

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

GEOTECHNICAL DATA REPORT

Preservation of:

**LANE'S ISLAND BRIDGE
LANE'S ISLAND ROAD OVER TIDAL FLOW (CARVER'S HARBOR)
VINALHAVEN, MAINE**

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STP-2170(700)
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Soils Report 2019-14
Bridge No. 5270

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1.0 INTRODUCTION

The purpose of this Geotechnical Data Report is to present subsurface information for the preservation of Lane's Island Bridge. Lane's Island Bridge carries Lane's Island Road over Tidal Flow (Carvers Harbor) in Vinalhaven, Maine. This report presents the subsurface information obtained at the site during two subsurface investigations.

The existing Lane's Island Bridge was constructed in 1954 and is a one lane, seven span, non-continuous bridge. The substructures consist of dry stacked granite blocks with concrete caps at the piers and abutments. The granite blocks at the abutments bear on marine sediments and glaciomarine silt, clay and sand. The substructure is in poor condition with voids, missing stones and shifting stones.

The 2018 Maine Department of Transportation (MaineDOT) Bridge Maintenance inspection report assigns the substructure a condition rating of 4 for poor, and the superstructure a 5 for fair. The bridge is currently not posted. The current structure is listed as Structural Deficient and has a Sufficiency Rating of 44.1 out of a possible 100.

The MaineDOT Bridge Program originally scoped this project as a bridge replacement. Input from the public resulted in the project being rescoped as bridge preservation. The scope of the preservation project will entail stabilizing the substructures, protecting the superstructure concrete and safety improvements. The dry stacked granite block abutments and piers will be maintained. Larger voids in the abutment and piers will be filled with grout. Larger loose stone may be secured by pinning in place. Locations where the riprap slopes have settled will be supplemented with additional riprap and crushed stone protection.

2.0 HISTORICAL BRIDGE PLANS

Based on the historical bridge plans (State Highway Commission, dated 1949-1951) the existing south and north abutments consist of stacked, dry-laid granite stone with concrete caps, each constructed on top of a pre-existing stacked granite pier from the original bridge construction (predating the 1949 bridge modifications). Spans leading up to the two existing abutments were "filled-in" and the remaining were piers abandoned in the bridge approaches. Based on the borings conducted at the site, it is inferred that both abutments and the northernmost pier, bear on marine sediments.

3.0 GEOLOGIC SETTING

Lane's Island Bridge in Vinalhaven, Maine crosses Carvers Harbor as shown on Sheet 1 – Location Map.

The Maine Geological Survey (MGS) Surficial Geology Map of the Vinalhaven Quadrangle, Maine, Open-file No. 86-52 (1986), indicates the bridge location is primary and areas of

bedrock outcrops with thin surficial tidal marsh and swamp deposits and glaciomarine silt and clay.

The Bedrock Geologic Map of North Haven and Vinalhaven Islands, Geologic Map No. 01-352 MGS (2001), cites the bedrock at the project site as plutonic gabbro and diabase with contacts to biotite-hornblende granite and quartz monzonite.

4.0 SUBSURFACE INVESTIGATION

Subsurface conditions at the site were explored by drilling three test borings. Borings BB-VCH-101 and BB-VCH-102 were drilled through the existing south and north abutments, respectively. Boring BB-VCH-201 was drilled through the north pier. The test boring locations are shown on Sheet 2 – Boring Location Plan.

The 100-series test borings were drilled between June 27 and 29, 2017 by the MaineDOT Materials Testing and Exploration (MTEx) drill rig. The 200-series boring was drilled on September 25 and 26, 2017. All borings were performed using solid stem auger, cased wash boring, and rock coring techniques. Soil samples were typically obtained at 5-foot intervals using Standard Penetration Test (SPT) methods. During SPT sampling, the split spoon sampler is driven 24 inches and the hammer blows for each 6-inch interval of penetration are recorded. The sum of the blows for the second and third intervals is the N-value, or standard penetration resistance. The MaineDOT drill rig is equipped with an automatic hammer to drive the split spoon sampler. The automatic hammer was calibrated per ASTM D4633 “Standard Test Method for Energy Measurement for Dynamic Penetrometers” in April of 2017. All N-values discussed in this report are corrected values computed by applying the corresponding average energy transfer factor of 0.854 to the raw field N-values. The hammer efficiency factor (0.854) and both the raw field N-values and the corrected N-values are shown on the boring logs provided in Appendix A – Boring Logs and Sheet 3 – Boring Logs.

Bedrock was cored in the three borings using an NQ-2” core barrel and the Rock Quality Designation (RQD) of the cores calculated. A Northeast Transportation Technician Certification Program (NETTCP) Certified Subsurface Inspector logged the subsurface conditions encountered. The MaineDOT geotechnical engineer selected the boring locations and drilling methods, designated type and depth of sampling techniques, reviewed draft boring logs, and identified field and laboratory testing requirements. The borings were located in the field by use of a tape after completion of the exploration program.

Details and sampling methods used, field data obtained, and soil and groundwater conditions encountered are presented on the boring logs provided in Appendix A – Boring Logs and Sheet 3 – Boring Logs.

5.0 LABORATORY TESTING

A laboratory testing program was conducted on selected soil samples recovered from test borings and the streambed to assist in soil classification, evaluation of engineering properties of the soils, and geologic assessment of the project site.

Soil laboratory testing consisted of two standard grain size analyses with natural water content determinations, five grain size analyses with hydrometer and three Atterberg limits tests. The results of soil laboratory tests are included as Appendix B – Laboratory Test Results. Laboratory test information is also shown on the boring logs provided in Appendix A – Boring Logs and on Sheet 3 – Boring Logs.

6.0 SUBSURFACE CONDITIONS

The borings were drilled vertically through the existing dry stacked granite abutments and the northernmost pier. Conditions encountered in the borings generally consisted of granular fill, concrete, granite blocks, marine sediments and glaciomarine deposits overlying plutonic bedrock. The boring logs are provided in Appendix A – Boring Logs and on Sheet 3 – Boring Logs. The following paragraphs discuss the subsurface conditions encountered:

6.1 Stacked Granite and Fill

The three test borings were drilled vertically through the existing dry stacked abutments and the north pier. The construction materials encountered generally consisted of boulder and cobble fill, concrete and granite blocks. Occasional voids were noted.

6.2 Marine Sediments

Marine sediments were encountered below the stacked granite stones that comprise the abutments the north pier. The thickness of the marine sediments ranged from approximately 2.9 to 15.5 feet and generally consisted of:

- Grey, wet, silty sand, trace gravel, trace of shells;
- Grey, wet, sand, little silt, little shells; and
- Dark brown, wet, silty fine sand, little clay, trace gravel, trace of shells.

Corrected SPT N-values in the marine sediments ranged from 4 to 17 blows per foot (bpf) indicating the deposits are very loose to medium dense in consistency. One grain size analysis of the deposit resulted in the soil being classified as A-4 under the AASHTO Soil Classification System and SC-SM under the Unified Soils Classification System (USCS). The moisture content of the tested sample was approximately 52 percent. One Atterberg limits test conducted on a sample of the marine deposits resulted in a classification of “nonplastic”.

Marine sediments were also encountered when streambed material was sampled using a 5-gallon bucket. Four grain size analyses of the soils sampled resulted in the soil being classified as A-1-b, A-1-a and A-2-4 under the AASHTO Soil Classification System and SC-SM, SM, and GW-GM under the USCS. The moisture contents of the samples tested ranged from approximately 51 to 77 percent.

6.3 Glaciomarine Deposit

Glaciomarine deposits were encountered below the marine sediments in BB-VCH-102. The thickness of the deposit was approximately 7.6 feet at the boring location. The deposit consisted of:

- Olive-grey, wet, clayey silt, trace fine sand, trace gravel, and
- Grey, wet, sand, some silt, some gravel, trace clay, trace shells.

Corrected SPT N-values in the deposit were 17 and 28 bpf indicating the deposit is very stiff to medium dense in consistency. Two grain size analyses of the deposit resulted in the soils being classified as A-4 and A-6 under the AASHTO Soil Classification System and CL and SC-SM under the USCS. The moisture contents of the tested samples ranged from approximately 14 to 26 percent. One of two Atterberg limits tests conducted on samples from the deposit resulted in a classification as “nonplastic”. The results of the second Atterberg limits test are summarized below

Boring No. and Sample No.	Soil Description	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index
BB-VCH-102, 3D	Clayey SILT	25.6	32	21	11	0.4

Table 1 – Summary of Atterberg Limits Test

The plasticity index of the sample classifies the soil as exhibit medium plastic (Burmister, 1949). The liquidity index was 0.4. Soils with liquidity indices of 1.0 or less are preconsolidated as the natural water content is less than the liquid limit.

6.4 Bedrock

Bedrock was encountered and cored in the three test borings. Table 2 summarizes approximate depths to bedrock, corresponding approximate top of bedrock elevations and RQD.

Boring	Station	Offset (feet)	Approximate Depth to Bedrock (feet)	Approximate Elevation of Bedrock Surface ¹ (feet)	RQD (Core Run)
BB-VCH-101	102+68.1	3.5 ft Rt.	23.9	-10.7	95% (R3) 89% (R4)
BB-VCH-201	103+35.2	3.9 ft Rt.	23.3	-15.5	82% (R5) 40% (R6)
BB-VCH-102	103+82.2	2.8 ft Rt.	36.6	-22.3	55% (R4) 64% (R5) 50% (R6)

Table 2 – Summary of Approximate Bedrock Depths and Elevations

The bedrock at the site is identified as black, fine grained, banded GABBRO, hard to very hard, fresh, with zones of slickensides and zones interspersed with granite, and black, fine grained BASALT/GABBRO, very hard, fresh, with granite intrusions and black GABBRO to DIORITE, hard, fresh to slightly weathered.

The RQD of the bedrock was determined to range from 40 to 95 percent correlating to a Rock Mass Quality of poor to excellent. Detailed bedrock descriptions and the RQD of each core run are provided on the boring logs in Appendix A – Boring Logs.

6.5 Groundwater

Water levels were not recorded in the borings. Water levels will fluctuate with the tides, storm surge, seasonal changes, precipitation, runoff, and construction activities.

7.0 PROJECT ALTERNATIVES

7.1 Abutment Reuse

The project was originally scoped as a bridge replacement. Subsequently, the design team broadened the scope alternatives to include bridge rehabilitation with re-use of the existing dry laid granite block abutments and piers.

Geotechnical design parameters for repurposing the existing abutments were developed and provided in a Geotechnical Design Memorandum of September 26, 2017. This memorandum is provided in Appendix C – Geotechnical Memorandum.

¹ Elevations based off NAVD 1988

7.2 Bridge Preservation

Input from the public resulted in the project being rescoped as bridge preservation. The scope of the preservation project will consist of stabilizing the dry stacked granite block substructures, protecting the superstructure concrete and safety improvements. Larger voids in the dry stacked granite block abutment and piers will be filled with grout. Larger loose stone may be secured by pinning in place. Locations where the riprap slopes have settled will be supplemented with additional riprap and crushed stone protection.

8.0 CLOSURE

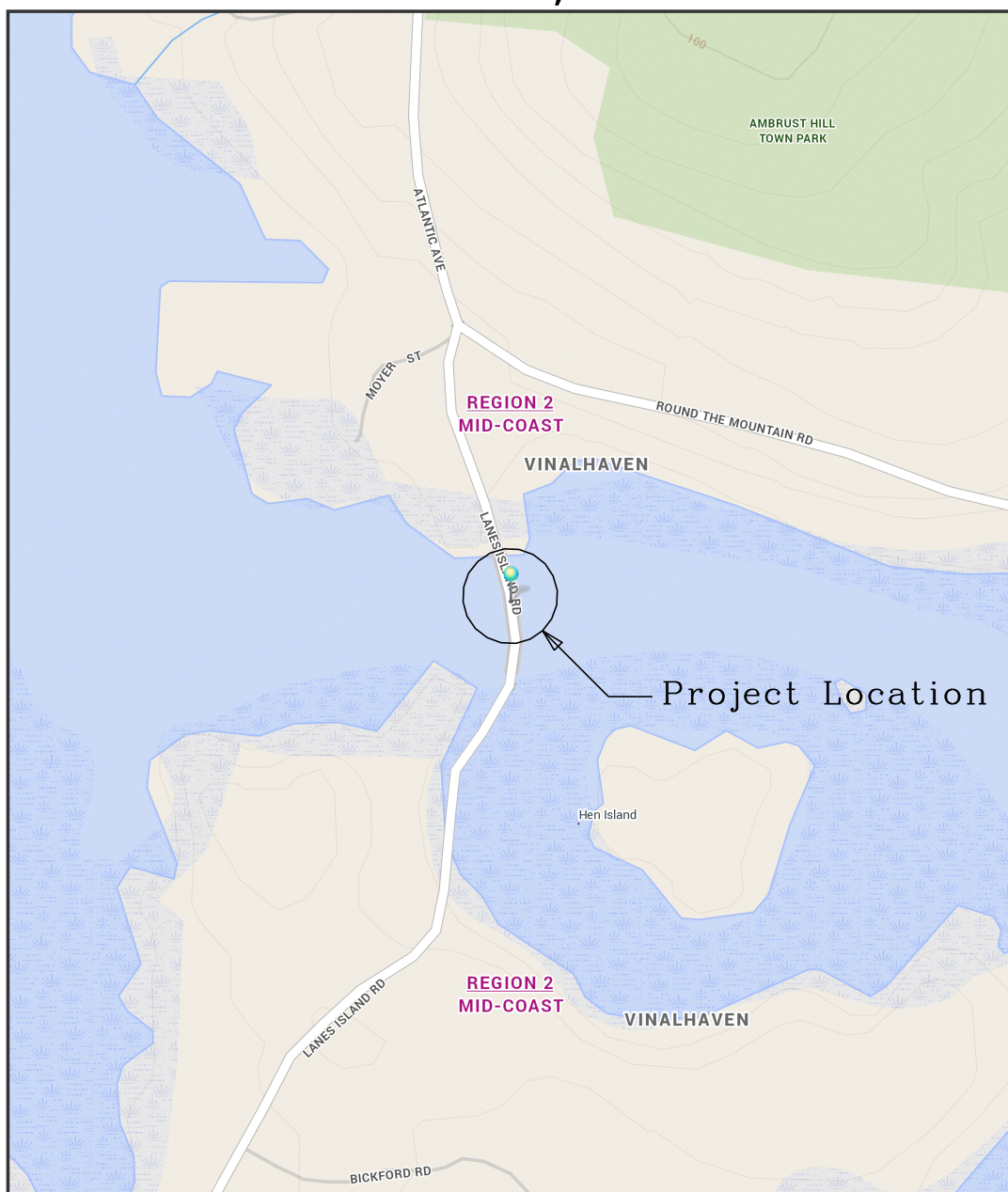
This Geotechnical Data Report has been prepared for the use of the MaineDOT Bridge Program for specific application to the proposed preservation of Lane's Island Bridge in Vinalhaven, Maine. The report was prepared in accordance with generally accepted geotechnical and foundation engineering practices. No other intended use or warranty is expressed or implied.

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

Sheets



VINALHAVEN, MAINE

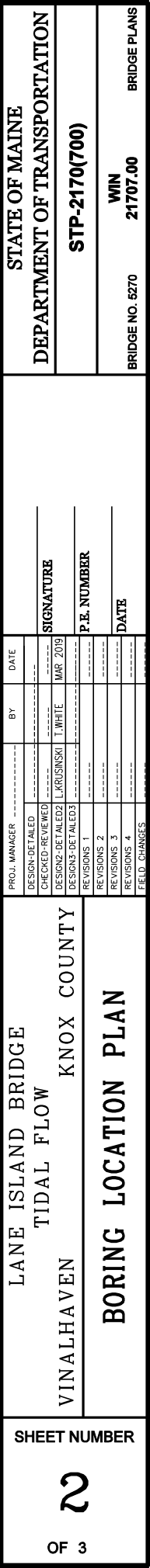


The Maine Department of Transportation provides this publication for information only. Reliance upon this information is at user risk. It is subject to revision and may be incomplete depending upon changing conditions. The Department assumes no liability if injuries or damages result from this information.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

0.04 Miles
1 inch = 0.04 miles

Date: 3/19/2019
Time: 8:03:06 AM

SHEET NUMBER 1 OF 3	LANE ISLAND BRIDGE TIDAL FLOW		STATE OF MAINE DEPARTMENT OF TRANSPORTATION	
	VINALHAVEN KNOX COUNTY		STP-2170(700)	
	LOCATION MAP		WIN	
			BRIDGE NO. 5270 21707.00 BRIDGE PLANS	



Maine Department of Transportation				Project: Lane Island Bridge #202 carries Lane Island Road over Tidal Flow Location: Vinalhaven, Maine				Boring No.: BB-VCH-102					
Soil/Block Exploration Log US CUSTOMARY UNITS				WIN: 21707.00									
Driller: MaineDOT				Elevation (ft.): 14.3				Auger ID/DD: 5" Solid Stem					
Operator: Travis/James/Rick				Datum: NAVD88				Sampler: Standard Split Spoon					
Logged By: B. Wilder				Rig Type: CME 45C				Hammer Wt./Fall: 140#/30"					
Date Start/Finish: 6/28-29/2017 09:00-15:00				Drilling Method: Cased Wash Boring				Core Barrel: NQ-2"					
Boring Location: 103+82.2, 2.8 ft Rt.				Casing ID/DD: HW-4"/NIN-3"				Water Level*: None Observed					
Hammer Efficiency Factor: 0.854				Hammer Type: Automatic ☒ Hydraulic ☐ Rope & Cathead ☐									
Definitions: R = Rock Core Sample S _u = Peak/Retained Field Vane Undrained Shear Strength (psf) P _u = Pocket Torvane Shear Strength (psf) D = Split Spoon Sample S _u (lab) = Lab Vane Undrained Shear Strength (psf) WC = Water Content, percent ND = Unsuccessful Split Spoon Sample Attempt S _u = Unconfined Compressive Strength (ksi) LL = Liquid Limit U = Thin Wall Tube Sample RC = Roller Cone PL = Plastic Limit MU = Unsuccessful Thin Wall Tube Sample Attempt W _h = Weight of 140lb. Hammer Hammer Efficiency Factor = Rig Specific Annual Calibration Value P ₁ = Plasticity Index V = Field Vane Shear Test P ₁ = Pocket Penetrometer W _h = Weight of Rod or Casing C = Grain Size Analysis NV = Unsuccessful Field Vane Shear Test Attempt W _h = Weight of One Person W _h = (Hammer Efficiency Factor/60%)/W-uncorrected C = Consistency Test													
Sample Information								Visual Description and Remarks				Laboratory Testing Results/AASHTO and Unified Class	
Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blow 1/6 in. Strength (ft. RDD 1%)	N-uncorrected	N ₆₀	Casing Blows						
0							SSA	14.1		3" HMA.	0.3		
	R1	48/48	2.00 - 6.00				SPUN CASE	11.8 11.5		Concrete and Granite Block to 2.5 ft bgs.	2.5 2.8		
											Concrete from 2.8-5.0 ft bgs.		
5								9.3		Granite Blocks.	5.0		
	R2	86.4/56.4	6.00 - 13.20					8.3			6.0		
10								2.3		VOID, casing dropped.	12.0		
								1.1		Granite Blocks.	13.2		
15										Mud Line, bottom of Abutment.	21.2		
	R3	102/36	13.20 - 21.70							Grey, wet, loose, fine to coarse SAND, little silt, with shells. (Marine Sediment).			
20										Grey, wet, very loose, Silty fine to coarse SAND, trace gravel. (Marine Sediments).	21.2		
25										Olive grey, wet, very stiff, Clayey SILT, trace fine sand, trace gravel. (Glaciomarine).	29.0	GH20826 A=6, CL WC=25.6%, LL=32 PL=21 PI=11	
	20	24/4	25.00 - 27.00	2/1/2/4	3	4				Failed vane attempt, would not push.			
30										Grey, wet, medium dense, SAND, some silt, some gravel, trace clay, trace shells. (Glaciomarine).	33.0	GH20827 A=4, SC=SM WC=13.6%, Nonplastic	
	30	24/24	30.00 - 32.00	4/6/6/7	12	17							
35										Top of Bedrock at Elev. -22.3 ft. R4: Bedrock: Block, GABBRD to D(ORITE), hard, fresh to slightly weathered, joint sets at low angles, close to moderately close, smooth, planar, changing to moderately dipping, close, planar to undulating. Rock Mass Quality = Fair R4: Core Times (min:sec) 36.6-37.6 ft (2:10) 37.6-38.6 ft (4:01) 38.6-39.6 ft (5:57) 39.6-40.6 ft (6:03) 40.6-41.6 ft (6:17) 82% Recovery 41.6			
	4D	24/15	34.50 - 36.50	9/10/10/8	20	28							
40										R5: Bedrock: Block, fine grained, GABBRD, hard, fresh, joints similar to above, planar to uneven. Rock Mass Quality = Fair. R5: Core Times (min:sec) 41.6-42.6 ft (8:50) 42.6-43.6 ft (9:39) 43.6-45.9 ft (5:00) 100% Recovery Core Blocked 43.9			
	R5	27.6/27.6	41.60 - 43.90	RDD = 64%									
45										R6: Bedrock: Similar to R5. Rock Mass Quality = Poor R6: Core Times (min:sec) 43.9-44.6 ft (8:30) 100% Recovery Core Blocked 44.6			
	R6	8.4/8.4	43.90 - 44.60	RDD = 50%									
50										Bottom of Exploration at 44.6 feet below ground surface.	44.6		
Remarks:													
N197815.3439 E1717529.6565													
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.													
Boring No.: BB-VCH-102													

Maine Department of Transportation				Project: Lane Island Bridge #220 carries Lane Island Road over Tidal Flow Location: Vinalhaven, Maine		Boring No.: BB-VCH-201	
Soil/Rock Exploration Log US CUSTOMARY UNITS						WIN: 21707.00	
Driller: MaineDOT		Elevation (ft.): 7.8		Auger ID/OD: N/A			
Operator: Travis/James		Datum: NAVD88		Sampler: Standard Split Spoon			
Logged By: B. Wilder		Rig Type: CME 45C		Hammer Wt./Fall: 140#/30"			
Date Start/Finish: 9/25/2017-9/26/2017		Drilling Method: Cased Wash Boring		Core Barrel: N0-2"			
Boring Location: 103+35.2, 3.9 ft Rt.		Casing ID/OD: HW-4"/NW-3"		Water Level: None Observed			
Hammer Efficiency Factor: 0.854		Hammer Type: Automatic ☒ Hydraulic ☐ Rope & Cathode ☐					
Definitions: R = Rock Core Sample S _u = Peak/Retained Field Vane Undrained Shear Strength (psf) P = Pocket Torque Shear Strength (psf) D = Split Spoon Sample S ₁ = Lab Vane Undrained Shear Strength (psf) W _c = Water Content, percent MD = Unsuccessful Split Spoon Sample Attempt HSA = Hollow Stem Auger Q _p = Unconfined Compressive Strength (ksf) LL = Liquid Limit U = Thin Wall Tube Sample RC = Roller Cone N _u = Uncorrected = Raw Field SPT N-value PL = Plastic Limit MU = Unsuccessful Thin Wall Tube Sample Attempt WH = Weight of 140lb. Hammer Hammer Efficiency Factor = R/S Specific Annual Calibration Value PI = Plasticity Index V = Field Vane Shear Test PP = Pocket Penetrometer WDC = Weight of Rod or Casing N ₆₀ = SPT Uncorrected Corrected for Hammer Efficiency C = Grain Size Analysis NW = Unsuccessful Field Vane Shear Test Attempt WDP = Weight of One Person N ₆₀ = Hammer Efficiency Factor (0.65) W _u = Uncorrected C = Consolidation Test							
Sample Information							
Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (1/6 in. Strength (lb/ft ²) or RQD (%))	Uncorrected	N ₆₀	Coring Blows
0	R1	60/53	0.00 - 5.00				N0-2
5	R2	60/34	5.00 - 10.00				
10	R3	60/28	10.00 - 15.00				
15	R4	42/14	15.00 - 18.50				
20	1D	24/15	19.00 - 21.00	1/2/2/4	4	6	8
25	R5	60/60	23.30 - 28.30	RQD = 82%			0/10 N0-2
30	R6	60/60	28.30 - 33.30	RQD = 40%			
35							
40							
45							
50							
Visual Description and Remarks Set in NW Casing to Top of Pier Cap. Spun large Roller Cone from 0.0-20.0 ft. R1: Concrete, Granite Blocks. R1 Core Times (min:sec) 0.0-1.0 ft (2:10) 1.0-2.0 ft (2:15) 2.0-3.0 ft (2:00) 3" Drop 3.0-4.0 ft (2:11) 2" Drop 4.0-5.0 ft (2:52) 88% Recovery R1: Granite Blocks. R1 Core Times (min:sec) 5.0-6.0 ft (2:24) 6.0-7.0 ft (4:09) 7.0-8.0 ft (0:15) 14" Drop 8.0-9.0 ft (2:37) 9.0-10.0 ft (3:24) 72% Recovery R3: Granite Blocks R3 Core Times (min:sec) 10.0-11.0 ft (0:30) 15" Drop 11.0-12.0 ft (0:32) 12.0-13.0 ft (2:25) 13.0-14.0 ft (2:15) 14.0-15.0 ft (7:21) 47% Recovery R4: Granite Blocks R4 Core Times (min:sec) 15.0-16.0 ft (4:31) 16.0-17.0 ft (1:32) 17.0-18.0 ft (0:10) 18.0-18.5 ft (0:10) 33% Recovery Bottom of Pier at 16.1 ft. Dark brown, wet, loose, silty fine SAND, little clay, trace gravel, trace marine shells. (Marine Sediments). Set in NW Casing at 20.0 ft. 070 blows for 0.3 ft. Top of Bedrock at Elev. -15.5 ft. 23.3 ft from Top of Pier Cap. R5: Bedrock: Black, fine grained BASALT/GABBRO, very hard, fresh, with fine grained granite intrusion at the bottom of the core run. R5 Core Times (min:sec) 23.3-24.3 ft (2:58) 24.3-25.3 ft (3:12) 25.3-26.3 ft (2:31) 26.3-27.3 ft (2:48) 27.3-28.3 ft (2:51) 100% Recovery R6: Bedrock: Black, fine grained, BASALT/GABBRO with fine grained granite intrusions throughout the core. Fresh, 3 steep to vertical joints, and low angle horizontal joints, close, partly healed joints in granite. R6 Core Times (min:sec) 28.3-29.3 ft (2:07) 29.3-30.3 ft (2:10) 30.3-31.3 ft (2:33) 31.3-32.3 ft (3:14) 32.3-33.3 ft (2:25) 100% Recovery Bottom of Exploration at 33.3 feet below ground surface.							
Laboratory Testing Results/AASHTO Unified Classification G#30306 A-4, SC-SM WC=52.1% Non-Plastic							
Remarks: 9" Concrete Bridge Deck. 5.5' Top of Bridge Deck to Top of Pier Cap. N197768.5495 E11717538.0454							
Stratification lines represent approximate boundaries between soil type transitions may be gradual.							
* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.							

Appendix A

Boring Logs

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)	GRAVEL WITH FINES (Appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures.	TERMS DESCRIBING DENSITY/CONSISTENCY														
		GC	Clayey gravels, gravel-sand-clay mixtures.																
		CLEAN SANDS	SW	Well-graded sands, gravelly sands, little or no fines	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).														
		(little or no fines)	SP	Poorly-graded sands, gravelly sand, little or no fines.															
		SANDS WITH FINES (Appreciable amount of fines)	SM	Silty sands, sand-silt mixtures	Density of Cohesionless Soils				Standard Penetration Resistance N-Value (blows per foot)										
SC	Clayey sands, sand-clay mixtures.																		
FINE-GRAINED SOILS (more than half of material is smaller than No. 200 sieve size)	SILTS AND CLAYS (liquid limit less than 50)		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity.	Consistency of Cohesive soils		SPT N-Value (blows per foot)		Approximate Undrained Shear Strength (psf)		Field Guidelines								
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.	Very Soft	WOH, WOR, WOP, <2	0 - 250		Fist easily penetrates										
					Soft	2 - 4	250 - 500		Thumb easily penetrates										
				Medium Stiff	5 - 8	500 - 1000		Thumb penetrates with moderate effort											
				Stiff	9 - 15	1000 - 2000		Indented by thumb with great effort											
	SILTS AND CLAYS (liquid limit greater than 50)	OL	Organic silts and organic silty clays of low plasticity.	Very Stiff	16 - 30	2000 - 4000		Indented by thumbnail											
				Hard	>30	over 4000		Indented by thumbnail with difficulty											
		HIGHLY ORGANIC SOILS	Pt	Peat and other highly organic soils.	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																			
<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	51 - 75	Good	76 - 90	Excellent	91 - 100
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Poor	26 - 50																		
Fair	51 - 75																		
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Excellent	91 - 100																		
Desired Soil Observations (in this order, if applicable): Color (Munsell color chart) Moisture (dry, damp, moist, wet) Density/Consistency (from above right hand side) Texture (fine, medium, coarse, etc.) Name (sand, silty sand, clay, etc., including portions - trace, little, etc.) Gradation (well-graded, poorly-graded, uniform, etc.) Plasticity (non-plastic, slightly plastic, moderately plastic, highly plastic) Structure (layering, fractures, cracks, etc.) Bonding (well, moderately, loosely, etc.,) Cementation (weak, moderate, or strong) Geologic Origin (till, marine clay, alluvium, etc.) Groundwater level					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 Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Lane Island Bridge #5270 carries Lanes Island Road over Tidal Flow Location: Vinalhaven, Maine		Boring No.: BB-VCH-101 WIN: 21707.00						
Driller: MaineDOT		Elevation (ft.) 13.2		Auger ID/OD: 5" Solid Stem								
Operator: Travis/James/Rick		Datum: NAVD88		Sampler: Standard Split Spoon								
Logged By: B. Wilder		Rig Type: CME 45C		Hammer Wt./Fall: 140#/30"								
Date Start/Finish: 6/26-27/2017; 09:00-15:00		Drilling Method: Cased Wash Boring		Core Barrel: NQ-2"								
Boring Location: 102+68.1, 3.5 ft Rt.		Casing ID/OD: NW-3"		Water Level*: None Observed								
Hammer Efficiency Factor: 0.854		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	13.0		3" HMA.		
										Boulders and Cobbles, (Fill).		
	R1	128.4/52.8	3.80 - 14.50				NQ-2					
5							SPUN CASE					
								6.7		Concrete layer from 6.5-8.5 ft bgs.		
								4.7			Granite Block.	
10												
	MD	36/0	13.60 - 16.60					-0.4			Failed sample attempt. Void from 13.6-16.6 ftb bgs. Spun Casing may have gone between Granite Blocks.	
15												
	MD	8/0	16.60 - 17.27	11/25(2")	---							
	R2		17.10 - 21.30				NQ-2	-3.9		Granite Blocks		
20												
								-7.8		Mud Line. Grey, wet, medium dense, Silty fine to coarse SAND, trace shells, (Marine Sediments).		
	1D	24/13	21.30 - 23.30	21/6/6/5	12	17						
25								-10.7		Top of Bedrock at Elev. -10.7 ft.		
	R3	60/60	24.00 - 29.00	RQD = 95%			NQ-2				R3: Bedrock: Black, very fine grained, GABBRO with olivine	
Remarks: N197701.1754 E1717529.4141												
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-VCH-101	

[illegible]

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Lane Island Bridge #5270 carries Lanes Island Road over Tidal Flow Location: Vinalhaven, Maine				Boring No.: BB-VCH-102 WIN: 21707.00																																																																																																																																																																																																																															
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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Lane Island Bridge #5270 carries Lanes Island Road over Tidal Flow Location: Vinalhaven, Maine				Boring No.: BB-VCH-201 WIN: 21707.00					
Driller: MaineDOT				Elevation (ft.): 7.8				Auger ID/OD: N/A					
Operator: Travis/James				Datum: NAVD88				Sampler: Standard Split Spoon					
Logged By: B. Wilder				Rig Type: CME 45C				Hammer Wt./Fall: 140#/30"					
Date Start/Finish: 9/25/2017-9/26/2017				Drilling Method: Cased Wash Boring				Core Barrel: NQ-2"					
Boring Location: 103+35.2, 3.9 ft Rt.				Casing ID/OD: HW-4"/NW-3"				Water Level*: None Observed					
Hammer Efficiency Factor: 0.854				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													
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0	R1	60/53	0.00 - 5.00				NQ-2			Set in HW Casing to Top of Pier Cap. Spun large Roller Cone from 0.0-20.0 ft. R1: Concrete, Granite Blocks. R1: Core Times (min:sec) 0.0-1.0 ft (2:10) 1.0-2.0 ft (2:15) 2.0-3.0 ft (2:00) 3" Drop 3.0-4.0 ft (2:11) 2" Drop 4.0-5.0 ft (2:52) 88% Recovery R1: Granite Blocks. R1: Core Times (min:sec) 5.0-6.0 ft (2:24) 6.0-7.0 ft (4:09) 7.0-8.0 ft (0:15) 14" Drop 8.0-9.0 ft (2:37) 9.0-10.0 ft (3:24) 72% Recovery R3: Granite Blocks R3: Core Times (min:sec) 10.0-11.0 ft (0:30) 15" Drop 11.0-12.0 ft (0:32) 12.0-13.0 ft (2:25) 13.0-14.0 ft (2:15) 14.0-15.0 ft (7:21) 47% Recovery R4: Granite Blocks R4: Core Times (min:sec) 15.0-16.0 ft (4:31) 16.0-17.0 ft (1:32) 17.0-18.0 ft (0:10) 18.0-18.5 ft (0:10) 33% Recovery Bottom of Pier at 16.1 ft. Dark brown, wet, loose, Silty fine SAND, little clay, trace gravel, trace marine shells. (Marine Sediments). Set in NW Casing at 20.0 ft. G#303076 A-4, SC-SM WC=52.1% Non-Plastic a70 blows for 0.3 ft. Top of Bedrock at Elev. -15.5 ft. 23.3 ft from Top of Pier Cap.			
5	R2	60/34	5.00 - 10.00										
10	R3	60/28	10.00 - 15.00										
15	R4	42/14	15.00 - 18.50										
20	1D	24/15	19.00 - 21.00	1/2/2/4	4	6							
							8						
							18						
							16						
	R5	60/60	23.30 - 28.30	RQD = 82%			a70 NQ-2						
25													
Remarks: 9" Concrete Bridge Deck. 5.5' Top of Bridge Deck to Top of Pier Cap. N197768.5495 E1717538.0454													
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-VCH-201		

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Fresh, 3 steep to vertical joints, and low angle horizontal joints, close, partly healed joints in granite. 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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.: BB-VCH-201																																																																																																																																																																																																																																																																																																																	

Appendix B

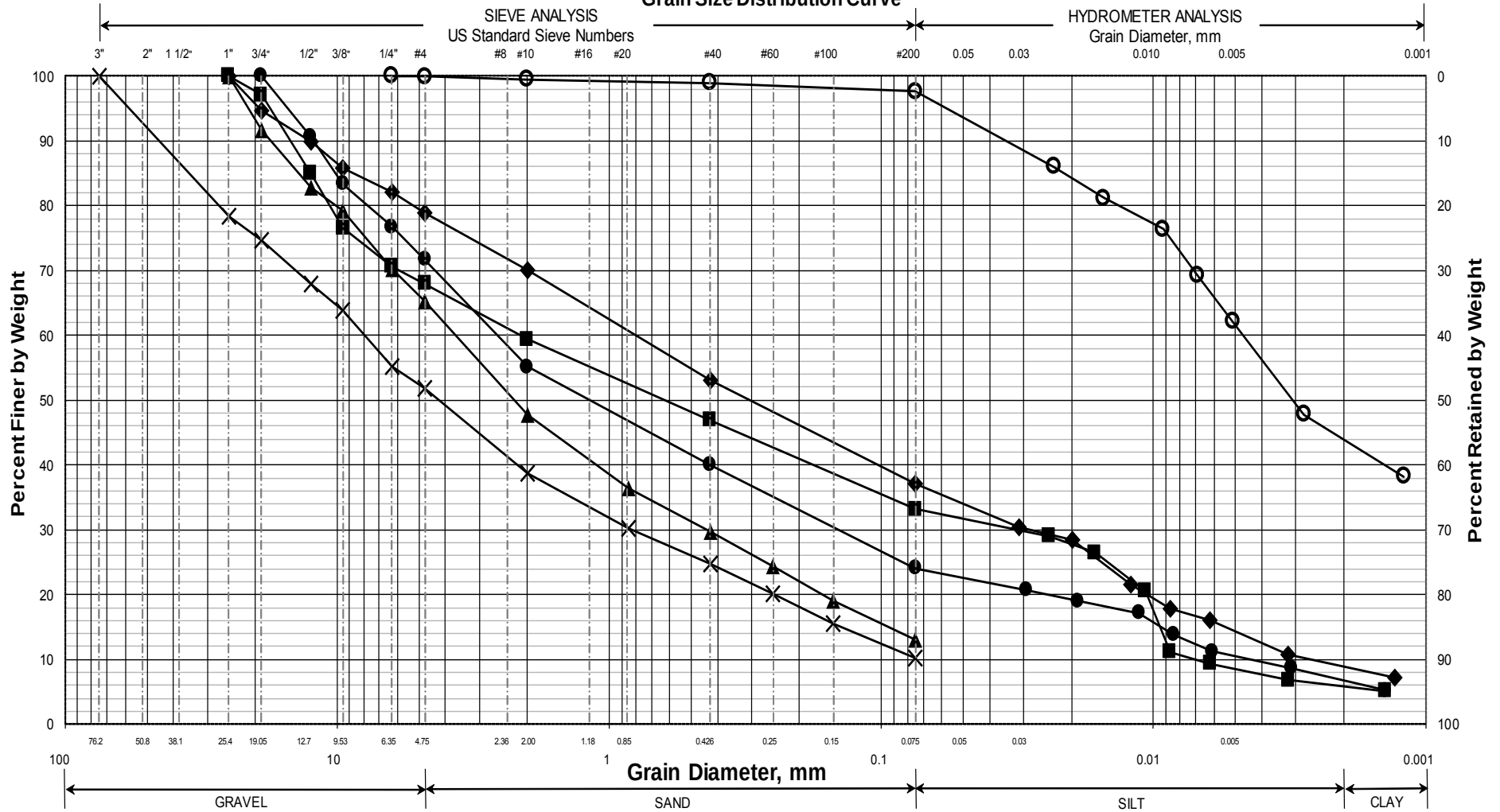
Laboratory Test Results

Work Number: 21707.00

*Streambed samples taken at Low Water line to the Northeast of BB-VCH-102.

1 of 1

Maine Department of Transportation Grain Size Distribution Curve

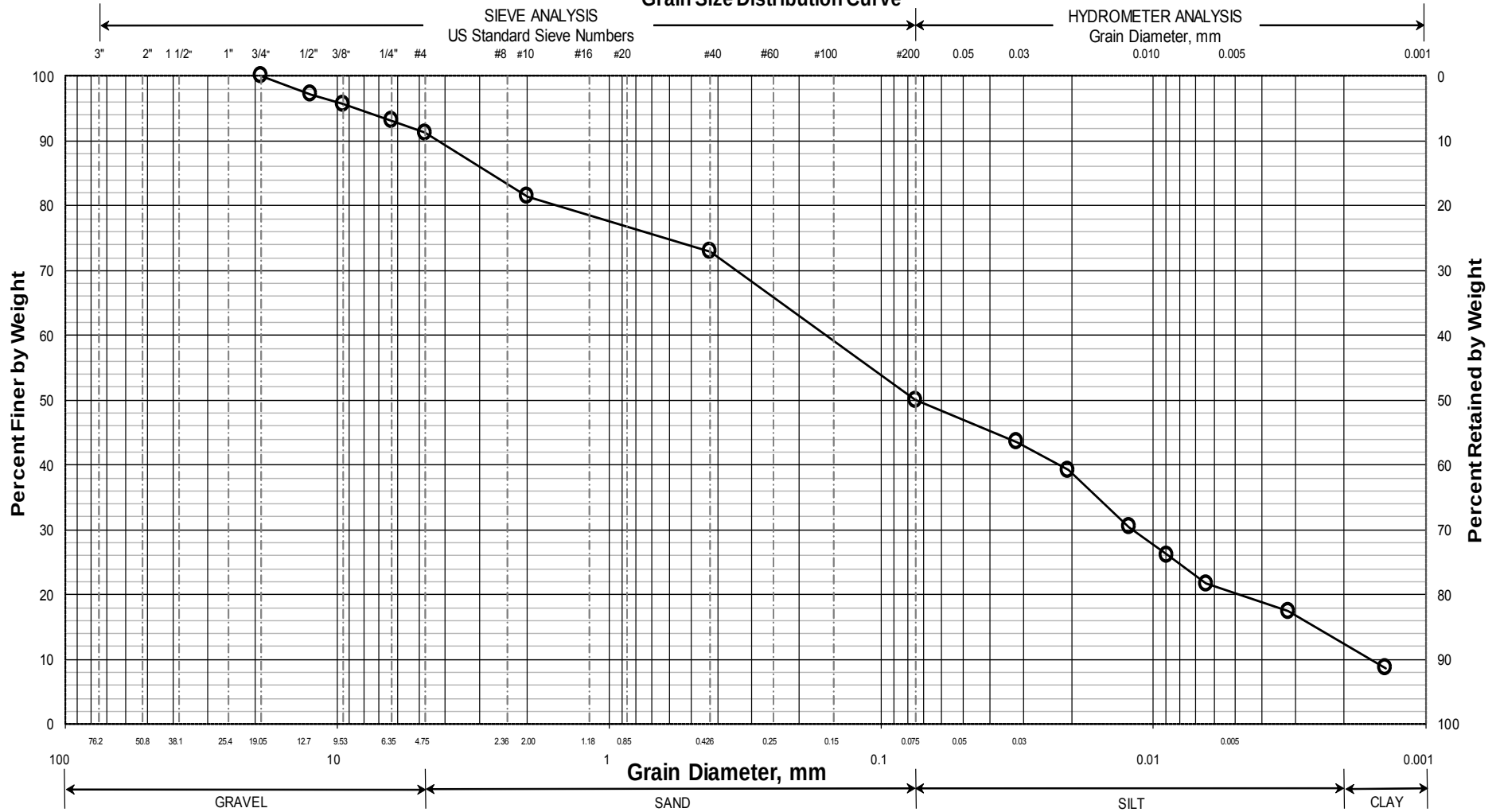


UNIFIED CLASSIFICATION

	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	WC, %	LL	PL	PI
○	BB-VCH-102/3D	103+82.2	2.8 RT	30.0-32.0	Clayey SILT, trace sand, trace gravel.	25.6	32	21	11
◆	BB-VCH-102/4D	103+82.2	2.8 RT	34.5-36.5	SAND, some silt, some gravel, trace clay.	13.6			NP
■	GS-VCH-01	See Note		SEAFLOOR	SAND, some gravel, some silt, trace clay.	76.6			
●	GS-VCH-02	See Note		SEAFLOOR	SAND, some gravel, little silt, trace clay.	60.2			
▲	GS-VCH-03	See Note		SEAFLOOR	SAND, some gravel, little silt.	67.1			
×	GS-VCH-04	See Note		SEAFLOOR	Sandy GRAVEL, trace silt.	50.7			

WIN	
021707.00	
Town	
Vinalhaven	
Reported by/Date	
WHITE, TERRY A	3/18/2019

Maine Department of Transportation Grain Size Distribution Curve



UNIFIED CLASSIFICATION

	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	WC, %	LL	PL	PI
○	BB-VCH-201/1D	103+35.2	3.9 RT	19.0-21.0	Silty SAND, little clay, trace gravel.	52.1			NP
◆									
■									
●									
▲									
X									

WIN
021707.00
Town
Vinalhaven
Reported by/Date
WHITE, TERRY A 3/18/2019



GEOTECHNICAL TEST REPORT

Central Laboratory

SAMPLE INFORMATION

Reference No. **270826** Boring No./Sample No. **BB-VCH-102/3D** Sample Description **GEOTECHNICAL (DISTURBED)** Sampled **6/29/2017** Received **7/5/2017**

Sample Type: **GEOTECHNICAL** Location: Station: **103+82.2** Offset, ft: **2.8** RT Dbfg, ft: **30.0-32.0**

WIN/Town **021707.00 - VINALHAVEN** Sampler: **BRUCE WILDER**

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]	99.9
No. 10 [2.00 mm]	99.5
No. 20 [0.850 mm]	
No. 40 [0.425 mm]	99.0
No. 60 [0.250 mm]	
No. 100 [0.150 mm]	
No. 200 [0.075 mm]	97.6
[0.0232 mm]	86.0
[0.0152 mm]	81.2
[0.0092 mm]	76.4
[0.0069 mm]	69.3
[0.0051 mm]	62.1
[0.0028 mm]	47.8
[0.0012 mm]	38.2

Miscellaneous Tests

Liquid Limit @ 25 blows (T 89), %	32
Plastic Limit (T 90), %	21
Plasticity Index (T 90), %	11
Specific Gravity, Corrected to 20°C (T 100)	2.66
Loss on Ignition, % (T 267)	
Water Content (T 265), %	25.6

Consolidation (T 216)

Trimmings, 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:

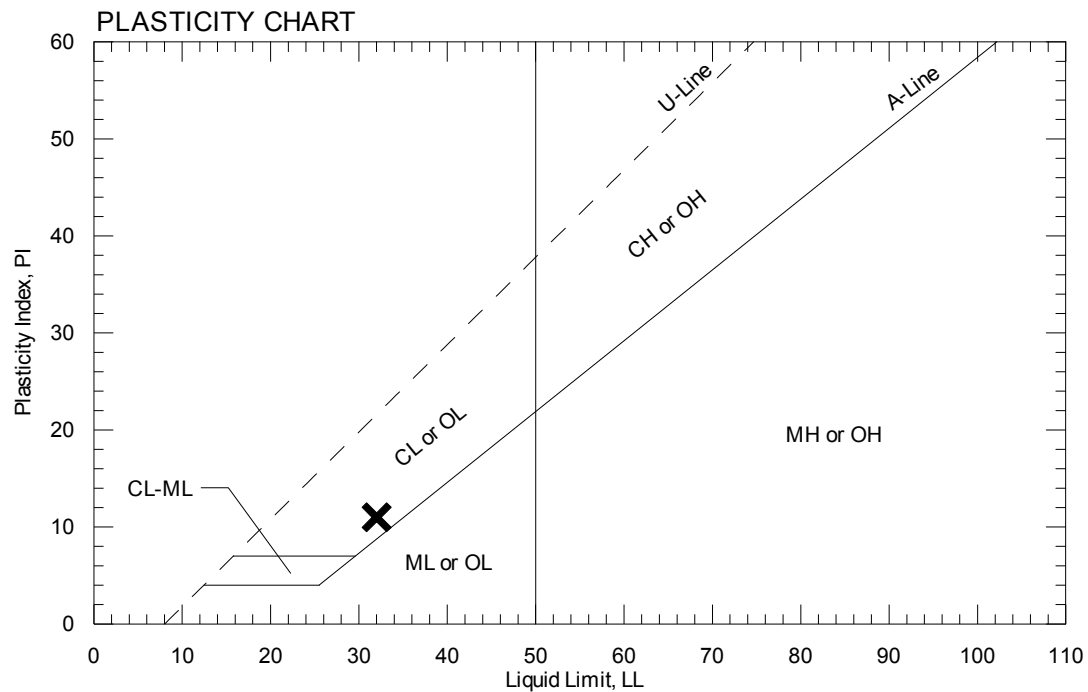
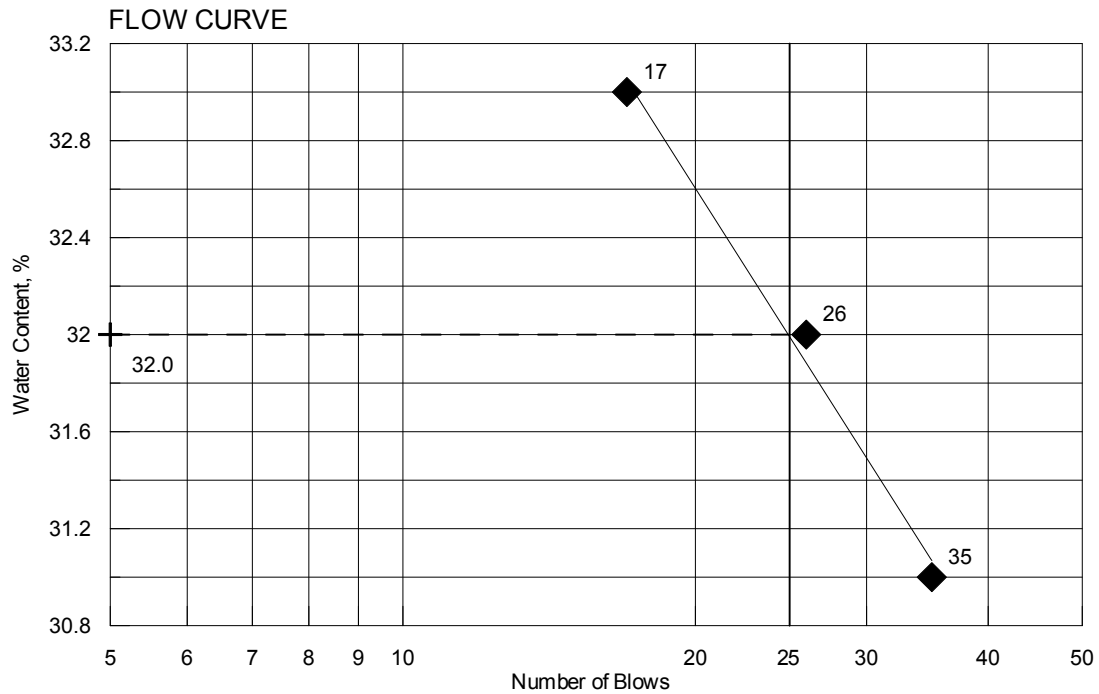
AUTHORIZATION AND DISTRIBUTION

Reported by: **GREGORY LIDSTONE**

Date Reported: **7/15/2017**

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TOWN	Vinalhaven	Reference No.	270826
WIN	021707.00	Water Content, %	25.6
Sampled	6/29/2017	Liquid Limit @ 25 blows (T 89), %	32
Boring No./Sample No.	BB-VCH-102/3D	Plastic Limit (T 90), %	21
Station	103+82.2	Plasticity Index (T 90), %	11
Depth	30.0-32.0	Tested By	BBURR





GEOTECHNICAL TEST REPORT

Central Laboratory

SAMPLE INFORMATION

Reference No. **270827** Boring No./Sample No. **BB-VCH-102/4D** Sample Description **GEOTECHNICAL (DISTURBED)** Sampled **6/29/2017** Received **7/5/2017**

Sample Type: **GEOTECHNICAL** Location: Station: **103+82.2** Offset, ft: **2.8** RT Dbfg, ft: **34.5-36.5**

WIN/Town **021707.00 - VINALHAVEN** Sampler: **BRUCE WILDER**

TEST RESULTS

Sieve Analysis (T 88)

Wash Method

SIEVE SIZE U.S. [SI]	% Passing
3 in. [75.0 mm]	
1 in. [25.0 mm]	100.0
¾ in. [19.0 mm]	94.6
½ in. [12.5 mm]	89.9
⅜ in. [9.5 mm]	85.9
¼ in. [6.3 mm]	82.1
No. 4 [4.75 mm]	78.9
No. 10 [2.00 mm]	70.1
No. 20 [0.850 mm]	
No. 40 [0.425 mm]	53.0
No. 60 [0.250 mm]	
No. 100 [0.150 mm]	
No. 200 [0.075 mm]	37.1
[0.0311 mm]	30.4
[0.0199 mm]	28.5
[0.0121 mm]	21.5
[0.0087 mm]	17.9
[0.0062 mm]	16.1
[0.0032 mm]	10.7
[0.0013 mm]	7.2

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)	2.68
Loss on Ignition, % (T 267)	
Water Content (T 265), %	13.6

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: **7/18/2017**

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GEOTECHNICAL TEST REPORT

Central Laboratory

SAMPLE INFORMATION

Reference No. **303076** Boring No./Sample No. **BB-VCH-201/1D** Sample Description **GEOTECHNICAL (DISTURBED)** Sampled **9/25/2017** Received **10/7/2017**

Sample Type: **GEOTECHNICAL** Location: Station: **103+35.2** Offset, ft: **3.9** RT Dbfg, ft: **19.0-21.0**

WIN/Town **021707.00 - VINALHAVEN** Sampler: **BRUCE WILDER**

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]	100.0
½ in. [12.5 mm]	97.2
⅜ in. [9.5 mm]	95.7
¼ in. [6.3 mm]	93.1
No. 4 [4.75 mm]	91.3
No. 10 [2.00 mm]	81.4
No. 20 [0.850 mm]	
No. 40 [0.425 mm]	72.9
No. 60 [0.250 mm]	
No. 100 [0.150 mm]	
No. 200 [0.075 mm]	50.0
[0.0318 mm]	43.5
[0.0206 mm]	39.2
[0.0123 mm]	30.4
[0.0089 mm]	26.1
[0.0064 mm]	21.7
[0.0032 mm]	17.4
[0.0014 mm]	8.7

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)	2.61
Loss on Ignition, % (T 267)	
Water Content (T 265), %	52.1

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: **11/15/2017**

Paper Copy: Lab File; Project File; Geotech File



GEOTECHNICAL TEST REPORT

Central Laboratory

SAMPLE INFORMATION

Reference No. **270828** Boring No./Sample No. **GS-VCH-01** Sample Description **GEOTECHNICAL (DISTURBED)** Sampled **6/29/2017** Received **7/5/2017**

Sample Type: **GEOTECHNICAL** Location: Station: **See Note** Offset, ft: Dbfg, ft: **SEAFLOOR**

WIN/Town **021707.00 - VINALHAVEN** Sampler: **BRUCE WILDER**

TEST RESULTS

Sieve Analysis (T 88)

Wash Method

SIEVE SIZE U.S. [SI]	% Passing
3 in. [75.0 mm]	
1 in. [25.0 mm]	100.0
¾ in. [19.0 mm]	97.1
½ in. [12.5 mm]	85.0
⅜ in. [9.5 mm]	76.6
¼ in. [6.3 mm]	70.6
No. 4 [4.75 mm]	68.0
No. 10 [2.00 mm]	59.4
No. 20 [0.850 mm]	
No. 40 [0.425 mm]	46.9
No. 60 [0.250 mm]	
No. 100 [0.150 mm]	
No. 200 [0.075 mm]	33.2
[0.0241 mm]	29.0
[0.0164 mm]	26.5
[0.0107 mm]	20.5
[0.0087 mm]	11.1
[0.0062 mm]	9.4
[0.0032 mm]	6.8
[0.0014 mm]	5.1

Miscellaneous Tests

Liquid Limit @ 25 blows (T 89), %	
Plastic Limit (T 90), %	
Plasticity Index (T 90), %	
Specific Gravity, Corrected to 20°C (T 100)	2.62
Loss on Ignition, % (T 267)	
Water Content (T 265), %	76.6

Consolidation (T 216)

Trimmings, 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:

Riverbed sample.

AUTHORIZATION AND DISTRIBUTION

Reported by: **GREGORY LIDSTONE**

Date Reported: **7/15/2017**

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GEOTECHNICAL TEST REPORT

Central Laboratory

SAMPLE INFORMATION

Reference No. **270829** Boring No./Sample No. **GS-VCH-02** Sample Description **GEOTECHNICAL (DISTURBED)** Sampled **6/29/2017** Received **7/5/2017**

Sample Type: **GEOTECHNICAL** Location: Station: **See Note** Offset, ft: Dbfg, ft: **SEAFLOOR**

WIN/Town **021707.00 - VINALHAVEN** Sampler: **BRUCE WILDER**

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]	100.0
½ in. [12.5 mm]	90.6
⅜ in. [9.5 mm]	83.4
¼ in. [6.3 mm]	76.7
No. 4 [4.75 mm]	71.7
No. 10 [2.00 mm]	55.1
No. 20 [0.850 mm]	
No. 40 [0.425 mm]	40.0
No. 60 [0.250 mm]	
No. 100 [0.150 mm]	
No. 200 [0.075 mm]	24.1
[0.0292 mm]	20.7
[0.0190 mm]	19.0
[0.0113 mm]	17.2
[0.0084 mm]	13.8
[0.0061 mm]	11.2
[0.0031 mm]	8.7
[0.0014 mm]	5.2

Miscellaneous Tests

Liquid Limit @ 25 blows (T 89), %	
Plastic Limit (T 90), %	
Plasticity Index (T 90), %	
Specific Gravity, Corrected to 20°C (T 100)	2.60
Loss on Ignition, % (T 267)	
Water Content (T 265), %	60.2

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:

Riverbed sample.

AUTHORIZATION AND DISTRIBUTION

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Date Reported: **7/15/2017**

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GEOTECHNICAL TEST REPORT

Central Laboratory

SAMPLE INFORMATION

Reference No. **270830** Boring No./Sample No. **GS-VCH-03** Sample Description **GEOTECHNICAL (DISTURBED)** Sampled **6/29/2017** Received **7/5/2017**

Sample Type: **GEOTECHNICAL** Location: Station: **See Note** Offset, ft: Dbfg, ft: **SEAFLOOR**

WIN/Town **021707.00 - VINALHAVEN** Sampler: **BRUCE WILDER**

TEST RESULTS

Sieve Analysis (T 27, T 11)	
Wash Method	
Procedure A	
SIEVE SIZE U.S. [SI]	% Passing
3 in. [75.0 mm]	
1 in. [25.0 mm]	100.0
¾ in. [19.0 mm]	91.6
½ in. [12.5 mm]	82.8
⅜ in. [9.5 mm]	79.2
¼ in. [6.3 mm]	70.3
No. 4 [4.75 mm]	65.3
No. 10 [2.00 mm]	47.7
No. 20 [0.850 mm]	36.4
No. 40 [0.425 mm]	29.7
No. 60 [0.250 mm]	24.4
No. 100 [0.150 mm]	19.0
No. 200 [0.075 mm]	13.0

Miscellaneous Tests	
Liquid Limit @ 25 blows (T 89), %	
Plastic Limit (T 90), %	
Plasticity Index (T 90), %	
Specific Gravity, Corrected to 20°C (T 100)	
Loss on Ignition, % (T 267)	
Water Content (T 265), %	67.1

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:

Riverbed sample.

AUTHORIZATION AND DISTRIBUTION

Reported by: **GREGORY LIDSTONE**

Date Reported: **7/11/2017**

Paper Copy: Lab File; Project File; Geotech File



GEOTECHNICAL TEST REPORT

Central Laboratory

SAMPLE INFORMATION

Reference No. **270831** Boring No./Sample No. **GS-VCH-04** Sample Description **GEOTECHNICAL (DISTURBED)** Sampled **6/29/2017** Received **7/5/2017**

Sample Type: **GEOTECHNICAL** Location: Station: **See Note** Offset, ft: Dbfg, ft: **SEAFLOOR**

WIN/Town **021707.00 - VINALHAVEN** Sampler: **BRUCE WILDER**

TEST RESULTS

Sieve Analysis (T 27, T 11)	
Wash Method	
Procedure A	
SIEVE SIZE U.S. [SI]	% Passing
3 in. [75.0 mm]	100.0
1 in. [25.0 mm]	78.3
¾ in. [19.0 mm]	74.6
½ in. [12.5 mm]	67.9
⅜ in. [9.5 mm]	63.9
¼ in. [6.3 mm]	55.2
No. 4 [4.75 mm]	51.8
No. 10 [2.00 mm]	38.7
No. 20 [0.850 mm]	30.3
No. 40 [0.425 mm]	24.8
No. 60 [0.250 mm]	20.2
No. 100 [0.150 mm]	15.5
No. 200 [0.075 mm]	10.2

Miscellaneous Tests	
Liquid Limit @ 25 blows (T 89), %	
Plastic Limit (T 90), %	
Plasticity Index (T 90), %	
Specific Gravity, Corrected to 20°C (T 100)	
Loss on Ignition, % (T 267)	
Water Content (T 265), %	50.7

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:

Riverbed sample.

AUTHORIZATION AND DISTRIBUTION

Reported by: **GREGORY LIDSTONE**

Date Reported: **7/11/2017**

Paper Copy: Lab File; Project File; Geotech File

Appendix C

Geotechnical Memorandum

To: Peter Perkins, Kyle Turschman, CHA
From: Laura Krusinski, MaineDOT
Cc: Joel Kittredge, MaineDOT
Subject: Preliminary Geotechnical Design Parameters for Abutment Reuse
Lane's Island Bridge #5279
Date: September 26, 2017; Revised April 8, 2019
WIN: 21707.00
Town: Vinalhaven

This memorandum provides preliminary geotechnical design parameters to evaluate repurposing the existing dry laid, granite abutments of the Lane's Island Bridge in Vinalhaven, Maine. These design recommendations are in accordance with AASHTO LRFD Bridge Design Specifications 7th Edition, 2014 with interims through 2016 (LRFD) and MaineDOT Bridge Design Guide (BDG) Section 10.6 - Substructure Rehabilitation and BDG Section 10.7 - Substructure Reuse.

1.0 ABUTMENT REUSE

Repurposed abutments shall be evaluated to ensure that they meet current AASHTO LRFD standards for sliding, eccentricity, bearing resistance and global stability. Repurposed and rehabilitated abutments shall be proportioned for all applicable load combinations specified in LRFD Articles 3.4.1 and 11.5.5 and shall be evaluated for all relevant strength, extreme and service limit states. LRFD Figures C11.5.6-1 and C11.5.6-2 illustrate the typical load factors to produce the extreme factored effect for bearing resistance, sliding and eccentricity.

1.1 Sliding

Based on the historical bridge plans (State Highway Commission, dated 1949-1951) the existing South and North Abutments consist of stacked, dry-laid granite stone with concrete caps, each constructed on top of a pre-existing stacked granite pier from the original bridge construction (predating the 1949 bridge modifications). Spans leading up to the two existing abutments were "filled-in" and the remaining were piers abandoned in the bridge approaches. Based on the borings conducted at the site, it is assumed the South and North Abutments are bearing on marine sediments. Table 1 presents the resistance factors, ϕ_τ , for sliding analyses for the abutments.

Substructure	Assumed Bearing Material	Condition	Limit State	Sliding Resistance Factor ϕ_τ	LRFD Reference
South Abutment	Marine Sediments	Granite blocks/stone on Silty Sand	Strength	0.90	Table 10.5.5.2.2-1
			Service	1.0	Article 10.5.5.1
			Extreme	1.0	Article 10.5.5.3
North Abutment	Marine Sediments overlying Clayey Silt	Granite blocks/stone on Silty Sand & Clayey Silt	Strength	0.85	Table 10.5.5.2.2-1
			Service	1.0	Article 10.5.5.1
			Extreme	1.0	Article 10.5.5.3

Table 1 – Resistance Factors for Sliding

The sliding resistance of the South Abutment footing to lateral loads shall be calculated using the maximum coefficient of friction provided in Table 2:

Substructure	Interface Materials	Limit State	Friction Angle, δ_{soil}	Coefficient of Friction, $\tan \delta$ (dim.)	C^1	LRFD Reference
South Abutment	Granite blocks/stones on Silty Sand (Marine Sediments)	All	17°	0.31	0.8	Table C3.11.5.3-1

¹ Per LRFD Article 10.6.3.4 and Equation 10.6.3.4-2, $C=0.8$ for footings which are not cast-in-place

Table 2 – Maximum Coefficients of Friction for Sliding at South Abutment

Sensitivity analyses are recommended for sliding evaluations of the North Abutment using the soil properties in Table 3, below.

Substructure	Interface Materials	Limit State	Friction Angle, δ_{soil}	Coefficient of Friction, $\tan \delta$ (dim.)	C^1	Undrained Shear Strength, S_u (ksf)	LRFD Reference
North Abutment	Granite blocks/stones on layered Silty Sand and Clayey Silt (Marine)	All	17°	0.31	0.8	--	Table C3.11.5.3-1
			-	-	-	2.0	Correlations to SPT

¹ Per LRFD Article 10.6.3.4 and Equation 10.6.3.4-2, $C=0.8$ for footings which are not cast-in-place

Table 3 – Soil Parameters for Sliding at North Abutment

Passive earth pressure due to soil in front of the abutment footings shall be neglected in the sliding analyses.

1.2 Bearing Resistance and Eccentricity

Based on the historical bridge plans and the borings conducted at the site it is assumed that existing South and North Abutments are founded on native marine sediments. Repurposed abutments shall be checked to ensure that they meet current LRFD standards against bearing capacity failure.

Application of permanent and transient loads is specified in LRFD Article 11.5.6. The stress distribution at both abutments may be assumed to be a linearly distributed pressure over the effective base as shown in LRFD Figure 11.6.3.2-1. Table 4 summarizes the factored bearing resistances for the existing abutments:

Substructure	Assumed Bearing Material	Limit State	Resistance Factor, ϕ_b	Factored Bearing Resistance ¹ (ksf)	LRFD Reference
South Abutment ²	Marine Sediments	Service	1.0	4.0	Article 10.5.5.1
		Strength	0.45	2.8	Table 10.5.5.2.2-1
		Extreme	0.8	5.0	Article C11.5.8
North Abutment ³	Marine Sediments overlying Clayey Silt	Service	1.0	3.0	Article 10.5.5.1
		Strength	0.45	2.5	Table 10.5.5.2.2-1
		Extreme	0.8	4.4	Article C11.5.8

¹ Factored bearing resistance assumes 1-foot of embedment of stone abutment footings

² Footing width of 10.5 feet assumed per State Highway Commission Plans, 1949-1951, Sheet 2 of 9 (Abut. #3).

³ Footing width of 17 feet assumed per State Highway Commission Plans, 1949-1951, Sheet 2 of 9 (Abut. #1)

Table 4 – Bearing Resistances

For each abutment footing, the eccentricity limits are presented in Table 5. LRFD Figures C11.5.6-2 and C11.5.6-4 illustrate the typical load factors to produce the extreme factored effect for evaluating eccentricity.

Substructure	Assumed Bearing Material	Location of Resultant Forces	LRFD Reference
South Abutment	Marine Sediments	Within the middle two-thirds (2/3) of the base width	Article 11.6.3.3
North Abutment	Marine Sediments overlying Clayey Silt	Within the middle two-thirds (2/3) of the base width	Article 11.6.3.3

Table 5 – Eccentricity Limits

1.3 Earth Pressures and Surcharge Forces

Repurposed abutments should be evaluated for active earth pressure over the abutment height. Coulomb wedge theory applies for gravity and semi-gravity walls. In designing for active pressure, a Coulomb active earth pressure coefficient, K_a , of 0.28 is recommended assuming level backfill and a friction angle of 21° between the backfill and wall as specified in LRFD Table 3.11.5.3-1.

The designer may assume Soil Type 4 (MaineDOT Bridge Design Guide (BDG)) Section 3.6.1) for granular backfill soil properties. The backfill properties are as follows: $\phi = 32^\circ$, $\gamma = 125$ pcf.

Additional lateral earth pressure due to construction surcharge or live load surcharge is required per Section 3.6.8 of the MaineDOT BDG for the abutments if an approach slab is not present. When a structural approach slab is specified, reduction, not elimination of the surcharge loads is permitted per LRFD Article 3.11.6.5. The live load surcharge on abutments may be estimated as a uniform horizontal earth pressure due to an equivalent height of soil (h_{eq}) taken from Table 6.

Abutment Height (feet)	h_{eq} (feet)
5	4.0
10	3.0
≥ 20	2.0

Table 6 - Equivalent Height of Soil for Estimating Live Load Surcharge Of Abutments Perpendicular to Traffic

1.4 Global Stability

The global stability of the existing abutments have not been evaluated for proposed loads.