Preliminary Geotechnical Data Report

Emergency Bridge Package 3 –
SC 34 Bridge Replacement over Heller's Creek
Newberry County, South Carolina

November 10, 2015 (Rev. 2)
Terracon Project No. 73155050F

Prepared for:
South Carolina Department of Transportation
Columbia, South Carolina

Prepared by:
Terracon Consultants, Inc.
Columbia, South Carolina

November 10, 2015 (Rev. 2)

South Carolina Department of Transportation
955 Park Street, Room 421
Columbia, South Carolina 29201

Attn: Mr. Trapp Harris, P.E.
Geotechnical Design Engineer – Design-Build Section

Re: Preliminary Geotechnical Data Report
Emergency Bridge Package 3 –
SC 34 Bridge Replacement over Heller's Creek
Newberry County, South Carolina
Terracon Project Number: 73155050F

Dear Mr. Harris:

Terracon Consultants Inc. (Terracon) has completed the geotechnical exploration and testing services for the above referenced project. These services were conducted in general accordance with the SCDOT Request for Subsurface Exploration and Laboratory Testing dated October 23, 2015. This geotechnical data report presents the findings of the subsurface exploration and laboratory testing along with an overview of testing activities.

1.0 INTRODUCTION

The South Carolina Department of Transportation (SCDOT) has contracted Terracon to perform subsurface exploration and laboratory testing for the Emergency Bridge Package 3 – SC 34 Bridge Replacement over Heller's Creek in Newberry County, South Carolina, South Carolina. The purpose this work is to develop information relative to subsurface soil and groundwater conditions at the bridge location. This report presents the results of that work. No geotechnical recommendations are associated with the requested scope of study.

The following sections of this report contain a summary of the activities our field exploration and laboratory testing. The logs of the borings, the Site Location Map and the Exploration Plan are included in Appendix A of this report. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included in Appendix B of this report. Descriptions of the field exploration and laboratory testing are included in their respective appendices.

2.0 PROJECT DESCRIPTION

The project bridge replacement project is located on SC 34 in Newberry County, SC. Site location and boring locations plans are presented in Appendix A of this report. It is our understanding that the project will include the demolition/removal of the existing bridge structure and the replacement with a new bridge on the existing or similar horizontal alignment. The existing bridge is a multi-span structure apparently supported steel piles. It crosses Heller's Creek. The surface of the stream flow was about 17 feet below the existing bridge deck.

3.0 GEOTECHNICAL TESTING

Between October 29 and October 30 2015, two (2) soil test borings (designated STB-1 and STB-2) were performed at the bridge location. Borings STB-1 and STB-2 were performed approximately 10 feet to the east and west of the ends of the existing bridge, respectively, as shown on Exhibit A-2 in Appendix A.

3.1 Field Exploration

Our field exploration at the site consisted of two (2) Standard Penetration Test (SPT) Borings (STB-1, STB-2) at the general test locations provided to Terracon by the 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 Construction Support Services, LLC, after completion. At the time of our field exploration, the roadway in the area of the bridge was closed due to a washout on the east side of the bridge. The set up at each boring is provided in the photographs below.

Photo 1. Drill rig at STB-1 (SC-34)

Photo 2. Drill rig at STB-2 (SC-34)

3.2 Laboratory Testing

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

- Twelve (12) Natural Moisture Content Tests (ASTM D2216)
- Four (4) Atterberg Limits Tests (ASTM D4318)
- Eight (8) Wash #200 Tests
- Six (6) Compressive Strength of Rock Tests

The laboratory procedures and results of the laboratory tests are presented in Appendix B.

4.0 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.

Joseph D.M. Fredendall, E.I.T.
Field Engineer

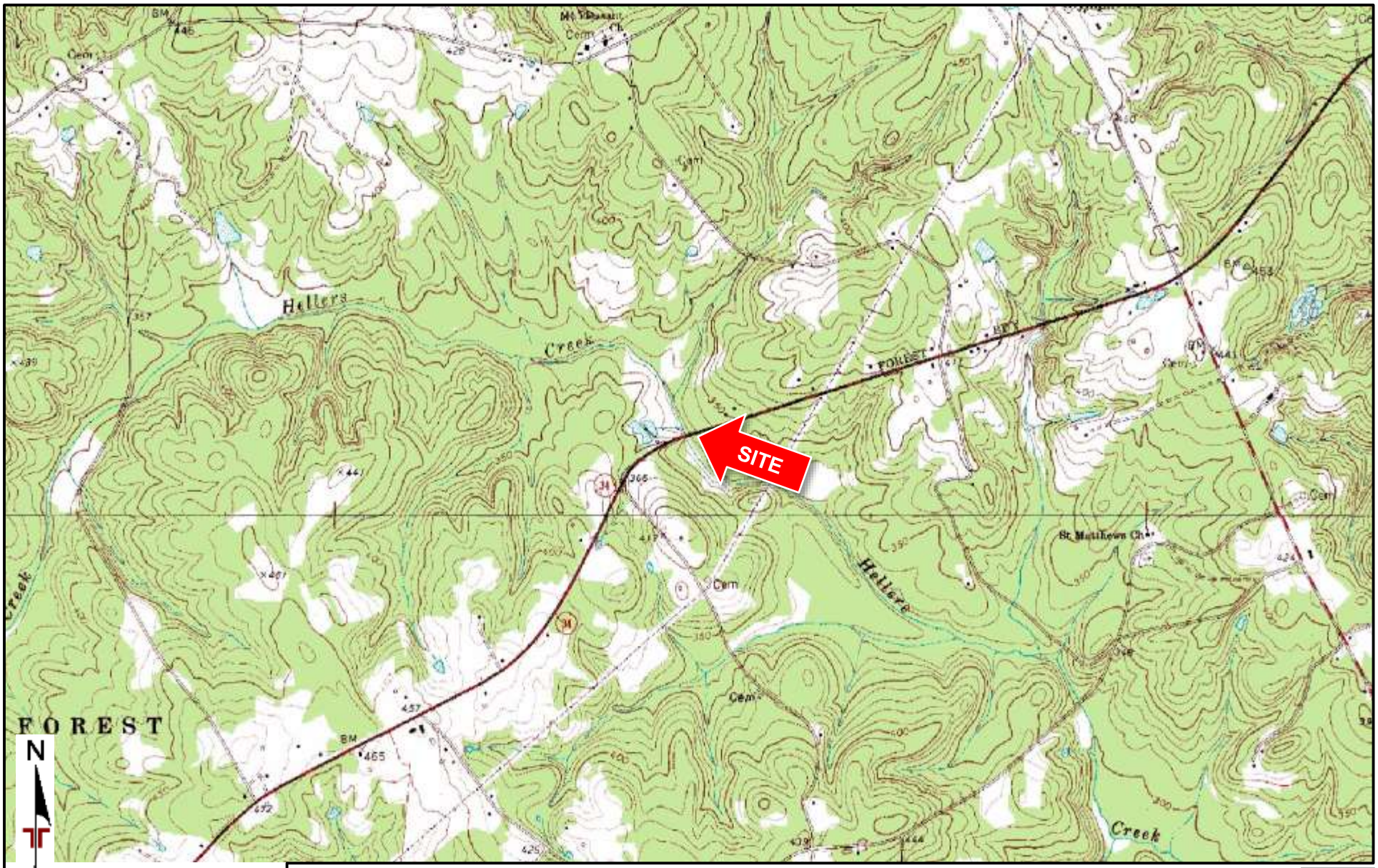
Phillip A. Morrison, P.E.
Geotechnical Department Manager
SC Registration No. 17275

Attachments

Copies: Addressee (1 via email)
File (1)

APPENDIX A - FIELD EXPLORATION

Exhibit A-1 – Site Location Map
Exhibit A-2 – Exploration Plan
Exhibit A-3 – Summary of Boring Data
Exhibit A-4 – Field Testing Description
Exhibit A-5 – Soil Description Terms
Exhibit A-6 – Rock Description Terms
Exhibits A-7 and A-8 - Boring Logs
Exhibit A-9 - Rock Core Photographs



TOPOGRAPHIC MAP IMAGE COURTESY OF THE U.S. GEOLOGICAL SURVEY QUADRANGLES INCLUDE: BLAIR, SC (1/1/1969) and POMARIA, SC (1/1/1969).

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

Project Manager:	PAM
Drawn by:	PTK
Checked by:	PAM
Approved by:	PAM

Project No.	73155050F
Scale:	1"=24,000 SF
File Name:	A-1 & A-2
Date:	Nov. 2015

Terracon
521 Clemson Road
Columbia, SC 29229

SITE LOCATION MAP

SC 34 Bridge Replacement over Heller's Creek
Newberry County, South Carolina

Exhibit
A-1

AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

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

Project Manager:	PAM
Drawn by:	PTK
Checked by:	PAM
Approved by:	PAM

Project No.	73155050F
Scale:	AS SHOWN
File Name:	A-1 & A-2
Date:	Nov. 2015

Terracon
521 Clemson Road
Columbia, SC 29229

EXPLORATION PLAN

SC 34 Bridge Replacement over Heller's Creek
Newberry County, South Carolina

Exhibit

A-2

Summary of Boring Data

Boring No.	Ground Elevation (ft.)	Test Depth (ft.)	Northing	Easting	Latitude	Longitude
STB-1	334.4	50.1	926291.789	1867276.964	34.378446	-81.439904
STB-2	334.7	37.0	926249.284	1867173.742	34.378328	-81.440246

FIELD EXPLORATION DESCRIPTION

Overview

The testing locations were provided by the SCDOT and located in the field by Terracon by taking measurements from the existing bridge. The borings were surveyed by Construction Support Services, LLC after drilling was complete. The locations are shown on the Exploration Plan (Exhibit A-2).

A field log of each test location was prepared by our field 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 2010
- ASTM D5783, "Standard Guide for Use of Direct Rotary Drilling with Water-Based Drilling Fluid for Geo-environmental Exploration"
- ASTM D1586 "Test Method for Penetration Test and Split-Barrel Sampling of Soils"
- ASTM D2113 "Standard Practice for Rock Core Drilling and Sampling of Rock for Site Exploration"
- ASTM D4220 "Standard Practices for Preserving and Transporting Soil"

Each boring was advanced using rotary wash drilling techniques. Five samples were collected in the upper 10 feet. Below that depth, samples were obtained at 5-foot intervals. 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 inches (24-inches in the upper 10 feet) 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 the three, 6-inch increments is recorded. A fourth reading was recorded in the upper 10 feet. 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

consistency (based on standard penetration resistance). An explanation of the soil descriptions shown on the logs is provided on Exhibit A-5.

The borings were advanced to refusal of the drilling equipment and 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 on Exhibit A-6. Photos of the recovered rock core specimens are provided on Exhibit A-9 of the Appendix.

Due to the drilling method, time-of-drilling water levels could not be recorded as it as well as the rock coring introduces water into the borehole. The 24-hour groundwater readings were collected from the borings, where possible. These are indicated on the boring logs. As the roadway was being paved at the time of the field exploration, 24-hour groundwater measurements could not be collected at Boring STB-1. At the conclusion of the work, the boreholes were backfilled and capped with cold-patch asphalt.

SOIL DESCRIPTION TERMS

Relative Density/Consistency Terms

Relative Density[1]			Consistency[2]		
Descriptive Term	Relative Density	SPT Blow Count	Descriptive Term	Unconfined Compression Strength (q_u) (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

Descriptive Term	Criteria
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[1]

Descriptive Term	Criteria
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[3]

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

Cementation[3]

Descriptive Term	Criteria
Weakly Cemented	Crumbles or breaks with handling or little finger pressure
Moderately Cemented	Crumbles or breaks with considerable finger pressure
Strongly Cemented	Will not crumble or break with finger pressure

Particle-Size Range[1]

Gravel	Diameter, mm	Sieve Size	Sand	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[1, 2]

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

[1] Applies to coarse-grained soils (major portion retained on No. 200 sieve)
[2] Applies to fine-grained soils (major portion passing No. 200 sieve)
[3] 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 [a]

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

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

Rock Quality Designator (RQD) a

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

a. 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 1/8 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.

SCDOT Soil Test Log

Project ID:	Emergency Bridge Package 3	**County:**	Newberry	**Boring No.:**	STB-1		
Site Description:	SC 34 Bridge Replacement over Heller's Creek			**Route:**	SC 34		
Eng./Geo.:	K. Zur	**Boring Location:**	WBL	**Offset:**	CTR	**Alignment:**	MAINLINE
Elev.:	334.4 ft	**Latitude:**	34.378446	**Longitude:**	-81.439904	**Date Started:**	10/29/2015
Total Depth:	50.1 ft	**Soil Depth:**	30.1 ft	**Core Depth:**	50.1 ft	**Date Completed:**	10/29/2015
Bore Hole Diameter (in):	2.94	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 55	**Drill Method:**	RW/RC	**Hammer Type:**	Automatic	**Energy Ratio:**	81.9%
Core Size:	NQ2	**Driller:**	C. Fredrychowski	**Groundwater:**	**TOB** N/R	**24HR**	N/R

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0	Roadway							
	0.5	Asphalt Concrete (6.5 inches)		0.5					
		FILL -Medium dense, moist, yellowish red, subrounded, weakly cemented, fine clayey SAND (SC) (A-2-6) 5YR5/8			SS-1	5	10/7		17
	2.0	NMC=15.8		2.0					
		FILL -Medium dense, moist, yellowish red, subrounded, weakly cemented, fine silty SAND (SM) (A-2-4) 5YR5/8			SS-2	5	9/8	7	17
	4.0	NMC=11.4, %#200=20.5		4.0					
329.4		**FILL -**Medium dense, moist, yellowish red, subrounded, weakly cemented, fine silty SAND (SM) (A-2-4) 5YR5/8			SS-3	7	6/5	5	11
	6.0	LL=NP, PL=NP, NMC=11.3, %#200=30.3		6.0					
		FILL -Very loose to loose, moist, strong brown, subrounded, weakly cemented, fine silty SAND (SM) (A-2-4) 7.5YR5/8			SS-4	3	2/2	2	4
		NMC=16.7		8.0					
		LL=NP, PL=NP, NMC=16.9, %#200=28.8			SS-5	1	3/2	1	5
324.4									
	11.0	Firm, moist, gray, silty CLAY with sand seams (CL) (A-6) GLEY1_5/1							
		NMC=27.3		13.5	SS-6	3	2/3		5
319.4									
				18.5					
	19.0	Very soft from 18.5 to 19 feet							
		NMC=35.7			SS-7	WOH/6"	3/6		9

● SPT N VALUE ●

PL MC LL

▲ FINES CONTENT (%)

0 10 20 30 40 50 60 70 80 90

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	

SCDOT Soil Test Log

Project ID:	Emergency Bridge Package 3			**County:**	Newberry	**Boring No.:**	STB-1
Site Description:	SC 34 Bridge Replacement over Heller's Creek					**Route:**	SC 34
Eng./Geo.:	K. Zur	**Boring Location:**	WBL	**Offset:**	CTR	**Alignment:**	MAINLINE
Elev.:	334.4 ft	**Latitude:**	34.378446	**Longitude:**	-81.439904	**Date Started:**	10/29/2015
Total Depth:	50.1 ft	**Soil Depth:**	30.1 ft	**Core Depth:**	50.1 ft	**Date Completed:**	10/29/2015
Bore Hole Diameter (in):	2.94	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 55	**Drill Method:**	RW/RC	**Hammer Type:**	Automatic	**Energy Ratio:**	81.9%
Core Size:	NQ2	**Driller:**	C. Fredrychowski	**Groundwater:**	**TOB** N/R	**24HR**	N/R

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6" / 2nd 6" / 3rd 6"	N Value	SPT N VALUE / PL MC LL / FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90
		Loose, wet, dark greenish gray, angular, weakly cemented fine silty SAND (SM) (A-2-4) 10GY3/2						
	22.0							
		Dense, moist, very dark greenish gray to greenish black, micaceous, fine silty SAND (SM) (A-2-4) 10GY3/2 to GLEY1_2.5/1 LL=NP, PL=NP, NMC=24.2, %#200=18.6		23.5	SS-8	7 13/23	36	
309.4								
	27.0							
		Hard, moist, dark greenish gray, fine silty SAND (Partially Weathered Rock) (SM) (A-2-4) 10GY3/2						
	28.7			28.5				
		Very dense, moist, reddish brown, silty SAND (Partially Weathered Rock) (SM) (A-2-4) 5YR4/4			SS-9	2128/50/2"	50/2"	>>
304.4	30.1	NMC=16.5, %#200=17.8 ***Rotary Wash Refusal at 30.1 feet. Begin Coring.***		30.1				
		Igneous to Metamorphic (Granite to Gneiss), light brown and white, fine grained, subangular, fresh, strong, V, N, Su to Pa, Fe and Sa, Pl, 0 to 45 7.5YR6/4 White9.5/N, RQD=77, %REC=88, RMR=73, q_u=8,397psi			NQ2-1			RQD=77, %REC=88, RMR=76
299.4	35.1			35.1				
		Igneous to Metamorphic (Granite to Gneiss), light brown and white, fine grained, subangular, fresh, strong, V, N, Su to Pa, Fe and Sa, Pl, 0 to 45 7.5YR6/4 White9.5/N, RQD=68, %REC=75, RMR=69, q_u=5,421psi			NQ2-2			RQD=68, %REC=75, RMR=69

Continued Next Page

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	

SCDOT Soil Test Log

Project ID:	Emergency Bridge Package 3	**County:**	Newberry	**Boring No.:**	STB-1		
Site Description:	SC 34 Bridge Replacement over Heller's Creek			**Route:**	SC 34		
Eng./Geo.:	K. Zur	**Boring Location:**	WBL	**Offset:**	CTR	**Alignment:**	MAINLINE
Elev.:	334.4 ft	**Latitude:**	34.378446	**Longitude:**	-81.439904	**Date Started:**	10/29/2015
Total Depth:	50.1 ft	**Soil Depth:**	30.1 ft	**Core Depth:**	50.1 ft	**Date Completed:**	10/29/2015
Bore Hole Diameter (in):	2.94	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 55	**Drill Method:**	RW/RC	**Hammer Type:**	Automatic	**Energy Ratio:**	81.9%
Core Size:	NQ2	**Driller:**	C. Fredrychowski	**Groundwater:**	**TOB** N/R	**24HR**	N/R

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6" / 2nd 6" / 3rd 6"	N Value	● SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90
	40.1	Igneous (Granite), greenish black, fine grained, fresh, strong, V, N, Su to Pa, Fe and Sa, Pl, 0, 15, 45 GLEY12.5/1 and White9.5/N, RQD=58, %REC=94, RMR=69, q_u=8,218psi		40.1	NQ2-3			RQD=58, %REC=94, RMR=69
289.4	45.1	Igneous (Granite), greenish black, fine grained, fresh, strong, V, N, Su to Pa, Fe and Sa, Pl, 0, 15, 45 GLEY12.5/1 and White9.5/N, RQD=80, %REC=97, RMR=73		45.1	NQ2-4			RQD=80, %REC=97, RMR=73
284.4	50.1	***Coring Terminated at 50.1 feet.***						
279.4								

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 SC-34 SCDOT.GPJ SCDOT DATA TEMPLATE_12_30_2014.GDT 11/11/15

SCDOT Soil Test Log

Project ID:	Emergency Bridge Package 3	**County:**	Newberry	**Boring No.:**	STB-2		
Site Description:	SC 34 Bridge Replacement over Heller's Creek			**Route:**	SC 34		
Eng./Geo.:	K. Zur	**Boring Location:**	EBL	**Offset:**	CTR	**Alignment:**	MAINLINE
Elev.:	334.7 ft	**Latitude:**	34.378328	**Longitude:**	-81.440246	**Date Started:**	10/29/2015
Total Depth:	37 ft	**Soil Depth:**	17 ft	**Core Depth:**	37 ft	**Date Completed:**	10/30/2015
Bore Hole Diameter (in):	2.94	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 55	**Drill Method:**	RW/RC	**Hammer Type:**	Automatic	**Energy Ratio:**	81.9%
Core Size:	NQ2	**Driller:**	C. Fredrychowski	**Groundwater:**	**TOB** N/R	**24HR**	12 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	SPT N VALUE / PL MC LL / FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90
	0.0	Roadway								
	0.5	Asphalt Concrete (6 inches)		0.5						
		FILL -Medium dense, moist, yellowish red, subrounded, weakly cemented, fine silty SAND (SM) (A-2-4) 5YR5/8			SS-1	2	12/12		24	
	2.0	NMC=11.7, %#200=31.8		2.0						
		FILL -Medium dense to loose, moist, bronwish yellow to yellowish brown, subrounded, weakly cemented, fine silty SAND (SM) (A-2-4) 10YR6/6 to 10YR5/8			SS-2	8	5/6	6	11	
		LL=NP, PL=NP, NMC=13.2, %#200=27.1		4.0						
329.7					SS-3	2	3/3	2	6	
	6.0			6.0						
	7.0	**FILL -**Loose, wet, yellowish red, angular, weakly cemented, fine to coarse SAND (SP) (A-3) 5YR5/8			SS-4	2	3/2	3	5	
	8.0	**FILL -**Loose, wet, yellowish red, rounded, weakly cemented, fine silty SAND (SM) (A-2-4) 5YR5/8		8.0						
		FILL -Very loose, wet, yellow, subrounded, weakly cemented, fine silty SAND (SM) (A-2-4) 10YR7/8			SS-5	12	1/2	3	3	
324.7		NMC=14.5, %#200=26.1								
	12.0 ▼									
		Very dense, wet, yellow, subangular, weakly cemented, fine to coarse silty SAND (Partially Weathered Rock) (SM) (A-2-4) 10YR7/8		13.5	SS-6	50/5"			50/5"	>>
319.7										
	17.0	***Rotary Wash Refusal at 17.0 feet. Begin Coring.***		17.0						
		Igneous (Granite), bluish gray to black, fine grained, sub angular, fresh, strong rock, J, N, Su, Cl and Fe, Pl, C to VC, 30, GLEY2_6/1 to 2.5YR5/1, RQD=86, %REC=98, RMR=76, q_u=11,539psi			NQ2-1					RQD=86, %REC=98, RMR=76

Continued Next Page

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	

SCDOT Soil Test Log

Project ID:	Emergency Bridge Package 3	**County:**	Newberry	**Boring No.:**	STB-2		
Site Description:	SC 34 Bridge Replacement over Heller's Creek			**Route:**	SC 34		
Eng./Geo.:	K. Zur	**Boring Location:**	EBL	**Offset:**	CTR	**Alignment:**	MAINLINE
Elev.:	334.7 ft	**Latitude:**	34.378328	**Longitude:**	-81.440246	**Date Started:**	10/29/2015
Total Depth:	37 ft	**Soil Depth:**	17 ft	**Core Depth:**	37 ft	**Date Completed:**	10/30/2015
Bore Hole Diameter (in):	2.94	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 55	**Drill Method:**	RW/RC	**Hammer Type:**	Automatic	**Energy Ratio:**	81.9%
Core Size:	NQ2	**Driller:**	C. Fredrychowski	**Groundwater:**	**TOB** N/R	**24HR**	12 ft

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6" / 2nd 6" / 3rd 6"	N Value	SPT N VALUE / PL MC LL / FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90
	22.0			22.0				
309.7		Igneous (Granite), bluish gray to black, fine grained, sub angular, fresh, strong rock, J, N, Su, Fe, Pl, VC, 0 to 10, GLEY2_6/1 to 2.5YR5/1, RQD=58, %REC=94, RMR=72, q_u=21,268psi			NQ2-2			RQD=58, %REC=94, RMR=72
	27.0			27.0				
304.7		Igneous (Granite), bluish gray to black, fine grained, sub angular, fresh, strong rock, No, No, No, No, No, C to M, GLEY2_6/1 to 2.5YR5/1, RQD=100, %REC=100, RMR=79, q_u=17,138psi			NQ2-3			RQD=100, %REC=100, RMR=79
	32.0			32.0				
299.7		Igneous (Granite), bluish gray to black, fine grained, sub angular, fresh, strong rock, No, No, No, No, No, C to M, GLEY2_6/1 to 2.5YR5/1, RQD=82, %REC=93, RMR=71			NQ2-4			RQD=82, %REC=93, RMR=71
	37.0	***Coring Terminated at 37.0 feet.***						

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 SC-34 SCDOT.GPJ SCDOT DATA TEMPLATE_12_30_2014.GDT 11/11/15

Photo #1 STB-1 30.1'-40.1'

Photo #2 STB-1 40.1'-50.1'

Photo #3 STB-2 17'-27'

Photo #4 STB-2 17'-27'

APPENDIX B - LABORATORY TESTING

Exhibit B-1 – Laboratory Testing Description
Exhibit B-2 – Summary of Laboratory Data
Laboratory Data Sheets

LABORATORY TESTING DESCRIPTION

The samples collected during the field exploration were taken to our laboratory for additional testing. The laboratory testing program was developed by the SCDOT. Using the provided testing program, the laboratory tests were conducted on selected soil samples from the borings and the bulk samples 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:

■ Percent Fines	AASHTO T11 (ASTM D1140)
■ Atterberg Limits	AASHTO T89/T90(ASTM D4318)
■ Moisture Content Determination	AASHTO T265/(ASTM D2216)
■ Compressive Strength of Rock	ASTM D7012

Summary of Laboratory Results

BORING ID	Depth	USCS Classification and Soil Description	Compressive Strength (psf)	Liquid Limit	Plastic Limit	Plasticity Index	% <#200 Sieve	% Gravel	% Sand	% Silt	% Clay	Water Content (%)	Dry Density (pcf)
STB-1	0.5 - 2	CLAYEY SAND (SC)										15.8	
STB-1	2 - 4	SILTY SAND (SM)					20.5	0.0	0.0			11.4	
STB-1	4 - 6	SILTY SAND(SM)		NP	NP	NP	30.3	0.0	0.0			11.3	
STB-1	6 - 8	SILTY SAND (SM)										16.7	
STB-1	8 - 10	SILTY SAND(SM)		NP	NP	NP	28.8	0.0	0.0			16.9	
STB-1	13.5 - 15	SILTY CLAY (CL)										27.3	
STB-1	18.5 - 20	SILTY CLAY (CL)										35.7	
STB-1	23.5 - 25	SILTY SAND(SM)		NP	NP	NP	18.6	0.0	0.0			24.2	
STB-1	28.5 - 30	SILTY SAND (SM)					17.8	0.0	0.0			16.5	
STB-2	0.5 - 2	SILTY SAND (SM)					31.8	0.0	0.0			11.7	
STB-2	2 - 4	SILTY SAND(SM)		NP	NP	NP	27.1	0.0	0.0			13.2	
STB-2	8 - 10	SILTY SAND (SM)					26.1	0.0	0.0			14.5	

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. OLD-LAB SUMMARY: USCS SC-34 LAB TESTING.GPJ TERRACON2012.GDT 11/11/15

PROJECT: Emergency Bridge Package 3

SITE: SC-34 Bridge Replacement over Heller's Creek

Terracon
521 Clemson Road
Columbia, South Carolina

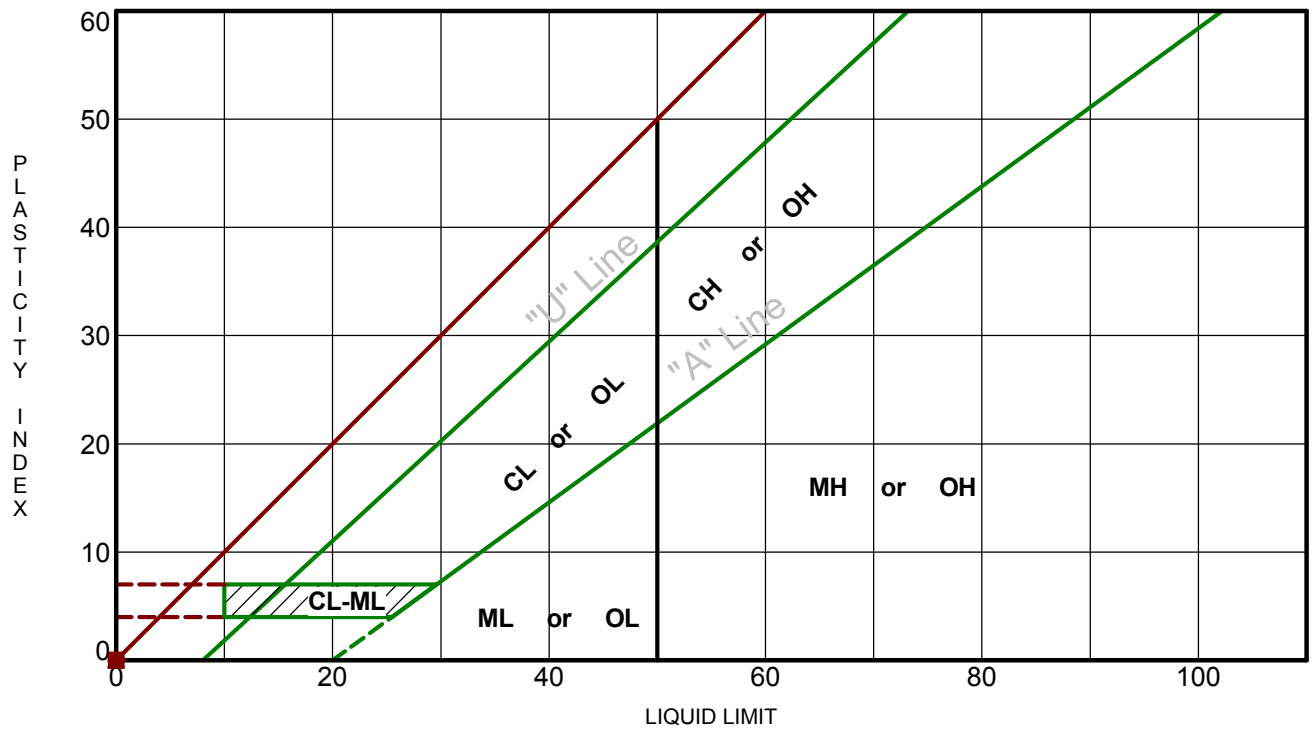
PROJECT NUMBER: 73155050F

CLIENT: SCDOT

EXHIBIT: B-2

ATTERBERG LIMITS RESULTS

ASTM D4318



Boring ID	Depth	LL	PL	PI	Fines	USCS	Description
● STB-1	4 - 6	NP	NP	NP	30	SM	SILTY SAND
⊠ STB-1	8 - 10	NP	NP	NP	29	SM	SILTY SAND
▲ STB-1	23.5 - 25	NP	NP	NP	19	SM	SILTY SAND
★ STB-2	2 - 4	NP	NP	NP	27	SM	SILTY SAND

PROJECT: Emergency Bridge Package 3

SITE: SC 34 Bridge Replacement over Heller's Creek

Terracon
521 Clemson Road
Columbia, South Carolina

PROJECT NUMBER: 73155050F

CLIENT: SCDOT

EXHIBIT: B-3

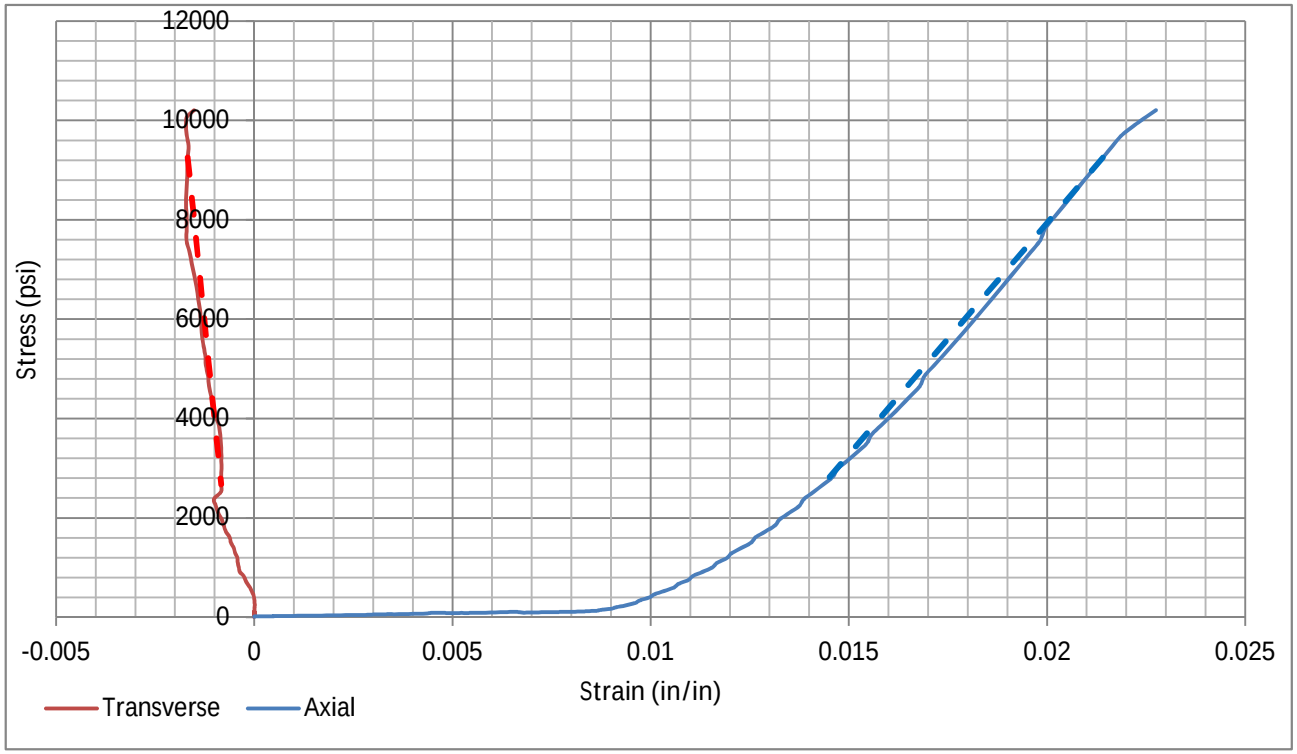
COMPRESSIVE STRENGTH AND ELASTIC MODULUS OF INTACT ROCK ASTM D7012

Terracon Consulting Engineers & Scientists

Client:	**Emergency Bridge Package**
Project:	**SCDOT**
Project Number:	**73155050F(SC 34)**
Task:	**0**
Boring:	**STB-1**
Depth:	**30.1 - 35.1**
Sample Number:	
Lab Number:	**8994**
Date Tested:	**11/3/2015**
Tested By:	**GAS**
Date Reduced:	**11/3/2015**
Reduced By:	**STT**

Slightly Weathered Granite

Core Length		Core Diameter		L/D Ratio	Mass	Density	
in	cm	in	cm		g	lb/ft^3	g/cm^3
4.11	10.44	1.98	5.03	2.08	539.7	162.48	2.60



Failure Load	Failure Stress	Elastic Modulus, E		Poisson's Ratio,
lbs	psi	ksi	Gpa	ν
31,425	10,206	933	6.4	0.12

Exhibit: B-4

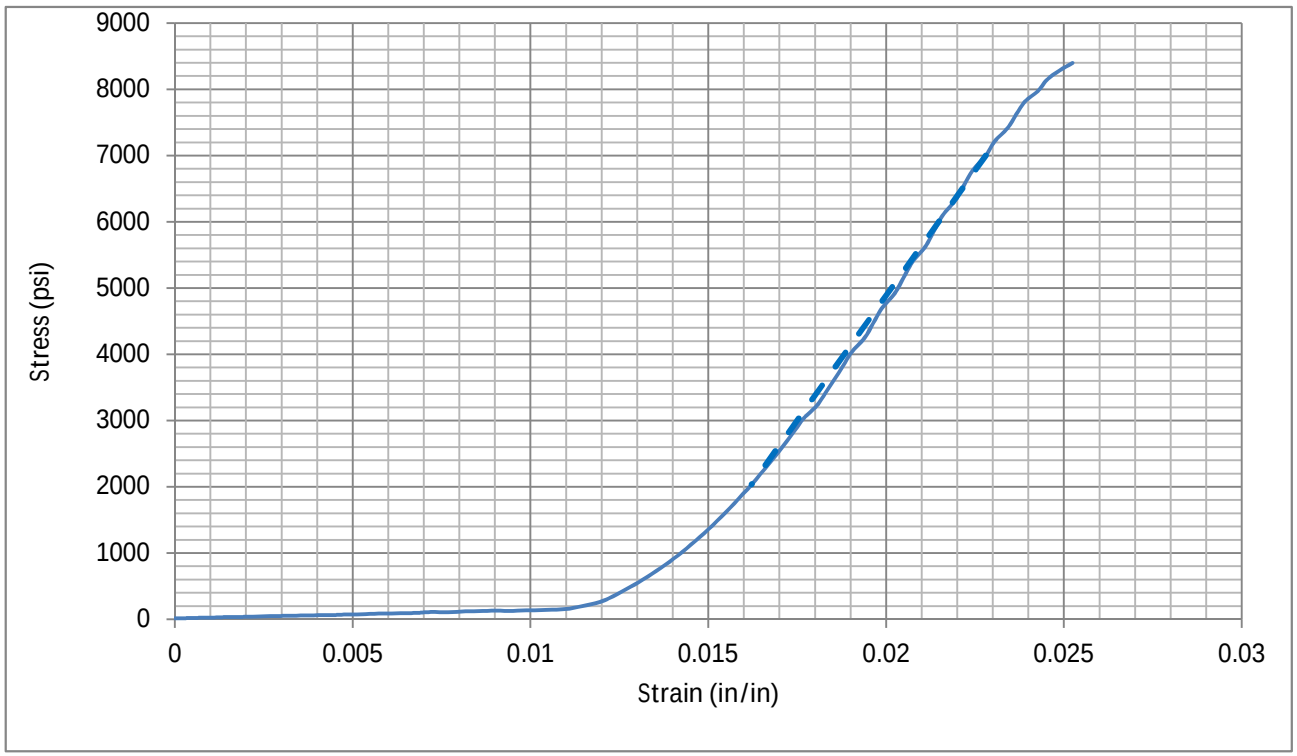
COMPRESSIVE STRENGTH AND ELASTIC MODULUS OF INTACT ROCK ASTM D7012

Terracon Consulting Engineers & Scientists

Client:	**Emergency Bridge Package**
Project:	**SCDOT**
Project Number:	**73155050F(SC 34)**
Task:	**0**
Boring:	**STB-1**
Depth:	**30.1 - 35.1**
Sample Number:	
Lab Number:	**8994A**
Date Tested:	**11/3/2015**
Tested By:	**GAS**
Date Reduced:	**11/4/2015**
Reduced By:	**STT**

Granite

Core Length		Core Diameter		L/D Ratio	Mass	Density	
in	cm	in	cm		g	lb/ft^3	g/cm^3
4.10	10.41	1.98	5.03	2.07	544.9	164.44	2.63



Unconfined Compressive Strength		Failure Load	Failure Strain
psi	kPa	lbs	%
8,397	57,897	25,856	2.52

Elastic Modulus, E	
ksi	Gpa
754	5.2

Exhibit: B-5

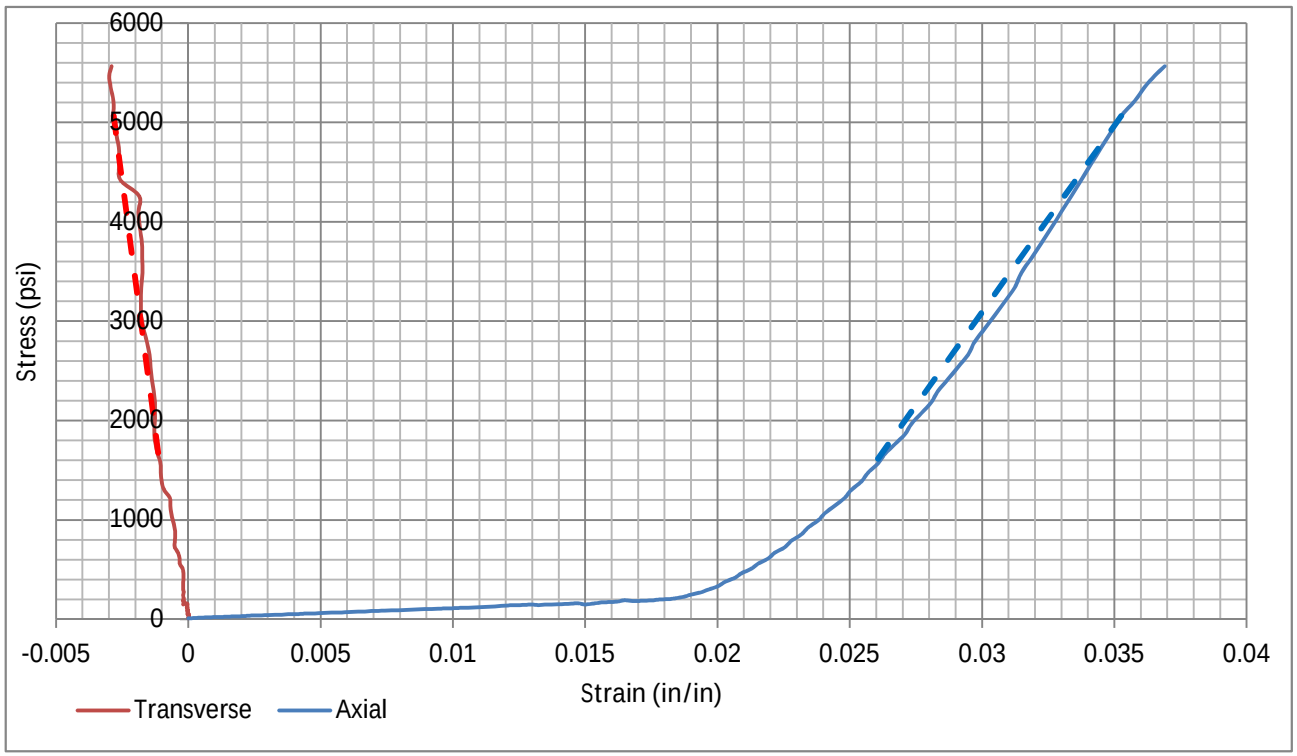
COMPRESSIVE STRENGTH AND ELASTIC MODULUS OF INTACT ROCK ASTM D7012

Terracon Consulting Engineers & Scientists

Client:	**Emergency Bridge Package**
Project:	**SCDOT**
Project Number:	**73155050F(SC 34)**
Task:	**0**
Boring:	**STB-1**
Depth:	**35.1 - 40.1**
Sample Number:	
Lab Number:	**8995**
Date Tested:	**11/3/2015**
Tested By:	**GAS**
Date Reduced:	**11/4/2015**
Reduced By:	**STT**

Slighty Weathered Granite

Core Length		Core Diameter		L/D	Mass	Density	
in	cm	in	cm	Ratio	g	lb/ft^3	g/cm^3
3.97	10.08	1.98	5.03	2.01	510.6	159.14	2.55



Failure Load	Failure Stress	Elastic Modulus, E		Poisson's Ratio,
lbs	psi	ksi	Gpa	ν
17,136	5,565	375	2.6	0.19

Exhibit: B-6

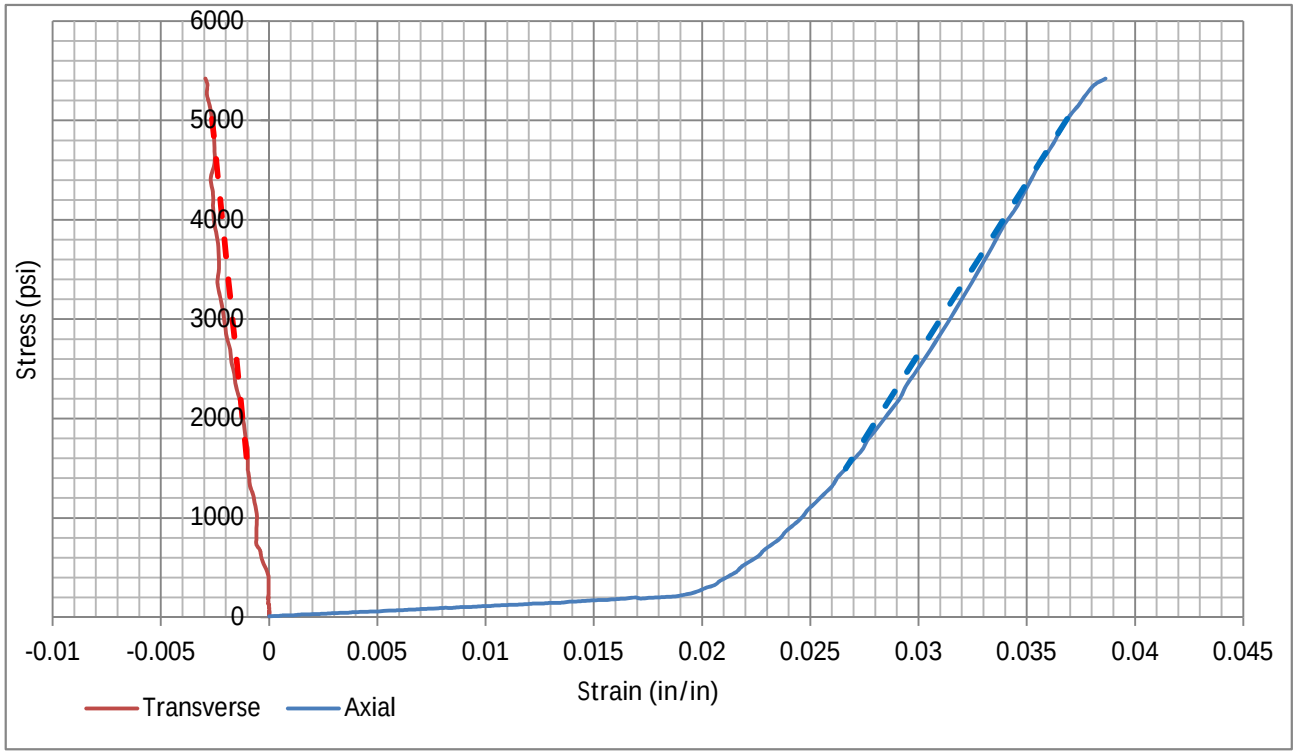
COMPRESSIVE STRENGTH AND ELASTIC MODULUS OF INTACT ROCK ASTM D7012

Terracon Consulting Engineers & Scientists

Client:	**Emergency Bridge Package**
Project:	**SCDOT**
Project Number:	**73155050F(SC 34)**
Task:	**0**
Boring:	**STB-1**
Depth:	**35.1 - 40.1**
Sample Number:	
Lab Number:	**8995A**
Date Tested:	**11/3/2015**
Tested By:	**GAS**
Date Reduced:	**11/4/2015**
Reduced By:	**STT**

Slighty Weathered Granite

Core Length		Core Diameter		L/D Ratio	Mass	Density	
in	cm	in	cm		g	lb/ft^3	g/cm^3
3.96	10.06	1.98	5.03	2.00	509.7	159.25	2.55



Failure Load	Failure Stress	Elastic Modulus, E		Poisson's Ratio,
lbs	psi	ksi	Gpa	ν
16,692	5,421	344	2.4	0.16

Exhibit: B-7

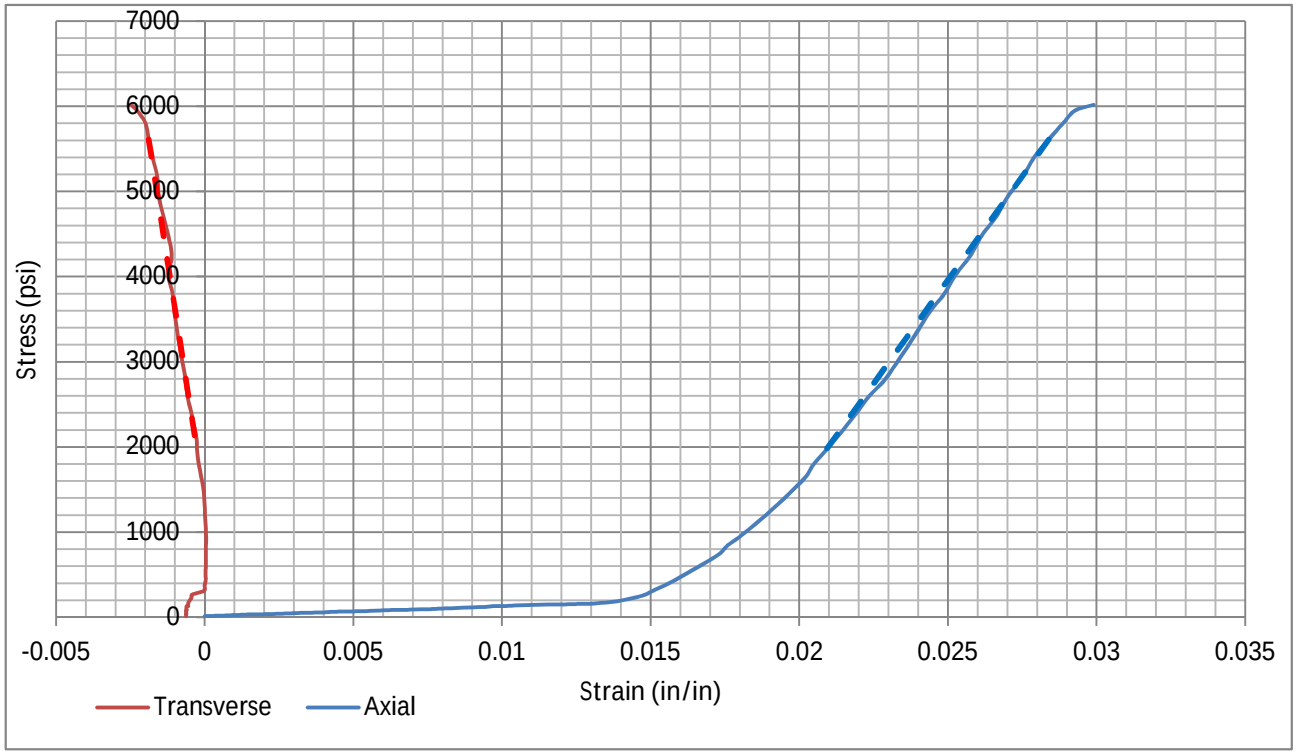
COMPRESSIVE STRENGTH AND ELASTIC MODULUS OF INTACT ROCK ASTM D7012

Terracon Consulting Engineers & Scientists

Client:	**Emergency Bridge Package**
Project:	**SCDOT**
Project Number:	**73155050F(SC 34)**
Task:	**0**
Boring:	**STB-1**
Depth:	**40.1 - 45.1**
Sample Number:	
Lab Number:	**8996**
Date Tested:	**11/3/2015**
Tested By:	**GAS**
Date Reduced:	**11/4/2015**
Reduced By:	**STT**

Slighty Weathered Granite

Core Length		Core Diameter		L/D Ratio	Mass	Density	
in	cm	in	cm		g	lb/ft^3	g/cm^3
3.98	10.11	1.98	5.03	2.01	518.3	161.12	2.58



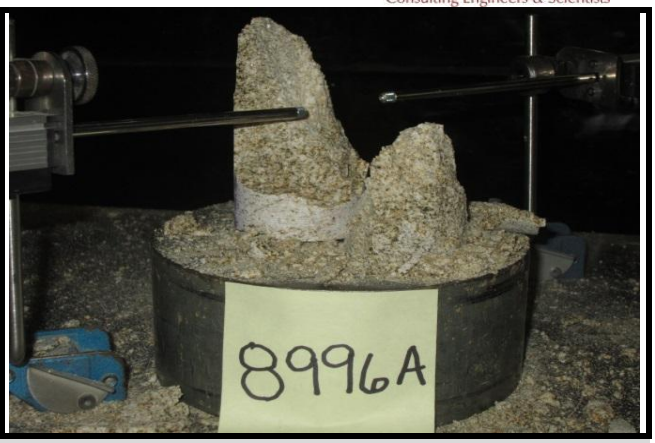
Failure Load	Failure Stress	Elastic Modulus, E		Poisson's Ratio,
lbs	psi	ksi	Gpa	ν
18,528	6,018	486	3.4	0.22

Exhibit: B-8

COMPRESSIVE STRENGTH AND ELASTIC MODULUS OF INTACT ROCK ASTM D7012

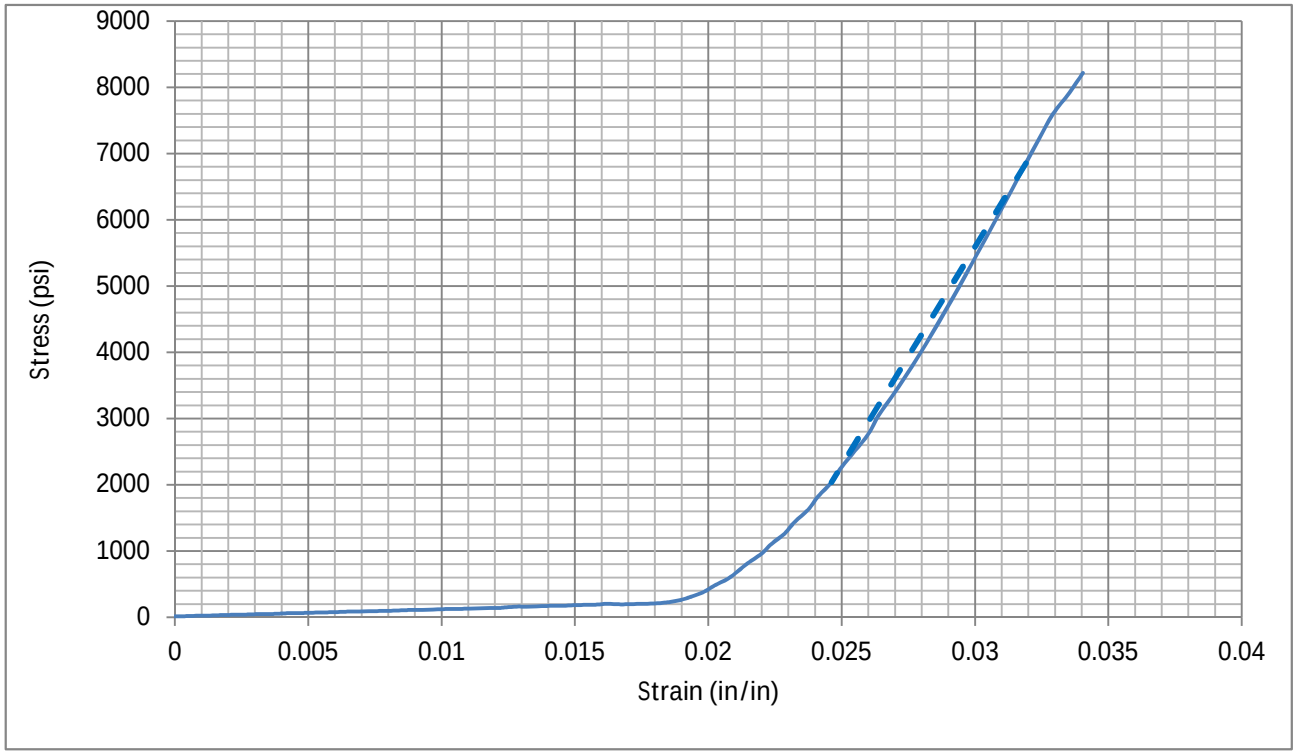
Terracon Consulting Engineers & Scientists

Client:	**Emergency Bridge Package**
Project:	**SCDOT**
Project Number:	**73155050F (SC 34)**
Task:	**0**
Boring:	**STB-1**
Depth:	**40.1 - 45.1**
Sample Number:	
Lab Number:	**8996A**
Date Tested:	**11/3/2015**
Tested By:	**GAS**
Date Reduced:	**11/4/2015**
Reduced By:	**STT**



Slighty Weathered Granite

Core Length		Core Diameter		L/D Ratio	Mass	Density	
in	cm	in	cm		g	lb/ft^3	g/cm^3
3.98	10.11	1.98	5.03	2.01	520.3	161.74	2.59



Unconfined Compressive Strength		Failure Load	Failure Strain
psi	kPa	lbs	%
8,218	56,660	25,303	3.40

Elastic Modulus, E	
ksi	Gpa
661	4.6

Exhibit: B-9

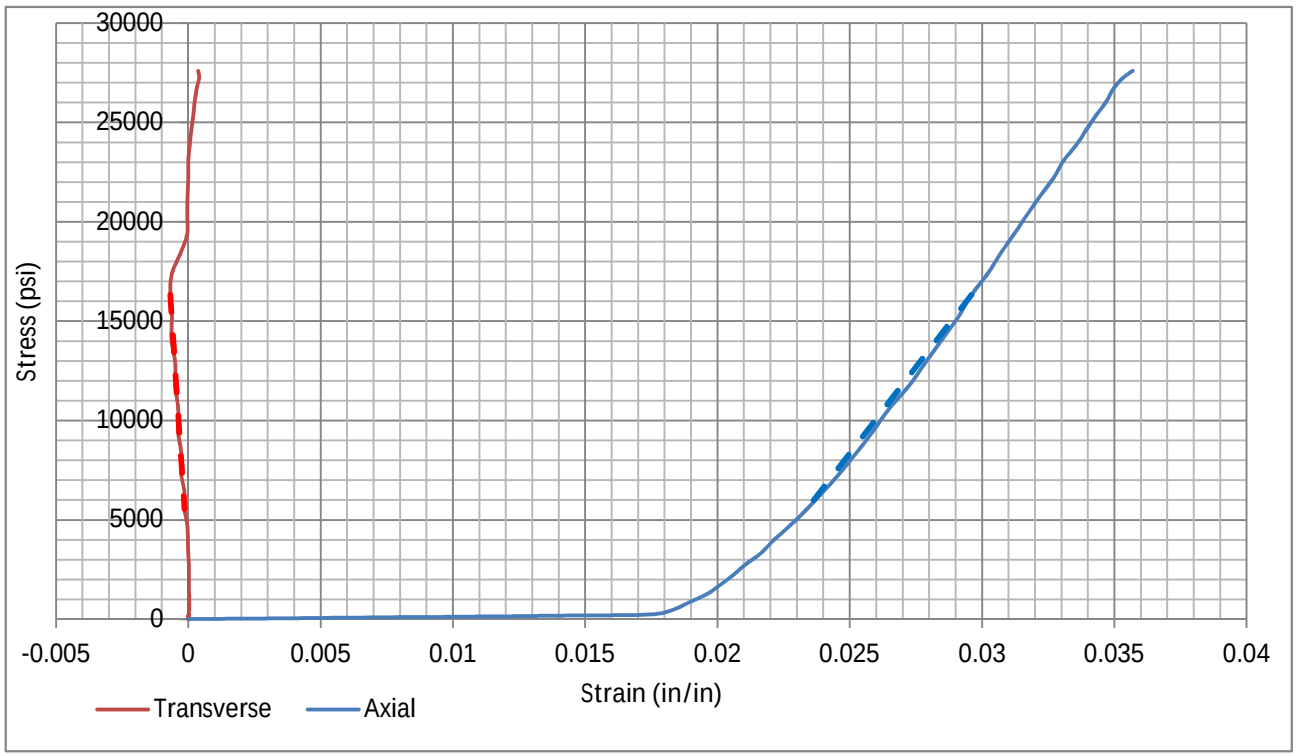
COMPRESSIVE STRENGTH AND ELASTIC MODULUS OF INTACT ROCK ASTM D7012

Terracon Consulting Engineers & Scientists

Client:	**Emergency Bridge Package**
Project:	**SCDOT**
Project Number:	**73155050F(SC 34)**
Task:	**0**
Boring:	**STB-2**
Depth:	**17.0 - 22.0**
Sample Number:	
Lab Number:	**8997**
Date Tested:	**11/3/2015**
Tested By:	**GAS**
Date Reduced:	**11/4/2015**
Reduced By:	**STT**

Granite

Core Length		Core Diameter		L/D	Mass	Density	
in	cm	in	cm	Ratio	g	lb/ft^3	g/cm^3
4.02	10.21	1.98	5.03	2.03	534.5	164.51	2.64



Failure Load	Failure Stress	Elastic Modulus, E		Poisson's Ratio,
lbs	psi	ksi	Gpa	ν
84,978	27,599	1,734	12.0	0.09

Exhibit: B-10

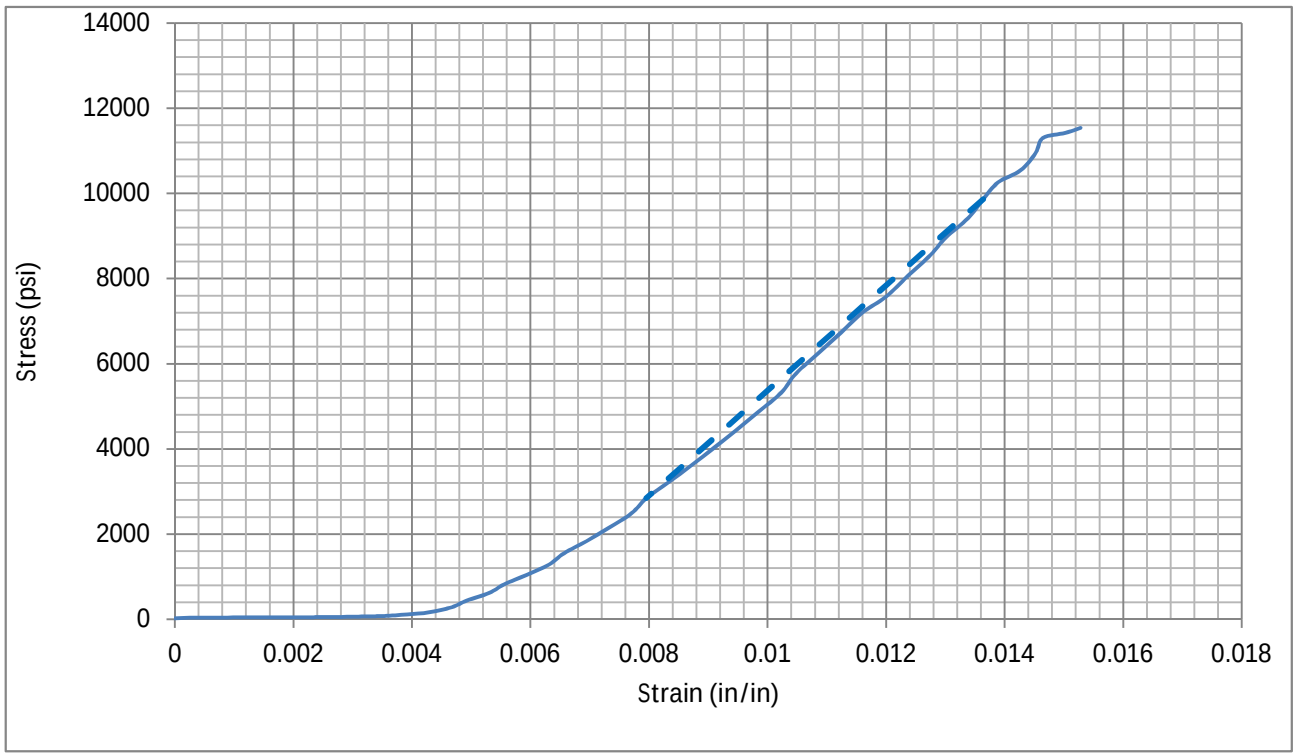
COMPRESSIVE STRENGTH AND ELASTIC MODULUS OF INTACT ROCK ASTM D7012

Terracon Consulting Engineers & Scientists

Client:	**Emergency Bridge Package**
Project:	**SCDOT**
Project Number:	**73155050F (SC 34)**
Task:	**0**
Boring:	**STB-2**
Depth:	**17.0 - 22.0**
Sample Number:	
Lab Number:	**8997A**
Date Tested:	**11/3/2015**
Tested By:	**GAS**
Date Reduced:	**11/4/2015**
Reduced By:	**STT**

Granite

Core Length		Core Diameter		L/D Ratio	Mass	Density	
in	cm	in	cm		g	lb/ft^3	g/cm^3
3.96	10.06	1.98	5.03	2.00	529.3	165.38	2.65



Unconfined Compressive Strength		Failure Load	Failure Strain
psi	kPa	lbs	%
11,539	79,555	35,528	1.53

Elastic Modulus, E	
ksi	Gpa
1,235	8.5

Exhibit: B-11

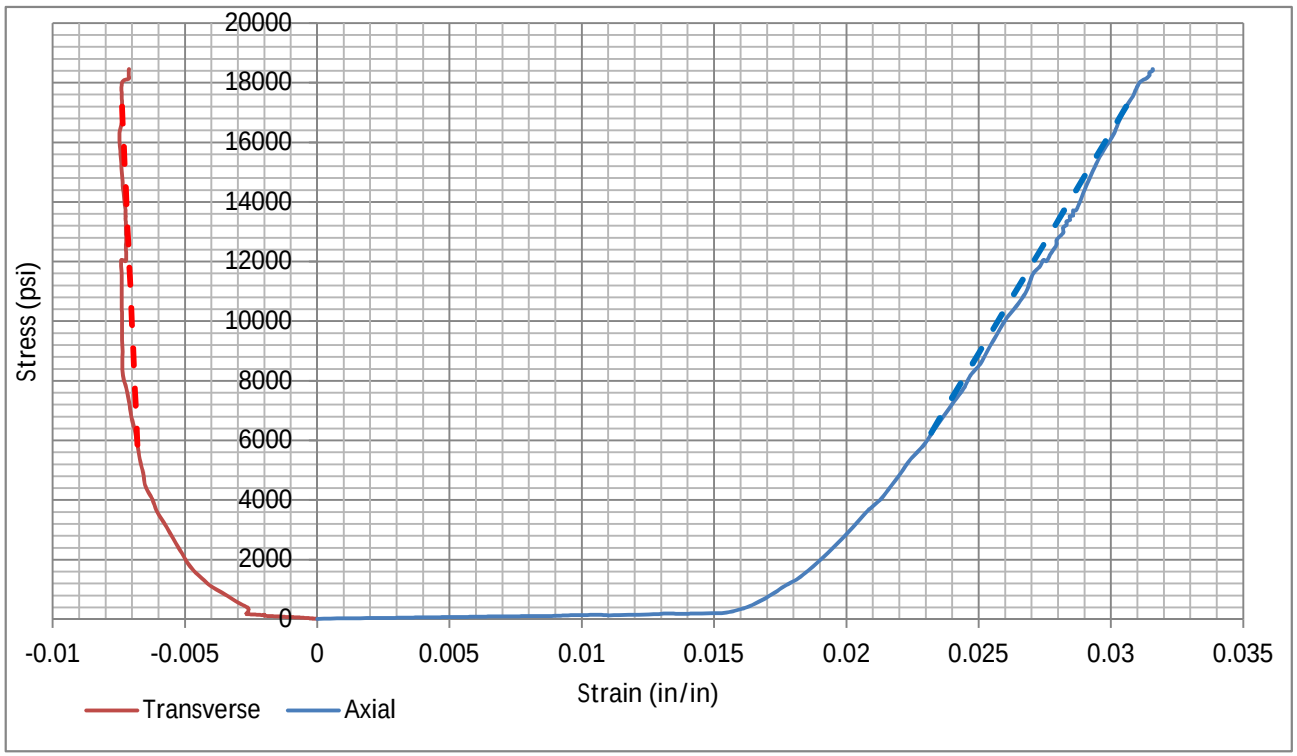
COMPRESSIVE STRENGTH AND ELASTIC MODULUS OF INTACT ROCK ASTM D7012

Terracon Consulting Engineers & Scientists

Client:	**Emergency Bridge Package**
Project:	**SCDOT**
Project Number:	**73155050F (SC 34)**
Task:	**0**
Boring:	**STB-2**
Depth:	**22.0 - 27.0**
Sample Number:	
Lab Number:	**8998A**
Date Tested:	**11/3/2015**
Tested By:	**GAS**
Date Reduced:	**11/4/2015**
Reduced By:	**STT**

Granite

Core Length		Core Diameter		L/D Ratio	Mass	Density	
in	cm	in	cm		g	lb/ft^3	g/cm^3
3.99	10.13	1.98	5.03	2.02	527.2	163.48	2.62



Failure Load	Failure Stress	Elastic Modulus, E		Poisson's Ratio,
lbs	psi	ksi	Gpa	ν
56,832	18,458	1,485	10.2	0.08

Exhibit: B-12

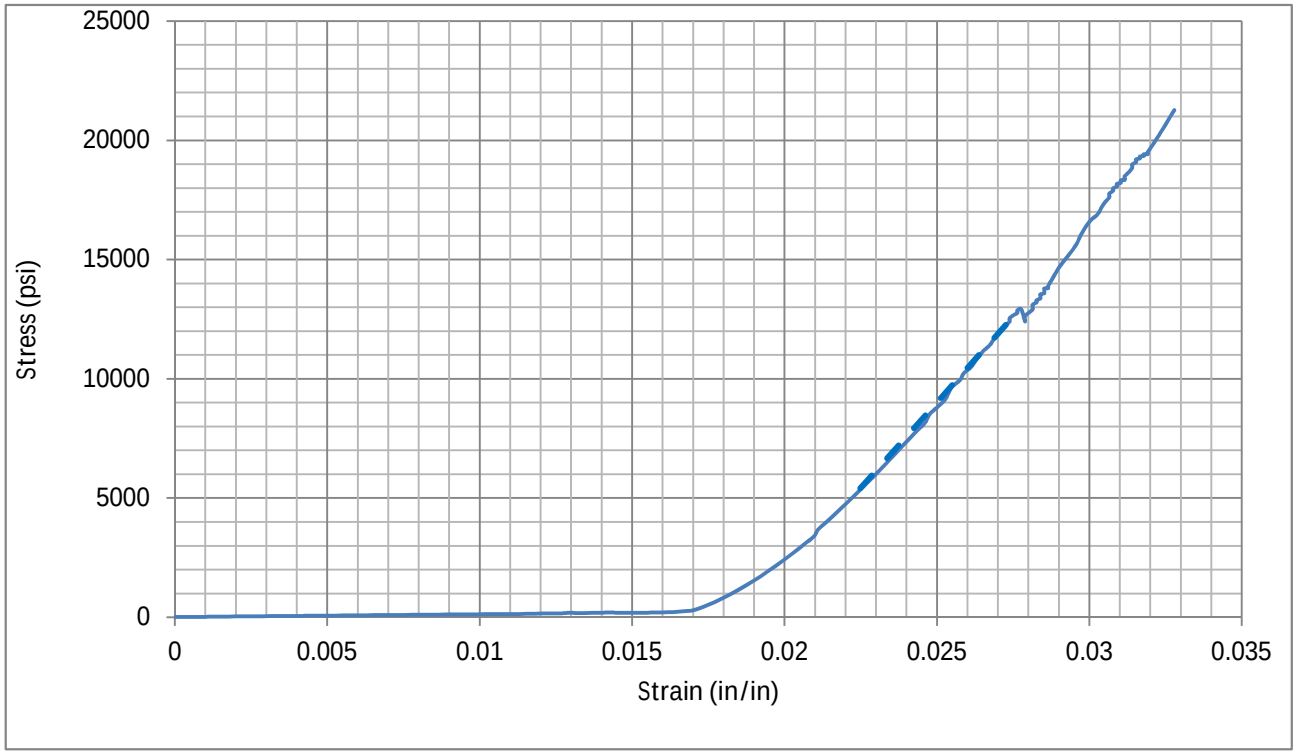
COMPRESSIVE STRENGTH AND ELASTIC MODULUS OF INTACT ROCK ASTM D7012

Terracon Consulting Engineers & Scientists

Client:	**Emergency Bridge Package**
Project:	**SCDOT**
Project Number:	**73155050F (SC 34)**
Task:	**0**
Boring:	**STB-2**
Depth:	**22.0 - 27.0**
Sample Number:	
Lab Number:	**8998**
Date Tested:	**11/3/2015**
Tested By:	**GAS**
Date Reduced:	**11/4/2015**
Reduced By:	**STT**

Granite

Core Length		Core Diameter		L/D Ratio	Mass	Density	
in	cm	in	cm		g	lb/ft^3	g/cm^3
3.98	10.11	1.98	5.03	2.01	526.2	163.56	2.62



Unconfined Compressive Strength		Failure Load	Failure Strain
psi	kPa	lbs	%
21,268	146,641	65,487	3.28

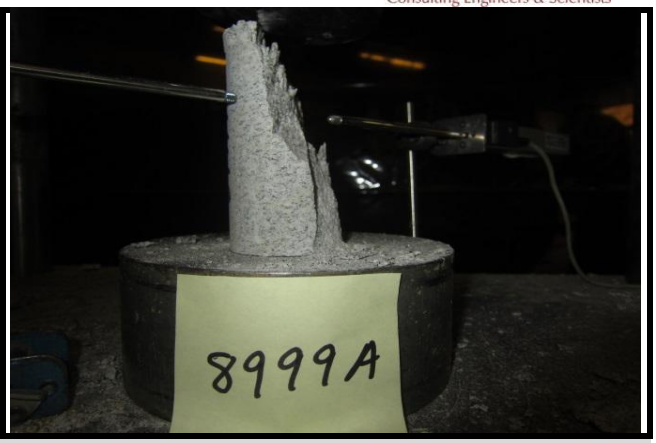
Elastic Modulus, E	
ksi	Gpa
1,434	9.9

Exhibit: B-13

COMPRESSIVE STRENGTH AND ELASTIC MODULUS OF INTACT ROCK ASTM D7012

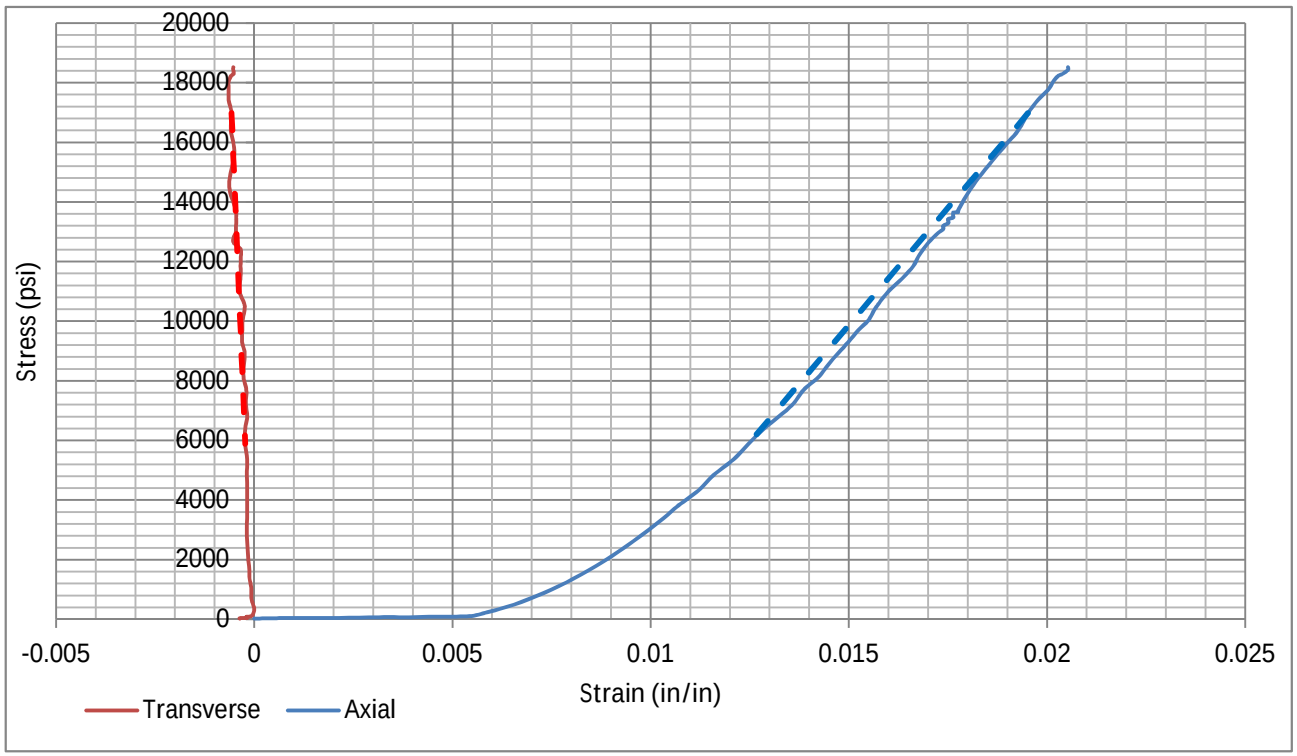
Terracon Consulting Engineers & Scientists

Client:	**Emergency Bridge Package**
Project:	**SCDOT**
Project Number:	**73155050F (SC 34)**
Task:	**0**
Boring:	**STB-2**
Depth:	**27.0 - 32.0**
Sample Number:	
Lab Number:	**8999A**
Date Tested:	**11/3/2015**
Tested By:	**GAS**
Date Reduced:	**11/4/2015**
Reduced By:	**STT**



Granite

Core Length		Core Diameter		L/D Ratio	Mass	Density	
in	cm	in	cm		g	lb/ft^3	g/cm^3
3.97	10.08	1.98	5.03	2.01	528.2	164.61	2.64



Failure Load	Failure Stress	Elastic Modulus, E		Poisson's Ratio,
lbs	psi	ksi	Gpa	ν
57,023	18,519	1,573	10.8	0.05

Exhibit: B-14

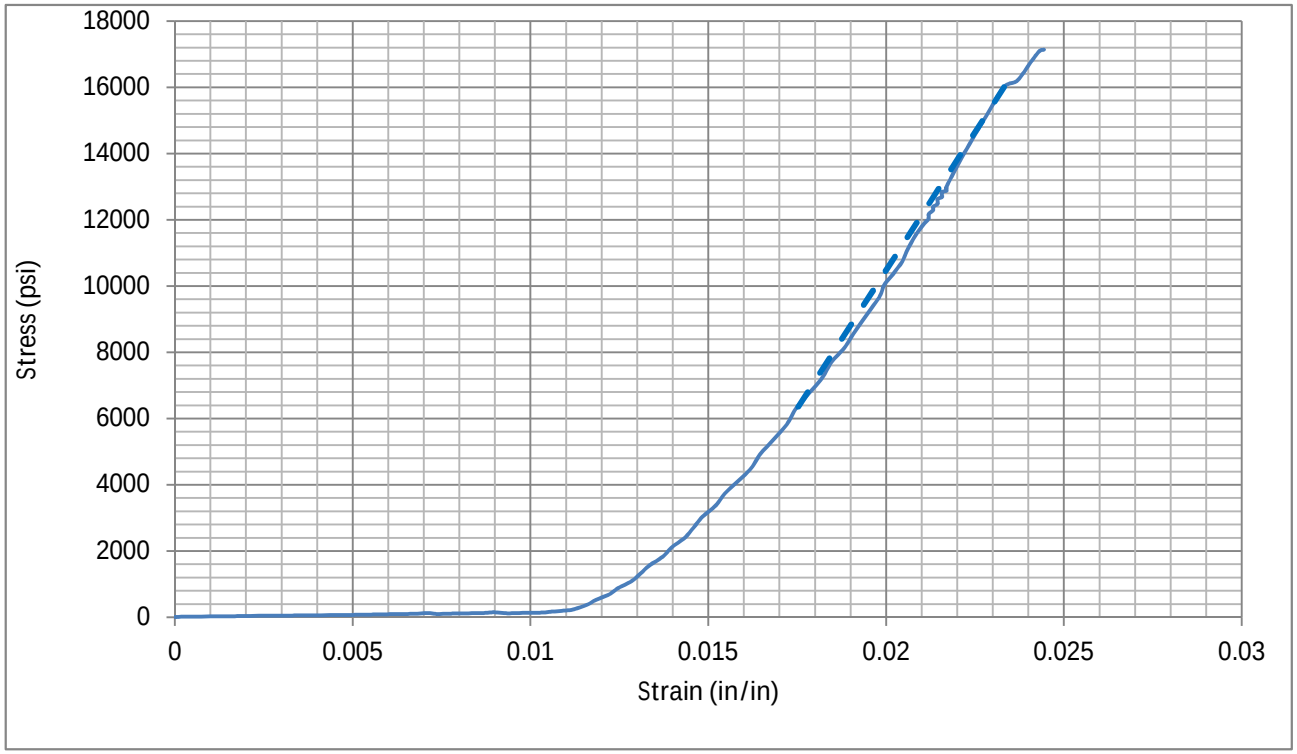
COMPRESSIVE STRENGTH AND ELASTIC MODULUS OF INTACT ROCK ASTM D7012

Terracon Consulting Engineers & Scientists

Client:	**Emergency Bridge Package**
Project:	**SCDOT**
Project Number:	**73155050F (SC 34)**
Task:	**0**
Boring:	**STB-2**
Depth:	**27.0 - 32.0**
Sample Number:	
Lab Number:	**8999**
Date Tested:	**11/3/2015**
Tested By:	**GAS**
Date Reduced:	**11/4/2015**
Reduced By:	**STT**

Granite

Core Length		Core Diameter		L/D Ratio	Mass	Density	
in	cm	in	cm		g	lb/ft^3	g/cm^3
4.01	10.19	1.98	5.03	2.03	532.8	164.38	2.63



Unconfined Compressive Strength		Failure Load	Failure Strain
psi	kPa	lbs	%
17,138	118,164	52,770	2.44

Elastic Modulus, E	
ksi	Gpa
1,667	11.5

Exhibit: B-15

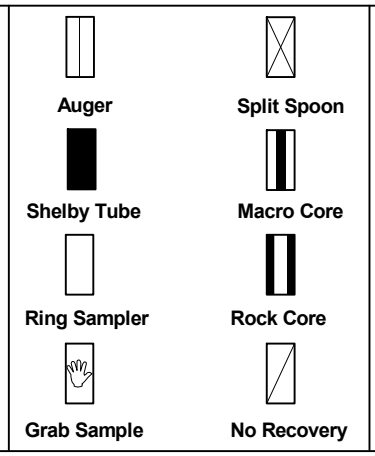
APPENDIX C - SUPPORTING DOCUMENTS

Exhibit C-1 – General Notes
Exhibit C-2 – Unified Soil Classification System

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING



WATER LEVEL

Water Initially Encountered

Water Level After a Specified Period of Time

Water Level After a Specified Period of Time

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

FIELD TESTS

(HP)	Hand Penetrometer
(T)	Torvane
(b/f)	Standard Penetration Test (blows per foot)
(PID)	Photo-Ionization Detector
(OVA)	Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance Includes gravels, sands and silts.			CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance			
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength, Qu, psf**	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**
Very Loose	0 - 3	0 - 6	Very Soft	less than 500	0 - 1	< 3
Loose	4 - 9	7 - 18	Soft	500 to 1,000	2 - 4	3 - 4
Medium Dense	10 - 29	19 - 58	Medium-Stiff	1,000 to 2,000	4 - 8	5 - 9
Dense	30 - 50	59 - 98	Stiff	2,000 to 4,000	8 - 15	10 - 18
Very Dense	> 50	≥ 99	Very Stiff	4,000 to 8,000	15 - 30	19 - 42
			Hard	> 8,000	> 30	> 42

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 - 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm
Silt or Clay	Passing #200 sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 - 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	Group Name [B]
Coarse Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]		GW	Well-graded gravel [F]
			$Cu < 4$ and/or $1 > Cc > 3$ [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F,G,H]
			Fines classify as CL or CH		GC	Clayey gravel [F,G,H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]		SW	Well-graded sand [I]
			$Cu < 6$ and/or $1 > Cc > 3$ [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G,H,I]
			Fines classify as CL or CH		SC	Clayey sand [G,H,I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A" line [J]		CL	Lean clay [K,L,M]
			PI < 4 or plots below "A" line [J]		ML	Silt [K,L,M]
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay [K,L,M,N]
			Liquid limit - not dried			Organic silt [K,L,M,O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K,L,M]
			PI plots below "A" line		MH	Elastic Silt [K,L,M]
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay [K,L,M,P]
			Liquid limit - not dried			Organic silt [K,L,M,Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

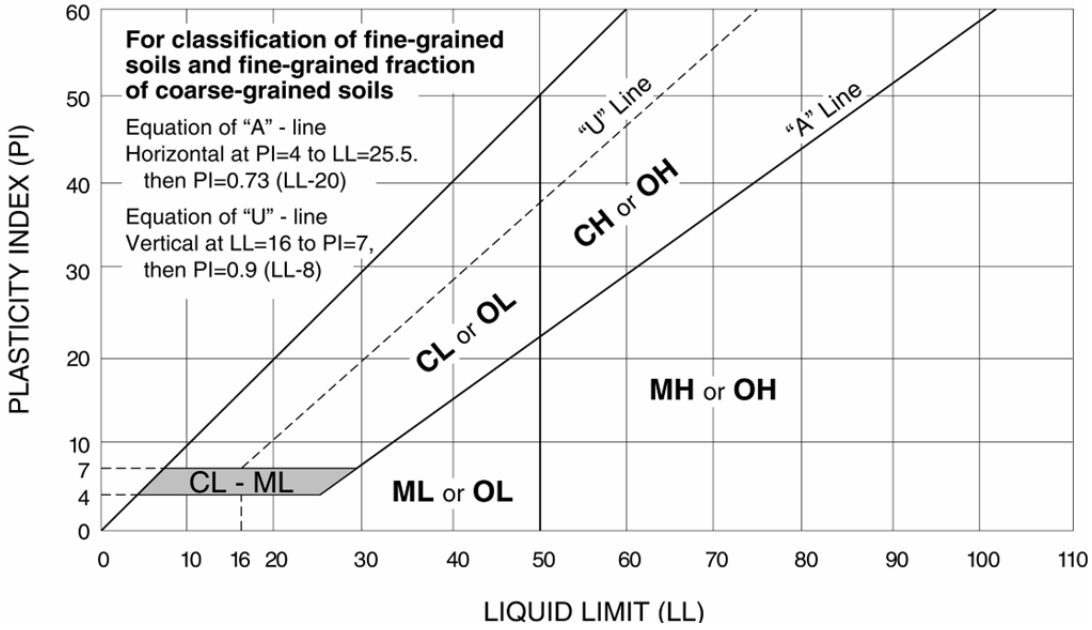
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



Terracon

Exhibit C-2