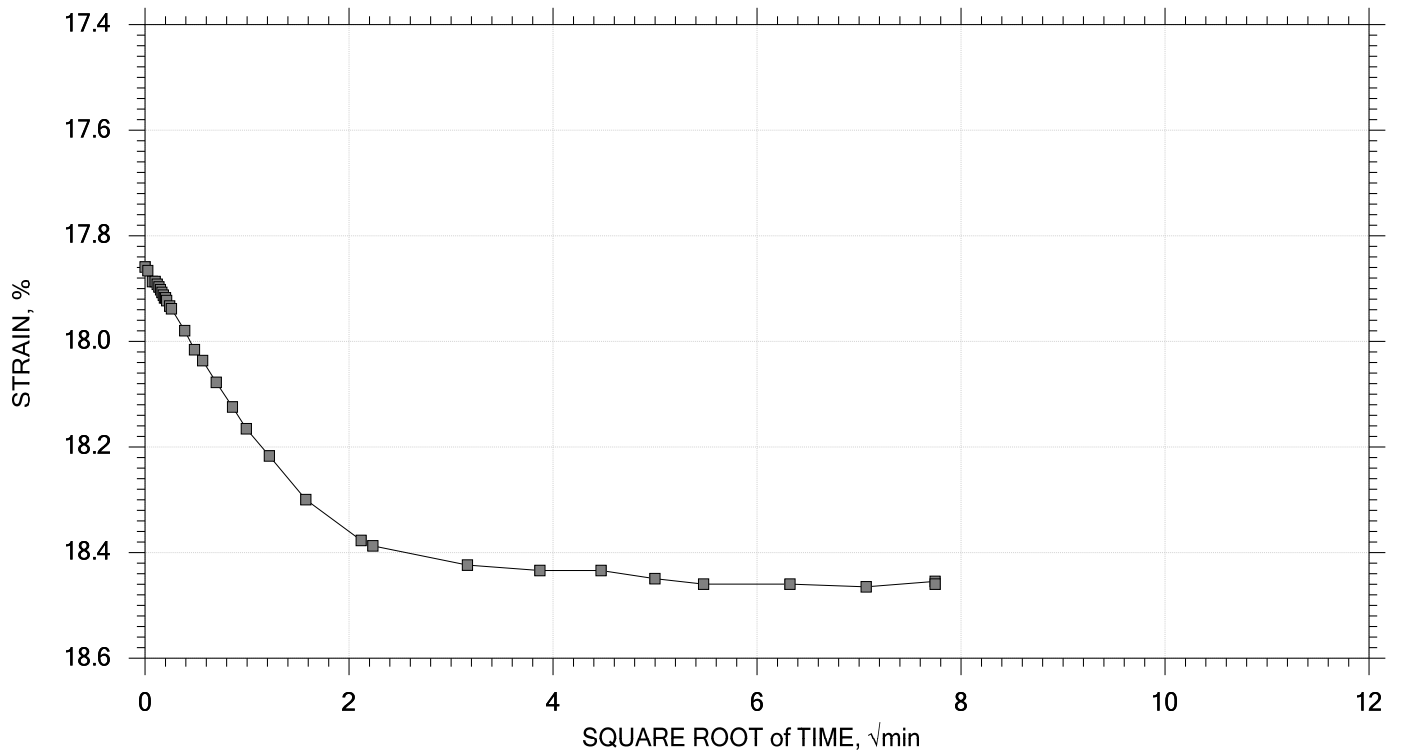
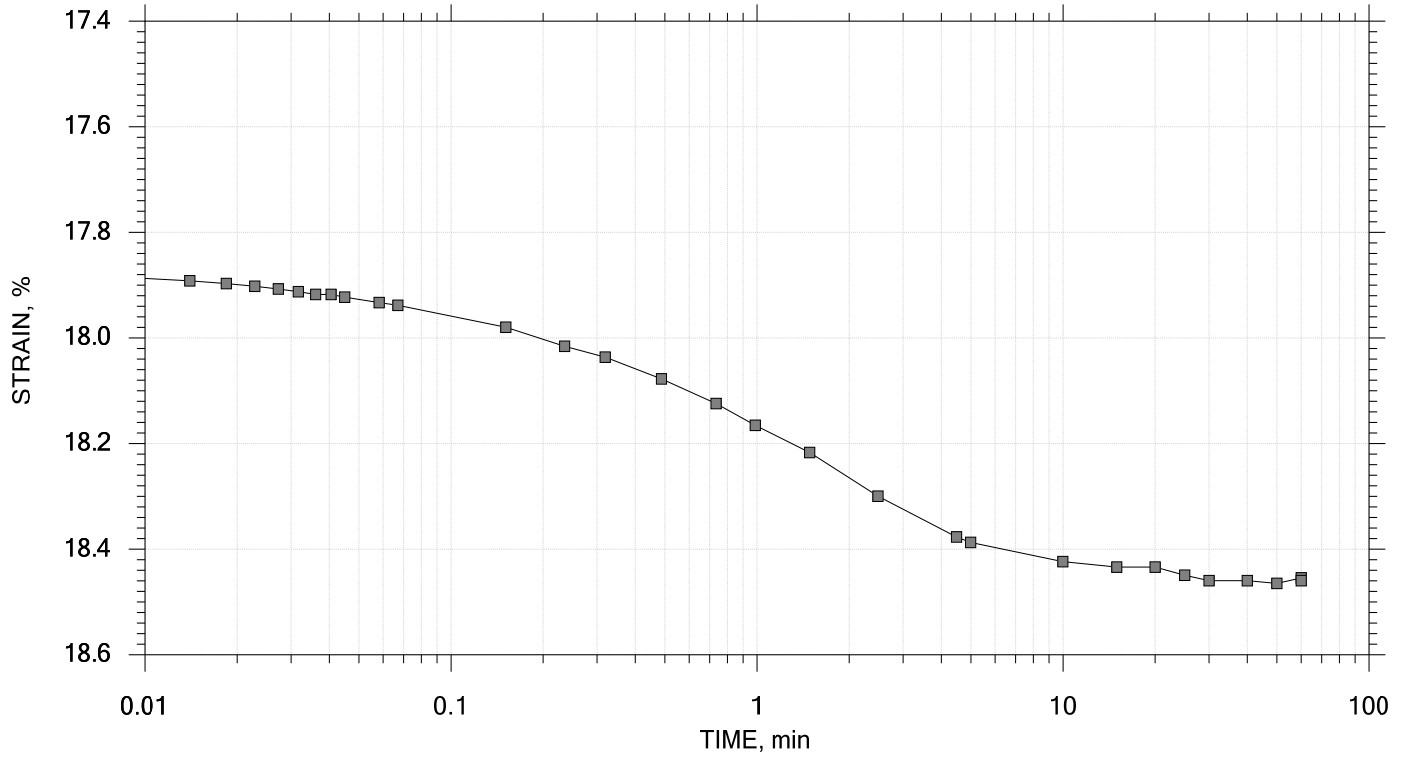
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	Depth: 30.0-32.0 FT	Sample Type: INTACT	Elevation: --
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 14 of 21

Stress: 2 tsf



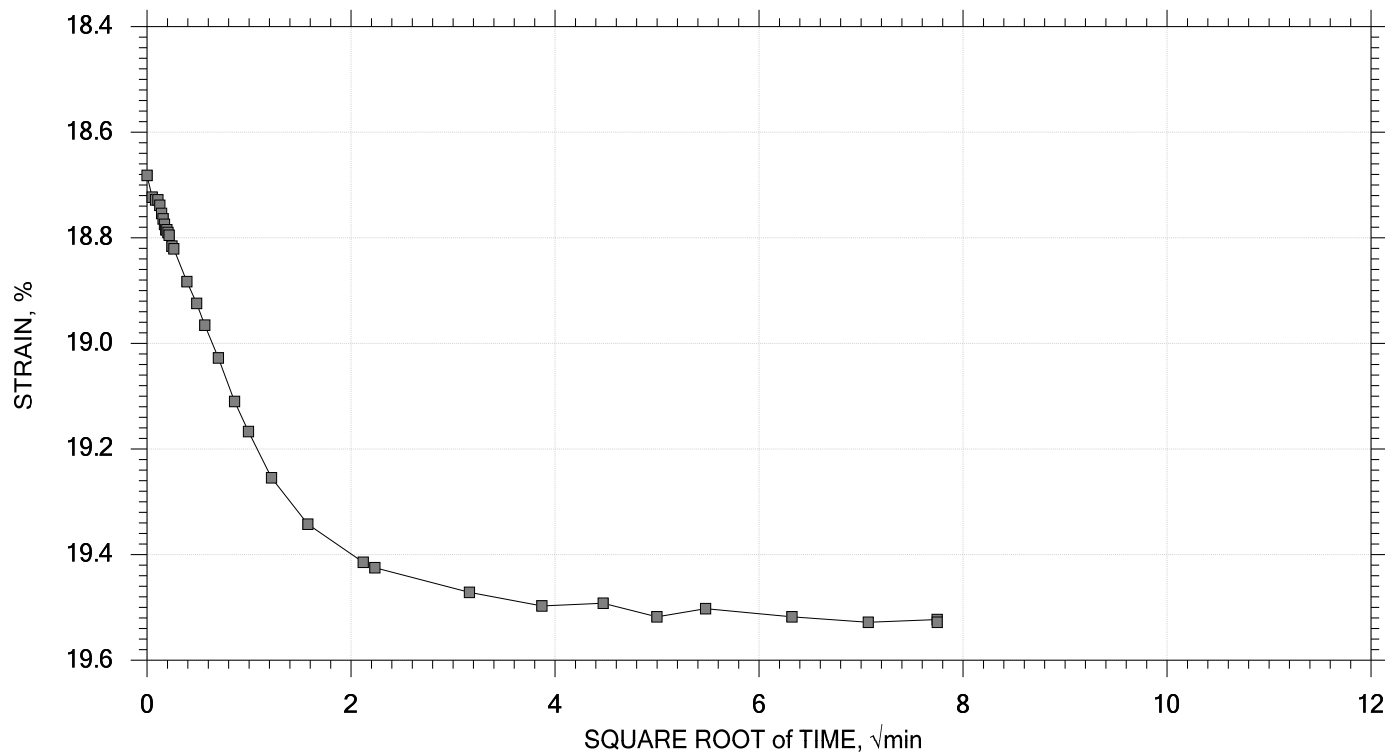
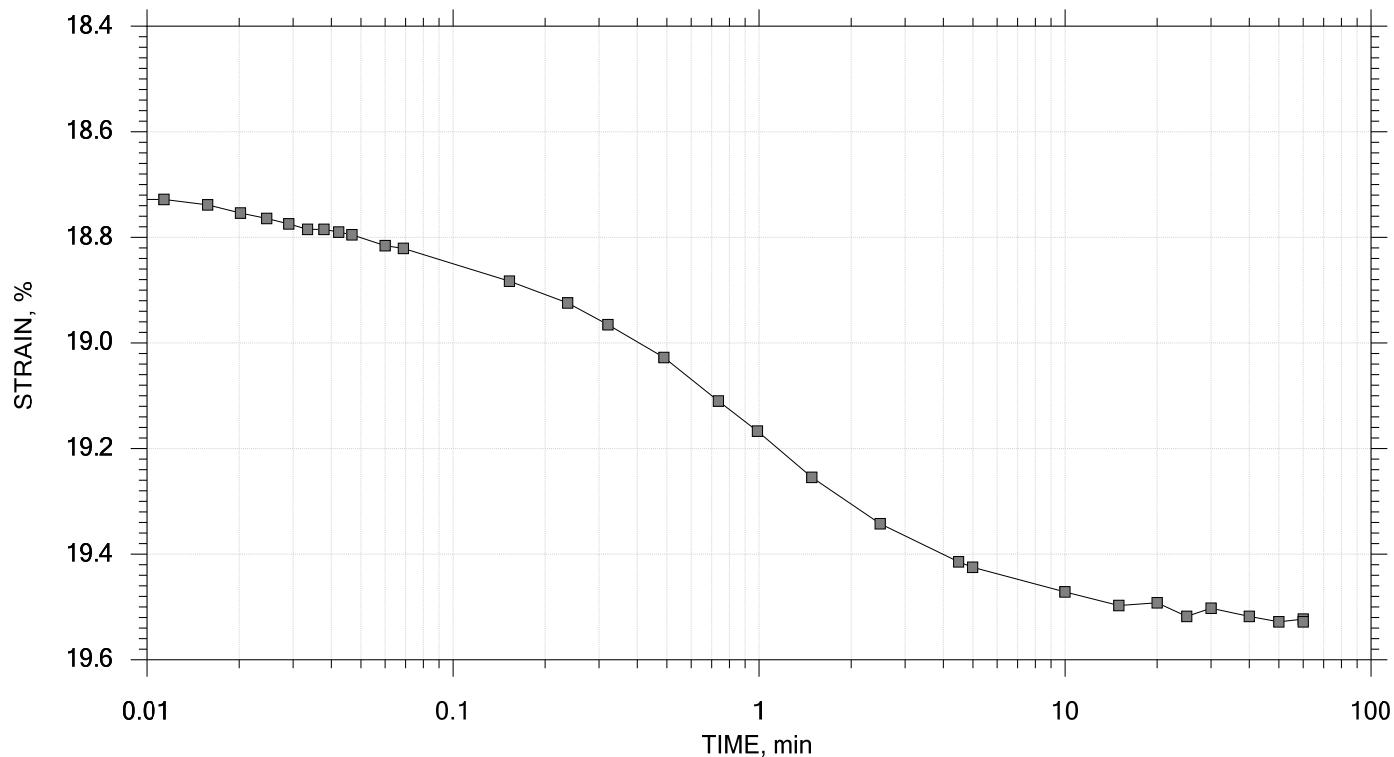
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	Sample No.: 2U	Test Date: 6/25/16	Test No.: 270885
	Depth: 30.0-32.0 FT	Sample Type: INTACT	Elevation: --
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 15 of 21

Stress: 4 tsf



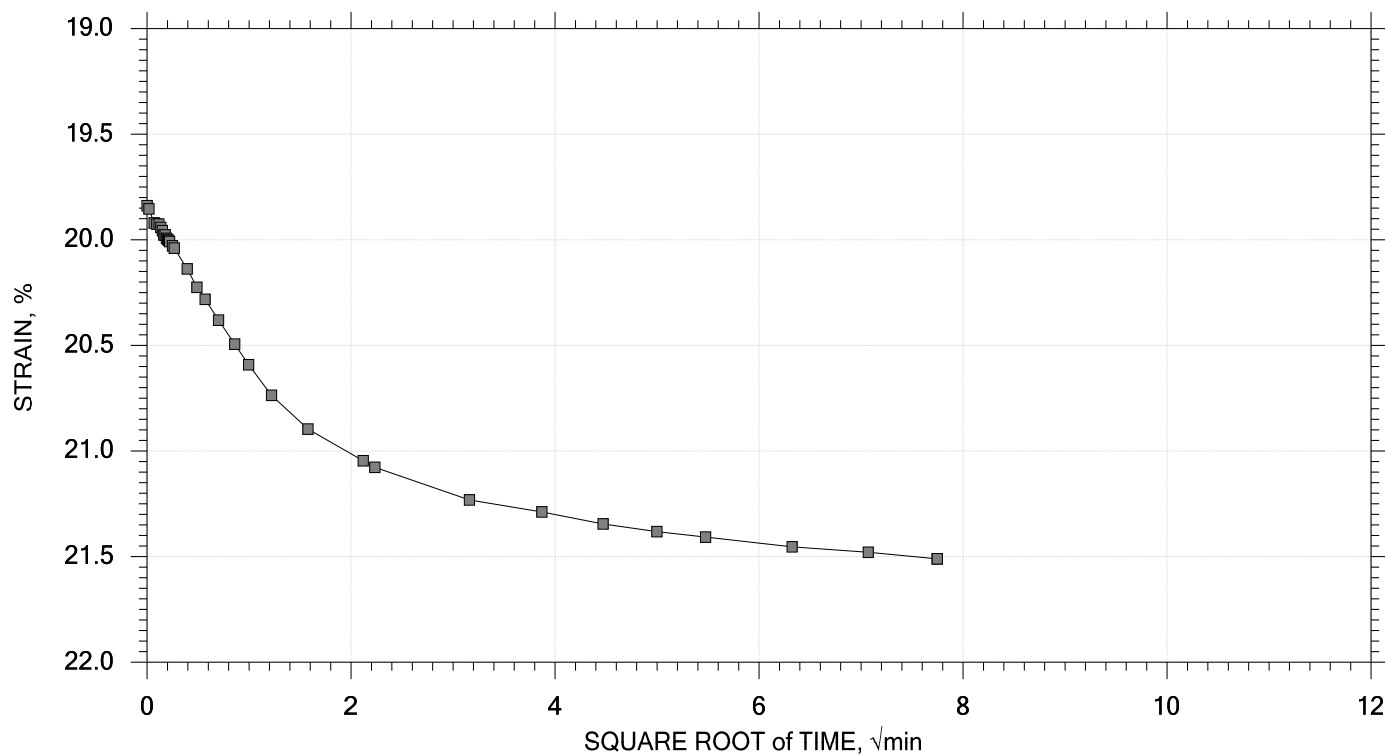
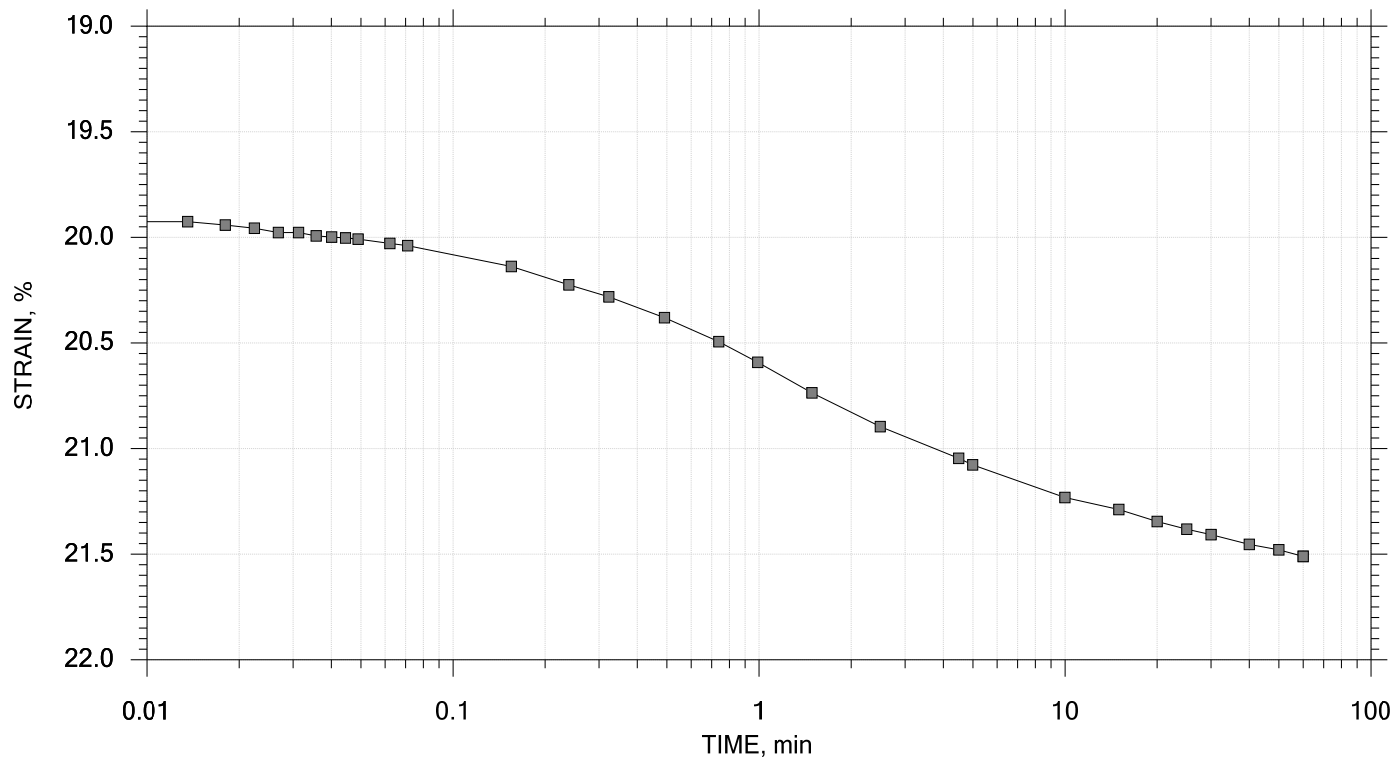
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	Boring No.: BB-WCWB-102	Tested By: GSL	Checked By: --
	Sample No.: 2U	Test Date: 6/25/16	Test No.: 270885
	Depth: 30.0-32.0 FT	Sample Type: INTACT	Elevation: --
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 16 of 21

Stress: 8 tsf



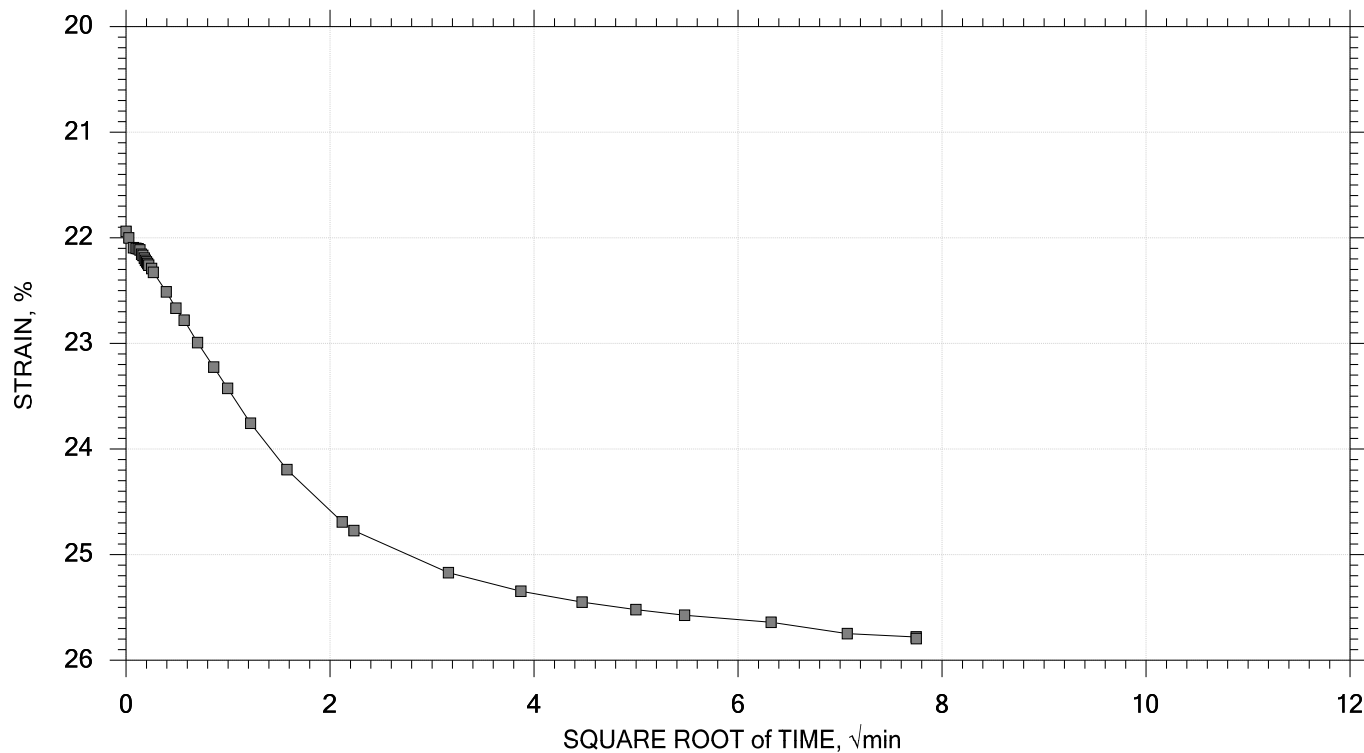
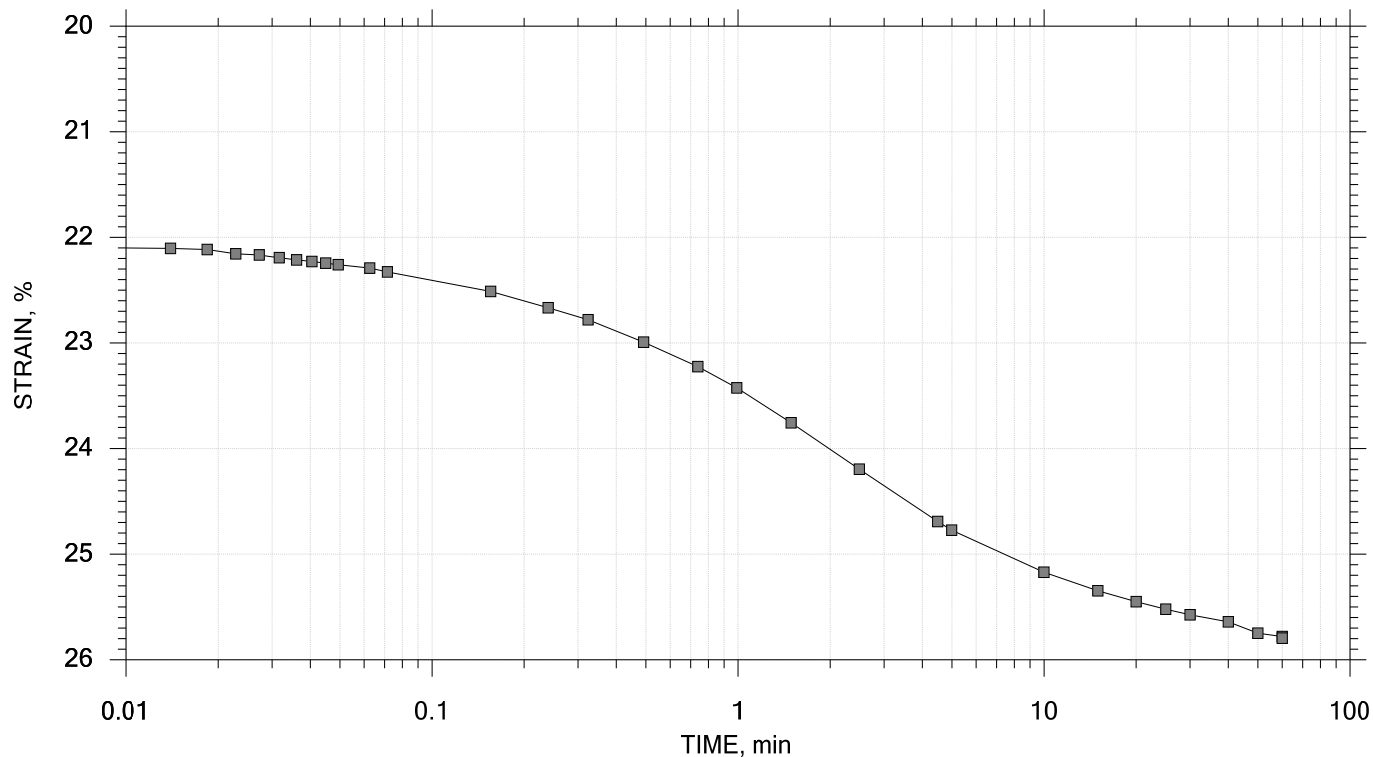
	Project: WINDHAM	Location: --	Project No.: 21924.00
	Boring No.: BB-WCWB-102	Tested By: GSL	Checked By: --
	Sample No.: 2U	Test Date: 6/25/16	Test No.: 270885
	Depth: 30.0-32.0 FT	Sample Type: INTACT	Elevation: --
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 17 of 21

Stress: 16 tsf



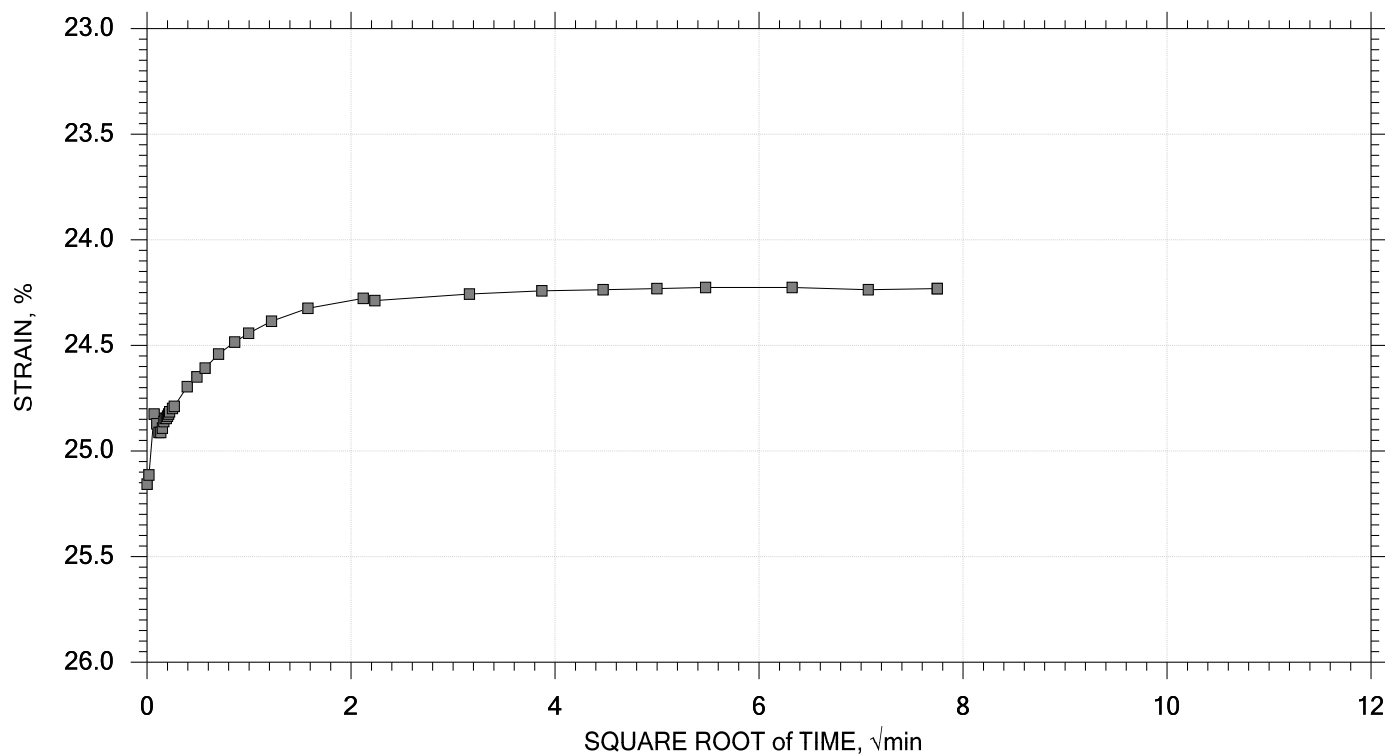
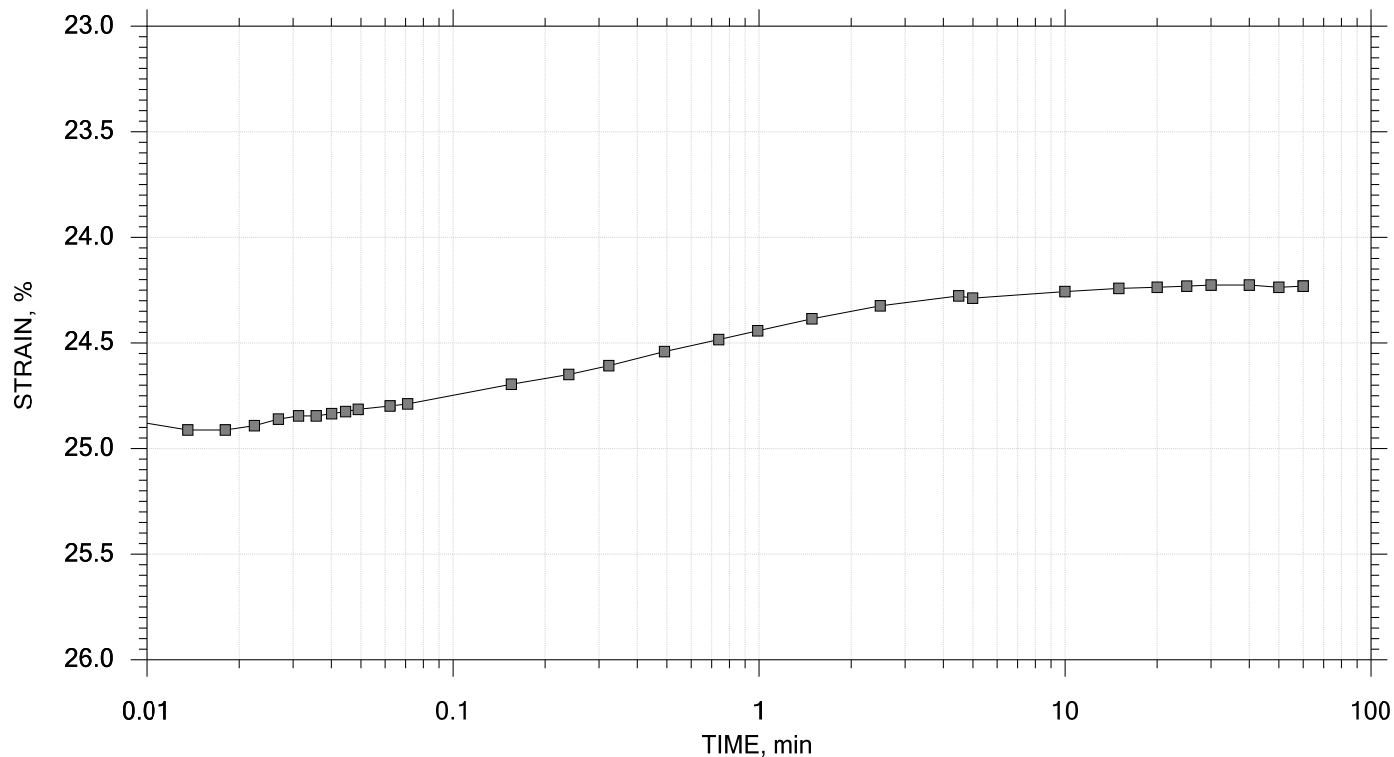
	Project: WINDHAM	Location: --	Project No.: 21924.00
	Boring No.: BB-WCWB-102	Tested By: GSL	Checked By: --
	Sample No.: 2U	Test Date: 6/25/16	Test No.: 270885
	Depth: 30.0-32.0 FT	Sample Type: INTACT	Elevation: --
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 18 of 21

Stress: 4 tsf



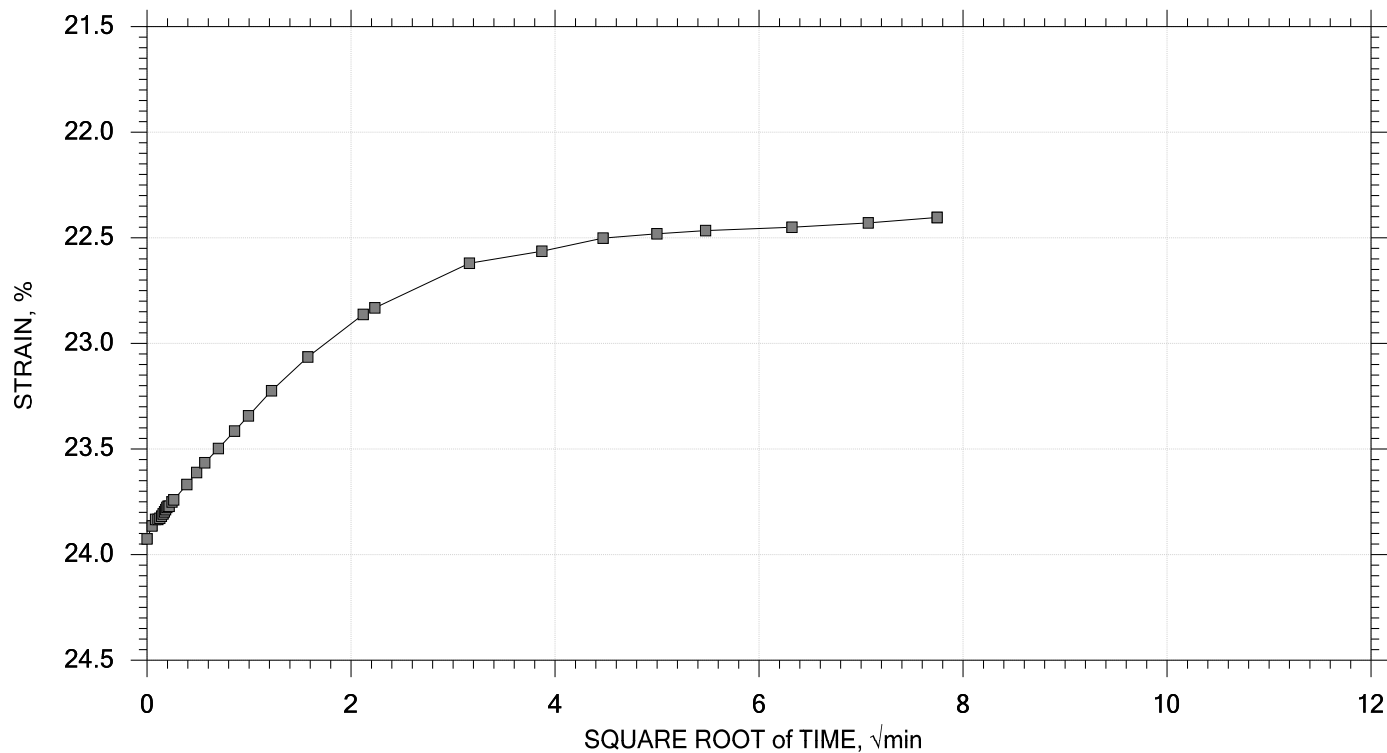
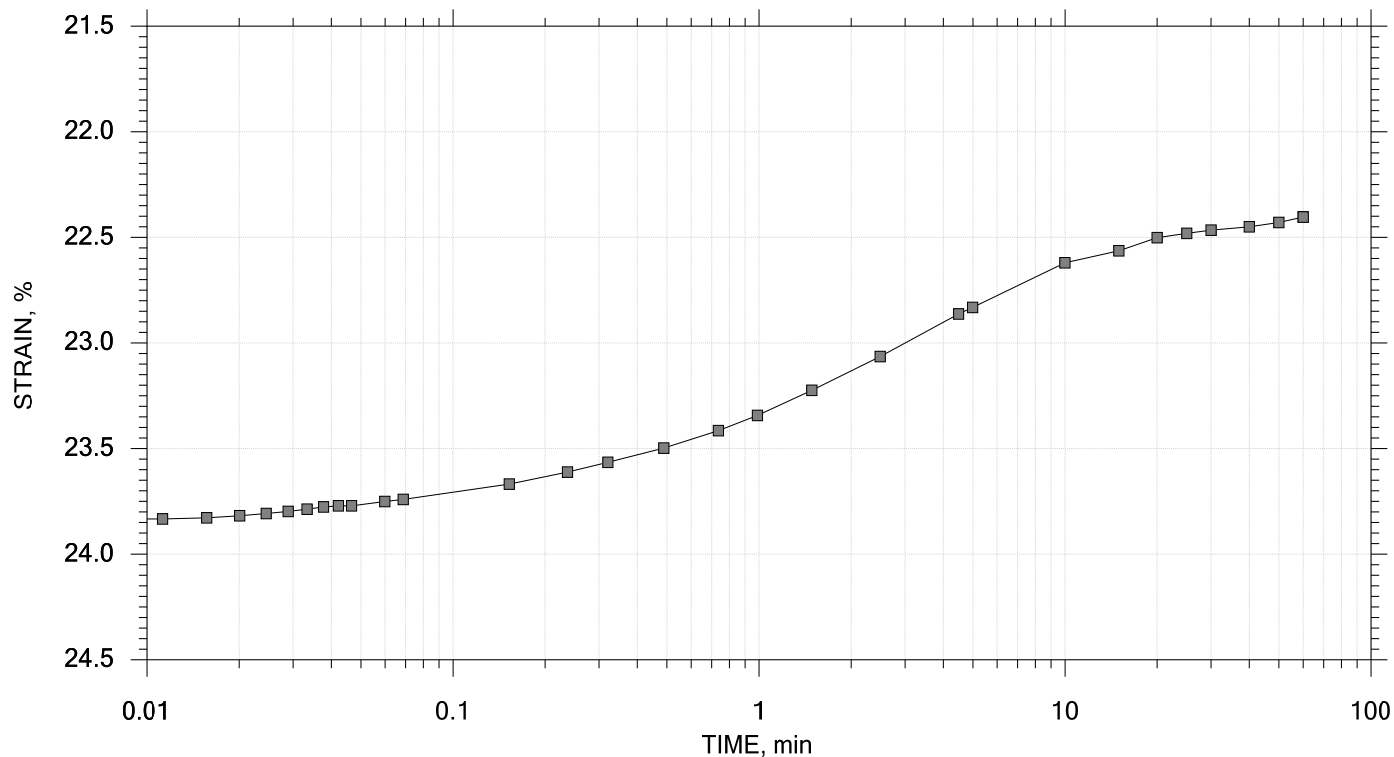
	Project: WINDHAM	Location: --	Project No.: 21924.00
	Boring No.: BB-WCWB-102	Tested By: GSL	Checked By: --
	Sample No.: 2U	Test Date: 6/25/16	Test No.: 270885
	Depth: 30.0-32.0 FT	Sample Type: INTACT	Elevation: --
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 19 of 21

Stress: 1 tsf



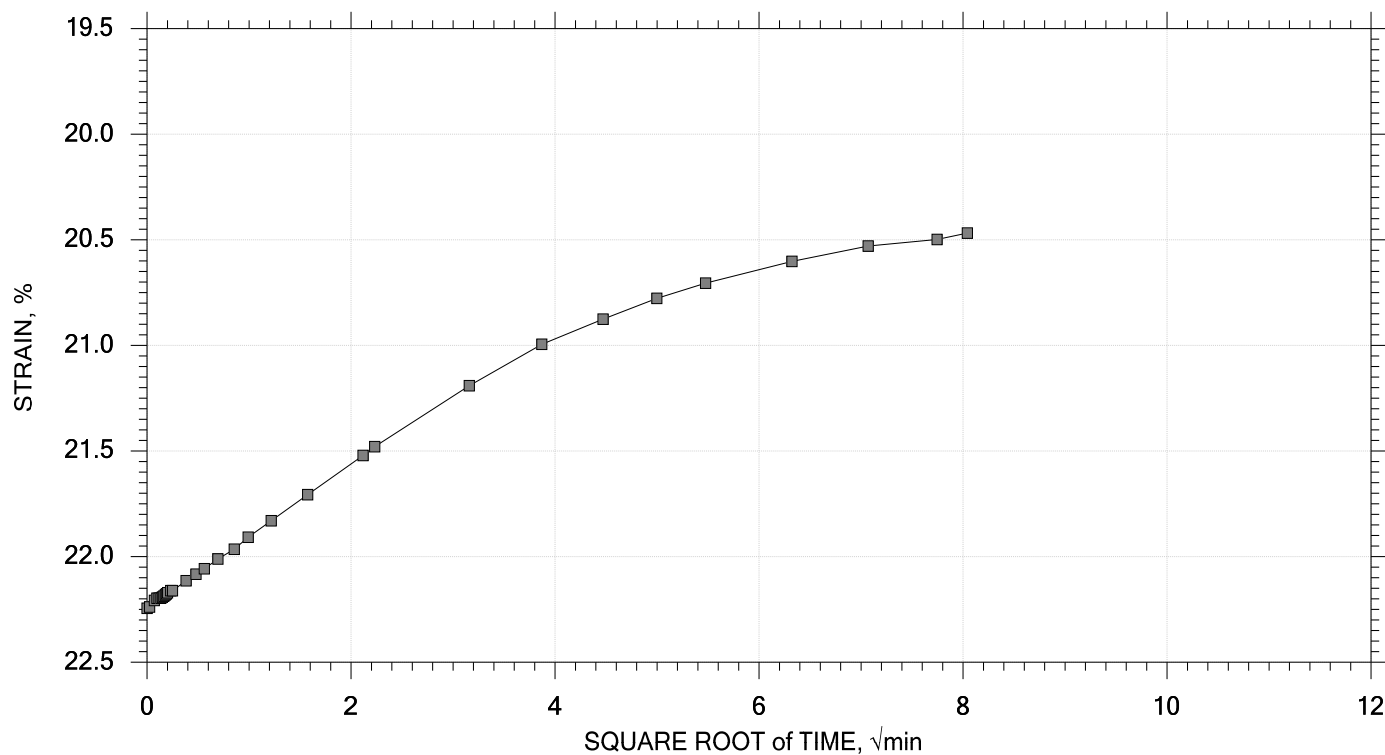
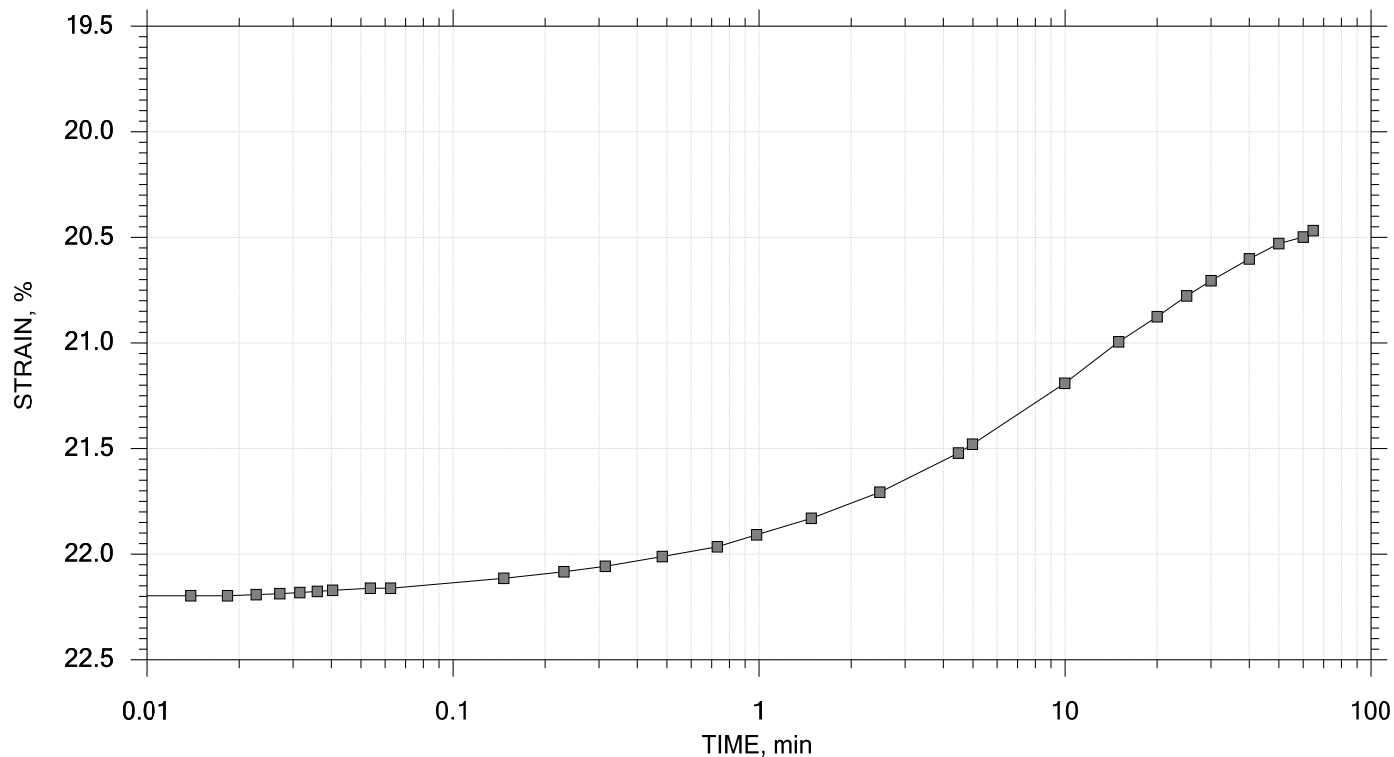
	Project: WINDHAM	Location: --	Project No.: 21924.00
	Boring No.: BB-WCWB-102	Tested By: GSL	Checked By: --
	Sample No.: 2U	Test Date: 6/25/16	Test No.: 270885
	Depth: 30.0-32.0 FT	Sample Type: INTACT	Elevation: --
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 20 of 21

Stress: 0.25 tsf



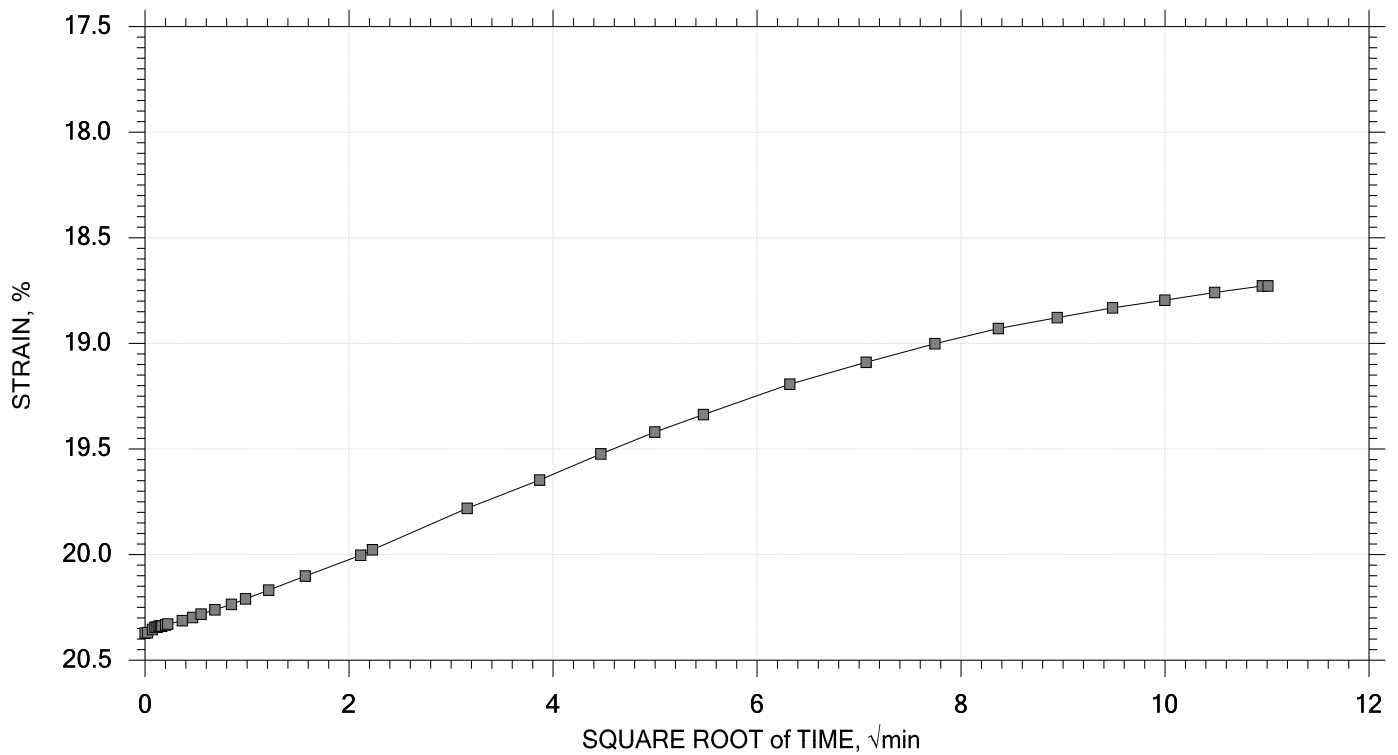
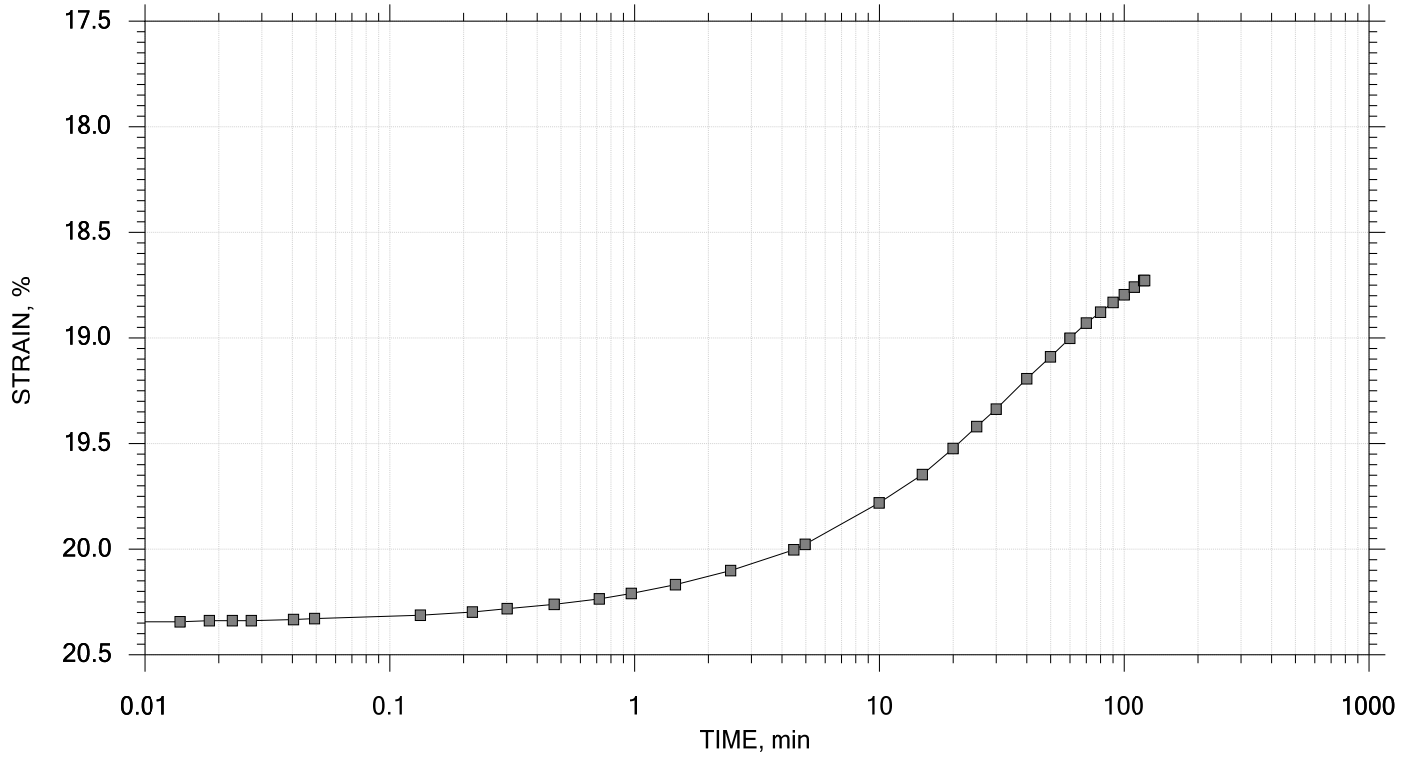
	Project: WINDHAM	Location: --	Project No.: 21924.00
	Boring No.: BB-WCWB-102	Tested By: GSL	Checked By: --
	Sample No.: 2U	Test Date: 6/25/16	Test No.: 270885
	Depth: 30.0-32.0 FT	Sample Type: INTACT	Elevation: --
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

TIME CURVES

Constant Load Step 21 of 21

Stress: 0.0625 tsf



	Project: WINDHAM	Location: --	Project No.: 21924.00
	Boring No.: BB-WCWB-102	Tested By: GSL	Checked By: --
	Sample No.: 2U	Test Date: 6/25/16	Test No.: 270885
	Depth: 30.0-32.0 FT	Sample Type: INTACT	Elevation: --
	Description: GRAY CLAY		
	Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test		

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: WINDHAM
 Boring No.: BB-WCWB-102
 Sample No.: 2U
 Test No.: 270885

Location: --
 Tested By: GSL
 Test Date: 6/25/16
 Sample Type: INTACT

Project No.: 21924.00
 Checked By: --
 Depth: 30.0-32.0 FT
 Elevation: --

Soil Description: GRAY CLAY

Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

Measured Specific Gravity: 2.73
 Initial Void Ratio: 1.19
 Final Void Ratio: 0.782

Liquid Limit: ---
 Plastic Limit: ---
 Plasticity Index: ---

Specimen Diameter: 2.50 in
 Initial Height: 1.04 in
 Final Height: 0.85 in

Container ID	Before Consolidation		After Consolidation	
	Trimmings	Specimen+Ring	Specimen+Ring	Trimmings
	129	RING	RING	82
Wt. Container + Wet Soil, gm	193.66	407.99	396.53	199.14
Wt. Container + Dry Soil, gm	158.80	366.61	366.61	168.87
Wt. Container, gm	61.970	262.15	262.15	63.180
Wt. Dry Soil, gm	96.830	104.46	104.46	105.69
Water Content, %	36.00	39.61	28.64	28.64
Void Ratio	---	1.19	0.782	---
Degree of Saturation, %	---	90.67	99.99	---
Dry Unit Weight, pcf	---	77.729	95.640	---

One-Dimensional Consolidation by ASTM D2435 - Method B

Project: WINDHAM
 Boring No.: BB-WCWB-102
 Sample No.: 2U
 Test No.: 270885

Location: --
 Tested By: GSL
 Test Date: 6/25/16
 Sample Type: INTACT

Project No.: 21924.00
 Checked By: --
 Depth: 30.0-32.0 FT
 Elevation: --

Soil Description: GRAY CLAY

Remarks: Maine Sensitive Load/Unload/Reload/Unload Consolidation Test

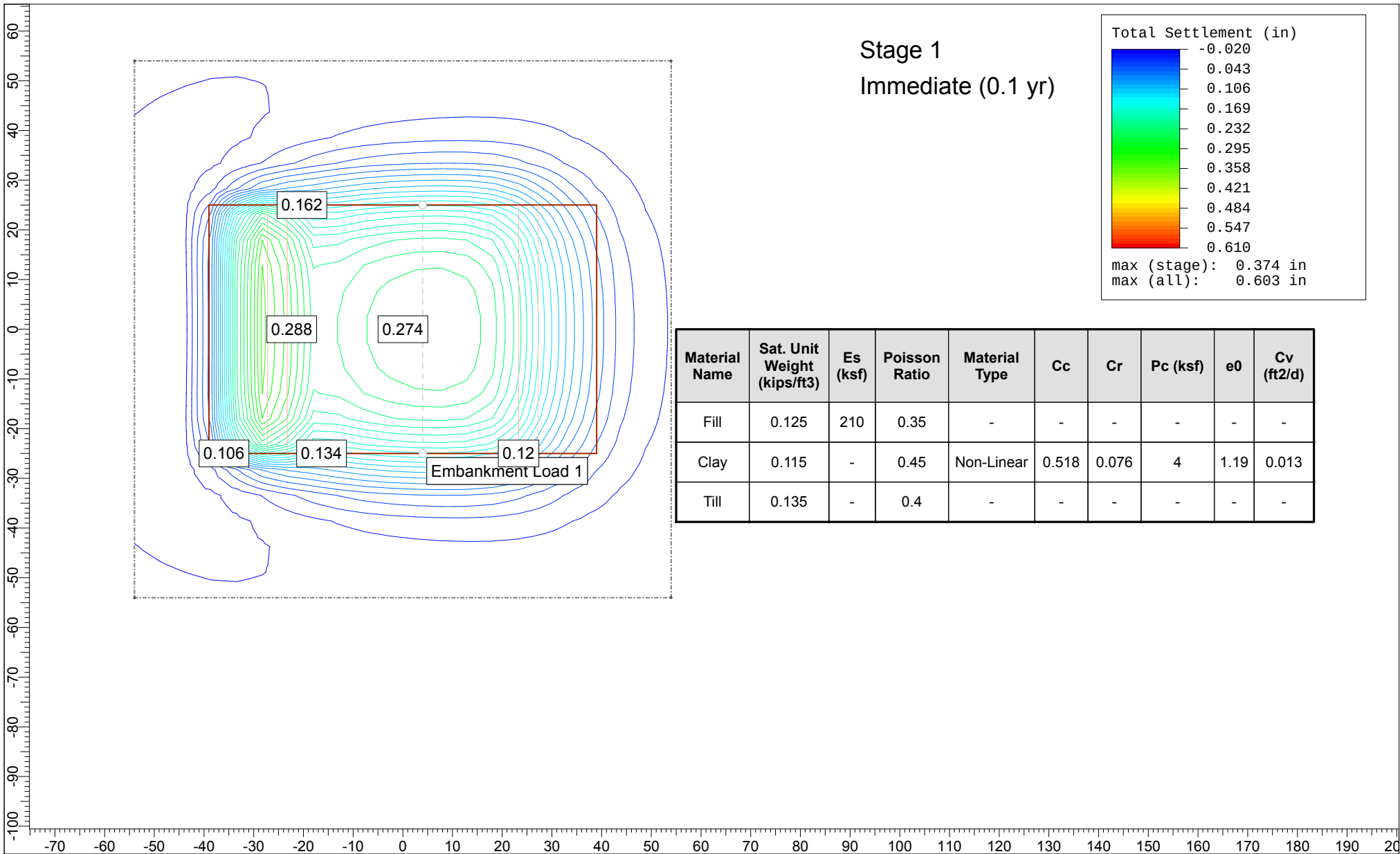
Displacement at End of Increment

	Applied Stress tsf	Final Displacement in	Void Ratio	Strain at End %	Sq.Rt T90 min	Cv ft ² /sec	Mv 1/tsf	k ft/day
1	0.0626	0.03220	1.12	3.09	0.000	0.00e+000	4.93e-001	0.00e+000
2	0.125	0.03661	1.12	3.51	2.916	8.56e-006	6.78e-002	1.57e-003
3	0.250	0.04323	1.10	4.15	3.634	6.79e-006	5.08e-002	9.31e-004
4	0.500	0.05007	1.09	4.80	2.620	9.30e-006	2.62e-002	6.58e-004
5	1.00	0.05852	1.07	5.61	2.686	8.93e-006	1.62e-002	3.90e-004
6	2.00	0.07451	1.04	7.14	6.360	3.68e-006	1.53e-002	1.52e-004
7	4.00	0.1376	0.903	13.2	12.638	1.70e-006	3.02e-002	1.39e-004
8	8.00	0.2119	0.747	20.3	13.908	1.33e-006	1.78e-002	6.39e-005
9	4.00	0.2052	0.761	19.7	0.542	3.15e-005	1.60e-003	1.36e-004
10	2.00	0.1979	0.777	19.0	2.527	6.87e-006	3.51e-003	6.51e-005
11	1.00	0.1897	0.794	18.2	5.494	3.22e-006	7.90e-003	6.86e-005
12	0.500	0.1807	0.813	17.3	15.223	1.19e-006	1.71e-002	5.48e-005
13	1.00	0.1848	0.804	17.7	3.803	4.77e-006	7.85e-003	1.01e-004
14	2.00	0.1925	0.788	18.5	3.682	4.86e-006	7.38e-003	9.68e-005
15	4.00	0.2037	0.764	19.5	3.410	5.14e-006	5.34e-003	7.40e-005
16	8.00	0.2244	0.721	21.5	6.165	2.74e-006	4.96e-003	3.66e-005
17	16.0	0.2690	0.627	25.8	5.186	3.00e-006	5.36e-003	4.33e-005
18	4.00	0.2527	0.661	24.2	0.682	2.20e-005	1.30e-003	7.73e-005
19	1.00	0.2337	0.701	22.4	5.927	2.65e-006	6.09e-003	4.35e-005
20	0.250	0.2135	0.744	20.5	25.622	6.43e-007	2.58e-002	4.48e-005
21	0.0625	0.1953	0.782	18.7	87.412	1.97e-007	9.28e-002	4.94e-005

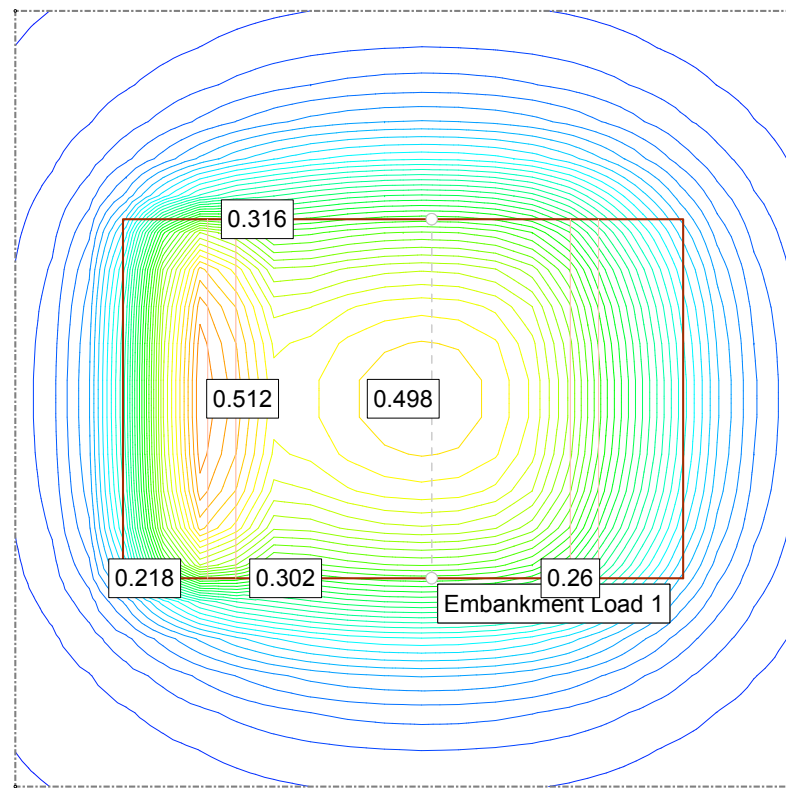
	Applied Stress tsf	Final Displacement in	Void Ratio	Strain at End %	Log T50 min	Cv ft ² /sec	Mv 1/tsf	k ft/day	Ca %
1	0.0626	0.03220	1.12	3.09	0.000	0.00e+000	4.93e-001	0.00e+000	0.00e+000
2	0.125	0.03661	1.12	3.51	0.000	0.00e+000	6.78e-002	0.00e+000	0.00e+000
3	0.250	0.04323	1.10	4.15	0.000	0.00e+000	5.08e-002	0.00e+000	0.00e+000
4	0.500	0.05007	1.09	4.80	0.000	0.00e+000	2.62e-002	0.00e+000	0.00e+000
5	1.00	0.05852	1.07	5.61	0.385	1.45e-005	1.62e-002	6.33e-004	0.00e+000
6	2.00	0.07451	1.04	7.14	0.809	6.72e-006	1.53e-002	2.78e-004	0.00e+000
7	4.00	0.1376	0.903	13.2	0.000	0.00e+000	3.02e-002	0.00e+000	0.00e+000
8	8.00	0.2119	0.747	20.3	2.525	1.70e-006	1.78e-002	8.18e-005	0.00e+000
9	4.00	0.2052	0.761	19.7	0.000	0.00e+000	1.60e-003	0.00e+000	0.00e+000
10	2.00	0.1979	0.777	19.0	0.477	8.47e-006	3.51e-003	8.02e-005	0.00e+000
11	1.00	0.1897	0.794	18.2	1.127	3.65e-006	7.90e-003	7.77e-005	0.00e+000
12	0.500	0.1807	0.813	17.3	2.371	1.77e-006	1.71e-002	8.18e-005	0.00e+000
13	1.00	0.1848	0.804	17.7	0.723	5.83e-006	7.85e-003	1.23e-004	0.00e+000
14	2.00	0.1925	0.788	18.5	1.071	3.89e-006	7.38e-003	7.74e-005	0.00e+000
15	4.00	0.2037	0.764	19.5	0.520	7.82e-006	5.34e-003	1.13e-004	0.00e+000
16	8.00	0.2244	0.721	21.5	1.009	3.88e-006	4.96e-003	5.19e-005	0.00e+000
17	16.0	0.2690	0.627	25.8	1.181	3.06e-006	5.36e-003	4.42e-005	0.00e+000
18	4.00	0.2527	0.661	24.2	0.208	1.67e-005	1.30e-003	5.88e-005	0.00e+000
19	1.00	0.2337	0.701	22.4	1.894	1.93e-006	6.09e-003	3.16e-005	0.00e+000
20	0.250	0.2135	0.744	20.5	0.000	0.00e+000	2.58e-002	0.00e+000	0.00e+000
21	0.0625	0.1953	0.782	18.7	0.000	0.00e+000	9.28e-002	0.00e+000	0.00e+000

APPENDIX E

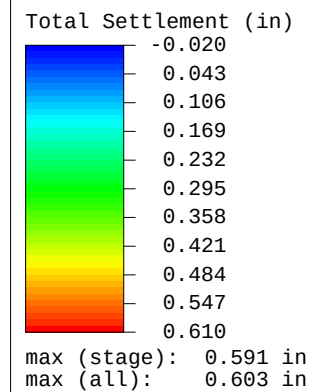
Calculations



	Project		Doles Bridge #5061 - Abutment No. 1	
	Analysis Description		Settlement Evaluation - Embankment Widening and 2 ft Grade Raise	
	Drawn By		Michael St. Pierre, P.E.	Company S. W. Cole Engineering, Inc.
	Date		February 2019 / Revised March 2019	File Name Abutment 1 Embankment Rev1.s3z



Stage 2
1 yr



Material Name	Sat. Unit Weight (kips/ft ³)	Es (ksf)	Poisson Ratio	Material Type	Cc	Cr	Pc (ksf)	e0	Cv (ft ² /d)
Fill	0.125	210	0.35	-	-	-	-	-	-
Clay	0.115	-	0.45	Non-Linear	0.518	0.076	4	1.19	0.013
Till	0.135	-	0.4	-	-	-	-	-	-



SETTLE3D 4.018

Project

Doles Bridge #5061 - Abutment No. 1

Analysis Description

Settlement Evaluation - Embankment Widening and 2 ft Grade Raise

Drawn By

Michael St. Pierre, P.E.

Company

S. W. Cole Engineering, Inc.

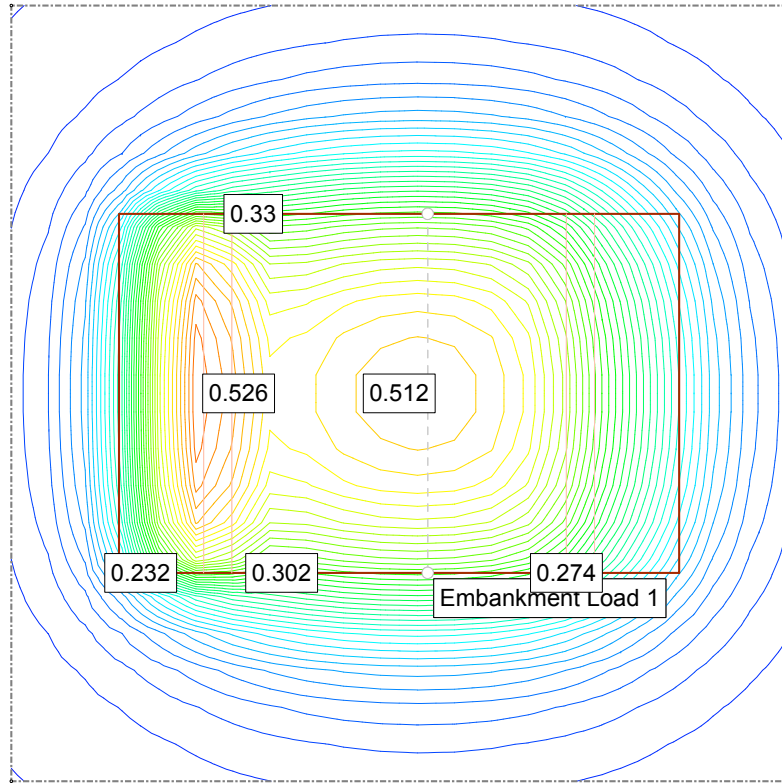
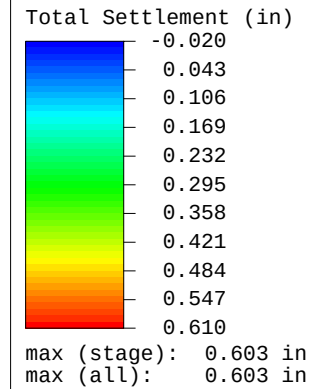
Date

February 2019 / Revised March 2019

File Name

Abutment 1 Embankment Rev1.s3z

Stage 3
50 yr



Material Name	Sat. Unit Weight (kips/ft ³)	Es (ksf)	Poisson Ratio	Material Type	Cc	Cr	Pc (ksf)	e0	Cv (ft ² /d)
Fill	0.125	210	0.35	-	-	-	-	-	-
Clay	0.115	-	0.45	Non-Linear	0.518	0.076	4	1.19	0.013
Till	0.135	-	0.4	-	-	-	-	-	-

Project

Doles Bridge #5061 - Abutment No. 1

Analysis Description

Settlement Evaluation - Embankment Widening and 2 ft Grade Raise

Drawn By

Michael St. Pierre, P.E.

Company

S. W. Cole Engineering, Inc.

Date

February 2019 / Revised March 2019

File Name

Abutment 1 Embankment Rev1.s3z

rocscience

Settle3D Analysis Information

Doles Bridge #5061 - Abutment No. 1

Project Settings

Document Name	Abutment 1 Embankment Rev1.s3z
Project Title	Doles Bridge #5061 - Abutment No. 1
Analysis	Settlement Evaluation - Embankment Widening and 2 ft Grade Raise
Author	Michael St. Pierre, P.E.
Company	S. W. Cole Engineering, Inc.
Date Created	February 2019 / Revised March 2019

Comments

Reviewed by TJB March 2019	
Stress Computation Method	Boussinesq
Time-dependent Consolidation Analysis	
Time Units	years
Permeability Units	feet/day
Poisson ratio for Boussinesq stress computation	0.2

Calculate settlement with mean stress

Include buoyancy effect when material settles below water table

Use average properties to calculate layered stresses

Ignore negative effective stresses in settlement calculations

Stage Settings

Stage #	Name	Time [years]
1	Stage 1	0
2	Stage 2	0.1
3	Stage 3	1
4	Stage 4	50

Results (relative to Stage: Stage 1 = 0 y)

Time taken to compute: 0 seconds

Stage: Stage 1 = 0 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	0
Total Consolidation Settlement [in]	0	0
Virgin Consolidation Settlement [in]	0	0
Recompression Consolidation Settlement [in]	0	0
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress ZZ [ksf]	0	0
Loading Stress XX [ksf]	0	0
Loading Stress YY [ksf]	0	0
Effective Stress ZZ [ksf]	0	0
Effective Stress XX [ksf]	0	0
Effective Stress YY [ksf]	0	0
Mean Stress [ksf]	0	0
Total Stress ZZ [ksf]	0	0
Total Stress XX [ksf]	0	0
Total Stress YY [ksf]	0	0
Modulus of Subgrade Reaction (Total) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Immediate) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Consolidation) [ksf/ft]	0	0
Total Strain	0	0
Pore Water Pressure [ksf]	0	0
Excess Pore Water Pressure [ksf]	0	0
Degree of Consolidation [%]	0	0
Pre-consolidation Stress [ksf]	0	0
Over-consolidation Ratio	0	0
Void Ratio	0	0
Permeability [ft/d]	0	0
Coefficient of Consolidation [ft ² /d]	0	0
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	0
Undrained Shear Strength	0	0

Stage: Stage 2 = 0.1 y

Data Type	Minimum	Maximum
Total Settlement [in]	-0.0189742	0.373564
Total Consolidation Settlement [in]	-0.0108612	0.226082
Virgin Consolidation Settlement [in]	0	0
Recompression Consolidation Settlement [in]	-0.0108612	0.226082
Immediate Settlement [in]	-0.0113558	0.149923
Secondary Settlement [in]	0	0
Loading Stress ZZ [ksf]	2.55006e-005	0.968464
Loading Stress XX [ksf]	-0.136419	0.376767
Loading Stress YY [ksf]	-0.217881	0.686084
Effective Stress ZZ [ksf]	-0.0309817	0.968464
Effective Stress XX [ksf]	-0.119449	0.99799
Effective Stress YY [ksf]	-0.224336	1.08002
Mean Stress [ksf]	-0.436792	0.564338
Total Stress ZZ [ksf]	2.55006e-005	0.968464
Total Stress XX [ksf]	-0.0924739	0.981508
Total Stress YY [ksf]	-0.193066	1.1492
Modulus of Subgrade Reaction (Total) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Immediate) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Consolidation) [ksf/ft]	0	0
Total Strain	-0.000437258	0.00904824
Pore Water Pressure [ksf]	-0.635095	0.393918
Excess Pore Water Pressure [ksf]	-0.635849	0.392177
Degree of Consolidation [%]	0	79.2283
Pre-consolidation Stress [ksf]	0	0.968424
Over-consolidation Ratio	-2.73812	0.240127
Void Ratio	-0.0204191	0.000957594
Permeability [ft/d]	0	0
Coefficient of Consolidation [ft ² /d]	0	0
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	0
Undrained Shear Strength	-0.00283065	0.0487092

Stage: Stage 3 = 1 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	0.590612
Total Consolidation Settlement [in]	0	0.443131
Virgin Consolidation Settlement [in]	0	0
Recompression Consolidation Settlement [in]	0	0.443131
Immediate Settlement [in]	-0.0113558	0.149923
Secondary Settlement [in]	0	0
Loading Stress ZZ [ksf]	2.55006e-005	0.968464
Loading Stress XX [ksf]	-0.136419	0.376767
Loading Stress YY [ksf]	-0.217881	0.686084
Effective Stress ZZ [ksf]	-0.000431887	0.968464
Effective Stress XX [ksf]	-0.0926382	1.24197
Effective Stress YY [ksf]	-0.168839	1.35906
Mean Stress [ksf]	-0.436792	0.564338
Total Stress ZZ [ksf]	2.55006e-005	0.968464
Total Stress XX [ksf]	-0.091813	0.981508
Total Stress YY [ksf]	-0.192557	1.15033
Modulus of Subgrade Reaction (Total) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Immediate) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Consolidation) [ksf/ft]	0	0
Total Strain	-0.000159854	0.0113011
Pore Water Pressure [ksf]	-0.71856	0.00193092
Excess Pore Water Pressure [ksf]	-0.720064	0.000550264
Degree of Consolidation [%]	0	99.8267
Pre-consolidation Stress [ksf]	0	0.968424
Over-consolidation Ratio	-3.71775	0.0046138
Void Ratio	-0.0249069	0
Permeability [ft/d]	0	0
Coefficient of Consolidation [ft ² /d]	0	0
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	0
Undrained Shear Strength	-2.31557e-006	0.0575171

Stage: Stage 4 = 50 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	0.603084
Total Consolidation Settlement [in]	0	0.455602
Virgin Consolidation Settlement [in]	0	0
Recompression Consolidation Settlement [in]	0	0.455602
Immediate Settlement [in]	-0.0113558	0.149923
Secondary Settlement [in]	0	0
Loading Stress ZZ [ksf]	2.55006e-005	0.968464
Loading Stress XX [ksf]	-0.136419	0.376767
Loading Stress YY [ksf]	-0.217881	0.686084
Effective Stress ZZ [ksf]	-0.000439136	0.968464
Effective Stress XX [ksf]	-0.0926382	1.24197
Effective Stress YY [ksf]	-0.168839	1.35906
Mean Stress [ksf]	-0.436792	0.564338
Total Stress ZZ [ksf]	2.55006e-005	0.968464
Total Stress XX [ksf]	-0.0917722	0.981508
Total Stress YY [ksf]	-0.192525	1.1504
Modulus of Subgrade Reaction (Total) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Immediate) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Consolidation) [ksf/ft]	0	0
Total Strain	-0.000159854	0.0113275
Pore Water Pressure [ksf]	-0.71851	0.00198924
Excess Pore Water Pressure [ksf]	-0.720064	0.000550264
Degree of Consolidation [%]	0	100
Pre-consolidation Stress [ksf]	0	0.968424
Over-consolidation Ratio	-3.72357	0.00491971
Void Ratio	-0.0249317	0
Permeability [ft/d]	0	0
Coefficient of Consolidation [ft ² /d]	0	0
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	0
Undrained Shear Strength	-2.31557e-006	0.0575171

Embankments**1. Embankment: "Embankment Load 1"**

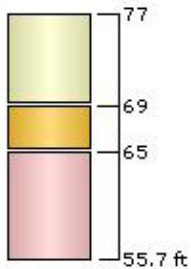
Label	Embankment Load 1
Center Line	(4, -25) to (4, 25)
Number of Layers	2
Near End Angle	90 degrees
Far End Angle	90 degrees
Base Width	70

Layer	Stage	Left Bench Width (ft)	Left Angle (deg)	Height (ft)	Unit Weight (kips/ft ³)	Right Angle (deg)	Right Bench Width (ft)
1	Stage 1 = 0 y	0	27	6	0.12	27	0
2	Stage 2 = 0.1 y	0	27	2	0.125	27	0

Soil Layers

Ground Surface Drained: Yes

Layer #	Type	Thickness [ft]	Depth [ft]	Drained at Bottom
1	Fill	8	-77	Yes
2	Clay	4	-69	No
3	Till	9.3	-65	Yes



Soil Properties

Property	Fill	Clay	Till
Color			
Unit Weight [kips/ft ³]	0.12	0.11	0.13
Saturated Unit Weight [kips/ft ³]	0.125	0.115	0.135
Poisson's Ratio	0.35	0.45	0.4
K0	1	1	1
Immediate Settlement	Enabled	Disabled	Disabled
E [ksf]	210	-	-
Eur [ksf]	210	-	-
Primary Consolidation	Disabled	Enabled	Disabled
Material Type		Non-Linear	
Cc	-	0.518	-
Cr	-	0.076	-
e0	-	1.19	-
Pc [ksf]	-	4	-
Cv [ft ² /d]	-	0.013	-
Cvr [ft ² /d]	-	0.013	-
B-bar	-	1	-
Undrained Su A [kips/ft ²]	0	0	0
Undrained Su S	0.2	0.2	0.2
Undrained Su m	0.8	0.8	0.8
Piezo Line ID	2	2	2

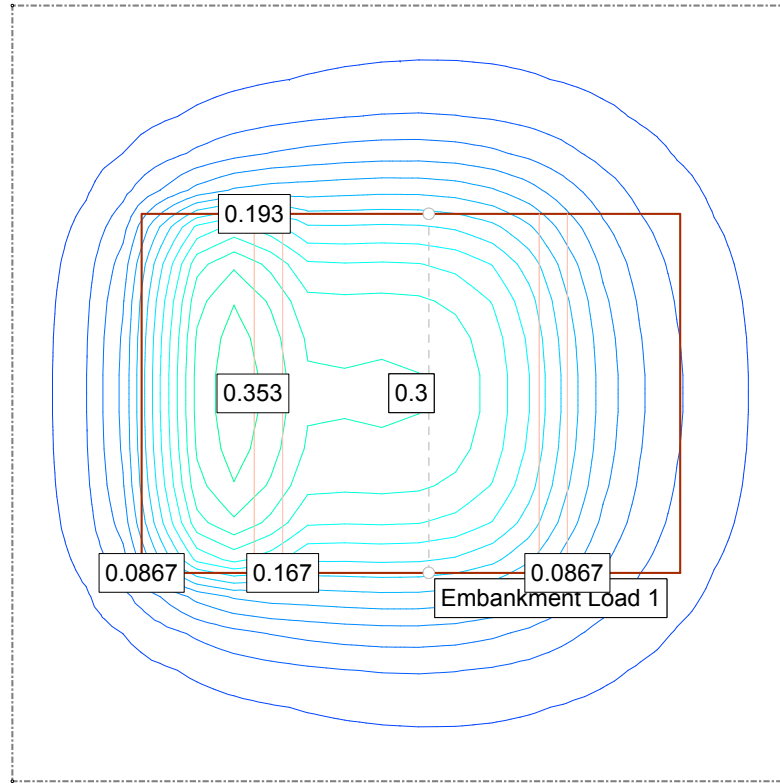
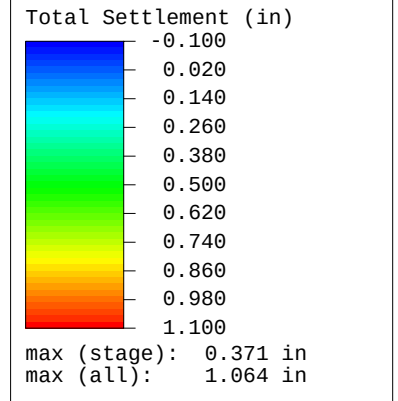
Groundwater

Groundwater method Piezometric Lines
Water Unit Weight 0.0624 kips/ft³

Piezometric Line Entities

ID	Depth (ft)
2	-76 ft

Stage 1
Immediate (0.1 yr)



Material Name	Sat. Unit Weight (kips/ft ³)	Es (ksf)	Poisson Ratio	Material Type	Cc	Cr	Pc (ksf)	e0	Cv (ft ² /d)
Fill	0.125	210	0.35	-	-	-	-	-	-
Clay 1	0.115	-	0.45	Non-Linear	0.402	0.051	3.1	1.1	0.007
Clay 2	0.115	-	0.45	Non-Linear	0.518	0.076	4	1.19	0.013
Till	0.135	-	0.4	-	-	-	-	-	-

Project

Doles Bridge #5061 - Abutment No. 2

Analysis Description

Settlement Evaluation - Embankment Widening and 2 ft Grade Raise

Drawn By

Michael St. Pierre, P.E.

Company

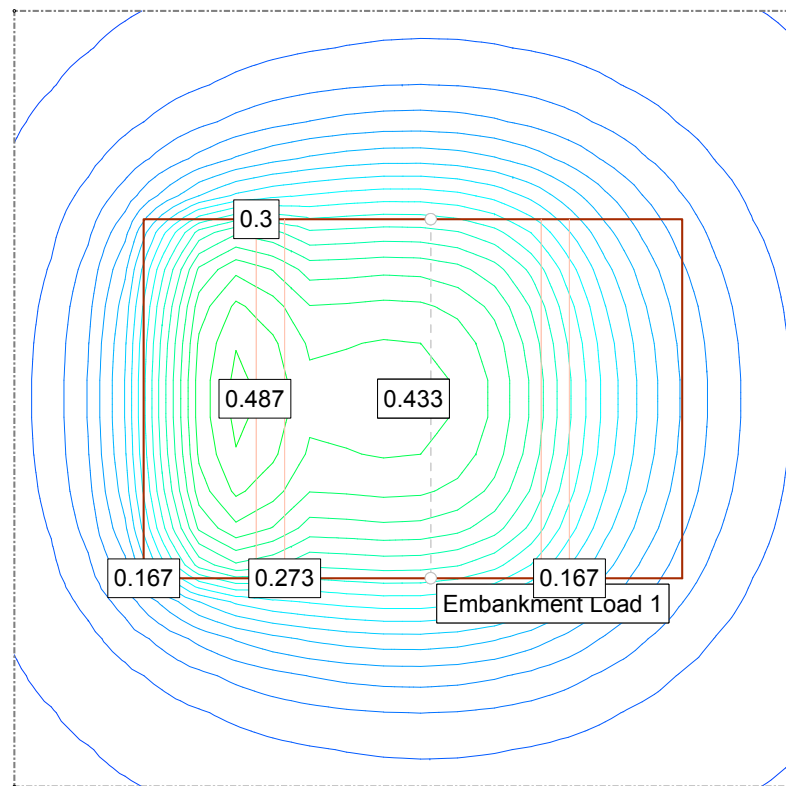
S. W. Cole Engineering, Inc.

Date

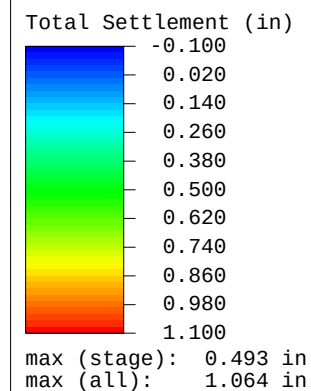
February 2019 / Revised March 2019

File Name

Abutment 2 Embankment Rev1.s3z



Stage 2
1 yr



Material Name	Sat. Unit Weight (kips/ft ³)	Es (ksf)	Poisson Ratio	Material Type	Cc	Cr	Pc (ksf)	e0	Cv (ft ² /d)
Fill	0.125	210	0.35	-	-	-	-	-	-
Clay 1	0.115	-	0.45	Non-Linear	0.402	0.051	3.1	1.1	0.007
Clay 2	0.115	-	0.45	Non-Linear	0.518	0.076	4	1.19	0.013
Till	0.135	-	0.4	-	-	-	-	-	-



SETTLE3D 4.018

Project

Doles Bridge #5061 - Abutment No. 2

Analysis Description

Settlement Evaluation - Embankment Widening and 2 ft Grade Raise

Drawn By

Michael St. Pierre, P.E.

Company

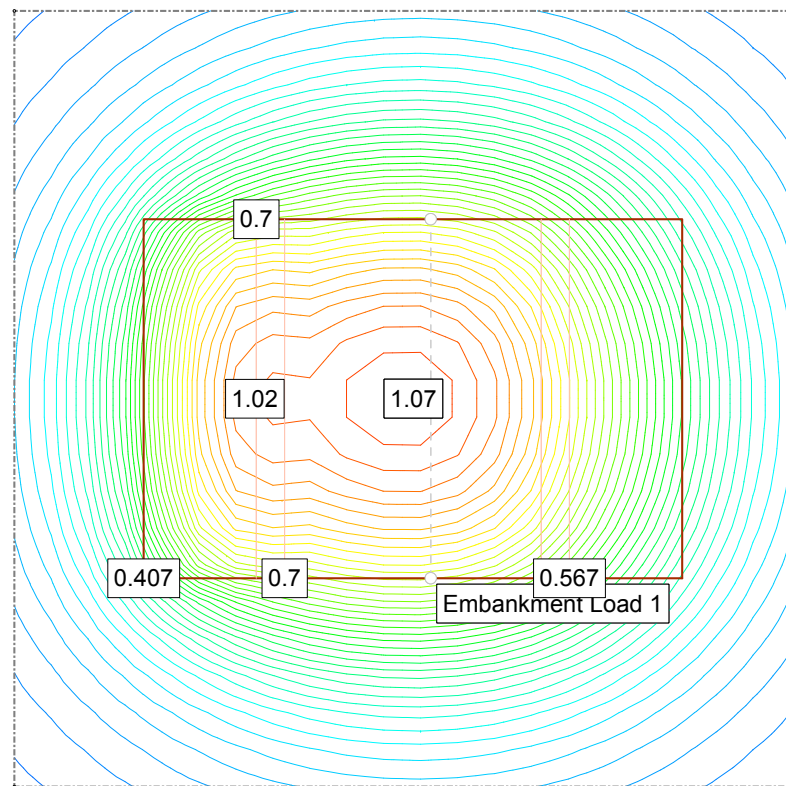
S. W. Cole Engineering, Inc.

Date

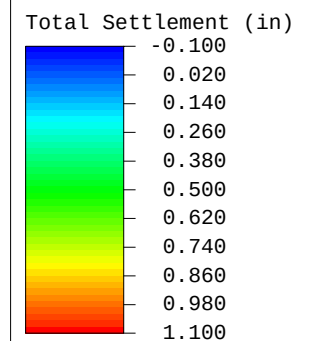
February 2019 / Revised March 2019

File Name

Abutment 2 Embankment Rev1.s3z



Stage 3
50 yr



max (stage): 1.064 in
max (all): 1.064 in

Material Name	Sat. Unit Weight (kips/ft ³)	Es (ksf)	Poisson Ratio	Material Type	Cc	Cr	Pc (ksf)	e0	Cv (ft ² /d)
Fill	0.125	210	0.35	-	-	-	-	-	-
Clay 1	0.115	-	0.45	Non-Linear	0.402	0.051	3.1	1.1	0.007
Clay 2	0.115	-	0.45	Non-Linear	0.518	0.076	4	1.19	0.013
Till	0.135	-	0.4	-	-	-	-	-	-

Project

Doles Bridge #5061 - Abutment No. 2

Analysis Description

Settlement Evaluation - Embankment Widening and 2 ft Grade Raise

Drawn By

Michael St. Pierre, P.E.

Company

S. W. Cole Engineering, Inc.

Date

February 2019 / Revised March 2019

File Name

Abutment 2 Embankment Rev1.s3z

rocscience

Settle3D Analysis Information

Doles Bridge #5061 - Abutment No. 2

Project Settings

Document Name	Abutment 2 Embankment Rev1.s3z
Project Title	Doles Bridge #5061 - Abutment No. 2
Analysis	Settlement Evaluation - Embankment Widening and 2 ft Grade Raise
Author	Michael St. Pierre, P.E.
Company	S. W. Cole Engineering, Inc.
Date Created	February 2019 / Revised March 2019

Comments

Reviewed by TJB March 2019	
Stress Computation Method	Boussinesq
Time-dependent Consolidation Analysis	
Time Units	years
Permeability Units	feet/day
Poisson ratio for Boussinesq stress computation	0.2

Calculate settlement with mean stress

Include buoyancy effect when material settles below water table

Use average properties to calculate layered stresses

Ignore negative effective stresses in settlement calculations

Stage Settings

Stage #	Name	Time [years]
1	Stage 1	0
2	Stage 2	0.1
3	Stage 3	1
4	Stage 4	50

Results (relative to Stage: Stage 1 = 0 y)

Time taken to compute: 7.60821 seconds

Stage: Stage 1 = 0 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	0
Total Consolidation Settlement [in]	0	0
Virgin Consolidation Settlement [in]	0	0
Recompression Consolidation Settlement [in]	0	0
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress ZZ [ksf]	0	0
Loading Stress XX [ksf]	0	0
Loading Stress YY [ksf]	0	0
Effective Stress ZZ [ksf]	0	0
Effective Stress XX [ksf]	0	0
Effective Stress YY [ksf]	0	0
Mean Stress [ksf]	0	0
Total Stress ZZ [ksf]	0	0
Total Stress XX [ksf]	0	0
Total Stress YY [ksf]	0	0
Modulus of Subgrade Reaction (Total) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Immediate) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Consolidation) [ksf/ft]	0	0
Total Strain	0	0
Pore Water Pressure [ksf]	0	0
Excess Pore Water Pressure [ksf]	0	0
Degree of Consolidation [%]	0	0
Pre-consolidation Stress [ksf]	0	0
Over-consolidation Ratio	0	0
Void Ratio	0	0
Permeability [ft/d]	0	0
Coefficient of Consolidation [ft ² /d]	0	0
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	0
Undrained Shear Strength	0	0

Stage: Stage 2 = 0.1 y

Data Type	Minimum	Maximum
Total Settlement [in]	-0.0121014	0.371486
Total Consolidation Settlement [in]	-0.00951786	0.265603
Virgin Consolidation Settlement [in]	0	0
Recompression Consolidation Settlement [in]	-0.00951786	0.265603
Immediate Settlement [in]	-0.0103055	0.106321
Secondary Settlement [in]	0	0
Loading Stress ZZ [ksf]	6.30218e-005	0.358012
Loading Stress XX [ksf]	-0.117213	0.220325
Loading Stress YY [ksf]	-0.186565	0.405937
Effective Stress ZZ [ksf]	-0.014474	1.03523
Effective Stress XX [ksf]	-0.100733	1.23861
Effective Stress YY [ksf]	-0.184802	1.33428
Mean Stress [ksf]	0.00160194	0.3771
Total Stress ZZ [ksf]	6.30218e-005	0.358012
Total Stress XX [ksf]	-0.100726	0.516771
Total Stress YY [ksf]	-0.167915	0.711371
Modulus of Subgrade Reaction (Total) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Immediate) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Consolidation) [ksf/ft]	0	0
Total Strain	-0.000150608	0.00587432
Pore Water Pressure [ksf]	-0.930224	0.176227
Excess Pore Water Pressure [ksf]	-0.930753	0.174844
Degree of Consolidation [%]	0	83.1812
Pre-consolidation Stress [ksf]	0	1.03021
Over-consolidation Ratio	-69.2457	183.777
Void Ratio	-0.0124603	0.000316276
Permeability [ft/d]	0	0
Coefficient of Consolidation [ft ² /d]	0	0
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	4.64424
Undrained Shear Strength	-0.00185988	0.0391223

Stage: Stage 3 = 1 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	0.493458
Total Consolidation Settlement [in]	0	0.387576
Virgin Consolidation Settlement [in]	0	0
Recompression Consolidation Settlement [in]	0	0.387576
Immediate Settlement [in]	-0.0103055	0.106321
Secondary Settlement [in]	0	0
Loading Stress ZZ [ksf]	6.30218e-005	0.358012
Loading Stress XX [ksf]	-0.117213	0.220325
Loading Stress YY [ksf]	-0.186565	0.405937
Effective Stress ZZ [ksf]	-0.00650347	1.19952
Effective Stress XX [ksf]	-0.100733	1.37753
Effective Stress YY [ksf]	-0.149661	1.48975
Mean Stress [ksf]	0.00160194	0.3771
Total Stress ZZ [ksf]	6.30218e-005	0.358012
Total Stress XX [ksf]	-0.100727	0.517262
Total Stress YY [ksf]	-0.167916	0.712007
Modulus of Subgrade Reaction (Total) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Immediate) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Consolidation) [ksf/ft]	0	0
Total Strain	-0.000144558	0.00662845
Pore Water Pressure [ksf]	-0.980668	0.10897
Excess Pore Water Pressure [ksf]	-0.98169	0.108018
Degree of Consolidation [%]	0	99.7535
Pre-consolidation Stress [ksf]	0	1.1948
Over-consolidation Ratio	-69.2451	0.188384
Void Ratio	-0.0139682	0.000164261
Permeability [ft/d]	0	0
Coefficient of Consolidation [ft ² /d]	0	0
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	26.4593
Undrained Shear Strength	-3.22682e-006	0.0439505

Stage: Stage 4 = 50 y

Data Type	Minimum	Maximum
Total Settlement [in]	0	1.0636
Total Consolidation Settlement [in]	0	0.97814
Virgin Consolidation Settlement [in]	0	0
Recompression Consolidation Settlement [in]	0	0.97814
Immediate Settlement [in]	-0.0103055	0.106321
Secondary Settlement [in]	0	0
Loading Stress ZZ [ksf]	6.30218e-005	0.358012
Loading Stress XX [ksf]	-0.117213	0.220325
Loading Stress YY [ksf]	-0.186565	0.405937
Effective Stress ZZ [ksf]	-0.000381345	1.1963
Effective Stress XX [ksf]	-0.100733	1.37753
Effective Stress YY [ksf]	-0.136365	1.48975
Mean Stress [ksf]	0.00160194	0.3771
Total Stress ZZ [ksf]	6.30218e-005	0.358012
Total Stress XX [ksf]	-0.100727	0.519319
Total Stress YY [ksf]	-0.167916	0.714644
Modulus of Subgrade Reaction (Total) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Immediate) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Consolidation) [ksf/ft]	0	0
Total Strain	-0.000144558	0.00663793
Pore Water Pressure [ksf]	-0.978492	0.00386754
Excess Pore Water Pressure [ksf]	-0.98169	0.000390676
Degree of Consolidation [%]	0	100
Pre-consolidation Stress [ksf]	0	1.1948
Over-consolidation Ratio	-69.2425	0.353908
Void Ratio	-0.0139545	0
Permeability [ft/d]	0	0
Coefficient of Consolidation [ft ² /d]	0	0
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	99.2375
Undrained Shear Strength	-3.22682e-006	0.0439505

Embankments**1. Embankment: "Embankment Load 1"**

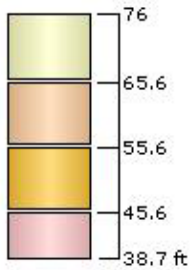
Label	Embankment Load 1
Center Line	(4, -25) to (4, 25)
Number of Layers	2
Near End Angle	90 degrees
Far End Angle	90 degrees
Base Width	70

Layer	Stage	Left Bench Width (ft)	Left Angle (deg)	Height (ft)	Unit Weight (kips/ft ³)	Right Angle (deg)	Right Bench Width (ft)
1	Stage 1 = 0 y	0	27	8	0.12	27	0
2	Stage 2 = 0.1 y	0	27	2	0.125	27	0

Soil Layers

Ground Surface Drained: Yes

Layer #	Type	Thickness [ft]	Depth [ft]	Drained at Bottom
1	Fill	10.4	-76	Yes
2	Clay 1	10	-65.6	No
3	Clay 2	10	-55.6	Yes
4	Till	6.9	-45.6	Yes



Soil Properties

Property	Fill	Clay 1	Clay 2	Till
Color				
Unit Weight [kips/ft ³]	0.12	0.11	0.11	0.13
Saturated Unit Weight [kips/ft ³]	0.125	0.115	0.115	0.135
Poisson's Ratio	0.35	0.45	0.45	0.4
K0	1	1	1	1
Immediate Settlement	Enabled	Disabled	Disabled	Disabled
E [ksf]	210	-	-	-
Eur [ksf]	210	-	-	-
Primary Consolidation	Disabled	Enabled	Enabled	Disabled
Material Type		Non-Linear	Non-Linear	
Cc	-	0.402	0.518	-
Cr	-	0.051	0.076	-
e0	-	1.1	1.19	-
Pc [ksf]	-	3.1	4	-
Cv [ft ² /d]	-	0.007	0.013	-
Cvr [ft ² /d]	-	0.007	0.013	-
B-bar	-	1	1	-
Undrained Su A [kips/ft ²]	0	0	0	0
Undrained Su S	0.2	0.2	0.2	0.2
Undrained Su m	0.8	0.8	0.8	0.8
Piezo Line ID	2	2	2	2

Groundwater

Groundwater method Piezometric Lines
Water Unit Weight 0.0624 kips/ft³

Piezometric Line Entities

ID	Depth (ft)
2	-76 ft

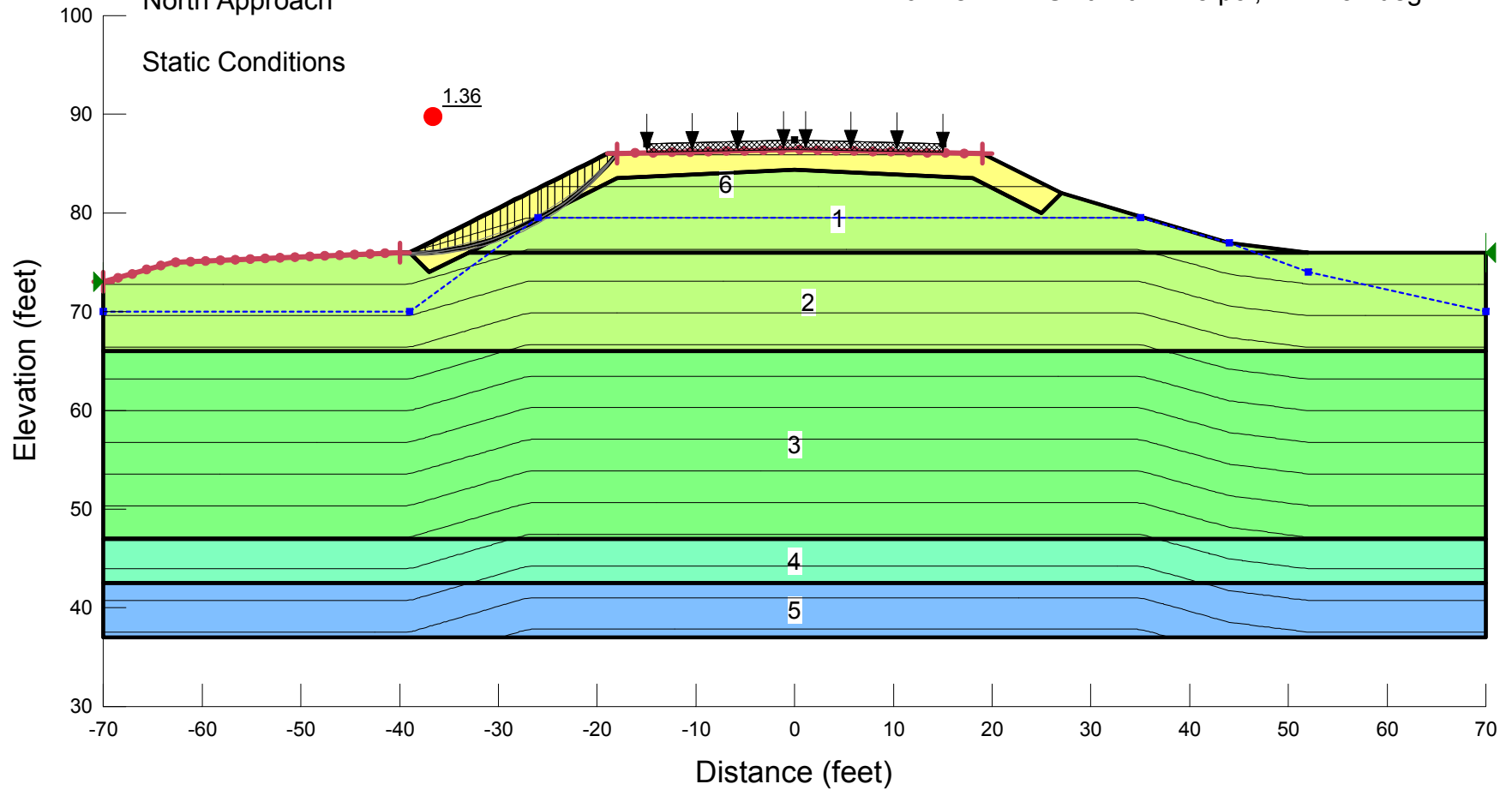
WIN 21924
Doles Bridge #5061
Windham, Maine

Station 911+00
North Approach

Static Conditions

Materials:

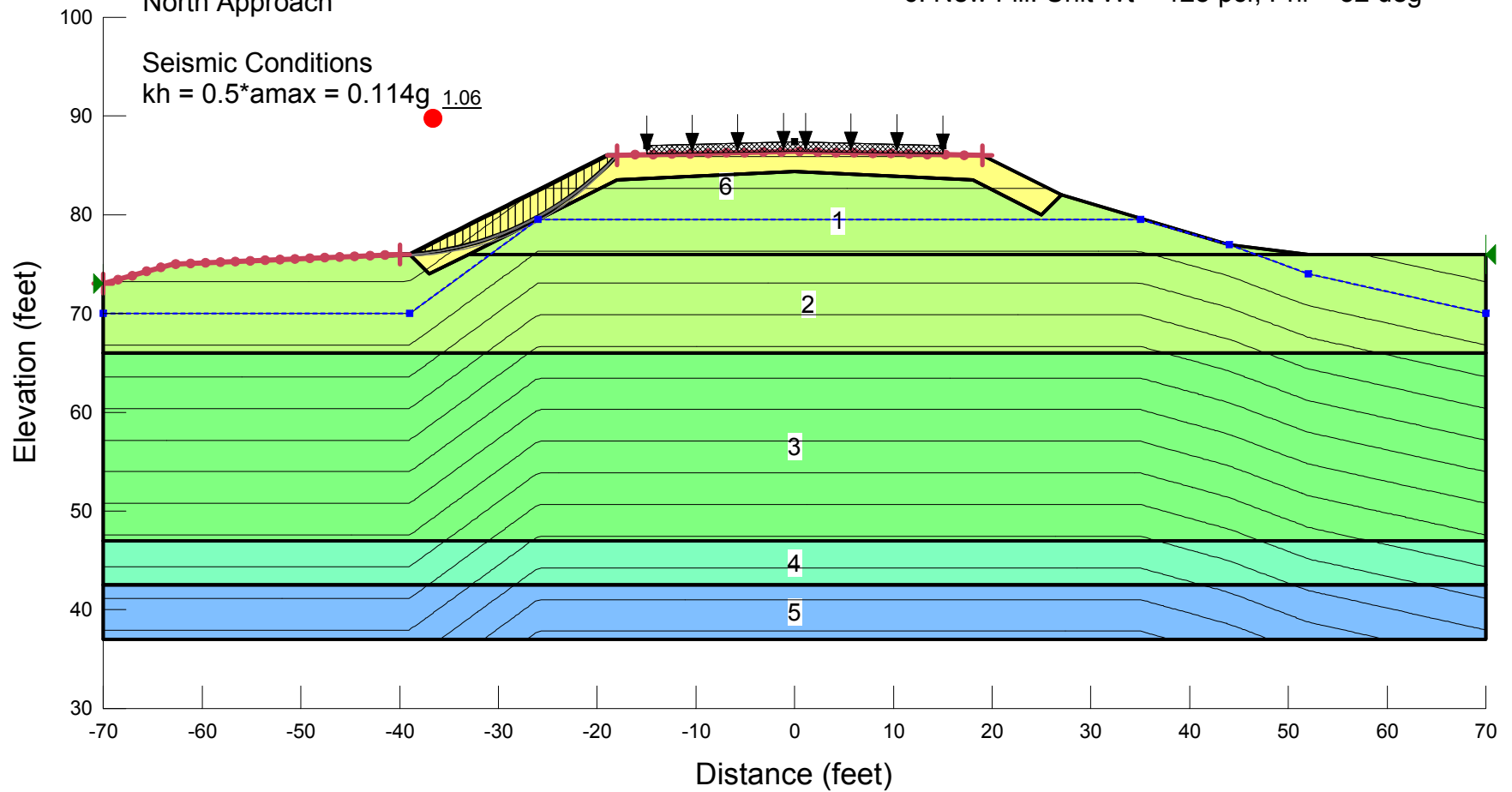
- 1+2. Existing Fill: Unit Wt = 120 pcf, $\Phi = 30^\circ$
- 3. Marine Clay: Unit Wt = 115 pcf, $C = 700$ psf
- 4. Glacial Till: Unit Wt = 130 pcf, $\Phi = 34^\circ$
- 5. Bedrock: Impenetrable
- 6. New Fill: Unit Wt = 125 pcf, $\Phi = 32^\circ$



Station 911+00
North Approach

4g 1.06

- 1+2. Existing Fill: Unit Wt = 120 pcf, $\Phi = 30^\circ$
3. Marine Clay: Unit Wt = 115 pcf, $C = 700$ psf
4. Glacial Till: Unit Wt = 130 pcf, $\Phi = 34^\circ$
5. Bedrock: Impenetrable
6. New Fill: Unit Wt = 125 pcf, $\Phi = 32^\circ$



Design of Bearing H-Piles

Reference:

1. AASHTO LRFD Bridge Design Specifications, 8th Edition, 2017.
2. AASHTO Standard Specifications for Highway Bridges 17th Edition, 2002.

Bedrock Properties

RQD:	BB-WCWB-102	R1 = 76%
	BB-WCWB-102A	R1 & R2 = 91 & 84%
	BB-WCWB-201	R1 & R2 = 40 & 87%

Rock Type: GRANOFELS, hard, very slightly weathered, low to moderately dipping close, and tight

Friction Angle: $\phi = 34$ to 40 deg (LRFD Table C10.4.6.4-1)

$C_o = 9,000 - 55,000$ psi (AASHTO Table 4.4.8.1.2B)

Pile Properties:

HP12x53

HP12x74

HP14x73

HP14x89

NOTE: ALL MARTICES IN THIS ORDER

$$f_y := 50 \text{ ksi}$$

$$A_s := \begin{bmatrix} 15.5 \\ 21.8 \\ 21.4 \\ 26.1 \end{bmatrix} \cdot \text{in}^2$$

$$d := \begin{bmatrix} 11.8 \\ 12.1 \\ 13.6 \\ 13.8 \end{bmatrix} \cdot \text{in}$$

$$b := \begin{bmatrix} 12.0 \\ 12.2 \\ 14.6 \\ 14.7 \end{bmatrix} \cdot \text{in}$$

$$A_p := \overrightarrow{(d \cdot b)} = \begin{bmatrix} 141.6 \\ 147.62 \\ 198.56 \\ 202.86 \end{bmatrix} \text{in}^2 \quad \text{Area of Perimeter}$$

Nominal and Factored Structural Compressive Resistance

Find Nominal Axial Structural Resistance

$$Q := 1 \quad \text{Slenderness reduction factor, LRFD Article 6.9.4.2}$$

$$P_o := f_y \cdot A_s = \begin{bmatrix} 775 \\ 1090 \\ 1070 \\ 1305 \end{bmatrix} \text{ kip}$$

Structural Resistance of unbraced segment

Assume 4 foot unbraced section due to scour $L_u=4$

Determine elastic critical buckline resistance P_e

$$E_s := 29000 \text{ ksi}$$

$$K_{eff} := 2.0 \quad \text{effective length factor / LRFD Table C4.6.2.5-1}$$

$$l_{unbraced} := 4 \text{ ft} \quad \text{unbraced length top of pile}$$

$$r_y := \begin{bmatrix} 2.86 \\ 2.92 \\ 3.49 \\ 3.53 \end{bmatrix} \cdot \text{in} \quad \text{radius of gyration, weak axis / LRFD Article C6.9.4.1.2}$$

LRFD Eqn 6.9.4.1.2-1

$$P_e := \left(\frac{\pi^2 \cdot E_s}{\left(\frac{K_{eff} \cdot l_{unbraced}}{r_y} \right)^2} \cdot A_s \right) = \begin{bmatrix} 3937 \\ 5773 \\ 8095 \\ 10101 \end{bmatrix} \text{ kip}$$

LRFD Article 6.9.4.1.1

$$\frac{P_e}{P_o} = \begin{bmatrix} 5.081 \\ 5.296 \\ 7.565 \\ 7.74 \end{bmatrix} \quad P_n := \left\| \begin{array}{l} \text{if } \left\| \frac{P_e}{P_o} \geq 0.44 \right\| \\ \left\| \frac{0.658 \left(\frac{P_o}{P_e} \right) \cdot P_o}{\frac{P_e}{P_o}} \right\| \\ \text{if } \left\| \frac{P_e}{P_o} < 0.44 \right\| \\ \left\| 0.877 \cdot P_e \right\| \end{array} \right\| = \begin{bmatrix} 714 \\ 1007 \\ 1012 \\ 1236 \end{bmatrix} \text{ kip}$$

Find Factored Axial Structural Resistance at Strength Limit State

$$\phi_{cu} := 0.7 \quad \text{LRFD Article 6.5.4.2}$$

$$P_r := \phi_{cu} \cdot P_n = \begin{bmatrix} 500 \\ 705 \\ 709 \\ 865 \end{bmatrix} \text{ kip} \quad \text{LRFD Eqn 6.9.2.1-1}$$

Find Factored Axial Structural Resistance at Strength Limit State

Structural Resistance of braced length

$$l_{braced} := 0.1 \text{ ft}$$

LRFD Eqn 6.9.4.1.2-1

$$P_e := \left(\frac{\pi^2 \cdot E_s}{\left(\frac{K_{eff} \cdot l_{braced}}{r_y} \right)^2} \cdot A_s \right) = \begin{bmatrix} 6299978 \\ 9236288 \\ 12952091 \\ 16160886 \end{bmatrix} \text{ kip}$$

LRFD Article 6.9.4.1.1

$$\frac{P_e}{P_o} = \begin{bmatrix} 8129.004 \\ 8473.659 \\ 12104.758 \\ 12383.821 \end{bmatrix} \quad \text{if } P_e/P_o \geq 0.44 \text{ then} \quad P_n := 0.658 \left(\frac{P_o}{P_e} \right) \cdot P_o = \begin{bmatrix} 775 \\ 1090 \\ 1070 \\ 1305 \end{bmatrix} \text{ kip}$$

Find Factored Axial Structural Resistance at Strength Limit State

$$\phi_c := 0.5 \quad \text{LRFD Article 6.5.4.2}$$

$$P_r := \phi_c \cdot P_n = \begin{bmatrix} 387 \\ 545 \\ 535 \\ 652 \end{bmatrix} \text{ kip} \quad \text{LRFD Eqn 6.9.2.1-1}$$

Nominal and Factored Geotechnical Resistance

LRFD Article 10.7.3.2.3 states "the nominal resistance of piles driven to point bearing on hard rock where pile penetration into the rock formation is minimal is controlled by the structural limit state. The nominal bearing resistance shall not exceed the values obtained from Article 6.9.4.1 with the resistance factor specified in Article 6.5.4.2 and Article 6.15 for severe driving conditions. A pile-driving acceptance criteria shall be developed that will prevent pile damage."

Nominal Structural Resistance

$$P_n = \begin{bmatrix} 775 \\ 1090 \\ 1070 \\ 1305 \end{bmatrix} \text{ kip}$$

Find Factored Geotechnical Resistance at Strength, Service and Extreme Limit States

$$\phi_c := 0.5 \quad \text{LRFD 6.9.2.1-1 for Strength Limit State}$$

$$P_r := \phi_c \cdot P_n = \begin{bmatrix} 387 \\ 545 \\ 535 \\ 652 \end{bmatrix} \text{ kip}$$

$$\phi_{s_ex} := 1.0 \quad \text{LRFD 6.9.2.1-1 for the Services and Extreme Limit States}$$

$$P_{r_e} := \phi_{s_ex} \cdot P_n = \begin{bmatrix} 775 \\ 1090 \\ 1070 \\ 1305 \end{bmatrix} \text{ kip}$$

Drivability Analysis

From LRFD Article 10.7.8

For steel piles in compression or tension, limit driving stresses to 90% f_y

$$\phi_{da} := 1.0 \quad \text{LRFD Table 10.5.5.2.3-1, Drivability Analysis, Steel Piles}$$

$$\sigma_{da} := 0.9 \cdot f_y \cdot \phi_{da} = 45 \text{ ksi} \quad \text{LRFD Eqn 10.7.8.1}$$

Per LRFD, limit driving stresses to 45 ksi or less or

Per BDG Section 501, limit blow counts to 5-15 blows to inch (bpi) with 6-10 bpi optimal

Find maximum resistance from drivability analysis:

$$\phi_{dyn} := 0.65 \quad \text{LRFD Table 10.5.5.2.3-1 Strength Limit State}$$

$$\phi_s := 1 \quad \text{Service and Extreme Limit States}$$

GRLWeap Soil and Pile Model Assumptions

Estimated pile lengths (bottom of pile cap to bedrock from explorations):

19.7 ft (Abutment 1) / 33.3 ft (Abutment 2)

Assume contractor drives **45 ft piles** (worst case) to account for additional pile length for testing (5 ft), rock embedment (up to 2 ft), pile cap embedment (3 ft) + cut off.

Delmag D19-42 Hammer was chosen as typical pile hammer capable of producing energy of about 42,000 ft-lbs. The following pile hammer and cushion parameters were used in the analysis:

Hammer parameters			
Efficiency	0.8		
Pressure	1600	psi	Fixed 100 %
Stroke	10.81	ft	Fixed

From GRLWeap output:

$$R_{ndr} := \begin{bmatrix} 420 \\ 634 \\ 631 \\ 675 \end{bmatrix} \text{ kip} \quad \begin{array}{l} \text{HP12x53} \\ \text{HP12x74} \\ \text{HP14x73} \\ \text{HP14x89} \end{array}$$

Cushion Information			
	Hammer	Pile	
Area	227.	0.	in ²
Elastic Modulus	175.	0.	ksi
Thickness	2.	0.	in
C.O.R.	0.92	0.	
Stiffness	0.	0.	kips/in
Helmet Weight	3.		kips

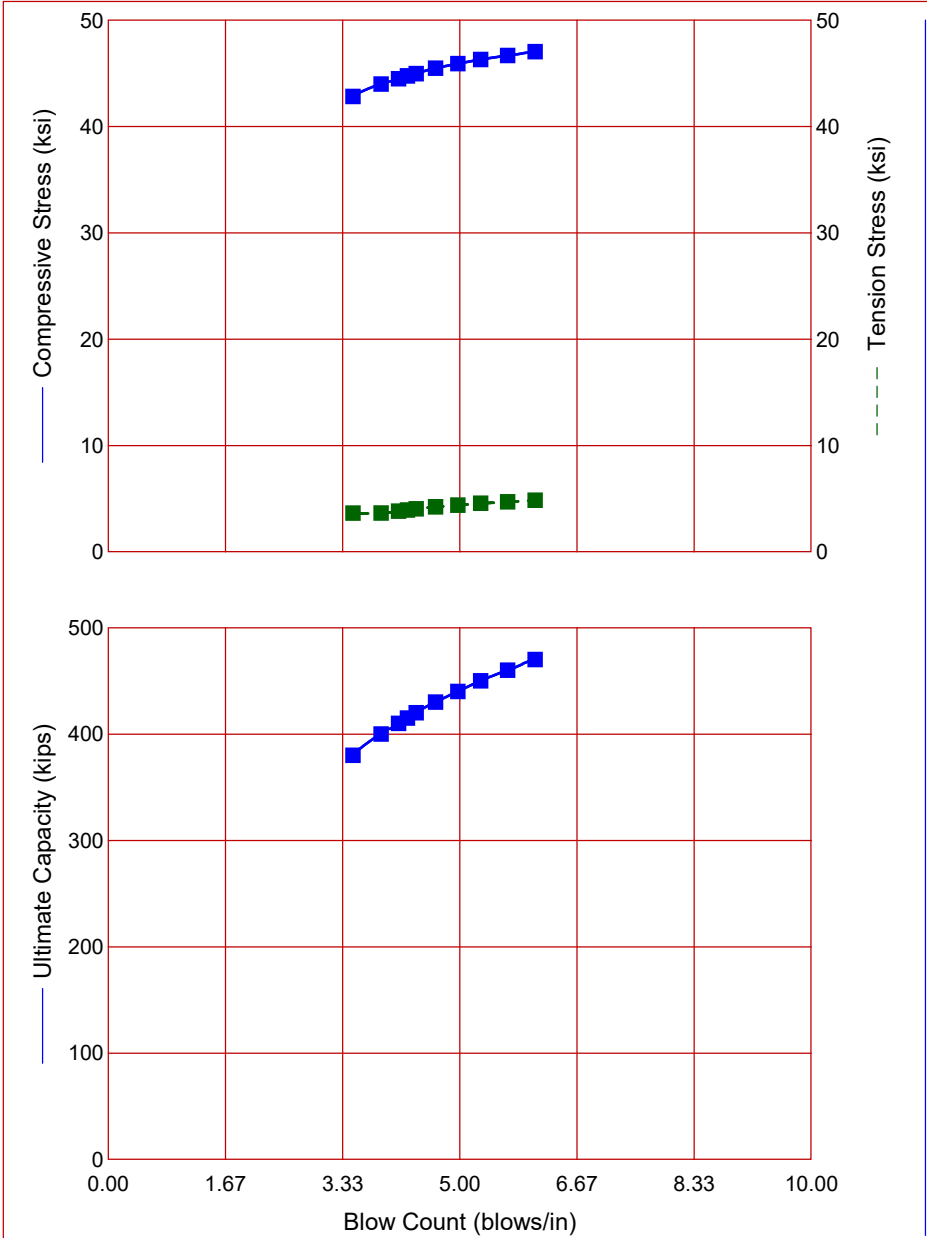
Strength Limit State

$$R_{fdr} := \overrightarrow{R_{ndr}} \cdot \phi_{dyn} = \begin{bmatrix} 273 \\ 412 \\ 410 \\ 439 \end{bmatrix} \text{ kip}$$

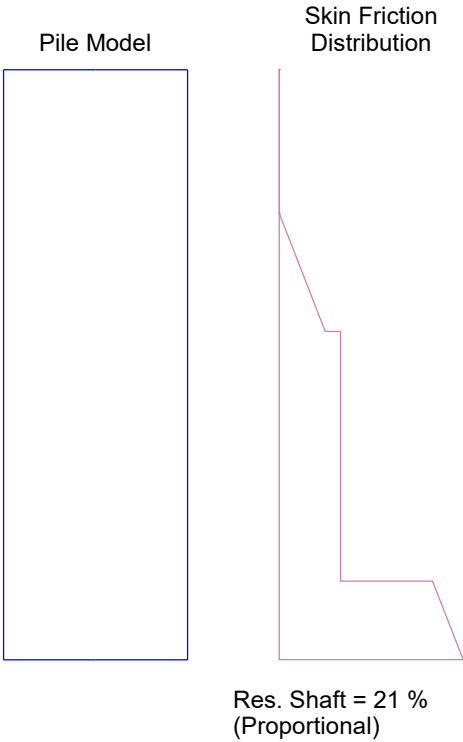
Service and Extreme Limit States

$$R_{dr} := \overrightarrow{R_{ndr}} \cdot \phi_s = \begin{bmatrix} 420 \\ 634 \\ 631 \\ 675 \end{bmatrix} \text{ kip}$$

HP12x53

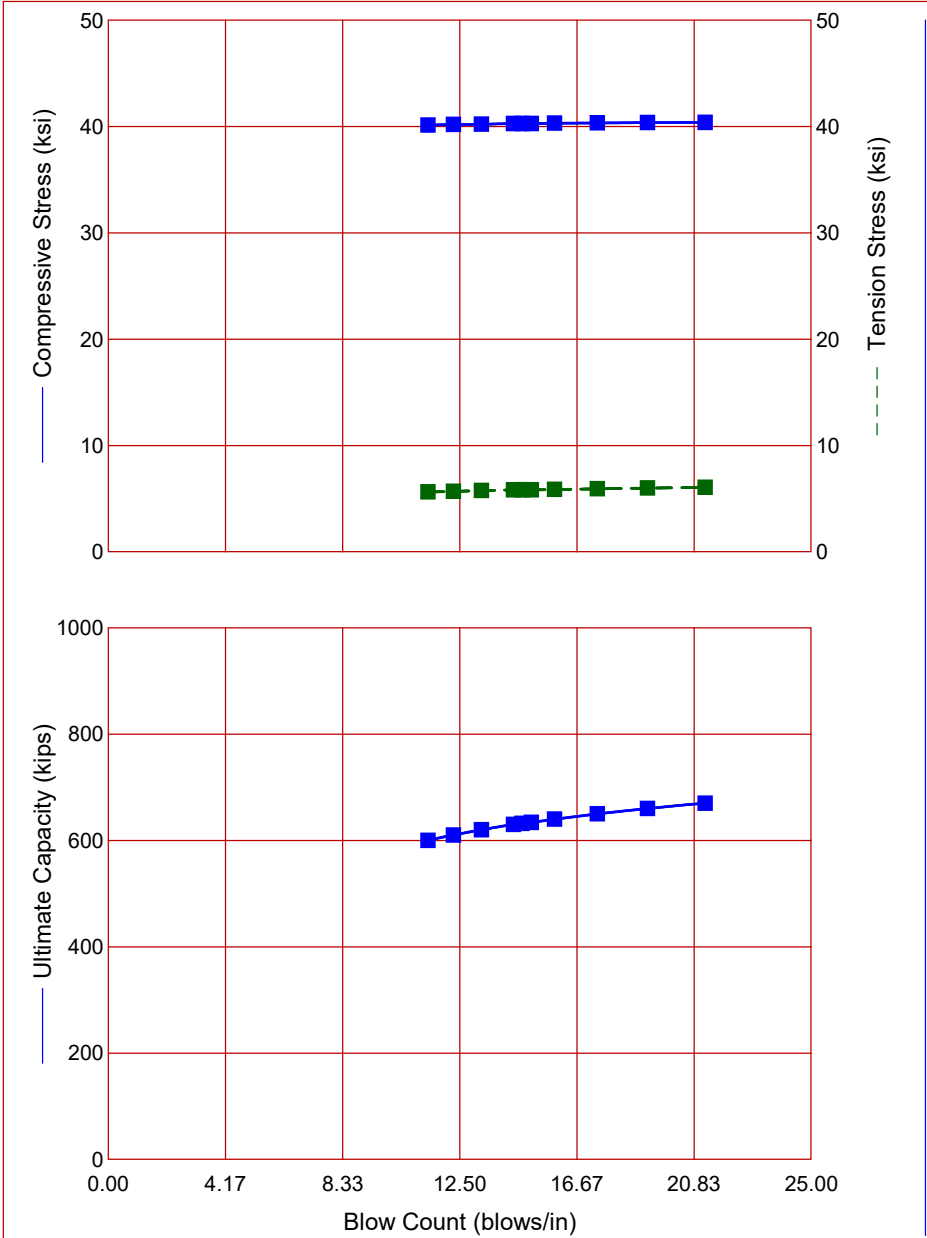


DELMAG D 19-42	
Stroke	10.81 ft
Ram Weight	4.00 kips
Efficiency	0.800
Pressure	Variable
Helmet Weight	3.00 kips
Hammer Cushion	34825 kips/in
COR of H.C.	0.920
Skin Quake	0.100 in
Toe Quake	0.100 in
Skin Damping	0.050 s/ft
Toe Damping	0.150 s/ft
Pile Length	45.00 ft
Pile Penetration	34.00 ft
Pile Top Area	15.50 in2



Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count blows/in	Stroke ft	Energy kips-ft
380.0	42.81	3.64	3.5	10.81	26.27
400.0	43.98	3.65	3.9	10.81	26.21
410.0	44.47	3.82	4.1	10.81	26.06
415.0	44.74	3.93	4.3	10.81	26.04
420.0	44.96	4.04	4.4	10.81	26.02
430.0	45.47	4.23	4.7	10.81	25.98
440.0	45.90	4.39	5.0	10.81	25.87
450.0	46.29	4.56	5.3	10.81	25.86
460.0	46.66	4.70	5.7	10.81	25.77
470.0	47.02	4.85	6.1	10.81	25.76

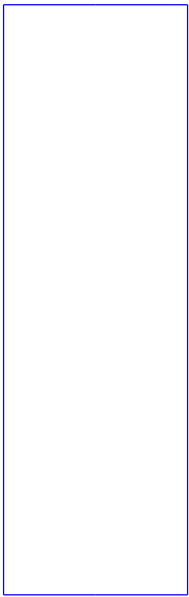
HP12x74



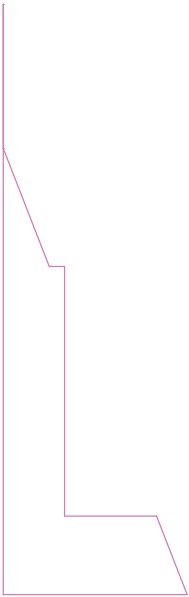
DELMAG D 19-42

Stroke	10.81 ft
Ram Weight	4.00 kips
Efficiency	0.800
Pressure	Variable
Helmet Weight	3.00 kips
Hammer Cushion	34825 kips/in
COR of H.C.	0.920
Skin Quake	0.100 in
Toe Quake	0.100 in
Skin Damping	0.050 s/ft
Toe Damping	0.150 s/ft
Pile Length	45.00 ft
Pile Penetration	34.00 ft
Pile Top Area	21.80 in2

Pile Model



Skin Friction
Distribution



Res. Shaft = 21 %
(Proportional)

HP12x74

Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count blows/in	Stroke ft	Energy kips-ft
600.0	40.13	5.63	11.4	10.81	24.00
610.0	40.18	5.69	12.3	10.81	23.99
620.0	40.21	5.77	13.3	10.81	23.99
630.0	40.27	5.83	14.4	10.81	23.99
632.0	40.28	5.84	14.7	10.81	23.97
634.0	40.27	5.84	15.0	10.81	23.93
640.0	40.31	5.87	15.9	10.81	23.93
650.0	40.33	5.93	17.4	10.81	23.94
660.0	40.36	6.00	19.2	10.81	23.94
670.0	40.38	6.07	21.2	10.81	23.96

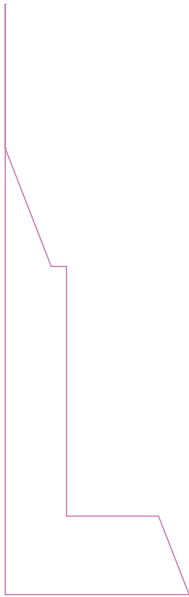
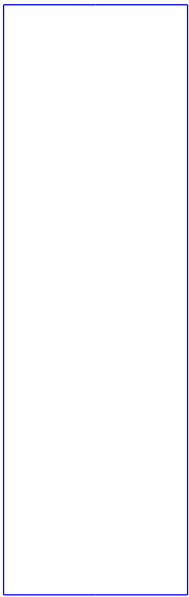
HP14x73

DELMAG D 19-42

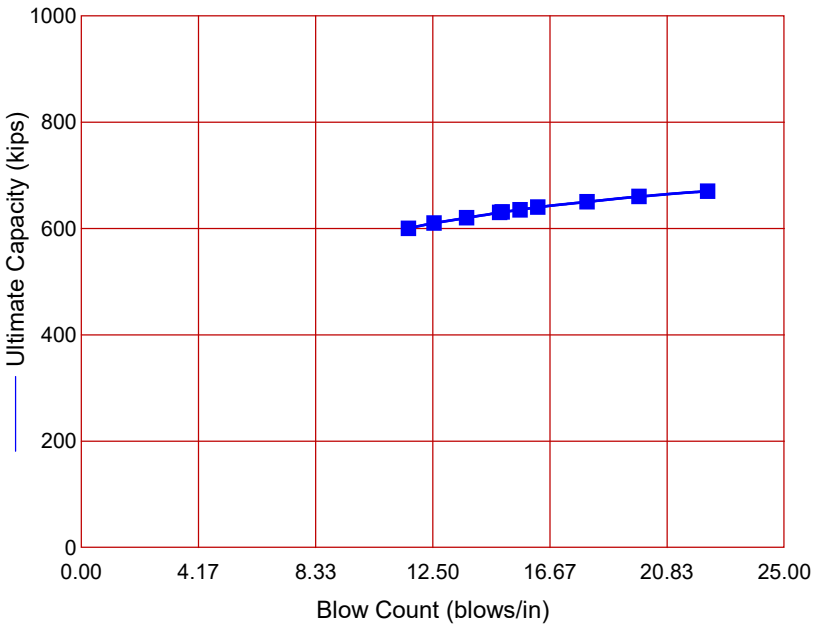
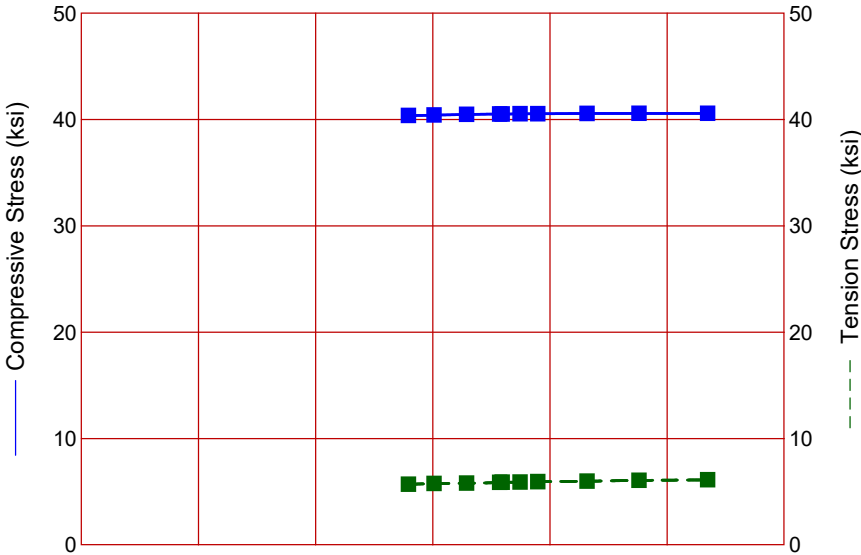
Stroke	10.81 ft
Ram Weight	4.00 kips
Efficiency	0.800
Pressure	Variable
Helmet Weight	3.00 kips
Hammer Cushion	34825 kips/in
COR of H.C.	0.920
Skin Quake	0.100 in
Toe Quake	0.100 in
Skin Damping	0.050 s/ft
Toe Damping	0.150 s/ft
Pile Length	45.00 ft
Pile Penetration	34.00 ft
Pile Top Area	21.40 in2

Skin Friction
Distribution

Pile Model



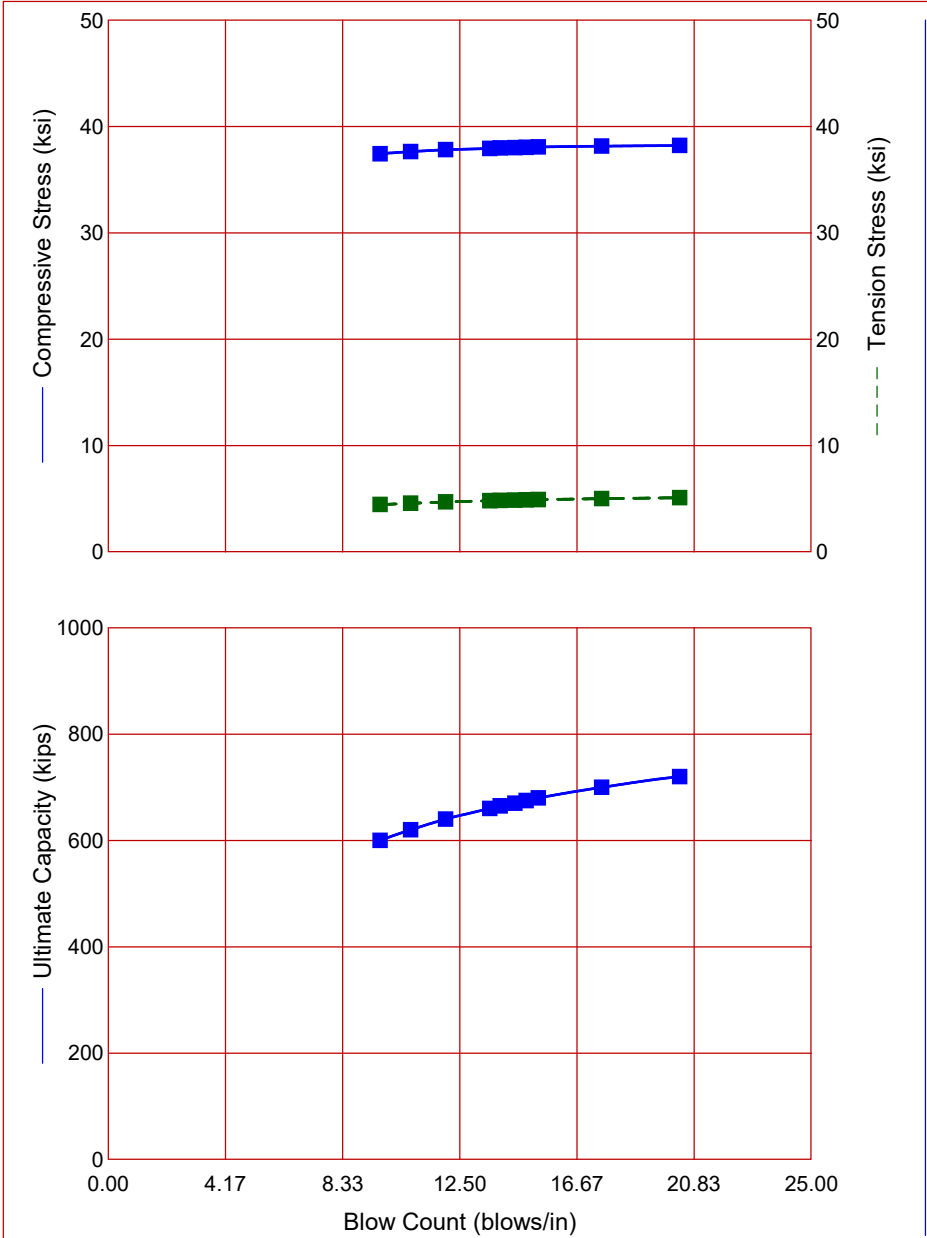
Res. Shaft = 21 %
(Proportional)



HP14x73

Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count blows/in	Stroke ft	Energy kips-ft
600.0	40.37	5.70	11.6	10.81	23.97
610.0	40.41	5.77	12.5	10.81	23.99
620.0	40.47	5.81	13.7	10.81	23.93
630.0	40.51	5.88	14.9	10.81	23.96
631.0	40.51	5.89	15.0	10.81	23.98
635.0	40.53	5.90	15.6	10.81	23.94
640.0	40.54	5.95	16.2	10.81	23.98
650.0	40.57	5.99	18.0	10.81	23.94
660.0	40.57	6.07	19.8	10.81	23.96
670.0	40.57	6.12	22.3	10.81	23.93

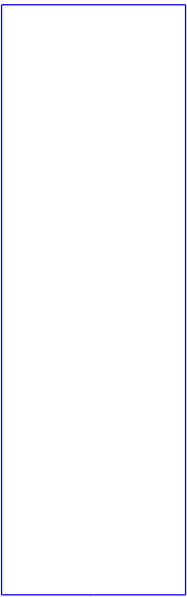
HP14x89



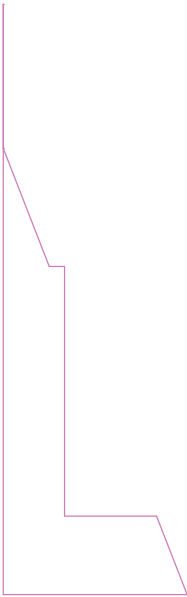
DELMAG D 19-42

Stroke	10.81 ft
Ram Weight	4.00 kips
Efficiency	0.800
Pressure	Variable
Helmet Weight	3.00 kips
Hammer Cushion	34825 kips/in
COR of H.C.	0.920
Skin Quake	0.100 in
Toe Quake	0.100 in
Skin Damping	0.050 s/ft
Toe Damping	0.150 s/ft
Pile Length	45.00 ft
Pile Penetration	34.00 ft
Pile Top Area	26.10 in2

Pile Model



Skin Friction Distribution



Res. Shaft = 21 %
(Proportional)

HP14x89

Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count blows/in	Stroke ft	Energy kips-ft
600.0	37.43	4.45	9.7	10.81	23.98
620.0	37.64	4.57	10.8	10.81	23.96
640.0	37.81	4.70	12.0	10.81	23.96
660.0	37.93	4.81	13.6	10.81	23.89
665.0	37.97	4.84	13.9	10.81	23.92
670.0	38.00	4.87	14.5	10.81	23.86
675.0	38.04	4.90	14.9	10.81	23.89
680.0	38.07	4.92	15.3	10.81	23.91
700.0	38.15	5.01	17.5	10.81	23.87
720.0	38.21	5.09	20.3	10.81	23.84

Evaluation of Downdrag on Abutment Piles**Abutment 2 / North Approach**Reference:

1. AASHTO LRFD Bridge Design Specifications, 8th Edition, 2017.
2. MaineDOT Bridge Design Specifications, 2003 with updates to June 2018
3. NAVFAC DM-7.2

Assumptions:

1. Soil profile based on borings BB-WCWB-102 and BB-WCWB-202
2. Settlement within Marine Clay layer only

Soil Properties:Undrained Shear Strengths (S_u) values:700, 714, 1099, 909, 912, 917, 810, 783 psf ==> **mean value = 840 psf**

$$S_u := 840 \text{ psf}$$

$$H_c := 20.1 \text{ ft} \quad \text{from ISP}$$

Effective Stress at top of Clay Layer @ El 68.4 ft (Z = 16 ft)

$$\sigma_{o_top} := 120 \text{ pcf} \cdot 16 \text{ ft} - 62.4 \text{ pcf} \cdot 6 \text{ ft} = 1546 \text{ psf}$$

Effective Stress in middle of Clay Layer

$$\sigma_{o_mid} := \sigma_{o_top} + 52.6 \cdot \text{pcf} \cdot 10.05 \text{ ft} = 2074 \text{ psf}$$

Effective Stress at bottom of Clay Layer @ El 48.3 ft (Z = 36.1 ft)

$$\sigma_{o_bottom} := \sigma_{o_top} + 52.6 \cdot \text{pcf} \cdot 20.1 \text{ ft} = 2603 \text{ psf}$$

Pile Properties:HP12x53 **NOTE: ALL MATRICES IN THIS ORDER**

HP12x74

HP14x73

HP14x89

Depth of Pile

$$d := \begin{bmatrix} 15.5 \\ 12.1 \\ 13.6 \\ 13.8 \end{bmatrix} \text{ in}$$

Width of Pile

$$b_f := \begin{bmatrix} 12.0 \\ 12.2 \\ 14.6 \\ 14.7 \end{bmatrix} \text{ in}$$

Perimeter of Pile

$$P := 2 \cdot d + 2 \cdot b_f = \begin{bmatrix} 4.6 \\ 4.1 \\ 4.7 \\ 4.8 \end{bmatrix} \text{ ft}$$

NAVFAC DM 7.2-211 recommends β between 0.2 and 0.3. Use $\beta = 0.25$

$$\beta := 0.25$$

$$q_{s_top} := \beta \cdot \sigma_{o_top} = 386.4 \text{ psf}$$

$$q_{s_bottom} := \beta \cdot \sigma_{o_bottom} = 650.7 \text{ psf}$$

$$q_{s_mid} := \beta \cdot \sigma_{o_mid} = 518.6 \text{ psf}$$

Downdrag Force in middle of Marine Clay layer

$$DD := q_{s_mid} \cdot H_c \cdot P = \begin{bmatrix} 47.8 \\ 42.2 \\ 49 \\ 49.5 \end{bmatrix} \text{ kip} \quad \text{for} \quad \begin{array}{l} \text{HP12x53} \\ \text{HP12x74} \\ \text{HP14x73} \\ \text{HP14x89} \end{array}$$

Evaluation of Passive Earth Pressure for IAB

Assumed Backfill Values

MaineDOT BDG Section 3.6.1 - Soil Type 4

$$\gamma_1 := 125 \text{ } pcf$$

Unit Weight

$$\phi_1 := 32 \text{ } deg$$

Friction Angle

$$c_1 := 0 \text{ } psf$$

Cohesion

Integral Abutment Wall Parameters

$$\beta := 0 \text{ } deg$$

Continuous Backslope Angle(s) (from horizontal)

$$\theta := 90 \text{ } deg$$

Angle of back face of wall (from horizontal)

$$\delta := 19.5 \text{ } deg$$

For IAB, Interface Friction between Fill and Wall
LRFD Table 3.11.5.3-1, $\delta = 17$ to $22 \text{ } deg$

Coulomb Theory Passive Earth Pressure Coefficient

$$\Gamma_{p-c} := \left(1 - \sqrt{\frac{\sin(\phi_1 + \delta) \cdot \sin(\phi_1 + \beta)}{\sin(\theta + \delta) \cdot \sin(\theta + \beta)}} \right)^2$$

$$k_{p-c} := \frac{\sin(\theta - \phi_1)^2}{\Gamma_{p-c} \cdot (\sin(\theta))^2 \cdot (\sin(\theta + \delta))}$$

$$k_{p-c} = 6.7 \quad \text{for} \quad \beta = 0 \text{ } deg$$

Rankine Theory Passive Earth Pressure Coefficient

$$k_{p-r} := \frac{\cos(\beta) + \sqrt{\cos(\beta)^2 - \cos(\phi_1)^2}}{\cos(\beta) - \sqrt{\cos(\beta)^2 - \cos(\phi_1)^2}}$$

$$k_{p-r} = 3.3 \quad \text{for} \quad \beta = 0 \text{ } deg$$

Estimated Frost Penetration Depth

Based on MaineDOT Bridge Design Guide Section 5.2.1

Site Location: Windham, Maine

Soil Conditions: silty CLAY (Fine Grained)

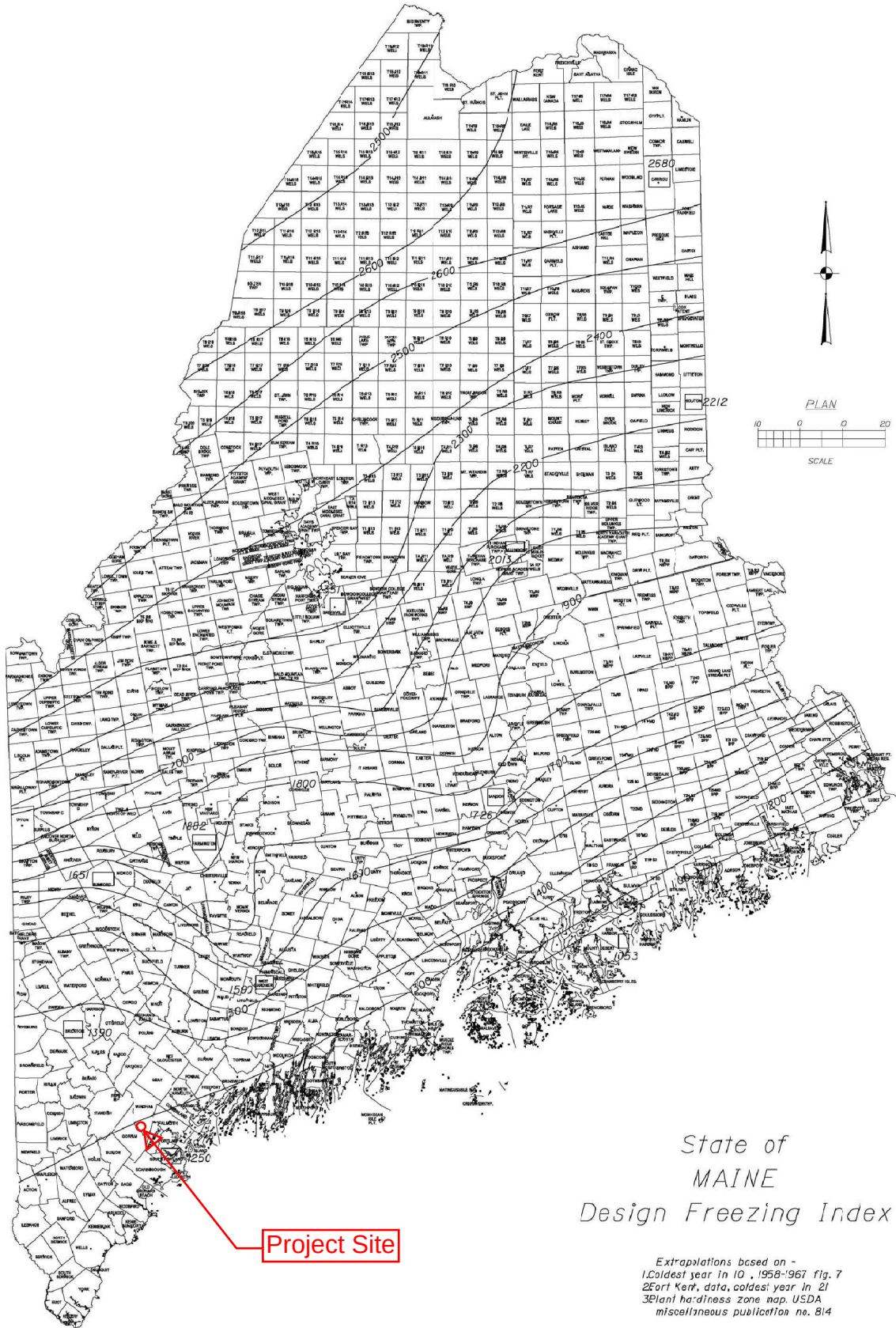
Step 1. From Figure 5-1: Design Freezing Index = ± 1300 freezing degree-days

Step 2. From laboratory test results: natural soil water content > 30%

Step 3. From Table 5-1: Depth of frost penetration = 42.2 inches = 3.5 feet

Calculated by: MAS
Checked by: TJB
Date: July, 20, 2016

Figure 5-1 Maine Design Freezing Index Map



5.2 General

5.2.1 Frost

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

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

Table 5-1 Depth of Frost Penetration

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

Determine Seismic Site Classification per AASHTO LRFD Table C3.10.3.1-1 - Method B

Data From Boring BB-WCWB-101

Layer No.	Layer Description	Depth Range (ft)		N ₆₀ values recorded within layer								Average N ₆₀ value	Layer Thickness	d _i /N _i
		Top	End									N _i	d _i	
1	Fill	0	11.3	65	28	5	15	14	5			22.0	11.3	0.51
2	Clay	11.3	34	3	2	2	2					2.3	22.7	10.09
3	Till	34	45	28								28.0	11	0.39
4	Bedrock	45	100	100								100.0	55	0.55

Notes: 1. N₆₀ value for bedrock taken as N=100 $\Sigma = 100$ 11.55

$$N_{\text{bar}} = d_i/d_i/N_i = 8.66$$

Site Class E

Data From Boring BB-WCWB-102 & BB-WCWB-102A

Layer No.	Layer Description	Depth Range (ft)		N ₆₀ values recorded within layer								Average N ₆₀ value	Layer Thickness	d _i /N _i
		Top	End									N _i	d _i	
1	Fill	0	18	45	22	9	26	100	14			36.0	18	0.50
2	Clay	18	33	1								1.0	15	15.00
3	Till	33	41.7	25	76							50.5	8.7	0.17
4	Bedrock	41.7	100	100								100.0	58.3	0.58

Notes: 1. Weight of rod (WOR) and weight of hammer (WOH) values taken as N=1

 $\Sigma = 100$ 16.262. N₆₀ values > 100 taken as N=1003. N₆₀ value for bedrock taken as N=100

$$N_{\text{bar}} = d_i/d_i/N_i = 6.15$$

Site Class E

Data From Boring BB-WCWB-103

Layer No.	Layer Description	Depth Range (ft)		N ₆₀ values recorded within layer								Average N ₆₀ value	Layer Thickness	d _i /N _i
		Top	End									N _i	d _i	
1	Fill	0	18.8	36	12	11	12	8	8	22	3	14.0	18.8	1.34
2	Clay	18.8	27	3	3							3.0	8.2	2.73
3	Till	27	35.2	73								73.0	8.2	0.11
4	Bedrock	35.2	100	100								100.0	64.8	0.65

Notes: 1. N₆₀ value for bedrock taken as N=100 $\Sigma = 100$ 4.84

$$N_{\text{bar}} = d_i/d_i/N_i = 20.68$$

Site Class D

Data From Boring BB-WCWB-201

Layer No.	Layer Description	Depth Range (ft)		N ₆₀ values recorded within layer								Average N ₆₀ value	Layer Thickness	d _i /N _i
		Top	End									N _i	d _i	
1	Fill	0	15	29	21	17	7	4				15.6	15	0.96
2	Clay	15	19	1								1.0	4	4.00
3	Till	19	28.3	59	21							40.0	9.3	0.23
4	Bedrock	28.3	100	100								100.0	71.7	0.72

Notes: 1. N₆₀ value for bedrock taken as N=100 $\Sigma = 100$ 5.91

$$N_{\text{bar}} = d_i/d_i/N_i = 16.92$$

Site Class D

Data From Boring BB-WCWB-202

Layer No.	Layer Description	Depth Range (ft)		N ₆₀ values recorded within layer								Average N ₆₀ value	Layer Thickness	d _i /N _i
		Top	End									N _i	d _i	
1	Fill	0	15.5	41	10	11	14	2				15.6	15.5	0.99
3	Clay	15.5	36	4	1	1	1					1.8	20.5	11.71
4	Till	36	42.9	21								21.0	6.9	0.33
5	Bedrock	42.9	100	100								100.0	57.1	0.57

Notes: 1. N₆₀ value for bedrock taken as N=100 $\Sigma = 100$ 13.61

$$N_{\text{bar}} = d_i/d_i/N_i = 7.35$$

Site Class E

021924 Doles Bridge #5061

Conterminous 48 States

2007 AASHTO Bridge Design Guidelines

AASHTO Spectrum for 7% PE in 75 years

Latitude = 43.726513

Longitude = -070.406225

Site Class B

Data are based on a 0.05 deg grid spacing.

Period (sec)	Sa (g)	
0.0	0.091	PGA - Site Class B
0.2	0.180	Ss - Site Class B
1.0	0.046	S1 - Site Class B

Conterminous 48 States

2007 AASHTO Bridge Design Guidelines

Spectral Response Accelerations SDs and SD1

Latitude = 43.726513

Longitude = -070.406225

As = FpgaPGA, SDs = FaSs, and SD1 = FvS1

Site Class E - Fpga = 2.50, Fa = 2.50, Fv = 3.50

Data are based on a 0.05 deg grid spacing.

Period (sec)	Sa (g)	
0.0	0.227	As - Site Class E
0.2	0.449	SDs - Site Class E
1.0	0.160	SD1 - Site Class E

Conterminous 48 States

2007 AASHTO Bridge Design Guidelines

Design Response Spectra for Site Class E

Latitude = 43.726513

Longitude = -070.406225

As = FpgaPGA, SDs = FaSs, SD1 = FvS1

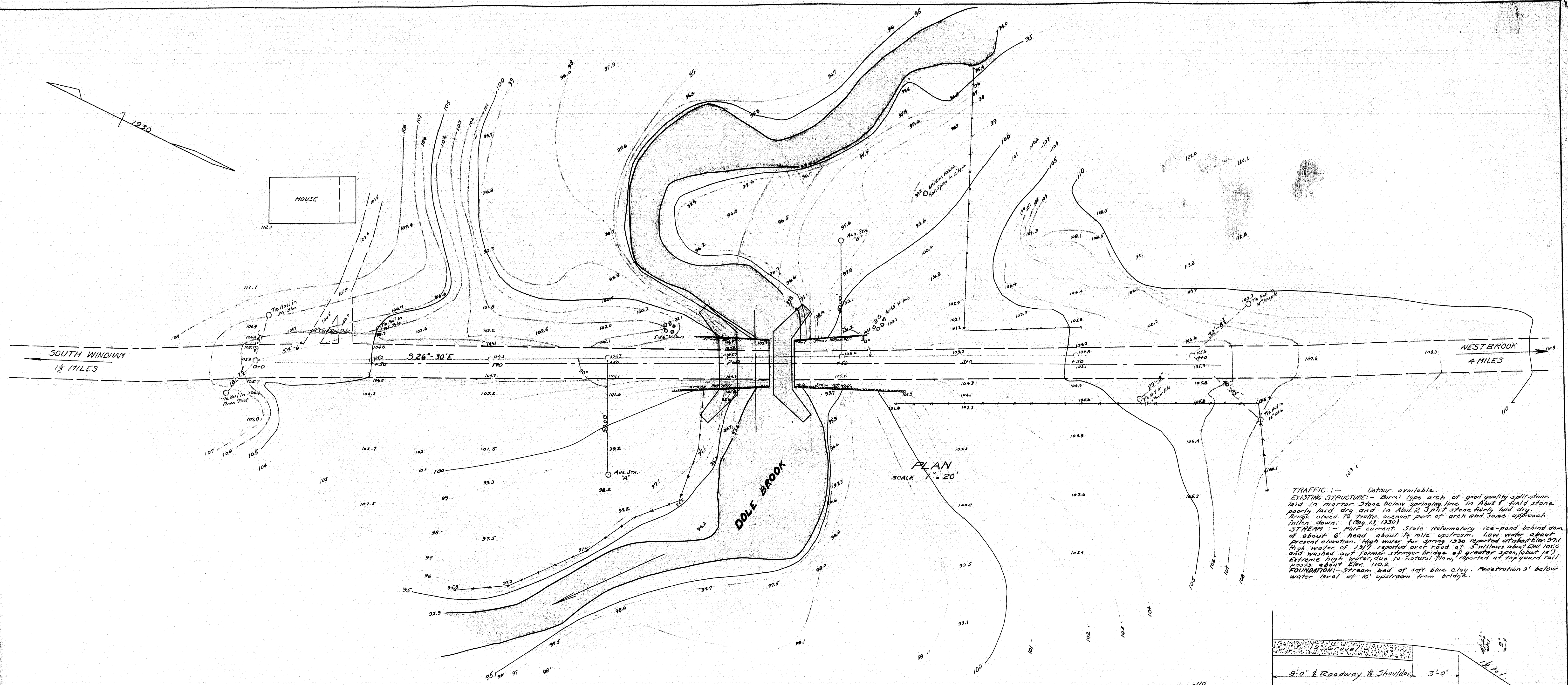
Site Class E - Fpga = 2.50, Fa = 2.50, Fv = 3.50

Data are based on a 0.05 deg grid spacing.

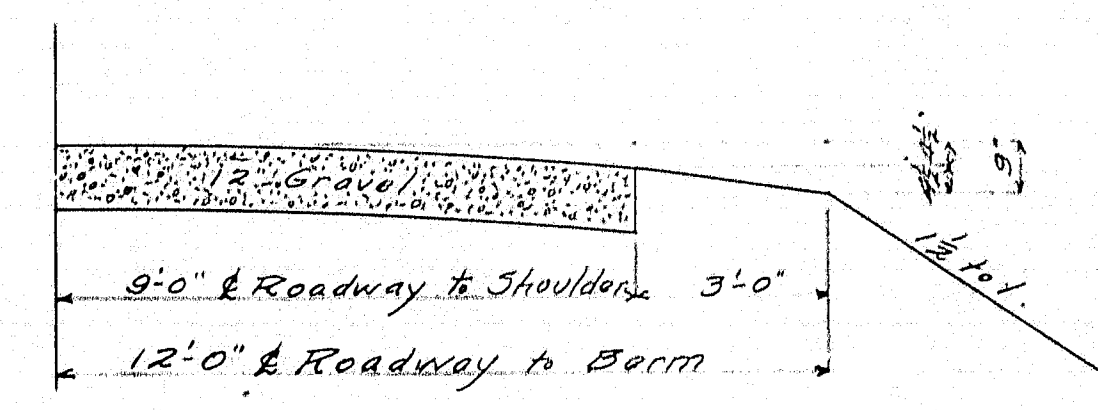
Period (sec)	Sa (g)	Sd in.	
0.000	0.227	0.000	T = 0.0, Sa = As
0.071	0.449	0.022	
0.200	0.449	0.176	T = 0.2, Sa = SDs
0.356	0.449	0.556	T = Ts, Sa = SDs
0.400	0.400	0.625	
0.600	0.267	0.938	
0.800	0.200	1.250	
1.000	0.160	1.563	T = 1.0, Sa = SD1
1.200	0.133	1.875	
1.400	0.114	2.188	
1.600	0.100	2.500	
1.800	0.089	2.813	
2.000	0.080	3.125	
2.200	0.073	3.438	
2.400	0.067	3.750	
2.600	0.062	4.063	
2.800	0.057	4.375	
3.000	0.053	4.688	

3.200	0.050	5.000
3.400	0.047	5.313
3.600	0.044	5.625
3.800	0.042	5.938
4.000	0.040	6.251

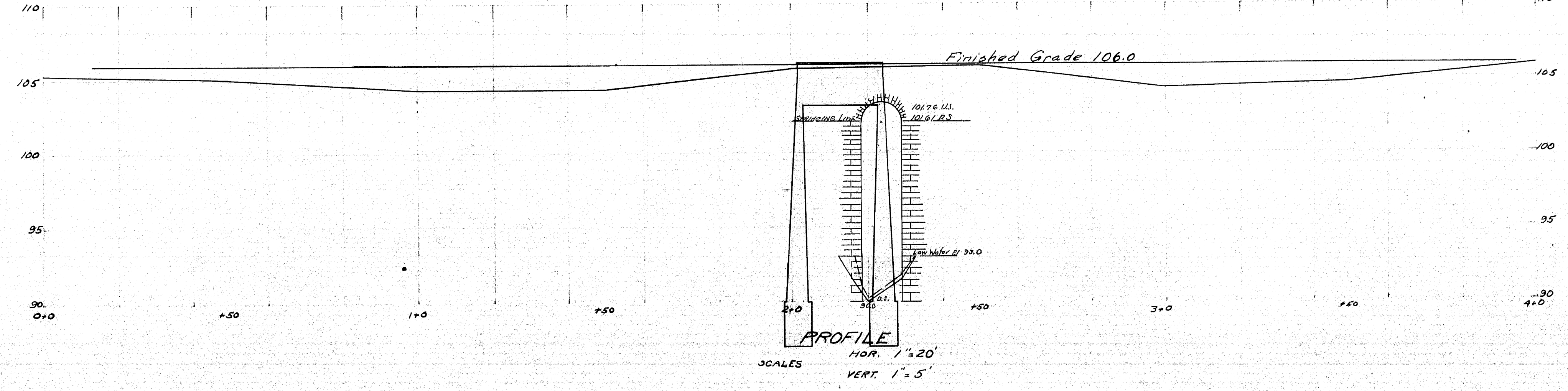
APPENDIX F
Historical Bridge Plans



TRAFFIC: - Detour available.
 EXISTING STRUCTURE: - Barrel type arch of good quality split-stone laid in mortar. Stone below springing line in Abut. 1 found stone poorly laid and in Abut. 2 split-stone fairly well dry. Bridge closed for traffic account part of arch and some approach filling down. (May 13, 1930)
 STREAM: - Fair current. State Informationary ice pond behind dam of about 6' head about 1/4 mile upstream. Low water about present elevation. High water for spring 1930 reported at elevation 97.1. High water of 1937 reported over road at S. willows about Elev. 105.0 and washed out former stringer bridge of greater span (about 12'). Extreme high water due to natural flow reported at top guard rail 105.3 about Elev. 110.2
 FOUNDATION: - Stream bed of soft blue clay. Penetration 3' below water level at 10' upstream from bridge.



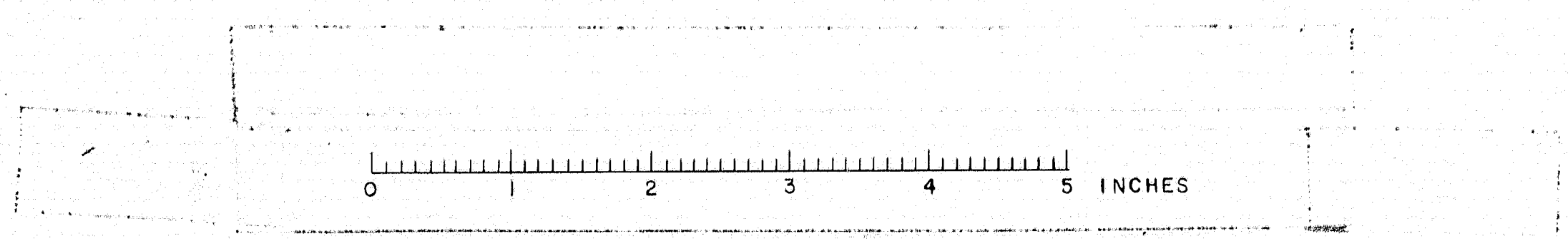
APPROACH FILL SECTION.



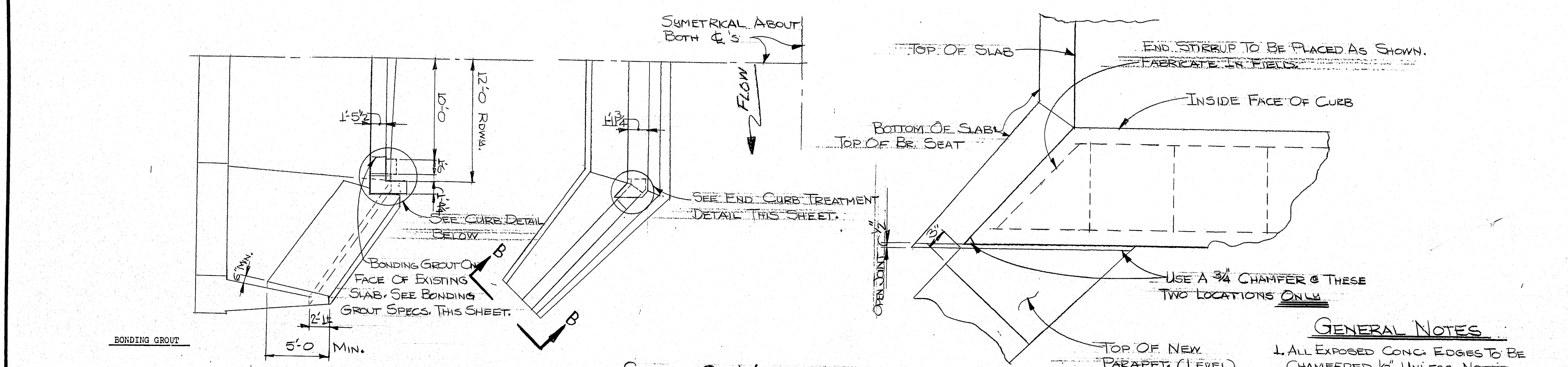
MAINE HIGHWAY COMMISSION
 BRIDGE DIVISION
DOLE BROOK BRIDGE
 OVER
DOLE BROOK
 IN THE TOWN OF
WINDHAM
CUMBERLAND CO.
 SURVEY PLAN
 SHEET 1 OF 2. AUGUSTA, ME. JUNE 4, 1930

10-107

SURVEYED - BECKMAN
 PLOTTED - JOHNSON
 TRACED - JOHNSON



F.R.M.A. REG. NO.	STATE	PROJECT NUMBER	SHEET NO.	TOTAL SHEETS
1	MAINE			



surface must be thoroughly sandblasted and cleaned to remove all dust or loose materials immediately before the bonding grout is placed.

surface to be surface dry when bonding grout is applied.

The bonding grout shall consist of equal parts by weight of Portland Cement and concrete sand with the plus No. 8 material removed and mixed with enough water to give a thick creamy consistency.

Bonding grout to be evenly broomed onto the concrete surface ensuring that the entire surface is coated and that no excess grout collects in low spots or pockets. Grout shall be thoroughly broomed under and around reinforcing bars.

Rate of application must be controlled so that the grout does not dry before the new concrete is placed.

QUARTER PLAN

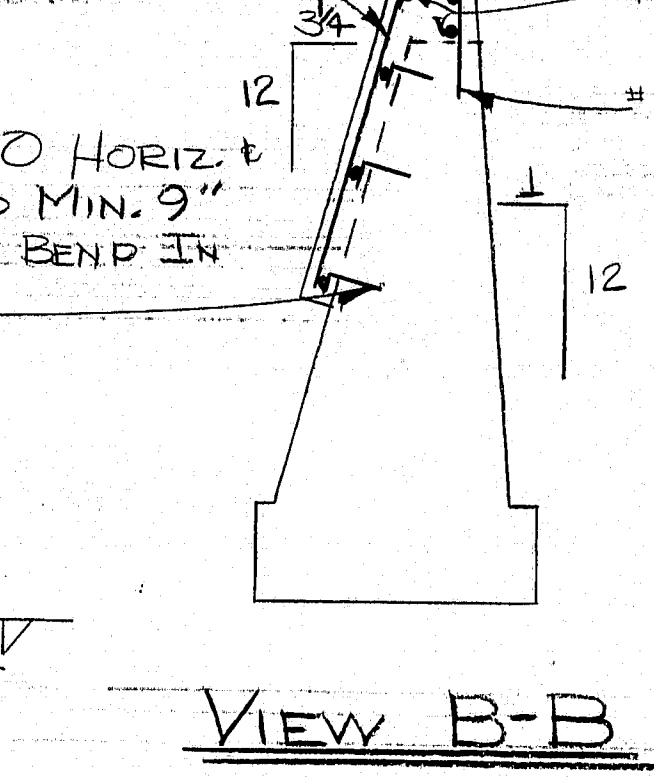
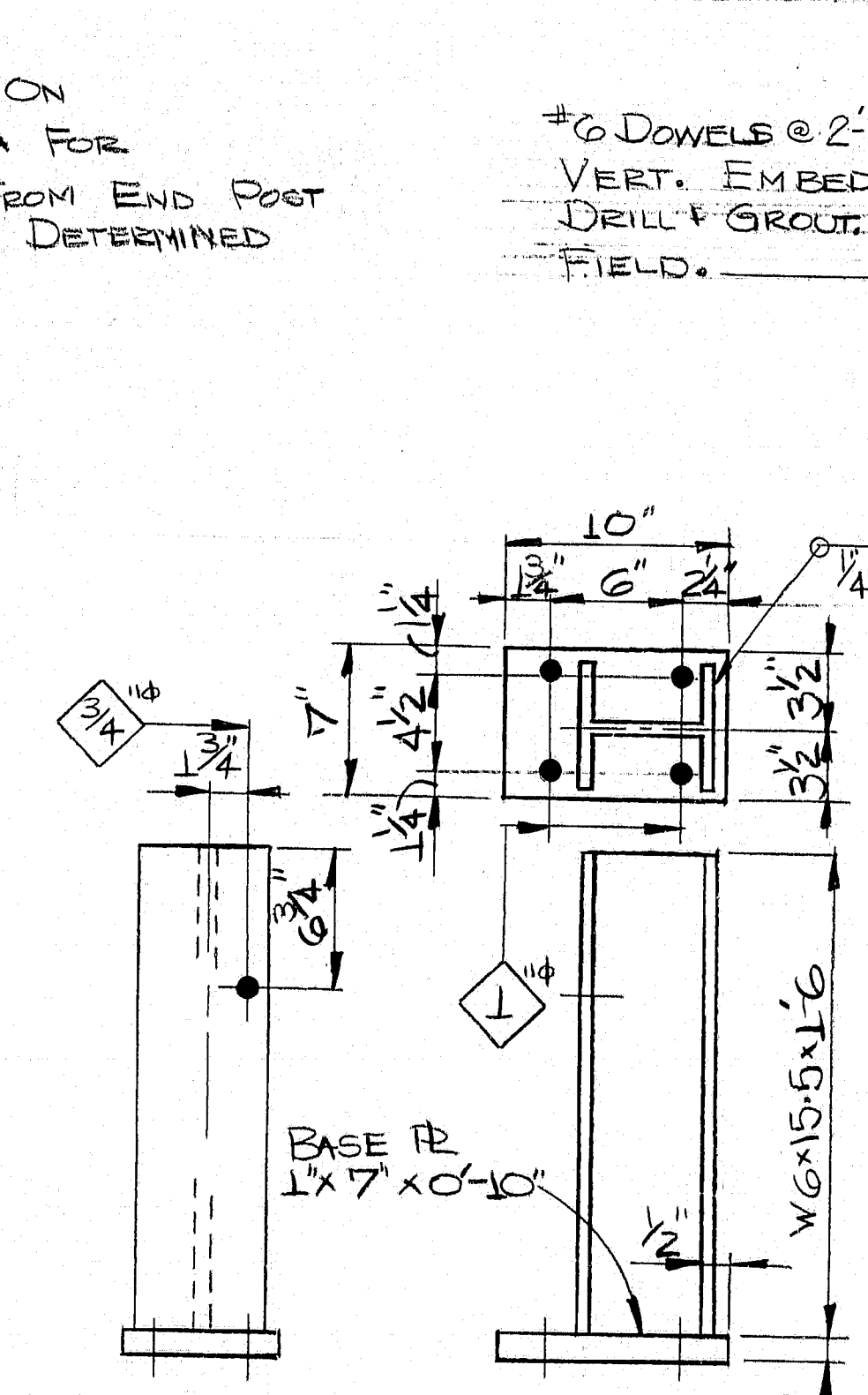
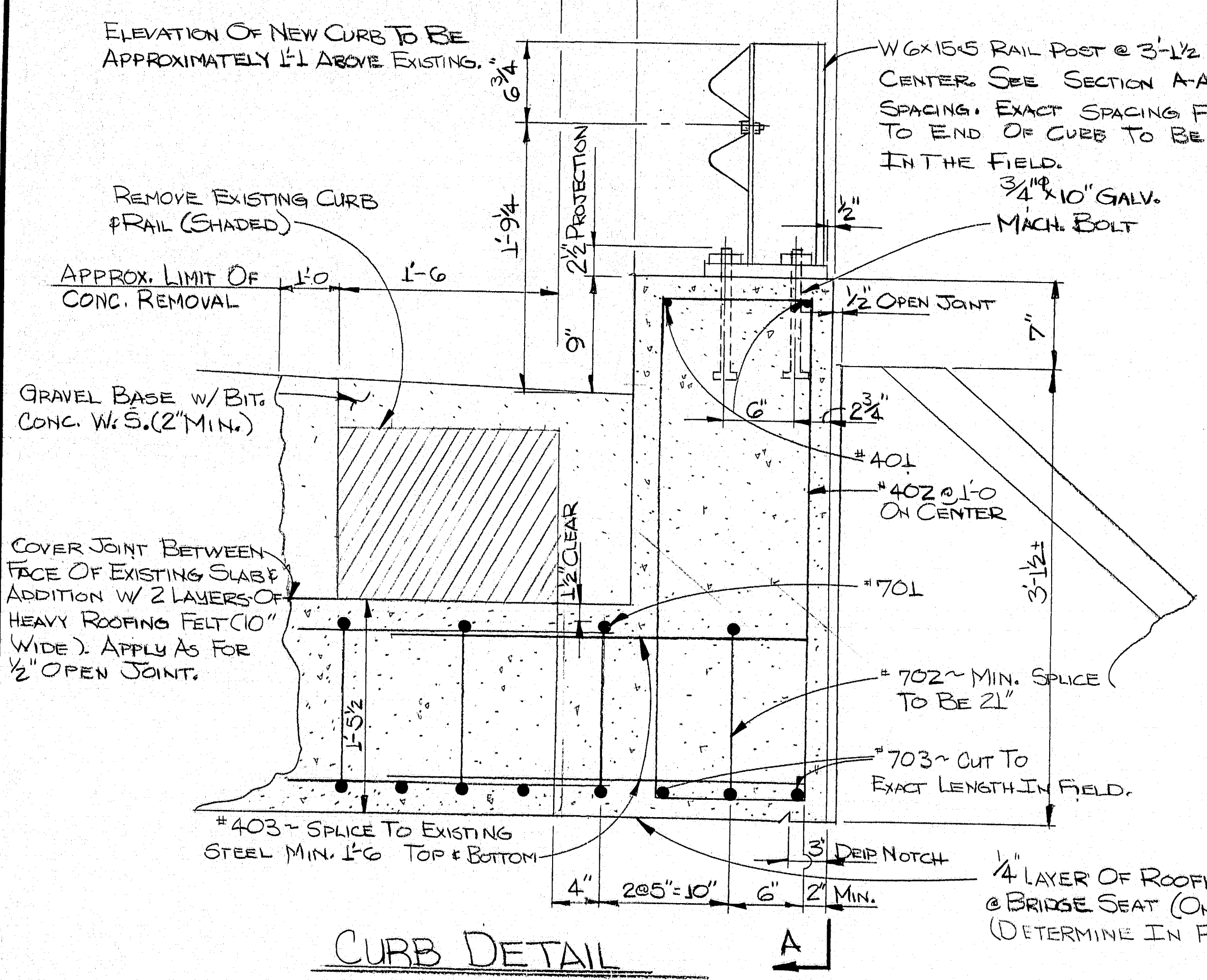
SCOPE OF WORK

REMOVE EXISTING RAILS & CURBS UNTIL SOUND CONC. IS REACHED. WIDEN STRUCTURE AS SHOWN. REPAIR WINGWALLS AS NECESSARY. INSTALL NEW BEAM TYPE GUARD RAIL.

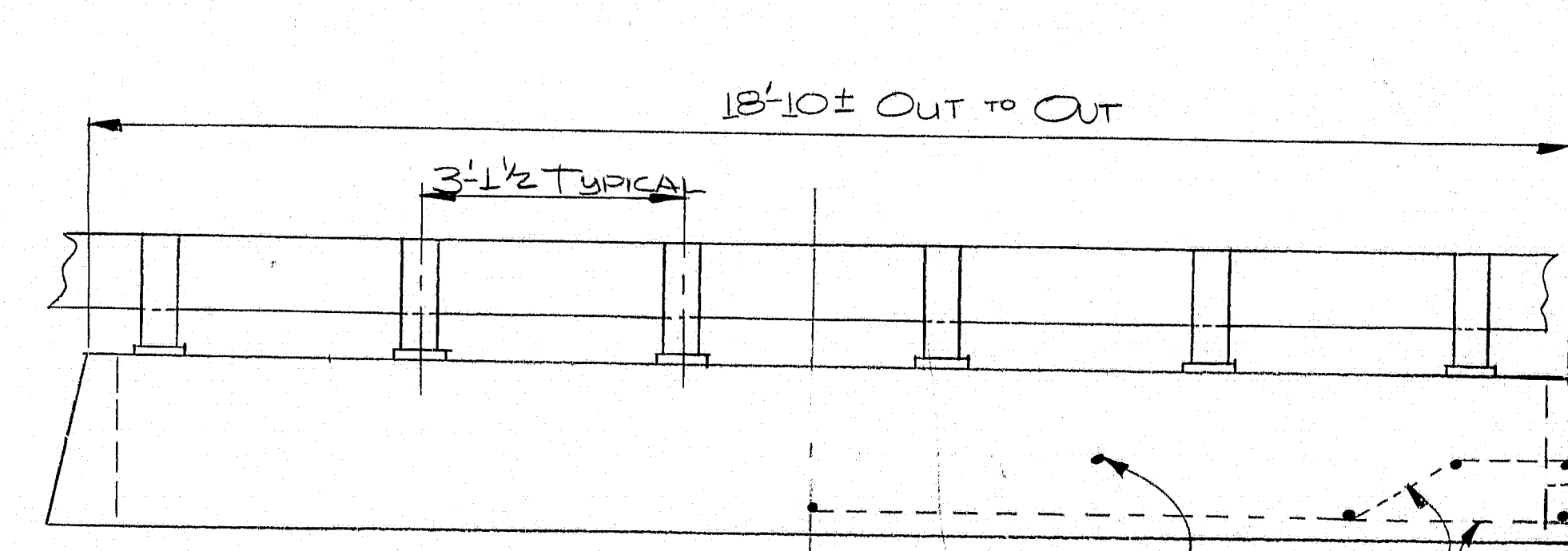
CURB END TREATMENT

GENERAL NOTES

1. ALL EXPOSED CONC. EDGES TO BE CHAMFERED 1/2" UNLESS NOTED.
2. ALL REINFORCING TO HAVE 2" COVER UNLESS NOTED.
3. COVER THE 1/2 VERT. SLOT BETWEEN SUPERSTRUCTURE & WING W/ 2 LAYERS OF ROOFING FELT (10" WIDE). COAT EACH LAYER & CONC. W/ ROOF CEMENT. RECESS THE AREA 1/4" BEFORE PLACING CONC.

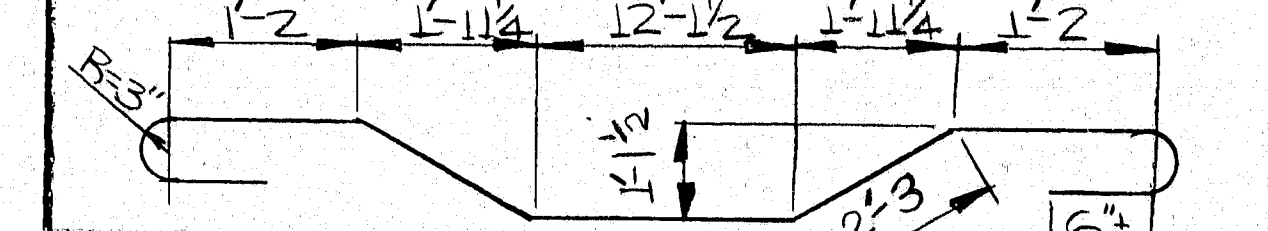


VIEW B-B



SECTION A-A

*5061 REINFORCING SCHEDULE



NOTE: BARS 701 & 702 ONLY ARE DIMENSIONED 701 ~ 2 REQ'D ALONG C.

MARK	SIZE	NO.	LENGTH	LOCATION
401	#4	4	20'-0"	CURB ~ TRIM TO FIT IN FIELD
*402	#4	40	9'-6"	CURB ~ STIRRUPS
403	#4	22	3'-4"	SLAB ~ TRANSVERSE
*701	#7	2	21'-6"	SLAB ~ CRANK BAR
*702	#7	4	12'-5"	SLAB ~ CRANK BAR
703	#7	4	24'-0"	SLAB ~ TRIM TO FIT IN FIELD
Field	#4	30	20'-0"	WINGS ~ CUT TO FIT IN FIELD
Field	#6	25	20'-0"	WINGS ~ 40

MARK	SIZE	NO.	LENGTH	LOCATION
401	#4	4	20'-0"	CURB ~ TRIM TO FIT IN FIELD
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Field	#4	30	20'-0"	WINGS ~ CUT TO FIT IN FIELD
Field	#6	25	20'-0"	WINGS ~ 40

* DENOTES BENT BAR
~ ALL DIMENSIONS ARE OUT-TO-OUT UNLESS NOTED.

EST. WT. REINFORCING = 1,891 lbs.

MARK	NO.	SHAPE	LENGTH	WT.	REMARKS
Field	12	W6x15.5	1'-6"	279	
Field	12	#1 1/2"	0'-10"	238	
Field	48	#4 BARS	0'-10"		"GALVANIZE"

EST. WT = 517 lbs.

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

#5061

DOLE BROOK BR.
OVER
DOLE BROOK
IN THE TOWN OF
WINDHAM
IN
CUMBERLAND CO.
WIDENING
SHEET 1 OF 1
AUGUSTA, MAINE 11/5/81

100-373