



GEODesign, Inc.
85 Granite Shed Lane, Unit #1
Montpelier, VT 05602
(802) 674-2033

May 5, 2024
Project No.: 0750-012.27

Mr. Stephen Madden
Vermont Agency of Transportation (VTRANS)
Construction and Materials Bureau
2178 Airport Road, Unit B
Berlin, VT 05641

Email: Stephen.Madden@vermont.gov

RE: Geotechnical Data and Design Parameter Recommendations Report
Norton BF-0321(21)
Bridge No. 41 – VT Route 114 Norton, VT
PIN: 22b360

SUMMARY

GEODesign completed soil borings and rock coring at the request of VTrans for Bridge No. 41 along Route 114 in Norton, Vermont. This report transmits our subsurface findings and associated recommendations for soil parameters to be used in foundation design for the new bridge. Work was completed in accordance with the Norton – BF 0321(21) contract (WAN #PS0837-WA00020). Refer to Figure 1 in Appendix A for the general project location.

GEOLOGIC SETTING

Available surficial geology mapping (Natural Resources Atlas, Vermont Agency of Natural Resources) in the site vicinity indicates surficial materials at this site consist of a kame moraine, which are a glacial outwash deposit. Glacial till is also mapped nearby. Bedrock at the site is mapped as a gray to pink granite of the Averill pluton formation.

Natural soils and bedrock encountered in the soil borings were generally consistent with mapped conditions.

SUBSURFACE EXPLORATIONS

A total of four test borings and roller bit probes (B-101 through B-104) were drilled between March 12 to 14, 2024 by New England Boring Contractors, Inc. using an ATV -mounted drilling rig equipped with an automatic hammer (estimated Energy Correction Factor, $C_E=1.3$). Borings and probes were advanced using wash drive methods to the top of bedrock. In Borings B-101 and B-102, split spoon samples were collected in general accordance with the Standard Penetration Test (SPT) per ASTM D 1586. Blow counts are recorded on the logs. Ten feet of NX rock core was also obtained in borings B-101 and B-102 upon encountering bedrock.

Probes B-103 and B-104 were terminated upon encountering inferred top of bedrock based upon roller bit resistance.

Test borings were drilled at the approximate locations shown on the attached Exploration Location Plan (Figure 2 in Appendix A). Station, offset, and ground surface elevations shown on the boring logs and in the table below are based on taped measurements made in the field by GEODesign personnel and electronic site plans provided by VTrans.

GEODesign personnel coordinated, observed, and logged all soil explorations on a full-time basis. Refer to Appendix B for boring logs.

Boring Location Table*

Boring Number	Ground Surface Elevation	Station	Offset (ft)	Northing	Easting
B-101	1310'	197+02	10R	907595	1818722
B-102	1310'	196+85	9L	907591	1818698
B-103	1310'	196+81	10R	907578	1818712
B-104	1310'	197+05	9L	907608	1818708

*Northing, Easting and Ground Surface Elevation are shown in VTSPG NAD83 survey feet. Locations and elevations are based on taped measurements from existing features made in the field by GEODesign and an electronic survey file provided by VTrans.

LABORATORY TESTING

GEODesign performed index testing on representative split-spoon samples collected from the various strata observed in the borings. This included 4 soil gradation sieve analyses (AASHTO T27/T11) and moisture content determinations (AASHTO T255). Refer to Appendix C for the laboratory testing results. A summary of the results is also depicted for the samples that were tested on the boring logs included in Appendix B.

SUBSURFACE CONDITIONS AND DESIGN PARAMETERS

Generalized Subsurface Profile

We observed a generalized subsurface profile in our soil borings as outlined below. Refer to Figure 3 in Appendix A for a visual depiction.

Non-Engineered Fill – Fill that has not been placed and compacted in a controlled and consistent manner to a specified density is considered non-engineered. We encountered approximately 21 to 22 feet of this material in both Boring B-101 and B-102. The non-engineered fill consisted of primarily sand with varying amounts of silt and gravel. SPT N-values in the non-engineered fill were erratic and varied widely from 1 to 41 blows per foot (bpf).

Glacial Till – Natural soil was first encountered approximately 21 to 22 feet below existing grade at a layer of very dense glacial till consisting of primarily sand and silt with varying amounts of gravel. This layer was encountered in both B-101 and B-102. SPT N-values in the glacial till exceeded 50 bpf, indicating a very dense soil condition.

Bedrock – Bedrock was inferred to begin at approximately 25 to 25.4 feet below existing grade on the east side of the bridge (B-101, P-103), and 21.5 to 24 feet below existing grade on the west side of the bridge (B-102 and P-104). Increased roller bit resistance along with excellent quality rock cores support these approximate depths.

Groundwater – Groundwater was inferred to be between approximately 14 to 20 feet deep based on wet samples encountered in the drilling, generally deepening from east to west (in the direction of the river flow) and are consistent with the river level. Groundwater observation wells were not installed. Groundwater conditions encountered while drilling are not necessarily indicative of actual groundwater conditions due to factors including the time it can take for groundwater to accumulate within a borehole, or the drilling method (e.g., with addition of drilling fluids). The depth to groundwater observed in the borings is also likely to vary from conditions which will be encountered during construction due to factors such as seasonal variations, temperature, rainfall, and other factors that differ from conditions at the time the subsurface explorations were made.

Recommended Design Parameters

Based on the results of our soil borings and laboratory testing, we recommend the following soil parameters for use in design.

Note: Earth pressure coefficients provided herein assume a vertical wall face and level backfill. The designer needs to consider if using passive pressure will be appropriate on a case-by-case basis given the large amount of movement required to mobilize passive pressure. Furthermore, we recommend neglecting passive pressure within frost depth, where the potential for scour exists, or the grade slopes away from the wall.

Fill

Fill Parameter	Value
Unit Weight γ	115 pcf
Friction Angle Φ	30°
Cohesion c	0 psf
Active Earth Pressure Coefficient K_a	0.33
At-Rest Earth Pressure Coefficient K_0	0.47
Passive Earth Pressure Coefficient K_p	3.00
Lateral Subgrade Modulus k (Above Water)	30 pci
Lateral Subgrade Modulus k (Below Water)	20 pci

Glacial Till

Glacial Till Parameter	Value
Unit Weight γ	135 pcf
Friction Angle Φ	41°
Cohesion c	0 psf
Active Earth Pressure Coefficient K_a	0.21
At-Rest Earth Pressure Coefficient K_0	0.35
Passive Earth Pressure Coefficient K_p	4.81
Lateral Subgrade Modulus k (Below Water)	160 pci

Assuming backfill behind retaining walls / wingwalls will consist of Granular Backfill for Structures, we recommend the following parameters provided the backfill is compacted to 95% maximum laboratory compaction as determined by Modified Proctor (AASHTO T180):

Granular Backfill for Structures

Granular Backfill for Structures Parameter	Value
Unit Weight γ	140 pcf
Friction Angle Φ	34°
Cohesion c	0 psf
Active Earth Pressure Coefficient K_a	0.28
At-Rest Earth Pressure Coefficient K_0	0.44
Passive Earth Pressure Coefficient K_p	3.54

REPORT LIMITATIONS

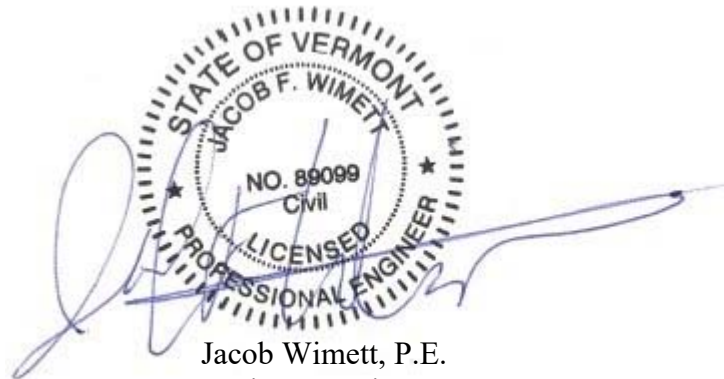
This geotechnical report is subject to the limitations in Appendix D.

Sincerely,

GEODesign, Inc.



Jack Cassara, EIT
Senior Staff Engineer



Jacob Wimett, P.E.
Senior Associate

Appendices:

Appendix A – Figures

Appendix B – Boring Logs

Appendix C – Laboratory Testing Results

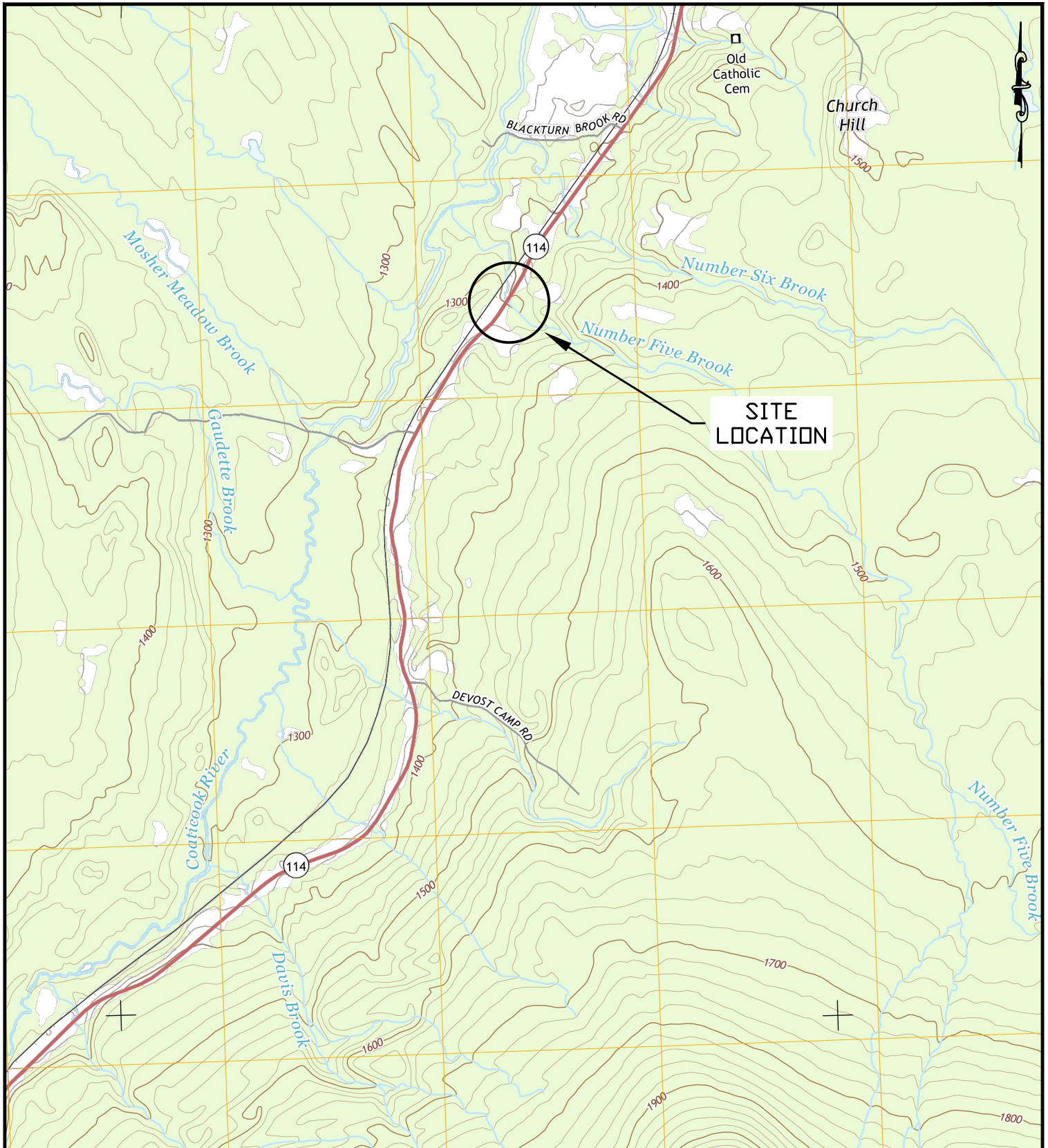
Appendix D – Limitations



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APPENDIX A – FIGURES

- FIGURE 1 – SITE LOCATION
- FIGURE 2 – EXPLORATION LOCATION PLAN
- FIGURE 3 – SUBSURFACE PROFILE A-A'



GEO DESIGN

85 GRANITE SHED LANE
UNIT 1
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QUADRANGLE LOCATION

SITE LOCATION PLAN
NORTON BF 0321(21)
NORTON, VERMONT

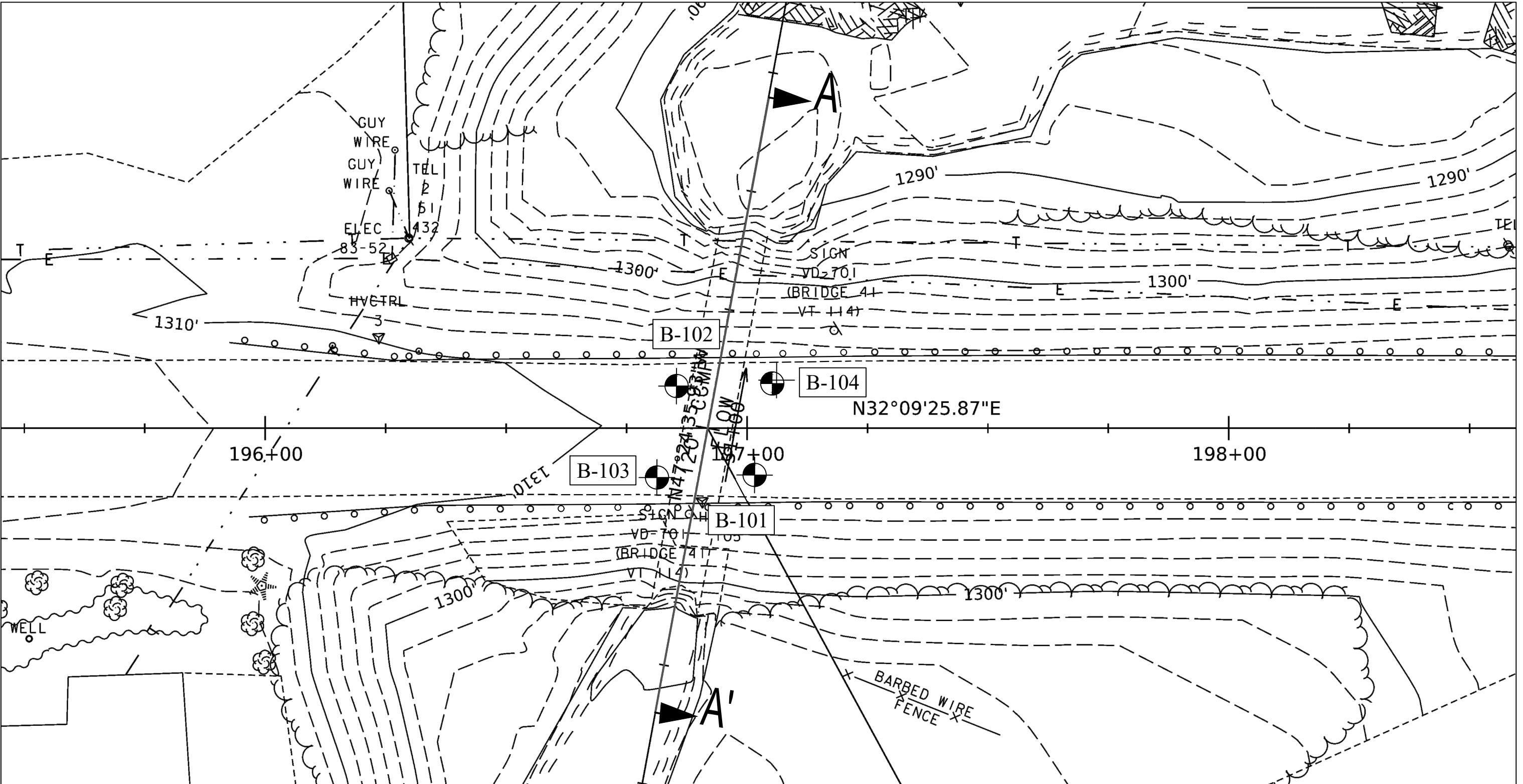
REFERENCE:
U.S.G.S. 7.5 MINUTE QUADRANGLE: NORTON POND, VT

SCALE IN FEET



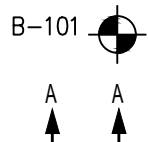
PROJECT NO.	0750-12.27
DATE	3/29/2024
FIGURE NO.	1

DRAWN BY:	JAC	REVIEWED BY:	JFW
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NOTES:
1) BASE MAP DEVELOPED FROM ELECTRONIC SITE PLANS PROVIDED BY VTRANS TITLED "s22b360 Boring Request Sheet" PREPARED BY VTRANS, AND DATED 06/29/23.
2) BORINGS WERE PERFORMED BY NEW ENGLAND BORING CONTRACTORS ON MARCH 12 TO 14, 2024, AND OBSERVED AND LOGGED BY GEODESIGN PERSONNEL.
3) BORING LOCATIONS ARE APPROXIMATE BY TAPED MEASUREMENTS TO EXISTING FEATURES. THESE LOCATIONS SHOULD BE CONSIDERED ACCURATE ONLY TO THE DEGREE IMPLIED BY THE METHOD USED.

LEGEND



B-101 AS-DRILLED TEST BORING NO. & LOCATION BY GEODESIGN
A A' SUBSURFACE PROFILE ID AND LOCATION

GEO DESIGN

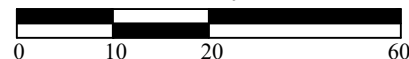
85 GRANITE SHED LANE
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DRAWN BY: JAC

REVIEWED BY: JFW

EXPLORATION LOCATION PLAN
NORTON BF 0321(21)
NORTON, VT
PROJECT NO: 0750-12.27

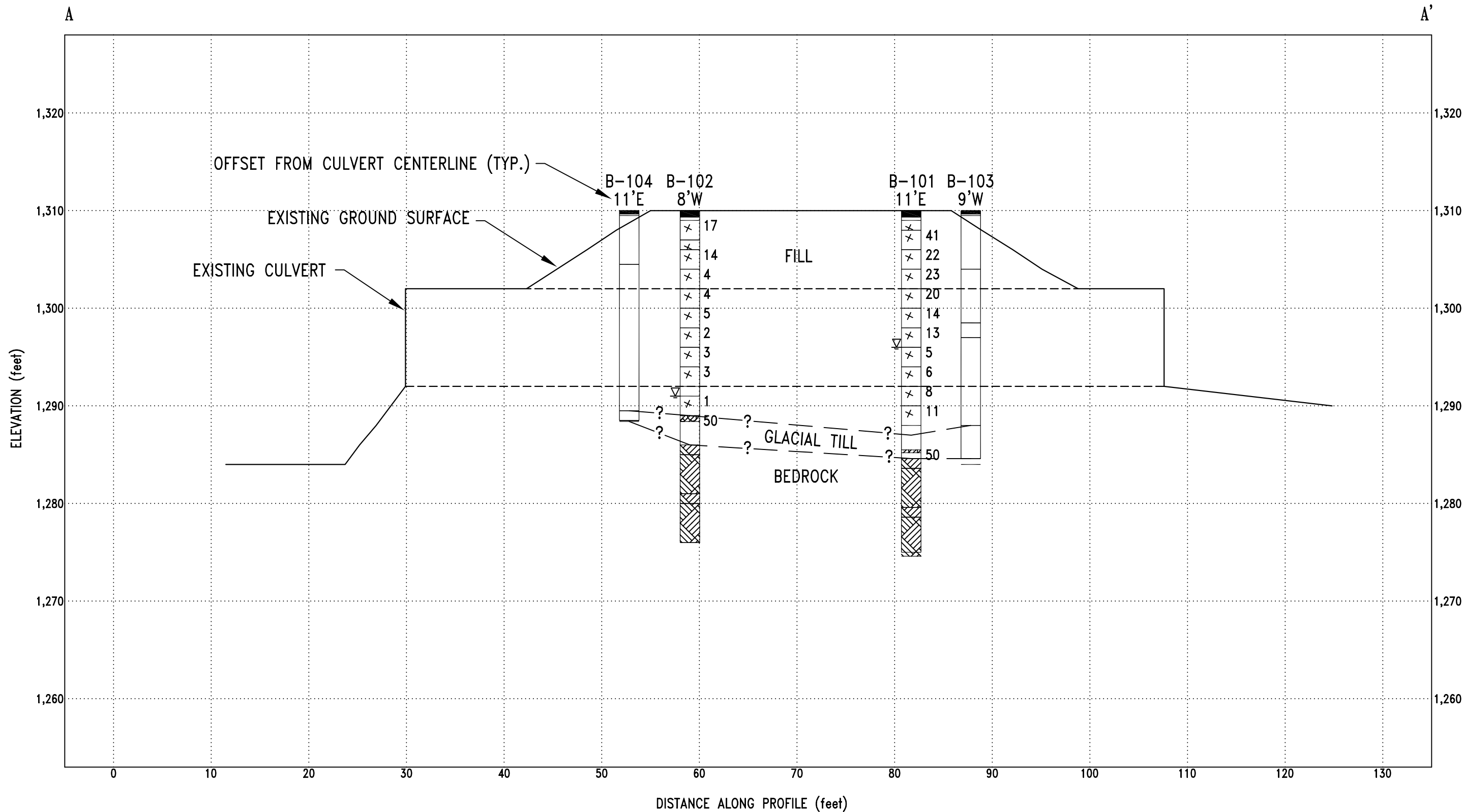
APPROXIMATE SCALE IN FEET
1" = 20'



DATE: MAY 3, 2024

FIGURE NO.2

GEO-VTRANS PROFILE NORTON BF 0321(21) BORING LOGS.GPJ FBNWAL01.GDT 4/19/24

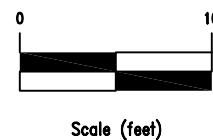


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STATE OF VERMONT
AGENCY OF TRANSPORTATION
MATERIALS & RESEARCH SECTION
SUBSURFACE INFORMATION



Notes:

1. Data concerning the various strata have been interpreted at boring locations only. The stratigraphy between borings may vary from that shown.
2. Refer to plan view for subsurface profile location. For strata details and symbol legend, see Subsurface Profile Legend and boring logs appended to this report.
3. Numbers displayed beside boring(s) represent SPT "N" values corresponding to their respective sampling interval. Where coring was performed, numbers represent Recovery and RQD values.

Date: 05/03/2024

Drawn By: JAC

Reviewed By: JFW

SUBSURFACE PROFILE

VT 114 BR41 Norton, VT
Norton BF 0321(21)
GeoDesign File No.

File No.: 0750-12.27

Figure No.: 3



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APPENDIX B – SOIL BORING LOGS

EXPLANATION OF THE FORM - BORING LOG

The following provides an explanation of the various fields on the Boring Log form.

BORING LOG HEADING

Project and Boring Details

Within the upper portion of the Boring Log, details with regards to the Project Name and Location, Boring Number, and GeoDesign's file number are provided. In addition, within the upper section of the Boring Log, the Drilling Company's name, and their representative, together with the name of GeoDesign's representative, are presented. Details with regards to the dates when the boring was drilled, its coordinates or other location references and the corresponding surface elevation may also be provided. Where applicable, the Datum used is provided in the text of the Report.

Casing and Sampler

This section provides a summary of the typical size of samplers and casings used, together with the type of drilling rig. See below for a description of samplers.

Groundwater Observations

Water levels typically indicated on the Boring Log are levels measured in the boring at the times indicated. In permeable materials, the indicated levels may reflect the location of groundwater. In low permeability soils and/or due to effects of the casing, the accurate determination of groundwater levels may not be possible with only short term observations.

CENTRAL PORTION OF BORING LOG

DEPTH

This column gives the depth scale of the boring, in feet or meters.

CASING BLOWS

Indicates the number of blows per foot (0.3 m) required to advance the casing, using a 136 kg (300-pound) hammer.

SAMPLE INFORMATION

The initial columns provide the sample number, sample type, penetration, recovery and sample depth. The Sample Type Coding is as follows:

A - Auger Sample PS - Undisturbed Piston - 3" (76 mm) SSL - Large Split-Barrel - 3" (76 mm) V - Vane Test
C - Core - Diamond Bit - NX double tube, unless otherwise noted. SS - Split-Barrel (Split-Spoon) ST - Shelby Tube - 3" (76 mm)

Blows / 6 inch (0.15 meter) Interval

Representative soil samples were obtained in the boring by split-barrel sampling procedures in general accordance with ASTM D 1586. The split-barrel sampling procedure utilizes a standard 51 mm (2") outside diameter split-barrel sampler that is driven into the bottom of the boring with a 63.5 kg (140-pound) hammer falling a distance of 0.76 m (30"). The number of blows required to advance the sampler in 0.15 m (6") increments is recorded as part of the Standard Penetration Test (SPT). These values are indicated at their depth of occurrence.

The number of blows required to advance the split-barrel sampler the middle two - 0.15 m (6") increments of a 0.61 m (24") penetration is recorded as the Standard Penetration Resistance Value ("N").

Where the sampler advanced by Weight of Rods or Weight of Hammer, the designation WOR and WOH, respectively, was used. In the case of PS or ST samples, the designation PUSH was used.

Coring Time

This column provides the rate in minutes at which the core barrel was advanced into the bedrock (or boulder) in one foot (0.3 m) intervals.

PID Reading - Where Applicable

This column provides results for samples which were screened in the field with a photoionization detector for the presence of volatile organic compounds (including certain petroleum constituents) calibrated relative to benzene in air standard.

Moisture Content (%) - Where Applicable

This column provides moisture content determination results for the samples tested.

SAMPLE DESCRIPTION

This column provides a description of the soil and bedrock units, based on visual observation of the samples, sometimes in conjunction with field and laboratory tests. Each sample was generally described according to the following classification and terminology. In general, description of the soil units followed the Burmister classification system.

SOIL PROPERTIES & DESCRIPTIONS

TEXTURE*		COMPOSITION		COHESIVE SOILS		COHESIONLESS SOILS	
Component	Size (mm)			ESTIMATED CONSISTENCY	"N" Value	ESTIMATED COMPACTNESS	"N" Value
CLAY	< 0.002 mm	Principal Component in Upper Case i.e. >50%		CLASSIFICATION ***		DESCRIPTION ***	
SILT	< #200 Sieve (0.075 mm)	CLAY, SILT, SAND, GRAVEL, COBBLES, BOULDERS		Very Soft	< 2		
SAND	#200 to #4 Sieve (0.075 mm to 4.75 mm)	Minor Component Upper and Lower Case i.e. <50%		Soft	2 - 4	Very Loose	< 4
	Fine #200 to #40 Sieve (0.075 mm to 0.425 mm)	Clay, Silt, Sand, Gravel, Cobbles, Boulders		Medium	4 - 8	Loose	4 - 10
	Medium #40 to #10 Sieve (0.425 mm to 2.00 mm)			Stiff	8 - 15	Medium Dense	10 - 30
	Coarse #10 to #4 Sieve (2.00 mm to 4.75 mm)			Very Stiff	15 - 30	Dense	30 - 50
GRAVEL	#4 Sieve to 3 in (4.75 mm to 76 mm)	trace	<10 %	Hard	> 30	Very Dense	> 50
	Fine #4 Sieve to 3/4 in (4.75 mm to 19 mm)	little	10 - 20 %	*** empirical relationship			
	Coarse 3/4 in to 3 in (19 mm to 76 mm)	some	20 - 35 %				
		and	35 - 50 %	PLASTICITY - Burmister		STRUCTURE	
		MOISTURE CONDITION		Degree of Plasticity	Soil Type	Smallest Diameter of Thread**	
				Non-Plastic	SILT	None	Stratified, >6 mm (1/4")
				Slight	Clayey SILT	1/4" (6 mm)	Laminated, < 6 mm (1/4")
COBBLES	3 in to 12 in (76 mm to 305 mm)	Dry	Absence of moisture, dusty	Low	SILT & CLAY	1/8" (3 mm)	Parting, 0 to 1.6 mm (1/16")
BOULDERS	> 12 in (305 mm)	Moisture	Damp but no visible water	Medium	CLAY & SILT	1/16" (1.6 mm)	Seam, 1.6 to 13 mm (1/2")
		Wet	Visible free water	High	Silty CLAY	1/32" (0.8 mm)	Layer, 13 to 305 mm (12")
				Very High	CLAY	1/64" (0.4 mm)	Stratum, > 305 mm (12")

*textural classification as determined by sieve and hydrometer analyses

** moisture at or near optimum

BEDROCK PROPERTIES & DESCRIPTIONS

RECOVERY AND ROCK QUALITY DESIGNATION (RQD)

Recovery is defined as the length of core obtained expressed as a percentage of the total length cored.

RQD is defined as the total length of sound core pieces, 4 inches (100 mm) or greater in length, excluding drilling breaks, expressed as a percentage of the total length cored. RQD provides an indication of the integrity of the rock mass and relative extent of seams and bedding planes.

Classification	RQD %
Very Poor Quality	0 - 25
Poor Quality	25 - 50
Fair Quality	50 - 75
Good Quality	75 - 90
Excellent Quality	90 - 100

WEATHERING

Fresh	No visible signs of weathering
Slightly Weathered	Slight discoloration of parent material in joints and seams
Moderately Weathered	Less than 35% of rock material is decomposed. Fresh or discolored rock is present.
Highly Weathered	More than 35% of rock material is decomposed. Fresh or discolored rock is present.
Extremely Weathered	All rock material is decomposed to soil. Rock mass structure may still be intact.

When classification of rock materials has been estimated from disturbed samples, core samples and petrographic analysis may reveal other rock types.

SYMBOL

This column provides a graphical representation of the soil and bedrock units, and inferred geological contacts. See Subsurface Profile Legend.

HARDNESS

TYPICAL ROCK TYPES

Hard	Cannot be scratched with knife
Moderately Hard	Can scratch with knife but not fingernail
Soft	Can be scratched with fingernail

SANDSTONE

Well Cemented	Capable of scratching a knife blade
Cemented	Can be scratched with knife
Poorly Cemented	Can be broken apart easily with fingers

Moh's Hardness Scale

> 5.5
5.5 - 2.5
< 2.5

SANDSTONE

Well Cemented	Capable of scratching a knife blade
Cemented	Can be scratched with knife
Poorly Cemented	Can be broken apart easily with fingers

SPACING OF DISCONTINUITIES





















Bedding	Jointing	Spacing (inches)	Spacing (mm)
Very Thick Bedded	Very Wide	>80	>2000
Thick Bedded	Wide	24 - 80	600 - 2000
Medium Bedded	Moderate	8 - 24	200 - 600
Thin Bedded	Close	2.4 - 8	60 - 200
Very Thin Bedded	Very Close	0.8 - 2.4	20 - 60
Laminated	Shattered	0.24 - 0.8	6 - 20
Thinly Laminated	Fissured	<0.24	<6

BORING LOG FOOTER

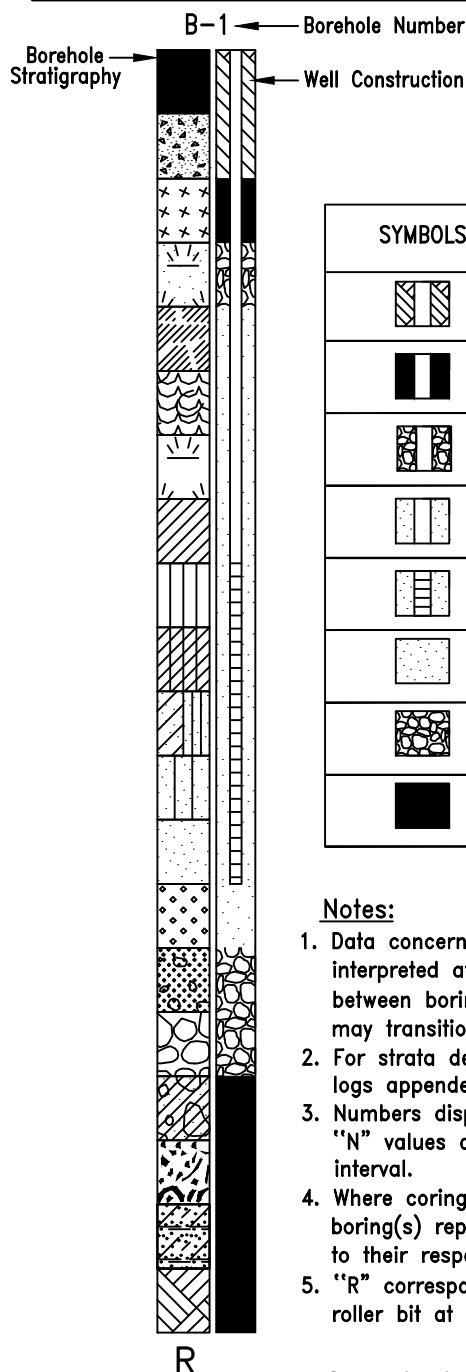
The lower portion of the log provides additional drilling notes within the Remarks section together with additional General Notes.

geo/cl/temp/explofboringlogs









STRATIGRAPHY SYMBOLS

SYMBOLS	TYPICAL DESCRIPTIONS OF PREDOMINANT MATERIAL TYPE
	ASPHALT
	CONCRETE
	FILL
	TOPSOIL
	SUBSOIL
	ORGANIC SILT OR CLAY WITH SHELLS
	PEAT
	CLAY
	SILT
	CLAY/SILT MIXTURE
	CLAY/SILT/SAND MIXTURE
	SANDY SILT
	SILTY SAND
	POORLY-GRADED SAND
	WELL-GRADED SAND
	SAND/SILT/GRAVEL MIXTURE
	BOULDERS AND/OR COBBLES
	GLACIAL TILL
	WEATHERED BEDROCK
	BEDROCK

EXPLANATION OF BORING



WELL SYMBOLS

SYMBOLS	TYPICAL DESCRIPTIONS
	CEMENT SEAL: 1 PIPE
	BENTONITE SEAL: 1 PIPE
	SLOUGH BACKFILL: 1 PIPE
	FILTER PACK: 1 PIPE
	SLOTTED PIPE WITH FILTER PACK: 1 PIPE
	FILTER PACK AT BOTTOM OF HOLE
	SLOUGH AT BOTTOM OF HOLE
	BENTONITE AT BOTTOM OF HOLE

Notes:

1. Data concerning the various strata have been interpreted at boring locations only. The stratigraphy between borings may vary from that shown, and may transition more gradually within borings.
2. For strata details, see Report and boring logs appended to this report.
3. Numbers displayed beside boring(s) represent SPT "N" values corresponding to their respective sampling interval.
4. Where coring was performed, numbers displayed beside boring(s) represent Recovery and RQD values corresponding to their respective sampling interval.
5. "R" corresponds to refusal of sampler, casing and/or roller bit at bottom of boring.

Groundwater Observations (where applicable)

- ▽ Water Level Reading at time of drilling.
- ▼ Water Level Reading after completing drilling.

GEO DESIGN

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BORING LOG /
SUBSURFACE PROFILE LEGEND



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

BORING LOG

Norton BF 0321(21)
0750-12.27
VT 114 BR41 Norton, VT

Boring No.: **B-101**
Page No.: 1 of 1
Pin No.: 22b360
Checked By: JFW

Boring Crew: Walter Hoeckele (NEBC), Jack Cassara (GEO)

Date Started: 3/13/24 Date Finished: 3/13/24

VTSPG NAD83: N 907595 ft E 1818722 ft

Station: 197+02 Offset: 10' R

Ground Elevation: 1310.0 ft

Casing Sampler
Type: FJ SS
I.D.: 4 in 2 in
Hammer Wt: 140 lb. 140 lb.
Hammer Fall: 30 in. 30 in.
Hammer/Rod Type: Auto
Rig: Mobile B-53 Track $C_E = 1.3$

Groundwater Observations

Date	Depth (ft)	Notes
03/13/24	14.0	Wet sample.

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Run (Dip deg.)	Core Rec. % (RQD %)	Drill Rate minutes/ft	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %	LL %	PI %
		8" Asphalt										
5	X X X	S1) Medium dense, brown fine to coarse SAND and SILT, trace fine Gravel, dry. Rec. = 1.0 ft				14-14						
	X X X	S2) Dense, brown fine to coarse SAND and SILT, trace fine Gravel, dry. Rec. = 1.3 ft				35-21-20-23 (41)		11.0	76.4	12.6	NP	NP
	X X X	S3) Medium dense, brown fine to coarse SAND, little Silt, trace fine Gravel, moist. Rec. = 1.3 ft (A-2-4.)				8-10-12-10 (22)						
	X X X	S4) Medium dense, brown fine to coarse SAND, some Silt, trace fine Gravel, moist. Rec. = 0.8 ft				9-11-12-15 (23)						
10	X X X	S5) Medium dense, brown fine to coarse SAND, some Silt, trace Organics, moist. Rec. = 0.8 ft				9-11-9-6 (20)		12.9	75.9	11.3	NP	NP
	X X X	S6) Medium dense, brown fine to coarse SAND, little Silt, trace fine Gravel, moist. Rec. = 0.8 ft (A-2-4.)				3-7-7-7 (14)						
	X X X	S7) Medium dense, brown fine to coarse SAND and SILT, trace fine to coarse Gravel, moist. Rec. = 0.5 ft				9-6-7-7 (13)						
15	X X X	S8) Loose, brown fine to coarse SAND and SILT, trace fine Gravel, wet. Rec. = 0.5 ft				2-3-2-3 (5)						
	X X X	S9) Loose, brown fine to coarse SAND and SILT, trace fine Gravel, wet. Rec. = 0.3 ft				3-3-3-5 (6)						
	X X X	S10) Loose, brown fine to coarse SAND and SILT, trace coarse Gravel, wet. Rec. = 0.4 ft				4-4-4-3 (8)						
20	X X X	S11) Medium dense, dark brown fine to coarse SAND and SILT, wet. Granite chunk in spoon tip. Rec. = 0.4 ft				3-1-10-12 (11)						
	X X X											
25	X X X X X	S12) Refusal, brown/gray/tan fine to coarse SAND and SILT, some fine to coarse Gravel, wet. Rec. = 0.3 ft 25.4 ft to 30.4 ft, C1) Excellent quality, moderately hard, fresh, gray with black speckled GRANITE, close to wide jointing. NX	C1	97.5 (100)	5.3 5.5 4.9 4.8 4.3	7-50/4" (50)		Top of Bedrock @ 25.0 ft				
30		30.4 ft to 35.4 ft, C2) Excellent quality, moderately hard, slightly weathered, gray with black speckled GRANITE, close to wide jointing. NX	C2	95.8 (100)	4.3 3.9 4.9 4.6 5.2							
35		Hole stopped @ 35.4 ft										
40		Remarks: 1) Roller bit grinding during advance from 6' to 8' deep on an inferred cobble. Obstruction was not encountered during split spoon sampling. 2) Casing refusal at approximate depth 23.0', broke through potential boulder or weathered rock seam with rollerbit and splitspoon sample. Casing refusal again at 25' on bedrock. 3) C1 wash water grayish pink. 4) Hammer energy correction is assumed based on the hammer type.										
45												

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 of groundwater may occur due to other factors than those present at the time measurements were made.



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

BORING LOG

Norton BF 0321(21)

0750-12.27

VT 114 BR41 Norton, VT

Boring No.: **B-102**

Page No.: 1 of 1

Pin No.: 22b360

Checked By: JFW

Boring Crew: Walter Hoeckele (NEBC), Jack Cassara (GEO)

Date Started: 3/12/24 Date Finished: 3/12/24

VTSPG NAD83: N 907591 ft E 1818698 ft

Station: 196+85 Offset: 9' L

Ground Elevation: 1310.0 ft

Type:

I.D.:

Hammer Wt:

Hammer Fall:

Hammer/Rod Type:

Rig: Mobile B-53 Track

Casing

FJ

4 in

140 lb.

30 in.

Auto

C_E = 1.3

Sampler

SS

2 in

140 lb.

30 in.

Auto

C_E = 1.3

Groundwater Observations

Date

Depth (ft)

Notes

03/12/24

19.0

Wet sample.

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Run (Dip deg.)	Core Rec. % (RQD %)	Drill Rate minutes/ft	Blows/ft (N Value)	Moisture Content %	Gravel %	Sand %	Fines %	LL %	PI %
		8" Asphalt										
5	X X X	S1) Medium dense, brown fine to coarse SAND and SILT, trace fine Gravel, dry. Rec. = 1.5 ft				8-15-12-10 (17)						
	X X X	S2) Medium dense, brown fine to coarse SAND, little Silt, moist. Rec. = 0.5 ft				6-8						
	X X X	S3) Medium dense, brown fine to coarse SAND, little Silt, trace fine Gravel, moist. Rec. = 0.9 ft (A-2-4.)				6-7-7-7 (14)		15.7	72.9	11.4	NP	NP
	X X X	S4) Loose, brown fine to coarse SAND, some Silt, moist. Rec. = 0.5 ft				3-2-2-3 (4)						
	X X X	S5) Loose, brown fine to coarse SAND, little Silt, trace fine Gravel, moist. Rec. = 0.7 ft (A-1-b.)				2-2-2-1 (4)		14.6	75.2	10.2	NP	NP
10	X X X	S6) Loose, No Recovery. Rec. = 0.0 ft				1-2-3-2 (5)						
	X X X	S7) Very loose, brown fine to coarse SAND, trace Silt, moist. Rec. = 0.1 ft				2-1-1-2 (2)						
15	X X X	S8) Very loose, brown fine to coarse SAND, little Silt, moist. Rec. = 0.6 ft				2-1-2-1 (3)						
	X X X	S9) Very loose, brown fine to coarse SAND, little Silt, moist. Rec. = 0.2 ft				2-1-2-2 (3)						
20	X X X	S10) Very loose, brown fine to coarse SAND, little Silt, wet. Rec. = 0.4 ft				3-1/12"-1 (1)						
	X X X	S11) Refusal, grayish brown fine to coarse SAND and SILT, trace fine Gravel, wet. Rec. = 0.3 ft				18-50/1" (50)						
25		24.0 ft to 29.0 ft, C1) Excellent quality, moderately hard, fresh, gray with black speckled GRANITE, moderate to wide jointing. NX	C1	95 (100)	4.5 5.7 7 10.1 15.1			Top of Bedrock @ 24.0 ft				
30		29.0 ft to 34.0 ft, C2) Excellent quality, moderately hard, slightly weathered, gray with black speckled GRANITE, moderate to wide jointing. NX	C2	98.3 (100)	6.8 9.1 14.8 6 3.5							
35		Hole stopped @ 34.0 ft										
40		Remarks: 1) Casing refusal at 21.5' deep on inferred bedrock. Advance rollerbit to 24' deep with smooth hard drilling. 2) C1 wash water grayish pink. 3) Hammer energy correction is assumed based on the hammer type.										
45												

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 of groundwater may occur due to other factors than those present at the time measurements were made.

GEODESIGN BORING LOG NORTON BF 0321(21) BORING LOGS.GPJ VERMONT AOT GDT 5/5/24



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

BORING LOG

Norton BF 0321(21)
0750-12.27
VT 114 BR41 Norton, VT

Boring No.: **B-103**
Page No.: 1 of 1
Pin No.: 22b360
Checked By: JFW

Boring Crew: Walter Hoeckele (NEBC), Jack Cassara (GEO)

Date Started: 3/14/24 Date Finished: 3/14/24

VTSPG NAD83: N 907578 ft E 1818712 ft

Station: 196+81 Offset: 10' R

Ground Elevation: 1310.0 ft

Casing Sampler
Type: FJ
I.D.: 4 in
Hammer Wt: 140 lb. N.A.
Hammer Fall: 30 in. N.A.
Hammer/Rod Type: Auto
Rig: Mobile B-53 Track $C_E =$

Groundwater Observations

Date	Depth (ft)	Notes

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
5		6" Asphalt Moderate Drilling Effort					
10		Easy Drilling Effort					
15		1.5' Cobble Easy Drilling Effort					
20							
25		Difficult Drilling Effort					
25.4		Very Difficult Drilling Effort Hole stopped @ 25.4 ft					
30		Remarks: 1) Driller mentioned potential creasol smell while clearing through fill layer. 2) Advanced casing to 4', then 10', open hole advance with the rollerbit afterwards. 3) Granite chips in wash while clearing past 22'.					
35							
40							
45							

Top of Bedrock @ 25.4 ft

Notes:

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

GEODESIGN BORING LOG NORTON BF 0321 (21) BORING LOGS.GPJ VERMONT AOT.GDT 5/5/24



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

BORING LOG

Norton BF 0321(21)
0750-12.27
VT 114 BR41 Norton, VT

Boring No.: **B-104**
Page No.: 1 of 1
Pin No.: 22b360
Checked By: JFW

Boring Crew: Walter Hoeckele (NEBC), Jack Cassara (GEO)

Date Started: 3/13/24 Date Finished: 3/13/24

VTSPG NAD83: N 907608 ft E 1818708 ft

Station: 197+05 Offset: 9' L

Ground Elevation: 1310.0 ft

Casing Sampler
Type: FJ
I.D.: 4 in
Hammer Wt: 140 lb. N.A.
Hammer Fall: 30 in. N.A.
Hammer/Rod Type: Auto
Rig: Mobile B-53 Track $C_E =$

Groundwater Observations

Date	Depth (ft)	Notes

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
5		6" Asphalt Moderate Drilling Effort					
10		Easy Drilling Effort					
15							
20		Difficult Drilling Effort					
21.5		Very Difficult Drilling Effort Hole stopped @ 21.5 ft					
25		Remarks: 1) Advanced casing to 4', then 10', open hole advance with the rollerbit afterwards. 2) Very slow advancement at approximately 21.5' deep on inferred bedrock. Advance roller bit additional 1" and note granite chips in the wash water.					
30							
35							
40							
45							

Top of Bedrock @ 21.5 ft

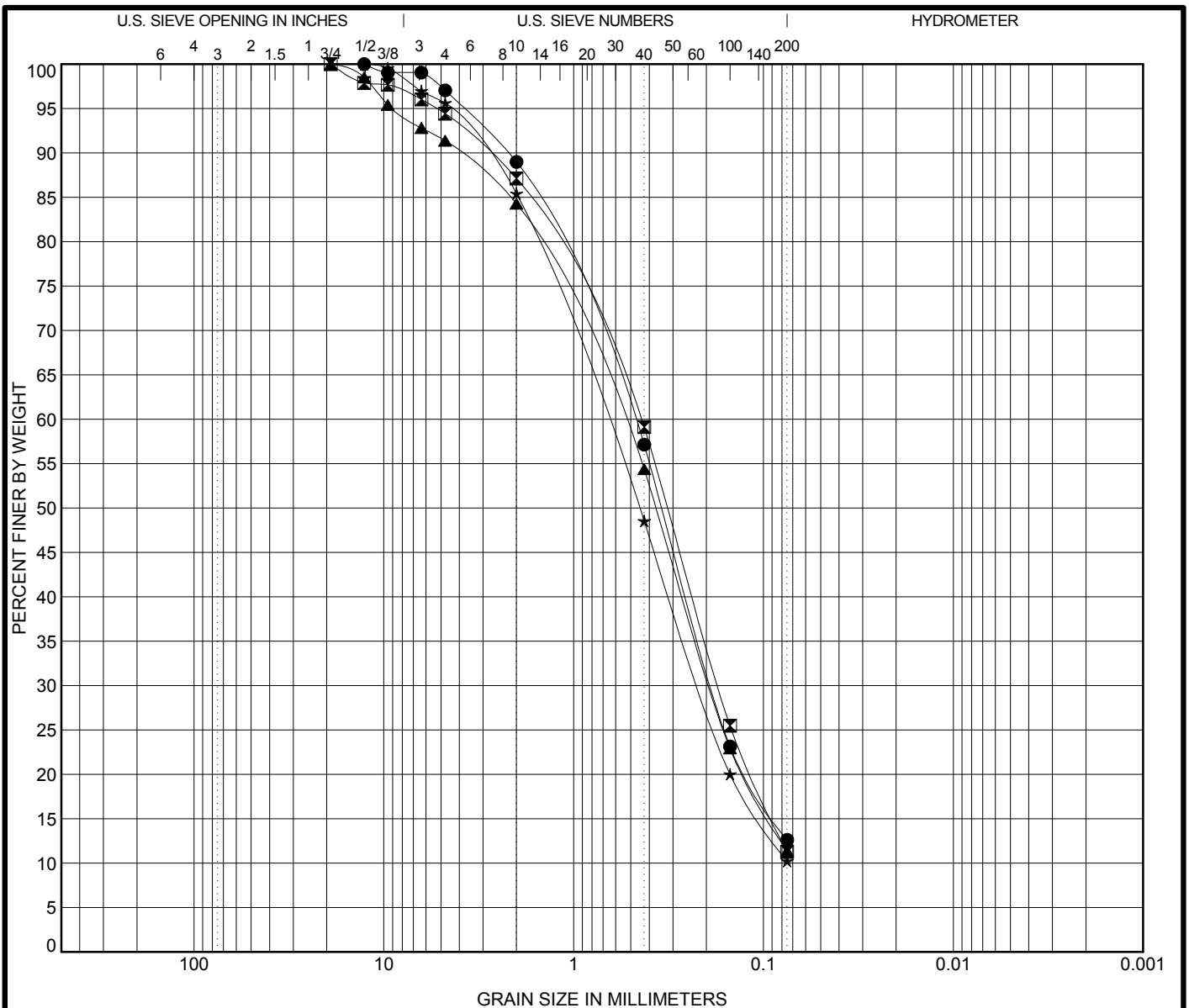
Notes:

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



GEODesign, Inc.
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Unit #1
Montpelier, VT 05602
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APPENDIX C – LABORATORY TESTING RESULTS



COBBLES	GRAVEL	SAND		SILT OR CLAY
		coarse	fine	

Boring	Start Depth (ft)	Classification (M145, D2487)				Moisture Content	LL	PL	PI	Cc	Cu
● B-101	4.0	A-2-4, SM				11.5	NP	NP	NP		
⊠ B-101	10.0	A-2-4, SP-SM				13.9	NP	NP	NP	0.95	6.33
▲ B-102	4.0	A-2-4, SP-SM				10.7	NP	NP	NP	0.92	8.24
★ B-102	8.0	A-1-b, SP-SM				17.8	NP	NP	NP	0.92	9.32
Boring	Start Depth (ft)	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay		
● B-101	4.0	12.7	0.488	0.185		11.0	76.4	12.6			
⊠ B-101	10.0	19.05	0.446	0.173		12.9	75.8	11.3			
▲ B-102	4.0	19.05	0.569	0.19		15.7	72.9	11.4			
★ B-102	8.0	12.7	0.688	0.216		14.6	75.2	10.2			



GEO DESIGN

GRAIN SIZE DISTRIBUTION

Project Name: Norton BF 0321(21) - VT 114 BR41 Norton, VT
 Number: 0750-12.27
 Testing Performed By: JAC
 Testing Reviewed By: JFW
 Testing Date: 04/02/24 to 04/03/24
 Testing performed in general accordance with AASHTO T27 & T11.



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APPENDIX D – LIMITATIONS



GEODesign, Inc.
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Geotechnical Limitations

Explorations

1. The analyses and recommendations submitted in this report are based in part upon the data obtained from widely spaced subsurface explorations. The nature and extent of variations between these explorations may not become evident until construction. If variations then appear evident, it will be necessary to reevaluate the recommendations of this report.
2. The generalized soil profile described in the text is intended to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized and have been developed by interpretations of widely spaced explorations and samples; actual soil transitions are probably more erratic. For specific information, refer to the boring logs.
3. Water level readings and moisture conditions have been made in the explorations, and from the samples at times and under conditions stated on the logs. These data have been reviewed and interpretations have been made in the text of this report. However, it must be noted that fluctuations in the level of the groundwater and moisture condition may occur due to variations in rainfall, temperature, and other factors occurring since the time measurements were made.

Review

4. In the event that any changes in the nature, design or location of the proposed structures is planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of this report modified or verified in writing by GEODesign, Inc. We recommend that we be provided the opportunity to review and comment on the finalized project design and relevant construction specifications in order that earthwork and foundation recommendations may be properly interpreted and implemented in the design and specifications.

Use of Report

5. This report has been prepared for the exclusive use of **VTrans**, for specific application to the **Norton – BF-0321(21)** project, as described in GEODesign's scope of services/ contract and related documents, in accordance with generally accepted soil and foundation engineering practices. No other warranty, express or implied, is made.
6. This report has been prepared for this specific project by GEODesign, Inc. This report is for design purposes only and is not sufficient to prepare an accurate bid. Contractors wishing a copy of the report may secure it with the understanding that its scope is limited to design considerations only, unless otherwise specified in the report.
7. Unless otherwise noted, the scope of our services did not include environmental assessment or investigation for the presence of hazardous or toxic materials in the soil, surface water, groundwater or air, on, below, or around this site.