

To: Rob Young, P.E., Structures Project Manager

END

From: Eric Denardo, P.E., Geotechnical Engineer

Date: July 15, 2024

Subject: Plymouth ER P23-1(328) – Geotechnical Data Report

1.0 INTRODUCTION

As requested, we have completed our geotechnical subsurface investigation for the proposed replacement of Bridge No. 7 located on VT Route 100A over the Piney Hollow Brook approximately 3.3 miles north of the intersection of VT 100A and VT 100 in Plymouth, Vermont. The borings were completed to determine the soil strata and depth to bedrock to aid in design of a replacement structure. Contained herein are the results of our field sampling and testing, laboratory analyses of soil samples, as well as attached boring logs.

2.0 FIELD INVESTIGATION

The field investigation was conducted between January 31, and February 14, 2024. Two standard penetration borings were drilled to evaluate the subsurface profile to aid in the design and construction of the replacement structure. Approximate boring locations were provided by Rob Young, VTrans Structures Section, in an email dated October 17, 2023, and final locations were identified at the site by members of the VTrans Drill Unit and Geotechnical Engineering Section during a site visit conducted January 12, 2024. A summary of the boring locations can be found in Table 2.1 as well as on the attached Boring Location Plan.

The values for the Northings and Eastings are based on the Vermont State Plane Grid Coordinate System NAD 83. The elevations for the borings are based on the North American Vertical Datum, NAVD 88. The boring locations were located by a VTrans Survey Crew. The locations of the borings should be considered accurate only to the degree implied by the method used to determine them.

Table 2.1: Boring Locations

Boring	Station	Offset (ft)	Northing (ft)	Easting (ft)	Elevation (ft)
B-101	171+71	-10.6	386424.8	1586608.0	1104.2
B-102	172+19	7.3	386433.2	1586659.2	1102.5

The borings were performed in general accordance with AASHTO T206, *Standard Method of Test for Penetration Test and Split-Barrel Sampling of Soils*. During the boring operations, split spoon samples and standard penetration tests (SPT) were taken continuously to 10 feet (ft) below ground surface (bgs), then at 5 ft intervals to approximately 40 ft bgs. No bedrock was encountered in either boring.

Soil samples were visually identified in the field and SPT blow counts were recorded on the boring logs when applicable. Soil samples were preserved and returned to the VTrans Construction and Materials Bureau Laboratory for testing and further evaluation. Upon completion of the laboratory testing of select representative samples, the borings logs were revised to reflect the results of the laboratory classification analysis. The attached boring logs display the types of soil strata encountered and include the laboratory test data, SPT data, and any pertinent observations made by the drilling crew.

3.0 FIELD AND LABORATORY TESTS

The standard penetration resistance of the in-situ soil is calculated as the number of blows required to drive a 2-inch(in) outside diameter (OD) split-barrel sampler 24 in into the soil by a 140-pound hammer dropped from a height of 30 in, in accordance with procedures specified in AASHTO T206. The number of blows required to drive the sampler each 6 in increment is recorded and the Standard Penetration Resistance (N-Value) is calculated as the sum of the blows over the second and third 6-in intervals.

The SPT N-value is commonly used with established correlations to estimate several soil parameters, particularly the shear strength and density of cohesionless soils. The N-values provided on the boring logs are raw values and have not been corrected for energy, borehole diameter, rod length, or overburden pressure. VTrans has determined a hammer correction value, C_E , to account for the efficiency of the SPT hammers on its drill rigs. For the borings, an Acker Renegade Track Rig was used. Because this is a new drill rig, a hammer energy correction factor has yet to be determined. As a result, a conservative C_E value of 1.3, based on a standard value for an automatic hammer, should be used in all soil parameter calculations.

Geotechnical laboratory tests were performed to assist with soil classification and evaluate engineering properties of the soil. Grain size analyses were performed on select representative soil samples in accordance with AASHTO T 88, *Standard Method of Test for Particle Size Analysis of Soils*.

4.0 SOIL PROFILE

Review of the laboratory data, field testing, and boring logs revealed the following information pertaining to the soil strata. It should be noted that groundwater elevations are subject to change. Because groundwater elevations can fluctuate seasonally and are affected by temperature and precipitation, groundwater may be encountered during construction when not previously noted in the logs.

B-101: The ground surface elevation at B-101 is approximately 1104.2 ft. Groundwater was measured at a depth of 10.6 ft bgs corresponding to an elevation of 1093.6 ft.

Table 4.1: B-101 Soil Strata

Depth (Below Ground Surface Elevation)	Soil Profile
0 – 0.4 ft	Asphalt Pavement
0.4 – 12.5 ft	Dense SAND, some Gravel, some Silt
12.5 – 41.4 ft	Medium Dense SAND and GRAVEL, some Silt

B-102: The ground surface elevation at B-102 is approximately 1102.5 ft. Groundwater was not measured during drilling operations.

Table 4.2: B-102 Soil Strata

Depth (Below Ground Surface Elevation)	Soil Profile
0 – 12.5 ft	Dense GRAVEL, some Sand, little Silt
12.5 – 27.5 ft	Medium Dense SAND, little Silt, trace Gravel
27.5 – 39.2 ft	Dense SAND, some Gravel, trace Silt

5.0 CONCLUSION

If you have any questions, or you would like to discuss this report, please contact us via email. Please let us know when more information is available for assistance with foundation analyses and design. Typed boring logs are attached and are available in the CADD design files:

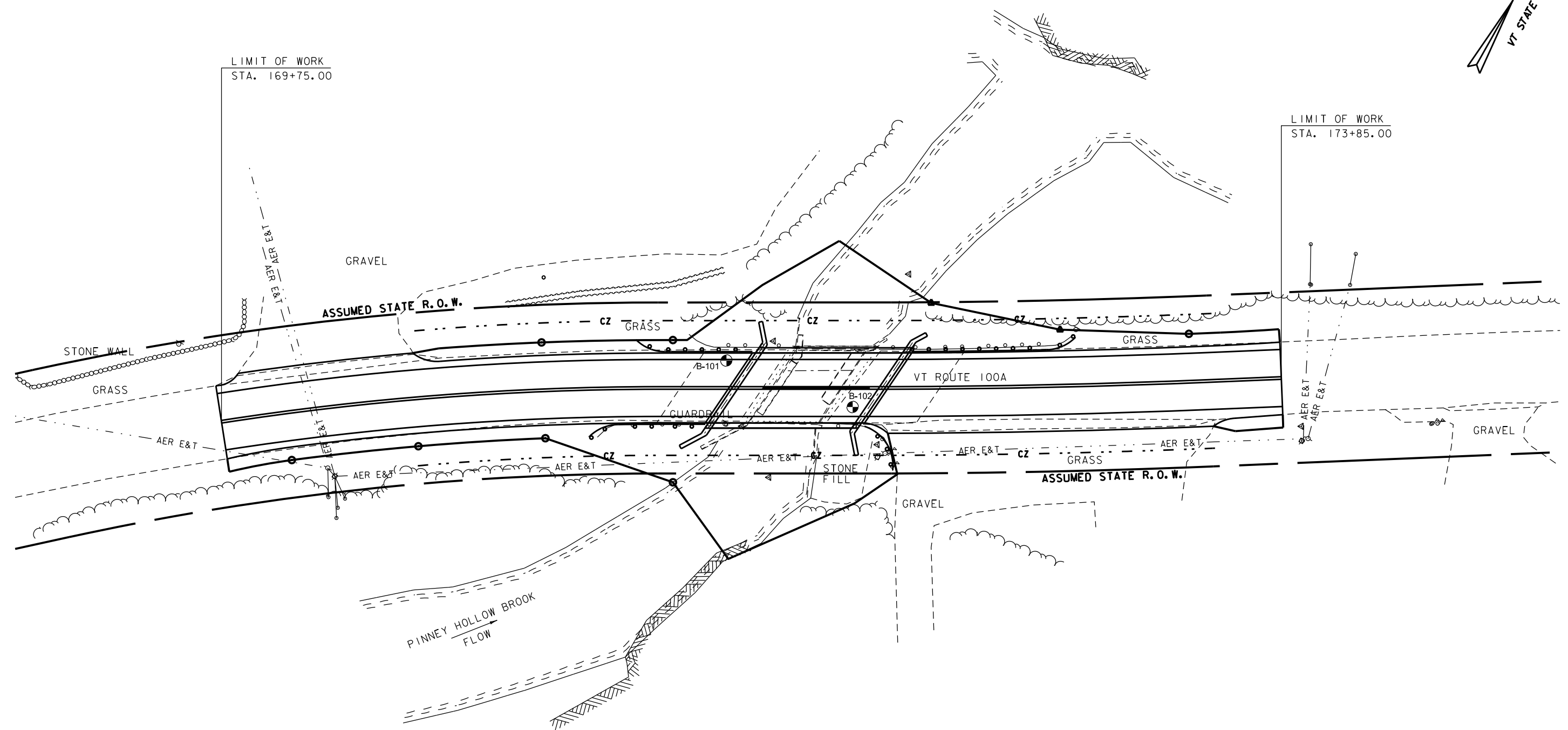
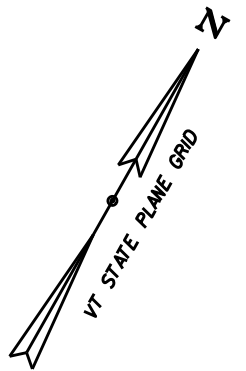
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Attachments: Boring Layout
Boring Logs (2 pages)

Reviewed by: August Arles, Geotechnical Engineer *AA*

cc: Read File/MG
Project File/CEE
END

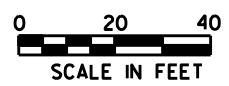
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BORING LAYOUT

BORING CHART

HOLE NO.	STATION	OFFSET (FT)	NORTHING (FT)	EASTING (FT)	APPROX. GROUND SURFACE ELEV. (FT)
B-101	171+71	10.6 LT	386424.8	1586608.0	1104.2
B-102	124+42	7.3 RT	386433.2	1586659.2	1102.5



GREEN INTERNATIONAL AFFILIATES, INC.
CIVIL AND STRUCTURAL ENGINEERS

PROJECT NAME:	PLYMOUTH	FILE NAME:	FILES	PLOT DATE:	DATE
PROJECT NUMBER:	ER P23-1(328)	PROJECT LEADER:	A. TSOUKALAS	DRAWN BY:	L. BYERS
DESIGNED BY:	F. EISINGER	CHECKED BY:	S. SACCO		
BORING LAYOUT				SHEET	SET OF TTLSET



STATE OF VERMONT
AGENCY OF TRANSPORTATION
CONSTRUCTION AND
MATERIALS BUREAU
CENTRAL LABORATORY

BORING LOG

Plymouth
ER 23-1(328)
VT 100A BR 07

Boring No.: **B-101**
Page No.: 1 of 1
Pin No.: 23b755
Checked By: END

Boring Crew: McGinley, Thurston, Arles
Date Started: 2/14/24 Date Finished: 2/14/24
VTSPG NAD83: N 386424.80 ft E 1586608.00 ft
Station: 171+70.70 Offset: -10.60
Ground Elevation: 1104.2 ft

Casing WB Sampler SS
Type: WB SS
I.D.: 3 in 1.5 in
Hammer Wt: N.A. 140 lb.
Hammer Fall: N.A. 30 in.
Hammer/Rod Type: Auto/AWJ
Rig: Acker Renegade ATV $C_E = 1.3$

Groundwater Observations

Date	Depth (ft)	Notes
02/14/24	10.6	WT after drilling

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
		Field Note:., Asphalt 0.0-0.4'					
		Field Description:., SAND and GRAVEL, brn, Moist, Rec. = 1.5 ft	16-30-41-				
			R@3"				
5		A-2-4, Lab Classification: SAND,some Gravel, some Silt, brn, Moist, Rec. = 1.2 ft	(71)	10.3	31.4	46.7	21.9
		Field Description:., SAND, trace Gravel, brn/gry, Moist, Rec. = 1.5 ft	11-12-12-14				
			(24)				
		Field Description:., SAND, brn, Moist, Rec. = 0.7 ft	5-6-5-5				
			(11)				
10		Field Note:., No recovery	7-4-3-2				
			(7)				
			11-11-6-4				
			(17)				
15		Field Note:., No recovery	8-7-5-5				
			(12)				
20		Field Description:., Coarse SAND and GRAVEL, brn, MTW, Rec. = 0.5 ft, Rollercone cleanout 24.5'-25.0'	7-4-5-6				
			(9)				
25		A-1-b, Lab Classification: SAND and GRAVEL, some Silt, brn/gry, Wet, Rec. = 0.8 ft	12-11-12-12	12.6	35.7	43.1	21.2
			(23)				
30		Field Description:., SAND, little Gravel, Lt brn, MTW, Rec. = 0.6 ft, Gravel in end of sampler. Lost water return at 32.5'	9-7-10-16				
			(17)				
35		A-2-4, Lab Classification: SAND and GRAVEL, some Silt, brn, MTW, Rec. = 1.6 ft	7-3-20-22	12.1	36.9	38.0	25.1
			(23)				
40		Field Description:., GRAVEL some Sand. Broken rock was within sample., Lt brn, Moist, Rec. = 0.5 ft, Split Sample	21-27-37-				
		Field Description:., Coarse SAND and GRAVEL, gry, Moist, Rec. = 0.2 ft	R@4"				
			(64)				
		Hole stopped @ 41.4 ft					
45		Remarks: Hole Collapsed @ 21 ft bgs.					

Notes: 1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_E is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations may occur due to other factors than those present at the time measurements were made.



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BORING LOG

Plymouth
ER 23-1(328)
VT 100A BR 07

Boring No.: **B-102**
Page No.: 1 of 1
Pin No.: 23b755
Checked By: END

Boring Crew: Thurston, Andrews(GeoDesign)
Date Started: 1/31/24 Date Finished: 1/31/24
VTSPG NAD83: N 386433.20 ft E 1586659.20 ft
Station: 172+19.40 Offset: 7.30
Ground Elevation: 1102.5 ft

Casing: WB Sampler: SS
Type: WB I.D.: 3 in 1.5 in
Hammer Wt: N.A. 140 lb.
Hammer Fall: N.A. 30 in.
Hammer/Rod Type: Auto/AWJ
Rig: Acker Renegade ATV C_E = 1.3

Groundwater Observations

Date	Depth (ft)	Notes

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
5		Field Description:., Fine to coarse GRAVEL, some fine to coarse Sand, little Silt, gry, Moist, Rec. = 0.9 ft Field Description:., Fine to coarse SAND and GRAVEL, some Silt, gry, Moist, Rec. = 1.3 ft	4-10-8-8 (18) 6-10-10-9 (20)	10.4	61.0	26.7	12.3
10		A-1-a, Lab Classification: GRAVEL, some Sand, little Silt, gry, Moist, Rec. = 0.7 ft Field Note:., No recovery	5-5-5-6 (10) 4-19-14-7 (33)				
15		Field Description:., Fine to coarse SAND and fine GRAVEL, little Silt, brn, Moist, Rec. = 0.9 ft	8-4-4-4 (8)				
20		Field Description:., Fine to medium SAND, trace fine Gravel, trace Silt, brn, Moist, Rec. = 0.4 ft	3-4-3-4 (7)	21.1	9.3	78.4	12.3
25		A-2-4, Lab Classification: SAND, little Silt, trace Gravel, brn, Moist, Rec. = 1.2 ft	3-4-7-8 (11)				
30		Field Note:., No recovery	9-19-23-29 (42)				
35		Field Description:., Fine to medium SAND, some fine Gravel, trace Silt, brn, Moist, Rec. = 0.5 ft, rock in end of sampler	5-12-40-R@1" (R)	5-17-R@2" (R)			
40		Field Note:., No recovery, rock in end of sampler Hole stopped @ 39.2 ft					
45		Remarks: 1) Losing water during casing advance from 6.5' - 7.0'. 2) Hard casing advance from 7.0' - 9.0'. 3) Unable to advance casing beyond 12'. Roller bit used to clear casing. 4) Very hard drilling effort at 36'. Probable weathered rock to 39.0'.					

Notes: 1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_E is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations may occur due to other factors than those present at the time measurements were made.