

# S-37-168 (Little Choestoea Road) Bridge Replacement over Little Choestoea Creek

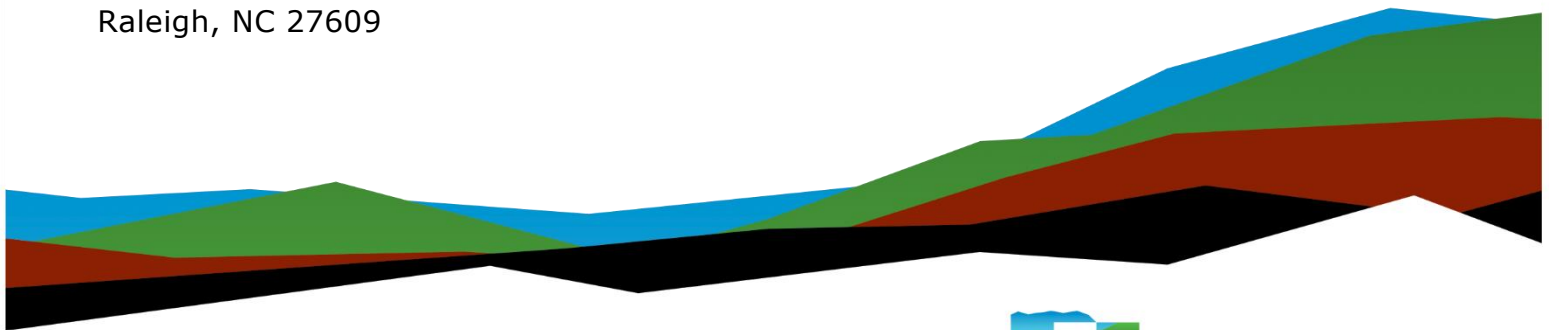
Oconee County, SC

## Geotechnical Baseline Report

March 22, 2025 | SCDOT Project ID: P042512  
Terracon Project No.: 8623P180

### Prepared for:

HNTB Corporation  
343 E. Six Forks Road, Suite 200  
Raleigh, NC 27609



Nationwide  
[Terracon.com](https://www.terracon.com)

- Facilities
- Environmental
- Geotechnical
- Materials



72 Pointe Circle  
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March 22, 2025

HNTB Corporation  
343 E. Forks Road, Suite 200  
Raleigh, NC 27609

Attn: Mr. Spencer Franklin, PE, Senior Vice President  
P: 919-546-8997

Re: Geotechnical Baseline Report  
S-37-168 Bridge Replacement over Little Choestoea Creek  
Oconee County, South Carolina  
SCDOT Project ID.: P042512  
Terracon Project No.: 8623P180

Dear Mr. Franklin:

Terracon Consultants Inc. (Terracon) has completed the exploration, testing and limited engineering analysis services for the above referenced project. The services were conducted in general accordance with our Task Order Number 001, dated May 25, 2023 and Supplement Number 001, dated October 31, 2023.

## Introduction

HNTB Corporation (HNTB) has contracted Terracon to perform subsurface exploration, laboratory testing and limited preliminary engineering recommendations for the replacement of the S-37-168 Bridge over Little Choestoea Creek in Oconee County, South Carolina. The results of the subsurface exploration and laboratory testing have been separately presented in a Geotechnical Subsurface Data Report (GSDR). For convenience, the data is also provided here in this Geotechnical Baseline Report (GBR) along with a characterization of the subsurface conditions for the project. Limited preliminary geotechnical design and construction considerations associated with the requested scope of work are included in this GBR. This GBR was prepared in general accordance with the 2022 SCDOT Geotechnical Design Manual (GDM) and Preconstruction Design Memorandum (PCDM) 11 - Supplemental Design Criteria for Low Volume Bridge Replacement Projects.

## Project Description

The project site is located at the S-37-168 (Little Choestoea Road) crossing over Little Choestoea Creek in Oconee County, South Carolina. Site location and exploration plans are

presented in Appendix A of this report. Based on the conceptual plans by HNTB dated 3/13/2025, the replacement bridge will be constructed on the same alignment as the current bridge and will be considered a low volume bridge. The current plans indicate the new bridge will be a 100-ft long single-span bridge constructed with an adjacent box beam.

## Geotechnical Testing

The geotechnical exploration for this project was performed between January 16 and January 17, 2024. The results of our field work and our associated laboratory testing are included in Appendices A and B.

### Field Exploration

Our field exploration consisted of the following:

- Two (2) Standard Penetration Test (SPT) Borings (S-37-168-1 and S-37-168-2)
- Two (2) offset auger probes near S-37-168-1 and S-37-168-2 for bulk sample collection

The tests were performed at the approximate locations that were approved by SCDOT. A description of our testing methods and graphical logs outlining the soil conditions at each test location are presented in Appendix A. The test locations were established in the field by Terracon and surveyed by Thomas & Hutton after completion.

### Laboratory Testing

The following laboratory tests were performed on the soil samples collected at the site.

- Twelve (12) Natural Moisture Content Tests
- Six (6) Atterberg Limits Tests
- Five (5) Grain Size Tests
- Four (4) Grain Size Tests with Hydrometer
- One (1) Remolded, Consolidated-Undrained (CU) Triaxial Compression Test with Pore Pressure Readings
- One (1) Standard Proctor Test
- One (1) Corrosivity Suite (pH, chloride content, sulfate content, and resistivity tests)
- Four (4) Compressive Strength of Rock Cores

The general scope of the laboratory testing frequency was determined by the SCDOT. The laboratory testing assignment was performed by our engineers. The laboratory procedures and results of the laboratory tests are presented in Appendix B.

## Subsurface Conditions

### Regional Geology

The bridge site is located on route S-37-168, north of the town of South Union in Oconee County, South Carolina. The site lies generally within the Piedmont Physiographic Province. More specifically, the site is located within the Sixmile Thrust Sheet. According to regional geologic mapping and published geologic reports, the project is in an area that contains muscovite-biotite schist, biotite schist, sillimanite-mica schist and gneiss, amphibolite, biotite gneisses including some that are porphyroblastic, felsic gneiss, and some manganiferous schist and metamorphosed manganese silicate. The rocks are likely metamorphosed marine sediments that also received some volcanic material. The bridge end bents and approach embankments contain existing fill above alluvial and/or residual soils, very dense residual soils classified as Intermediate Geomaterials (IGM) and bedrock.

### Soil and Rock Stratification

The soils at this site consist of fill that is very loose to loose poorly graded sand to silty/clayey sand in the upper 1 to 12 feet. Beneath the fill is alluvial soils consisting of very loose to medium dense poorly graded sand with silt, silty sands and very soft silts with sand to approximate depth of 22 feet below the ground surface. Below the alluvium, residual soils consisting of medium to very dense silty sands were encountered to approximate depths of 28 to 32 feet below ground surface, with some residual soils characterized as being intermediate geomaterials (IGM) exhibiting SPT N values of more than 100 blows per foot (bpf) and were followed by bedrock. In Boring S-37-168-2 an approximate 2-inch layer of residual soils were encountered 5 feet into the bedrock. Bedrock was present to the maximum depth explored of 48.3 feet.

Geology	Approximate Elevation of Layer Bottom (ft, NAVD88)	USCS Soil Type	Measured Field N Value	Plasticity Index	Fines Content	REC / RQD
Fill	693	SM, SC, SP	2 to 7	NP to 16	1 to 46	--
Alluvium	683	ML, SM, SP-SM	0 to 12	14	15 to 77	--
Residuum	673	SM	28 to 100+	NP	18	--
Rock	PMDE	--	--	--	--	22-100% / 10-100%

1. PMDE = Present to Maximum Depth Explored

2. NP=non-plastic

## Design and Construction Considerations

### Foundations

Driven steel H-piles driven to practical refusal on rock or within IGM materials (i.e., >20 blows per inch with appropriately sized hammer) are expected to be feasible for the proposed bridge end bents.

The approximate elevation to the top of very dense residual soils (IGM) at End Bent 1 is 683 feet NAVD88 and is about 10 feet thick overlying bedrock with a RQD of 80% at the top of rock. At End Bent 2, IGM was not encountered, and the top of rock is at an approximate elevation of 677 feet NAVD88 with a RQD of 10% in the top 5 feet of rock. Per section 16.3.1 of the GDM, reinforced pile tips will be needed to minimize potential pile damage while penetrating through IGM and the top of rock. Pile drivability using the wave equation should be performed along with estimating stresses during driving and, in general, verifying the ability of the Contractor's selected hammer to drive the piles to the desired penetration while preventing overstressing of the pile.

According to the conceptual bridge plans by HNTB dated 3/13/2025, approximately 4 feet of fill is expected at the end bent embankments. Foundations should typically be installed after the approach embankment construction to reduce potential downdrag settlement issues. The pile design should account for drag loads, should new fill be placed after installing foundation piles.

We have observed variability in the top of rock and thickness of IGM, as seen in **Soil and Rock Stratification**. Therefore, there is a potential for variability in foundation tip elevations at each bent location. Resistance of piles driven to practical refusal in IGM or rock will be limited by their structural resistance.

### Corrosion and Deterioration

Corrosion testing was performed on a composite sample obtained from split spoons in the upper 25 feet. Corrosion testing included pH, resistivity, chlorides, and sulfates content are summarized in the table below, and test results are included in Appendix B.

Corrosion Test	Results Bent 1, Boring S-137-168-2 Composite Sample from 2 to 25 feet	Indication of Corrosivity <sup>1</sup>
pH	5.7	Less than 5.5
Resistivity	3,350 ohm-cm	Less than 2,000 ohm-cm
Chloride	75 ppm	Greater than 500 ppm
Sulfate	72 ppm	Greater than 1,000 ppm

1. AASHTO LRFD bridge design specifications, Ninth Edition 2020, Section 10.7.5.

## Geotechnical Baseline Report

S-37-168 BRO Little Choestoea Creek | Oconee County, SC

March 22, 2025 | Terracon Project No. 8623P180 | SCDOT Project ID: P042512



Based on the criteria for electro-chemical properties in the GDM Section 7.18, the electro-chemical classification of the project site is non-aggressive. Interpretation of these data should be communicated with the project's structural engineer.

## Embankment Construction

Based on the conceptual plans by HNTB, approximately 4 feet of fill will be placed to meet the proposed grade with some embankment cut below the bridge and relatively short 2H:1V riprap lined slopes shown at the end abutments. Bulk samples were obtained near both end bents from the top 5 feet of existing embankment material. Per our scope, a bulk sample was tested for soil classification and was also remolded to about 95% of the Standard-effort Proctor prior to being tested for shear strength envelopes under CU Triaxial Compression with pore pressure readings. Test results are presented in Appendix B and summarized in the table below.

Sample No.	Station	Offset (ft)	Sample Depth (ft)	USCS Soil Type	Compaction		Shear Strength <sup>1</sup>	
					Optimum Moisture (%)	Max Dry Density (pcf)	Total (psi / °)	Effective (psi / °)
S-37-168-1/ 2 Bulk	45+77 46+75	7 R 5 L	0 – 5	SC	16.7	107.2	c=1.1 ø=21	c'=0.3 ø'=33

1. Based on a maximum deviator stress failure criterion

## Geotechnical Baseline Report

S-37-168 BRO Little Choestoea Creek | Oconee County, SC

March 22, 2025 | Terracon Project No. 8623P180 | SCDOT Project ID: P042512



## Closure

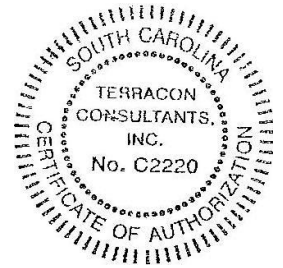
We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or we may be of further service, please contact us.

Sincerely,

**Terracon Consultants, Inc.**

Maggie McKenney, EIT  
Senior Staff Engineer

Jonathan Ard, PE  
Regional Service Manager  
SC Registration No. 30886



Reviewed by Terracon's Authorized Project Reviewer: Abdul Fekrat, P.E.

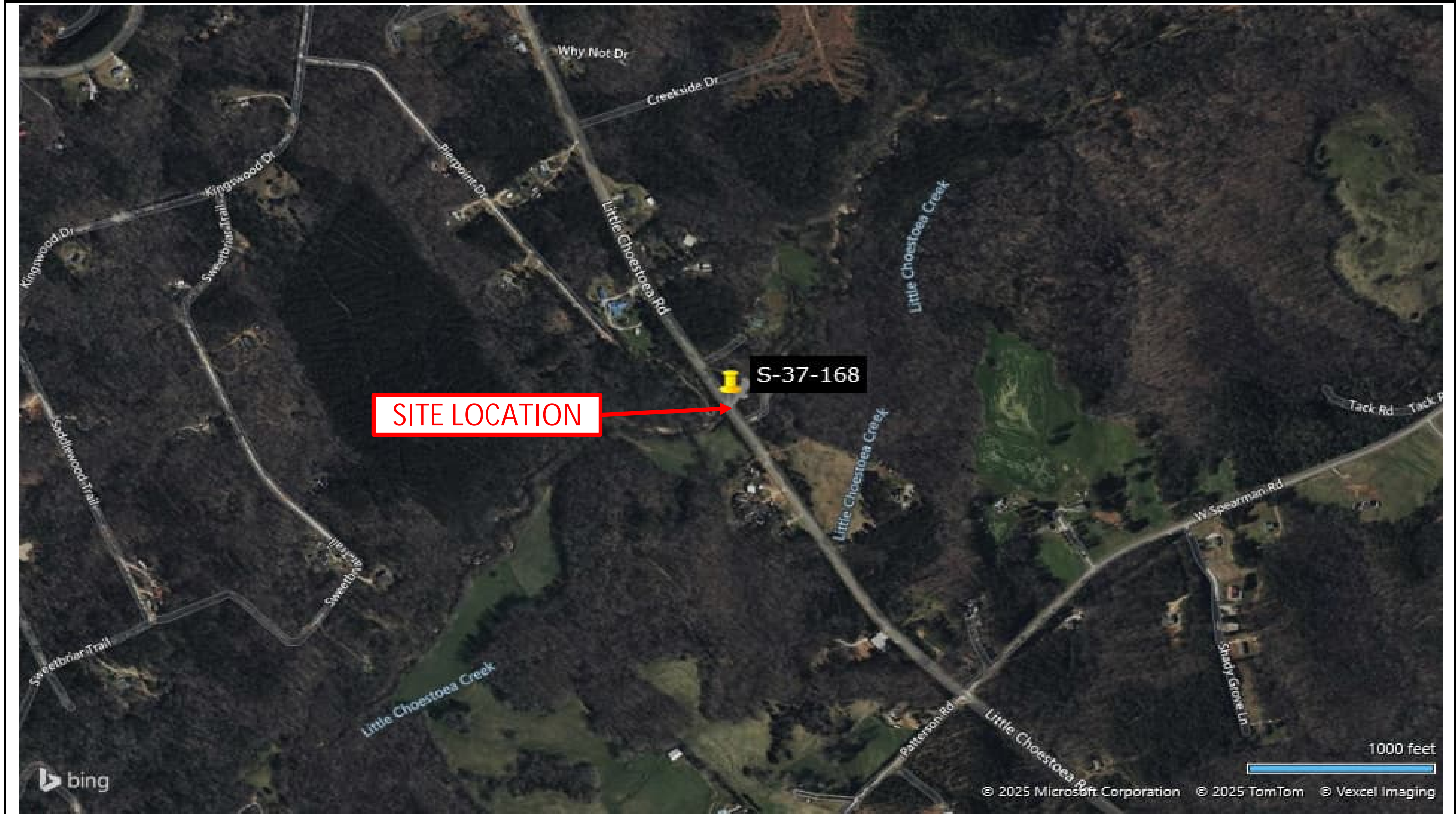
## **Appendix A**

### **Field Exploration**

- Exhibit A-1 – Site Location Map
- Exhibit A-2 – Aerial Exploration Plan
- Exhibit A-3 – Boring Location Diagram
- Exhibit A-4 – Field Testing Summary
- Exhibit A-5 – GeoScoping Form (2 Pages)
- Exhibit A-6 – Field Exploration Description (2 Pages)
- Exhibit A-7 – Soil/Rock Description Terms (2 Pages)
- Exhibit A-8 – Soil/Rock Symbols
- Exhibit A-9 – Boring Logs (4 Pages)
- Exhibit A-10 – Grout Logs (4 Pages)
- Exhibit A-11 – Rock Core Photograph Logs (2 Pages)

Note: All exhibits are one page unless noted above





AERIAL PHOTOGRAPHY PROVIDED BY BING  
DIAGRAM IS FOR GENERAL LOCATION ONLY,  
AND IS NOT INTENDED FOR CONSTRUCTION  
PURPOSES

Project Mgr:	JA	Project No.	8623P180
Drawn by:	MM	Scale:	AS SHOWN
Checked by:	JA	Date:	3/21/2025
Approved by:	JA		



**SITE LOCATION MAP**  
**S-37-168 (Little Choestoea Road) Bridge**  
**Replacement over Little Choestoea Creek**  
Oconee County, SC P042512

**EXHIBIT**  
**A-1**



AERIAL PHOTOGRAPHY PROVIDED BY BING  
DIAGRAM IS FOR GENERAL LOCATION ONLY,  
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PURPOSES

Project Mgr:	JA
Drawn by:	MM
Checked by:	JA
Approved by:	JA

Project No.	8623P180
Scale:	AS SHOWN
Date:	3/21/2025













AERIAL EXPLORATION PLAN	
<b>S-37-168 (Little Choestoea Road) Bridge Replacement over Little Choestoea Creek</b>	
Oconee County, SC	P042512

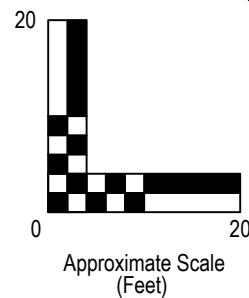
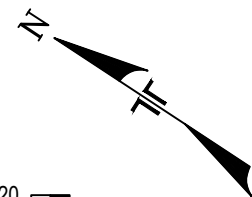
**EXHIBIT**  
**A-2**

# LEGEND

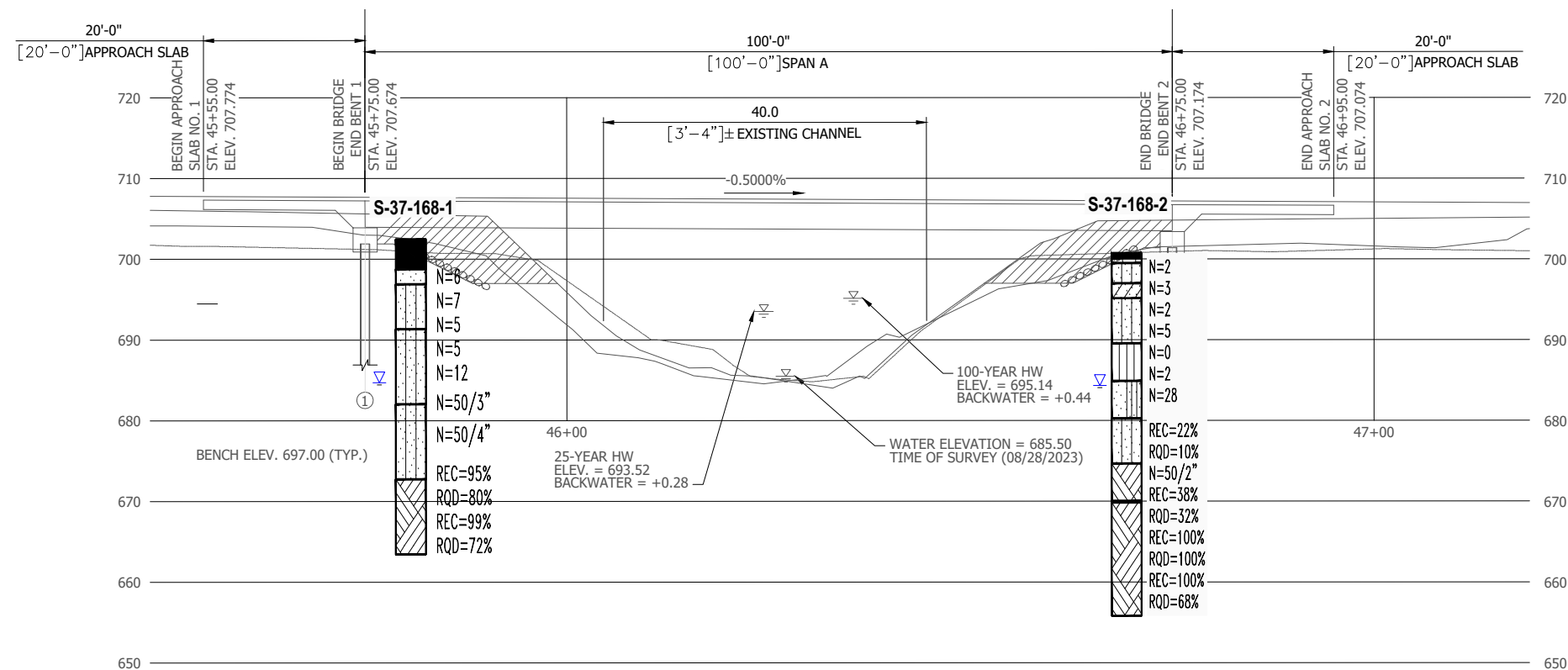
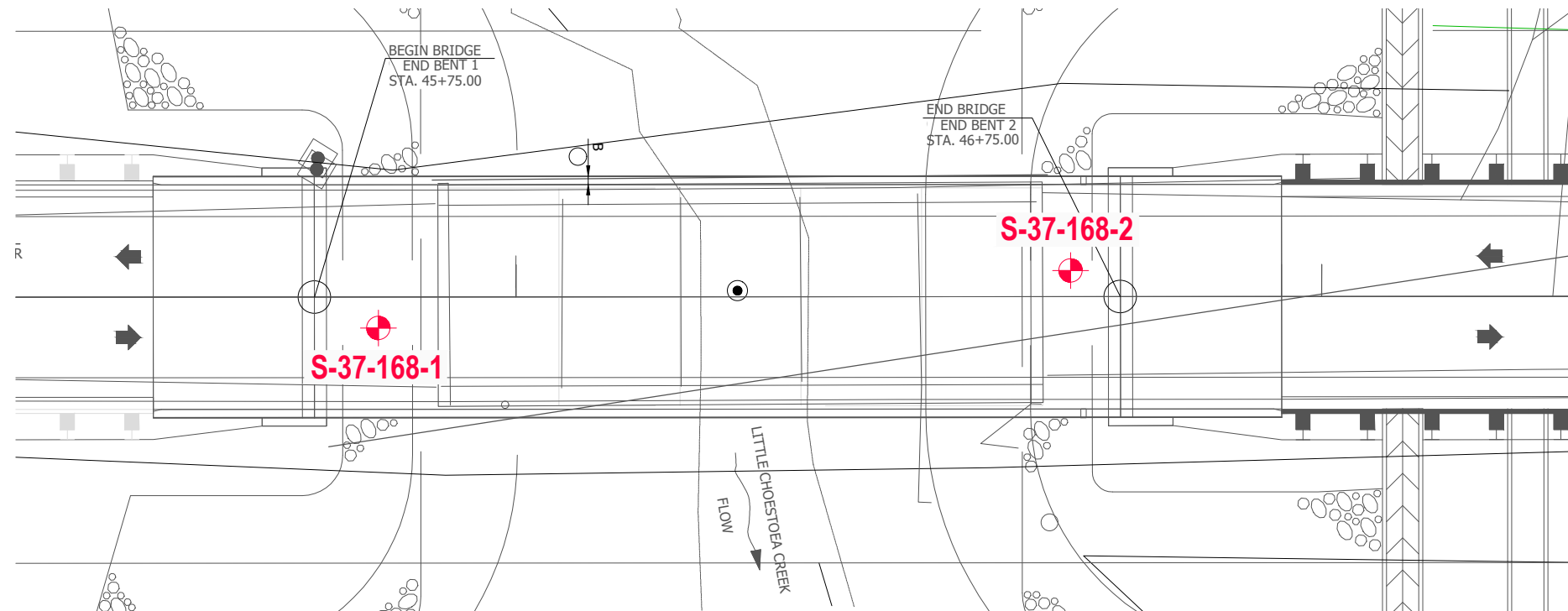
 APPROXIMATE BORING LOCATION

 SCDOT-ASPHALT   
  SCDOT-GP   
  SCDOT-FILL  
 SCDOT-MLS   
 SCDOT-SC   
 SCDOT-CLS  
 SCDOT-SM   
 SCDOT-BEDROCK

 Water Level Reading at time of drilling.  
 Water Level Reading after drilling.




THIS DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES



## PROFILE

Project Mngr: MM  
 Drawn By: RLW  
 Checked By: MM/MRF  
 Approved By: JNA

Project No. 8623P180  
 Scale: AS SHOWN  
 File No. 8623P180 PC  
 Date: MARCH 2025

  
 72 Pointe Circle Greenville, SC 29615  
 864-292-2901 864-292-6361

BORING LOCATION DIAGRAM  
 SCDOT PROJECT ID: P042512  
 S-37-168 LITTLE CHOESTOE CREEK  
 OCONEE COUNTY  
 SOUTH CAROLINA

EXHIBIT  
 A-3

Soil Testing Location Table - Exhibit A-4

S-37-168 Bridge Replacement over Little Choestoea Creek | Oconee County, SC

Terracon Project No.: 8623P180 | SCDOT Project ID: P042512



Test Number	Type	Test Hole Local	Northing	Easting	Latitude	Longitude	Station <sup>1</sup>	Offset <sup>1</sup>	Elevation <sup>2</sup> (ft)	Depth (ft)
S-37-168-1	STB	Begin Bridge	1001703.78	1377333.70	34.56933	-83.06854	45+83	6.8-R	705.3	42.0
S-37-168-2	STB	End Bridge	1001639.44	1377386.39	34.56915	-83.06836	46+69	5-L	704.8	48.3

1. Stations and offsets were based on the state plane coordinates collected by Thomas & Hutton and measured from center line by Terracon in MicroStation.
2. Elevations are based on vertical datum NAVD 88.
3. A composite bulk sample was collected approximately 6 feet northwest of S-37-168-1 and approximately 6 feet southeast of S-37-168-2.

## Exhibit A-5: GeoScoping Form

PROJECT INFORMATION			
Project ID:	P042512	Date of Trip:	1/16/2024
County:	Oconee	Location:	Westminster
Rd/ Route:	S-37-168	Local Name:	Little Choestoea
Attendees:	M. McKenney		Road

EXISTING BRIDGE INFORMATION			
Bridge Length:	75 ft	Bridge Width:	27.7 ft
Superstructure Type:	Concrete framing and decking	Substructure Type:	Timber and Steel H-Piles
Begin Bridge Sta <sup>1</sup> :	45+75	End Bridge Sta <sup>1</sup> :	46+75
Begin Bridge Embankment Sta <sup>1</sup> :	44+75	End Bridge Embankment Sta <sup>1</sup> :	47+75
Structure Number:	05821	Posted Weight Limit:	45 tons
Crossing:	Little Choestoea Creek	Skew:	N/A
Latitude:	34.56926°	Longitude:	-83.06846°
Existing Fill Height:	approx 12 ft	Approx Existing Slope Angle:	2H:1V

1. Begin & End Bridge Embankment 100 ft down Sta. or up Sta., respectively. Sta. estimated from overlay of bridge plan provided by HNTB.

EXISTING ROADWAY EMBANKMENT INFORMATION			
Begin Project Sta:	44+50	Begin Bridge Embankment Sta:	44+75
Accessibility Issues:	None Observed		
Ground Cover:	Asphalt pavement and grassed shoulders		
Existing Fill Height:	12 feet, sloping	Approx Existing Slope Angle:	2H:1V
Local Development:	developed - residential		
Topography:	graded slope to creek		
Traffic Control Necessary:	No, bridge closed to traffic		
Surface Soils:	sand	Muck:	No
Exposed Rock in Stream Bed:	Yes	Exposed Rock in banks:	No
Wetlands on Site:	Yes	Wetland Adjacent:	Yes
Depth FG to Water:	19 feet	Water Depth:	1 foot
Depth to Existing Ground:	approximately 20 feet at center of bridge		
Scour Condition at EB:	Critical	Scour Condition at IB:	Critical

End Bridge Embankment Sta:	47+75	End Project Sta:	48+65
Accessibility Issues:	None Observed		
Ground Cover:	Asphalt pavement and grassed shoulders		
Existing Fill Height:	12 feet, sloping	Approx Existing Slope Angle:	2H:1V
Local Development:	developed - residential		
Topography:	graded slope to creek		
Traffic Control Necessary:	No, bridge closed to traffic		
Surface Soils:	silty sand	Muck:	No
Exposed Rock in Stream Bed:	Yes	Exposed Rock in banks:	No
Wetlands on Site:	Yes	Wetland Adjacent:	Yes
Depth FG to Water:	19 feet	Water Depth:	1 foot
Depth to Existing Ground:	approximately 20 feet at center of bridge		
Scour Condition at EB:	Critical	Scour Condition at IB:	Critical

## Exhibit A-5: GeoScoping Form

UTILITIES INFORMATION	
Attached:	A water line was observed attached along the northeast side of the bridge.
Above Ground:	Overhead power was observed crossing diagonally over the bridge.
Underground:	None.

Comments:

## **Field Exploration Description Overview**

The testing locations were determined by Terracon and submitted to SCDOT for approval. Terracon located the test locations in the field using handheld GPS and measurements from existing structures shown on the provided drawings. The borings were surveyed by Thomas & Hutton after testing and drilling was complete. The locations, as shown in the Exploration Plans, are shown to the scale indicated.

A field log of each test location was prepared by our engineer. The final boring logs included with this report represent the engineer's description of the encountered conditions modified as necessary based on laboratory test results of the individual samples.

### **Soil Test Borings (STB)**

All boring and sampling operations were conducted in general accordance with the following procedures:

- SCDOT Geotechnical Design Manual 2022
- ASTM D5783, "Standard Guide for Use of Direct Rotary Drilling with Water-Based Drilling Fluid for Geo-environmental Exploration"
- ASTM D6151, "Standard Practice for Using Hollow-Stem Augers for Geotechnical Exploration and Soil Sampling"
- ASTM D1586 "Test Method for Penetration Test and Split-Barrel Sampling of Soils"
- ASTM D4220 "Standard Practices for Preserving and Transporting Soil"
- ASTM D2113 "Standard Practice for Rock Core Drilling and Sampling of Rock for Site Exploration"
- ASTM D5079 "Standard Practices for Preserving and Transporting Rock Core Samples"

Each soil test boring was advanced using rotary wash drilling techniques. Soil samples were obtained with a standard 1.4-inch I.D., 2-inch O.D., split-barrel sampler, also known as a standard split-spoon. The sampler is advanced into the soil a total of 18 to 24 inches by striking the drill rod using a 140-pound automatic hammer falling 30 inches. The number of blows required to advance the sampler for each of three to four, 6-inch increments is recorded. The sum of the number of blows for the second and third increments is called the "Standard Penetration Value", or N-value ( $N_{meas}$ , blows per foot). The N-value, when properly evaluated, is an index to the soil strength.

Soil classification provides a general guide to the engineering properties of various soil types and enables the engineer to apply his experience to current situations. In our exploration, samples obtained during drilling operations are examined and visually classified by a geotechnical engineer using the procedures outlined in ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System). Laboratory testing was also performed on select split-spoon samples to evaluate index properties for further classification. The soils are described according to color, texture, and relative density or

**Exhibit A-6 – Subsurface Exploration Description**

S-37-168 BRO Little Choestoea Creek | Oconee County, SC  
Terracon Project No. 8623P180 | SCDOT Project ID: P042512



consistency (based on standard penetration resistance). The designations shown on the logs are described in the 2022 SCDOT Geotechnical Design Manual, Chapter 6.

The borings were advanced either to the planned drilling depth at which they were terminated, or to refusal of the drilling equipment. Select borings were continued below this depth using diamond bit rock coring techniques. NQ2 sized cores were recovered from the borehole. The rock recovery ratios (REC, percentage of the total core run), Rock Quality Designation (RQD, percentage of the total core run of pieces greater than 4 inches) were recorded along with a description of the rock. An explanation of the rock descriptions shown on the logs is provided in the SCDOT GDM Chapter 6. Photos of the recovered rock core specimens are provided in the Rock Core Photograph Log.

Groundwater readings were collected from the soil test borings after 24 hours if site constraints allowed the borings to stay open. If collected, water levels are indicated on the boring logs. The borings were advanced using mud rotary drilling techniques, and time-of-drilling water levels may not be reliable.

At the conclusion of the work, the boreholes were backfilled with the drill cuttings and clean sand. The upper 20 feet of the tests in the existing roadways and embankments were grouted with a cement bentonite grout. Test locations performed in existing pavements were capped with cold-patch asphalt.



## SOIL DESCRIPTION TERMS

### Relative Density/Consistency Terms

<u>Relative Density</u> <sup>1</sup>			<u>Consistency</u> <sup>2</sup>		
Descriptive Term	Relative Density	SPT Blow Count	Descriptive Term	Unconfined Compression Strength (q <sub>u</sub> ) (tsf)	SPT Blow Count
Very Loose	0 to 15%	4 and less	Very Soft	0.25 and less	2 and less
Loose	16 to 35%	5 to 10	Soft	0.26 to 0.50	3 to 4
Medium Dense	36 to 65%	11 to 30	Firm	0.51 to 1.00	5 to 8
Dense	66 to 85%	31 to 50	Stiff	1.01 to 2.00	9 to 15
Very Dense	86 to 100%	51 and more	Very Stiff	2.01 to 4.00	16 to 30
			Hard	4.01 and more	31 and more

### Moisture Condition

<u>Descriptive Term</u>	<u>Criteria</u>
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually in coarse-grained soils below the water table

### Color

Describe the sample color while sample is still moist.

### Angularity<sup>1</sup>

<u>Descriptive Term</u>	<u>Criteria</u>
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces.
Subangular	Particles are similar to angular description but have rounded edges.
Subrounded	Particles have nearly plane sides but have well-rounded corners and edges.
Rounded	Particles have smoothly curved sides and no edges.

### HCl Reaction<sup>3</sup>

<u>Descriptive Term</u>	<u>Criteria</u>
None Reactive	No visible reaction
Weakly Reactive	Some reaction, with bubbles forming slowly
Strongly Reactive	Violent reaction, with bubbles forming immediately

### Cementation<sup>3</sup>

<u>Descriptive Term</u>	<u>Criteria</u>
Weakly Cemented	Crumbles or breaks with handling or little finger pressure
Cemented	Crumbles or breaks with considerable finger pressure
Strongly Cemented	Will not crumble or break with finger pressure

### Particle-Size Range<sup>1</sup>

<u>Gravel</u>	Diameter, mm	Sieve Size	<u>Sand</u>	Diameter, mm	Sieve Size
Fine	4.76 to 19.1	#4 to ¾ inch	Fine	0.074 to 0.42	#200 to #40
Coarse	19.1 to 76.2	¾ inch to 3 inch	Medium	0.42 to 2.00	#40 to #10
			Coarse	4.00 to 4.76	#10 to #4

### Primary Soil Type<sup>1, 2</sup>

The primary soil type will be shown in all capital letters.

### USCS Soil Designation

Indicate USCS soil designation as defined in ASTM D-2487 and D-2488

### AASHTO Soil Designation

Indicate AASHTO soil designation as defined in AASHTO M-145 and ASTM D-3282

<sup>1</sup>Applies to coarse-grained soils (major portion retained on No. 200 sieve)

<sup>2</sup>Applies to fine-grained soils (major portion passing No. 200 sieve)

<sup>3</sup>Use as required

## DESCRIPTION OF ROCK PROPERTIES

### WEATHERING

Fresh	Rock fresh, crystals bright, few joints may show slight staining. Rock rings under hammer if crystalline.
Very slight	Rock generally fresh, joints stained, some joints may show thin clay coatings, crystals in broken face show bright. Rock rings under hammer if crystalline.
Slight	Rock generally fresh, joints stained, and discoloration extends into rock up to 1 in. Joints may contain clay. In granitoid rocks some occasional feldspar crystals are dull and discolored. Crystalline rocks ring under hammer.
Moderate	Significant portions of rock show discoloration and weathering effects. In granitoid rocks, most feldspars are dull and discolored; some show clayey. Rock has dull sound under hammer and shows significant loss of strength as compared with fresh rock.
Moderately Severe	All rock except quartz discolored or stained. In granitoid rocks, all feldspars dull and discolored and majority show kaolinization. Rock shows severe loss of strength and can be excavated with geologist's pick.
Severe	All rock except quartz discolored or stained. Rock "fabric" clear and evident, but reduced in strength to strong soil. In granitoid rocks, all feldspars kaolinized to some extent. Some fragments of strong rock usually left.
Very severe	All rock except quartz discolored or stained. Rock "fabric" discernible, but mass effectively reduced to "soil" with only fragments of strong rock remaining.
Complete	Rock reduced to "soil". Rock "fabric" not discernible or discernible only in small, scattered locations. Quartz may be present as dikes or stringers.

### HARDNESS (for engineering description of rock – not to be confused with Moh's scale for minerals)

Very hard	Cannot be scratched with knife or sharp pick. Breaking of hand specimens requires several hard blows of geologist's pick.
Hard	Can be scratched with knife or pick only with difficulty. Hard blow of hammer required to detach hand specimen.
Moderately hard	Can be scratched with knife or pick. Gouges or grooves to ¼ in. deep can be excavated by hard blow of point of a geologist's pick. Hand specimens can be detached by moderate blow.
Medium	Can be grooved or gouged 1/16 in. deep by firm pressure on knife or pick point. Can be excavated in small chips to pieces about 1-in. maximum size by hard blows of the point of a geologist's pick.
Soft	Can be gouged or grooved readily with knife or pick point. Can be excavated in chips to pieces several inches in size by moderate blows of a pick point. Small thin pieces can be broken by finger pressure.
Very soft	Can be carved with knife. Can be excavated readily with point of pick. Pieces 1-in. or more in thickness can be broken with finger pressure. Can be scratched readily by fingernail.

### Joint, Bedding, and Foliation Spacing in Rock<sup>a</sup>

Spacing	Joints	Bedding/Foliation
Less than 2 in.	Very close	Very thin
2 in. – 1 ft.	Close	Thin
1 ft. – 3 ft.	Moderately close	Medium
3 ft. – 10 ft.	Wide	Thick
More than 10 ft.	Very wide	Very thick

<sup>a</sup>Spacing refers to the distance normal to the planes, of the described feature, which are parallel to each other or nearly so.

### Rock Quality Designation (RQD)<sup>a</sup>

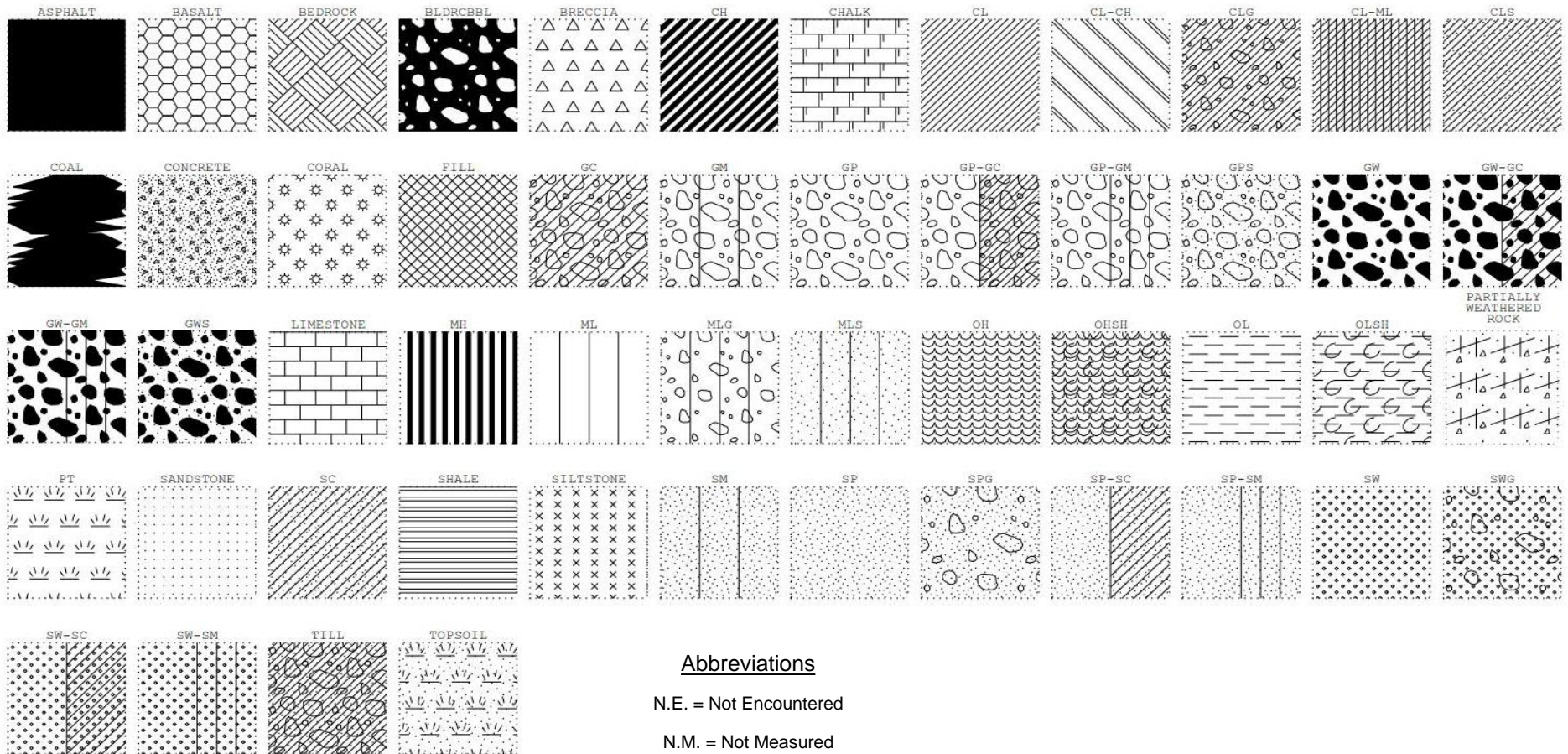
RQD, as a percentage	Diagnostic Description
Exceeding 90	Excellent
90 – 75	Good
75 – 50	Fair
50 – 25	Poor
Less than 25	Very poor

<sup>a</sup>RQD (given as a percentage) = length of core in pieces 4 in. and longer/length of run.

### Joint Openness Descriptors

Openness	Descriptor
No Visible Separation	Tight
Less than 1/32 in.	Slightly open
1/32 to 3/8 in.	Moderately open
1/8 to 3/8 in.	Open
3/8 in. to 0.1 ft.	Moderately wide
Greater than 0.1 ft.	Wide

References: American Society of Civil Engineers. Manuals and Reports on Engineering Practice - No. 56. Subsurface Investigation for Design and Construction of Foundations of Buildings. New York: American Society of Civil Engineers, 1976. U.S. Department of the Interior, Bureau of Reclamation, Engineering Geology Field Manual.



Project Manager:  
MEM

Drawn by:  
K.JZ

Checked by:  
SG

Approved by:  
DJC

Project No.  
8623P180

Scale:  
N.T.S.

File Name:  
Soil – Rock – Log

Date:  
Jul 2023

**Terracon**

72 Pointe Circle  
PH. (864) 292-2901

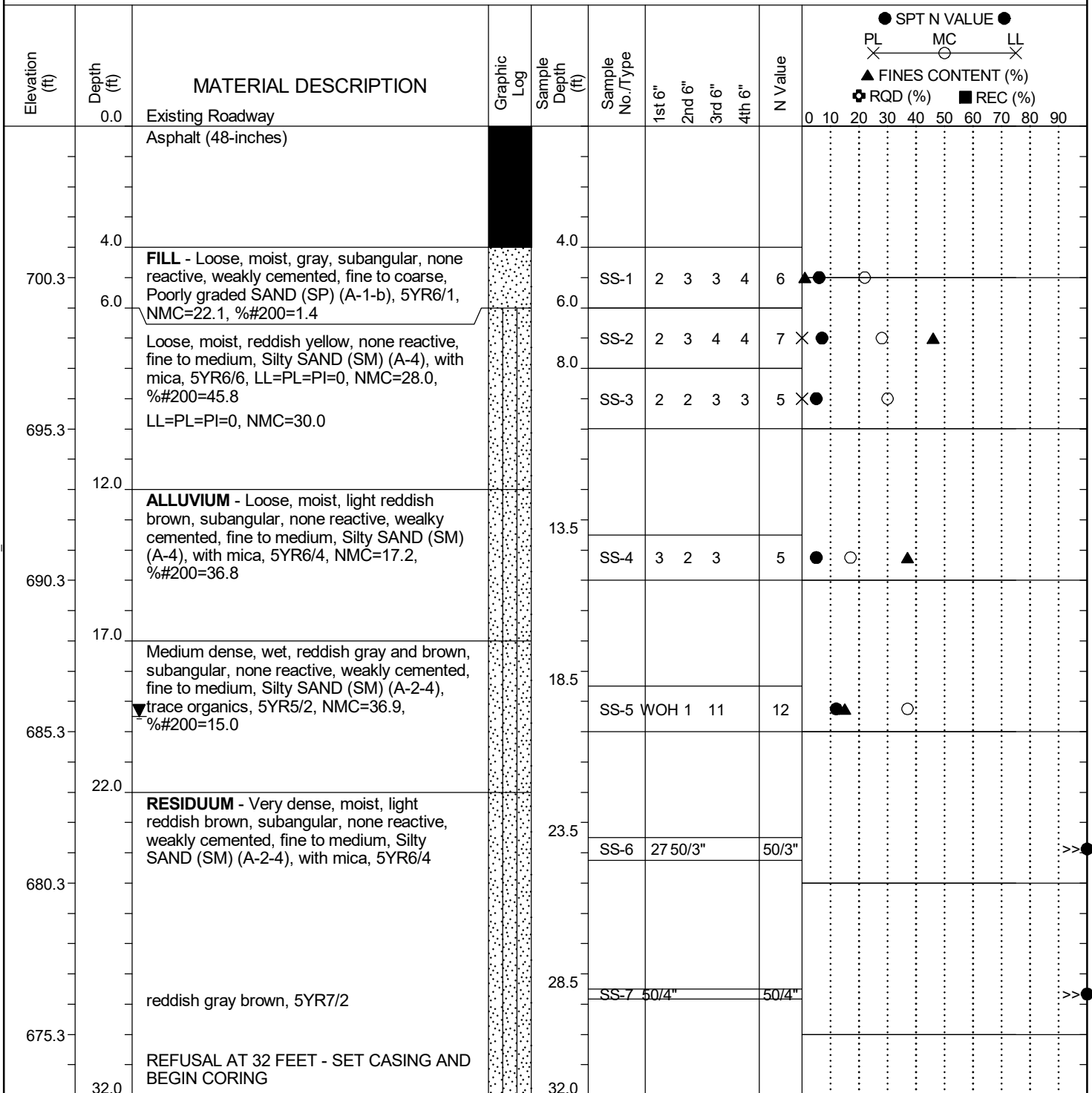
Greenville, SC 29615  
FAX. (864) 292-6361

## SOIL AND ROCK SYMBOLS

Exhibit A-8

# SCDOT Soil Test Log

<b>Project ID:</b>	P042512				<b>County:</b>	Oconee		<b>Boring No.:</b>	S-37-168-1		
<b>Site Description:</b>	S-37-168 (Little Choestoea Road) BRO Little Choestoea Creek							<b>Route:</b>	S-37-168		
<b>Eng./Geo.:</b>	M. McKenney		<b>Boring Location:</b>	45+83		<b>Offset:</b>	6.8R	<b>Alignment:</b>	Existing		
<b>Elev.:</b>	705.3 ft		<b>Latitude:</b>	34.56933		<b>Longitude:</b>	-83.06854		<b>Date Started:</b>	1/16/2024	
<b>Total Depth:</b>	42 ft		<b>Soil Depth:</b>	32 ft		<b>Core Depth:</b>	10 ft		<b>Date Completed:</b>	1/17/2024	
<b>Bore Hole Diameter (in):</b>	4		<b>Sampler Configuration</b>			<b>Liner Required:</b>	Y (N)		<b>Liner Used:</b>	Y (N)	
<b>Drill Machine:</b>	DR#554		<b>Drill Method:</b>	RW/RC		<b>Hammer Type:</b>	Automatic		<b>Energy Ratio:</b>	88.5%	
<b>Core Size:</b>	NQ2		<b>Driller:</b>	B. Burnette		<b>Groundwater:</b>	TOB	N.M.		<b>24HR</b>	19.5 ft



## LEGEND

Continued Next Page

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC.DOT 8623P180 SCDOT BRIDGE PACKAGE 19 S-37-168 LITTLE CHOESTOE CREEK DOT - MEM.GPJ SCDOT\_DATATEMPLATE.GDT 3/22/25

# SCDOT Soil Test Log

<b>Project ID:</b>	P042512				<b>County:</b>	Oconee		<b>Boring No.:</b>	S-37-168-1		
<b>Site Description:</b>	S-37-168 (Little Choestoea Road) BRO Little Choestoea Creek							<b>Route:</b>	S-37-168		
<b>Eng./Geo.:</b>	M. McKenney		<b>Boring Location:</b>	45+83		<b>Offset:</b>	6.8R		<b>Alignment:</b>	Existing	
<b>Elev.:</b>	705.3 ft		<b>Latitude:</b>	34.56933		<b>Longitude:</b>	-83.06854		<b>Date Started:</b>	1/16/2024	
<b>Total Depth:</b>	42 ft		<b>Soil Depth:</b>	32 ft		<b>Core Depth:</b>	10 ft		<b>Date Completed:</b>	1/17/2024	
<b>Bore Hole Diameter (in):</b>	4		<b>Sampler Configuration</b>			<b>Liner Required:</b>	Y (N)		<b>Liner Used:</b>	Y (N)	
<b>Drill Machine:</b>	DR#554		<b>Drill Method:</b>	RW/RC		<b>Hammer Type:</b>	Automatic		<b>Energy Ratio:</b>	88.5%	
<b>Core Size:</b>	NQ2		<b>Driller:</b>	B. Burnette		<b>Groundwater:</b>	<b>TOB</b>	N.M.		<b>24HR</b>	19.5 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	4th 6"	N Value	● SPT N VALUE ● PL X MC O LL X ▲ FINES CONTENT (%) + RQD (%) ■ REC (%)
670.3	37.0	<b>GRANITIC GNEISS</b> - Very dark gray and white, thinly laminated foliation, medium grained, subangular, slightly weathered, very strong rock, 0-15°, J, T to N, No, No, Pl, VC to W, SR, 7.5YR3/1 and 7.5YR8/1 NQ-1: RQD=80, %REC=95, GSI=70-80, RMR=74, qu=16,681 psi, time rate=2.41 min/ft		37.0	NQ-1						0 10 20 30 40 50 60 70 80 90 + RQD (%) ■ REC (%)
665.3	42.0	<b>QUARTZITE GRANITIC GNEISS</b> - White, no foliation, medium grained, subangular, slightly weathered, strong, 0-15°, J, VN to N, Fi, Fe, Pl, C to M, SR, 7.5YR8/2 NQ-2: RQD=72, %REC=99, GSI=55-65, RMR=55, qu=10.385 psi, time rate=2.24 min/ft			NQ-2						0 10 20 30 40 50 60 70 80 90 + RQD (%) ■ REC (%)
660.3											
655.3											
650.3											
645.3											

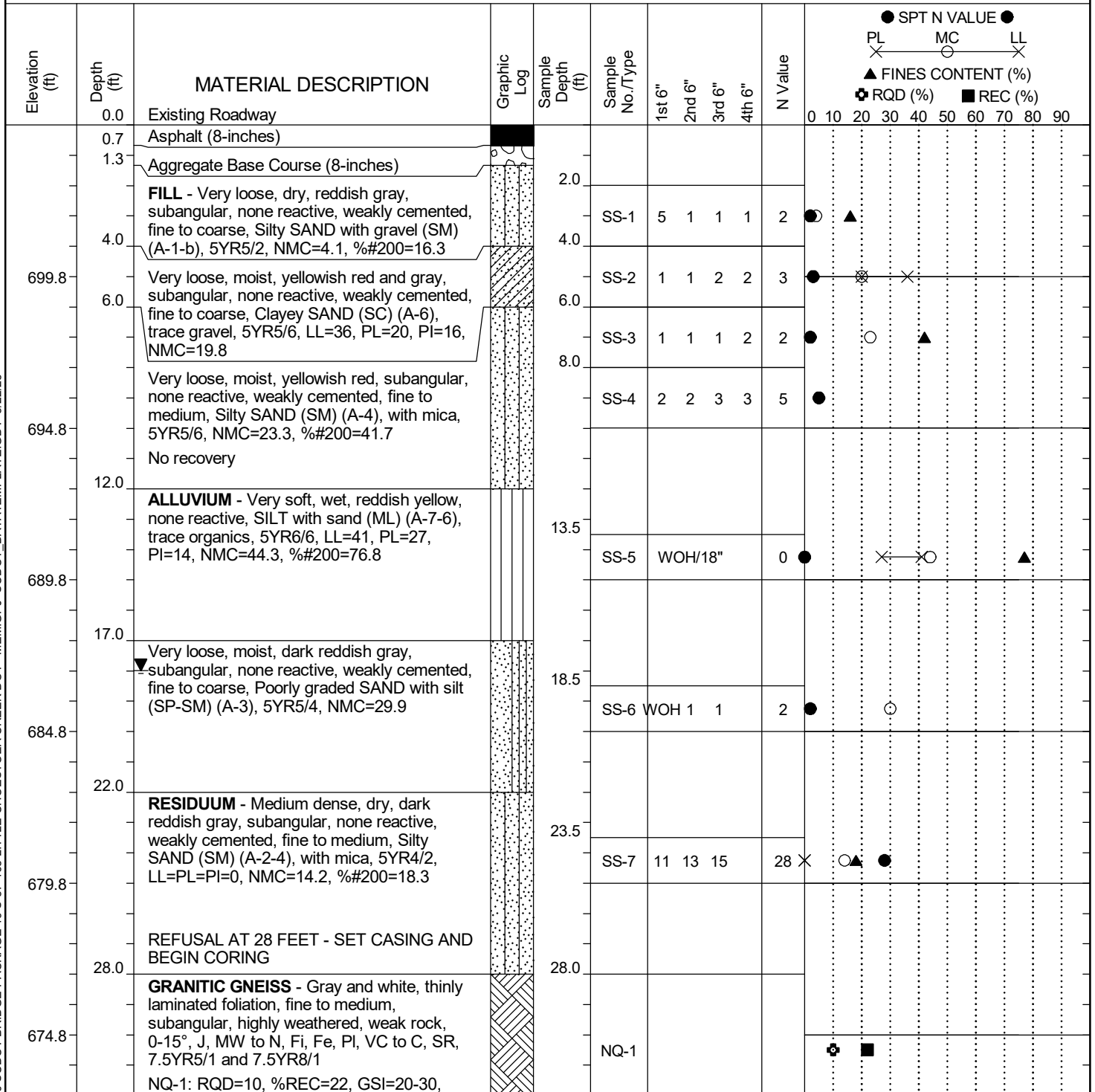
## LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
UD - Undisturbed Sample	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC.DOT 8623P180 SCDOT BRIDGE PACKAGE 19 S-37-168 LITTLE CHOESTOEAL CREEK DOT - MEM.GPJ SCDOT\_DATATEMPLATE.GDT 3/22/25

# SCDOT Soil Test Log

<b>Project ID:</b>	P042512				<b>County:</b>	Oconee		<b>Boring No.:</b>	S-37-168-2		
<b>Site Description:</b>		S-37-168 (Little Choestoea Road) BRO Little Choestoea Creek						<b>Route:</b>	S-37-168		
<b>Eng./Geo.:</b>		M. McKenney		<b>Boring Location:</b>		46+69		<b>Offset:</b>	5L		
<b>Alignment:</b>		Existing									
<b>Elev.:</b>	704.8 ft		<b>Latitude:</b>	34.56915		<b>Longitude:</b>	-83.06836		<b>Date Started:</b>	1/16/2024	
<b>Total Depth:</b>		48.3 ft		<b>Soil Depth:</b>		28 ft		<b>Core Depth:</b>	20 ft		
<b>Date Completed:</b>										1/16/2024	
<b>Bore Hole Diameter (in):</b>		4		<b>Sampler Configuration</b>		<b>Liner Required:</b>		Y (N)		<b>Liner Used:</b>	Y (N)
<b>Drill Machine:</b>		DR#554		<b>Drill Method:</b>		RW/RC		<b>Hammer Type:</b>		Automatic	
<b>Energy Ratio:</b>										88.5%	
<b>Core Size:</b>		NQ2		<b>Driller:</b>		B. Burnette		<b>Groundwater:</b>		TOB N.M.	
<b>24HR</b>										18 ft	



## LEGEND

Continued Next Page

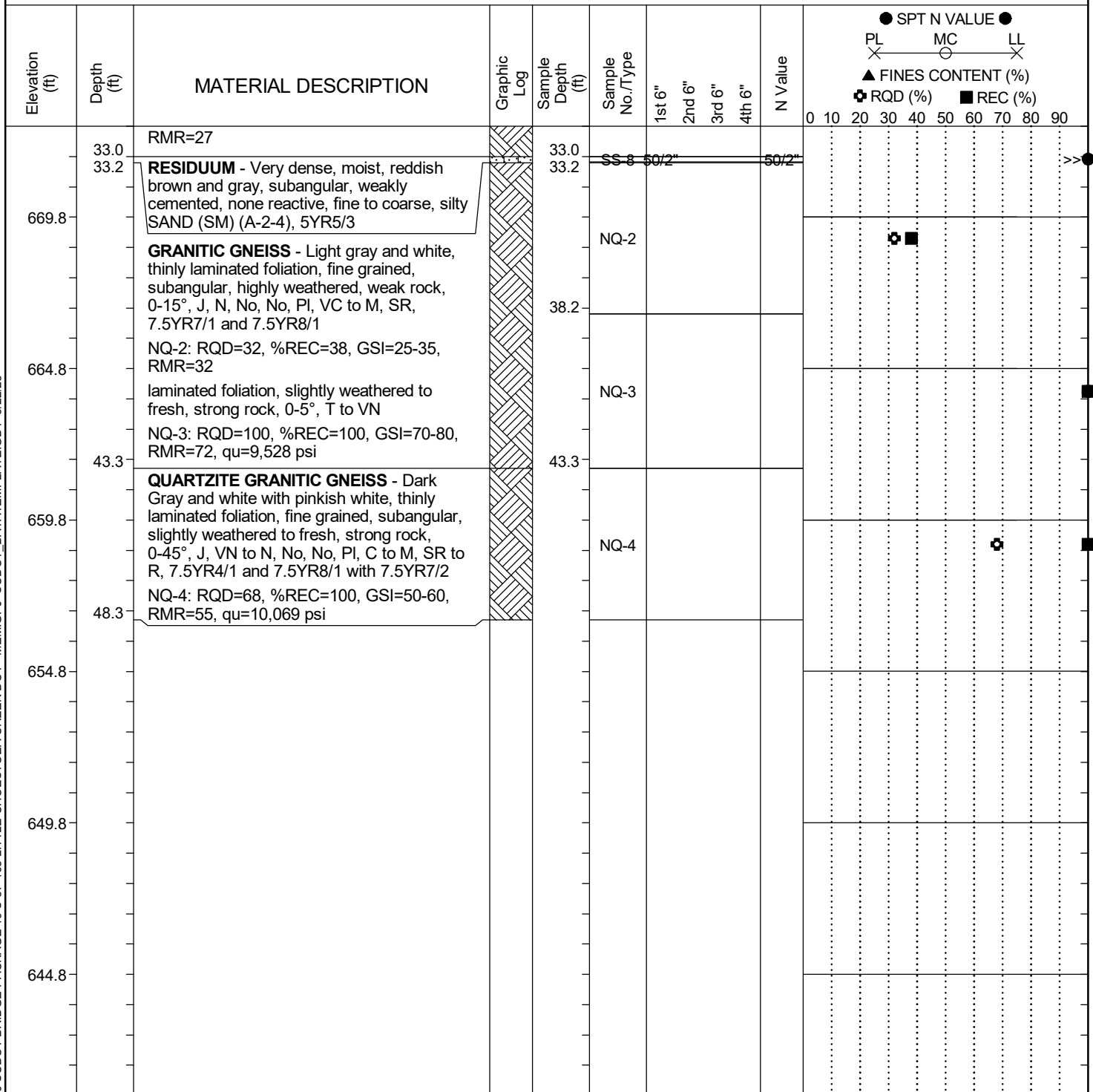
SAMPLER TYPE		DRILLING METHOD	
SS	- Split Spoon	HSA	- Hollow Stem Auger
UD	- Undisturbed Sample	CFA	- Continuous Flight Augers
AWG	- Rock Core, 1-1/8"	DC	- Driving Casing
NQ	- Rock Core, 1-7/8"	RW	- Rotary Wash
CU	- Cuttings	RC	- Rock Core
CT	- Continuous Tube		

SC.DOT 8623P180 SCDOT BRIDGE PACKAGE 19 S-37-168 LITTLE CHOESTOE CREEK DOT - MEM.GPJ SCDOT\_DATATEMPLATE.GDT 3/22/25



# SCDOT Soil Test Log

Project ID: P042512				County: Oconee		Boring No.: S-37-168-2		
Site Description:		S-37-168 (Little Choestoea Road) BRO Little Choestoea Creek					Route: S-37-168	
Eng./Geo.: M. McKenney		Boring Location: 46+69		Offset: 5L		Alignment: Existing		
Elev.: 704.8 ft		Latitude: 34.56915		Longitude: -83.06836		Date Started: 1/16/2024		
Total Depth: 48.3 ft		Soil Depth: 28 ft		Core Depth: 20 ft		Date Completed: 1/16/2024		
Bore Hole Diameter (in): 4		Sampler Configuration		Liner Required: Y (N)		Liner Used: Y (N)		
Drill Machine: DR#554		Drill Method: RW/RC		Hammer Type: Automatic		Energy Ratio: 88.5%		
Core Size: NQ2		Driller: B. Burnette		Groundwater: TOB N.M.		24HR: 18 ft		



## LEGEND

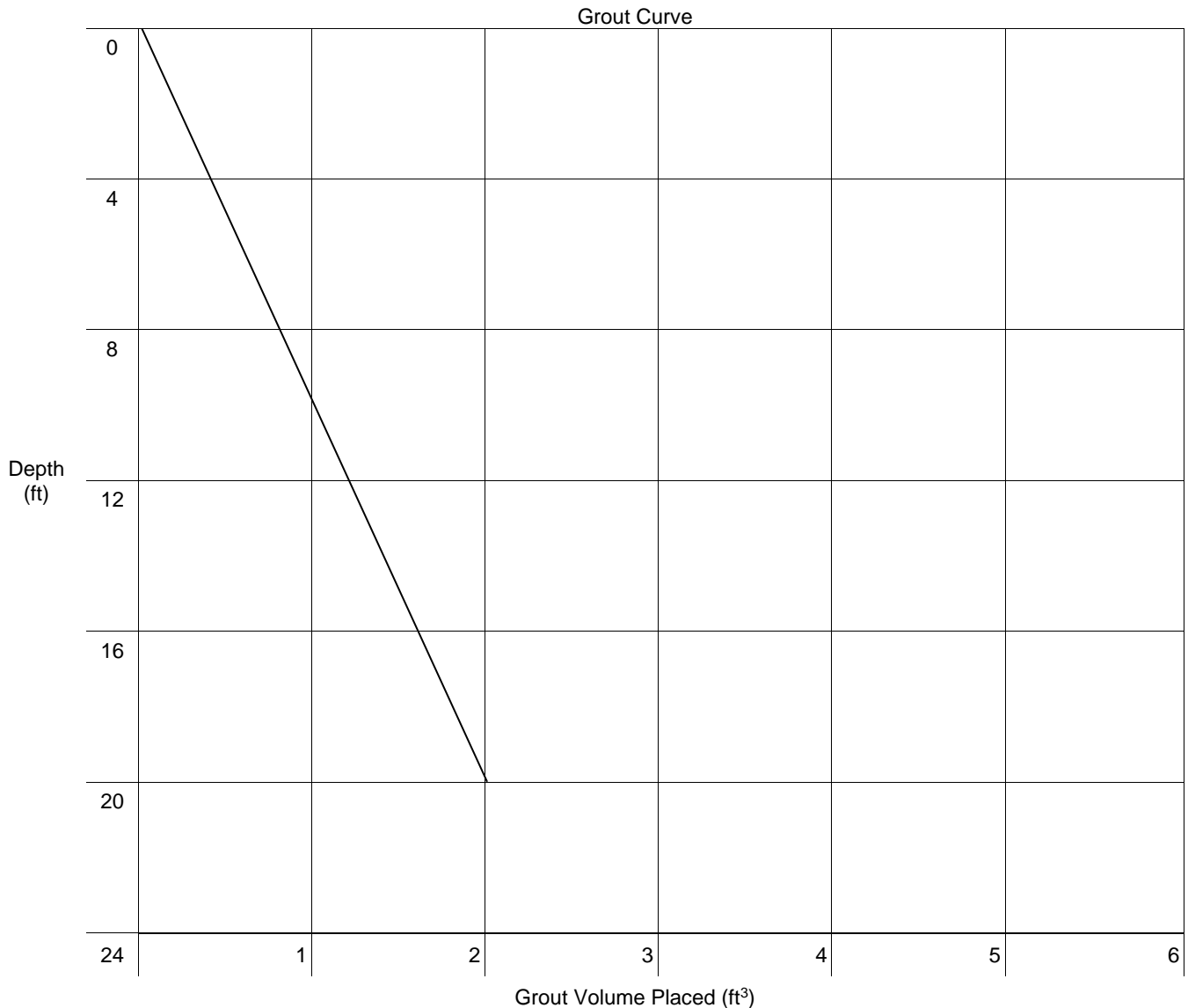
SAMPLER TYPE		DRILLING METHOD	
SS	- Split Spoon	HSA	- Hollow Stem Auger
UD	- Undisturbed Sample	CFA	- Continuous Flight Augers
AWG	- Rock Core, 1-1/8"	DC	- Driving Casing
NQ	- Rock Core, 1-7/8"	RW	- Rotary Wash
CU	- Cuttings	RC	- Rock Core
CT	- Continuous Tube		

SC.DOT 8623P180 SCDOT BRIDGE PACKAGE 19 S-37-168 LITTLE CHOESTOEAK CREEK DOT - MEM.GPJ SCDOT\_DATATEMPLATE.GDT 3/22/25



## Exhibit A-10: GROUT LOG OF TEST HOLES FOR GEOTECHNICAL ON-CALL

Project Name:	S-37-168 BRO Little Choestoea Creek		Test Hole No.:	S-37-168-1	
Project ID:	P042512		Station:	45+83	
Consultant Firm:	Terracon Consultants, Inc.	Date	1/17/24	Offset:	6.8R
Grouted By:	Burnette				
Notes:	Mix design: 1 pound cement mix, 1 pound bentonite, 6 pounds water				



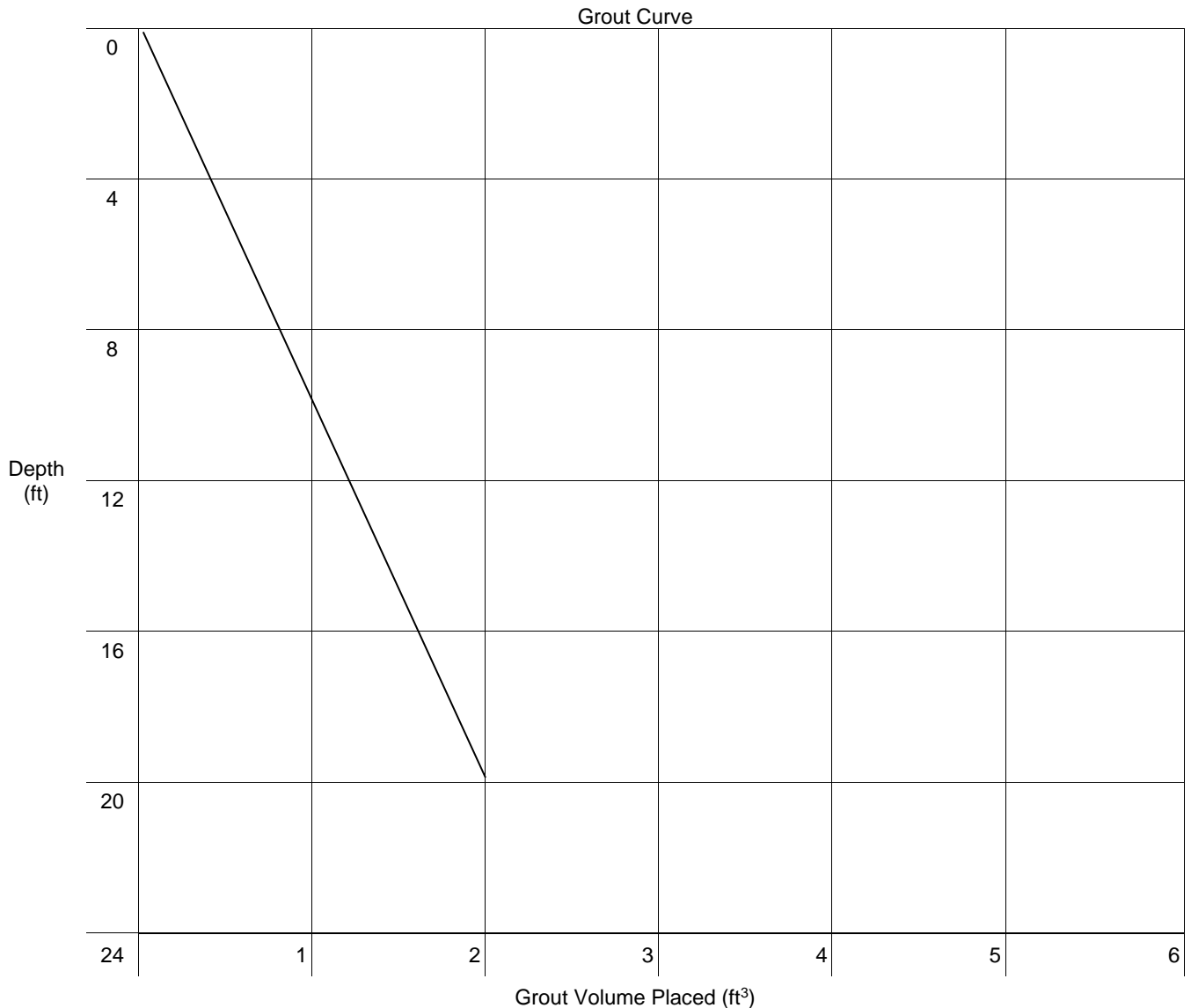
Number of Bags On-Site	20	ea.
Depth of Test Hole Grouted	20	ft.
Diameter of Test Hole	0.33	ft.
Area of Test Hole	0.09	ft²
Volume of Test Hole	1.74	ft³
Volume of Casing (If applicable)	-	ft³
Theoretical Volume of Test Hole	1.74	ft³
Number of Bags Used	2.5	ea.
Volume Placed	2	ft³





## Exhibit A-10: GROUT LOG OF TEST HOLES FOR GEOTECHNICAL ON-CALL

Project Name:	S-37-168 BRO Little Choestoea Creek		Test Hole No.:	S-37-168-2
Project ID:	P042512		Station:	46+69
Consultant Firm:	Terracon Consultants, Inc.	Date	1/17/2024	Offset:
Grouted By:	Burnette			5L
Notes:	Mix design: 1 pound cement mix, 1 pound bentonite, 6 pounds water			

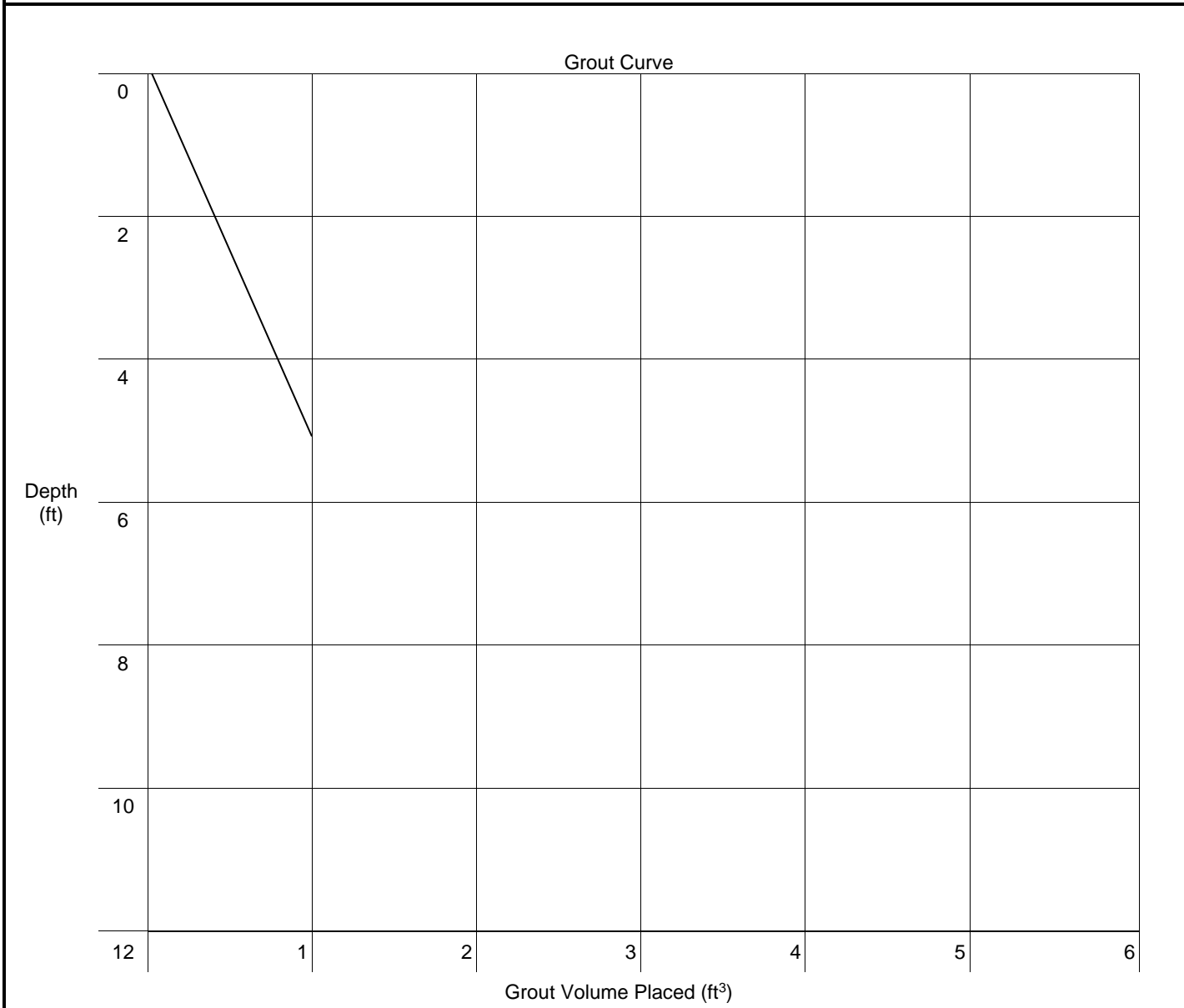


Number of Bags On-Site	20	ea.
Depth of Test Hole Grouted	20	ft.
Diameter of Test Hole	0.33	ft.
Area of Test Hole	0.09	ft²
Volume of Test Hole	1.74	ft³
Volume of Casing (If applicable)	-	ft³
Theoretical Volume of Test Hole	1.74	ft³
Number of Bags Used	2.5	ea.
Volume Placed	2	ft³



## Exhibit A-10: GROUT LOG OF TEST HOLES FOR GEOTECHNICAL ON-CALL

Project Name:	S-37-168 BRO Little Choestoea Creek		Test Hole No.:	S-37-168-1
Project ID:	P042512		Station:	Bulk
Consultant Firm:	Terracon Consultants, Inc.		Offset:	45+77
Grouted By:	Burnette	Date	1/17/2024	7R
Notes:	Mix design: 1 pound cement mix, 1 pound bentonite, 6 pounds water			



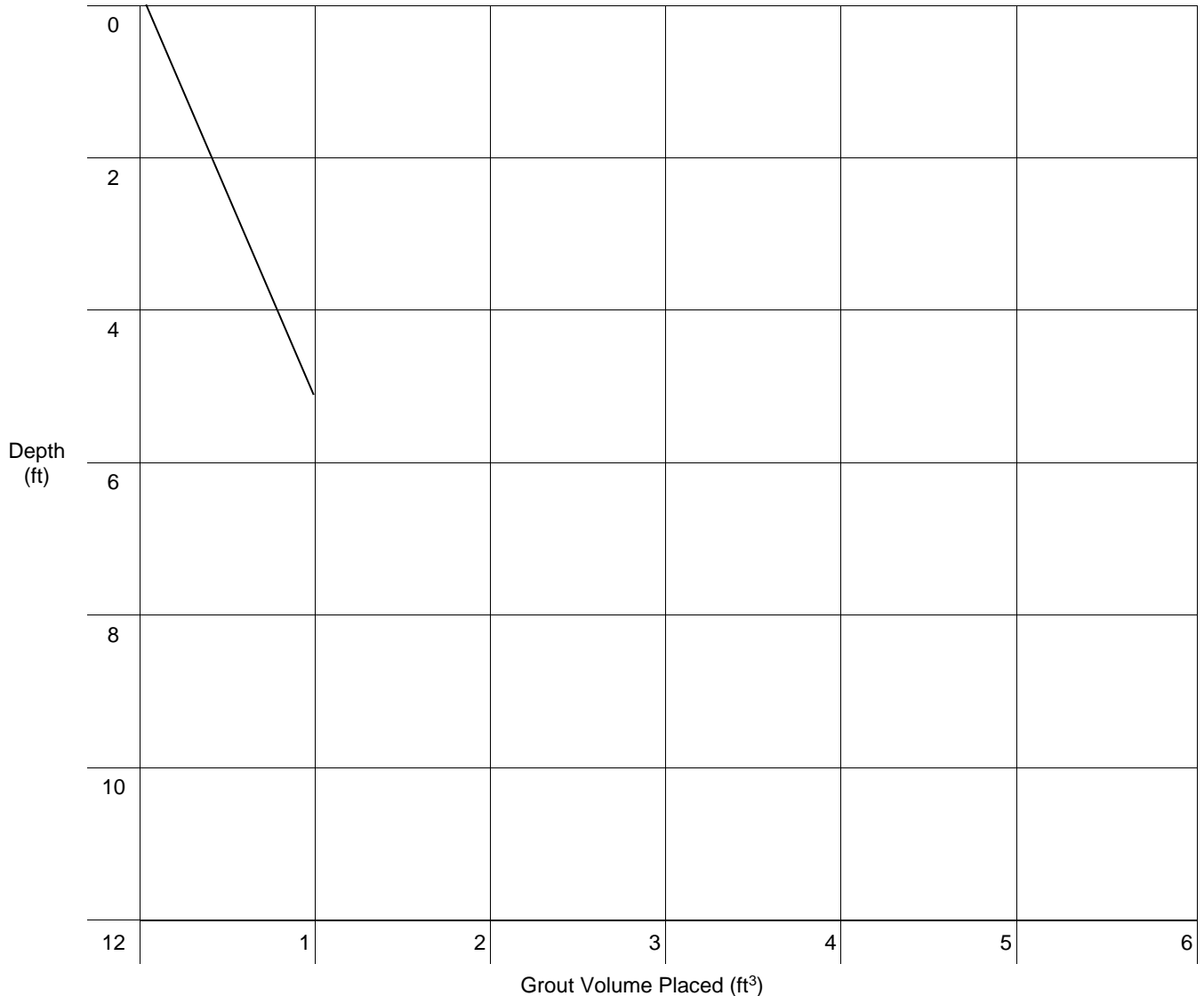
Number of Bags On-Site	20	ea.
Depth of Test Hole Grouted	5	ft.
Diameter of Test Hole	0.5	ft.
Area of Test Hole	0.20	ft²
Volume of Test Hole	1.0	ft³
Volume of Casing (If applicable)	-	ft³
Theoretical Volume of Test Hole	1.0	ft³
Number of Bags Used	2	ea.
Volume Placed	1.0	ft³



## Exhibit A-10: GROUT LOG OF TEST HOLES FOR GEOTECHNICAL ON-CALL

Project Name:	S-37-168 BRO Little Choestoea Creek		Test Hole No.:	S-37-168-2
Project ID:	P042512		Station:	Bulk
Consultant Firm:	Terracon Consultants, Inc.		Offset:	46+75
Grouted By:	Burnette	Date	1/17/2024	5L
Notes:	Mix design: 1 pound cement mix, 1 pound bentonite, 6 pounds water			

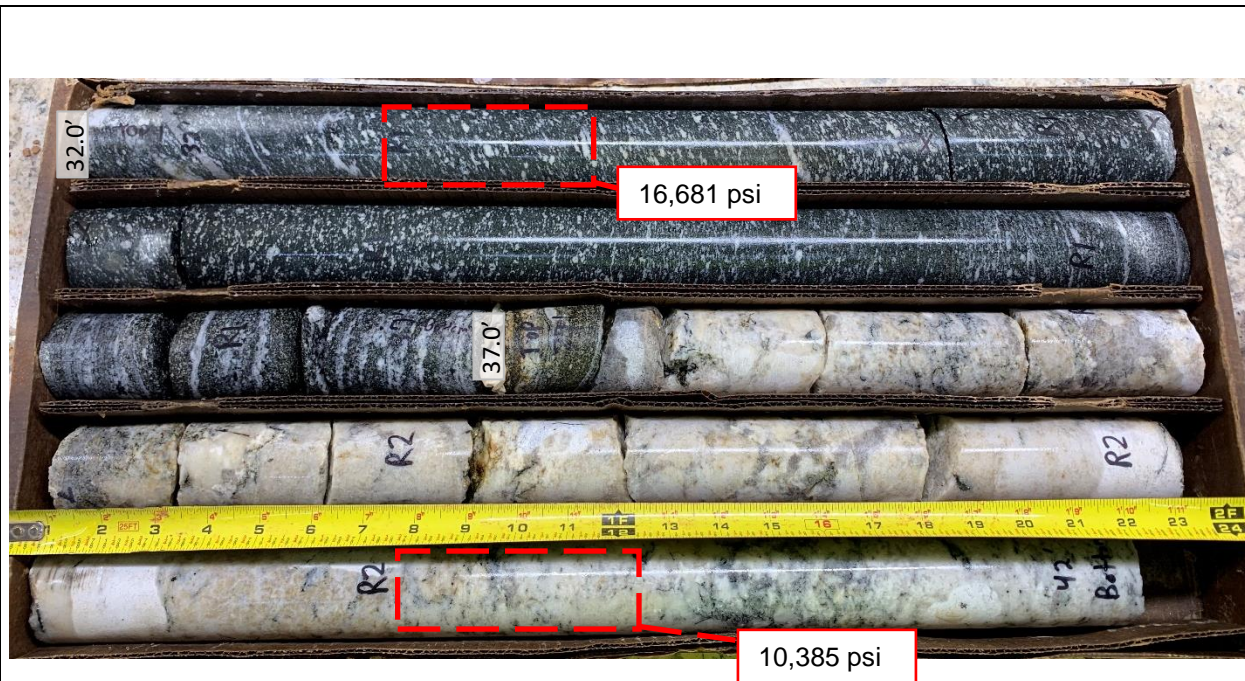
Grout Curve



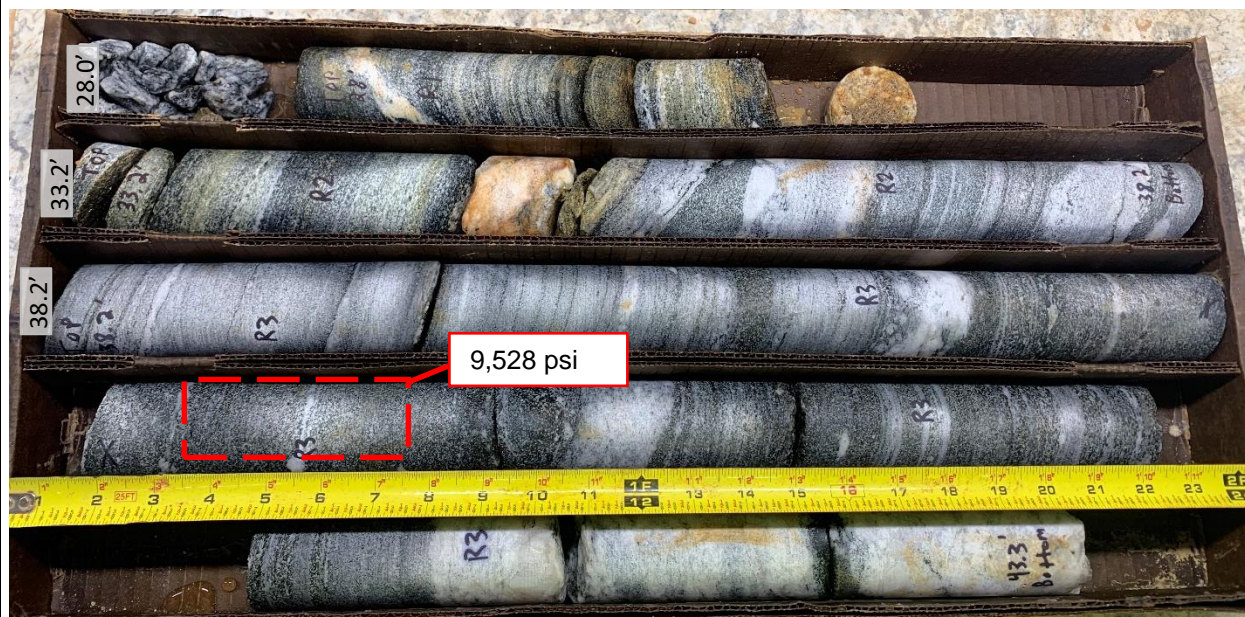
Number of Bags On-Site	20	ea.
Depth of Test Hole Grouted	5	ft.
Diameter of Test Hole	0.5	ft.
Area of Test Hole	0.20	ft²
Volume of Test Hole	1.0	ft³
Volume of Casing (If applicable)	-	ft³
Theoretical Volume of Test Hole	1.0	ft³
Number of Bags Used	2	ea.
Volume Placed	1.0	ft³

**Rock Core Photograph Logs – Exhibit A-11**

S-37-168 BRO Little Choestoea Creek | Oconee County, SC  
Terracon Project No. 8623P180T | SCDOT Project ID: P042512



S-37-168-1, NQ-1 and NQ-2 (32 to 42 feet)

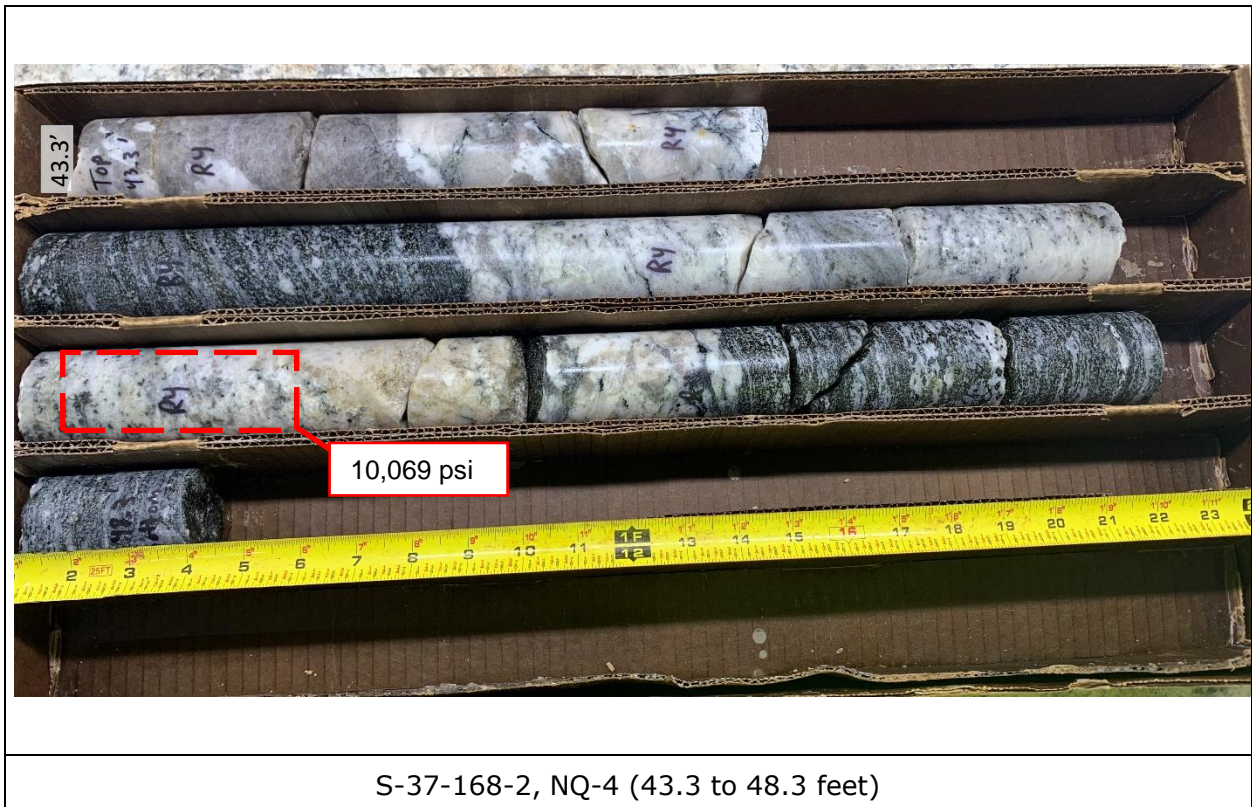


S-37-168-2, NQ-1, NQ-2, and NQ-3 (28 to 43.3 feet)



**Rock Core Photograph Logs – Exhibit A-11**

S-37-168 BRO Little Choestoea Creek | Oconee County, SC  
Terracon Project No. 8623P180T | SCDOT Project ID: P042512



**Appendix B – Laboratory Testing**

S-37-133 BRO Little Choestoea Creek | Oconee County, SC  
Terracon Project No. 8623P180 | SCDOT Project ID: P042512



## **Appendix B**

### **Laboratory Testing**

Exhibit B-1 – Laboratory Testing Description  
Summary of Laboratory Data  
Laboratory Data Sheets (19 Pages)

Note: All exhibits are one page unless noted above.

## Laboratory Testing Description

The samples collected during the field exploration were taken to our laboratory for additional testing. The laboratory testing scope was developed by the SCDOT and laboratory assignment was performed by Terracon. The laboratory tests were conducted on selected soil samples from the borings and the bulk sample locations. The test results are presented in this appendix.

The laboratory test results were used to confirm the soil descriptions presented on the boring logs in Appendix A. Laboratory tests were performed in general accordance with the applicable ASTM, AASHTO, SCDOT or other accepted standards.

Selected soil samples obtained from the site were tested for the following engineering properties:

■ Moisture Content	AASHTO T265/(ASTM D2216)
■ Atterberg Limits	AASHTO T89/T90(ASTM D4318)
■ Proctor (Standard effort)	AASHTO T99/ (ASTM D698)
■ Triaxial Shear CU w/ PP	AASHTO T297/(ASTM D4767)
■ Grain Size Distribution	ASTM D6913
■ Hydrometer	ASTM D7928
■ Compressive Strength of Rock Cores	ASTM D7012
■ Corrosion Series	AASHTO D422
	AASHTO T289/ASTM G51
	AASHTO T290/ASTM C1580
	AASHTO T291

Summary of Laboratory Results

Boring ID	Depth (Ft.)	Soil Classification USCS & AASHTO	Liquid Limit	Plastic Limit	Plasticity Index	% Gravel	% Sand	% Fines	% Silt	% Clay	Water Content (%)	Proctor Dry Density (pcf)/Opt. Moisture (%)
S-37-168-1	4-6	POORLY GRADED SAND(SP) / A-1-b **				2.8	95.8	1.4			22.1	
S-37-168-1	6-8	SILTY SAND(SM) / A-4 (0)	NP	NP	NP	0.7	53.5	45.8			28.0	
S-37-168-1	8-10	SILTY SAND(SM) / A-4 **	NP	NP	NP						30.0	
S-37-168-1	13.5-15	SILTY SAND(SM) / A-4 **				0.0	63.2	36.8	17.8	19.0	17.2	
S-37-168-1	18.5-20	SILTY SAND(SM) / A-2-4 **				0.0	85.0	15.0	5.8	9.2	36.9	
S-37-168-2	2-4	SILTY SAND with GRAVEL(SM)/A-1-b **				26.0	44.9	16.3			4.1	
S-37-168-2	4-6	CLAYEY SAND(SC) / A-6 **	36	20	16						19.8	
S-37-168-2	6-8	SILTY SAND(SM) / A-4 **				2.2	56.1	41.7			23.3	
S-37-168-2	13.5-15	SILT WITH SAND(ML) / A-7-6 (11)	41	27	14	0.0	23.2	76.8	38.2	38.5	44.3	
S-37-168-2	18.5-20	POORLY GRADED SAND WITH SILT(SP-SM) / A-3 **									29.9	
S-37-168-2	23.5-25	SILTY SAND(SM) / A-2-4 (0)	NP	NP	NP	1.3	80.4	18.3	13.3	5.0	14.2	
S-37-168-1/2 Bull.	1-5	CLAYEY SAND(SC) / A-6 (4)	40	24	16	0.7	54.2	45.1			7.5	107.3 / 16.7





# INDEX PROPERTIES VERSUS DEPTH

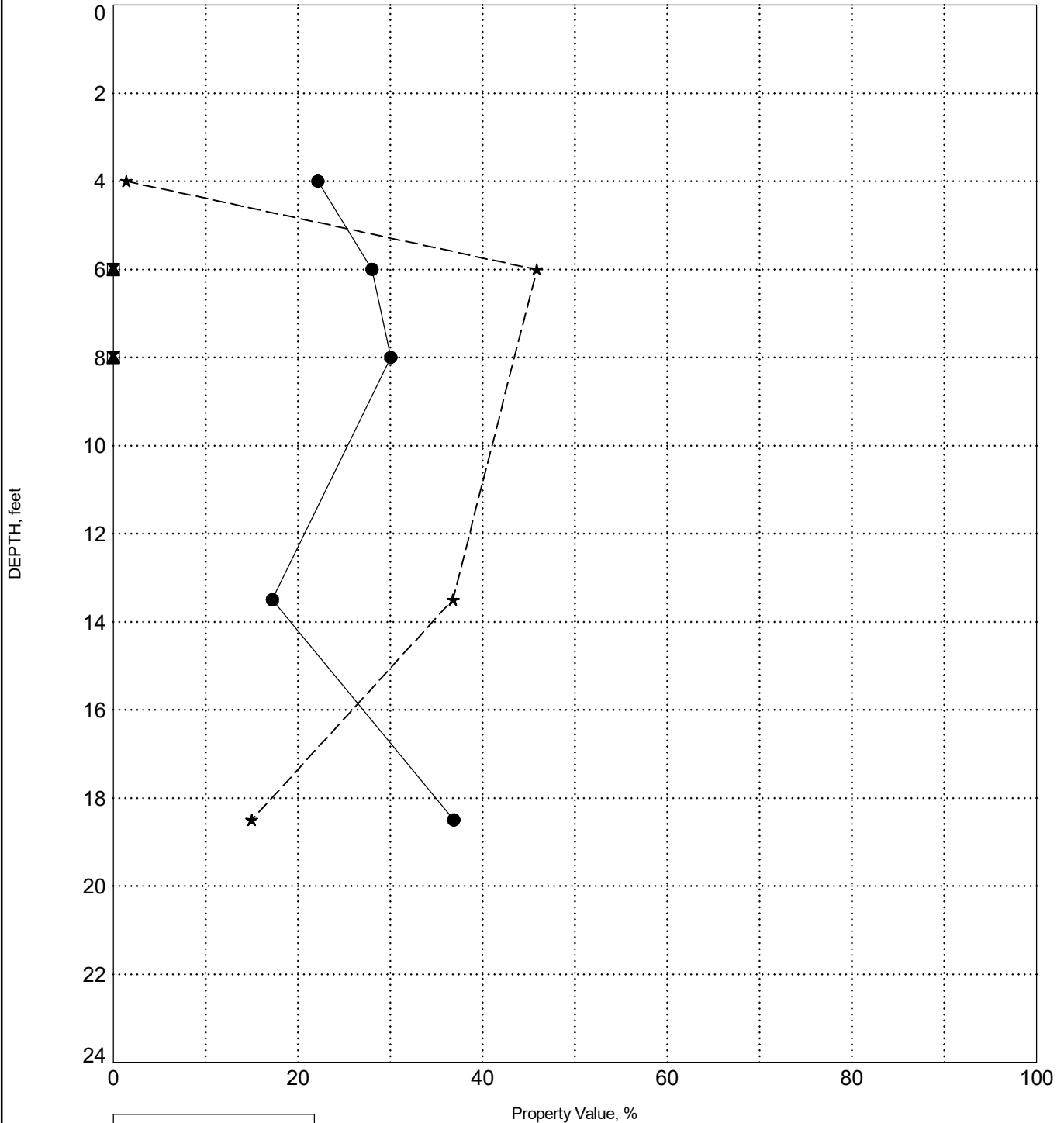
PROJECT ID P042512

PROJECT NAME S-37-168 (Little Choestoea Road) BRO Little Choestoea Creek

PROJECT COUNTY Oconee

SURFACE ELEVATION: 705.3

## BORING S-37-168-1



LEGEND	
●	Water Content
■	Plastic Limit
▲	Liquid Limit
★	Fines



# INDEX PROPERTIES VERSUS DEPTH

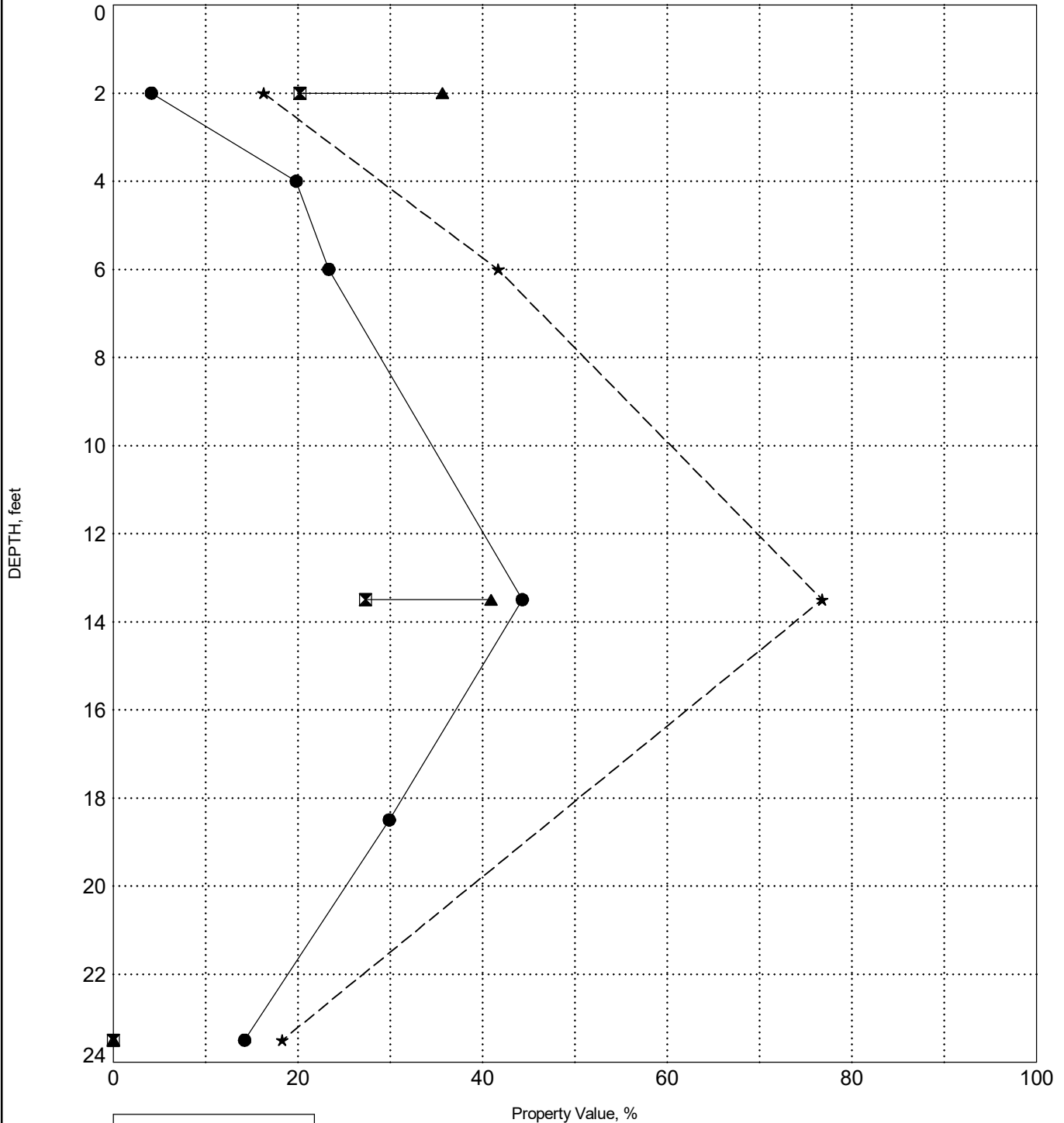
PROJECT ID P042512

PROJECT NAME S-37-168 (Little Choestoea Road) BRO Little Choestoea Creek

PROJECT COUNTY Oconee

SURFACE ELEVATION: 704.8

## BORING S-37-168-2



LEGEND	
●	Water Content
⊠	Plastic Limit
▲	Liquid Limit
★	Fines



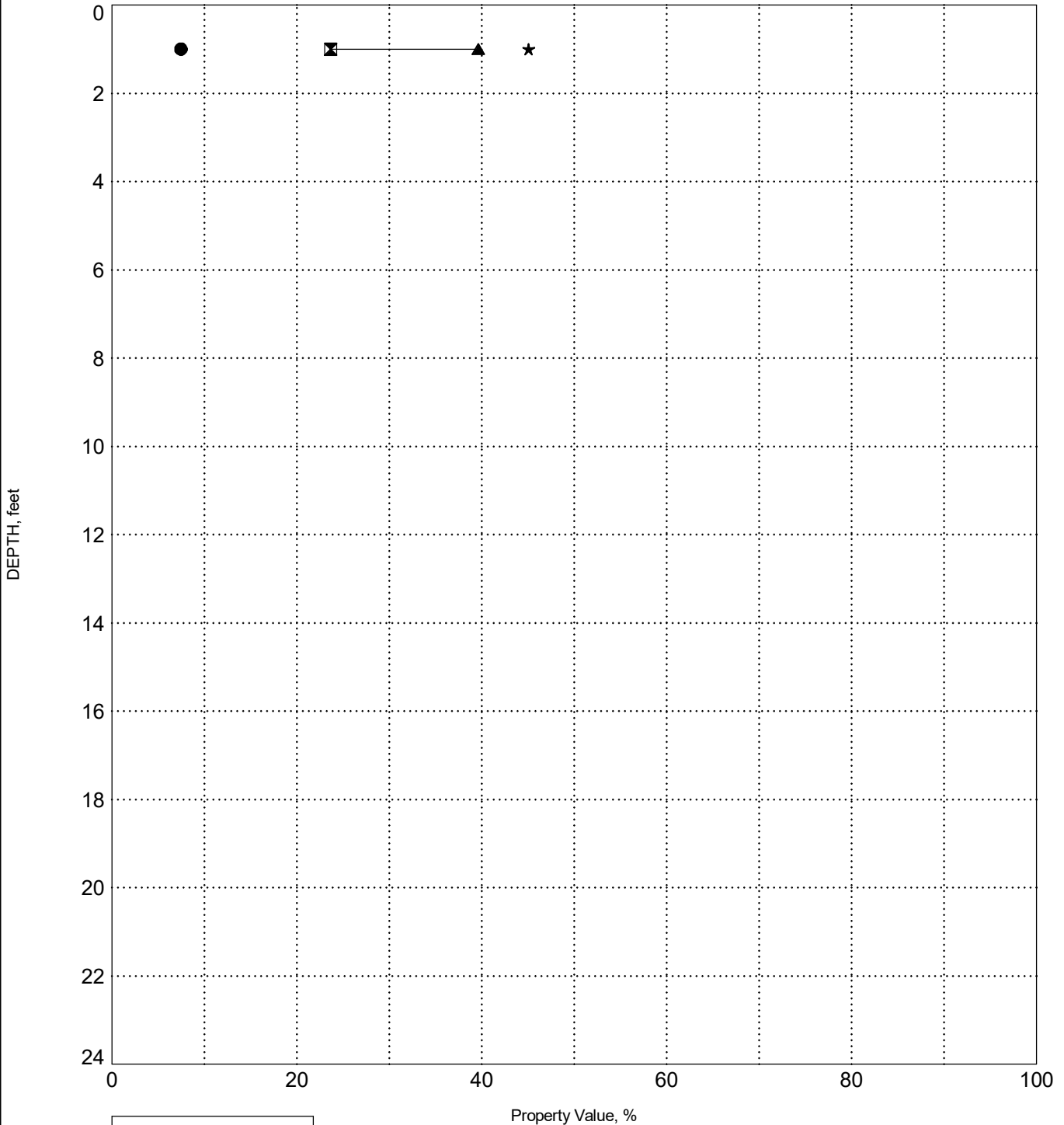
# INDEX PROPERTIES VERSUS DEPTH

PROJECT ID P042512

PROJECT NAME S-37-168 (Little Choestoea Road) BRO Little Choestoea Creek

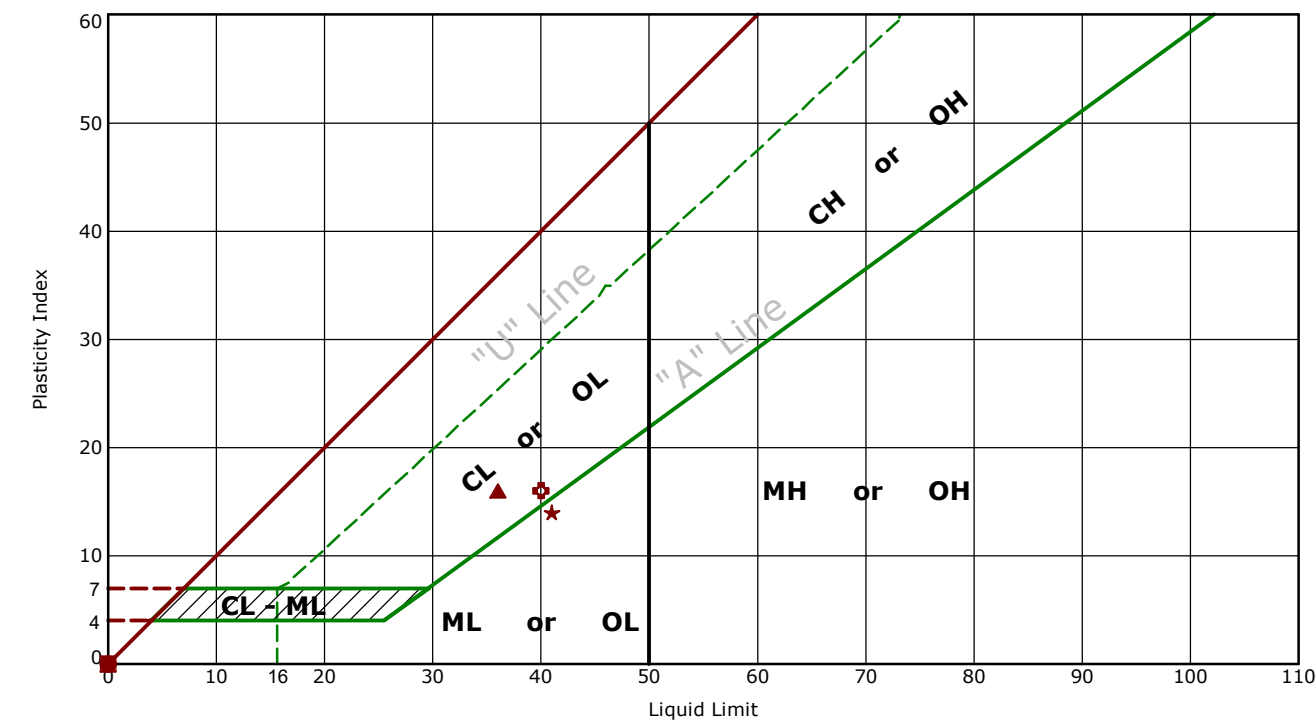
PROJECT COUNTY Oconee

## BORING S-37-168-1/2 Bulk



LEGEND	
●	Water Content
☒	Plastic Limit
▲	Liquid Limit
★	Fines

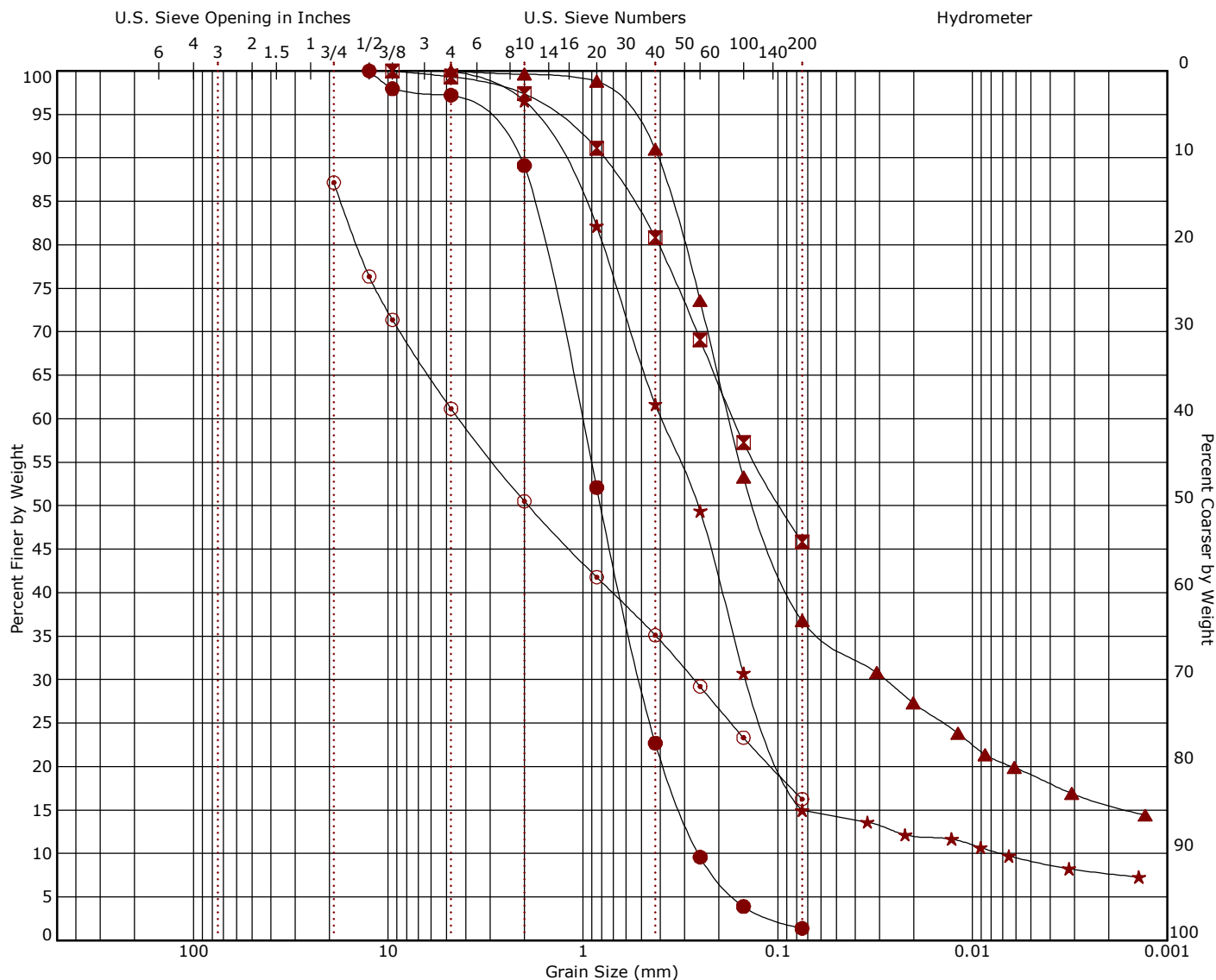
Atterberg Limit Results  
ASTM D4318



	Boring ID	Depth (Ft)	LL	PL	PI	Fines	AASHTO	Description
●	S-37-168-1	6 - 8	NP	NP	NP	45.8	A-4 (0)	SILTY SAND
⊠	S-37-168-1	8 - 10	NP	NP	NP		A-4	SILTY SAND
▲	S-37-168-2	4 - 6	36	20	16		A-6	CLAYEY SAND
★	S-37-168-2	13.5 - 15	41	27	14	76.8	A-7-6 (11)	SILT with SAND
⊙	S-37-168-2	23.5 - 25	NP	NP	NP	18.3	A-2-4 (0)	SILTY SAND
⊕	S-37-168-1/2 Bulk	1 - 5	40	24	16	45.1	A-6 (4)	CLAYEY SAND

## Grain Size Distribution

ASTM D422 / ASTM C136



**Cobbles**

**Gravel**

coarse

fine

**Sand**

coarse

medium

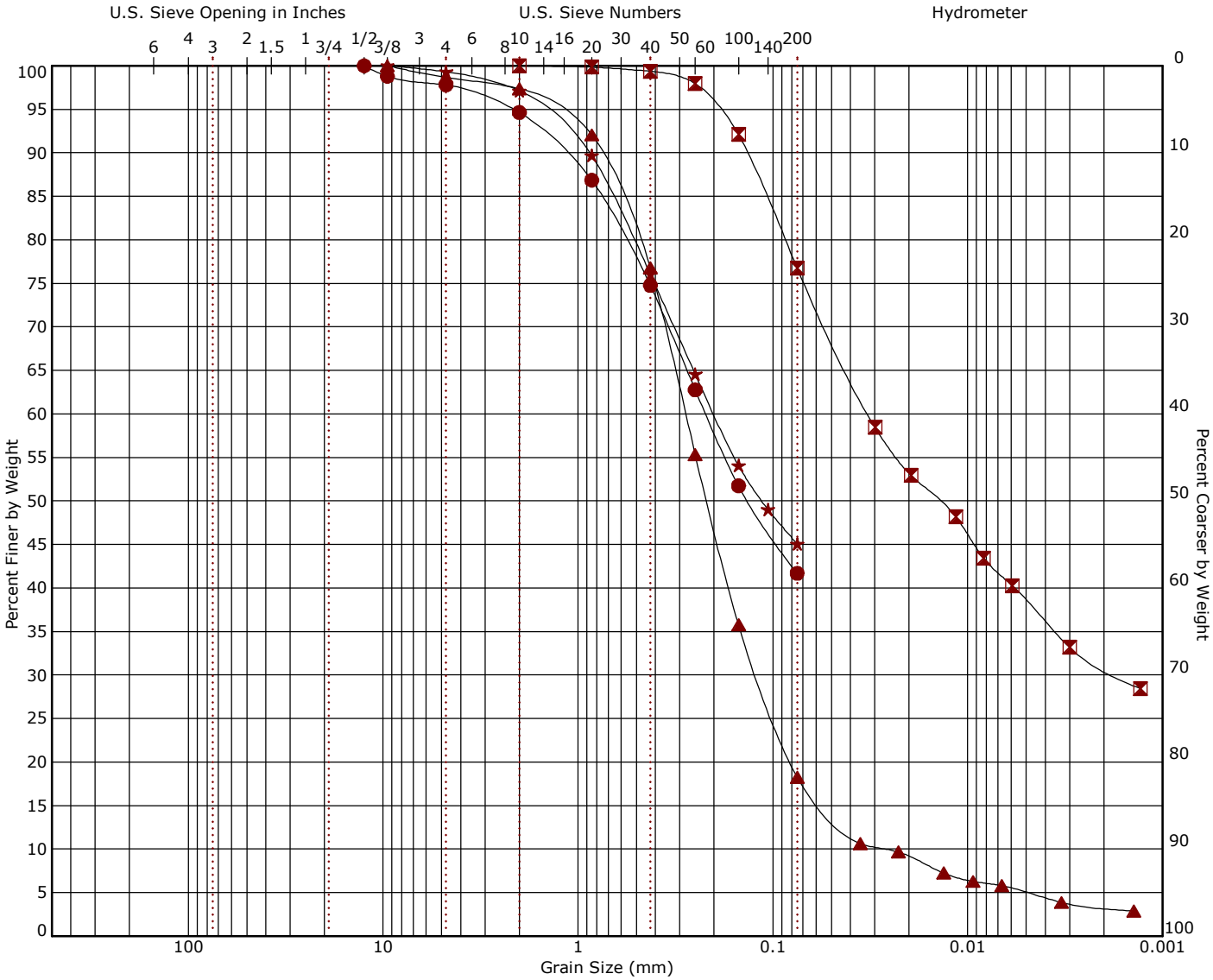
fine

**Silt or Clay**

Boring ID	Depth (Ft)	USCS Classification	USCS	AASHTO	LL	PL	PI	Cc	Cu
● S-37-168-1	4 - 6	POORLY GRADED SAND	SP	A-1-b				0.98	4.01
⊠ S-37-168-1	6 - 8	SILTY SAND	SM	A-4 (0)	NP	NP	NP		
▲ S-37-168-1	13.5 - 15	SILTY SAND	SM	A-4					
★ S-37-168-1	18.5 - 20	SILTY SAND	SM	A-2-4				7.46	55.34
⊙ S-37-168-2	2 - 4	SILTY SAND with GRAVEL	SM	A-1-b					

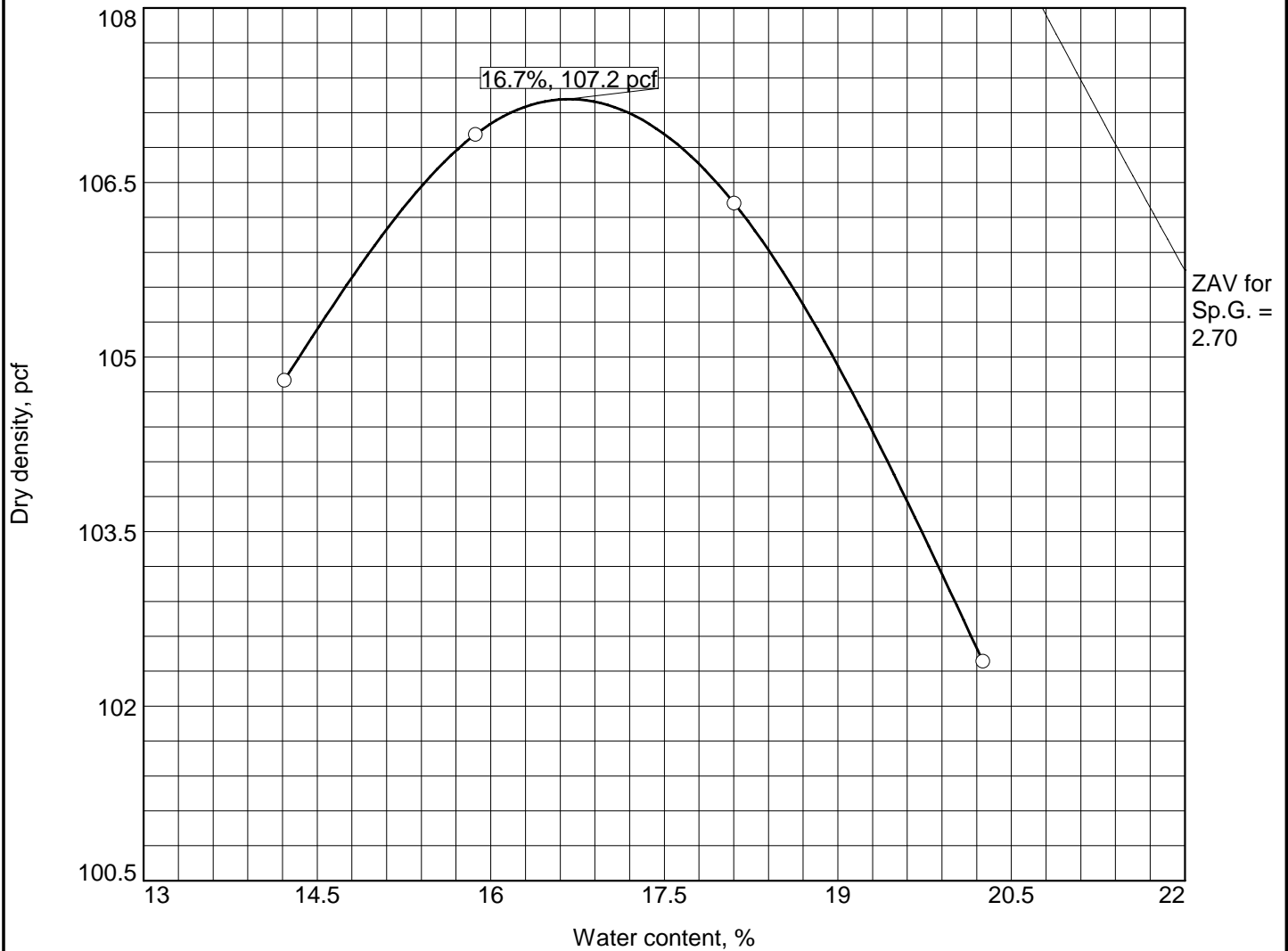
Boring ID	Depth (Ft)	D <sub>100</sub>	D <sub>60</sub>	D <sub>30</sub>	D <sub>10</sub>	%Cobbles	%Gravel	%Sand	%Fines	%Silt	%Clay
● S-37-168-1	4 - 6	12.5	1.02	0.505	0.254	0.0	2.8	95.8	1.4		
⊠ S-37-168-1	6 - 8	9.5	0.169			0.0	0.7	53.5	45.8		
▲ S-37-168-1	13.5 - 15	4.75	0.178	0.028		0.0	0.0	63.2		17.8	19.0
★ S-37-168-1	18.5 - 20	4.75	0.396	0.145	0.007	0.0	0.0	85.0		5.8	9.2
⊙ S-37-168-2	2 - 4	19	4.324	0.268			26.0	44.9	16.3		

**Grain Size Distribution**  
**ASTM D422 / ASTM C136**



	Cobbles	Gravel		Sand			Silt or Clay				
		coarse	fine	coarse	medium	fine					
Boring ID	Depth (Ft)	USCS Classification			USCS	AASHTO	LL	PL	PI	Cc	Cu
●S-37-168-2	6 - 8	SILTY SAND			SM	A-4					
▣S-37-168-2	13.5 - 15	SILT with SAND			ML	A-7-6 (11)	41	27	14		
▲S-37-168-2	23.5 - 25	SILTY SAND			SM	A-2-4 (0)	NP	NP	NP	1.92	10.61
★S-37-168-1/2 Bulk	1 - 5	CLAYEY SAND			SC	A-6 (4)	40	24	16		
Boring ID	Depth (Ft)	D <sub>100</sub>	D <sub>60</sub>	D <sub>30</sub>	D <sub>10</sub>	%Cobbles	%Gravel	%Sand	%Fines	%Silt	%Clay
●S-37-168-2	6 - 8	12.5	0.22			0.0	2.2	56.1	41.7		
▣S-37-168-2	13.5 - 15	2	0.032	0.002		0.0	0.0	23.2		38.2	38.5
▲S-37-168-2	23.5 - 25	9.5	0.281	0.119	0.026	0.0	1.3	80.4		13.3	5.0
★S-37-168-1/2 Bulk	1 - 5	9.5	0.2			0.0	0.7	54.2	45.1		

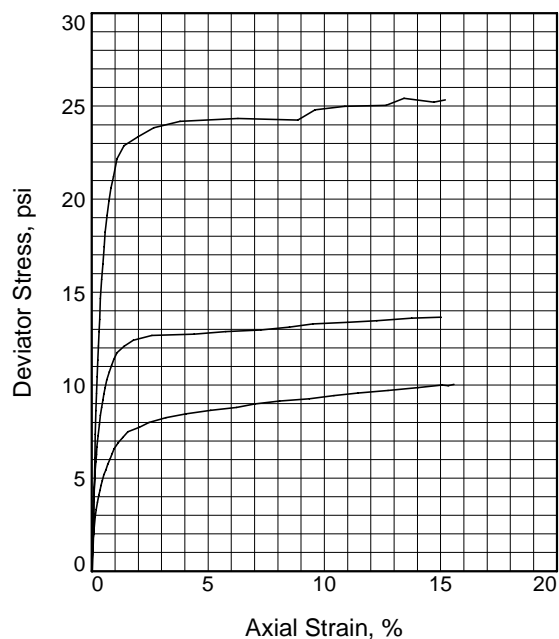
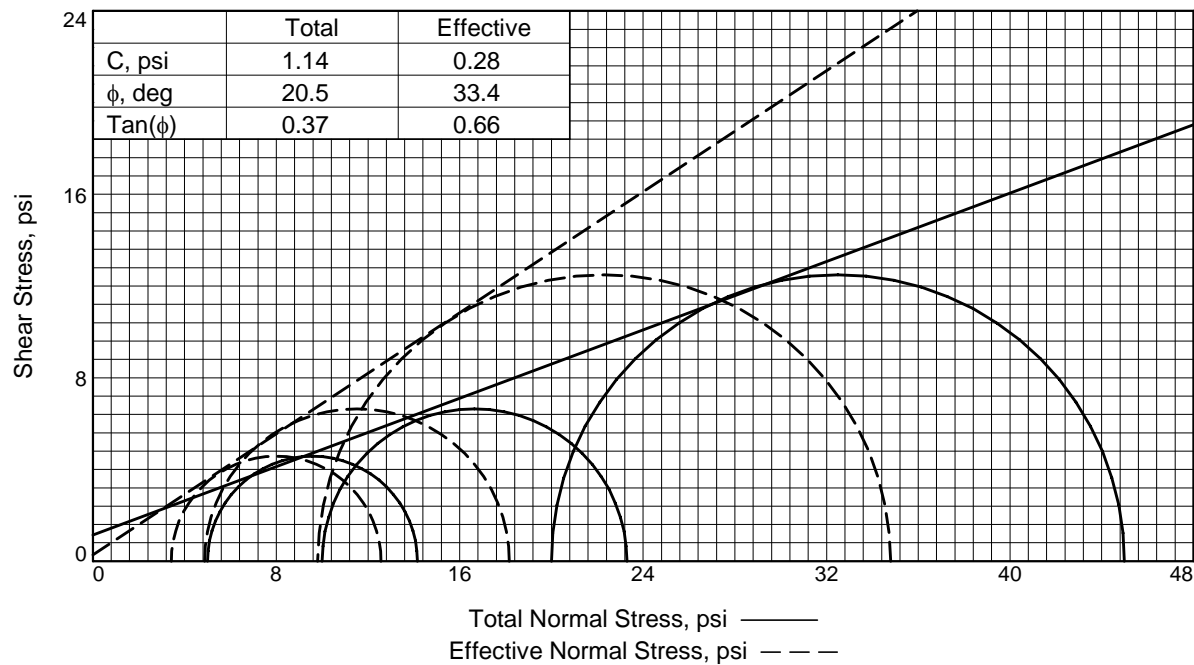
# COMPACTION TEST REPORT



Test specification: ASTM D 698-12 Method B Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/8 in.	% < No.200
	USCS	AASHTO						
1.0-5.0 ft	SC	A-6(4)	7.5	2.7	40	16	0.0	45.1

TEST RESULTS		MATERIAL DESCRIPTION
Maximum dry density = 107.2 pcf		Reddish Brown Clayey Sand (SC)
Optimum moisture = 16.7 %		
<b>Project No.</b> 8623P180 <b>Client:</b> HNTB North Carolina PC <b>Project:</b> SCDOT Bridge Package 19 <div><b>Date:</b> 2/27/25</div> <div><b>Source of Sample:</b> Bulks                    <b>Sample Number:</b> S-37-168-1&amp;2-OS</div>		<b>Remarks:</b>
<div><b>Terracon Consultants, Inc.</b></div> <div><b>North Charleston, South Carolina</b></div>		



Sample No.		1	2	3
Initial	Water Content, %	16.7	16.7	16.7
	Dry Density, pcf	101.8	101.8	101.8
	Saturation, %	68.7	68.7	68.7
	Void Ratio	0.6565	0.6565	0.6565
	Diameter, in.	2.85	2.85	2.85
	Height, in.	6.00	6.00	6.00
At Test	Water Content, %	21.7	23.6	22.3
	Dry Density, pcf	106.0	102.3	104.4
	Saturation, %	99.3	98.4	98.0
	Void Ratio	0.5903	0.6475	0.6147
	Diameter, in.	2.81	2.85	2.83
	Height, in.	5.92	5.99	5.95
Strain rate, in./min.		0.001	0.001	0.001
Back Pressure, psi		50.0	50.0	50.0
Cell Pressure, psi		55.0	60.0	70.0
Fail. Stress, psi		9.2	13.3	25.0
Excess Pore Pr., psi		1.6	5.1	10.2
Ult. Stress, psi				
Excess Pore Pr., psi				
$\bar{\sigma}_1$ Failure, psi		12.6	18.2	34.8
$\bar{\sigma}_3$ Failure, psi		3.4	4.9	9.8

#### Type of Test:

CU with Pore Pressures

**Sample Type:** Remolded

**Description:** Reddish Brown Clayey Sand (SC)

**LL=** 40

**PL=** 24

**PI=** 16

**Assumed Specific Gravity=** 2.7

**Remarks:** Three Specimen Series

**Client:** HNTB North Carolina PC

**Project:** SCDOT Bridge Package 19

**Source of Sample:** Bulks

**Depth:** 1.0-5.0 ft

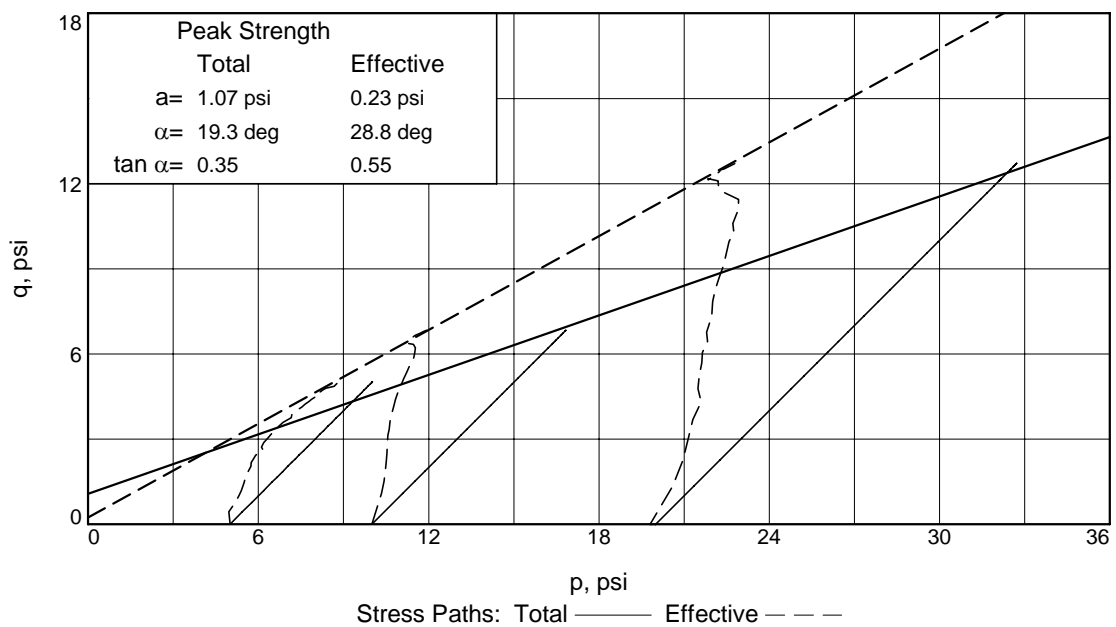
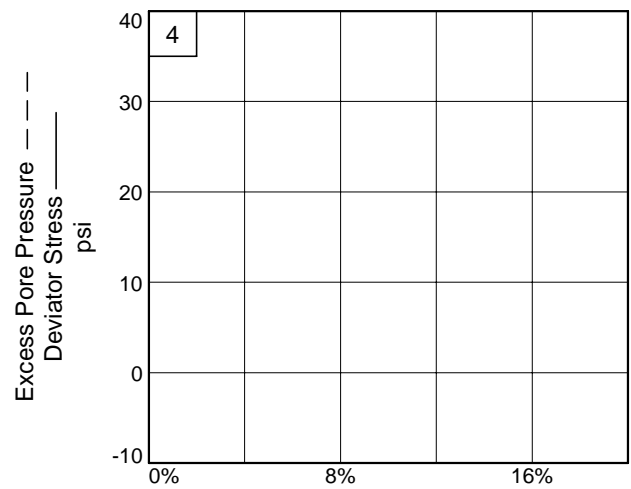
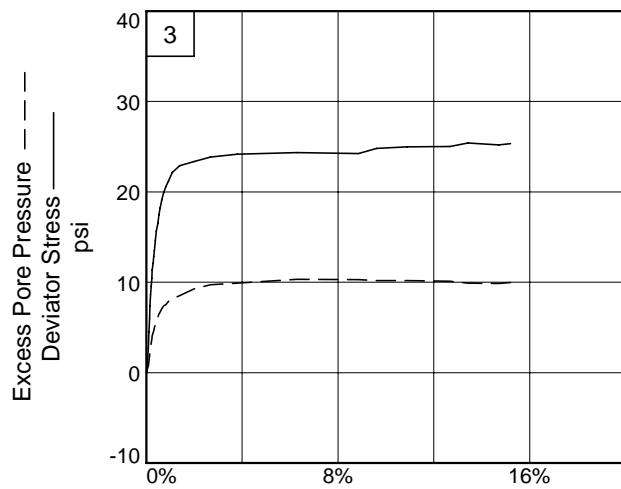
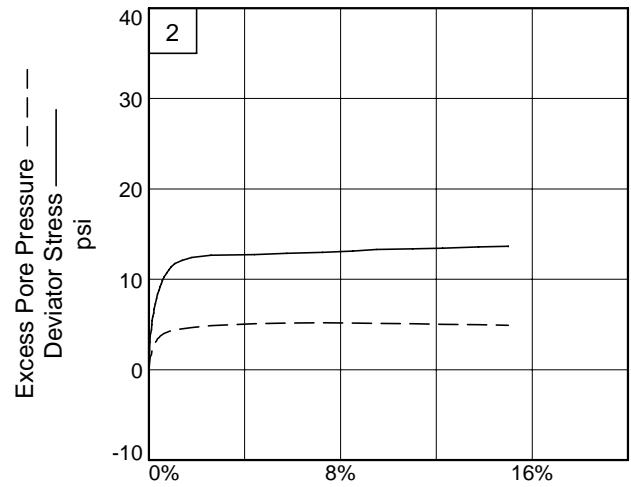
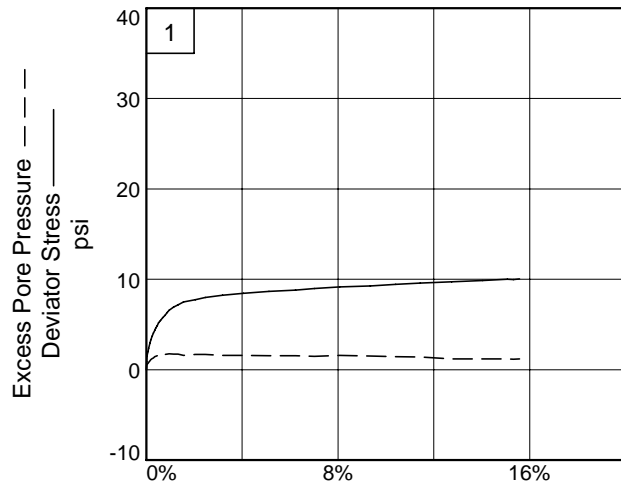
**Sample Number:** S-37-168-1&2-OS

**Proj. No.:** 8623P180

**Date Sampled:** 1/13/25

**TRIAXIAL SHEAR TEST REPORT**  
 Terracon Consultants, Inc.  
 North Charleston, South Carolina





**Client:** HNTB North Carolina PC

**Project:** SCDOT Bridge Package 19

**Source of Sample:** Bulks

**Depth:** 1.0-5.0 ft

**Sample Number:** S-37-168-1&2-OS

**Project No.:** 8623P180

**Terracon Consultants, Inc.**

750 Pilot Road, Suite F  
Las Vegas, Nevada 89119  
(702) 597-9393



## Client

HNTB North Carolina PC

## Project

SCDOT Bridge Package 19 - Little Choestoea Creek

**Sample Submitted By:** Terracon (86)

**Date Received:** 2/7/2025

**Lab No.:** 25-0055

## Results of Corrosion Analysis

<b>Sample Number</b>	--
<b>Sample Location</b>	S-37-168-2
<b>Sample Depth (ft.)</b>	2.0-25.0
pH Analysis, AASHTO T289	5.66
Water Soluble Sulfate (SO <sub>4</sub> ), AASHTO T290 (mg/kg)	72
Sulfides, ASTM D4658, (ppm)	Nil
Red-Ox, ASTM G200, (mV)	+734
Chlorides, AASHTO T291, (mg/kg)	75
Saturated Minimum Resistivity, ASTM G-57, (ohm cm)	3350

**Analyzed By**

A handwritten signature in black ink, appearing to read 'N. Campo'.

Nathan Campo  
Laboratory Coordinator

The tests were performed in general accordance with applicable ASTM and AWWA test methods. This report is exclusively for the use of the client indicated above and shall not be reproduced except in full without the written consent of our company. Test results transmitted herein are only applicable to the actual samples tested at the location(s) referenced and are not necessarily indicative of the properties of other apparently similar or identical materials.



PROJECT ID P042512 PROJECT NAME S-37-168 (Little Choestoea Road) BRO Little Choestoea Creek  
PROJECT COUNTY Oconee

Borehole	Core Run Number	Core Run Top Depth	REC (%)	RQD (%)	q <sub>u</sub> (psi)	Poisson's Ratio	Secant Modulus (ksi)	Unit Weight (pcf)	RMR	GSI
S-37-168-1	NQ-1	32.0	95	80	16681	0.17	868	173	74	75
S-37-168-1	NQ-2	37.0	99	72	10385	0.15	637	169	55	60
S-37-168-2	NQ-1	28.0	22	10					27	25
S-37-168-2	NQ-2	33.2	38	32					32	30
S-37-168-2	NQ-3	38.2	100	100	9528	0.18	530	173	72	75
S-37-168-2	NQ-4	43.3	100	68	10069	0.17	540	163	55	55



Compressive Strength and Elastic Moduli of Intact Rock Core  
Specimens under Varying Stress and Temperatures

ASTM D 7012

Method D

Laboratory Services Group

192 Exchange Boulevard

Glendale Heights, IL 60139

Phone: (630) 717-4263

Fax: (630) 357-9489

Project No.: 8623P180  
Project Name: SCDOT Bridge Package 19

Tested By: EB  
Calculated By: EB  
Checked By: WPQ

Date: 3/12/2025  
Date: 3/12/2025  
Date: 3/14/2025

Sample No. S-37-168-1 Run/Sam No.: NQ-1  
Depth (ft): 32.0'-33.6'  
Description: Greenish Gray / Grayish Brown Gneiss

Rock Sample Moisture Condition at Time of Test: As Received

ASTM D4543 TOLERANCE CHECK

Side Straightness	Maximum Gap $\leq$ 0.020 in.					Tolerance Met	
End Flatness: Max.	Diameter 1a	in	Diameter 1b	in	$\leq$ 0.0010	Tolerance Met	
End Flatness: Max.	Diameter 2a	in	Diameter 2b	in	$\leq$ 0.0010	Tolerance Met	
Perpendicularity Slope	Diameter 1a		Diameter 1b		$\leq$ 0.0043	Tolerance Met	
Perpendicularity Slope	Diameter 2a		Diameter 2b		$\leq$ 0.0043	Tolerance Met	

Length (in): 1) 4.326 2) 4.326 3) 4.327 Avg. 4.326 in

Diameter (in): 1) 1.973 2) 1.973 3) 1.973 Avg. 1.973 in

Uniaxial Compressive Strength: 16,681 psi Mass: 601.5 g

Load: 50,981 lbs. Wet Unit Weight: 173.3 pcf

L/D: 2.2 Dry Unit Weight: 172.8 pcf

Water Content: 0.3 %

Time to Failure: 2.60 min

Load Rate: 327 lbs/sec

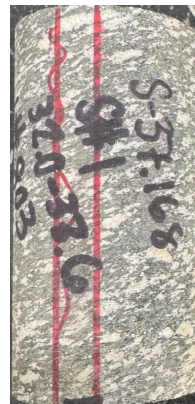
Young's Modulus	
Et (50% Co)	8.68E+05

Poisson's Ratio	
ut (50% Co)	0.166

REMARKS:

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- Prepared in general accordance to ASTM D4543
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Before



After



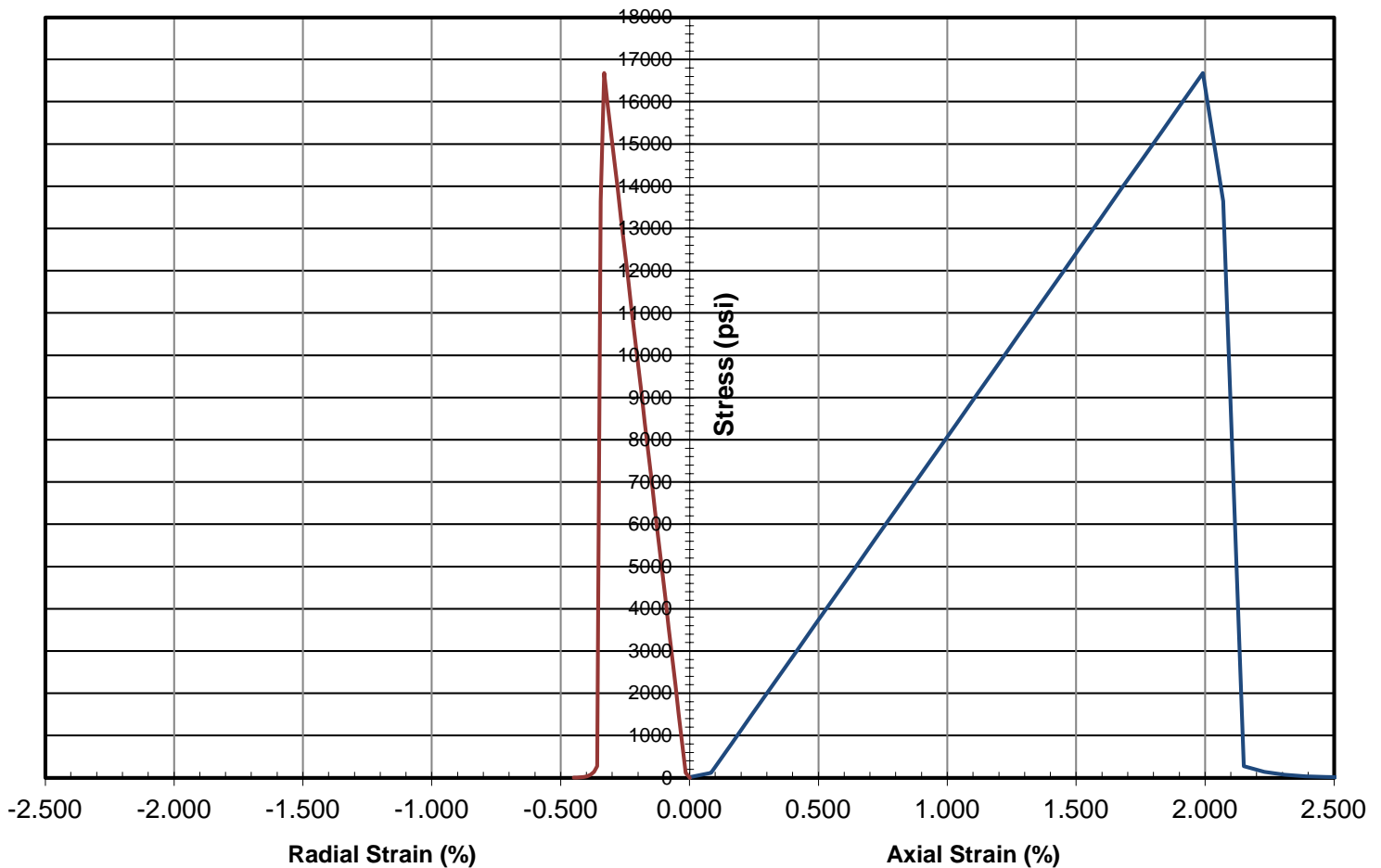


Compressive Strength and Elastic Moduli of Intact Rock Core  
Specimens under Varying Stress and Temperatures  
ASTM D 7012  
Method D

Laboratory Services Group	192 Exchange Boulevard	Glendale Heights, IL 60139	Phone: (630) 717-4263	Fax: (630) 357-9489
Project No.:	8623P180	Tested By:	EB	Date: 03/12/25
Project Name:	SCDOT Bridge Package 19	Calculated By:	EB	Date: 03/12/25
Boring No.:	S-37-168-1	Run No.:	NQ-1	Date: 03/14/25
Depth (ft):	32.0'-33.6'	Checked By:	WPQ	

Stress vs Radial Strain

Stress vs Axial Strain



Young's Modulus

$C_o$  Max = 16,681 psi    50%  $C_o$  Max 8,340 psi  
10%  $C_o$  Max 1,668 psi

$E_t$  (50%)  $C_o$  = 8.68E+05 psi

Poisson's Ratio

$C_o$  Max = 16,681 psi    50%  $C_o$  Max 8,340 psi  
10%  $C_o$  Max 1,668 psi

$\nu_t$  (50%)  $C_o$  = 0.166



Compressive Strength and Elastic Moduli of Intact Rock Core  
Specimens under Varying Stress and Temperatures

ASTM D 7012

Method D

Laboratory Services Group

192 Exchange Boulevard

Glendale Heights, IL 60139

Phone: (630) 717-4263

Fax: (630) 357-9489

Project No.: 8623P180  
Project Name: SCDOT Bridge Package 19

Tested By: EB  
Calculated By: EB  
Checked By: WPQ

Date: 3/12/2025  
Date: 3/12/2025  
Date: 3/14/2025

Sample No. S-37-168-1 Run/Sam No.: NQ-2  
Depth (ft): 38.9'-42.0'  
Description: Very Pale Brown / Light Gray Gneiss

Rock Sample Moisture Condition at Time of Test: As Received

ASTM D4543 TOLERANCE CHECK

Side Straightness	Maximum Gap $\leq 0.020$ in.						Tolerance Met	Yes
End Flatness: Max.	Diameter 1a	0.0008	in	Diameter 1b	0.0006	in	$\leq 0.0010$	Tolerance Met Yes
End Flatness: Max.	Diameter 2a	0.0008	in	Diameter 2b	0.0008	in	$\leq 0.0010$	Tolerance Met Yes
Perpendicularity Slope	Diameter 1a	0.00040		Diameter 1b	0.00040		$\leq 0.0043$	Tolerance Met Yes
Perpendicularity Slope	Diameter 2a	0.00030		Diameter 2b	0.00040		$\leq 0.0043$	Tolerance Met Yes

Length (in): 1) 4.248 2) 4.248 3) 4.248 Avg. 4.248 in

Diameter (in): 1) 1.980 2) 1.980 3) 1.979 Avg. 1.979 in

Uniaxial Compressive Strength: 10,385 psi Mass: 580.9 g

Load: 31,954 lbs. Wet Unit Weight: 169.3 pcf

L/D: 2.1 Dry Unit Weight: 168.9 pcf

Water Content: 0.3 %

Time to Failure: 2.30 min

Load Rate: 232 lbs/sec

Young's Modulus

Et (50% Co) 6.37E+05

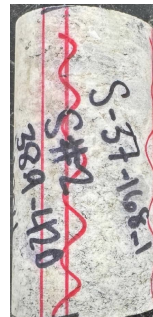
Poisson's Ratio

ut (50% Co) 0.148

REMARKS:

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Before



After



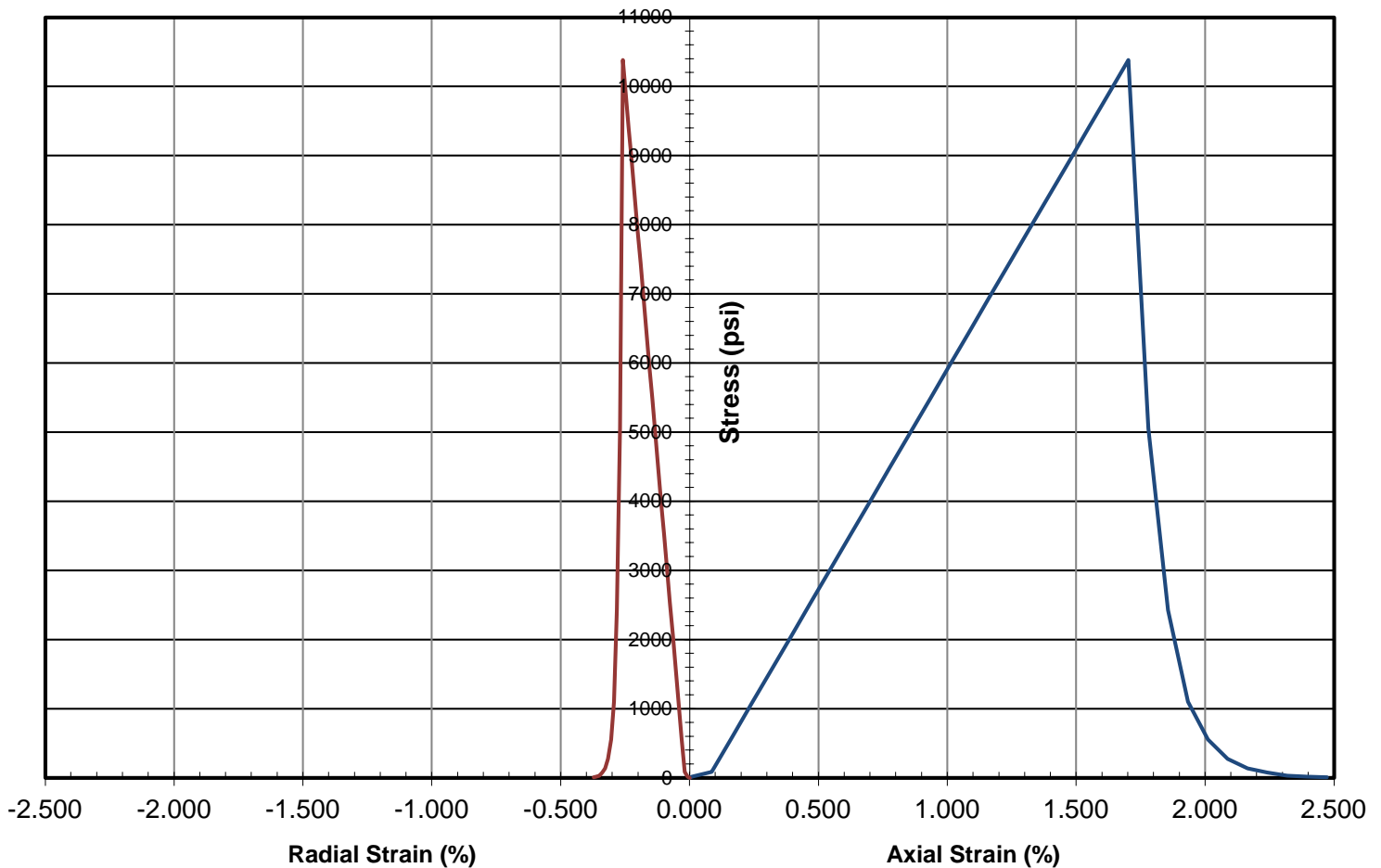


Compressive Strength and Elastic Moduli of Intact Rock Core  
Specimens under Varying Stress and Temperatures  
ASTM D 7012  
Method D

Laboratory Services Group	192 Exchange Boulevard	Glendale Heights, IL 60139	Phone: (630) 717-4263	Fax: (630) 357-9489
Project No.:	8623P180	Tested By:	EB	Date: 03/12/25
Project Name:	SCDOT Bridge Package 19	Calculated By:	EB	Date: 03/12/25
Boring No.:	S-37-168-1	Run No.:	NQ-2	Date: 03/14/25
Depth (ft):	38.9'-42.0'	Checked By:	WPQ	

Stress vs Radial Strain

Stress vs Axial Strain



Young's Modulus

$C_0$  Max = 10,385 psi    50%  $C_0$  Max 5,192 psi  
10%  $C_0$  Max 1,038 psi

$E_t$  (50%)  $C_0$  = 6.37E+05 psi

Poisson's Ratio

$C_0$  Max = 10,385 psi    50%  $C_0$  Max 5,192 psi  
10%  $C_0$  Max 1,038 psi

$\nu_t$  (50%)  $C_0$  = 0.148





Compressive Strength and Elastic Moduli of Intact Rock Core  
Specimens under Varying Stress and Temperatures

ASTM D 7012

Method D

Laboratory Services Group

192 Exchange Boulevard

Glendale Heights, IL 60139

Phone: (630) 717-4263

Fax: (630) 357-9489

Project No.: 8623P180  
Project Name: SCDOT Bridge Package 19

Tested By: EB Date: 3/12/2025  
Calculated By: EB Date: 3/12/2025  
Checked By: WPQ Date: 3/14/2025

Sample No. S-37-168-2 Run/Sam No.: NQ-3  
Depth (ft): 40.2'-40.9'  
Description: Greenish Gray / Light Greenish Gray Gneiss

Rock Sample Moisture Condition at Time of Test: As Received

ASTM D4543 TOLERANCE CHECK

Side Straightness		Maxumum Gap ≤ 0.020 in.						Tolerance Met	Yes
End Flatness: Max.	Diameter 1a	0.0008	in	Diameter 1b	0.0008	in	≤ 0.0010	Tolerance Met	Yes
End Flatness: Max.	Diameter 2a	0.0007	in	Diameter 2b	0.0006	in	≤ 0.0010	Tolerance Met	Yes
Perpendicularity Slope	Diameter 1a	0.00040		Diameter 1b	0.00035		≤ 0.0043	Tolerance Met	Yes
Perpendicularity Slope	Diameter 2a	0.00040		Diameter 2b	0.00030		≤ 0.0043	Tolerance Met	Yes

Length (in): 1) 4.200 2) 4.200 3) 4.200 Avg. 4.200 in

Diameter (in): 1) 1.980 2) 1.979 3) 1.980 Avg. 1.979 in

Uniaxial Compressive Strength: 9,528 psi Mass: 585.8 g

Load: 29,317 lbs. Wet Unit Weight: 172.7 pcf

L/D: 2.1 Dry Unit Weight: 172.4 pcf

Water Content: 0.2 %

Time to Failure: 2.60 min

Load Rate: 188 lbs/sec

Young's Modulus

Et (50% Co) 5.30E+05

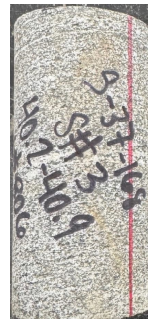
Poisson's Ratio

ut (50% Co) 0.177

REMARKS:

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Before



After



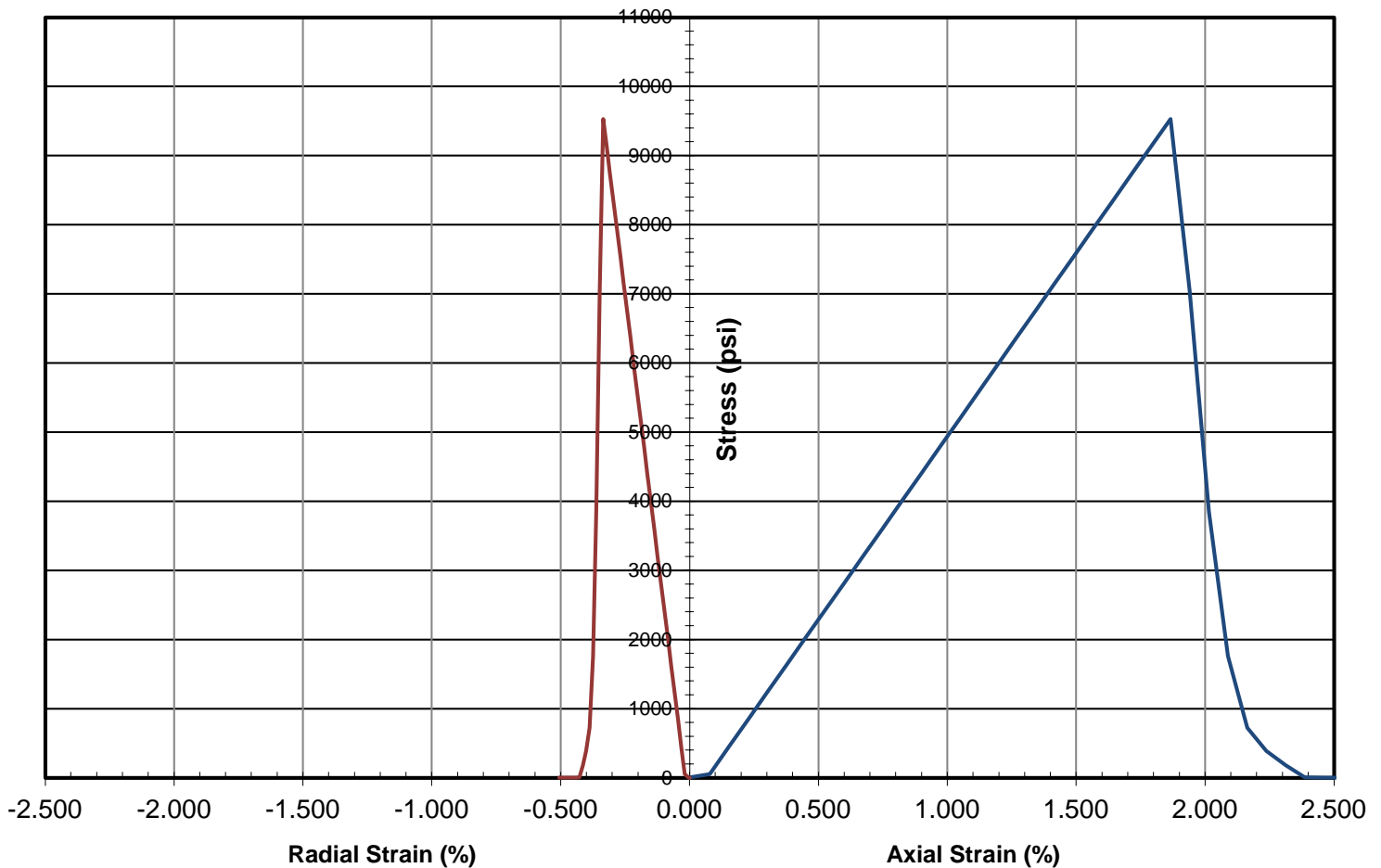


Compressive Strength and Elastic Moduli of Intact Rock Core  
Specimens under Varying Stress and Temperatures  
ASTM D 7012  
Method D

Laboratory Services Group	192 Exchange Boulevard	Glendale Heights, IL 60139	Phone: (630) 717-4263	Fax: (630) 357-9489
Project No.:	8623P180	Tested By:	EB	Date: 03/12/25
Project Name:	SCDOT Bridge Package 19	Calculated By:	EB	Date: 03/12/25
Boring No.:	S-37-168-2	Run No.:	NQ-3	Date: 03/14/25
Depth (ft):	40.2'-40.9'	Checked By:	WPQ	

Stress vs Radial Strain

Stress vs Axial Strain



Young's Modulus

$C_0$  Max = 9,528 psi    50%  $C_0$  Max 4,764 psi  
10%  $C_0$  Max 953 psi

$E_t$  (50%)  $C_0$  = 5.30E+05 psi

Poisson's Ratio

$C_0$  Max = 9,528 psi    50%  $C_0$  Max 4,764 psi  
10%  $C_0$  Max 953 psi

$\nu_t$  (50%)  $C_0$  = 0.177



Compressive Strength and Elastic Moduli of Intact Rock Core  
Specimens under Varying Stress and Temperatures

ASTM D 7012

Method D

Laboratory Services Group

192 Exchange Boulevard

Glendale Heights, IL 60139

Phone: (630) 717-4263

Fax: (630) 357-9489

Project No.: 8623P180  
Project Name: SCDOT Bridge Package 19

Tested By: EB  
Calculated By: EB  
Checked By: WPQ

Date: 3/12/2025  
Date: 3/12/2025  
Date: 3/14/2025

Sample No. S-37-168-2 Run/Sam No.: NQ-4  
Depth (ft): 46.0'-46.9'  
Description: Very Pale Brown / Light Gray Gneiss

Rock Sample Moisture Condition at Time of Test: As Received

ASTM D4543 TOLERANCE CHECK

Side Straightness	Maximum Gap $\leq 0.020$ in.					Tolerance Met
End Flatness: Max.	Diameter 1a	in	Diameter 1b	in	$\leq 0.0010$	Tolerance Met
End Flatness: Max.	Diameter 2a	in	Diameter 2b	in	$\leq 0.0010$	Tolerance Met
Perpendicularity Slope	Diameter 1a		Diameter 1b		$\leq 0.0043$	Tolerance Met
Perpendicularity Slope	Diameter 2a		Diameter 2b		$\leq 0.0043$	Tolerance Met

Length (in): 1) 4.265 2) 4.265 3) 4.265 Avg. 4.265 in

Diameter (in): 1) 1.980 2) 1.980 3) 1.980 Avg. 1.980 in

Uniaxial Compressive Strength: 10,069 psi Mass: 560.7 g

Load: 30,997 lbs. Wet Unit Weight: 162.7 pcf

L/D: 2.2 Dry Unit Weight: 162.0 pcf

Water Content: 0.4 %

Time to Failure: 2.70 min

Load Rate: 191 lbs/sec

Young's Modulus

Et (50% Co) 5.40E+05

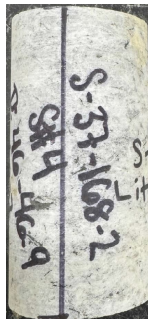
Poisson's Ratio

ut (50% Co) 0.168

REMARKS:

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Before



After



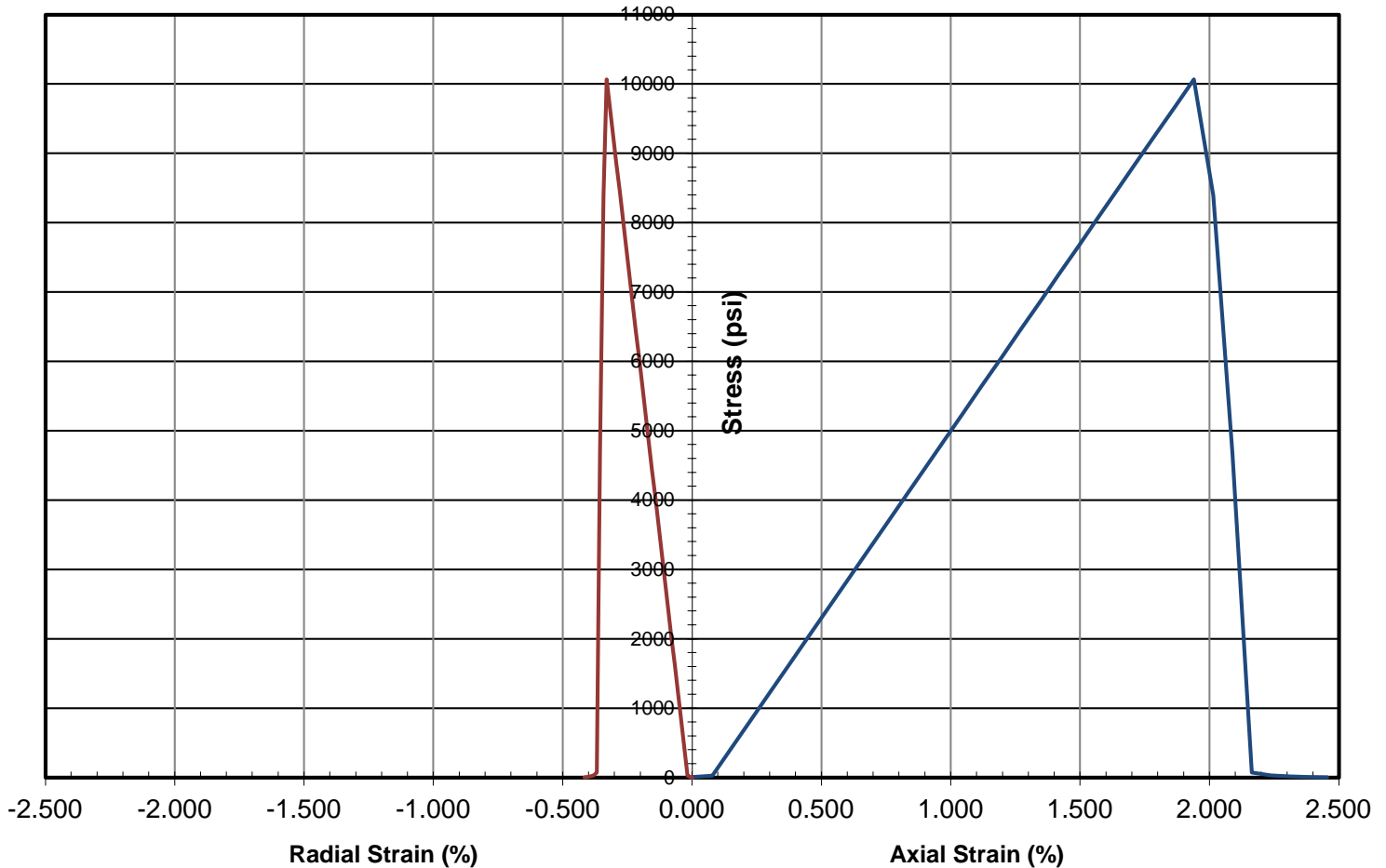


Compressive Strength and Elastic Moduli of Intact Rock Core  
Specimens under Varying Stress and Temperatures  
ASTM D 7012  
Method D

Laboratory Services Group	192 Exchange Boulevard	Glendale Heights, IL 60139	Phone: (630) 717-4263	Fax: (630) 357-9489
Project No.:	8623P180	Tested By:	EB	Date: 03/12/25
Project Name:	SCDOT Bridge Package 19	Calculated By:	EB	Date: 03/12/25
Boring No.:	S-37-168-2	Run No.:	NQ-4	Date: 03/14/25
Depth (ft):	46.0'-46.9'	Checked By:	WPQ	

Stress vs Radial Strain

Stress vs Axial Strain



Young's Modulus

$C_o$  Max = 10,069 psi    50%  $C_o$  Max 5,034 psi  
10%  $C_o$  Max 1,007 psi

$E_t$  (50%)  $C_o$  = 5.40E+05 psi

Poisson's Ratio

$C_o$  Max = 10,069 psi    50%  $C_o$  Max 5,034 psi  
10%  $C_o$  Max 1,007 psi

$\nu_t$  (50%)  $C_o$  = 0.168

**Appendix C – Supporting Documents**

S-37-168 BRO Little Choestoea Creek | Oconee County, SC  
Terracon Project No. 8623P180 | SCDOT Project ID: P042512



## **Appendix C**

### **Supporting Documents**

Rig Calibration Report – DR#554 (5 Pages)

Note: All exhibits are one page unless noted above.

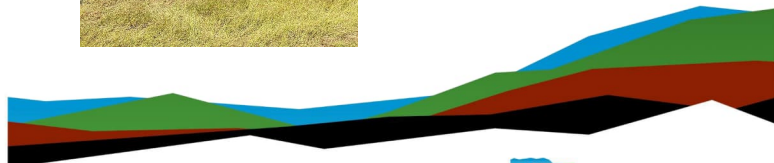
# SPT Automatic Hammer Energy Measurement Report

Drill Rig Model: GeoProbe 3126

Drill Rig Serial Number: 3126TTS52010006

Asset Number: DR#554

August 21, 2023



## Prepared for:

Terracon  
Greenville-Spartanburg, South Carolina



July 19, 2023

Terracon  
72 Pointe Circle  
Greenville, South Carolina 29607

Attn: Maggie McKenney  
E: m.mckenney@terracon.com

**Re:** SPT Automatic Hammer Energy Measurement Report  
Rig Serial Number: 3126TTS52010006  
Terracon Project Number: DYXX0500

Dear Ms. McKenney:

This report provides the Energy Transfer Ratio (ETR) for the Standard Penetration Testing (SPT) automatic hammer as summarized below:

**Table 1: Hammer Efficiency Summary**

Drill Rig Make/Model	Drill Rig Serial Number	Drill Rig Year	Asset Number	Energy Transfer Ratio (ETR)	Hammer Efficiency Correction (Ce)
GeoProbe 3126	3126TTS52010006	2021	GP#554	88.5% ± 4.2%	1.48

If you have any questions concerning this summary, or if we may be of further service, please contact us.

*Jim Smith*

James P. Smith  
National Manager of Equipment & Training

*Rob Kramer*

Rob Kramer  
Group Manager Geophysics

## Attachments:

Exhibit A: PDA SPT Analyzer Results  
Exhibit B: PDA Equipment Calibration

Facilities | Environmental | **Geotechnical** | Materials |



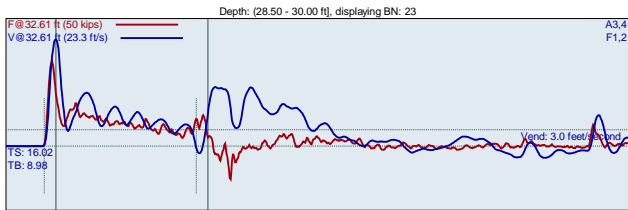
## MEASUREMENT SUMMARY

ITEM	DESCRIPTION
Drill Rig Owner	Terracon Greenville-Spartanburg - Greenville, SC
Drill Rig Operator	Brett Burnett; Terracon Exploration Services
Testing Date	08/21/2023
Testing Location	Spartanburg, SC
Boring Identification	B-1
Hammer Type	140 pounds (automatic)
Boring Method	Hollow Stem Auger
Drill Rods	<ul style="list-style-type: none"> <li>AWJ</li> <li>1-3/4" outside diameter</li> <li>3/16" wall thickness</li> </ul>
Calibration Testing Equipment	<ul style="list-style-type: none"> <li>2-foot AWJ rod instrumented w/ two strain gauges and two accelerometers</li> <li>Model SPT Analyzer™ (PDA)</li> </ul>
ASTM Methods Used	<p><b>ASTM D1586</b>, Standard Test Method for Standard Penetration Test and Split-Barrel Sampling of Soils</p> <p><b>ASTM D4633-16</b>, Standard Method for Energy Measurement for Dynamic Penetrometers</p>
SPT Calibration Personnel	Jim Smith, National Manager of Equipment and Training

## Exhibit A

### PDA SPT Analyzer Results

GP554-3126  
JIM SMITH  
TB-1  
AR: 1.20 in/2  
LE: 32.61 ft  
WS: 16807.9 fts  
28.5-30  
Interval start: 8/21/2023  
SP: 0.492 k/ft3  
EM: 30000 ksi



F1 : [648AWJ1] 226.21 PDICAL (1) FF1  
F2 : [648AWJ2] 225.58 PDICAL (1) FF1  
A3 (PR): [K4483] 410.187 mv/6.4v/5000g (1) VF1  
A4 (PR): [K10491] 421.907 mv/6.4v/5000g (1) VF1

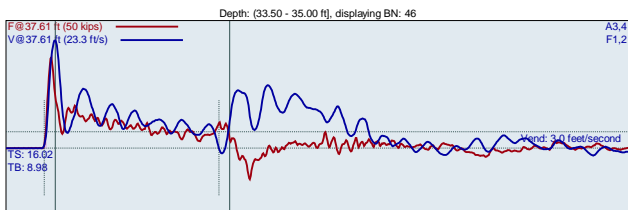
FMX: Maximum Force  
VMX: Maximum Velocity  
BPM: Blows/Minute  
EFV: Maximum Energy  
ETR: Energy Transfer Ratio - Rated

BL#	BC /6"	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ETR %
1	6	40	19.4	1.9	234	84.1
2	6	39	19.2	51.9	292	83.4
3	6	25	16.9	52.7	274	78.2
4	6	28	17.9	52.4	273	77.9
5	6	32	19.6	52.6	294	83.9
6	6	27	17.3	53.1	268	79.5
7	8	38	19.0	52.7	289	82.5
8	8	39	19.6	52.4	305	87.2
9	8	36	19.2	52.7	290	82.8
10	8	28	18.2	52.5	292	83.4
11	8	38	19.0	53.0	293	83.8
12	8	35	19.4	52.6	282	80.4
13	8	36	19.1	52.9	299	85.3
14	8	34	19.8	52.8	307	87.7
15	11	34	19.5	52.7	307	87.6
16	11	33	19.5	52.9	299	85.6
17	11	36	19.4	52.7	308	88.1
18	11	37	18.5	52.8	320	91.4
19	11	32	19.6	52.9	301	86.1
20	11	39	18.7	52.9	301	85.9
21	11	26	17.5	52.8	277	79.1
22	11	30	19.1	52.6	306	87.4
23	11	33	19.5	52.7	298	85.1
24	11	35	19.9	52.4	303	86.5
25	11	36	19.4	53.1	313	89.6

Average	34	19.2	52.8	299	85.6
Std Dev	3	0.6	0.2	10	3.0
Maximum	39	19.9	53.1	320	91.4
Minimum	26	17.5	52.4	277	79.1
N-value: 19					

Sample Interval Time: 27.36 seconds.

GP554-3126  
JIM SMITH  
TB-1  
AR: 1.20 in/2  
LE: 37.61 ft  
WS: 16807.9 fts  
28.5-30  
Interval start: 8/21/2023  
SP: 0.492 k/ft3  
EM: 30000 ksi



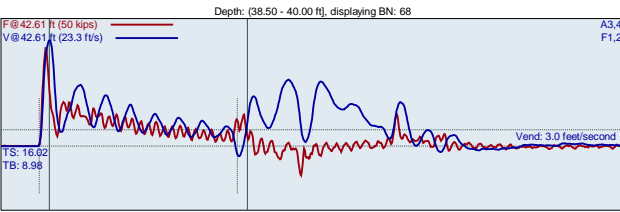
F1 : [648AWJ1] 226.21 PDICAL (1) FF1  
F2 : [648AWJ2] 225.58 PDICAL (1) FF1  
A3 (PR): [K4483] 410.187 mv/6.4v/5000g (1) VF1  
A4 (PR): [K10491] 421.907 mv/6.4v/5000g (1) VF1

BL#	BC /6"	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ETR %
26	5	38	19.1	1.9	302	86.4
27	5	35	18.9	52.0	301	86.1
28	5	29	18.8	52.0	299	85.5
29	5	35	19.2	52.7	299	85.5
30	5	37	19.4	52.5	297	84.8
31	8	37	19.5	52.4	307	87.7
32	8	26	16.4	52.7	282	80.5
33	8	34	19.5	52.4	307	87.6
34	8	40	19.1	52.2	307	87.6
35	8	37	19.4	52.6	299	85.5
36	8	40	20.6	52.4	321	91.7
37	8	41	19.6	52.8	308	87.9
38	8	40	19.8	52.7	313	89.5
39	10	34	20.2	52.2	323	92.2
40	10	32	19.4	52.8	297	84.9
41	10	36	19.8	52.6	311	88.8
42	10	37	19.7	52.5	317	90.7
43	10	35	20.0	52.6	324	92.6
44	10	38	19.5	52.7	308	88.1
45	10	34	20.1	52.4	322	92.0
46	10	35	19.7	52.4	322	92.0
47	10	37	19.9	52.6	314	89.7
48	10	37	19.8	52.7	332	94.8
Average		36	19.6	52.6	312	89.1
Std Dev		3	0.8	0.2	12	3.3
Maximum		41	20.6	52.8	332	94.8
Minimum		26	16.4	52.2	282	80.5
N-value: 18						

Sample Interval Time: 25.16 seconds.



GP554-3126  
JIM SMITH  
TB-1  
AR: 1.20 in/2  
LE: 42.61 ft  
WS: 16807.9 fts  
28.5-30  
Interval start: 8/21/2023  
SP: 0.492 kftG  
EM: 30000 ksi



F1 : [648AWJ1] 226.21 PDICAL (1) FF1			A3 (PR): [K4483] 410.187 mm/6.4w/5000g (1) VF1			
F2 : [648AWJ2] 225.58 PDICAL (1) FF1			A4 (PR): [K10491] 421.907 mm/6.4w/5000g (1) VF1			
BL#	BC /6"	FMX kips	VMX ft/s	BPM bpm	EFV ft-lb	ETR %
49	5	34	19.6	1.9	307	87.6
50	5	34	19.3	52.0	301	86.1
51	5	27	16.5	52.7	278	79.4
52	5	33	19.9	52.5	310	88.6
53	5	29	17.7	52.7	288	82.2
54	8	29	18.6	52.5	295	84.2
55	8	23	15.6	52.9	287	82.0
56	8	34	20.1	52.6	323	92.2
57	8	28	18.1	52.8	295	84.3
58	8	38	18.8	53.1	312	89.1
59	8	35	19.2	52.6	329	94.0
60	8	36	19.3	52.9	327	93.3
61	8	40	19.7	52.8	323	92.4
62	9	35	18.8	53.0	320	91.3
63	9	37	19.1	52.7	320	91.3
64	9	35	19.9	52.9	327	93.4
65	9	29	18.8	52.7	314	89.7
66	9	35	19.7	53.0	342	97.8
67	9	36	19.9	52.8	331	94.5
68	9	38	19.3	52.8	335	95.8
69	9	36	19.9	52.5	325	92.9
70	9	39	19.5	52.9	329	94.0
Average		34	19.1	52.8	320	91.3
Std Dev		4	1.0	0.2	15	4.1
Maximum		40	20.1	53.1	342	97.8
Minimum		23	15.6	52.5	287	82.0
N-value: 17						

Sample Interval Time: 23.91 seconds.

Summary of SPT Test Results

Project: GP554-3126, Test Date: 8/21/2023				EFV: Maximum Energy				
FMX: Maximum Force				ETR: Energy Transfer Ratio - Rated				
VMX: Maximum Velocity								
BPM: Blows/Minute								
Test Length ft	Blows Applied /6"	N Value	N60 Value	Average FMX kips	Average VMX ft/s	Average BPM bpm	Average EFV ft-lb	Average ETR %
32.61	6-8-11	19	28	34	19.2	52.8	299	85.6
37.61	5-8-10	18	26	36	19.6	52.6	312	89.1
42.61	5-8-9	17	25	34	19.1	52.8	320	91.3
Overall Average Values:				35	19.3	52.7	310	88.5
Standard Deviation:				4	0.8	0.2	15	4.2
Overall Maximum Value:				41	20.6	53.1	342	97.8
Overall Minimum Value:				23	15.6	52.2	277	79.1



Exhibit B

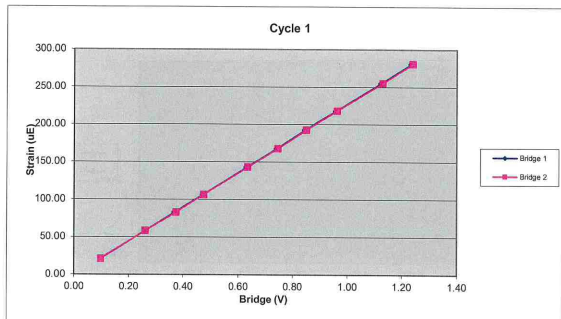
PDA Equipment Calibration



648AWJ		Cycle 1		
Sample	Force (lb)	Strain (µE)	Bridge 1 (V)	Bridge 2 (V)
1	0.00	0.00	0.00	0.00
2	799.99	21.12	0.10	0.10
3	2111.63	58.22	0.26	0.26
4	2997.39	82.70	0.37	0.37
5	3848.07	106.26	0.47	0.47
6	5131.83	143.07	0.63	0.63
7	6017.79	167.81	0.74	0.75
8	6872.07	192.74	0.85	0.85
9	7783.57	218.15	0.96	0.96
10	9136.93	255.02	1.12	1.13
11	10026.70	280.73	1.24	1.24

Bridge 1		Bridge 2	
Force Calibration (lb/V)	8120.30	Force Calibration (lb/V)	8089.75
Offset	-4.24	Offset	-2.24
Correlation	0.999998	Correlation	0.999995
Strain Calibration (µE/V)	228.56	Strain Calibration (µE/V)	227.70
Offset	-1.57	Offset	-1.51
Correlation	0.999991	Correlation	0.999983

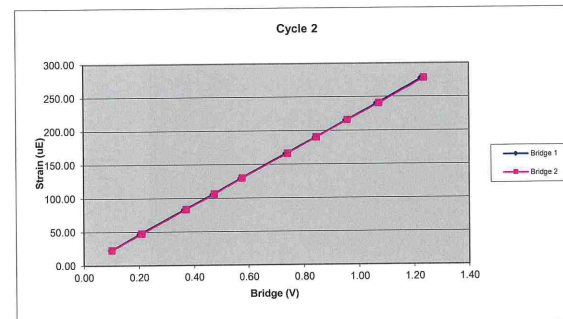
Force Strain Calibration	
EA (Kips)	35527.98
Offset	51.69
Correlation	0.999986



648AWJ		Cycle 2		
Sample	Force (lb)	Strain (µE)	Bridge 1 (V)	Bridge 2 (V)
1	0.00	0.00	0.00	0.00
2	805.54	22.23	0.10	0.10
3	1679.81	47.04	0.20	0.21
4	2989.11	83.03	0.37	0.37
5	3830.62	105.81	0.47	0.47
6	4658.00	129.50	0.57	0.58
7	5984.74	165.81	0.74	0.74
8	6848.87	189.76	0.84	0.84
9	7747.90	215.15	0.95	0.96
10	8674.21	240.08	1.07	1.07
11	9994.82	277.48	1.23	1.24

Bridge 1		Bridge 2	
Force Calibration (lb/V)	8127.14	Force Calibration (lb/V)	8103.79
Offset	10.37	Offset	-14.59
Correlation	0.999997	Correlation	0.999997
Strain Calibration (µE/V)	225.29	Strain Calibration (µE/V)	224.64
Offset	0.36	Offset	-0.33
Correlation	0.999990	Correlation	0.999992

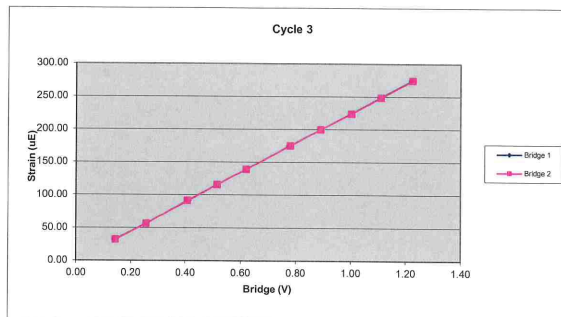
Force Strain Calibration	
EA (Kips)	36073.41
Offset	-2.66
Correlation	0.999993



648AWJ		Cycle 3		
Sample	Force (lb)	Strain (µE)	Bridge 1 (V)	Bridge 2 (V)
1	0.00	0.00	0.00	0.00
2	1153.24	31.90	0.14	0.14
3	2056.55	56.28	0.26	0.26
4	3310.19	91.18	0.41	0.41
5	4155.51	115.51	0.51	0.51
6	5035.81	139.16	0.62	0.62
7	6303.78	175.10	0.78	0.78
8	7221.91	199.87	0.89	0.89
9	8120.94	223.92	1.00	1.00
10	9001.15	248.68	1.11	1.11
11	9931.66	274.33	1.22	1.23

Bridge 1		Bridge 2	
Force Calibration (lb/V)	8132.32	Force Calibration (lb/V)	8118.57
Offset	-20.37	Offset	-15.36
Correlation	0.999998	Correlation	0.999997
Strain Calibration (µE/V)	224.79	Strain Calibration (µE/V)	224.41
Offset	-0.57	Offset	-0.43
Correlation	0.999984	Correlation	0.999985

Force Strain Calibration	
EA (Kips)	36175.62
Offset	0.42
Correlation	0.999984



Bridge Excitation (V) 5  
Shunt Resistor (ohm) 60.4k

Calibration Factors		648AWJ	
Bridge 1 (µE/V)	226.21	Bridge 2 (µE/V)	225.58
EA Factor (Kips)	35925.67	Area (in <sup>2</sup> )	1.20

Calibrated by: *Aht*  
Calibrated Date: 3/3/2022

Pile Dynamics Inc  
30725 Aurora Rd  
Solon, OH 44139

Traceable to N.I.S.T.

Accelerometer Calibration Certificate  
Pile Dynamics, Inc.



Calibrated by Pile Dynamics, Inc.  
Calibration performed on 26Oct2021

Serial No: K4483 Temperature: 22.1 °C  
Model: PR Humidity: 45%  
Calibrated on: Channel 3 on 8G 5161 LE

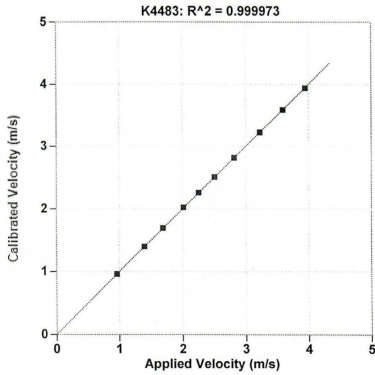
PDA CALIBRATION FACTOR  
410.2 mv/5000g  
(62.0  $\mu$ v/g)  
R<sup>2</sup>: 0.999973 [Chip programmed]

Operator: William Johnson

Signed

Ref Acc 1: 690961 Cal on: 27Jan2021  
978 g's/volt  
Ref Acc 2: 691321 Cal on: 09Feb2021  
960 g's/volt

Reference accelerometer calibrations are traceable to  
the United States National Institute of Standards and  
Technology (NIST).



Date printed: 26Oct2021, version: 2020.30.170 0.57

Accelerometer Calibration Certificate  
Pile Dynamics, Inc.



Calibrated by Pile Dynamics, Inc.  
Calibration performed on 25Jan2022

Serial No: K10491 Temperature: 19.3 °C  
Model: PR Humidity: 30%  
Calibrated on: Channel 3 on 8G 5161 LE

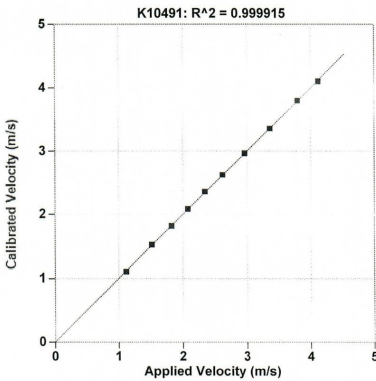
PDA CALIBRATION FACTOR  
421.9 mv/5000g  
(84.4  $\mu$ v/g)  
R<sup>2</sup>: 0.999915 [Chip programmed]

Operator: William Johnson

Signed

Ref Acc 1: 691321 Cal on: 09Feb2021  
960 g's/volt  
Ref Acc 2: 690961 Cal on: 27Jan2021  
978 g's/volt

Reference accelerometer calibrations are traceable to  
the United States National Institute of Standards and  
Technology (NIST).



Date printed: 25Jan2022, version: 2020.30.170 0.05