

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

END

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

Date: August 18th, 2025

Subject: Plymouth ER P23-1(328) – Supplemental Subsurface Investigation

1.0 INTRODUCTION

As requested, we have completed an additional 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. Additional borings were completed to understand depth to bedrock to aid in design of a replacement structure foundation. Contained herein are the results of our field sampling and testing, laboratory analyses of rock samples, as well as attached boring logs.

2.0 FIELD INVESTIGATION

An initial field investigation for Borings B-101 and B-102 was conducted between January 31st and February 14th, 2024. The results from that investigation showed subsurface materials to be a mixture of sands and gravels to about 40 feet below the ground surface and can be found in a report submitted July 15th, 2024.

The initial borings were terminated around 40 feet prior to encountering bedrock. Additional borings, B-201 and B-202, were conducted between July 1st and July 7th, 2025. The locations of the additional borings were located and laid out in the field by members of the Geotechnical Section. The as-drilled borings were located using the Geotechnical Section's handheld Trimble TDC600 and Trimble DA2 GNSS GPS receiver with submeter accuracy. A summary of the final location of each boring and corresponding approximate ground surface elevation can be found in Table 2.1 as well as 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, based on the North American Vertical Datum, NAVD 88, were estimated using the design file z23b755sv.dgn, dated November 2024. The locations and elevations for 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)	Approx. Bedrock Elevation (ft)
B-201	171+69	10.6 LT	386423.9	1586606.2	1104.2	1058.7
B-202	172+21	7.3 RT	386434.1	1586661.0	1102.5	1065.3

The borings were advanced to bedrock without sampling. When bedrock was encountered, two 5-foot (ft) BX rock core runs, totaling 10 ft of core, were taken to confirm the presence of bedrock.

Details of the bedrock coring were recorded on the boring logs when applicable. Cores were then placed in core boxes and returned to the VTrans Construction and Materials Bureau Laboratory

for further evaluation and testing, where applicable. The boring logs were revised to reflect the classification and description of the bedrock cores and any pertinent observations made by the drilling crew during the subsurface investigation.

3.0 RESULTS

A summary of the rock core findings are provided attached in Figure 1 as well as available in the attached boring logs. Information from the cores indicate the bedrock present at the project site is moderately hard to medium hard, light gray to green magnetite-garnet-chlorite-muscovite-quartz PHYLLITE and QUARTZITE. The bedrock had an average rock quality designation (RQD) of 0 because of excessive breakage, some natural and some due to the drilling process. The average rock mass rating (RMR) is 41, indicating poor rock.

Drilling conditions were largely favorable for driving H-piles; however, the depth to bedrock may provide a layer of complexity to the design of pile supported abutments. In the location of the eastern abutment, bedrock was encountered approximately 37 ft below the top of pavement with cobbles/boulders/weathered rock encountered as shallow as 33 feet below the ground surface. Depending on the abutment geometry and scour conditions at this structure, the piles may develop short pile behavior and require predrilling sockets into rock to achieve fixity. Based on the length of pre-drilling required through soil and the unknown structure type at this stage, abutments supported on drilled micropiles should also be considered in design.

4.0 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 and we'd be happy to assist with foundation analyses and design. Typed boring logs are attached and are available in the CADD design files: <M:\Projects\23b755MaterialsResearch>

CEE

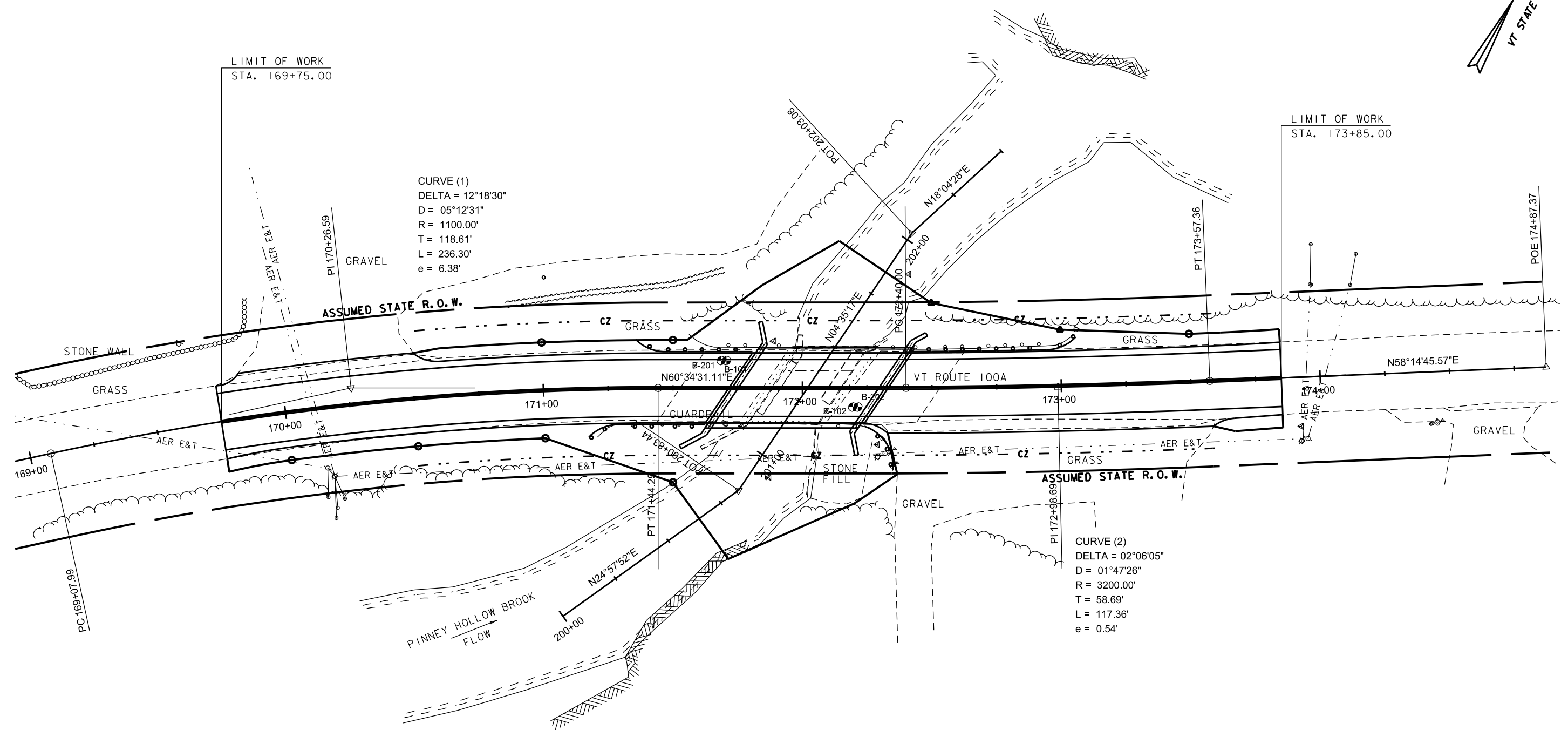
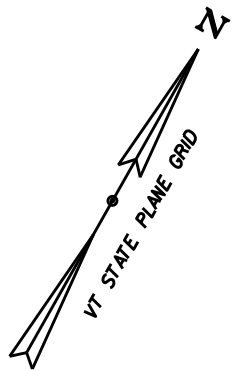
Reviewed by: Callie Ewald, P.E., Senior Geotechnical Engineer

Attachments: Figure 1: Rock Core Sample Results
Boring Layout (1 Page)
Boring Logs (3 pages)

cc: Read File/MG
Project File/CEE
END

Figure 1: Rock Core Sample Results

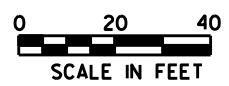
Boring	Run No.	Core Size	Depth (ft)	Recovery (%)	RQD (%)	Dip (°)	Lithologic Description	RMR
B-201	1	BX	45.5-50.5	36	0	30-40	Light-gray to pale-green magnetite-garnet-chlorite-muscovite-quartz PHYLLITE, with thin beds of QUARTZITE. Orange/ rust colored stains along natural breaks. Close joint spacing. Moderately hard to medium hard, Slightly weathered	40
B-201	2	BX	50.5-55.5	60	0	30-40	Light-gray to pale-green magnetite-garnet-chlorite-muscovite-quartz PHYLLITE, with thin beds of QUARTZITE. Orange/ rust colored stains along natural breaks. Close joint spacing. Moderately hard to medium hard, Slightly weathered	42
B-202	1	BX	37.2-42.2	48	0	30-40	Light-gray to pale-green garnet-chlorite-muscovite-quartz PHYLLITE, with thin beds of QUARTZITE. Orange/ rust colored stains along natural breaks. Close joint spacing. Moderately hard to medium hard, Slightly weathered	41
B-202	2	BX	42.2-46.7	60	0	40-50	Light-gray to pale-green garnet-chlorite-muscovite-quartz PHYLLITE, with thin beds of QUARTZITE. Orange/ rust colored stains along natural breaks. Close joint spacing. Moderately hard to medium hard, Slightly weathered	42



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	172+20	7.3 RT	386433.2	1586659.2	1102.5
B-201	171+69	10.6 LT	386423.9	1586606.2	1104.2
B-202	172+21	7.3 RT	386434.1	1586661.0	1102.5



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



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BORING LOG

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

Boring No.: **B-201**
Page No.: 1 of 2
Pin No.: 23b755
Checked By: END

Boring Crew: McGinley, Thurston, Lubas Degener
Date Started: 7/01/25 Date Finished: 7/02/25
VTSPG NAD83: N 386423.90 ft E 1586606.20 ft
Station: 171+69 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: Diedrich 25 $C_F = 1.45$

Groundwater Observations

Date	Depth (ft)	Notes
07/02/25	10.4	WT before drilling

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Run (Dip deg.)	Core Rec. % (RQD %)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
5		Field Note:., Asphalt 0.0-0.4'							
10									
15									
20									
25									
30		Field Note:., Added bentonite to drilling fluid							
35									
40		Field Description:., Very dense fine SAND and Gravel. Weathered rock in the end of sampler. Refusal at 100 blows., Rollercone cleanout 42.0'-45.0'			15-11-44-R@4" (55)				
45		Field Note:., Assumed boulder/cobbles or weathered rock.							
		45.5 ft - 50.5 ft, Light gray to green, magnetite-garnet-chlorite-muscovite-quartz PHYLLITE, with thin beds of QUARTZITE. Orange/ rust colored stains along natural breaks. Close joint spacing. Moderately hard to medium hard, Slightly weathered, Poor rock, BX	R1 (30-40)	36 (0)	Top of Bedrock @ 45.5 ft				

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_F 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.

BORING LOG PLYMOUTH ER 23-1(328).GPJ VERMONT AOT.GDT 8/18/25



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BORING LOG

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

Boring No.: **B-201**
Page No.: 2 of 2
Pin No.: 23b755
Checked By: END

Boring Crew: McGinley, Thurston, Lubas Degener
Date Started: 7/01/25 Date Finished: 7/02/25
VTSPG NAD83: N 386423.90 ft E 1586606.20 ft
Station: 171+69 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: Diedrich 25 $C_E = 1.45$

Groundwater Observations

Date	Depth (ft)	Notes
07/02/25	10.4	WT before drilling

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Run (Dip deg.)	Core Rec. % (RQD %)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
55		50.5 ft - 55.5 ft, Light gray to green, magnetite-garnet-chlorite-muscovite-quartz PHYLLITE, with thin beds of QUARTZITE. Orange/ rust colored stains along natural breaks. Close joint spacing. Moderately hard to medium hard, Slightly weathered, Fair rock, BX	R2 (30-40)	60 (0)					
60		Hole stopped @ 55.5 ft							
65		Remarks: Hole Collapsed @ 8.8 ft bgs.							
70									
75									
80									
85									
90									
95									

Notes:

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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-202**
Page No.: 1 of 1
Pin No.: 23b755
Checked By: END

Boring Crew: McGinley, Thurston, Lubas Degener
Date Started: 7/07/25 Date Finished: 7/08/25
VTSPG NAD83: N 386434.10 ft E 1586661.00 ft
Station: 172+21 Offset: 7.30
Ground Elevation: 1102.5 ft

Casing: WB Sampler: SS
Type: WB I.D.: 3 in
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: Diedrich 25 $C_E = 1.45$

Groundwater Observations

Date	Depth (ft)	Notes
07/08/25	7.9	WT after drilling

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Run (Dip deg.)	Core Rec. % (RQD %)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
		Field Note:., Asphalt 0.0-0.2'							
10		Field Note:., Cleanout BXDC 9.0'-10.5'							
		Field Note:., Cleanout BXDC 13.0'-15.5'							
20									
30		Field Note:., Rollercone cleanout 28.0'-30.0' to advance casing							
		Field Note:., Assumed boulder or weathered bedrock, Cleanout BXDC 33.0'-35.0'. Added bentonite to drilling fluid. multiple rock types in cleanout barrel							
		Field Note:., Rollercone cleanout 34.0'-37.0'							
40		37.2 ft - 42.2 ft, Light gray to green, Garnet-chlorite-muscovite-quartz PHYLLITE, with thin beds of QUARTZITE. Orange/ rust colored stains along natural breaks. Close joint spacing. Moderately hard to medium hard, Slightly weathered, Fair rock, BX	R1 (30-40)	48 (0)	Top of Bedrock @ 37.2 ft				
		42.2 ft - 46.7 ft, Light gray to green, Garnet-chlorite-muscovite-quartz PHYLLITE, with thin beds of QUARTZITE. Orange/ rust colored stains along natural breaks. Close joint spacing. Moderately hard to medium hard, Slightly weathered, Fair rock, BX	R2 (40-50)	60 (0)					
50		Hole stopped @ 46.7 ft							
		Remarks: Hole Collapsed @ 13.2 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.

BORING LOG PLYMOUTH ER 23-1(328).GPJ VERMONT AOT.GDT 8/18/25