

GEOTECHNICAL AND WATER RESOURCES ENGINEERING

FACILITIES DATA REPORT ADDENDUM NO. 3

THORNTON JUSTICE CENTER FACILITIES Adams County, Colorado

Submitted to

City of Thornton 12450 Washington Street, Suite 100 Thornton, Colorado 80241

Submitted by

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> February 2022 Project 21129



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SECTION 1 – INTRODUCTION

1.1 Purpose and Objective

The purpose of this *Thornton Justice Center Facilities Data Report Addendum No. 3* (Addendum) is to present site and geotechnical data collected subsequent to completion of the Phase II remediation work. Information presented in this Addendum supplements data presented in the preceding RJH Consultants, Inc. (RJH) data reports (2015, 2016, 2018), and was collected to support concept-level and final design of expansive subgrade mitigation measures associated with Phase III.

Information regarding evaluation of mitigation concepts are presented in the *Draft Phase III Concept Memorandum* (RJH, 2022).

1.2 Background

The City of Thornton (Thornton) retained RJH to provide engineering services to evaluate expansive soil and bedrock conditions, and to assist in implementing mitigation measures to reduce the impact of expansive materials. The Thornton Justice Center (Justice Center) is located at 9551 Civic Center Drive in Thornton, Colorado and is comprised of a police building, courts building, bi-level parking structure, parking areas, and landscape areas. The Justice Center is located east of Interstate 25, west of Civic Center Drive, north of Thornton Parkway, and south of Croke Lake as shown on Figure 1.1.

The overall project was divided into three primary phases. Phase I mitigation was generally around the courts building located at the southern extent of the Justice Center. Phase II mitigation was located around the west side of the police building and lower parking lot. Phase III mitigation will address areas east of the police building, Memorial Plaza, and the upper parking area. The data collected during Phase I was provided in the *Thornton Justice Center Facilities Data Report* (RJH, 2015) and *Thornton Justice Center Facilities Data Report*, *Addendum No. 1* (RJH, 2016). Phase I construction was completed in fall 2017.

The data collected during Phase II was provided in *Thornton Justice Center Facilities Data Report Addendum No. 2* (RJH, 2018). Phase II construction was completed in October 2020.



This Phase III investigation provides additional subsurface data needed to support project design of the deep foundation required at the mechanically stabilized earth retaining wall at the north side of the upper parking area (MSEW-2), the collection trench at the east side of the upper parking area and Memorial Plaza, and the upper parking area (Project).

1.3 Scope of Services

RJH performed the following services as a part of the data collection task for Phase III:

- Prepared for field work, which included creating a Project-specific Health and Safety Plan, developing an exploration plan, and coordinating underground utility locates.
- Performed a subsurface exploration, and provided a field engineer to observe and document site conditions and subsurface conditions.
- Performed quality assurance of collected samples and draft boring logs.
- Performed laboratory testing on select soil and bedrock materials.
- Prepared final boring logs based on field logs, quality assurance, and laboratory test results.
- Prepared this Addendum.

1.4 Authorization and Project Personnel

This work was performed in general accordance with the terms and conditions of Purchase Order Number 2101396 between Thornton and RJH dated August 27, 2021.

The following personnel from RJH are responsible for the work contained in this Addendum:

Project Manager, Geotechnical Engineer:	Robert Huzjak, P.E.
Project Engineer, Civil Engineer:	Nicole Alizadeh, P.E.
Staff Geological or Geotechnical Engineers:	Claire Stewart, E.I.
	Jake Weems, E.I.





SECTION 2 – SITE INVESTIGATIONS AND EXPLORATIONS

2.1 General

The first stage of field work for the site investigation began on November 15, 2021 and concluded on November 20, 2021. The site investigation work consisted of:

• Drilling, sampling, and logging eight boreholes around the eastern perimeter of the Justice Center, in parking lots, sidewalks, and landscaped areas near MSEW-2.

The second stage of field work occurred on January 3, 2022 and consisted of drilling, sampling, and logging two boreholes in Memorial Plaza.

2.2 Subsurface Exploration

RJH retained Elite Drilling Services, LLC (Elite) of Denver, Colorado to provide drilling equipment and services. An RJH geotechnical engineer was on-site during drilling. Ten borings were drilled for the Project. B-601 through B-607B were performed during the first stage of field work, and B-608 and B-609 were performed during the second stage of field work. B-607A was abandoned after drilling approximately 46.0 feet below the ground surface (bgs) because coring equipment could not be retrieved from the bottom of the boring. B-607B was drilled approximately 5.0 feet north of B-607A to complete sampling to a depth of approximately 50.0 feet. Groundwater was not encountered in the borings. The horizontal coordinates and ground surface elevations at the boring locations are provided in Table 2.1 and the approximate boring locations are shown on Figure 2.1. Logs of each boring are provided in Appendix B.2.



Boring ID ⁽¹⁾	Northing (ft) ⁽²⁾	Easting (ft) ⁽²⁾	Ground Surface Elevation (ft) ⁽³⁾	Estimated Top of Bedrock (ft)	Total Boring Depth (ft)
B-601	1196459.73	3145241.9	5438.68	Not Encountered	10.0
B-602	1196406.83	3145245.7	5437.27	6.0	10.0
B-603	1196332.23	3145248.1	5436.29	3.5	10.0
B-604	1196222.91	3145246.4	5436.54	2.2	10.0
B-605	1196158.09	3145238.2	5437.67	6.0	10.0
B-606	1196496.12	3145233.1	5435.02	18.8	53.0
B-607A	1196447.31	3145146.8	5424.48	8.9	46.0
B-607B	1196454.78	3145146.8	5425.00	8.9	49.0
B-608	1196140.49	3145254.52	5437.67	5.7	8.5
B-609	1196096.80	3145266.18	5437.67	7.1	10.0

TABLE 2.1 SUMMARY OF BORINGS

Notes:

1. Boring locations are approximate and were located using a handheld GPS.

2. Modified Colorado State Plane NAD83, North Zone. Conversion factor is 0.999721940.

3. Vertical Datum is North American Vertical Datum of 1988.

 Ground surface elevations are approximate and based on survey data collected as part of the Phase I investigation.

Elite used a track-mounted Mobile B48X drill rig to advance B-601 through B-607B. In addition, a CME-550X rubber tire all-terrain vehicle mounted rig was used to advance B-607B from 41.0 to 49.0 feet bgs after the track-mounted drill rig became inoperable. Elite used a Geoprobe 6620DT tracked drill rig to advance B-608 and B-609. Borings were advanced through soil and bedrock using 5.75-inch outside diameter (O.D) (3.0-inch inside diameter [I.D.]), 6-inch O.D. (3.25-inch I.D.) or 7.625-inch O.D. (3.75-inch I.D.) hollow-stem augers (HSA). HSA samples were generally obtained at 2.5- or 5.0-foot intervals using the following methods:

- 1.375-inch I.D. (2.0-inch O.D.) standard split-spoon sampler (American Society for Testing and Materials International [ASTM] D1586). These samples are denoted with the prefix "S" on the boring logs.
- 2.5-inch I.D. (3.0-inch O.D.) ring-lined split barrel (Modified California) sampler (ASTM D3550). These samples are denoted with the prefix "MC" on the boring logs.

B-606 and B-607A were advanced through bedrock using 3-inch O.D. (1.875-inch I.D.) NQ wireline coring. B-607B was advanced through bedrock using HSA because coring equipment was abandoned in B-607A.



A Standard Penetration Test (SPT) was performed in general accordance with ASTM D1586 at the location of each split-spoon sample. At each SPT location, RJH recorded a "standard penetration resistance" or SPT N-value. The SPT N-value equals the number of blows that are required from a 140-pound hammer dropped 30 inches to drive a standard split-spoon sampler from 6 to 18 inches into the native soil or bedrock. The SPT N-values presented in this Addendum have not been adjusted to account for overburden pressures, hammer energy, etc. Sampler refusal was defined as 50 blows for less than 6 inches of penetration prior to advancing 18 inches. Some sample locations encountered refusal prior to advancing 18 inches. A summary of SPT N-values is presented in Table 2.2

Geologic Unit	Number of Tests	Number of Tests Reporting Refusal	Minimum N-Value	Maximum N-Value	Average N-Value
Fill	21	0	4	20	11
Denver Formation	19	2	11	43	24

SUMMARY OF SPT N-VALUES

TABLE 2.2

Notes:

1. The presented N-values are field measurements and were not adjusted to account for overburden pressures, hammer energy, etc.

2. Blow counts obtained while advancing Modified California samplers (10 samples) are not included in the tabulated data.

3. Tests that reported N-value as refusal (2 samples) were omitted while identifying the maximum and calculating the average.

Hammer blow counts were recorded for each 6-inch interval of penetration while advancing Modified California samplers. These blow counts differ from SPT data; however, blow counts can be used to monitor the relative consistency (i.e., soil stiffness or density) of the sampled materials. Hammer blow counts measured when advancing Modified California samplers are presented on the boring logs and figures but do not appear in the text or tables of this Addendum.

Bedrock was sampled continuously in B-606 and B-607A using NQ-size (1.875-inch core diameter, 3-inch hole diameter) wireline rock coring techniques in general accordance with ASTM D2113. Bedrock core runs ranged in length from 0.5 to 5.0 feet and were generally 5 feet.

Sampling in B-607B began at a depth of 20.0 feet bgs. This depth was selected to correlate bedrock material properties obtained from Modified California samplers, and standard split-spoon samplers in B-607B to coring information obtained in B-607A.



Borings were backfilled with cement-bentonite grout. Borings advanced through landscaped areas were capped with soil cuttings and borings advanced through pavements were capped with ready-mix concrete or asphalt.

2.3 Logging and Sample Package Procedures

RJH observed drilling procedures, recorded relevant drilling information, photographed and visually classified the soil and bedrock samples, and prepared a field log of each boring. Photographs of selected site and boring activities are presented in Appendix A.

In the field, soil samples were classified in general accordance with ASTM D2488 (visual-manual method) and rock samples were classified in general accordance with the U.S. Bureau of Reclamation (USBR) Engineering Geology Field Manual (USBR, 2001).

Collected soil samples were packaged and transported in general accordance with ASTM D4220. Recovered split-spoon samples were placed in sealed plastic bags to help preserve the natural moisture content of the material. Samples recovered from Modified California samplers were kept in brass liners that were capped and sealed with vinyl tape.

Bedrock core samples were photographed, logged, and placed in wooden core boxes. Core samples were wrapped in plastic to help preserve the natural moisture content, and some core samples were also wrapped with tape to maintain the samples in compression for possible laboratory testing.

RJH prepared final boring logs based on field and laboratory classifications, quality assurance review of samples, and indirect observations (i.e., drill chatter, drill resistance, etc.) as appropriate. Between recovered samples, the lithology presented on the boring logs is interpreted. Explanations of the soil and rock descriptors used on the boring logs are presented in Appendix B.1. Boring logs are provided in Appendix B.2.





SECTION 3 – LABORATORY TESTING

Laboratory tests were performed on select samples of soil and bedrock collected during the subsurface exploration. RJH retained Advanced Terra Testing of Lakewood, Colorado to perform the laboratory tests. The tests consisted of:

- Ten natural moisture content and density tests (ASTM D2216 and ASTM D7263).
- Six Atterberg limits tests (ASTM D4318).
- Two grain-size analyses (ASTM D6913).
- Two grain-size analyses with hydrometer (ASTM D7928 and ASTM D6913).
- Three minus No. 200 sieve analyses (ASTM D1140).
- Five swell-consolidation tests (ASTM D4546 Denver Method Pre-2008).
- Four unconfined compressive strength (UCS) tests (ASTM D7012).

Laboratory test results are provided in Appendix C and are summarized in Table 3.1. Atterberg limits and grain-size analysis test results are presented graphically on Figures 3.1 and 3.2, respectively.



							Atterberg Limits		Gradation				Swell / Consolidation ⁽²⁾		
											Fines (<#	200) (%)			
				USCS Classification							Silt (<#200	Clay			Unconfined
		Тор	Bottom	(Group Symbol) or	Moisture	Dry Unit	Liquid	Plasticity	Gravel (<3"	Sand (<#4	to >0.002	(<0.002	Inundation	Swell /	Compression
Boring ID	Sample ID	Depth	Depth	Bedrock Description ⁽¹⁾	Content	Weight	Limit	Index, PI	to >#4)	to >#200)	mm)	mm)	Pressure	Consolidation	Strength
		(ft)	(ft)		(%)	(pcf)	(%)	(%)	(%)	(%)	(%)	(%)	(pcf)	(%) ⁽³⁾	(psf)
								Fill							
B-602	S-1	1.0	2.5	Clayey Sand (SC)					0	53					
B-603	S-1	1.0	2.5	Fat Clay (CH)			52	33	1	7					
B-607A	S-1	1.0	2.5	Fat Clay with Sand (CH)					2	14					
B-605	S-2	3.5	5.0	Sandy Fat Clay (CH)			57	38	6	28					
B-607A	MC-3	6.5	7.0	Fat Clay with Sand (CH)	23.4	96.6	56	39					2700	-0.53	
B-607A	MC-3	7.0	7.5	Fat Clay with Sand (CH)	23.1	102.0									3435
B-606	MC-4	9.5	10.0	Lean Clay with Sand (CL)	22	103.5	49	34					210	0.70	
Denver Formation															
B-604	S-3	6.0	7.5	Claystone					0	3	97	7			
B-606	MC-7	21.0	21.5	Claystone	20.4	104.7									5379
B-607A	NQ-2	22.6	23.1	Claystone	18.9	108.1	68	43							
B-607A	NQ-6	35.0	35.6	Clayey Sandstone	19	110.3			0	55	4	5	5989	-0.14	
B-606	NQ-5	42.0	42.4	Claystone	15.7	117.0									20541
B-606	NQ-5	42.4	42.8	Claystone	16.2	111.7	59	30	0	15	85	5	3578	1.44	
B-606	NQ-7	50.7	51.2	Claystone	18.2	111.4							4600	0.41	
B-606	NQ-7	50.7	51.2	Claystone	16.1	113.7									8971
1 Beard on visual/manual electrification and laboratory text results															

TABLE 3.1 SUMMARY OF LABORATORY TEST RESULTS

Based on visual/manual classification and laboratory test results. Tests performed using ASTM D4546 Pre-2008 Denver Method.

1. 2. 3. Positive values indicate swell and negative values indicate consolidation.







SECTION 4 – SUBSURFACE CONDITIONS

4.1 General

Ten geotechnical borings were drilled for this phase of work and encountered materials similar to those identified in borings from previous phases. Boring locations are presented on Figure 2.1, and boring logs are in Appendix B. Subsurface Sections A and B are presented on Figures 4.2 and 4.3 respectively, and an explanation of the subsurface sections is provided on Figure 4.1. Subsurface materials encountered in the borings consisted of pavement, fill, and bedrock. Bedrock was encountered in all borings except for B-601, which was located in MSEW-2 fill. Descriptions of the materials encountered near the collection trench, the upper parking area, and MSEW-2 are provided in the following sections.

Groundwater was not encountered in the borings drilled for Phase III. A water level measurement was recorded at 10.1 feet bgs in B-606, but is considered to represent the level of drilling fluids within the borehole.

4.2 Collection Trench

B-601 through B-605, B-608, and B-609 are considered collection trench borings. These borings were selected based on the general location near the concept-level alignment for a collection trench in the east side of the upper parking area.

4.2.1 Fill

Fill was encountered in all of the collection trench borings during Phase III. The top of fill ranged from 0.5 to 0.9 feet bgs, and the bottom of fill ranged from 2.2 to 10.0 feet bgs. Fill near the collection trench primarily consisted of medium to high plasticity clay with various amounts of sand and gravel sized particles. Visual classification included fat clay with sand, fat clay, sandy fat clay, sandy lean clay, and lean clay. Sand content typically ranged from 5- to 45-percent, and gravel content was typically less than 10-percent with a maximum particle size of 0.75-inch. The stiffness of the fill ranged from soft to hard and was typically medium stiff to stiff.

Coarse-grained fill was encountered in B-602 at a depth from 0.9 to 4.3 feet and in B-609 at a depth from 0.5 to 2.5 feet and consisted of clayey sand. The coarse-grained fill was medium dense and the maximum particle size was about 1.25-inches.



Unconfined compression strength from pocket penetrometer ranged from 0.75 to 4.25 tons per square foot (tsf) and was typically 2.0 tsf. The apparent moisture content of fill was generally dry to moist. Reaction with hydrochloric acid was typically weak to strong.

Index testing was performed on three samples of fill near the collection trench, and the results included:

- Liquid limit ranging from 52 to 57 percent with an average of 55 percent.
- Plasticity index ranging from 33 to 38 percent with an average of 36 percent.
- Fines content ranging from 47 to 92 percent with an average of 69 percent.
- Sand content ranging from 7 to 53 percent with an average of 29 percent.
- Gravel content ranging from 0 to 6 percent with an average of 2 percent.

4.2.2 Denver Formation Bedrock

Denver Formation bedrock was encountered in all of the collection trench except in B-601 which was located in MSEW-2 fill. The top of bedrock ranged from 2.2 to 7.1 feet bgs. The bottom of bedrock extended to the bottom of each boring except in B-601. Denver Formation near the collection trench was classified as medium to high plasticity claystone. Sand content was typically less than 10-percent with no gravel. Weathering ranged from moderately weathered to decomposed and was typically very intensely weathered. Fracturing could not be identified in the bedrock samples near the collection trench because samples were obtained using split-spoon or Modified California samplers and were disturbed. Unconfined compression strength from pocket penetrometer ranged from 2.0 to greater than 4.5 tsf and were typically 3.0 to 4.0 tsf. The apparent moisture content was generally dry to moist. Occasional iron staining and calcium seams and nodules were present in bedrock. The Denver Formation was typically light brown to light gray to gray, and the bedrock hardness was very soft.

One grain-size analysis test was performed on a sample of the Denver Formation near the collection trench, and resulted in 97 percent fines content and 3 percent sand content.

4.2.3 Previous Investigations

Phase III geotechnical data near the collection trench is generally in agreement with geotechnical data near the collection trench from Phase II. Phase II geotechnical data generally classified fill with lower plasticity and bedrock as less weathered than Phase III. Figure 2.1 presents the location of previously drilled borings near the proposed



collection trench which include B-303A and B-305. The subsurface conditions in B-303A consisted of asphalt pavement from 0.0 to 0.4 feet, fill from 0.4 to 2.6 feet, and bedrock extending from 2.6 feet to the bottom of the boring at 20.5 feet. The subsurface conditions in B-305 consisted of concrete pavement from 0.0 to 0.5 feet, fill from 0.5 to 12.0 feet, and bedrock extending from 12.0 feet to the bottom of the boring at 19.7 feet.

Fill near the collection trench from Phase II primarily consisted of low to medium plasticity fine-grained material with soil classifications of sandy lean clay, lean clay with gravel, and lean clay. One medium to high plasticity fine-grained material classified as fat clay with sand. Fine-grained material ranged from very soft to stiff and was typically medium stiff to stiff. Fine-grained fill generally consisted of 25 to 35 percent sand and less than 10 percent gravel. Some of the fill consisted of coarse-grained material with the classification of clayey sand. Coarse-grained material was medium dense. Fill was moist to very moist with some claystone fragments in the soil matrix. Unconfined compression strength from pocket penetrometer ranged from 1.0 to 1.5 tsf.

Denver Formation bedrock near the collection trench from Phase II was classified as low to high plasticity claystone. Sand content was typically less than 10 percent with no gravel content. Weathering ranged from fresh to intensely weathered and was typically classified as moderately to intensely weathered. Rock hardness classified as very soft rock. Occasional iron staining and calcium seams and nodules were present in bedrock. Groundwater was not encountered in the borings.

4.3 Upper Parking Area

No borings drilled for this phase of work were considered within the area identified as the upper parking area; however, a discussion of data from previous investigations for the upper parking area is provided below.

4.3.1 Previous Investigations

Figure 2.1 presents the location of previously drilled borings near the upper parking area, which include B-303B(P), B-304(P), B-103(P), and B-104(P). The subsurface conditions typically consisted of pavement from 0.0 to 0.5 feet over fill that extended from 10.5 to 32.8 feet, and bedrock below the fill to the bottom of each boring, which ranged from 15.0 to 50.0 feet. Generally, the top of rock elevation decreased from east to west.

Fill beneath the upper parking area was primarily classified as medium to high plasticity fine-grained material with soil classifications of fat clay with sand, sandy fat clay, and fat



clay, with some low to medium plasticity fine-grained material that classified as lean clay, sandy lean clay, and lean clay with sand. Fine-grained material ranged from soft to very stiff and was typically medium stiff to stiff. Fine-grained fill generally consisted of 20 to 30 percent sand and less than 5 percent gravel. Some of the fill was classified as coarse-grained material with the soil classifications of poorly graded sand with clay and gravel, clayey sand with gravel, well graded sand with silt and gravel, clayey sand, silty sand with gravel, and well graded sand with clay and gravel. Coarse-grained material was medium dense to very dense and was typically medium dense. Fill was typically slightly moist to moist with some claystone fragments in the soil matrix. Unconfined compression strength from pocket penetrometer ranged from 1.5 to 3.2 tsf and were typically 2.0 tsf.

Denver Formation bedrock beneath the upper parking area was primarily classified as low to high plasticity claystone with some classifications of low to medium plasticity silty claystone. Plasticity of claystone beneath the upper parking area from previous investigations was based on laboratory test results and visual classification. Sand content was typically less than 10 percent with no gravel content. Weathering ranged from fresh to intensely weathered and was typically moderately weathered. Bedrock hardness was very soft. Unconfined compression strength from pocket penetrometer was greater than 4.5 tsf. Occasional iron staining on fracture surfaces and calcium seams and nodules were present in bedrock. Groundwater was not encountered in the borings.

4.4 MSEW-2

B-606, B-607A, and B607B are considered MSEW-2 borings. The locations of these borings were generally in the vicinity of existing MSEW-2 and were selected to evaluate the subsurface conditions in the vicinity of the wall. The subsurface conditions in B-607B from 0.0 to 20.0 feet are considered to be the same as the subsurface conditions encountered in B-607A because B-607B was located about five feet north of B-607A.

4.4.1 Fill

Fill was encountered in all of the MSEW-2 borings, which were drilled on the downslope (north) side of the MSEW-2 within a sloped, landscaped area. Fill was encountered at the ground surface, and the bottom of fill ranged from 8.9 to 18.8 feet bgs. Fill near MSEW-2 primarily consisted of medium to high plasticity fine-grained clay with soil classifications of lean clay with sand, fat clay with sand, sandy lean clay, and sandy fat clay. Stiffness ranged from medium stiff to hard and was typically stiff to very stiff. Sand content typically ranged from 10 to 35 percent, and gravel content was typically



less than 10 percent with a maximum particle size of about 1.25-inches. Unconfined compression strength from pocket penetrometer ranged from 2.0 to 4.5 tsf and was typically 3.0 tsf. The apparent moisture content of fill was generally dry to moist. Reaction with hydrochloric acid was typically weak to strong.

Laboratory testing was performed on four samples of fill near MSEW-2, and the results included:

- Moisture content ranging from 22.0 to 23.4 percent with an average of 22.8 percent.
- Dry unit weight ranging from 97 to 104 pounds per cubic foot (pcf) with an average of 101 pcf.
- Liquid limit ranging from 49 to 56 percent with an average of 53 percent.
- Plasticity index ranging from 34 to 39 percent with an average of 37 percent.
- Fine content of 84 percent, sand content of 14 percent, and gravel content of 2 percent.
- Consolidation of -0.53 percent with inundation pressure of 2,700 pounds per square foot (psf) and swell of 0.70 percent with inundation pressure of 210 psf.
- Unconfined compression strength of 3,435 psf.

4.4.2 Denver Formation Bedrock

Denver Formation bedrock was encountered in all of the MSEW-2 borings. The top of bedrock ranged from 8.9 to 18.8 feet bgs, and bedrock extended to the bottom of each boring. Denver Formation near MSEW-2 primarily consisted of medium to high plasticity claystone. Sand content was typically less than 10 percent with no gravel content. A thin layer of clayey sandstone was encountered at B-606 from elevation (El.) 5390.1 to El. 5388.9 (44.9 to 46.1 feet bgs) and El 5389.9 to El. 5387.7 (34.6 to 36.8 feet bgs) at B-607A. The fines content of clayey sandstone ranged from 25- to 50-percent and consisted of low to medium plasticity fines. A layer of sandstone was encountered in B-607B from El. 5382.5 to El. 5376.3 (42.5 to 48.7 feet bgs). The fines content of sandstone ranged from 5- to 15-percent and consisted of low to medium plasticity fines. Gravel was not present in bedrock. Weathering ranged from fresh to decomposed with claystone typically ranging from moderately to intensely weathered, and coarse-grained bedrock typically ranging from slightly to intensely weathered. Reduction of weathering intensity was not apparent with depth. Fracturing density ranged from unfractured to very intensely fractured. Claystone was typically slightly to moderately fractured, and



coarse-grained bedrock was typically slightly fractured. Pattern of fracturing density was not apparent with depth. Randomly oriented fractures were noted throughout the claystone bedrock. Bedrock hardness ranged from soft to very soft. Unconfined compression strength from pocket penetrometer ranged from 3.0 to 4.0 tsf. The apparent moisture content of the bedrock was generally dry to moist. Occasional iron staining and calcium seams and nodules were present in bedrock with trace manganese staining. The bedrock was typically light brown to light gray to gray.

Laboratory testing was performed on seven samples of the Denver Formation near MSEW-2, and the results included:

- Moisture content ranging from 15.7 to 20.4 percent with an average of 17.8 percent.
- Dry unit weight ranging from 105 pcf to 117 pcf with an average of 111 pcf.
- Liquid limit ranging from 59 to 68 percent with an average of 64 percent.
- Plasticity index ranging from 30 to 43 percent with an average of 37 percent.
- Clayey sandstone fines content of 45 percent, sand content of 55 percent, and no gravel content.
- Claystone fines content of 85 percent, sand content of 15 percent, and no gravel content.
- Consolidation of -0.14 percent with inundation pressure of 5,989 psf, swell of 1.44 percent with inundation pressure of 3,578 psf, and swell of 0.41 percent with inundation pressure of 4,600 psf.
- Unconfined compression strength of claystone specimens ranging from 5,379 psf to 20,541 psf with an average of 11,630 psf.

4.4.3 Previous Investigations

Phase III geotechnical data near MSEW-2 is generally in agreement with geotechnical data near the MSEW-2 from Phase II. Phase II geotechnical data generally classified fill with less sand content and softer stiffness and bedrock as slightly less weathered than Phase III. Figure 2.1 presents the location of previously drilled borings near MSEW-2 which include B-301(P), B-501, B-502, and B-503. B-501 and B-503 were drilled on the upslope (south) side of MSEW-2 within the upper parking area while B-301(P) and B-502 were drilled on the downslope (north) side of the MSEW-2 within a sloped, landscaped area. Depth of fill is greater at B-501 and B-503 than at B-301(P) and B-502



because the borings on the upslope side of the wall advanced through MSEW-2 backfill, and foundation fill and borings on the downslope side of the wall advanced through foundation fill only. However, geotechnical data of the MSEW-2 backfill was similar to the foundation fill, and the soils were grouped together as one unit. The subsurface conditions of the Phase II borings typically consisted of asphalt pavement from 0.0 to 0.7 feet (for B-501 and B-503) over fill that extended to bottom depth ranging from 9.5 to 32.0 feet, and bedrock below the fill to the bottom of each boring which ranged from 29.0 to 51.0 feet.

Fill near MSEW-2 from Phase II primarily consisted of medium to high plasticity finegrained material with soil classifications of fat clay, fat clay with sand, and sandy fat clay with one soil classification of lean clay. Fine-grained material ranged from very soft to very stiff and was typically medium stiff. Fine-grained fill generally consisted of 15 to 25 percent sand and less than 10 percent gravel. Coarse-grained fill was encountered in B-503 from 29.5 to 32.0 feet and consisted of clayey sand. Coarse-grained material was medium dense. Fill was typically moist to very moist with some claystone fragments in the soil matrix. Reaction to hydrochloric acid was typically weak to strong. Unconfined compression strength from pocket penetrometer ranged from less than 0.5 to 3.0 tsf and was typically 1.5 tsf.

Denver Formation bedrock near MSEW-2 from Phase II was classified as medium to high plasticity claystone. Sand content was typically less than 10 percent with no gravel content. Weathering ranged from slightly to very intensely weathered and was typically classified as moderately weathered. Rock hardness classified as very soft rock. Unconfined compression strength from pocket penetrometer ranged from 2.5 to greater than 4.5 tsf and was typically 4.0 tsf. Iron and manganese staining was common on discontinuity surfaces. Groundwater was not encountered in the borings during Phase II.





P: \21129 - JUSTICE CENTER PHASE II\CAD\FIGURES\GDR\21129_PHASEII_BORINGS.DWG 2/7/2022 3:44 PM





30 T	ÜÒÚÜU ÖWÔÒÁ ÞÁÔU ŠUÜ PRELIMINARY NOT FOR CONSTRUCTION
ŰÞÁRWÙVÔÔĊÁÔÒÞVÒÜ ÚPOÈÙÒÁQQ	Ù₩ÓÙ₩ÜØŒĴÒÂÙÒÔVQJÞÁÓ
JRÒÔVÁÞUĚÆFFGJ	Ø^à¦˘æ ^ˆ ÁG€GG Figure 4.3

SECTION 5 – LIMITATIONS

This Addendum has been prepared for the exclusive use of RJH and Thornton to support mitigation work around the east side of the police building, Memorial Plaza, and the upper parking area. RJH is not responsible for technical interpretations of this data by others. RJH has endeavored to conduct our professional services for this Project in a manner consistent with a level of care and skill ordinarily exercised by members of the engineering profession currently practicing in Colorado under similar conditions as this Project. RJH makes no other warranty, expressed or implied.

The methods used in this investigation indicate subsurface conditions only at the specific locations, where samples were obtained, only at the time they were obtained, and only to the depths penetrated. Samples cannot be relied on to accurately reflect variations in subsurface conditions that may exist between sampling locations.

The nature and extent of variations between borings may not become evident until construction. Timely and comprehensive observation and evaluation of actual subsurface conditions, supported by appropriate field and laboratory testing, will be critical during construction as variations from anticipated subsurface conditions may be encountered.



SECTION 6 – REFERENCES

- RJH Consultants, Inc. (2015). *Thornton Justice Center Facilities Data Report Justice Center Expansive Soils Project*, January.
- RJH Consultants, Inc. (2016). Thornton Justice Center Facilities Data Report Addendum No.1 – Justice Center Expansive Soils Project, May.
- RJH Consultants, Inc. (2018). Thornton Justice Center Facilities Data Report Addendum No.2 – Justice Center Expansive Soils Project, December.
- RJH Consultants, Inc. (2022). Draft Phase III Concept Memorandum Thornton Justice Center Expansive Soil Mitigation Project, January.
- U.S. Bureau of Reclamation (USBR) (2001). Engineering Geology Field Manual.



APPENDIX A

PHOTOGRAPHS



Photograph 1: B-601 S-1 from 1.0 to 2.5 feet below ground surface (bgs). Typical split spoon sample of asphalt pavement.



Photograph 2: B-602 S-1 from 1.0 to 2.5 feet bgs. Typical split spoon sample of fill classified as sandy fat clay.

11/16 21129 B-606 -150) 13.5 bottom got top A PROVINCE 8

Photograph 3: B-606 S-5 from 13.5 to 15.0 feet bgs. Typical split spoon sample of fill classified as fat clay with sand.



Photograph 4: B-605 S-2 from 3.5 to 5.0 feet bgs. Typical split spoon sample of fill classified as fat clay.



Photograph 5: B-603 S-1 from 1.0 to 2.5 feet bgs. Typical split spoon sample of fill classified as lean clay.



Photograph 6: B-604 S-3 from 6.0 to 7.5 feet bgs. Typical split spoon of Denver Formation classified as intensely to very intensely weathered claystone.



Photograph 7: B-607A S-5 from 13.5 to 15.0 feet bgs. Typical split spoon sample of Denver Formation classified as moderately to intensely weathered claystone.



Photograph 8: B-606 NQ-2 from 28.0 to 32.5 feet bgs. Typical NQ core run of Denver Formation classified as slightly to intensely weathered claystone.



Photograph 9: B-607A NQ-3 from 26.8 to 29.0 feet bgs. Typical NQ core run of Denver Formation classified as moderately weathered to decomposed claystone.



Photograph 10: B-606 NQ-6 from 43.0 to 48.0 feet bgs. Typical NQ core run of Denver Formation classified as moderately to very intensely weathered claystone from 43.0 to 44.9 feet and 46.1 to 48.0 feet and fresh to slightly weathered clayey sandstone from 44.9 to 46.1 feet.



Photograph 11: B-607A NQ-1 through NQ-6 from 16.5 to 38.0 feet bgs. B-607A Core Box 1 of 2 of Denver Formation typically classified as moderately to very intensely weathered claystone.



Photograph 12: B-607B S-5 from 48.5 to 49.0 feet bgs. Typical split spoon of Denver Formation classified as moderately to intensely weathered sandstone.

APPENDIX B

BORING LOGS

- B.1 RJH SOIL AND ROCK DESCRIPTORS
- B.2 BORING LOGS

APPENDIX B.1

RJH ROCK AND SOIL DESCRIPTORS
SOIL CLASSIFICATION FLOWCHARTS AND DESCRIPTION CRITERIA

COARSE GRAINED SOILS

(< 50% FINES)



B) FLOWCHART APPLIED TO FIELD CLASSIFIED SOIL SAMPLES. ADAPTED FROM ASTM D 2488 DESCRIPTION AND IDENTIFICATION OF SOILS (VISUAL-MANUAL PROCEDURE).

GROUP SYMBOL

		≤5% FINES	WELL GRADED — POORLY GRADED —		GW	<pre> <15% SAND </pre> ≥15% SAND <15% SAND ≥15% SAND	→ WELL GRADED GRAVEL → WELL GRADED GRAVEL WITH SAND → POORLY GRADED GRAVEL → POORLY GRADED GRAVEL WITH SAND
	VEL > %SAND		WELL GRADED	FINES = ML or MH	─ - GW-GM < ─ - GW-GC <	<15% SAND ≥15% SAND <<15% SAND ≥15% SAND	→ WELL GRADED GRAVEL WITH SILT → WELL GRADED GRAVEL WITH SILT AND SAND → WELL GRADED GRAVEL WITH CLAY → WELL GRADED GRAVEL WITH CLAY AND SAND
NEO	GRA %GRAVEL	FINES \	POORLY GRADED <	FINES = ML or MH	─ → GP-GM < ─ → GP-GC <	<15% SAND ≥15% SAND <<15% SAND ≥15% SAND	→ POORLY GRADED GRAVEL WITH SILT → POORLY GRADED GRAVEL WITH SILT AND SAND → POORLY GRADED GRAVEL WITH CLAY → POORLY GRADED GRAVEL WITH CLAY AND SAND
		l≥15% FINES		FINES = ML or MH	GM GC	 <15% SAND ≥15% SAND <15% SAND <15% SAND ≥15% SAND 	→ SILTY GRAVEL → SILTY GRAVEL WITH SAND → CLAYEY GRAVEL → CLAYEY GRAVEL WITH SAND
		≤5% FINES	WELL GRADED		→ SW → SP	<15% GRAVEL — ≥15% GRAVEL — <15% GRAVEL — <15% GRAVEL — ≥15% GRAVEL —	→ WELL GRADED SAND → WELL GRADED SAND WITH GRAVEL → POORLY GRADED SAND → POORLY GRADED SAND WITH GRAVEL
	ND %GRAVEL		WELL GRADED	FINES = ML or MH — FINES = CL or CH —	─ - SW-SM < ─ - SW-SC <	<15% GRAVEL — ≥15% GRAVEL — <15% GRAVEL — ≥15% GRAVEL — ≥15% GRAVEL —	WELL GRADED SAND WITH SILT WELL GRADED SAND WITH SILT AND GRAVEL WELL GRADED SAND WITH CLAY WELL GRADED SAND WITH CLAY AND GRAVEL
	SAND >		POORLY GRADED <	FINES = ML or MH — FINES = CL or CH —	─ - SP-SM < ─ - SP-SC <	 <15% GRAVEL — ≥15% GRAVEL — <15% GRAVEL — ≥15% GRAVEL — 	→ POORLY GRADED SAND WITH SILT → POORLY GRADED SAND WITH SILT AND GRAVEL → POORLY GRADED SAND WITH CLAY → POORLY GRADED SAND WITH CLAY AND GRAVEL
		≥15% FINES		FINES = ML or MH		← <15% GRAVEL	

GROUP NAME

FINE GRAINED SOILS (≥ 50% FINES)

A) FLOWCHART APPLIED TO LABORATORY TESTED SOIL SAMPLES. ADAPTED FROM ASTM D 2487 CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES (USCS).



B) FLOWCHART APPLIED TO FIELD CLASSIFIED SOIL SAMPLES. ADAPTED FROM ASTM D 2488 DESCRIPTION AND IDENTIFICATION OF SOILS (VISUAL-MANUAL PROCEDURE).

GROUP STMBUL		GROUP NAME
< 30 % +No. 200 < <15 % +No. 200 15-29 % +No. 200 ≥ 30 % +No. 200 % SAND ≥ % GRAVE	← % SAND ≥ % GRAVEL - % SAND < % GRAVEL - < < 15% GRAVEL - ≥15% GRAVEL -	
% SAND < % GRAVE < 30 % +No. 200 < 15-29 % +No. 200 ML ≥ 30 % +No. 200 % SAND ≥ % GRAVED % SAND ≥ % GRAVED % SAND < % GRAVED		GRAVELLY LEAN CLAY GRAVELLY LEAN CLAY WITH SAND SILT SILT SILT WITH SAND SILT WITH GRAVEL SANDY SILT SANDY SILT GRAVELLY SILT GRAVELLY SILT GRAVELLY SILT
<pre>< 30 % +No. 200 </pre> < 30 % +No. 200 <15 % +No. 200 CH> 30 % +No. 200 % SAND ≥ % GRAVEN% SAND ≥ % GRAVEN% SAND < % GRAVEN	% SAND ≥ % GRAVEL - % SAND < % GRAVEL - <15% GRAVEL ≥15% GRAVEL <15% SAND ≥15% SAND	FAT CLAY FAT CLAY WITH SAND FAT CLAY WITH GRAVEL SANDY FAT CLAY SANDY FAT CLAY WITH GRAVEL GRAVELLY FAT CLAY GRAVELLY FAT CLAY GRAVELLY FAT CLAY
<pre>< 30 % +No. 200 </pre> <15 % +No. 200 15-29 % +No. 200 MH≥ 30 % +No. 200 % SAND ≥ % GRAVEN% SAND < % GRAVEN		
ORGANIC		
SOIL / < 30 % +No. 200 - 15-29 % +No. 200 - 15-29 % +No. 200 - 200		ORGANIC SOIL ORGANIC SOIL ORGANIC SOIL
OL/OH ≥ 30 % +No. 200 % SAND ≥ % GRAVEI % SAND < % GRAVEI	SAND < % GRAVEL → <15% GRAVEL → ≥15% GRAVEL → ≥15% GRAVEL → <15% SAND →	GRGANIC SOIL WITH GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL WITH GRAVEI GRAVELLY ORGANIC SOIL

NOTE

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THE PLASTIC 1.

A COMBINATION OF THE VISUAL MANUAL CRITERIA ON THE FOLLOWING PAGE WERE USED TO IDENTIFY THE GROUP SYMBOL FOR FLOWCHART B.



A) IDENTIFICATION OF FINES GROUP SYMBOL FROM LABORATORY TESTS. REPRODUCED FROM ASTM D 2487 CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES (USCS).

B) IDENTIFICATION OF FINES GROUP SYMBOL FROM VISUAL-MANUAL CRITERIA. REPRODUCED FROM ASTM D 2488 DESCRIPTION AND IDENTIFICATION OF SOILS (VISUAL-MANUAL PROCEDURE).

	DRY STRENGTH
DESCRIPTION	CRITERIA
NONE	CRUMBLES TO POWDER WHILE HANDLING.
LOW	CRUMBLES TO POWDER WITH SOME FINGER PRESSURE.
MEDIUM	BREAKS INTO PIECES OR CRUMBLES WITH CONSIDERABLE FINGER PRESSURE.
HIGH	CANNOT BE BROKEN WITH FINGER PRESSURE. BREAKS INTO PIECES BETWEEN THUMB AND HARD SURFACE.
VERY HIGH	CANNOT BE BROKEN BETWEEN THUMB AND HARD SURFACE.
D	LATANCY (RESISTANCE TO SHAKING)
DESCRIPTION	CRITERIA
NONE	NO VISIBLE CHANGE IN SPECIMEN.
SLOW	WATER APPEARS SLOWLY ON THE SURFACE OF THE SPECIMEN DURING SHAKING AND DOES NOT DISAPPEAR OR DISAPPEARS SLOWLY UPON SQUEEZING.
RAPID	WATER APPEARS QUICKLY ON THE SURFACE OF THE SPECIMEN DURING SHAKING AND DISAPPEARS QUICKLY UPON SQUEEZING.

тоυ	TOUGHNESS (CONSISTENCY NEAR PLASTIC LIMIT)		
DESCRIPTION	CRITERIA		
LOW	ONLY SLIGHT PRESSURE IS REQUIRED TO ROLL THE THREAD. THREAD AND LUMP ARE WEAK AND SOFT.		
MEDIUM	MEDIUM PRESSURE IS REQUIRED TO ROLL THE THREAD. THREAD AND LUMP HAVE MEDIUM STIFFNESS.		
HIGH	CONSIDERABLE EFFORT IS REQUIRED TO ROLL THE THREAD. THREAD AND LUMP HAVE HIGH STIFFNESS.		
PLASTICITY			
DESCRIPTION	CRITERIA FOR A $\frac{1}{6}$ -INCH (3 mm) THREAD.		
NON-PLASTIC	THREAD CANNOT BE ROLLED.		
LOW	THREAD CAN BARELY BE ROLLED AND THE LUMP CANNOT BE FORMED WHEN DRIER THAN THE PLASTIC LIMIT.		
MEDIUM	THREAD IS EASY TO ROLL AND NOT MUCH TIME IS REQUIRED TO REACH THE PLASTIC LIMIT. THE THREAD CANNOT BE RE-ROLLED SEVERAL TIMES AFTER REACHING THE PLASTIC LIMIT. THE LUMP CRUMBLES WHEN DRIER THAN THE PLASTIC LIMIT.		
HIGH	IT TAKES CONSIDERABLE TIME ROLLING AND KNEADING TO REACH THE PLASTIC LIMIT. THE THREAD CAN BE RE-ROLLED SEVERAL TIMES AFTER REACHING THE PLASTIC LIMIT. THE LUMP CAN BE FORMED WITHOUT CRUMBLING WHEN DRIER THAN THE PLASTIC LIMIT.		

SYMBOL	DRY STRENGTH	DILATANCY	TOUGHNESS AND PLASTICITY	PLASTICITY
ML	NONE - LOW	SLOW - RAPID	LOW	LOW TO NON-PLASTIC
CL	MEDIUM - HIGH	NONE - SLOW	MEDIUM	LOW TO MEDIUM
MH	LOW - MEDIUM	NONE - SLOW	LOW TO MEDIUM	LOW TO MEDIUM
CH	HIGH - VERY HIGH	NONE	HIGH	HIGH



TABLE 1.1 CRITERIA FOR DESCRIBING SOIL STRUCTURE⁽¹⁾

Description	Criteria
Ùdæcãað åÁ	O≣c^\}æaāj*Ájaê^\•Áj_Áçæsh_ðj*Áj æc^\¦ãæqÁj\X&[[\Áj ão@Ájaê^\•Á`\^æc^\Xo@ebjAj\X^``æqÁ
	qíÁFÐDÁŞI&©Ab©BB&∖ÁQĈÁ;{DÁA
Šæ{ ∄}æe^åÁ	│ OE[c^\} æeā) * Áæê ^¦• Á; Áçæh ã) * Á; æe^¦ãæhÁ; ¦Á&[[¦Á; ãc@Áæê ^¦• Á^•• Ás@æh; ÁFED Á§; &@Ás@æk∖ Á
	ÇÎ Â, { DÂ
Øã∙ĭ¦^åÁ	Ó¦^æ\•Áæq[}*Á\$a^-ājāz^Áj æz^•Á[-A#;æ&c`¦^Á;ãc@4jācq^Á^•ã:cæ)&^Á[Á;æ&c`¦āj*Á
Ù ã&∖^}∙ãå^åÁ	Ølæ&cč¦^Áj æ)^•Áæj]^ækÁj[ã:@°åÁj¦Á* [••^Ê¥j[{^œi[^•Árdãæe^åÁ
Ó[[&\^Á	Ô[@)•ãç^Ár[ā¼k@æexk&æa}Áa^Áa; [\^}Áa[;}Áajq[Ár{æa Áaa}** æa'Á*{]•Á;@a&@4^•ãrcÁ
	∼`lc@\/Ásl^ætå[,}Á
Š^}∙^åÁ	Q&\`•ā[}Á[,Á{ aa Á[[&\^orÁ],Ásã^^!^}oÁ[ā+ĐĂ`&@Áse Á{ aa Á^}+^•^•Á[,Áa) åÁ
	●&ææc^\^^åÁs@[ૻ * @\$\$æÁ, æ••Á, Á& æÂ
P[{[*^}^[`•Á	∖Ùæ{^Á&[[[¦Áæ}}åÁæ]]^ælæ}&^Á∞@[ĭ*@[ĭdÁ

Þ[ơ∿KÁ

FĂ T [åãð åÁ¦[{ ÁŒUVT ÁÖÁG Ì Ì ÁDescription and Identification of Soils (Visual-Manual Procedure)Åæ) åÅåã⊷¦Á -{[{ Á@ ÁNÈUĚÓ` ¦^æ ʎ[-ÄÜ^&|æ] ætā] } Ængineering Geology Field ManualÁÇE€EDĚÁ

TABLE 1.2 RELATIVE DENSITY OF SANDS ACCORDING TO RESULTS OF STANDARD PENETRATION TEST⁽¹⁾

Number of Blows N	Relative Density
€ËÁ	X^¦^ <i>Á</i> Š[[•^Á
ÍËF€Á	Š[[•^Á
FF Ë I€Á	T^åã { Á
HFË€Á	Ö^}∙^Á
Uç^¦ Â €Á	X^¦^ ÁÖ^} ∙^Á

Þ[c∿k∰

FĚÁ T [åãað åÁ-4 [{Á/^1: æt @ãÁÚ/^&\Êaaa} åÁT ^•¦ãAÇFJJÎDĚÁ

TABLE 1.3GUIDE FOR STIFFNESS OF FINE-GRAINED SOILS⁽¹⁾

Description	Criteria	Estimated Unconfined Compressive Strength (TSF)
X^¦^ÂÛ[~cÁ	Ò¢dٽå^∙Áà^ç_^^}Áāj*^¦∙Á;@?}Át˘`^^:^åÁ	Ł€ÈGÍÁ
Ù[~đÁ	T[å^åÁ\$ì^Áð#@óÁðj,*^¦Áj¦^∙∙č¦^Á	€ÈGÍË€ĚÍ€Á
T^åã{Á	T[å^åÁà^Ád[}*Áaj*^¦Á¦!^••č¦^Á	€ËE€ÉÁ
Ùœ ̃. Á	Ü^ænå,Âşiå^}&^åÅa^}&@{à,Ái,Å^}^{aeA}*, aeA^{}	FÈ€€ËGÈ€€Á
X^¦^ÂÛcã-Á	Ü^æåā[^Á5yå^}c^åÁsi^Áo@{{à}æãjÁ	GÈEEËËÈEEÁ
Pæ¦åÁ	Quå^}c∿åÁ,ãc@Ásiã⊷a&č c´Ási^Ás@{{à}æaäjÁ	NIÈ€€Á

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FĚÁ Ü^]¦[å * &^åÁ+[{ Á ¤ OEX Ø OEÔ Á ÇFJÌÎ DĚÁ

TABLE 1.4 CRITERIA FOR DESCRIBING SOIL MOISTURE CONDITION⁽¹⁾

Description	Criteria
Ö¦^Á	OEa∙^}&^Á(,-Á([ã:č¦^Ê&i`•ĉÊ&i¦^Á([Á:@)Á([č&@Á
T[ãrÓÁ	Öæ;[]ÁsĭoA;[Áçãrãaa ^Á;æe∧¦Á
Y ^oÁ	Xãrãâ ^Á¦^^Á, æe^¦ÊÃ∙ĭæ î^Á[ã,¼ãrÁà^ [¸Ác@Á,æe^¦Ácæà ^Á

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TABLE 1.5 CRITERIA FOR DESCRIBING SOIL CEMENTATION⁽¹⁾⁽²⁾

Description	Criteria
Y^æ\Á	Ô¦`{à ^•Á;¦Ás: ^æà•Á;ãc@Á@ea)å ã;*Á;¦Áãcd^Áã;*^¦Á;¦^••`¦^Á
T[å^¦æe^Á	Ô¦`{à ^•A[¦Áà¦^aà•Á,ão@Á&[}•ãå^¦aàà ^Áā]*^¦Áj¦^••`¦^Á
Ùd[}*Á	Υậ ļÁ,[ơ&&l`{à ^/[t. Áa: ^æà,∮ão@Áāj,*^\ Á, ^••`\^Á

Þ[c∿∙ kÁ

 FEA
 Ü^] ¦[å* &^åÁ\[{ ÁCEÙVT ÁGI Ì Ì ÁDescription and Identification of Soils (Visual-Manual Procedure)ÈA

 GEA
 V@ Áseà•^} & A[* 48^{ } æ Á] [άΛ & [å^åÅ] Å [å* å[* ĚA

TABLE 1.6CRITERIA FOR DESCRIBING SOIL REACTION WITH HCL⁽¹⁾

Description	Criteria
Þ[}^ ^œ Á	Þ[Áçãa ãa ^Á/æ&cãį}Á
Y^æ\Á	Ù[{^Á^æ&cāį}Ě́,ãc@ésĭàà ^∙Á;¦{ãj*Á [, ^Á
Ùd[}*Á	Xā[^}oÁ^æ&cā[}Ěý,ãc@Ási`àà ^∙Á[[¦{ā];*Áā[{^åãæe^\ ^Á

Þ[c∿∙KÁ

FEĂ Ü^]¦[å ǎ &^åÁ¦[{ÁQEÙVT ÁGIÌÌÁÖ^•&¦a]qā[}Áæ)åÁQa^}cãã8ææā[}Á;ÁÅÜ[ā≉ÁQXã čæ)ËTæ)čæ)ÁÚ¦[&^åč¦^DĚÁÁ ŒĂ V@Áæà•^}&^ÁįÁæÁ^æ&aã[}Á;æA,[cÁv&[¦å^åA,[š]*á][*ā]*Á][*•ĚÁ







	PLASTICITY
DESCRIPTION	CRITERIA
NON-PLASTIC	A $\%$ in. (3mm) THREAD CANNOT BE ROLLED AT ANY WATER CONTENT.
LOW	THE THREAD CAN BARELY BE ROLLED AND THE LUMP CANNOT BE FORMED WHEN DRIER THAN THE PLASTIC LIMIT.
MEDIUM	THE THREAD IS EASY TO ROLL AND NOT MUCH TIME IS REQUIRED TO REACH THE PLASTIC LIMIT. THE THREAD CANNOT BE RE-ROLLED AFTER REACHING THE PLASTIC LIMIT. THE LUMP CRUMBLES WHEN DRIER THAN THE PLASTIC LIMIT.
HIGH	IT TAKES CONSIDERABLE TIME ROLLING AND KNEADING TO REACH THE PLASTIC LIMIT. THE THREAD CAN BE RE-ROLLED SEVERAL TIMES AFTER REACHING THE PLASTIC LIMIT. THE LUMP CAN BE FORMED WITHOUT CRUMBLING WHEN DRIER THAN THE PLASTIC LIMIT.

NOTES:

1. SOURCE: ASTM D2488.

2. ONLY APPLIES TO FINE-GRAINED ROCKS SUCH AS CLAYSTONE.

TABLE 2.1 GENERAL SEDIMENTARY ROCK TYPES

Rock Type	General Description		
Ô[}* [{ ^¦æe^Á	T[●d^Át¦æç^ É&&[àà ^●É&[¦Á\$j[č å^¦●LÁt¦æðj●Áset^Á[č}}å^åÁ{[Átčà¦[č}}å^åÉ&A		
Ó¦^&&ãæÁ	T[●d^Źt¦æç^ É&&[àà ^●É4[¦Á\$i[č å^¦●LŹt¦æa])●Ásek^Áse)*č æ6Á{[Á*čàæ))*č æ6Æ[
Ùæ)å∙q{}^Á	T[•d^Áæ)åÁã^åÁjælæ&l/∿ĐĂ		
Ùãjo•q[}^Á	Τ [• qˆ ÁiājœÁā ^å Ą́, æidā& ,^• Ás@æen&ei^ Át^} ^¦æ ˆ Á; [} Á§[Á[¸ Á; æidā&ĐĂ		
Ô æ̂∙₫}^Á	T[•q^Á&yæ^Ááā^åAjæ+ca&y^•Ás@een&=*^Á*^}^\approx hag^AgÁ[Ág# A@# @Aj æ+ca&Aaj ^• EA		
Tčå∙q{}^Á	T[•d^Á&yæ`Áā^åÅjæ;dæy/∿•Ás@een%æ;^Á*^}^¦æy ^Á[Å[Á@ã*@4j, æ•dæ%A3j,^•ÈÁ Ő^}^¦æy ^Á/∿••Á&[{]^c^}c%}d‰ajå{[¦^Á;ãæà]^Ás@æajÁ&yæ`•d[}^ÈÁÁ		
Ù@æ∲^Á	T[•q^Á&yæ`Á\ã^åÅjæba&y^•Ás@eenÁseh^Á\}^¦æn ^Á[Á[[_Át[Á@ã'@4), æ•a&AA3),^•LÁ;[¦^Á &[{]^c^}of(@æ),Á&yæ`•q{}^LÁæï•ã†^Áseq[}*Áshaåa3),*Áj æ3),^•EA		

TABLE 2.2

BEDDING, FOLIATION, OR FLOW TEXTURE DESCRIPTIONS⁽¹⁾⁽²⁾

Descriptor	Thickness/Spacing
Tæ•∙ãç^Á	Õ¦^æe^¦Ác@ee)ÁF€ÁdĚAÇHÁ(DÁ
X^¦^Á/@38&\ ^Á¢,Ó^åå^åÊ927[ãæe&^åÊ4x[¦ÁÓæa)å^åDÁ	HÁŧ ÁR€Á¢ÈÄQFÁŧ ÁHÁ, DÁÁ
V@28&\ ^Á	FÁE ÁHÁdĚQH€€Á, { ÁE ÁFÁ, DÁ
T[å^¦æe^\ ^Á	€ÌÈHÁĮ ÁFÁdÄQF€€ÁĮ ÁH€€Áį { DÁ
V@aj ^Á	€ÈFÁ¢Í Á€ÈHÁ¢Ë¢ÇH€Á¢Í ÁF€€Á; { DÁ
X^¦^Á/@aj ^Á	€ÈEHÃEHÐ Ë3, ÈÁ4, Á€ÈEÁdĚ4ÇF€Á4, ÁH€Á, { DÁ
Šæ{ājæe^åÁÇQ;c^}∙^ ˆÁ2[ãæer^åÁ{\ÁÓæ}å^åDÁ	Š^••Ác@e)Á€TEHÁcEŽÁHDĚ3; á4ÇF€Á; { DÁ

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FĚÁ V@/ÁsājA,Áx@/Ás/ååāj*Á,[c^å/4,]Áx@/Á[*•/ÆiÁ,^æ*`¦^åÁ;[{Á@;¦ã[}caa/Á[¦Áç^\ca&ad/ás[¦^@;|^@;AsejåA,[¦{ad/A

Á

TABLE 2.3 WEATHERING DESCRIPTORS

		Diagnostic Fe	eatures		
	Chemical Weathering – Discoloration and/o	or Oxidation	Mechanical Weathering (Grain boundary conditions-use with		
Weathering Descriptor	Body of Rock	Fracture Surfaces ⁽²⁾	grained sediments)	Texture	Solutioning
Ø!^•@Á	Þ[Ásář&[[¦æa‡í]}ÉÅ[(xátášá^åÁ	Þ[Ásåār&[[¦æaaā]}Á[¦Á [¢ãaæaaā]}Á	Þ[Á^]æiæaaj }Ê\$j æ&oáçã @DÁ	Þ[Á&@æ)*^Á	Þ[ÁÛ[ǐcā[}ā]*Á
	Sli	ghtly weathered to fresh ⁽¹⁾			
Ù∣ā*@4^Á, ^æe@⊹^åÁ	Öār&[[¦æaā]}Á(¦Á(¢ãåæaā]}ÁsiÁā[ār\åÁ(FÁ`¦-æ&∧Á(¦Á\@Q;¦cÁ åãicæ)&∧Á¦[{ÈŦæ&c`¦^∙KA([{^A^(å•]æA&\%\^eœ4+Åsi^Åsi" Á	Tāj[¦Áq[Á&]{] ^c^Á åãe&{ [¦ææā]}Á[¦Á[¢ãāæaā]}Á [-Á[[●ÓA[˘¦-æ&&∿●Á	Þ[Áçãi ãa ^Á^] ætæaaj}}ÊÁ ðj cæ&cvQcat @DÁ	Ú¦^∙^¦ç^åÁ	Tậ[¦Ár\æ&@3)*Á;—Á[{^Á ●[ĭà ^Á;ậ^\¦æ†>Á;æêÁà^Á }[c°åÁ
	Mode	rately to slightly weathered $^{ m (}$	1)		
T[å^¦æe^ ^Á,^æe@-¦^åÁ	Öãr&[[[¦æađā]}Ár[¦Árçaãæađā]}Ár¢c¢}å•Á/[{Áiæ&Ci¦^•ÉAi•čæ fÁ c@[[`*@[`dx627\⊟*Á;ā]^¦æ‡+Áec^Á‰i•Ci+ÉA^ å•]æiÁ&i^•cæ‡+Áec^Á %&a[[`å^+Á	OЩÁ¦æ&c'¦∧Árč¦-æ&∧∙Áed-^Á åãa&[∥[¦^åÁ[¦Á[¢ããã ^åÁ	Úæic⿇Á^]æiæaā[}Á[Á à[ĭ}åæia?∙Áçārāa ^Á	Õ^}^¦æ∥ˆÁ́J¦^∙^¦ç^åÁ	Ù[˘à ^Á(身^¦a‡+Á(æíÁà^Á {[•q^Á^a&&@°åÁ
	Intense	ely to moderately weathered	(1)		
₽¢}•^ ^Á,^æ@¦^åÁ	Öār&[[[¦æaā]}Á;[Á;¢āāæaā]}Áv@[`*@[`d&a‡ Á^ å•]æ+ÁæjåAØ^Ë T*Á;ā]^¦æ‡+Áæd^Áædo'¦^åÁqíÁ&Jæ3ÁgíÁr[{^Á^cor}dÁ;¦Á&@{&&ædÁ æ¢o'¦æaā]}Á;![å`&^+Á9jËaãčÁāāæë*¦^*æaā]}ÉA\^^Ár¦æa9jÁ à[`}åæ3ã+Á&[}åãaā]}+Á	OĘ Á¦æ&c`¦∧Ár`¦æ&∧•Áæ¦∧Á åã•&[[¦^åÁ;lÁ;¢ããã^åÊÁ •`¦æ&∧•Á¦ãæà ^Á	ÚælaāeķÁ^) ælæaāi}}ÉÅ[&\ÁsrÁ √äæe)^LÁsiÁr^{ aĒzebāeÁ &[}åãaāi}●Á*¦æ)ãaã&eÁeb^Á åãræ**¦^*æe∿åÁ	V^¢c`¦^Áædyo'¦^åÁsa`Á &@{a8ædyÁ åãra]c**¦æædj}}Á Ç@妿ædj}Ê&ed**aj æædj}DÁ	Š^æ&@3)*Á[-Á[[ĭà ^Á[3]^¦æ†-Á {æîÁa^Á&[{] ^c^A
	Ve	ery intensely weathered ⁽¹⁾			
Ö^&[{][•^åÁ	Ӧ著&[[¦^âʎ;¦ʎ;¢ãăã^â/à/ko@[`*@[`dbǎi`dh/∿āræa);dk;ā]^!a‡+Á ●`&@kane Á`æic ʎ;æi/kai/kā}a‡do'¦^â/kaiµlÁv[å•]æi-Áa);å/ko?日*Á {ā]^!æ‡+Áa±/Á&[{] ^cv]^Aa‡do'!^â/kaj/æiÁ	Á	Ô[{] ^c^Á^]æbæaā}}Á;-Á *¦æ5jÁ\$[`}åæb∂?●Á Çããæt*¦^*ær^åDÁ	Ü^•^{à ^•ÁæÁ[ã)Éðasomá •d`&c`¦^Á(æêÁà^Á¦^•^\ {ã}^\æ†Á•`æ îÁ&[{]/	¢ÉÅ,¦Á&[{] ^♂Á^{}&);oóA[&\Á ç^åLÁ^æ&&@3)*Á[,~Á[]ĭà ^Á ;ơÁ

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FÈÅ Ó[{àā]æā]}Á\$\•&¦ā]ç[!•Áæ*A]Åa

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TABLE 2.4 FRACTURE DENSITY DESCRIPTORS⁽¹⁾

Descriptor	Criteria
	(Excludes Mechanical Breaks)
W}√¦æ&c`¦^åÁ	Þ[Á[à•^¦ç^åÁ l æ&č¦^•ĔĂ
X^¦^ÂÙ ãt@e¦^ÁØlaa&cč¦^åÁ	Ô[¦^Á^&[ç^¦^åÁ[[•d^Á§jÁ^}*c@!Á*¦^æe^¦Ás@æ)jÁHÁ^^cÁQFÁ;DĎÁ
	Slightly to Very Slightly Fractured ⁽²⁾
Ù ā*@4^ <i>Á</i> 87 <i>æ</i> 8£č ¦^åÁ	Ô[¦^Á^&[ç^¦^åÁ;[•d^Á§,Á^}*c@,Á'[{ Á∓Á;Á+Á^^óQ+E€Á;ÁFÊEE€Á;{ÆÊEE€Á;{ DÁ,ãc@Á -^Á*&æec^¦^åÁ^}*c@,Á^••Ác@a),ÁFÁ;[oáQ+E€Á;{ Dá;¦Á*¦^æe^¦Ác@a),Á+Á^^oÁ ÇFÊEE€Á;{ DDÁ
	Moderately to Slightly Fractured ⁽²⁾
T[å^¦æe^\ ^ÁØl/æ&cč¦^åÁ	Ô[¦^Á^&[ç^¦^åÁ;[•d^Á§;Á^}*c@;Á4[{ÁEÈÈHÁ;[ÁFÈEÁ;[cÁÇF€EÁ;[ÁHE€Á;{DÁ ^}*c@;Á;ãc@á;[•dÁv}*c@;Áæà]čdÆÈËÏÁ;[cÁÇC€€Á;{DÉÁ
	Intensely to Moderately Fractured ⁽²⁾
Q;c^} ∙^ ^ <i>Á</i> 2¦æ&č ¦^åÁ	Š^}*c@-Áæç^¦æ*^Á¦[{ÁEÈE-Á[ÁEÈHHÁ[[ơÁC}HEÁ[ÁFE€EÁ[{DÁ]ão@Á&&æc∿¦^åÁ ⊰æ*{^}&*å/Á5]&'çæ†ÞĚÁÔ[¦^Á^&[ç^¦^åÁ[[•qˆÁ5]Á^}*c@-Á∿••Ás@æ)ÁEÈEHÁ -{[ơÁC]F€€Á[{DÉÁ
	Very Intensely to Intensely Fractured ⁽²⁾
X^¦^ÁQ;œ}●^ ^ÁØiæ&č ¦^åÁ	Ô[¦^Á^&[ç^¦^åÁ; [•qˆÁæ•Á&@])•Áæ)åÁ¦æt { ^}o•Á;ão@kad^`; Á&ææc^¦^åÁ;@[¦óÁ &[¦^Á^}*c@ÈÁ

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FĚĂ Ü^]¦[å* &^åÁ¦[{ÁNÈ)ĚÁÓ`¦^æ Áį́, ÁÜ^&¦æ; æãį}, Engineering Geology Field Manual ÇG€€FDĚÁ

 $\mathbf{CE} \hat{\mathbf{A}} = \mathbf{CE} \hat{\mathbf{A}$ $+ \left| \tilde{a}^{*} \right|^{2} \hat{A} + \frac{1}{2} \hat{a} + \hat{a}$

 $8\left[\left| ^{A} \not{k}\right] \circ \left| \left| cak \not{k}\right| + A \circ \left| cak k \right| + A \circ \left| cak$

TABLE 2.5 ROCK HARDNESS / STRENGTH DESCRIPTORS⁽¹⁾

Alphanumeric Descriptor	Descriptor	Criteria
PFÁ	Ò¢d^{ ^ ^ <i>Á</i> Pæ¦åÁ	Ô[¦^ÊÁ\æt{^}dÊĄ\¦Á\¢][•`¦^Á&æə}}[ơ&s^Á<&læ&@åÁ,ão@Á}ã^Á(¦Á @eel]Á]ã&\L&æa}A(;}^Á&@a]]^åÁ,ão@A^]^æe^åÁ@>æç^Á@ee({^¦Á& [,ÈÁ
PGÁ	X^¦^ Á Pæ¦åÁ	Ôæ)}[o%a^Á&¦æe&@åá,ãc@á}ã^á(¦Á@ee)]Ájã&\ÈÄÔ[¦^Á(¦Á+æ*{^}o%a}\^æ•Á jãc@á^]^æe^åÁ@æeç^Á@ee{{^¦Áa [jÈĂ
PHÁ	Pæ¦åÁ	Ôæ) As\Ak&¦æ&&@åÁ,ão@A}ã^A(¦Á@ee)]Ájā&∖Á,ão@&ãa-a&` c`ÁQ@æç^Á]¦^∙•`¦^DDÁAP^æç^Á@ee{{ ^¦Ási[[,Á^``ã^åÅ{{Ás!^æ}A`]^&&ã(^}ÈÁ
PI Á	T[å^¦æe^\ ^ÁR?æs¦åÁ	Ôæ) Ast^At&læe&@@åÁ;ão@A;}ã^At¦At@eet]Aj;380,Á;ão@Afat@eAt¦At[[å^læe*A]¦^••`¦^ÈMÔ[¦^At¦At¦æt{^}oAst¦^aet•A;ão@At[[å^læe*A@eet{{^!&at}}
PÍÁ	T[å^¦æe^\ ^ÂÛ[⊶eÁ	Ôæ) As∿At¦[[ç^åAFBFÎA5}&@AQCA;{D&si^^]As^A;}ã^A;¦Ai@ee]Aja&\Ájão@A {[å^¦æe*A;¦A@:æe;^A;¦^•••`¦^DAXÔ[¦^A;¦A';æt{ ^}oAsi¦^æe•Ajão@Aat@oA @ee;{ ^¦Asi[[, A;¦A@:æe;^A;æ)`æAjA;¦^•••`¦^DA
PÎ Á	Ù[~Á	Ôæ) Ás\At: [[ç^åAt: At[`*^åAtæ;ā^As^A;] ã^A; A:@ee] Á;38\Á;ão@4at@eA] ¦^••` ¦^ĔAЮæ) Ás^A:&!æe&@aA;ão@Az;*^¦}æajEAO(^æ;•A;ão@4at@eA; { [å^!æe^A(;æ)`æ4A;!^••`¦^EA
ΡΪÁ	X^¦^ÂĴ[≁Á	Ôæ) Aà^Áræåaî Aşiå^}c°åÉAt¦[[ç^åÉAi¦Ăt[ĭ*^åÁjão@Áaj*^¦}æajÉAi¦Á&ædç^åÁ jão@ÁæÁ}}ã^ÈÁKO¦^æà●Ájão@Áat@A{iæ}`æAj¦^●●ĭ¦^ÈÁ

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FĚĂ Ü^]¦[å* &^åÁ¦[{ÁNÈ)ĖÉÓ`¦^œĂ(Á,ÁÜ^&|æ;æa]}, Engineering Geology Field Manual Q€€FDÉĂ

TABLE 2.6 FRACTURE OPENNESS DESCRIPTORS⁽¹⁾

Alphanumeric Descriptor	Descriptor	Openness
U€Á	Vãt@cÁ	Þ[Áçãrãa ^Á^]ælæaaā[}Á
UFÁ	Ù ãt@d;^ÁU]^}Á	Š^••Ác@ed;ÁEÌEEEHÁcÁEFBHGÁB;ÁQCÁFÁ;{DÁ
UGÁ	T[å^¦æe^\ ^ÁU]^}	EÈEEHÁ{ÁEÈEFÁcÁŽEÐ+GÁ{ÁFÐÌÁ§áQFÁ{ÁHÁ {DÁ
UHÁ	U] ^} Á	€ÈEFÁ{ÁEÈEHÁ AŽETÐÁ{ÁTÐÁ§ÁQHÁ{ÁF€Á{ C
ULÁ	T[å^¦æe^\ ^ÁYãå^Á	€ÈEHÁY Á€ÈEÁAŽÁHÐÁY ÁFÈGÁY ÁQF€ÁY ÁH€Á; { DÁ
UÍ Á	Yããa^Á	Õ¦^æe^¦Ás@ee; Á∈ÈEÁaÃEÈEÁs; áÁçNÁ+H€Á;{DÁÅ

Þ[c∿kÁ

FĚÁ Ü^] ¦[å` &^åÁ¦[{ ÁΛĖĽ)ĖÁÓ` ¦^æ` Áį ÁÜ^&¦æ; æāį } , Engineering Geology Field Manual ÇG€€FDĚÁ

TABLE 2.7 FRACTURE ROUGHNESS DESCRIPTORS⁽¹⁾

Alphanumeric Descriptor	Roughness Descriptor	Criteria
ÜFÁ	Ùơ^]]^åÁ	Þ^æb贳[¦{ækÁrc^]∙Áæ)åÁãå*^∙Á(&&č¦Á(}Ác@Á¦æ&č¦^Ář`¦-æ&^ĚÁ
ÜGÁ	Ü[Šæl*^Áæ);*` ælÁæe]^¦ãna?∙Á&æ);Áa^Á(^^} ĔĂ
ÜHÁ	T[å^¦æe^\îÁ Ü[`*@Á	O≣]^¦ãna∿•Áad^Á&d^æd ^Áçãrãal^Áad}åÁd¦æ&c`¦^Ár`¦-æ&∿Á^^ •Áada¦æ∙ãç^ÈÁ
ÜI Á	Ù ãt@d;^ÁÜ[ĭ*@Á	Ù{ æ⋕ĺÁæ] ^¦ãa∄•Á;}Ás@ Á¦æ&č ¦^Á*`¦æ&^Áæ^Áçãrãa ^Áæ}åÁ&æ}Ás^Á^ dĚÅ
ÜÍ Á	Ù{ [[c@Á	Þ[Áæ•]^¦ãa∄•ÉÁ-{[[c@Á;[Ác@·Áq{č&@ÉÁ
ÜÎ Á	Ú[ã:@∿åÐÁ Ù ã&∖^}∙ãå^åÁ	Ò¢d^{ ^ ^Á{ [[c@ £xz) å Á @ 3) ^ ĚÁKDE∱[ã @ å Áæĕ o4\` ¦-æ&^Ê4, -c^} Á, ãc@ Á æ fjä]^æaāį} Á;æ bæ ^ Á{ Á@ Æsiā*] æ&^{ ^} o4siā^&cāj} ĚÁ

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FĚÁ Ü^] ¦[å š&åÁ ¦[{ Á ΛĖ̀) Ė́́́́O č ¦^æ ʎį́ -Á̈́U^& Jǽ́ą ǽ́ą́ }, Engineering Geology Field Manual Œ⊂∈FDÉÁ

TABLE 2.8FRACTURE FILLING THICKNESS DESCRIPTORS⁽¹⁾

Alphanumeric Descriptor	Fracture Filling Descriptor	Thickness
V€Á	Ô ^æ}Á	Þ[Áā]{Á[¦Á8[æaā];*Á
VFÁ	X^¦^ÁV@3jÁ	Š^••Ác@eg)ÁEÈEEHÁcÁŽFÐ+IGÁ§JÁQLÁFÁ{{DÁ
VGÁ	T[å^¦æe^\^Á/@3}Á	€ÈE€HÁ{ÁEÈEFÁcÁŽEÐ+GÁ{ÁFÐÌÁ§áÁÇFÁ{ÁHÁ {D
VHÁ	V@ajÁ	€ÈEFÁ¢Í ÁEÈEHÁ AÃE ĐÁ¢Í ÁHĐÁ§I Á¢CHÁ¢Í ÁF€Á; { DÁ
VI Á	T[å^¦æe^\ ^Á/@38&∖Á	€ÌEHÁĨEÐÁ§áA(ÁEÌEÁÁÇF€Á(ÁH€Á,{DÁ
VÍ Á	V@ans\Á	Õ¦^æe^¦Áo@ee}Á€ÈEÁAÁQNÁH€Á;{DÁ

Þ[c^kÁ

FĚÁ Ü^] ¦ [å` &^åÁ¦ [{ ÁΛĖÙĖÁÓ` ¦^æ` Áį ÁÜ^&|æ; æāj; } , Engineering Geology Field Manual ÇG€€FDĚÁ

TABLE 2.9REACTION WITH HCL(1)Á

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Descriptor	Criteria
Þ[}^ ^{(CEDÅ}	Þ[Áçãrāa ^Á^æ&dā]}Á
Y^ælÁ	Ù[{^Á^ <i>ae</i> soāį}ÊĂ,ãc@Ásĭàà ^∙Á{¦¦{āj,*Á [·] [, ^Á
Ùd[}*Á	Xā[^}cÁ^æ&cā[}ÈÉ,ãc@káĭàà ^∙Á[;¦{ā]*Áā[{^åãæe^\∩Á
Þ[♂∙KÁ	
FĚÁ Ü^]¦[å ̆&^å,Á+[{	[ÁQEÙVT ÁÖÁGIÌÌÁÖ^∙&¦ā]cā[}Ása)åÁGa^}cãa8aæaā[}Á[iAÛ[ā†ÁQXãrĭaa¦ËTaa)ĭaa(Á
Ū¦[&∧^åĭ¦∧DDÄ́,	
GEÄ V@:Åæà•^}&^/į →	ÅæÅ^æ&dāį}Å,æeÅ,[dÅ^&[¦å^åÅ;}Åå[¦ā]*Å[*•ÉÅ
Á	
Á	

TABLE 2.10CEMENTATION DESCRIPTORSÁ

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Descriptor	Criteria
Ùd[}* ^ÁÔ^{ ^}♂åÁ	Ùæ[] ^Áa\¦^æ)•ÁæeÁ*¦æajjÁa[ĭ}åæåð•Á,ão@Á@∘æçîÁ@æe[{^¦Áa [,ÈÁ
T[å^¦æe^ ^ÁÔ^{{^}} ♂\åÁ	Ùæ{] ^Aá¦^æ)•ÁæeÁ*¦æajÁa[ĭ}åæå?•Á,ãc@A([å^¦æe^Áq[Á@:æç^Á(æ);ĕaA
]¦^•••`¦^ÈÅ
Y^æà ^ÁÔ^{^}ĝ^åÁ	Ùæ{] ^Aa¦^æt•ÁæeA*¦æajAa[ĭ}}åæåå∙Á,ão@4åã@oA{[A{[å^¦æe^A{[æ}}
]¦^∙∙•`¦^ÊA;æ{] ^Æ;Á¦ãæà ^ÈÅ
Á	

TABLE 2.11ADDITIONAL TEXTURAL ADJECTIVES

	A
Descriptor	Criteria
Úãac^åÁ	Úāj@(^ÁqíÁEÈEHÁdĚq0+ĐÁnj&@DÁq2.FÁqíÁF€Á;{DÁ;]^}āj*•EĂ
X***^Á	Ù{æ‡[Á;]^}āj*•ÁÇ•`æ‡ ^Áāj^åÁjãœ&kk¦^•œa‡•DÁæj*āj*ÁsjÁsiãæ{^৫∿¦Á¦[{Á∈È€HÁ∞ÁÇ+ÐÒÁ
	aj&@dati Á∈ÉHHÁcÁQCÁSj&@•DÁQF€Áti ÁF€€Át {DÉÄ
ÔæçãĉÁ	OE;A[]^}ā]*Áped*^¦Áo@ea)ÁEÈEHHÁ AÁÇÁ53,&@DÁÇE €€Æ({ DÉA ã ^Ás^•&\a]ca[}•Áse^Á^˘˘ā^åÉA
	æ)åÁseåb∿&cãç∧∙Á`&@ÁseeÁ{æ)¦Éqæ**^É4∖c&È4(æêÁsh^Á •^åÈÁ
P[}^^&[{ à^åÁ	, QÁ,č{^¦[č•Á?}[č*@ko@eenÁ,} ^Áo@a,Á,æa¦•Á.^]ælæevÁajåãçãačæaAÁjão•Á,¦Áçč*•Êko@arÁ
	c^\{ Áĭ ¦c@;¦Áå^∙&¦ãa^•Áv@;Aj,¦^&^åãj*Áj[{ ^}& aæč¦^Áq[á3jå&aae*Á&∧ Ëjã^Áq[¦{ ÈÁ

Þ[c^kÁ

Ù [^{*} ; |&^ ká/NÈÙ ĖŹÓ` ; ^ æč /ą, ~ ÁÜ ^ &| æ; ææaj; } ÉŹÔ } * ð; ^ ^ ¦ ð; * ÁÔ^ [|[* ^ ÁØð* |å.ÁT æ) * æ¦Á

TABLE 2.12 IGNEOUS ROCK GRAIN SIZE AND TEXTURE

TEXTURE DESCRIPTION

X^¦^ÁÔ[æ⊌•^ÁÕ¦æ∰i,^åA,¦ÁÚ^*{ænaña&Á Ô[æ⊌•^ÆÕ¦æ∰i,^åÁ T^åã{ÆÔ¦æ∰i,^åÁ Ø∄i,^ÆÕ¦æ∰i,^åÁ O∏;@æ)jãa&ÆA& Q∰i@æ)jãa&A&A ^^DA

AVERAGE GRAIN DIAMETER

NF€Á{{ÁËÁQNHÐÌÁ§}ÈDÁ
Í Á EÁF€ÁL {Á EÁQ HEFÎ Á EÁHD Á§L DÁ
FÄÄÄÁ {ÄÄQEFEHGÄÄHEFĨÁ§LEDÁ
€ÌŦĂÄŦĂ`{ÁÄQ€Ì€€IĂÄŦ₽ŀĠÁ\$Ă
Ł€ÈÈÁ、{ÁËÁQL€ÈE€IÁ§ÈDÁ

Additional Textural Adjectives

DEFINITIONS

Aphanitic:ÁÁCE;^Áðj∧Ë'¦æðj^åÁ8T}^[`•Á[&∖Á;@[•^Á&[}•cãč^}c•Áæ¦^Át[[Á-{æ||Át[Áa-Áåārcðj*`ãr@*åÁ à^Ác@^Á}æãa^åÁ^^ĚA

Phaneritic:ÁÁ/@/Ác^¢cč¦^Át,-Áxa)Át}}^[č+Á[&\ÁsjÁ,@3&@Ás@/Ásjåãçãačæ4Á&[{][}^}orÁxa4^Á åãrcāj*čãr@emai|^Á,ãc@Á;}æsãa^åÁ^^AĚÁ

 $\begin{array}{l} \textbf{Phenocryst:} & \texttt{AU} \\ & \texttt{A}_{\text{A}} & \texttt{A}_{\text{A}} & \texttt{A}_{\text{A}} \\ & \texttt{A}_{\text{A}} & \texttt{A}_{\text{A}} & \texttt{A}_{\text{A}} \\ & \texttt{A}_{\text{A}} & \texttt{A}_{\text{A}} & \texttt{A}_{\text{A}} \\ & \texttt{A}_{\text{A}} & \texttt{A}_{\text{A}} & \texttt{A}_{\text{A}} & \texttt{A}_{\text{A}} \\ & \texttt{A}_{\text{A}} &$

Porphyry:/Á0E;Á\$\$}^[`•Á[&\Á;-Á\$}^Á&[{][•ã#]}Á@eæ/&[}cæ#j•Á&[}•]3&`[`•Á;@}[&\^•@*]á&^A;^Ë *¦æ#j^å/*i{[`}å{æ••L&e/s[!]@¦ã#3&/\$\$}^[`•Á[&\ÉÁ

VOLCANIC ROCK CLASSIFICATION



. General classification and nomenclature of some common plutonic rock types (*a*) and some common volcanic rock types (*b*). This classification is based on the relative percentages of quartz, alkali feldspar, and plagioclase, measured in volume percent. (Adapted from Subcommission on the Systematics of Igneous Rocks, *Geotimes*, 1973, v. 18, no. 10, pp. 26–30, and Hyndman, D. W., 1972, *Petrology of Igneous and Metamorphic Rocks*. McGraw-Hill Book Co., New York, p. 35.)

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APPENDIX B.2

BORING LOGS

	; OF	SOIL F	3ORING	<u>.</u>	Τ	Start Date: 11-15-2021		End Date: 11-15-2021	Borehole ID:
	iect name:			,	-	Driller: Elite-Lenny		Logged By: CLS	B-601
, F	Project No:	21129	Jentor i nace			Bedrock Depth: Not encount	ered	Checked By: JRW	Sheet 1 of 2
Boring	J Location:	N 1196459.7, E 3 ⁻	145241.9 ft			Drilling Rig: Track Mour	nted Mobi		
0	Ground El:	5438.7 ft To	otal Depth: 10.0 ft			Equipment: Hollow Ster	m Auger a	3.25" I.D. 6.0" U.D.	
Ground	dwater El:	Not Encountered	On Date:		╷└──	1			
	!			(Ĵ	(F				
io	(¥)	Type - No	Blows per 6 inch	atior	ery ('	Remarks	gy gy	Description and Cla	ssification of Materials
levat	epth			enetr	ecov		tholc		
Ξ		<u> </u>	!	٩.	Ř	+	05		
	Ę !			1		Concrete slab approximately 6			
	⊨ '			1		inches thick.		Q 1.	
1	E !							Reclaimed Asphalt Fill;	
								[Fill]	
	F . 1			!					
	F '			!					
5437.0	E !								
5437.0	E '	S - 1	30/4/4	1.5	0.7			S-1, S-2: Sandy Lean Clay Mostly fines, medium plastici	tv: 35-45% sand, fine to coarse
	2			!				grained, subangular to subro	unded; less than 5% gravel,
	F !							size = 0.75 inches; medium s	tiff; moist; light brown; PP =
	F !	<u> </u>		ļ!	–	-		0.75 tsf; weak to strong react [Fill]	ion with HCl; (CL);
	E			ľ					
				!					
		S-2	3/4/6	15	١٩٩				
	F !	0-2	01710	1.0	0.5				
	E '			!					
	Ę !			!					
	4		+		\vdash	-			
	F '								
5434.2	E '							MC-3, S-4, S-5: Fat Clay with	1 Sand
				1				Mostly fines, high plasticity; 1 grained subangular to subro	5-25% sand, fine to coarse unded: less than 5% gravel.
	5			<u> </u>	⊢	-		fine grained, subangular to su	Jbrounded; maximum particle
	F !			!				reaction with HCl; (CH);	SUM; MOIST; IIght brown, strong
	E '			!				[Fill]	
	F i	MC 2	4/7/9	4.5	1.0				
		MIC - 3	4///0	1.5	1.0				
	6								
	E '			!					
	-		+		\vdash	1		6.5 to 8.0 ft: Fines are me	dium to high plasticity; less
	F !			!				than 10% gravel, fine to co particle size = 1 inch; mec	oarse grained; maximum Jium stiff; white to light
	F 7							brown; (CH);	-
	E '	S - 4	1/1/3	1.5	1.0				
	F '			!					
	F !			!					
	F, I			_!					
	e a			· · · ·		1		'	
	F '			1					
			+		<u> </u>				
	F '			!					
	- 9							8.9 to 9.7 ft: PP = 2 tsf; (C	<u>.</u> H);
	Ę !	S - 5	3/5/5	1.5	1.1				
5429.0	F '			!				S-5: Lean Clay	
5428 7						Bottom of boring at 10.0 feet		Mostly fines, medium plasticit	ty; 5-15% sand, fine to medium
Notos			Loomples is internru					Continued	on next sheet
(coordinate	system is modifier	d from the Colorado	o Sta	te P	ane NAD1983 North Zone wi	ith convers	sion factor = 0.999721940.	

	i OF	SOIL F	BORING			Start Date: 11-15-2021		End Date: 11-15-2021	Borehole ID:
Proi	ect name:	Thornton Justice (Center Phase III	•	-	Driller: Elite-Lenny		Logged By: CLS	B-601
P	Project No: 2	21129			-	Bedrock Depth: Not encounte	red	Checked By: JRW	Sheet 2 of 2
Boring	Location:	N 1196459.7, E 3 [.]	145241.9 ft			Drilling Rig: Track Mount	ted Mot	bile B48X	
0	Ground EI:	5438.7 ft To	tal Depth: 10.0 ft			Equipment: Hollow Stem	1 Auger	3.25" I.D. 6.0" O.D.	
Groun	dwater EI:	Not Encountered	On Date:						
				(#)	t)				
5	(£	Type - No	Blows per 6 inch	ation	ery (f	Remarks	° ∑	Description and Clas	ssification of Materials
evati	pth (netra	COVE		aphi holo		
Ш. Ш.	ă			Pe	Re		ڭ ق	arained subangular to subrou	inded: medium stiff: moist:
	E I							dark brown; no to weak reacti	on with HCl; (CL);
								End of boring	g log at 10.00 ft
	F								
	-								
	F								
	- 12								
	E I								
	F								
	- 12								
	E								
	-								
	E I								
	14								
	–								
	E I								
	- 15								
	F								
	E								
	16								
	F								
	Ē								
	¢								
	- 17								
	E I								
	E								
	F								
	⊧ I								
	F								
	E I								
	19								
	¢								
	F								
	E I								
	20								
Notes	Litholoav be	etween recovered	samples is interpre	eted	Cont	acts are approximate Boring	was had	kfilled with arout. Horizontal	
(coordinate	system is modified	d from the Colorado	o Sta	te Pla	ane NAD1983 North Zone with	n conver	sion factor = 0.999721940 .	

LOG) OF	SOIL F	3ORINC	;	Τ	Start Date: 11-15-2021		End Date: 11-15-2021	Borehole ID:				
Proj	ject name:	Thornton Justice	Center Phase III	-	1	Driller: Elite-Lenny Redrock Depth: 6.0.ft		Logged By: CLS	B-602				
P	roject No:	21129	11010 7 4		\vdash	Drilling Rig: Track Mour	nted Mobi	le B48X	Sheet 1 of 1				
Boring	J Location: I Ground EI:	N 1196406.8, E 3 5437.3 ft To	145245.7 π otal Depth: 10.0 ft			Equipment: Hollow Ster	m Auger 3	3.25" I.D. 6.0" O.D.					
Groun	dwater EI:	Not Encountered	On Date:										
				£									
5		Type - No	Blows per 6 inch	tion (y (ft)	Remarks	>	Description and Clar	ssification of Materials				
vatio	pth (f	.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		netra	covel		aphic						
<u>е</u>				Pel	Ř		E E						
	E			ľ									
						Asphalt and subgrade							
	E !					approximately 11 inches thick.							
							1111	S-1, MC-2: Clavev Sand					
	- '						11/1	Mostly sand, fine to coarse gr	ained, angular to subrounded;				
	F !						11/1	dark brown to brown; PP = 4	tsf; iron staining common;				
			4 10 10				111	[Fill]);				
		S-1	4/6/9	1.5	1.0		111						
	2 						111						
	-			-			111						
	F !			1			111						
	- 3												
	- !			'	<u> </u>	1		2.5 to 1.2 ft: 15.25% fines	medium plasticitu: 5 15%				
	F !			!				gravel, fine to coarse grain	ned, angular to subrounded;				
	E, I			!			gravel, line to coarse grained, angular to subrou maximum particle size = 1 inch; light brown; (SC						
	_ 4		5/44/40	4.5									
5433.0		MC - Z	5/11/13	1.5	0.δ			MC-2: Lean Clay					
	F !			'				Mostly fines, medium plasticit medium dense; dry; light brov	y; 5-15% sand, fine grained; vn to white; weak to strong				
	E !			!				reaction with HCl; (CL); [Fill]					
	5		+	+	-								
	F !			1									
	E !			1									
				1									
5431.3	6				<u> </u>	Top of rock at 6.0 feet.	<u>,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,</u>	S 3 S 4: Claystone					
	E						======	Massive; Mostly fines, mediu	n plasticity; 5-15% sand, fine				
								apparent; dry to moist; light b	rown to gray; PP = 2.5 to 3.0				
		5-3	5/6/7	15	13			tsf; H7; behaves as a very stil with HCl; occasional iron stair	f fat clay; no to weak reaction ning;				
		3-3	5/0/1	1.5	1.5			[Denver Formation]					
	F ,												
							======						
	8												
				1									
					<u> </u>			8.5 to 10.0 ft: less than 10	- % sand:				
									•				
	- 9												
	F !	S-4	6/9/12	15	12								
	E !		0,0,12										
5 407 0	- !												
5427.3					Can	Bottom of boring at 10.0 feet.	was had	End of boring) log at 10.00 ft				
	coordinate	system is modifie	d from the Colorad	o Sta	te Pl	ane NAD1983 North Zone wit	th convers	ion factor = 0.999721940 .	RJH				

	G OF	SOIL F	3ORINC	ì		Start Date: 11-15-2021		End Date: 11-15-2021	Borehole ID:
Pro	ject name:	Thornton Justice	Center Phase III	•		Driller: Elite-Lenny		Logged By: CLS	B-603
F	Project No:	21129				Bedrock Depth: 3.5 ft	atad Mah	Checked By: JRW	Sheet 1 of 1
Boring	g Location:	N 1196332.2, E 3	145248.1 ft			Equipment: Hollow Ster	m Δuger '		
Crown	Ground El:	5436.3 ft To	otal Depth: 10.0 ft				III Auger (5.20 I.D. 0.0 O.D.	
Groun		Not Encountered							
				u (ff)	£				
io	(¥)	Type - No	Blows per 6 inch	ratio	ery (Remarks	ic ogy	Description and Cla	ssification of Materials
levat	epth			eneti	ecov		tholc		
ш	_		-		2		05		
	-								
	-					Asphalt and subgrade			
	-					approximately 11 inches thick.			
								S-1: Fat Clay	
								Mostly fines, medium to high	plasticity; less than 10% sand,
								= 4.25 tsf; occasional calciur	stiff to hard; dry; light gray; PP n seams and nodules;
	_							occasional iron staining; (CH);
	-	S - 1	8/8/12	1.5	1.1			[·]	
	- 2								
	-								
	E								
	3								
	-								
5432.8	.8					Top of rock at 3.5 feet.			
	F							Massive; mostly fines, mediu	m to high plasticity; 5-15%
								sand, fine to medium grained decomposed: fracturing not a	l; intensely weathered to apparent : dry: light brown: PP =
	- 4							3 tsf; H7; behaves as a very	stiff to hard fat clay; iron
	E	S - 2	6/8/13	1.5	1.4			weak to strong reaction with	HCI;
	_						======	[Denver Formation]	
	_								
	- 5								
	-								
	F								
	E								
	6							6.0 to 7.5 ft: less than 10	% sand; moderately to
	-							intensely weathered; dark iron staining; no calcium	c brown to gray; occasional nodules and seams;
	-								
	F	MC - 3	11/12/27	1.5	1.2				
	- 7								
	_								
	-		-				======	J	
	-								
	- 8								
	E								
	E								
									=
								8.7 to 10.0 ft: less than 10 intensely weathered; dark	0% sand; moderately to < brown to gray; PP = >4.5
	9						<u></u>	tsf; no iron staining;	-
	F	S - 4	8/11/19	1.5	1.4				
	F								
	E								
5426 3	- 10		ļ			Bottom of boring at 10 0 feet			
Notes	Lithology b	etween recovered	samples is interpr	eted	Con	tacts are approximate Boring	u was hack	End of borir Islined with arout Horizontal	ig iog at 10.00 π
	coordinate	system is modifie	d from the Colorad	o Sta	te Pl	ane NAD1983 North Zone wi	th convers	sion factor = 0.999721940.	RH

LOC	G OF	SOIL F	3ORINC	ì		Start Date: 11-15-2021		End Date: 11-15-2021	Borehole ID:
Pro	ject name:	Thornton Justice	Center Phase III	-		Driller: Elite-Lenny		Logged By: CLS	B-604
۱ ۱	Project No:	21129				Bedrock Depth: 2.2 ft Drilling Rig: Track Mour	nted Mob	Checked By: JRW	Sheet 1 of 1
Boring	g Location:	N 1196222.9, E 3	145246.4 ft			Equipment: Hollow Ster	neu Mob m Auger	3 25" I D 6 0" O D	
Grour	Ground El:	5436.5 ft IC	otal Depth: 10.0 ft				in agoi	0.20 1.2. 0.0 0.2.	
Gioui				_					
				on (ft)	(ff)				
ation	th (ft)	Type - No	Blows per 6 inch	etrati	nen	Remarks	ohic ology	Description and Cla	ssification of Materials
Elev	Depi			Pene	Rec		Grap		
	E								
	-					Asphalt and subgrade approximately 11 inches thick.			
	E								
	1		-					S-1: Fat Clay Mostly fines, medium to high	plasticity: 5-15% sand, fine to
	-							medium grained; stiff to very	stiff; dry; light gray to light
	-							iron staining and veins comm	ion; (CH);
	E	S - 1	7/8/10	1.5	1.4			[FIII]	
	- 2								
5434.3	-					Top of rock at 2.2 feet.		S-1 S-2 S-3 MC-4 Clavsto	ne
	E							Massive; Mostly fines, mediu	m to high plasticity; less than
								intensely weathered; fracturir	ng not apparent; dry; light gray
	F							to light brown; H7; iron veins seams and nodules;	common; occasional calcium
							======	[Denver Formation]	
	-								
	-						ack speckles common;		
	4								
	-	S - 2	7/7/14	1.5	1.2				
	-						======		
	- 5	ļ							
	F								
	E								
	-								
	6							6.0 to 7.5 ft: PP = 4.5 tsf; reaction with HCI:	trace black speckles; strong
									-
	-								
	E	S - 3	9/12/17	1.5	1.6				
	7								
	-								
	-			-					
	E								
	- 8								
	F								
	Ē								_
								8.5 to 10.0 ft: PP = >4.5 ts	sf; trace iron staining;
	-								
	E 9	MC - 4	15/50 for 6"	1.0	0.8				
	E I						<u></u>		
	E		+						
	F								
5426.5	<u> </u>					Bottom of boring at 10.0 feet.		End of borin	g log at 10.00 ft
Notes	Lithology be coordinate	etween recovered system is modifie	l samples is interpr d from the Colorad	reted. lo Sta	Con te Pl	tacts are approximate. Boring ane NAD1983 North Zone wit	was bacl th convers	xfilled with grout. Horizontal sion factor = 0.999721940.	ŔĴĤ

LOG	i OF	SOIL F	3ORING			Start Date: 11-15-2021		End Date: 11-15-2021	Borehole ID:
Proj	ect name:	Thornton Justice (Center Phase III	•	1	Driller: Elite-Lenny		Logged By: CLS	B-605
P	roject No:	21129				Bedrock Depth: 6.0 ft	atod Mob	Checked By: JRW	Sheet 1 of 1
Boring	Location:	N 1196158.1, E 31	145238.2 ft			Equipment: Hollow Ster			
Cround	Ground El:	5437.7 ft Tot	tal Depth: 10.0 ft				Auger	0.20 I.D. 0.0 O.D.	
Ground		Voi Encountered							
Elevation	Depth (ft)	Type - No	Blows per 6 inch	Penetration (ft)	Recovery (ft)	Remarks	Graphic Lithology	Description and Cla	ssification of Materials
						Concrete slab approximately 6 inches thick.			
		S-1	2/3/3	1.5	1.5	incres thick.		S-1, S-2: Sandy Fat Clay Mostly fines, high plasticity; 2 grained, subangular to subrou e 0.5 inches; medium stiff to s PP = 1 tsf; occasional calcium HCI; (CH); [Fill] 2.2 to 2.5 ft: dark brown; (3.5 to 5.0 ft: 20-30% sand 1.75 tsf; trace organics; tra strong reaction; (CH);	5-35% sand, fine to coarse inded; 5-15% gravel, fine inded; maximum particle size stiff; dry to moist; light brown; in nodules; strong reaction with <i>CH</i>); <i>c</i> dark brown to brown; <i>PP</i> = ace calcium nodules; no to
	-								
5431.7	- 6 	MC - 3	6/11/14	1.5	1.0	Top of rock at 6.0 feet.		MC-3, S-4: Claystone Massive; Mostly fines, mediur 10% sand, fine grained; very not apparent; dry to moist; lig tsf; H7; calcium nodules throu to strong reaction with HCl; [Denver Formation]	m to high plasticity; less than intensely weathered; fracturing ht gray to light brown; PP = 4.5 ighout; trace iron veins; weak
	- - - - - - - - - - - - - - - - - - -	S - 4	4/7/10	1.5	1.6			8.5 to 10.0 ft: PP = 2.5 tsf. iron veins and staining co	occasional calcium veins; mmon;
	E	1					======		
5427.7	- 10		ļ			Bottom of boring at 10.0 feet.		End of boring	1 log at 10 00 ft
Notes L	_ithology be coordinate	etween recovered system is modified	samples is interpre from the Colorado	eted. o Stat	Cont te Pla	tacts are approximate. Boring ane NAD1983 North Zone wi	y was back th convers	kfilled with grout. Horizontal sion factor = 0.999721940.	

LOG	G OF	SOIL E	BORING			Start Date: 11-16-2021		End Date: 11-16-2021	Borehole ID:
Pro	ject name:	Thornton Justice	Center Phase III			Driller: Elite-Lenny		Logged By: CLS	B-606
F	Project No:	21129				Drilling Rig: Track Mount	ted Mob		Sheet 1 of 7
Boring	Location:	N 1196496.1, E 3	145233.1 ft			Equipment: Hollow Sten	n Auger (3.75" I.D. 7-5/8" O.D.: NQ	Wireline Coring 1-7/8" I.D.
Groun	dwater El:	5435.UTI IC Not Encountered	On Date:			3" O.D.			
Groun					1				
				on (fl	(Ħ)				
ation	(ff)	Type - No	Blows per 6 inch	etrati	very	Remarks	hic	Description and Clas	ssification of Materials
Elex	Dept			Pene	Reco		Grap		
	E							S-1, MC-2: Sandy Lean Clay Mostly fines medium plasticit	v: 20-30% sand fine to coarse
								grained, angular to subrounde	ed; 10-20% gravel, fine to
	-							size = 1 inch; stiff to very stiff;	dry; brown; strong reaction
								(Fill]	
	- 1							1.0 to 2.5 ft: organics and	geotextile throughout; (CL);
	-								
	E								
	-	S - 1	5/5/6	1.5	0.7				
	2								
	E I								
	-								
	E								
	- 3								
	F								
	E								
	-							3.5 to 5.0 ft: 25-35% sand, 1.25 inches; very stiff to ha	: maximum particle size = ard; (CL);
	F,								
	4								
		MC - 2	8/10/16	1.5	0.7				
	-								
	5								
	F								
5429.5							******	S-3, MC-4, S-5, S-6: Lean Cla	ay with Sand
	F							Mostly fines, medium plasticit grained, subangular to subrou	y; 10-20% sand, fine to coarse inded; less than 10% gravel,
	6							fine to coarse grained, angula particle size = 1 inch; medium	r to subrounded; maximum stiff: drv to moist: brown to
	E							reddish brown; occasional cal	cium nodules ; (CL);
	E I							լւայ	
	E	S - 3	3/2/3	1.5	0.9				
	- 7								
	F								
	E I								
	F a								
	8								
	E							8.5 to 10.0 ft: 15-25% san stiff: PP = 2 tsf: no calcium	d, fine to medium grained; nodules: (CL):
	É								
	9								
	E	MC - 4	8/5/9	1.5	0.8				
	E								
	F								
	- 10							Continued	on next sheet
Notes	Lithology b coordinate	etween recovered system is modifie	l samples is interpred d from the Colorado	eted. o Sta	Con te Pl	tacts are approximate. Boring ane NAD1983 North Zone witl	was back h convers	filled with grout. Horizontal sion factor = 0.999721940.	RJH

	G OF	SOIL F				Start Date: 11-16-2021		End Date: 11-16-2021	Borehole ID:
	iect name:				-	Driller: Elite-Lenny		Logged By: CLS	B-606
F	Proiect No: 2	21129	Jenter i nase m			Bedrock Depth: 18.8 ft		Checked By: JRW	Sheet 2 of 7
Boring	Location:	N 1196496.1, E 3 ²	145233.1 ft			Drilling Rig: Track Mour	nted Mob	ile B48X	
(Ground EI:	5435.0 ft To	tal Depth: 53.0 ft			Equipment: Hollow Ster	m Auger	3.75" I.D. 7-5/8" O.D.; NQ	Wireline Coring 1-7/8" I.D.
Groun	dwater El:	Not Encountered	On Date:			3			
				ft)					
		Tuno No	Plows por 6 inch	ion (y (ft)	Bomarka		Description and Cla	scification of Materials
atior	th (ft	Type - No	Blows per 6 inch	etrat	over	Remarks	ohic ology	Description and Cla	SSILCATION OF MATERIALS
Шe	Dep			Pen	Reo		Grag		
	-					Water level measured at 10.1			
	E					leet alter drilling and coning.			
	_								
	- 11								
	E								
	-								
	E								
	12								
	-								
	-								
	- 13								
	-								
	E							13.5 to 15.0 ft: 5-15% san	d, fine to medium grained;
							rrained; maximum particle f: PP = 3.5 tsf: strong		
	- 14							reaction with HCI; (CL);	-
	- ···	S 5	4/5/7	15	1 /				
	-	3-5	4/5/7	1.5	1.4				
	-								
	-								
	- 15								
	E I								
	16								
	E								
	- -								
	E								
	- 17								
	-								
	-								
	- 18								
	E								
	E l								
	E I							18.5 to 18.8 ft: 15-25% sa subangular to subrounded	nd; Gravel is fine grained, ; maximum particle size =
5416.2	⊨ I					Top of rock at 18.8 feet.		0.5 inches; very stiff; stron S-6, MC-7, S-8; Claystone	g reaction with HCl; (CL);
								Massive; Mostly fines, high pl	asticity; less than 5% sand,
	⊨ I	S - 6	4/8/13	1.5	1.6		E=====	rine grained; slightly to moder oriented fractures throughout	atery weathered; randomly dry to moist; light gray to gray;
	F						======	H7; occasional calcium seam	s; occasional iron staining;
	FI							[Denver Formation]	,
	E 20								
Notes		atween recovered	samples is interar	otod	Con	tacte are approvimete. Perine		Continued	on next sheet
NOLES	coordinate	system is modified	d from the Colorad	o Sta	te Pl	ane NAD1983 North Zone wit	th convers	sion factor = 0.999721940 .	RJH



LO	OG OF ROCK CORE Project name: Thornton Justice Center Phase III									Star	t Dat Drille	e: 11- er: Elit	-16-2021 te-Lenny		End I Logge	Date: 11-16-2021 d By: CLS	Borehole ID:
Р	roject na	me: Thornton Jus	enter	Phas	e III			Bed	rock	Dept	h: 18.	.8 ft	С	hecke	d By: JRW	B-606	
	Project	No: 21129								۲ Drillir	ng Ri	e. 90. g: Tra	.u ack Mounted Mo	obile E	веа 348X	anng. N/A	Sheet 4 OF 7
Bor	ing Loca Ground	tion: N 1196496.1, 1 EI: 5435.0 ft	, E 314 Tota	15233 al Der	3.1 ft oth: 5:	3 0 ft				Equi	pmer	nt: Ho	llow Stem Auge	er 3.75	5" I.D. 1	7-5/8" O.D.; NQ Wirel	ine Coring 1-7/8" I.D. 3" O.D.
Gro	undwate	r EI: Not Encountered	(Dn Da	ate:	0.0.1											
				(ft)	t, (%)		a	sec				ing	_	0			
tion	(#)	Notes: Groundwater,	al (ft)	tration	very ft	ft (%)	g Time	of Piec	est (ft)	est (ft	less	u Testi	ription	Symbe	ogy		
Eleva	Dept	Drilling, Conditions, Circulation etc	Interv	Pene	Reco	RQD	Corin (min)	No.	Long	Short	Hard	In Sit	Joint Desc	Joint	Lithol	Description and	Classification of Materials
	=																
	-																
	21 —																
	-																
	-																
	-																
	22 —																
	-																
	-																
	23 —																
	25 -																
	-																
	26 —																
5408.5		Stop hollow stem										_				26.5 to 44.9 feet: Cla	wstone
		augering at 26.5 feet.Start NQ												\mathbb{N}		Massive; mostly fine 5, 15% sand, fine gra	s, medium to high plasticity;
	27 —	coring.	0.0 5										No Recovery			weathered; slightly fr	actured, randomly oriented
			26.5 to	1.5	0.7 (47)	0.7 (47)	1	2	0.4	0.3	H7		Mechanical Break			staining common; oc	casional calcium seams; weak
			28.0		Ì								Mechanical Break	┝		[Denver Formation]	
	-												Mechanical Break	-			
	28 —													$ \land $			
	-												No Recovery	X			
													Rubble	$\overline{\Sigma}$		28.4 to 30.3 ft: T moderately weat	hinly bedded; slightly to hered; moderately to very
													Slightly to moderately			intensely fracture	ed; gray;
	29 —				1								open, stepped to rough, clean				
	-				1								stepped to rough, clean				
	-	Good circulation.			1									$\overline{\Sigma}$			
	-												Rubble	\bigotimes			
Notes	Litholo	av between recov	ered s	ample	es is i	intern	reted	. Cor	tacts	area		 xima	te. Boring was	KX backfi	lled wi	Contir th grout. Horizontal	nued on next sheet
	coordi	nate system is mo	dified	from	the C	olora	do Sta	ate P	lane	NAD	1983	North	Tone with con	versio	on facto	or = 0.999721940.	RUH



IOG	OF ROC	2F				Star	t Date	e: 11- r: Elii	16-2021		End [Date: 11-16-2021	Borehole ID:		
Proiect	name: Thornton Jus		-	Bed	rock	Dept	n. ⊏⊪ h: 18.	8 ft	С	hecke	d By: JRW	B-606			
Proj	ect No: 21129							P	lunge	e: 90.	0		Bea	aring: N/A	Sheet 6 of 7
Boring Lo	ocation: N 1196496.1	, E 31452	233.1 ft					Drillir	ng Rig	g: Tra	ck Mounted Mo	bile E	348X		
Gro	und EI: 5435.0 ft	Total C	Depth: 5	3.0 ft				Equip	omen	it: Ho	llow Stem Auge	r 3.75	5" I.D. 7	7-5/8" O.D.; NQ Wirel	ine Coring 1-7/8" I.D. 3" O.D.
Groundwa	ater EI: Not Encountered	On	Date:	1											
Elevation Depth (ft)	Notes: Groundwater, Drilling, Conditions, Circulation etc	Interval (ft)	Penetration (ft) Recovery ft, (%)	RQD, ft (%)	Coring Time (min)	No. of Pieces	Longest (ft)	Shortest (ft)	Hardness	In Situ Testing	Joint Description	Joint Symbol	Lithology	Description and	d Classification of Materials
41 42 43 5390.1 45 5388.9 46 47 47 48 48 49 49 50 Notes Lith	Poor circulation.	38.0 to 43.0 to 43.0 to 48.0 to 48.0 to 5	5.0 5.0 (100) 5.0 (100) 5.0 (200) 5.0 (20	1.8 (36)	23 11	6 >10	2.9 1.3	<0.2	H7 H7 H6	xima	60 degrees, Slightly to moderately open, moderately open, rough, clean, Mn staining Moderately open, rough, clean 15 degrees, Slightly open, stepped to rough, clean 15 degrees, Slightly open, stepped to rough, clean 15 degrees, Slightly open, stepped to rough, clean 15 degrees, Slightly open, stepped to stepped, clean Slightly open, stepped to slightly rough, clean Slightly open, stepped, clean Slightly open, stepped, clean Mechanical Break Mechanical Break Mechanical Break Mechanical Break			44.9 to 46.1 feet: Cla Massive; mostly san low to medium plasti weathered; unfractuu cemented; increase [Denver Formation] 46.1 to 53.0 feet: Cla Massive; mostly fine 5% sand, fine graine weathered; moderat randomly oriented fr [Denver Formation] 46.1 to 47.0 ft: in slickensides con 47.8 to 53.0 ft: s weathered; very fractured; dark g	ayey Sandstone d, fine grained; 25-35% fines, city; fresh to slightly red; moist; light brown; weakly in grain size with depth; aystone s, medium plasticity; less than d; intensely to very intensely ly to very intensely fractured, actures throughout; dry; gray; tom staining throughout; mon; lightly to moderately slightly to moderately ray to gray to brown; hued on next sheet

LO	OG OF ROCK COR									Star	t Date	e: 11- r: Elit	16-2021 e-Lenny		End	Date: 11-16-2021	Borehole ID:
	roject na	me: Thornton Jus	enter	Phas	e III			Bed	rock	Dept	n: 18.	8 ft	С	hecke	d By: JRW	B-606	
	Project	No: 21129						_		P	lunge	e: 90.	0 als Maximta d Ma		Bea	aring: N/A	Sheet 7 of 7
Bor	ing Loca	tion: N 1196496.1	, E 314	5233	.1 ft					Equir	iy riq	j. ⊓a t∘⊔o			940A		line Caring 1 7/9" I.D. 2" O.D.
	Ground	d EI: 5435.0 ft	Tota	l Dep	oth: 5	3.0 ft				Equi	omen	ι. πο	low Stern Auge	9 3.75) I.D.	7-5/6 U.D., NQ WIFE	line Coning 1-776 I.D. 5 O.D.
Gro	undwate	r EI: Encountered	C)n Da	ite:	1								1		[
Elevation	Depth (ft)	Notes: Groundwater, Drilling, Conditions, Circulation etc	Interval (ft)	Penetration (ft)	Recovery ft, (%	RQD, ft (%)	Coring Time (min)	No. of Pieces	Longest (ft)	Shortest (ft)	Hardness	In Situ Testing	Joint Description	Joint Symbol	Lithology	Description an	d Classification of Materials
	51	Bottom of boring at 53.0 feet.	48.0 to 53.0	5.0	5.0 (100)	5.0 (100)	15	3	3.8	0.3	H7 to H6		Moderately open, rough to slightly rough, clean			End of n	ock core log at 53.00 ft
Notes	54	gy between recov	rered sa	ample	es is i	interp	reted	. Cor	htacts		appro	xima	te. Boring was	backfi	lled w	th grout. Horizontal	
	coordi	nate system is mo	dified f	from t	he C	olora	do Sta	ate P	lane	NAD1	1983	North	Zone with con	versic	on fact	or = 0.999721940.	

LOG	i OF	SOIL F	BORING	ì		Start Date: 11-17-2021		End Date: 11-19-2021	Borehole ID:
Proje	ect name:	Thornton Justice	Center Phase III	•	-	Driller: Elite-Lenny		Logged By: CLS	B-607A
P	roject No:	21129				Bedrock Depth: 8.9 ft	tod M-L	Checked By: JRW	Sheet 1 of 6
Boring	Location:	N 1196447.3, E 3	145146.8 ft			Drilling Rig: Track Moun			Mirolino Coring 1 7/9" I D
G	Fround El:	5424.5 ft To	tal Depth: 46.0 ft			2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	n Auger .	5.75 I.D. 7-5/6 O.D., NQ	Witeline Coning 1-7/6 1.D.
Ground	dwater El:	Not Encountered	On Date:				<u>г</u> т		
				(#	£				
Б	(u	Type - No	Blows per 6 inch	ation	ery (i	Remarks	ъб	Description and Clas	sification of Materials
evati	pth			enetr	SCOVE		aphi holo		
<u> </u>	ă			Pe	Å		55	S.1. S.2. MC 3: Eat Clay with	Sand
	-							Mostly fines, high plasticity; 10	0-20% sand, fine to coarse
	E I							grained, subangular to subrou very stiff to hard; dry; light bro	nded; less than 5% gravel; wn to brown; PP = 4.5 tsf;
	E I							occasional organics; iron stair	ing throughout; weak to
	E							[Fill]	3
	1								
	-								
	E	S - 1	6/5/5	15	10				
	-	0-1	0/0/0	1.5	1.0				
	- 2								
	-								
	E I								
	- 3								
	F								
	-								
	F								
	_ 4								
		S - 2	4/5/6	1.5	0.3				
	_								
	-								
	5								
	_								
	-								
	6							6.0 to 7.5 ft: 15-25% sand:	Gravel is fine grained
	F							subangular to subrounded;	maximum particle size = 2 ± 3 tsf: no to weak
	E							reaction with HCl; (CH);	3 131, 110 10 Weak
	_		5/4/0	4.5					
	_	MC - 3	5/4/8	1.5	1.5				
	7								
	-								
	E I							J	
	E I								
5416.5	⊨ ₈ ∣							C. 4. Condu E-4 O	
	F							S-4. Sandy Fat Clay Mostly fines, high plasticity; 35	5-45% sand, fine to coarse
	E I							grained, subangular to subrou fine grained, subangular to su	nded; less than 5% gravel, brounded; maximum particle
	E I							size = 0.5 inches; stiff; dry to r	noist; brown; no to weak
5415.6	E I					Top of rock at 8.9 feet			
	9							S-4, S-5: Claystone Massive; mostly fines, mediun	n to high plasticity; less than
	⊧ I	S - 4	4/8/11	1.5	1.7			10% sand, fine grained; very i	ntensely weathered; randomly
	F							brown; H7; iron staining and v	eins throughout; trace calcium
	E I							nodules; [Denver Formation]	
								•	
Notes I	ithology by	etween recovered	samples is intern	eted	Con	acts are approximate Boring	was hack	Continued of the continued of the continued of the content of the	on next sheet
c	coordinate	system is modified	d from the Colorad	o Sta	te Pl	ane NAD1983 North Zone wit	h convers	sion factor = 0.999721940 .	
									CONSULTANTS INC

LOG	GOF	SOIL E	3ORING			Start Date: 11-17-2021		End Date: 11-19-2021	Borehole ID:
Proj	ect name:	Thornton Justice (Center Phase III	•	1	Driller: Elite-Lenny		Logged By: CLS	B-607A
P	Project No:	21129				Bedrock Depth: 8.9 ft	tod Mob		Sheet 2 of 6
Boring	Location:	N 1196447.3, E 3	145146.8 ft			Equipment: Hellow Sten			Wiroling Coring 1 7/8" I D
0	Ground El:	5424.5 ft To	tal Depth: 46.0 ft			3" O.D.	Auger	5.75 I.D. 7-5/6 O.D., NQ	wireline Coning 1-7/6 1.D.
Groun	dwater EI:	Not Encountered	On Date:						
Groun	dwater EI:	Type - No	On Date: Blows per 6 inch	Penetration (ft)	Recovery (ft)	Remarks	Graphic Craphic Craphi	Description and Clas	ssification of Materials
	15 	S - 5	6/18/23	1.5	1.6			15.0 to 16.5 ft: moderately gray to dark gray; H6 to H; common; no calcium nodu	to intensely weathered; 7; iron staining and veins Jes;
5408.0	F					Stop hollow stem augering at 16.5 feet. Start NQ coring.		End of boring	log at 16.50 ft
	- 17 - 17 - 18 - 18 - 19 - 19 - 20								
Notes I	Lithology b coordinate	etween recovered system is modified	samples is interpre from the Colorado	eted. o Stat	Cont te Pla	acts are approximate. Boring ane NAD1983 North Zone wit	was bacł h convers	xfilled with grout. Horizontal sion factor = 0.999721940.	RJH

LOG OF ROCK CORE									Start Date: 11-17-2021 Driller: Elite-Lennv						End I	Borehole ID:		
Project name: Thornton Justice Center Phase III										Bedrock Depth: 8.9 ft						d By: JRW	B-607A	
	Project	No: 21129								⊢ Drillir	'lunge ng Rie	e: 90. g: Tra	.0 ack Mounted Mo	bile E	Веа 348Х	aring: N/A	Sheet 3 of 6	
Bori	ng Loca	tion: N 1196447.3, 1 El: 5424 5 ft	E 314 , Tots	15146 Nor	6.8 ft	6 0 ft			Equipment: Hollow Stem Auger 3.75" I.D. 7-5/8" O.D.; NQ Wireline Coring 1-7/8" I.D. 3" O.D.									
Gro	undwate	r El: Not Encountered	(Dep Dn Da	ate:	0.0 11												
		Encountered		(ŧ)	(%)			es				bu		_				
tion	(¥)	Notes: Groundwater.	al (ft)	ration	/ery ft,	ft (%)	g Time	f Piece	ist (ft)	est (ft)	ess	ı Testir	iption	Symbo	КВс			
Eleva	Depth	Drilling, Conditions, Circulation etc	Interv	Penet	Reco	RQD,	Corin (min)	No.	Longe	Short	Hardn	In Situ	Joint Descr	Joint :	Lithol	Description an	d Classification of Materials	
	_																	
	_																	
	-																	
	11 —																	
	-																	
	-																	
	-																	
	12 —																	
	_																	
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	13 —																	
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	14 —																	
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	-																	
	15 -																	
	_																	
	_																	
	 16																	
	-																	
5408.0	_	Stop hollow stem										-				16 E to 24 C foot: Cl	avatana.	
	-	augering at 16.5 feet. Start NQ												\mathbb{N}		Massive; mostly fine	es, medium to high plasticity;	
	17 —	coring.											No Recovery	Ŵ		very intensely weath	nered; slightly to moderately oriented fractures throughout:	
	-												Mechanical Break 25 degrees,	$ \ge $		dry to moist; gray; in throughout:	on staining and veins	
	-	Slow coring.											Moderately open, moderately to slightly rough, clean	\leq		[Denver Formation]		
	-												Mechanical Break Rubble					
	18 —		16.5								н7		Tight, rough to moderately rough,	-				
	_		to 21.5	5.0	4.3 (86)	3.6 (72)	21	8	2	<0.1	to		clean, Fe staining		=====			
	_		21.5								110							
	-																	
	19 —	Water flowing up boring on outside																
	-	of hollow stem augers and exiting																
	-	on ground surface.																
	-																	
Notes		av between recov	ered s	ample	es is	intern	reted	Cor	tacts	are		xima	te. Boring was h	 backfi	illed wi	Conti th arout Horizontal	nued on next sheet	
	coordi	nate system is mo	dified	from t	the C	olora	do St	ate P	lane	NAD	1983	North	Tone with conv	versio	on facto	r = 0.999721940.		

LOG OF ROCK CORE Project name: Thornton Justice Center Phase III									Start Date: 11-17-2021 Driller: Elite-Lenny						End I Logge	Date: 11-19-2021 d By: CLS	Borehole ID: B-607A
									Bed	rock P	Dept Nuna	h: 8.9)ft ∩	C	hecke Rea	d By: JRW	Sheet 4 of 6
_ .	Project	No: 21129	=							Drillir	ng Ri	g: Tra	ack Mounted Mo	bile E	348X		
Bori	ng Locat	tion: N 1196447.3	, E 314	15146 N Dan	5.8 ft	2 O #				Equip	omer	nt: Ho	llow Stem Auge	r 3.75	5" I.D. 1	7-5/8" O.D.; NQ Wire	line Coring 1-7/8" I.D. 3" O.D.
Cro	Ground	1 EI: 5424.5 II r EI: ^{Not}	1018	ai Dep Do Do	otn: 40	5.U II											
	unuwate	Encountered			ale.												
			£	on (ft	r ft, (9	(%	me	eces	£	(ft)		sting	5	lođ			
ation	th (ft)	Notes: Groundwater,	val (etrati	overy), ft (ng Ti	of Pi	gest (rtest	dnesa	itu Te	t cripti	t Syn	ygold		
Elev	Dept	Circulation etc	Inter	Pen	Rec	RQD	Cori (min	°. N	Lonç	Shoi	Harc	In Si	Joint Des	Joint	Litho	Description an	d Classification of Materials
	-												Slightly to moderately open, rough to				
	-												clean				
	-																
	-																
	21 —																
													Mechanical Break	\vdash			
	-																
	_													\mathbb{N}			
	-												No Recovery	$ \wedge$			
	22 —												Moderately open,	\square			
	-												rough, clean				
	-																
	-																
	22	Good circulation															
	23 -	Good circulation.															
	-																
																23.5 to 25.8 ft: v	very intensely weathered to
	-		04.5												=====	decomposed, b hard fat clay; lig	ehaves as a very stiff to ht brown; occasional
	24 —		21.5 to	5.0	4.5	4.0	14	4	4	<0.1	H7					reddish brown s	taining;
	-		26.5		(90)	(00)											
	-																
	-																
	3																
	25 —																
	-																
	-																
	-																
	-															25.8 to 27.8 ft: v	very intensely weathered to
	26 —												15 degrees, Slightly	-		hard fat clay; lig	ht brown; occasional
	-												to moderately open, rough, clean	\square		reddish brown s common;	taining; iron staining
	-											-	Mechanical Break				
	-												Moderately open				
	27 —												rough to slightly rough, clean				
													60 degrees, Slightly				
	-												to moderately open, rough to moderately				
			26.5		2.5						Н7		rough, clean	1	=====		
	-		to	2.5	(100	(84)	10	4	1.6	0.2	to						
	28 —		29.0								по		Mechanical Break				
	-																
	-																
	29 —	Water flowing up										-	No Recovery	\triangleright		29.0 to 31.0 ft: s	slightly to intensely
	-	equipment turned											Mechanical Break	\simeq		weathered; occa on fracture surfa	asional manganese staining ace increases with depth:
	_	off. Pressurized											internation broak				
	_	coning india.											Moderately open, stepped to rough,				
	-												clean, Fe and Mn staining				
																Conti	nued on next sheet
LO	OG OF ROCK CORE							Start Date: 11-17-2021 Driller: Elite-Lenny				-17-2021 te-Lenny	End Date: 11-19-2021 Borehole ID: Logged By: CLS			Borehole ID:	
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<u>Р</u>	roject na	ame: Thornton Jus	tice Ce	enter	Phas	e III			Bed	lrock	Dept	h: 8.9) ft	C	Checker	d By: JRW	B-607A
	Project	No: 21129						-		F Drilliu	<u>ิขุ่นท</u> g na Ri	<u>e: 90</u>	.0 ack Mounted Mc	hile l	Bea B48X	ring: N/A	Sheet 5 of 6
Bori	ng Loca	tion: N 1196447.3	, E 314	15146	3.8 ft				Equipment: Hollow Stem Auger 3.75" I.D. 7-5/8" O.D.; NQ Wireline Coring 1-7/8" I.D. 3'							line Coring 1-7/8" I.D. 3" O.D.	
Cro.	Ground	J EI: 5424.5 ft	Tota	il Dep	oth: 40	6.0 ft							5				
Gro	undwate	r EI: Encountered			ate:			\vdash	<u> </u>	<u> </u>	1	—		<u> </u>			
_			Û	on (ft	/ ft, (9	(%)	me	ieces	(ŧ	(ft)		sting	ч	lodn			
vatior	oth (ft	Notes: Groundwater, Drilling, Conditions,	erval (netrati	covery	D, ft (ing T	of P	Igest	ortest	dnes:	Situ Te	scripti	rt Syr	lology		
е Ш	Der	Circulation etc	Inte	Per	Rec	RQ	<u>a</u> c	Ň	Lor	Shc	Har	u -	- - - - - - - - - - - - - -	Joir	Ē	Description an	d Classification of Materials
		feet on 11/17/21.											open, stepped to rough, clean, Fe and		=====		
		feet on 11/18/21.											Mn staining				
	-		29.0	25	2.3	1.2	14	8	0.9	01	H7				=====		
	24 _		31.5	2.0	(92)	(48)		Ŭ	0.0	0.1	H5		Slightly open, moderately to slightly				
	31 -												Moderately open to open, stepped to	5	=====	31.0 to 32.2 ft: 5 occasional redc	5-15% sand; light brown; Jish brown staining;
													rough, clean Moderately open to	K	<u>}</u>	occasional man surface;	iganese staining on fracture
		-		+	\square	+	 		+		\vdash	1	open, stepped to rough, clean	\square	È=====		
	32 —		31.5		15												
	-		to	1.5	(100	1.3 (87)	4	2	1.3	0.2	H7					32.2 to 34.6 ft: i	intensely to very intensely
	1 -		33.0)											Weathered; light	<u>t brow</u> n;
													Slightly open,		E====]		
	33 —			\vdash	\vdash	<u> </u>		L	<u> </u>	<u> </u>	<u> </u>	_	moderately rough, clean	L	[]		
														$\left \right /$	[]		
													No Recovery	ΙV			
	-													/			
														\square	<u></u>		
	34 _												20 degrees, Moderately open,	-			
													stepped to rough, clean				
5389.9																	· · · ·
3003.0	-															34.6 to 36.8 teet: CI Massive; mostly sar	ayey Sandstone nd, fine grained; 40-50% fines,
	35 —															low to medium plast weathered: slightly f	ticity; slightly to moderately fractured: drv to moist; orangish
																brown to light brown	1; iron staining common;
			33.0 to	5.0	4.1	3.6	13	6	1.9	0.1	H7 to					[Denver Formation]	ese stanning, poorly comonice,
	_		38.0		(ŏ∠)	(12)					H6						
	36 -												Moderately open, stepped to rough.				
	-												clean, Fe and Mn staining				
	1 1																
5387.7	-												Slightly open, stepped to rough,	-	=====	36.8 to 42.7 feet: Cl	aystone
	37 —												clean, Fe and Mn staining		=====	Massive; mostly fine less than 5% sand,	es, medium to high plasticity; fine grained; intensely
	-															weathered to decom	nposed; slightly to moderately
													Mechanical Break			dry to moist; light br	own to gray; iron staining and
	-												moonanioar Broak		E=====	[Denver Formation]	iganese staining common;
	38 —			–	–		_	_	–	–	_	-	Moderately open,			38.0 to 38.7 ft: i	iron staining and mangagese
													stepped to rougn, clean, Fe and Mn staining			staining through	hout;
		-											15 degrees, Moderately open to		E		
	-												open, stepped to rough, clean, Fe and]	
													Mh staining				
	39																
	-																
	-															39.5 to 41.0 ft: s	slightly to moderately
																Weathered; no r	<u>manga</u> nese staining;
	40 —															Cont	linued on next sheet
Notes	Litholo coordi	gy between recov nate system is mo	rered s odified f	ample from f	es is i the C	interp olora	oreted do St	i. Cor ate P	ntacts ′lane	s are a NAD	appro 1983	oxima Nortl	ite. Boring was t h Zone with conv	oackf versi	illed wit on factc	h grout. Horizontal or = 0.999721940.	RJH

	GŪ	F ROC	Κ (CC) F	RE		Start Date: 11-17-2021 Driller: Elite-Lenny				17-2021 e-Lennv	End Date: 11-19-2021 Borehole ID: Logged By: CLS D COTA		Borehole ID:		
	roject na	me: Thornton Jus	tice Ce	enter	Phas	e III			Bedrock Depth: 8.9 ft					C	hecke	d By: JRW	B-607A
	Project	No: 21129						\vdash		P Drillir	'lunge 1a Rie	e: 90. a: Tra	u ck Mounted Mo	bile F	Bea 348X	aring: N/A	Sheet 6 of 6
Bori	ng Locat	tion: N 1196447.3,	E 314	5146	.8 ft				Equipment: Hollow Stem Auger 3.75" I.D. 7-5/8" O.D.; NQ Wireline Coring 1-7/8" I.D. 3" O.I.								
-	Ground	d EI: 5424.5 ft	Tota	l Dep	oth: 46	5.0 ft											
Grou	undwate	r EI: Encountered	C	Dn Da	ite:									1			
Elevation	Depth (ft)	Notes: Groundwater, Drilling, Conditions, Circulation etc	Interval (ft)	Penetration (ft)	Recovery ft, (%	RQD, ft (%)	Coring Time (min)	No. of Pieces	Longest (ft)	Shortest (ft)	Hardness	In Situ Testing	Joint Description	Joint Symbol	Lithology	Description and	I Classification of Materials
5381.8	41		38.0 to 43.0	5.0	5.0 (100)	4.3 (86)	13	6	4	0.1	H7 to H6		Mechanical Break Mechanical Break Moderately open, stepped to rough, clean 20 degrees, Slightly			41.1 to 42.7 ft: li calcium nodules 42.7 to 43.0 feet: Cla Similar to 34.6 to 36.	ght brown; occasional yey Sandstone 8 ft Except: moderately to
	43	Drillers dropped core barrel down the borehole and could not retrieve sample or equipment.	43.0 to 46.0	3.0	0.0 (0)	0.0 (0)	12	0	0	0			to moderately open, stepped to moderately rough, clean			intensely weathered; occasional calcium s [Denver Formation]	intenselý fractured; eams;
	46	Stop coring at 46.0 feet on 11/18/21. Bottom of boring at 46.0 feet. Moved drill rig aprpoximately 5.0 feet north of B-607A to complete drilling.														End of ro	ck core log at 46.00 ft
	50 —			L	L												

LOG	GOF	SOIL E	BORING	ì		Start Date: 11-19-2021		End Date: 11-20-2021 Borehole ID:		
Proj	ect name:	Thornton Justice (Center Phase III	-		Driller: Elite-Lenny		Logged By: LEA/JEL	B-607B	
Р	Project No:	21129				Drilling Rig: Track Moun	ted Mot	Dile B48X/CME-550X Rubb	Sheet 1 of 5 er Tire ATV Mounted Rig	
Boring	Location:	N 1196454.8, E 3 ⁻	145146.8 ft			Equipment: Hollow Sten	n Auger	3.75" I.D. 7-5/8" O.D.; NQ	Wireline Coring 1-7/8" I.D.	
Ground	dwater El:	0420.0 IL IO	On Date:			3" O.D.	0		0	
				£	1					
				on (f	(#)					
ation	th (ft)	Type - No	Blows per 6 inch	etrati	oven	Remarks	ohic ology	Description and Clas	sification of Materials	
Elev	Dept			Pene	Rec		Litho			
	E					B-607B was performed to complete drilling and sampling		0.0 to 20.0 ft: See B-607A log for c	lescription of materials.	
	-					to about 50.0 feet after B-607A				
	-					equipment at the bottom of				
	E					recovered. B-607B is				
	- 1					approximately 5.0 feet north of B-607A.				
	E									
	-					Smooth drilling.				
	F									
	_ 2									
	-									
	-					Dry, brown cuttings.				
	E									
	- 3									
	-									
	E									
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	Ē,									
	- 1									
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	F_									
	- 5									
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	E									
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	6									
	E									
	-									
	E									
	7									
	È									
	E					Dry to moist, brown cuttings.				
	E									
	8									
	E									
	E									
	E									
	Ē 9									
	Ę									
	F									
	E									
	È ,									
Notoc		atween recovered	 samples is interne	oted	Cor	tacte are approvimate. Pering		Continued	on next sheet	
(100005 L	coordinate	system is modified	d from the Colorad	o Sta	te Pl	ane NAD1983 North Zone with	n conver	sion factor = 0.999721940 .	RH	

	GOF	SOIL F	RORING	Start Date: 11-19-2021 End Date: 11-20-2021 Borehole ID:					
	oject name:	Thornton Justice	Center Phase III	-	-	Driller: Elite-Lenny		Logged By: LEA/JEL	B-607B
	Project No:	21129				Bedrock Depth: 8.9 ft		Checked By: JRW	Sheet 2 of 5
Borir	ng Location:	N 1196454.8, E 3	145146.8 ft			Drilling Rig: Track Mount	ed Mob	DIE B48X/CME-550X Rubb	er Tire ATV Mounted Rig
	Ground EI:	5425.0 ft To	otal Depth: 49.0 ft			Equipment: Hollow Sterr	n Auger	3.75" I.D. 7-5/8" O.D.; NQ	wireline Coring 1-7/8" I.D.
Grou	ndwater EI:	Not Encountered	On Date:			J U.D.		1	
				(ft)	_				
	£	Type - No	Blows per 6 inch	tion	y (ft	Remarks	~	Description and Clas	sification of Materials
/atio	th (f	Type No	Biomo por o mon	etra	iovei	Romano	phic olog	Booonplion and old	
Elev	Dep			Pen	Rec		Gra		
	-								
	-								
	- 11								
	_								
	-								
	-								
	- 12 -								
	E								
	- 13								
	-								
	-								
	-								
	14								
	E								
	-								
	-								
	15					Drillers report water level at about 15.0 feet after auger			
	-					removal. Water level was not			
	E					measureu.			
	- 16								
	-								
	-								
	-								
	E								
	17								
	F					Brown to gray cuttings.			
	E								
	- 18								
	E								
	- -								
	- 19								
	E								
	E								
	- 20							Continued	on next sheet
Notes	Lithology be coordinate	etween recovered system is modifie	l samples is interpre d from the Colorado	eted. o Sta	Cont te Pla	tacts are approximate. Boring ane NAD1983 North Zone with	was bac n convers	kfilled with grout. Horizontal sion factor = 0.999721940.	

						Start Date: 11-19-2021	End Date: 11-20-2021 Borehole ID:			
					-	Driller: Elite-Lenny		Logged By: LEA/JEL	B-607B	
Proje	ect name:	21120	Center Phase III			Bedrock Depth: 8.9 ft		Checked By: JRW	Sheet 3 of 5	
Porin-			145146 9 #			Drilling Rig: Track Moun	ted Mob	ile B48X/CME-550X Rubbe	er Tire ATV Mounted Rig	
Boring		11 1190404.0, E 3 5/25 0 ft To	140.0 IL			Equipment: Hollow Sten	n Auger	3.75" I.D. 7-5/8" O.D.; NQ \	Vireline Coring 1-7/8" I.D.	
Groups	dwater El	J+∠J.UIL IO	On Date:			3" O.D.	5	- ,	U	
Ground										
				(#)	(f					
Ę	f	Type - No	Blows per 6 inch	ltion	iry (I	Remarks	ຸຼຼ	Description and Clas	sification of Materials	
vatic	, xh			letra	;ove		olog			
Eley	Dep			Pen	Rec		Gra Lith			
	E					Augered without sampling to the		MC-1, S-2, S-3: Claystone	to high placticity loss than	
	FI					B-607A at 20.0 feet bgs.		5% sand, fine grained; intense	ely to very intensely	
	F I					Sampling began at 20.0 feet to	<u> </u>	weathered; fracturing not appa	arent; dry to moist; brown; PP	
	FI	MC - 1	15/35/50 for 5"	1.4	1.0	B-607A data.	E=====	[Denver Formation]	anu veins common,	
	F I							-		
	21									
	t l									
	E I			-		1	<u> </u>			
	E						FEEEEE			
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	22									
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	<u>⊢</u> 24						<u> </u>			
	t l						FEEEE			
	E I						<u></u>			
	E I									
	E I									
	25					Smooth drilling.				
	F						<u> </u>			
	F						<u> </u>			
	F									
	⊨ I									
	- 26						======			
	- ²⁰									
	E I						<u> </u>			
	F						E			
	F						<u> </u>			
	F						E=====			
	27									
	t l									
	E I					Dry to moist gray cuttings				
	E I					2., to molos, gray odulings.				
	E I						======			
	28						<u> </u>			
	F						F======			
	F									
	F						======			
	E I									
	- 20									
	- 29									
	F						<u> </u>			
	F						FEEEEE			
	F									
	⊨									
	- 30							Continued of	n next sheet	
Notes L	ithology be	etween recovered	samples is interpr	eted.	Con	tacts are approximate. Boring	was bacl	kfilled with grout. Horizontal		
	coordinate	system is modified	a from the Colorad	o Sta	le Pl	ane NAD 1983 North Zone wit	n convers	sion factor = $0.999/21940$.		



LOG OF SOIL BORING						Start Date: 11-19-2021 End Date: 11-20-2021 Borehole ID:					
Proj	ect name:	Thornton Justice	Center Phase III	-	Driller: Elite-Lenny Logged By: LEA/JEL B-60/ Bedrock Depth: 8.9.ft Checked By: JRW Sheet 5 of						
P	roject No:	21129	4 4 5 4 4 6 6 5 5		-	Drilling Rig: Track Moun	ted Mob	ile B48X/CME-550X Rubb	er Tire ATV Mounted Rig		
Boring	Location:	N 1196454.8, E 3 5425.0 ft To	145146.8 ft ital Depth [.] 49.0 ft			Equipment: Hollow Sten	n Auger :	3.75" I.D. 7-5/8" O.D.; NQ	Wireline Coring 1-7/8" I.D.		
Ground	dwater El:	Not Encountered	On Date:			3" O.D.					
				(£)	_						
Ę	(ji	Type - No	Blows per 6 inch	tion (ry (ff)	Remarks		Description and Clas	ssification of Materials		
evatic	pth (netra	cove		aphic holog				
<u> </u>	ð			Å	Re		<u>ٿ</u> ڻ	40.0 to 41.5 ft: light brown	mottled with orange: PP =		
	_							3.5 tsf; manganese stainin	g common;		
	_										
	-	S - 3	7/12/19	1.5	1.7						
	41					Stop drilling at 41.0 feet on					
	_					11/19/21. Start drilling at 41.0 feet on 11/21/21.					
	-										
	42										
	_										
5382.5								S-4, S-5: Sandstone			
	-							Massive; mostly sand, fine gra 5-15% fines, low to medium p	ained, angular to subrounded; lasticity: moderately to		
	43							intensely weathered; fracturin	g not apparent; moist; brown;		
	-							[Denver Formation]			
	-	S - 4	50 for 3"	0.3	0.2						
	44										
	-										
	-										
	45										
	-										
	-										
	46										
	-										
	47										
	48										
	-										
	E					Additional recovery possibly					
5376.3		S - 5	50 for 6"	0.5	1.2	nom slough of material swelling.		S-5: Sandy Claystone	n to high placticity 20, 200/		
5376.0	49					Bottom of boring at 49.0 feet.	<u></u>	sand, fine grained, angular to	subrounded; intensely to very		
								staining on contact with sands	gnt brown; H7; occasional iron		
	E							[Uenver Formation] End of boring	log at 49.00 ft		
	- 50										
Notes L	_ithology be coordinate	etween recovered system is modifie	samples is interproduced samples is interproduced to the colorado definition of the colorado definitic	eted. o Sta	Con te Pl	tacts are approximate. Boring ane NAD1983 North Zone wit	was back h convers	xfilled with grout. Horizontal sion factor = 0.999721940.			

I OG OF SOIL BORING						Start Date: 01-03-2022	2 End Date: 01-03-2022 Borehole ID:		
Proi	iect name:	Thornton Justice (Center Phase III	•	-	Driller: Elite-Lenny		Logged By: CLS	B-608
P	Project No:	21129				Bedrock Depth: 5.7 ft		Checked By: JRW	Sheet 1 of 1
Boring	Location:	N 1196140.5, E 3 ⁻	145254.5 ft			Drilling Rig: Track Geop	probe 662	20DT	
0	Ground EI:	5437.7 ft To	otal Depth: 8.5 ft			Equipment: Hollow Ster	m Auger 3	3.0" I.D. 5.75" O.D.	
Groun	dwater El:	Not Encountered	On Date:						
				(#)					
Ę	£	Type - No	Blows per 6 inch	tion	ry (ff	Remarks		Description and Cla	ssification of Materials
vatio	oth (1	.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		letra	ove		phic olog		
Шē	Dep			Pen	Rec		Gra Lith		
						inches thick.			
	-							S-1, S-2: Fat Clay with Sand	
	F							Mostly fines, medium to high coarse grained, subangular to	plasticity; 15-25% sand, fine to subrounded; less than 10%
								gravel, fine to coarse grained	, angular to subrounded;
	F							brown to dark brown; roots co	ommon; weak to strong
	E							reaction with HCl; (CH); [Fill]	
	E	_							
	E	S - 1	4/6/7	1.5	1.3				
	_ 2								
								2.5 to 4.0 ft: medium stiff t	o stiff; no gravel; no roots;
	- 3								
		S - 2	5/6/7	1.5	0.3				
	–								
	E I								
	-								
5433.7	- 4							S-3: Fat Clay	alasticity 40.450/ send firs to
	-							Mostly fines, medium to high medium grained; medium stiff	plasticity; 10-15% sand, fine to f; moist; dark brown; weak to
	F							strong reaction with HCI; (CH);
	-	S - 3	4/5/7	1.5	0.3			[Fm]	
	F_								
	- 5								
	E								
5432.2	E							S-4: Fat Clay with Sand	
5432.0						Top of rock at 5.7 feet.	<u> 622/22</u>	Similar to 0.9 to 4.0 ft Except:	less than 5% gravel, fine
	- 6							= 0.5 inches; medium stiff; no	gravel; no roots; (CH);
		0.4	4/5/0	4.5				[Fill] S-4 S-5: Claystone	
		5-4	4/5/9	1.5	1.1			Massive; mostly fines, mediu	n plasticity; less than 10%
								sand, fine to medium grained weathered; fracturing not app	; intensely to very intensely arent; moist; gray; PP = 2.5 to
	-							3.5 tsf; H7; occasional iron sta	aining and veins; calcium
	7							[Denver Formation]	
	F								
	F						======		
	F								
	F I	S - 5	3/8/12	1.5	1.3				
	8								
	E I								
5429.2	E I					Bottom of boring at 8.5 feet			
0-120.2	E					Dealon of borning at 0.0 root.		End of borin	g log at 8.50 ft
	E I								
	9								
	E								
	E I								
	¢ I								
	F _								
				<u> </u>			<u> </u>	20 1 20 2 2 2 2 2	. 🕰 🔺
Notes I	Lithology be	etween recovered system is modified	I samples is interpre d from the Colorade	eted. 5 Sta	Con te Pl	tacts are approximate. Boring ane NAD1983 North Zone wi	y was back th convers	tilled with grout. Horizontal	DIL
								0.000121040.	

ILUG	i OF	SOIL F	BORING			Start Date: 01-03-2022		End Date: 01-03-2022	Borehole ID:
Proje	ect name:	Thornton Justice	Center Phase III			Driller: Elite-Lenny		Logged By: CLS	B-609
P	roject No: 2	21129				Bedrock Depth: 7.1 ft	raha 660	Checked By: JRW	Sheet 1 of 1
Boring	Location: I	N 1196096.8, E 3	145266.2 ft			Drilling Rig: Track Geop			
G	Ground EI: 5	5437.7 ft To	tal Depth: 10.0 ft			Equipment: Hollow Ster	m Auger 、	3.0 1.D. 5.75 O.D.	
Ground	dwater El: Ւ	Not Encountered	On Date:				1		
				(ŧ	(f				
ы	£	Type - No	Blows per 6 inch	ation	ery (f	Remarks	د کو	Description and Clas	sification of Materials
evati	pth			netra	COVE		holo		
Ш	De			Pe	Re		Ŀ.		
						Concrete slab approximately 6 inches thick.			
	 						1111	S-1: Clayey Sand	
	-							Mostly sand, fine to coarse gr subrounded; 25-35% fines, m	ained, subangular to edium plasticity; 5-15% gravel,
								fine to coarse grained, angula	r to subrounded; maximum
							1111	weak to strong reaction with F	ICI; (SC);
							111	[Fm]	
		S 1	4/5/0	1 5	1 2		111		
	-	5-1	4/5/9	1.5	1.5				
	<u> </u>								
	-								
5435.2	E							S-2. S-3: Sandy Lean Clay	
								Mostly fines, low to medium p	lasticity; 30-40% sand, fine to
	- 3							gravel, fine grained, subangul	ar to rounded; maximum
		6.0	61716	1 5	10			particle size = 0.5 inches; stiff to brown; weak to strong reac	to very stiff; moist; light brown tion with HCI: (CL):
	-	5-2	0/7/0	1.5	1.2			[Fill]	
	-								
	-								
	- 4							4.0 to 5.5 ft: less than 10%	gravel, fine to coarse
	E							grained; maximum particle	e size = 0.75 inches; (CH);
	_								
		0.0	0/4/4	4.5					
		5-3	3/4/4	1.5	0.9				
	5								
	F								
5432.2	E						(1/1/1)	S-4, S-5: Fat Clay with Sand	
								Mostly fines, high plasticity; 1	5-25% sand, fine to coarse
	- 6							moist; brown; weak to strong	reaction with HCl; (CH);
		S 1	4/4/5	15	0.4			[Fill]	
	-	3-4	4/4/5	1.5	0.4				
	-								
	FI								
5430.6	7					Top of rock at 7.1 feet		7.0 to 7.1 ft: stiff; (CH);	
0400.0	E					וסף טו וטטוג מנ ז . ד וכפו.		S-5, S-6: Claystone	asticity: less than 5% cand
	⊨							fine to medium grained; very i	ntensely weathered to
	⊨	S _ 5	3/5/7	15	15		<u></u>	to 2.5 tsf; H7; calcium veins a	nd seams common; occasional
		0-0	51511	1.5	1.5		<u> </u>	iron veins; strong reaction with	n HCl;
	8							Loonton onnation]	
	E								
	È I							8.5 to 10.0 ft: trace manga	nese staining; trace iron
								staining; weak to strong re	action with HCI;
	⊨ ₉						<u> </u>		
		S - 6	2/3/8	15	1 1				
	F	0-0	2/0/0	1.5					
	F								
	E I								
5427.7	- 10					Bottom of boring at 10.0 feet.		End of boring	log at 10.00 ft
Notes L	ithology be	etween recovered system is modified	samples is interpred d from the Colorado	eted. o Sta	Con te Pl	tacts are approximate. Boring ane NAD1983 North Zone wit	y was back th convers	filled with grout. Horizontal ion factor = 0.999721940.	R ĴĤ

APPENDIX C

LABORATORY TEST RESULTS



Thursday, December 30,	2021
Project Number:	2679-166
Company:	RJH Consultants
Address:	
City:	
State:	
RE:	Soil Testing
	TJC Phase III
	21129

Dear Claire Stewart,

With this letter you will find a report on Soil samples assigned on 12/3/2021.

Testing was performed in accordance with standardized test methods, accepted industry practices as well as specific instructions received from you, our client. Advanced Terra Testing accepts no responsibility and makes no claims to the use or purpose of the material being tested. Furthermore, the results herein are based solely on the material received and tested. Please note that all material will be disposed of after thirty days unless other arrangements are made.

We respectfully request that sample reports be considered proprietary information and are not to be reproduced, except in full and only with prior written approval of Advanced Terra Testing. We are pleased to have been given the opportunity to perform high quality laboratory testing for your project. We sincerely hope the results herein provide you with all the information required. If you have questions or need anything further, please reach out and we will be happy to assist you.

Respectfully,

Kerry Repola



Moisture and Density ASTM D 2216 and ASTM D 7263

ÖŠOÒÞV ÜRPÁÔ[}•ĭ æ}o•		RUÓÆUÈ	GÎÎ JËÊÎÎ
ÚÜURÒÔV VRÔÁÚ@æ^ÁQQQ ÚÜURÒÔVÁ≂UÈ GFFGJ		ŠUÔŒ∕QJÞ	Ē
ÓUÜQEŐÁ=UÈ ÖÒÚVP ÙŒTÚŠÒÁ=UÈ ÖŒVÒÂUŒTÚŠÒÖ ÖŒVÒÁ/ÒÙVÒÖ VÒÔPÞØØQE= ÖÒÙÔÜŴVQUÞ	ÓËI€ICE GGEIÎEGHÈEC ⊨ÛËG FFEPIÏEOF FGEOIEDF FGEOIEDF RŠ		
Tæ••Á,-ÁY ^ơÂÙ[ā,Áæ)åÁÚæ)ÁÇDK Tæ•Á,-ÁÖ¦^ÂÙ[ā,Áæ)åÁÚæ)ÁÇDK Tæ•Á,-ÁÚæ)ÁÇDK T[ã č¦^ÁÇÃDK	G€HËG FÏ CBÈÍ ÎĔF 18.9		
Öãae(^c^¦ÁQ3)DK P^ãt@eÁQ3)DK Tær•Á(-ÁÝ^cÂù[ā)Áæ3)åÁÜā)*ÁQ5DK Tær•Á(-ÁÜā)*ÁQ5DK Y^cÁÖ^}•ãcÁQà•ĐcDK Ö¦^ÁÖ^}•ãcÁQà•Đc?): Y^cÁÖ^}•ãcÁQ`*EQ DK O¦^AO^}•ãcÁQ`*EQ 3):	FÈF GÈ€ GGÊËH €È€€ 128.5 108.1 2058 1731		
ÓUÜQEŐÁÐUÈ ÖÒÚVP ÙŒT ÚŠÒÁÐUÈ ÖŒVÒÁUŒT ÚŠÒÖ ÖŒVÒÁ/ÒÙVÒÖ VÒÔPÞØØŒĐ ÖÒÙÔÜŴVQUÞ			
Tæ••Á,-ÁY ^ơÂÙ[ā/Áæ)åÁÚæ)ÁÇDK Tæ••Á,-ÁÖ¦^ÂÙ[ā/Áæ)åÁÚæ)ÁÇDK Tæ••Á,-ÁÚæ)ÁÇDK T[ã:č¦^ÁQÃDK			
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ÞUVOU			
ÖæææÁr}d^ÁsîK RŚ Ô@e&⊾^åÁsîK SÜ Øāp^Ájæ≰^K GîïJFîî´´T[ãrč¦	- ^Áa)åÁÖ^}∙ã?ÁOÈÙVT	Ö. Ö. ÁÖÏGHÍ´€È¢∣∙{	æ^KFŒ₩EEŒF æ^KFŒ₩EE®EF



























Percent Minus #200 **ASTM D 1140**

ÔŠOÒÞV RUÓÁÞUÈ ÚÜURÒÔV ÚÜURÒÔVÁÞUÈ ŠUÔŒVQUÞ ÖŒVÒÁVÒÙVÒÖ VÒÔPÞÔQŒĐ	ÜRP ÁÔ[}•` æa)o Gîï j∄fîî VRÔÁÚ@ee^ Á0000 GFFGJ EË FGBFïE03F TT			ÓUÜQÞÕÁÞUÈ ÖÒÚVP ÙŒTÚŠÒÁÞUÈ ÖŒVÒÁÙŒTÚŠÒÖ ÖÒÙÔÜQÚVQUÞ	ÓËEIŒ HÍËHÍËC ÞÛË PFBFÌED Ë	
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Ùa∿ç^Áp`{à^¦	Ùã∿ç^ÁĴã^ÁÇ;{□	Tæ∙Á(-ÁÚæ)Áæ)å. Ù[≱ÁÇD	Tæ∙Á,ÁÚæ)ÁÇD	Tæ∙Á(-Á QaâãçããčædÁ Ü^cæa∄,^åÁQ[ã)4∕ÇD	Ô[¦¦^&cā[}Á Øæ&d[¦	Ú^¦&^}ơÁÚæ∙ã,*/ à^Á⁄^ã®á¢Çà D
#4 #200	IÈÍ €ÈEĨÍ	€È€ HH Ĕ	€È€ FÏ FÈ	ËË FÎ HÈ€	Ë FÈ€€	100.0 44.8
		USCS CI	assification AST	M D 2487		
OEer∿¦à WÙ	^*ÁÔ æ•ãã&æa‡i}K Õ¦[`]ÁÛ^{à[K IÔÙÁÔ æ∙ãã&æa‡i}K					
ÞUVÒÙ						
ÖæææÁ∧}d^ÁaîK Ô@&&∧åÁaîK Øä∤^Ájæ{^K	STÙ SÜ GÎJFÎδ´Ú^¦&^]	}oÁTą)č•ÁÀG€€ÁŒÙ	VT ÁÖFFI €´ €È¢ •{		Öæe^ŀ Öæe∕ŀ	(FGBB) BBF (FGBB) BBF



Percent Minus #200 **ASTM D 1140**

ÔŠOÒÞV RUÓÁÞUÈ ÚÜURÒÔV ÚÜURÒÔVÁÞUÈ ŠUÔOE/QJÞ ÖOE/ÒÁ/ÒÙVÒÖ VÒÔPÞ©©QEÞ	ÜRPÁÔ[}•č æa)o GÎÏJËFÎÎ VRÔÁÚ@ee^ÁOOQ GFFGJ ËË FGBOFFEOF RŠ			ÓUÜQÞÕÁÞUÈ ÖÒÚVP ÙŒTÚŠÒÁÞUÈ ÖŒVÒÂÙŒTÚŠÒÖ ÖÒÙÔÜQÚVQUÞ	ÓÉÍ€ ÎÈEEÏÉ́C ÙËH FFBFÍ£03F ËË								
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Ùa∿ç^Áp≚{à^¦	Ù&rç^ÁÙã^ÁQ;{D	Tæ∙Á, ÁÚæ) Áæ) å, Ù[ā,ÁÇD	Tæ•Á,-ÁÚæ)ÁÇD	Tæ∙Á(,-Á Q,åãçãaŭ æ)Á Ü^cæaaj,^åÁÛ[ãÅÁÇ,D	Ô[¦¦^&cāį}Á Øæ&d[¦	Ú^¦&^}oÁÚæ∙ã;*/ à^Á⁄^ã®ó4Çà D							
#4 #200	IËÍ €ÈËÍÍ	€È€ FÏÌÈE	€È€ FÏ FË	Ë ÎÈ	Ë FÈ€€	100.0 96.7							
	USCS Classification ASTM D 2487												
Onec∧¦à WÙ	^¦* ÁÔ æ•ãã&æa‡ai} k Õ¦[`] ÁÛ^{à[k IÔÙÁÔ æ∙ãã&æa‡ai} k	Ë Ë											
ÞUVÒÙ													
ÖæææÁr\}d^ÁaîK Ô@⊗&∖^åÁaîK Øã†A∱æ{^K	STÙ SÜ GÎIJFÎδ´´Ú^¦&^]	o∕ATą̃`•ÂAG€€ÁGÈ)"	VT ÁÖFFI €′ FÈ¢∳•{		Öæe^I Öæe^I	(FGBQ) BQF (FGBQ) BQF							



Percent Minus #200 **ASTM D 1140**

ÔŠOÒÞV RUÓÁÞUÈ ÚÜURÒÔV ÚÜURÒÔVÁÞUÈ ŠUÔOE/QJÞ ÖOE/ÒÁ/ÒÙVÒÖ VÒÔPÞOÔQEÞ	ÜRPÁÔ[}•ઁ æa)o GÌIJËFÎÎ VRÔÁÚ@ee^ÁOOQ GFFGJ ËË FGBOÏEDBF TT			ÓUÜQƏÕÁƏUÈ ÖÒÚVP ÙŒTÚŠÒÁƏUÈ ÖŒVÒÂÙŒTÚŠÒÖ ÖÒÙÔÜQÚVQUÞ	ÓÉÍ€G FÉGĂÍC ÙËF FF⊕PÍEGEF Ë	
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Ùa∿ç^Áp≚{à^¦	Ùa∿ç^ÁĴã^ÁQ;{D	Tæ∙Á(ÁÚæ)Áæ)å, Ù[≱ÁÇD	Tæ•Á,-ÁÚæ)ÁÇD	Tæ∙Á(,-Á Qåãçããĭæ)Á Ü^cæaa],^åÁÛ[ãÅḈD	Ô[: ^&cāj;}Á Øæ&d[:	Ú^¦&^}ơÁÚæ∙ậ*/ à^Á⁄^ã@ÁÇà D
#4 #200	IËÍ €ÈĒÍ	€ÈE EGIII	€È€ GGÎÈF	Ë G€È	Ë FÈ€€	100.0 47.3
		USCS CI	assification AST	VI D 2487		
On≣e∧¦à WÙ	^*ÁÔ æ∙ãã&æāį}k Õ¦[`]ÁÛ^{à[k IÔÙÁÔ æ∙ãã&æaįį}k					
ÞUVÒÙ						
Öæææá^}d^áàîK Ô@~&\^åAåîK Øã∤^Ájæ{^K	STÙ SÜ GÎJFÎδ´Ú^¦&^	} cÁT ãj ັ• ÁÀG€€ÁQÈÙ	VT ÁÖFFI €´ GÈ¢ •{		Öær∿ Öær∿⊦	(FGBD) EOF (FGED) EOF



Grain Size Analysis ASTM D 6913

ADVANCED TERRA TESTING

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ÔŠÔDÞV RUÓÁÞUÈ ÚÜURÒÔV ÚÜURÒÔVÁÞUÈ ŠUÔCE/QUÞ ÖCE/ÒÁ/ÒÙVÒÖ VÒÔPÞÔQDĐ	ÜRPÁÔ[}•ັ∣œ;)o GÎÏJËFÎÎ VRÔÁÚ@ee^ÁOOQ GFFGJ ËË FGEPÎEODF TT			ÓUÜQÞŐÁÞUÈ ÖÒÚVP ÙŒFÚŠÒÁÞUÈ ÖŒVÒÁÙŒFÚŠÒÖ ÖÒÙÔÜQÚVQUÞ	ÓËÍ€Î IGÈËGÈC ÞÛË PFF9FÎEGF Ë	
Hygroscopic M Tæ•Á∕ Tæ•ÁÖ	oisture of Fines ∿cÁÚæ), Áæ), åÁÙ[ã¦ÁÇD* ∖^ÁÚæ), Áæ), åÁÙ[ã¦ÁÇD*	KHH È.€ KHG Ě.F	V[cæ¢ÁY^oáTa V[cæ¢ÁQ'¦Čk	Sample Data e•Á,-ÂĴæ(] ^ÁÇD× e•Á,-ÂĴæ(] ^ÁÇD×	(Ġ È= (Ġ €È)	
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3/4"	FJÈÉ	€E	Ē	Ë	Ē	100.0
3/8"	JĚH	€ÈE	Ë	Ë	Ë	100.0
#4 #10	 	€ <u>€</u>		<u>⊭</u>	E FI ≹€	100.0
#20	€ÌÍ€	 ĒĒ	Ē	€Ē	FÈ€€	99.6
#40	€ÈĞ	ÍÈG	Ë	ÍÈG	FÈ€€	96.1
#60	€EG€	l E î à 	E	l E	FÆ€	91.2
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Grain Size Analysis ASTM D 6913

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1.5"	ΗĒ	€É€	Ē	Ē	Ē	100.0
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#4	<u> </u>	<u> </u> <u> </u> <u>⊭</u>	<u> </u>		<u>Fleet</u>	97.9
#10	GÊ€€	IÈ	Ê	IÈ	FÈ€€	96.9
#20	€ÌÌ€	ÍÈF	ΪË	ÍÈ	FÌ€€	95.6
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#40	ET G		<u> </u>		⊢œ€	93.0
#60	€EGI€	JE	E	JE	FÆ€	91.1
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ÔŠÒDÞV RUÓÁÞUÈ ÚÜURÒÔV ÚÜURÒÔVÁÞUÈ ŠUÔŒVAÞÞ	ÜRPÁÔ[}•ັ∣œ);o GÎÏJËEÎÎ VRÔÁÚ@œe^ÁQQQ GEFGJ ËË			ÓUÜQÞŐÁÞUÈ ÖÒÚVP ÙŒTÚŠÒÁÞUÈ ÖŒVÔÂÙŒTÚŠÒÖ ÖÒÙÔÜÓVØUÞ	ÓĒÍ€Í HĚÍEÍÈEC ÙËG FFBFÍEQEF Ë	
ÖŒL/ÒÁ/ÒÙVÒÖ VÒÔ₽ÞÔÔŒÐ	forðiððf RŠ					
Hygroscopic M Tæ•Á⁄ Tæ•ÁÖ Á	oisture of Fines ^oÁÚæ) Áæ) åÁÙ[ā/ÁÇD¤ ÂÚæ) Áæ) åÁÙ[ā/ÁÇD¤ Tæ∙Á[~ÁÚæ) ÁÇD¤ T[ācč¦^ÁÇÂDª	<pre>(FFI Ё Η (FFFI€) (Î Ё F (3.5)</pre>	V[cæ)ÁY^oÁTa V[cæ)ÁÖ¦^ÁTa Tæ•Á[-ÁÙ`àËÙæ	Sample Data e•Á,-ÁÙæ{] ^ÁÇD× e•Á,-ÁÙæ{] ^ÁÇD× Ù] ãÁƠ æ&cā,}k {] ^ÁƠ æ&cā, ÅÇD×	ΩHÍFÈ€ ΩH€È€ ΩÀF€ ΩÍFÈDH	
Ùa∿ç^Ápč{à^¦	Ùa∿ç^ÁÙã^ÁÇ;{□	Tæ∙Á(-ÁÚæ)Áæ)å, Ù[≇ÁÇD	Tæ∙Á,-ÁÚa),ÁÇD	Tæ∙Á(,-Á Q,åãçããă ăa∳Á Ü^cæã),^åÁQ[ãÅÁÇ:D	Ô[:¦^&cā[}Á Øæ&d[:	Ú^¦&^}oÁÚæ∙āj*/ à^Á⁄^ã*@óAÇà D
3" 1.5" 3/4" 3/8" #4	ΪÎÈG HÌÈE FJÈEÍ JĔH IÈĽÍ	eÈE eÈE FCÉE ÌÈG		E E FOEG ÌÈG	Ë Ë FÈ€€ FÈ€€	100.0 100.0 100.0 96.4 94.0
#10 #20 #40 #60 #100 #140	GÈ€ €ÌÍ€ €ÌG €ÌGÍ€ €ÌFÍ€	IÈH €È CÈH IÈF CÈH	E IÈG E €È€ E FÈ€ E GÈG E IÈE E GÈG		FÈ€€€ €ÈG €ÈG €ÈG €ÈG	92.7 92.0 88.5 84.3 76.8 72.6
#140 #200	<u>€ÈË Í</u> 1.5" 3/4" 3/8"	HĚ Percent Pas #4 #10	E E sing vs Log of Pa #20 #40 #60 #10	HĔ G article Size	€ÈG	66.1
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ÔŠODÞV RUÓÆUÈ ÚÜURÒÔV ÚÜURÒÔVÆUÈ ŠUÔŒVQUÞ ÖŒVÒÁVÒÙVÒÖ VÒÔPÞ©QOEÞ	ÜRPÁÔ[}•` œa)o GÎÏJËTÎÎ VRÔÁÚ@œe^ÁOOQ GFFGJ ËË FGBOÈEOGF RŠ			ÓUÜQPŐÁPUÈ ÖÒÚVP ÙŒFÚŠÒÁPUÈ ÖŒVÒÁÙŒFÚŠÒÖ ÖÒÙÔÜQÚVQUÞ	ÓËÍ€Í HĚÍĚÈEC ÙËG FF⊞PÍEOGF Ë	
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ÔŠOÒÞV RUÓÁÞUÈ ÚÜURÒÔV ÚÜURÒÔVÁÞUÈ ŠUÔOS/QUÞ	ÜRPÁÔ[}•č œ;)o GÎÏJËFÎÎ VRÔÁÚ@œ•^ÁOQQ GFFGJ ËË			ÓUÜQ-ÕÁ-UÈ ÖÒÚVP ÙŒ ÚŠÒÁ-UÈ ÖŒ/ÒÂÙŒ ÚŠÒÖ ÖÒÙÔÜQ/VQIP	ÓÊÍ€H FËBĂĽC ÙËF FFBFÍEDEF Ë	
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ÔŠODÞV RUÓÆUÈ ÚÜURÒÔV ÚÜURÒÔVÆUÈ ŠUÔŒVQUÞ ÖŒVÒÁVÒÙVÒÖ VÒÔPÞ©OQEÞ	ÜRPÁÔ[}•` œa)o GÎÏJËTÎÎ VRÔÁÚ@œe^ÁOOQ GFFGJ ËË FGBOÈEOGF RŠ			ÓUÜQPŐÁPUÈ ÖÒÚVP ÙŒI ÚŠÒÁPUÈ ÖŒVÔÂÙŒI ÚŠÒÖ ÖÒÙÔÜQÍVQUÞ	ÓËI€H FËGĂIC ÙËF FFBFÍEGOF ËË	
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ÔŠOÒÞV ÜRPÁÔ[}•˘ æ;)o RUÓÁ>UÈ G [°] IJËIÎ ÚÜURÒÔV VRÔÁÚ@;e^ÁQQ ÚÜURÒÔVÁ>UÈGFFGJ ŠUÔOS/QUÞ Ë ÖCS/ÒÁ/ÒÙVÒÖFGBEIÊBEF VÒÔPÞ©ÔQDE RŠ ÜCEYÁXOŠÒ ØCEŠÙÒ		######ÓUÜQÞŐÁÞUÈ ÓÉÍ€Í ######ÓUÜQÞŐÁÞUÈ I GÈ ÉI GÈ C ######ÓUCF ÚŠÒÁÞUÈ ÞÛÉI ######ÖCE/ÓÂUCF ÚŠÒÖ FFÐFÍ £Ð€GF ######ÖCE/ÓÁUCF ÚŠÒÖÁÓŸ ÉE ######ÖÒÙÔÜÚVQ/Þ &[¦^
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ÔŠOÒÞV ÜRPÁÔ[}•ઁ æ);o RUÓÆJUÈ GÎÏJËFÎÎ ÚÜURÒÔV VRÔÁÚ@æ^ÁOOQ ÚÜURÒÔVÆJUÈGFFGJ ŠUÔCE/OUÞ ËË ÖCE/ÒÁ/ÒÙVÒÖFGBEÏEDF VÒÔPÞOÔODE RŠ ÜCEYÁ2OŠÒ Ë			Ammúúuüœõá⊳uè Ammúòúvp Ammúùœrúšòá⊳uè Ammúöœròáùœrúšö Ammúùœrúšòöáóÿ Ammúòòùôü¢uvqu⊧	ÓÉ̀ό HÍÈEËHÍÈÈC ÞÛÉÍ ÖÖ FFBFÌEQSEGF EË &{¦^	
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ÔŠOÒÞV ÜRPÁÔ[}•ັ œ;)o RUÓÁÞUÈ GÎIJËEÎÎ ÚÜURÒÔV VRÔÁÚ@e=^ÁQQQ ÚÜURÒÔVÁÞUÈGEFGJ ŠUÔQE/QUÞ ËË ÖQE/ÒÁ/ÒÙVÒÖFGEÐĨEQEF VÒÔPÞQÔQQE RŠ ÜQEYÁ2OSSÒ Ë		<pre>////////////////////////////////////</pre>	ÓËÍ€Î ̀˼ËÍFÈBC ÞÛËIÁÇÎD Ö FF⊞FÎED€EGF ËË Ë	
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ÔŠOÒÞV ÜRPÁÔ[}•ັ∣œ);o RUÓÁ⊳UÈ GÎIJËÎÎ ÚÜURÒÔV VRÔÁÚ@ee^ÁQQQ ÚÜURÒÔVÁ⊳UÈGFFGJ ŠUÔOS/QUÞ Ë ÖOS/ÒÁ/ÒÙVÒÖFGBPĨEQF VÒÔPÞ©ÔQDE RŠ ÜOSYÁØŠO Ë		/////////////////////////////////////	ÓËI€ÏOE ÎĔIĒEC TÔËH FFBFĨEQSECF ËË Öæ{^•ÁBÁT[[¦^Á/~ à^
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O^-¦:^A/^•oA' aze•A, -A⁄ ^ AU[ā/sasā āAUā; * A⁄; OE-e^:¦Á/^•oÁT aze•Á; -Á⁄ ^ AÛ[ā/sasā à ÁÜā; * Á⁄; T aze•Á; -ÁÖ¦^ÂÙ[ā]ÉÄÜā; * Éšasā à ÁÚa; Á⁄; Öāna; ^ c^:¦ÁQā; Q ããana; A⁄?~ āt @A⁄Qā; T aze•Á; -ÁÜā; * Á⁄; T aze•Á; -ÁŬā; Á⁄; Q`} åaceā[} AŠ[aceåAÇÚa; U^å[{ ^ c*¦ÁQi;	DKFITEG DKFİFÈÎ DKFJGÈF DKÆÈ€ DKÆÈ€ DKHİÈI DKÍÆÈG ĐKGI€€ ØKFGJ DKCS/VËH	4,00^ / ۲۵۵ (4,00^ / ۲۵۹ (4,00^ / ۵,00 35 • (/ ۵۵ / ۵) 55 • (/ ۵۵ / ۵) 55 • (۵۵ / ۲۵۵ (50 - ۲۵۵ (56 (۵۵ / ۲۵۵ (56 (۵۵ / ۵) 55 • (۵۵ / ۵) 56 (۵۵ / ۵) 56 (۵۵ / ۵) 56 (۵۵ / ۵)	ac AG & HKFFJ⊞ ac ÁG & ĐKJÎË ÁG * Đ, BCFJ€Ì ÁG * Đ, DKFÍIÏ c ¦^ÁGĂ DKGHÈ ac ÁG & ĐKFHÏÈ ac ÁG & ĐKFFÍË ÁG * Đ, BKGCF€ ÁG * Đ, DKFÌÍI c ¦^ÁGĂ DKFJÈG	
	Swell /	Collapse Data		
Ö[∥æ] •^ÁĢÃ	DKË€ĒÍH	Ù_^ ÁJ¦∧∙∙` ÈL_A Á' \∧••`	ĺ¦^ÁQ;●~ÐKĒË	
Š[æůÅğ]•-Ð Ö^-{;; æði } Ågj I Údæði Ågj D FHG €EEEEE EEEE Gï €€ ËEEEFHÍ ËFĚ € Q`}åæ©^å ËEEEFHÍ ËFĚ € ÎÎÎÎ ËEEEFHÍ ËFĚ € Gï €€ ËEEEFHÍ ËFĚ € Q`}åæ©^å ËEEFHÍ ËDĚ € GIÎ] ËEEEFHÍ ËDĚ € GIÏ J€ ËEEFGFÌ ËFÉEFHĚ HÍ €€€ ËEEFHÍ J ËFÍ ÈF GIÏ J€ ËEEFHÍ J ËFÍ ÈF HÍ €€€ ËEEFHÍ J ËFÍ ÈF	0 -2 -4 -4 -4 -10 -12 -14 -16 100•	Strain Versus V	Vertical Stress	100000
○∞∞∞7;0,7∞,7∞ Ô@&\^å/&i^K STÙ Ø₫γ^Ájæ{ ^K GĨÏJΓĨĨ´´Ù,^ ÁÔ[æ])•^ÁΩĒÙ\	/TÁÖLÍLδHÈ¢∣•	{	Öæ	*KFCEE EDF





ÔŠODÞV RUÓÁÞUÈ ÚÜURÒÔV ÚÜURÒÔVÁÞU ŠUÔCE/QUÞ ÖCE/ÒÁ/ÒÙVÒĆ VÒÔPÞOÔODĐ ÜCEYÁZOŠÒ	ÜRPÁÔ[}•č œ;)o GÎÏJËEÎÎ VRÔÁJ@œ•^ÁQQQ ÈGFFGJ ËË DFGBPÍEQEF RŠ ËË		Somula		₽UÈ ₽UÈ ÚŠÒÖ ÁÓŸ /@IÞ	ÓÉÍ€Î JĚËF€È€C TÔË FFBFÎEQ€CF ËË Öæ{^•ÁBÁT[[¦^Á	Üą *
		حمد فري المع	Sample	e Conditions	<u>(</u> ∧ - 4Ö∧) - ≈ 20 0 0 0 0		
Ο^ϟ¦^Α/ ΟΞͼ ^κ ¦Ά/	, 044 28 • A, - A, • 26 00 047 28 • Á, -ÁC (AC) 28 • Á, -ÁC (AC) 29 • Á, -ÁC (AC) 29 • Á 20 • Á 20 • Á 20 • A 20 • A	ຊγ& ga A∪g^A, AÇD ຊγ& ga A∪g, AÇD * Ê & ga A(Ja), ÁÇD ° ã æ (^ α^\ / Á gD ° ã æ (^ α^\ / Á gD æ • Á , A(Ja), ÁÇD æ • Á , A(Ja), ÁÇD æ • Á , Á(Ja), ÁÇD [] / ÁS[æ å ÁQ • -D [] / ÁS[æ å ÁQ • -D [] / AS[~ α \ / Á Ö) +	(FI H£ G (FÎ JĒE) (GĒ F (Œ)€ (HÎ Ē J ((Œ)€ (GE/VĒG (Œ/VĒG	Aquas Q (+### '+`O`Aquas Q '+`O`Aquas Q Q Aquas (50 ^ Yaquas (50 '+`O`Aquas (50 D Q	Υ^Ο4O^}• ac Ay & HK (Ö ^ÁÖ^}• ac Áy & HK (Ö^}• ac Áy * E) 3 DK (`ÁÖ^}• ac Áy * E) DK (`AÖ^}• ac Áy & E) (`AÖ^}• ac Áy & H (Ö ^ÁÖ^}• ac Áy * E) 3 DK (AÖ^}• ac Áy * E) DK (AÖ^}• ac Áy * E) DK (A) * A A A A (A) * A A A A (A) * A	FG ⊞ F€HĚ :Œ€H :FÎ Î Ì :ŒÈ :FI FÈ€ :FFJË :GŒI Ì :FJFÌ :FJ È	
			Swell / C	Collapse Data			
		Ù, ^∥ÁÇÃ D•	<€Ë€	Ù, ^ Ù, ^	^ ÁÚ¦^∙•`¦^ÁÇ•-ÐK ÁÚ¦^••`¦^ÁÇÚæÐK	í I	
S[288ÅAG•-D FHÎ GF€ Q`}å288°å IH ÎIH FÎIJ HGÎH ÎÍ€H FGÌÏJ GÏJ€ HÍ€€€€	<u>O^-{</u> } <u>E</u> <u>E</u> <u></u>	Údæj AQAD €ÈEE ËEÈÈ EËÈG EËË G ËËË J ËËËG ËEËEG ËEËEG ËEËEG ËEËEG	2 0 -2 -4 -6 -10 -12 -14 100 	Strain \	Versus Vertical	Stress	
∪æææ•∧}d"4aîK Ô@∿&∖^åÁaîK Øã∤^Ájæ{^K	. KS STÙ ĜÏJFÎδ´´Ù,^∥Å	Ô[æ]•^ÁŒÙVT	<u>/Ö∣Í∣δ∣È¢</u> ∙{			Oæ¢KF Öæ€^KF	-000 00F -000 00F



ASTM D2166

ÔŠÒÒÞV ÜRPÁÔ[}•˘ œ}œ RUÓÁ>UÈ GĨIJËĨÎ ÚÜURÒÔV VRÔÁÚœe^ÁQQ ÚÜURÒÔVÁ>UÈ GFFGJ ŠUÔCE/QUÞ ËË ÖCE/ÒÁ/ÒÙVÒÖ FGÐPĨEØF VÒÔPÞ©ÔQQE ÔCEŠ			/////////////////////////////////////							
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			Ùdæðj ÁÜæ	e∿Áç&{Ð;ðjDK	€È€G					
			Üæj	ÁÖæææÅØä ^∙ i (G	ÎĴĒĒĨĨ́OĒĒĨĬ	F´ÞÜĒ´WÖÙĒ¢c				
					Moisture &	Density Data				
Tæ••A,-AY^OU[ā/AsējāAJæjAÇDB IIIE Tæ••Á,-ÁÖ¦^ÁÙ[ā/AsējāÁJæjÁÇDB IGÏÈE Tæ••Á,-ÁÚ)æjÁÇDB FÏGÈH Tæ••Á,-ÁY^OÁÙ[ā/ÁÇDB GJÎÈE Qããæ¢AÖãæؤ,^ơ:¦ÁĞ,DB FÈIÍÌ Qããæ¢AÕãæؤ,∧ơ:¦ÁĞ,DB FÈIÍÌ			Qamaaa,4A7 ^o4O^}∙ac'AG &-D! FHGH Qamaaa,4A7 ^o4O^}∙ac'ÁG &-D! FFHE Qamaaa,4A7 ^o4O^}∙ac'ÁG *EQ ³D! GFFÎ Qamaaa,4A7 [ãrc'¦^ÁGÃ D! FÌ GG Qamaaa,4A7 [ãrc'¦^ÁGÃ D! FÎ ÈF							
			io. D	ìıïr	Test	Results	- Á í A - À Á í A - A		ГÌ́Л	
		Ú^æ Aug^•• Ú^æ Áug^••	Ay,∙-un Á©,ÚæDn	IJIF IH€		U¢aæqAUC;æag,Aæq P^ãt@d	en-∪∧æan-∪c∧∙ §f ÁÖãæ∳ ^c∧¦	∙Aça ⊔r. ÁÜæcajiki	GEEKE	
			3		Displac	ement vs. Stress		•		
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	9000									
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f)										
sd) s	6000									
tres	5000								\mathbf{h}	
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Unconfined Compressive Strength ASTM D2166 (After Picture)

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ÔŠÒDÞV RUÓÁÞUÈ ÚÜURÒÔV ÚÜURÒÔVÁÞUÈ ŠUÔCE/QJÞ ÖCE/ÒÁ/ÒÙVÒÖ VÒÔPÞÔQDĐ	ÜRPÁÔ[}•` œ;)o GÎÏJËFÎÎ VRÔÁÚ@es^ÁOQQ GFFGJ ËË FGEPÎEOSF ÔOCŠ	///////////////////////////// ////////	ÓË €Î Í €Ë Ë FÈGC ÞÛË FFÐFÎ £Ø€CF &[¦^
ÞUVÓÚ	LIENT TT JOB NO. ORING DEPTH AMPLE NO. TEST TYPE CONFINING STRESS STM DESIGNATION	RJH 2679-166 B-606 50.7-51.2' NR -7 UCS D2166	
Úa&c'¦∧Á⊘a‡∧K Øa‡∧Ájæ{^K	GÎÏJËFÎδàËÉÊ´ GÎÏJFÎδ´WÔÙÁC	čĒľ ∕ WÔÙÈRÚŐ ÙVT ÁÖGFÎ Î ´€È¢∣∙{	

Unconfined Compressive Strength ASTM D2166

ÔŠÒÒÞ∨	ÜR₽ ÁÔ[}•ĭ æa);œ	/₩₩₩₩₩ÓUÜOÞÕǼUÈ	ÓËÊ€Î
RUÓÁÞUÈ	ĠĨJËĨÎ	AMMMMÖÖÚVP	Í€ÈËËÍFÈEC
ÚÜU RÒÔV	VRÔÁÚ@æ•^ÁCCQ	/₩₩₩₩₩₩ÛŒTÚŠÒÆÞUÈ	ÞÛË
ÚÜU RÒÔVÁÞ U È	GFFGJ	Á ÓÓÖE/ÒÁUCE ÚŠÒÖ	FFÐFÎEЀGF
ŠUÔŒVQUÞ	Ë	/₩₩₩₩₩ÖÒÙÔÜŴV@Þ	&[
ÖQE/ÒÁ/ÒÙ/\ÒÖ	Fœn∓Σ©e∓		
VÒÔPÞÔÔ0₽₽	ÔŒŠ		

Öãar] æ&∿{^}o4ĜajD	Öãr] æ&∿{^}o4ý2&{D	Ùclæna) ÁQÃ D	Oīç^¦æt^ÁÔ¦[••Á Ù^&a∄}}a¢/OE^æ/Q3,²D	Š[æåÁÇ]à∙D	Š[æå,Á∯⊃D	Ùd^•• Á Ç•≁Ð	Ùd^∙∙ÁÇÚæD
CÌÈCCCC	EÈEEE	€Ì€€	GÌÈH	€	€	€	€
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€È€FGÎ	€È€HG	€ÌĤ	GÌLI	ÎI	ĠI	HÍÎÌ	FÌ €
€È€FIÏ	€ÈEHÏ	€ÈG	GÌLI	Ï€	HFH	I FÍ Ì	FJJ
€È€FÎÌ	€ÈEIH	€ÈÌ	GÌLI	ÌF	HÎ F	IÏÌJ	GGJ
€È€FJ€	€ÈEIÌ	€ĚI	GÌLI	ÌÏ	ΗÌΪ	í fä	GÎ
€È€GFF	€ÈÉÍI	€Ì€	GÌLI	F€F	IIJ	ÍJIJ	ĠÍ
€È€GHG	€ÈÉÍJ	€ÈÎ	GÌLI	F€H	LÍÌ	΀ÎÎ	GI€
€È€GÍÍ	€ÈÊÍÍ	€ËG	GÌLÍ	FFF	I JÍ	ÎÍÍH	HFI
€È€GÏÍ	€ÈËÏ€	€ËÌ	GÌLÍ	FFI	Í€Ì	ÎÏG	HGG
€È€GJÎ	€ÈËÏÍ	€ÈI	GÌLÍ	FGG	ÍIF	Ϊ FÍ J	нн
€ÈEI-FÌ	€ÈÈÌF	€È€	GÌLÍ	FG	ÍÍF	ÏĠÏ	НÌ
€ÈEH€	€ÈÈÌÎ	€ÈÏ	GÌLÍ	FHG	ÍÌÍ	ΪΪGJ	HÏ€
€È€HÎH	€È€JG	FÈ€H	GÌLÍ	FIH	ÎHÎ	ÌHJF	I€G
€ÈEHÌÍ	€ÈEJÌ	FÈ€J	GÌLÍ	FLÌ	Î΀	ÌÏ€F	I FÏ
€ÈEI€Î	€È€H	FÈFÍ	GÌLÎ	FÍ H	ÎÌF	ÌJÏF	IH€
€ÈEI GÌ	€È€J	FÈG	GÌLÎ	FÍ H	ÎÌF	ÌJÎÎ	I GJ
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€ÈEIÏ€	€ÈFJ	FÈH	GÌLÎ	FLÌ	Î΀	ÌÎÌÎ	l FÎ
€ÈEIJF	€ÈGÍ	FÈ€	GÌLÎ	FIÍ	ÎIH	ÌIÎG	I€Í
€ÈÉÍFF	€ÈH€	FÈÍ	GÈÌÎ	FIH	ÎHÎ	ÌHÍH	I€€
€ÈÉÍHG	€ÈHÍ	FĚ F	GÈÌÎ	FÀ	ÍÏF	ΪIJÍ	HÍ J
€ÈÉÍÍH	€ÈI€	FĚÏ	GÌÌÏ	FGG	ÍIG	Ï FFG	HF
€ÈÉÍÏH	€ÈIÎ	FÊH	GÈÏ	FFJ	ÍĦF	Î JÎ Î	HH
€ÈÉÍJI	€ÈFÍF	FÊJ	GÈÏ	FFI	Í€Ì	ÎÎÍJ	HFJ
€ÈÉÎFJ	€ÈÍÏ	FĚÎ	GÈÏ	F€I	IÎÍ	΀ÌJ	GIG
€ÈÊIÏ	€ÈÎI	FÈI	GÌÌÏ	F€G	ΙÍG	ÍJGH	ĠІ
€ÈÊÏÏÍ	€ÈFÏF	FÈIG	GÌÌÏ	ÌН	HÎ J	IÌHG	GHF
€ÈÊĴĴÎ	€ÈÏÏ	FÈÌ	GÌLÌ	Ï€	HFH	ال€ ا	FJÎ



Øäf^Álæ{^K_

ASTM D2166

ÔŠOÒ⊳∨ ÜR₽ ÁÔ[}• ĭ |œ;) • *₩₩₩₩*ÓUÜQ⊳ÕÁ≂UÈ ÓËÊ€Î RUÓÁÞUÈ GÏJË AMMOOUVP IGÈEËIGÈEC ÚÜURÒÔV VRÔÁÚ@æ•^Á000 //////OET ÚŠÒÁÞUÈ ÞÛĦ ÚÜURÒÔVÁÞUÈ GFFGJ Ë ÞÝÁ&[¦^ ŠUÔ0E/0UÞ Ë Á₩₩₩ÖÒÙÔÜŴV@Þ FGEÐFÎEØSF ÖCE/ÒÁ/ÒÙ/ÒÖ VÒÔ₽ÞÔÔŒ₽ Ô0 **Test Parameters** Ùclænā, ÁÜæer ÁGā, EP ã, DK €È€HÍ Ùdæaã, ÁÜæe∿ÁQ&{Đ;ã, DK €ÈÈÈÌJ Üæç ÁÖæææÁØãA∕∙ikGïJĒFïïÓĒE€ïIGÞÜĒ′WÖÜĒ¢c Moisture & Density Data Tæ••Á;Ā⁄^A⁄^ÂÜ[ā)Áæ)åÁŪæ)ÁÇD4 II€ËG Q,ãããe;ÁY_^o/ÄÖ^} •ãĉ ÁQ; &-D FHÉ Tæ• Á ÁÖ¦^ ÁÙ[ãÁse) åÁÚæ) ÁC D Qããã chÁÖ ¦^ ÁÖ^ } • ãĉ ÁQ & -D ΙIJĖΪ FFÏ È€ Tæ∙Á, ÁÚæ) ÁÇD≉ Q,ãããee¦ÁY^^ÓÖ^} ●ãĉÁQ,*₽)³D• FÏJÈÏ GFÎÌ Tæ∙Á∖Á∕^óÛ[ẩÁÇD∕ Qãããed,ÁÖ¦^ÁÖ^}●ãĉÁQ*Ð D FÌÏI H€€ËĽÍ Q) ã ã ã d Á Ö ã a f ^ c^ ¦ Á G A D FËÍH Q,ãcãæ⇔ÁT[ã;č¦^ÁQÃD+ FÍΒ̈́ Qãããe(ÁP^ã @ÁQã D HĚ€Ï Test Results Ú^æàÁÙd^••ÁQ:•-D G€ÍIF OF¢ãæ¢ÁÙdæãjÁææÁÚ^æ∖ÁÙd^∙•ÁQÃDª FÈ Ú^æ\ÁÙd^∙∙ÁÇ ÚæD P^at @At AÖazet ^c^\AÜazetik GÈ€kF JÌT **Displacement vs. Stress** 25000 20000 Stress (psf) 15000 10000 5000 0 0.0000 0.0200 0.0400 0.0600 0.0800 0.1000 0.1200 Displacement (in) ÞUVÒÙK ÖæcæaAN}d^Aà^K ÖØŚ Öær^KFGEDEEDF Ô@∿&∖^åÁà^K SÜ Öæ^KF GEG GEG F

GÎÏJFÎδ´WÔÙÁŒÙVTÁÖGFÎδFÈ¢∣●{


Unconfined Compressive Strength **ASTM D2166** (After Picture)

ADVANCED TERRA TESTING

F

ÔŠÒÒÞV RUÓÁÞUÈ ÚÜURÒÔV ÚÜURÒÔVÁÞUÈ ŠUÔŒVQUÞ ÖŒVÒÁVÒÙVÒÖ VÒÔPÞÔQŒÞ	ÜRPÁÔ[}•` æa)o GÎÏJËFÎÎ VRÔÁÚ@æ^ÁQQQ GFFGJ ËË FOBPĨEQF ÔODŠ	 Á₩₩₩₩ÓUÜQeÕÁeUÈ ÓÊ €Î Á₩₩₩₩ÖOÚVQP I GÈEË GÈ C Á₩₩₩₩ÛOEF ÚŠÒÁeUÈ ÞÛĔ Á₩₩₩₩ÖOCE/ÒÁUCEF ÚŠÒÖ Á₩₩₩₩ÖOÙÔÜQUVQUP ÞÝÁ&[¦^
CLIEI ATT , BORI DEPT SAMI TEST CON ASTM	NT JOB NO. ING TH PLE NO. TYPE FINING STRESS DESIGNATION	RJH 2679-166 B-606 42.0-42.4' NQ-5' UC5 Dzic6
ÞUVOÜ		
Ú3&č¦^Á23≱^K 23ã¦^Ája≨(^K	GÎÏJËFÎδÓE΀δÞÛ GÎÏJFÎδ´WÔÙÁŒÙV	Í WÔÙÈ€ÚŐ ÁÖGFÎÎ Í ´FÈ¢∣∙{

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ÔŠÒÒÞV	ÜR₽ ÁÔ[}•ઁ œa); •	<i>₩₩₩₩₩</i> ₩ÓUÜΦ⊵ÕÆ⊨UÈ	ÓË€Î
RUÓÁÞUÈ	GÎÏJËÊÎÎ	/₩₩₩₩₩ÖÒÚ∨P	I GÈEË GÈLC
ÚÜURÒÔV	VRÔÁÚ@æ•^ÁŒQ	/₩₩₩₩₩₩ÛŒTÚŠÒÆÞUÈ	ÞÛË
ÚÜURÒÔVǼ∪È	GFFGJ	XXXXXXXXÖCE/ÒÁÙCET ÚŠÒÖ	Ë
ŠUÔŒĽ∕QUÞ	Ë	/////WWWWÖÒÙÔÜŴV@Þ	ÞÝÁ&[¦^
ÖQE/ÒÁ/ÒÙ/ÒÖ	FœFF		
VÒÔ₽ÞÔÔØ₽Þ	ÔŒŠ		

Öãr] æ&∧{^}o4(jä)D	Öãr] æ&∧{^}o4k@&{D	Ùdaaa) ÁÇÃ D	Oīç^¦æt*^ÁÔ¦[••Á Ù^&a∄}}a#ÁOE^æÁQ3,²D	Š[æåÁÇjà∙D	Š[æåÁ∯⊃D	Ùd^∙∙ÁÇ∙-Ð	Ùd^∙∙ÁÇÚæD
E	€ÌÈE€€	€È€€	GÌ F	€	€	€	€
CÌECCF	€Ì€€Í	€ÈÉÎ	GÌÌ F	G	Ì	F€H	Í
€È€€IG	€È€FF	€ÈG	GÌ G	J	١F	ÍÍF	Ĝ
€È€ÎH	€È€FÎ	€ÈÈÌ	GÌ G	FΪ	ΪÍ	F€€€	L)
€È€ÈH	€È€GF	€È	GÌ G	Ĝ	FFÍ	FÍ HH	ΪH
€È€F€H	€È€GÎ	€ÈJ	GÌ G	HÍ	FÍ Î	G€ÌÎ	F€€
€È€FCÌ	€ÈEHH	€ÌĤ	GÌ G	ΙÏ	G€J	Ġ IJĺ	FH
€È€FIÌ	€ÈEHÌ	€ÈG	GÌ G	ÍΪ	Я́Н	HHÏ Ì	FÎ G
€È€FÏH	€ÈEII	€ÈIJ	GÌ H	ΪI	HĜ	ΙHΪÎ	G∓€
€È€FJI	€ÈEIJ	€ĽÍÍ	GÌ H	ΪÏ	НÍ	I Í JÌ	GG€
€È€GFI	€ÈÉÍI	€ÈF	GÌÌH	F€Ï	ΙΪΪ	ÎHÍJ	H€I
€È€GHÍ	€ÈÊ΀	€ÈÏ	GÌÌH	FGH	ÍΙΪ	ΪĠΙ	НJ
€È€GÍÎ	€ÈÉÎÍ	€ËH	GÌÌH	FÄ	ÍÎÍ	Ϊ Í FÌ	H΀
€È€GÏÏ	€ÈEÏ€	€ËJ	GÌÌH	FÍΪ	Î JJ	JH€Ì	I I Î
€È€GJÏ	€ÈEÏÍ	€ÈÍ	GÌÌH	FÏ€	ΪÍΪ	F€€ÏH	IÌG
€È€HFJ	€ÈÈÈÌF	€ÈF	GÌLI	FÌ €	ΪJJ	F€ÎGH	Í€J
€È€HIH	€ÈÈÌÏ	€ÈÌ	GÌLI	FJÌ	ÌÌF	FFÎ JÌ	Í΀
€È€HÎJ	€È€JI	FÈEÍ	GÌLI	FJJ	ììî	FFÏ Î G	ÍÎΗ
€ÈEHJ€	€È€JJ	FÈF	GÌLI	ВÏ	F€JÎ	FIÍII	ÎJÎ
€ÈEIFI	€È€	FÈFÌ	GÌLI	СÍ G	FFGG	FIÌÎÌ	Ï FG
€ÈEIHÍ	€ÈF€	FÈG	GÌLI	Ġ G	FŒFF	F΀HÏ	ΪÎÌ
€ÈEIÍÏ	€ÈFÎ	FÈH€	GÌLÍ	G J	FG H	FÎ I Í G	ïìì
€ÈEIÏJ	€ÈGG	FÈHÏ	GÌLÍ	GJF	FGJÎ	FÏ FÍ G	ÌŒF
€ÈÉÍ€G	€ÈEGÌ	FÈH	GÌLÍ	H€Î	FH΀	FÏ JÏ Í	ÌÎF
€ÈÉÍG	€ÈH	FÈJ	GÌLÍ	HGF	FI GÌ	FÌÌÎÌ	J€H
€ÈÉÍIÎ	€ÈHJ	FĚÎ	GÌLÍ	HH	FIÌG	FJÍÎÏ	JHÏ
€ÈÉÍÏH	€ÈIÎ	FÈH	GÌLÍ	HHÏ	FÍ €€	FJÏÌÎ	JIÏ
€ÈÉÍJI	€ÈÉÍF	FÈÌJ	GÌLÎ	HG	FÍ Œ	G€€Ï I	JÎ F
€ÈÉÎFÌ	€ÈÍÏ	FËÎ	GÌLÎ	HÍ€	FÍÍJ	G€ÍIF	JÌI
€ÈÊÎHJ	€ÈÊÎ G	FÈG	GÌLÎ	HÍ€	FÍÍÎ	G€EIÌJ	JÌ F
€ÈÉÎÍJ	€ÈÎÏ	FÈÌ	GÌLÎ	НÍ	FÍ HH	G€FÏ€	JÎÎ
€ÈÉÎÌ€	€ÈËÏ H	FÈI	GÌLÎ	ΗF	FÍ FÌ	FJJÎ J	JÍÎ
€ÈËÏFG	€ÈÈÌ F	GÈ€H	GÌLÎ	HH€	FIÎJ	FJH€G	JG
€ÈËÏHG	€ÈÌÎ	GÈ€J	GÌLÎ	HFÏ	FI€J	FÌÍ€Ï	ììî
€ÈËÏÍG	€ÈFJF	GÌFI	GÈÏ	HFÍ	FI €H	FÌ I FF	ÌÌG
€ÈËÏÏI	€ÈJÏ	GÈF	GÈÏ	HFÍ	FI €H	FÌ HJJ	ÌÌF
€ÈËïJÍ	€È€G	GÈË	GÈÏ	HFÎ	FI €Í	FÌ I FG	ÌÌG
€ÈÈÌFÎ	€È£Ë	GÌH	GÈÏ	HFÎ	FI €Ì	FÌIII	ÌÌН
€ÈÈÌHJ	€ÈEFH	GÌHJ	GÈÏ	HFF	FHÌ H	FÌ F€Í	ÌÎÏ
€ÈÈÌÍJ	€ÈFÌ	GÌLÍ	GÈÏ	H€I	FHÍ H	FÏÏ€Î	ìtì
€ÈÈÌÏJ	€ÈGH	GŤF	GÈÈÌ	ĠĬ	FGGÍ	FÎ €FH	ΪÎΪ
€ÈJ€€	€ÈGJ	GĚÏ	GÈÈÌ	Ĝ G	FFÎ Î	fí Ghï	ΪH€
€È€JGÍ	€ÈH	GÊI	GÈÈÌ	ŒG	JI F	FGCÌJ	())

ÔŠÒÒÞV RUÓÁ•UÈ ÚÜURÒÔV ÚÜURÒÔVÁ•UÈ ŠUÔŒ/QUÞ ÖŒ/ÒÁ/ÒÙVÒÖ	ÜRPÁÔ[}•č œ;)o GÎÏJËEÎÎ VRÔÁÚ@œ:^ÁCOQ GEFGJ ËË FCEDFÎEDEF	₩₩₩₩₩₩ÓUÜΦÕÆUÈ ₩₩₩₩₩ÖÒÚVP ₩₩₩₩₩ÛŒÚŠÒÆUÈ ₩₩₩₩₩₩ŎŒVÔÂUŒÚŠÒÖ ₩₩₩₩₩₩ÖÒÙÔÜŴVØ₽	ÓËI€Î IGÈEEIGÈIC ÞÛÉI ËË ÞÝÁ&(¦^
ÖŒVÒÁVÒÙVÒÖ VÒÔPÞÔŒÞ	FGJEFÎ EQEF ÔCIŠ		P I Mong I°.

Öã•] æ&∧{^}ơ4Ça)D	Öãr] æ&∧{^}αÁÇ&{D	Ùclæa∯ÁQÃ D	OEç^¦æt*^ÁÔ¦[••Á Ù^&cāį}æ¢ÁŒL^æáÇaj²D	Š[æåÁ͡Ĵå∙D	Š[æåÁÇÞD	Ùd^•• <i>Á</i> ⊈•-Ð	Ùd^∙∙ÁÇÚæĐ
€Ì€JÍ €	€ÈG F	GËF	GÌLÌ	G€Í	JFF	FFÌ Ì H	ÍÎJ
€È€JÏF	€È∃Ϊ	GËÏ	GÌLÌ	FÏ Î	ΪÌF	F€FJ€	1ÌÌ
€È€JJF	€ÈÐÍG	GÌÈH	GÌÌ	FÍ Î	Î JI	J€IÏ	1 HH



ASTM D2166

ADVANCED TERRA TESTING

ÔŠÔ) RUÓ/ ÚÜU ÚÜU ŠUÔ ֌/(VÒÔI)ÞV ÆÙÊ RÒÔV RÒÔV/ ŒV0U⊧ ÒÁVÒÙ PÞOÔ0	Á≂UÈ ⊳ IVÒÖ ØD∋	ÜRPÁÔ[}•ĭ æa)or GÎÏJĒFÎÎ VRÔÁÚ@æ•^ÁQQQ GFFGJ ĒË FGEPFÎEQSF ÔOCĂS	,	//////////////////////////////////////	È Ć G È T ŠÒÖ F IÞ å	2Ê €Î FÈEÏCFĔC ÔË F⊕FÎ £05F ≩^¦	
				Test Pa	rameters			
		Ùc	¦æn∄, ÁÜæer∿ÁÇ3), E≬ã), DK	€€€				
		Úda	æjåÅÜæer∿Áç&{ EQ ãj DK	€ĒG				
			Uæ; Æ0ææ#Øå^∙⊩	GIJEFIÍOEI€ÍG Moisturo &	F'TOE'WOUE¢c			
Τæ•	• Á Á	^oAU[ālÁse) å ÁUæ) ÁC	Dr F€€IÉLI	woisture &	QããadAr^d	Ô^}●ãĉÂC;&-D	FGÏÈ€	
Тæ	•Ắ А́О́ Т	كُمُ فَحَلَمُهُ فَحَمَّهُمُ أَلَّهُمُ الْمُعَامُ (لَا مُ) 20 (مَحَلَمُهُ الْمُ- لَمُ حَفَقَهُ اللَّهُ مَعَ 20 (مَحَلَمُهُ اللَّهُ مِنْ المَّاصَعَةِ مِنْ المَّعَقَقَ مِ 20 (مَحَلَمُ المَا مَعَلَمُ مَعَلَمُ مَعَلَمُ مَعَلَمُ مَعَلَمُ مَعَلَمُ مُعَلَمُ مُعَلَمُ مُعَلَمُ مُعَلَمُ مُ	DP ÌÏJĒÌJ DP GÎGÈÈH DP ÏIHÈÌG DP GÈÈUH DP IÈÌJÌ		À^¦ÖÀ∰ããQ ∧ƠϘ^ \À∰ããQ ∧Ö\^¦Ö\°¦ãããQ Qãã∯Q	Ö^∮•ãĉÁQُ&-D }•ãĉÁQ̂*Ð;³D }•ãĉÁQ̂*Ð; D }•ãĉÁQ̂*Ð; D T[ãc`¦^ÁQÃ D	F€IĒË G€EFÌ FÎÏÏ G€ĒÈ	
				Test F	lesults			
		⊶ QÅ••^bÚà ఉ^Ù aù QÀ••^bÚà ه^Ù	ÐP. ÍHÏJ ÐPi GÍÌ		Ofçãæ¢ÁÙclæājÁæcÁÚ^a P^ãt@xÁtkáÖã	èrÁÙd^∙∙ÁÇÃ DP be{^c^¦ÁÜæenāik	HË GËKF	
				Displace	ment vs. Stress			
	6000 -							
osf)	5000 - 4000 -							
Stress (3000 -							
	1000 -							
	0 - 0.0	000 0.0	500 0.10	Displacement	0.1500 0.2 : (in)	2000	0.2500	0.3000
РUV Ôææ Ô@&	OUK ÀA}d^A &\^åÁa	δa^Κ ^Κ <	ÖCES SÜ GÎI LEÎÎ ((MÔI)	ίατιν <i>τ ί</i> όντεîîγ	ر اخت	Öæe^KF Öæe^KF	- - - - - - - - - - - - - - - - - - -	



Unconfined Compressive Strength ASTM D2166 (After Picture)

ÔŠOÒÞV RUÓÆUÈ ÚÜURÒÔV ÚÜURÒÔVÆUÈ ŠUÔŒVQJÞ ÖŒVÒÁ/ÒÙVÒÖ VÒÔPÞÔQŒÞ	ÜRPÁÔ[}•ັ∣œ)o GÎJËÎÎ VRÔÁÚ@æ^ÁQQQ GFFGJ ËË FGBPÎEQBF ÔCUŠ	₩₩₩₩ᡬUÜΦŐÆUÈ ₩₩₩₩ЮĊÚVP ₩₩₩₩ÛŒÚŠÒÆUÈ ₩₩₩₩ŎŒ/ÒÂیڊÒÖ	ÓË΀Î GFÈŒËGFĚLC TÔË FFBPÎED€GF ã]^¦
Ϸυνόύ	CLIENT ATT JOB NO. BORING DEPTH SAMPLE NO. TEST TYPE CONFINING STRESS ASTM DESIGNATION	8 JH 2679-166 8-606 21.0-21.5' MC-7 UCS D2166	
Ú3&cč¦^Á28∤^K Ø8∤^Ájæ{^K	GÎÏJËEÎδÓEʀδTÔ GÎÏJFÎδ´WÔÙÁQÈÙV	ŀË ´WÔÙÈRÚÕ TÁÖGFÎδGÈ¢∣∙{	

ÔŠÒÒÞ∨	ÜRP ÁÔ[} • ઁ œa); •	//////ÓUÜΦ₽ÕÁ≂UÈ	ÓËÊ€Î
RUÓÁPUÈ	Ğ ï J⊞ÎÎ	AMMMMÖÒÚVP	GFÈEËGFLĚC
ÚÜURÒÔV	VRÔÁÚ@æ•^ÁŒQ	/₩₩₩₩₩₩ÛŒETÚŠÒÆÞUÈ	ΤÔË
ÚÜURÒÔVÁÞUÈ	GFFGJ	XXXXXXXXÖOEVÒÂUCET ÚŠÒÖ	FFÐFÎÐЀGF
ŠUÔ0E/QUÞ	Ë	/₩₩₩₩₩ÖÒÙÔÜŴV@Þ	āj ^
ÖOE/ÒÁ/ÒÙ/ÒÖ	FGEPÎEQEF		
VÒÔPÞ@Ô@₽Þ	ÔŒŠ		

Öãe] æ&∧{^}o4Q3)D	Öãi] æ&^{^}α∮Q&{D	Ùclaaa) ÁQÃ D	OEç^¦æt'^ÁÔ¦[••Á Ù^&a∄[}æk/ÓEf^æk/G∄²D	Š[æåÁ∯à∙D	Š[æåÅÇ⊳D	Ùd^•• ÁÇ •-Ð	Ùd^∙∙ÂÇÚæĐ
EÈECECE	€Ì€€€€	€È€€	IĚ€	€	€	€	€
€È€€F	EÈEÈ	€ÈÊ	IĚ€	G	J	ÎÍ	Н
€È€€ÎF	€Ì€FÍ	€ÈFG	IĚ€	Í	Œ	FÍ H	Ï
€È€€JH	€È€G	€ÈFJ	IĚF	Ì	НÏ	GÎÎ	FH
€È€FG	€ÈEHF	€ÈÍ	IĔF	FG	ÍН	HÌI	FÌ
€È€FÍI	€È€HJ	€ÌF	IĚF	FÍ	îî	ΙΪF	Э
€È€FÌÍ	€ÈEIÏ	€ÌHÏ	IĚF	FΪ	ΪÎ	ĺΙΪ	Ĝ
€È€GFJ	€ÈÉÍÎ	€ÈI	IĚG	G€	J€	îн	ŀF
€Ì€GÍ€	€ÈÊÎI	€Ě€	IĚG	G	F€Ï	ïîì	нï
€È€GÌF	€ÈEÏF	€ĚÎ	IĚG	ď	FFF	ΪJI	HÌ
€È€HFF	€ÈEÏJ	€ÈG	IĚH	GJ	FGJ	JĞ	11
€È€HIG	€ÈÈÌÏ	€ĒÌ	ΙĚΗ	HF	FHÏ	JÏÏ	ΙÏ
€ÈEHÏÏ	€È€JÎ	€ËÍ	ΙĚΗ	нн	FLÎ	F€IÎ	Í€
€ÈEIFH	€ÌE€Í	€ÈH	١Ě١	HÎ	FÎ F	FFÍ G	ÍÍ
€È€IIÎ	€ÈFH	€ÈIJ	١Ě١	IF	FÌ F	FGJF	ÎG
€ÈEIÏÎ	€ÈFGF	€ÈÍ	١Ě١	١G	FÌΪ	FHHÎ	ÎI
€ÈÉÍ€Ï	€ÈGJ	FÈEF	١Ě١	LÎ	G€I	FIÍ€	ÎJ
€ÈÉÍI€	€ÈH	FÈEÌ	IĚÍ	IJ	ŒÎ	FÍ HÌ	ΪI
€ÈÉÍÏ€	€ÈIÍ	FÈFI	IĚÍ	ÍF	GÁ	F΀	ΪΪ
€ÈÊÊ€F	€ÈÉÍH	FÈ€€	IĚÍ	ÍI	GF	FÏ FG	ÌG
€È€ÎHÎ	€ÈÊÎG	FÌÈÏ	ΙĚÎ	ÍΪ	ĠÍ	FÌ FÍ	ÌÏ
€È€ÎÏ€	€ÈFÏ€	FÈH	I Ě Î	ÎG	GI	FJH	JH
€ÈEÏ€I	€ÈFïJ	FÈF	I Ě Î	ÎH	ĞI€	FJÌÏ	JÍ
€ÈEÏIF	€ÈÈÌÌ	FÈÌ	IĚÏ	ĴJ	H€Î	GFÏH	F€
€È€ÏÏG	€ÌEJÎ	FĚI	IĚÏ	ÏG	HŒF	GGÏÎ	F€J
€ÈÈÌ€H	€ÌG€I	FËF	IĚÏ	ΪÎ	ΗÎ	GHÌG	FFI
€ÈÈÌHH	€ÌÈ∓G	FÊÏ	IĚÏ	ΪΪ	HI	GHG	FFÎ
€ÈÈÌÏF	€ÈGF	FËI	I Ě Ì	ÌG	НÎН	GΊF	FGH
€Ì€J€H	€ÌÈGJ	FÈF	I Ě Ì	ÌÎ	нн	ĞEH	FGJ
€ÈEJHH	€ÌGHÏ	FÈÏ	I Ě Ì	JF	I€H	ĠÍ€	FHÎ
€ÈEĴĴĴ	€ÈGÍ	FÈH	IĚJ	JG	I€J	ĠÌÌ	FHÌ
€ÌE€Ê	€ÈGÍÎ	GÈ€F	IĚJ	JÍ	IŒ	GJÎÎ	FI G
€ÌE€HÎ	€ÈĜ́H	GÈEÏ	IĚJ	F€€		HFLÍ	FÍ F
€ÌE€ÎÏ	€ÈË F	GÈFH	IÈ€	F€H	ΙÍJ	HGHH	FÍÍ
€ÈF€€	€ÈGÏJ	GÌĐ€	IÈĖ€	F€Ï	ΙΪÍ	HH G	F΀
€ÈFHH	€ÈGÌÌ	GÈË	IÈĖ€	FFH	Í€	HÍT	FÏ€
€ÈFÎÏ	€ÈGJÎ	GÌH	IĒF	FFÎ	Í FÎ	HÎ GJ	FΪ I
€ÈFJÌ	€ÌHE	GÈ€	IĒF	FŒ	ÍHG	HÏI€	FΪJ
€ÈGH	€ÈFH	GÈÏ	IĒF	FG	ÍÍF	ΗÌΓ	FÌ Í
€ÈGi€	€ÈHGH	GŤI	IËF	FGJ	ίΪΗ	I€FÌ	FJG
€ÈH€H	€ÈHF	GÊF	IËG	FH	j l j	l FÏ G	G€€
€ÈHÏ	€ÈH€	GÊÌ	IËG	FHÎ	΀Ï	IÚF	Gel
€ÈEHÎÌ	€ÈHÏ	GËI	IÈG	FI€	ÎСН	I HÎ F	G€J

ÔŠÒÒÞ∨	ÜRP <i>Á</i> Ô[}●ઁ æaa)•	<i>₩₩₩₩₩</i> ÓUÜΦ₽ÕǼUÈ	ÓËÊ€Î
RUÓÁÞUÈ	ĠĨJËĨÎ	AMMMMÖÖÚVP	GFÈEËGFLĚC
ÚÜURÒÔV	VRÔÁÚ@æ•^Á@Q	/₩₩₩₩₩₩ÛŒUÚŠÒÆUÈ	ΤÔË
ÚÜURÒÔVÁÞUÈ	GFFGJ	XXXXXXXXÖCE/ÒÁÙCET ÚŠÒÖ	FFÐFÎÐĐ€GF
ŠUÔŒƯ∕QUÞ	Ë	₩₩₩₩₩ÖÒÙÔÜŴV@Þ	āj ^
ÖŒ/ÒÁ/ÒÙ/ÒÖ	Fœa≇îeœa∓		
VÒÔPÞÔØ∰-	ÔŒŠ		

Öãr] æ&∿{^}o4ĢjD	Öãr] æ&∧{^}αÁQ&{D	Ùclaaaa) ÁQÃ D	OEç^¦æt*^ÁÔ¦[••Á Ù^&a∄[}æk/OEr^æk/G3)²D	Šįa≊åÁ∯à∙D	Š[æå,Á∯⊃D	Ùd^•• <i>Á</i> Ç •-Ð	Ùd^∙∙ÁÇÚæĐ
€ÈHJ	€ÌHÍÍ	GÌÈ€	ΙĒΉ	FLI	ÎI€	ПÏЛ	GFI
€ÈIHI	€ÌĤ́I	GÈÏ	ΙĒΉ	FIΪ	ÎÍH	ΙÍÎΙ	ŒIJ
€ÈIÎI	€ÈHÏG	СÈН	ΙĒΉ	FÍ F	ÎÏG	I Î JI	GÁ
€ÈI JI	€ÈHÏJ	GÈJ	ΙĒΪΙ	FÍ H	ÎÌG	ΙΪÎG	Ġ
€ÈÉÍ GÍ	€ÌĤÏ	HÈ€Í	ΙĒΪΙ	FÍΪ	Î JJ	IÌÏÎ	GHH
€ÈÍÍÎ	€Ì₩Í	HÈFF	ΙĒΪΙ	FÍ Ì	Ï€	I JFG	GHÍ
€ÈÉÍÌJ	€Ì€	HÈFÌ	ΙĒŤÍ	FÎ G	ΪŒ	Í€H	G F
€ÈÊÎ Ĝ	€È FI	HÈĴ	ΙĒŤÍ	FÎ Í	ΪH	Í F€Ì	Дĺ
€ÌÎ΀	€ÈGG	HÈHG	ΙĒŤÍ	FÎÌ	ΪΙÌ	Í ŒÍ	Gl
€ÈÊÎJF	€ÈH€	HÈHÌ	ΙĒΪ	FÎ J	ΪÍΗ	Í GH	Я́ F
€ÈĨGG	€ÈHÏ	HÈÈÍ	ΙĒΪ	FΪF	ΪÍJ	ÍŒÌ	Я́Н
€ÈÏÍÏ	€ÈlÎ	HĚG	ΙĒΪ	FΪG	ΪÎΪ	íhôî	СÍ Í
€ÈËÏÌÌ	€ÌÍI	HĚÌ	ΙĒΪ	FΪ Η	ÏÏ€	ÍНН	GÍ Î
€ÈFÌ FÌ	€ÈÈÎG	HÈI	ΙĒΪ	FΪΙ	ΪΪÍ	ÍHÏÍ	ΒÍΪ
€ÈÈÌIJ	€ÈÏ€	HÈÈ€	ΙĒΪ	FΪΙ	ΪΪÎ	ÍHÏJ	Ć Ì
€ÈÌÏJ	€ÈÏÏ	HËÎ	ΙĒΪ	FΪ Í	ΪΪÎ	ÍHÏÌ	ĞΪ
€ÈFJF€	€ÈÌÍ	HÈLG	ΙĒΪÌ	FΪ Ι	ΪΪÍ	ĺΗΪΪ	ĞΪ
€ÈJIÎ	€ÈIJ	HÈLJ	ΙĒÌ	FΪ Η	ÏÏ€	íhgj	Я́ Í
€ÈJÏÎ	€ĽÉ€G	НÈÍ	ΙĒΪÌ	FÏ G	ΪÎÍ	ÍĠÏ	Я́Н
ÊÐEEÎ	€ĽÍF€	IÈ€F	IĒJ	FÏ €	ΪĺÌ	í GHÎ	Я́ F
€È€HÏ	€ĽÍ FÏ	I ÈÈÌ	IĒJ	FÎÌ	ΪΙÍ	ÍFIÍ	ВÎ
€È€ÎÏ	€ĽÍGÍ	I ÈI	ΙĒ̈́J	FÎ Î	ΪHJ	Í€JJ	GI
€È€IJ	€ĽH	IÈ€	ΙĒ̈́J	FÎ H	ΪĠΪ	Í€FF	G€
€ÈFGJ	€ĽÍIF	I ÈĴ	IË€	FÍ J	Ï€Ì	IÌÌF	GH
€ÈEFÎF	€ĚIJ	IÈHG	IË€	FÍΪ	Î JÏ	IÌ€€	GH€
€ÈEFJH	€ĚÍÏ	IÈU	IË€	FÍ H	ÎÌ€	IÎÌG	GGI
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€ÈCGÌH	€ĚÌ€	ΙĚΪ	ΙËΓ	FI €	ÎG	ΙĠΪ	G€Í
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€ÈGÍHÎ	€ËII	ÍÈEÏ	ΙĖΪΙ	F€H	ΙÍÎ	HFFÎ	FIJ



ASTM D2166

ADVANCED TERRA TESTING

RU OA ÚÜUI ŠU Ô(ÖOE/(VÒÔF	È⊧UÈ RÒÔV RÒÔV/ Œ/QJ⊧ ÒÁ/ÒÙ P⊧@û	Á⊳UÈ > VÒÖ DDE⊃	GEI GEI EE FOI ÔO	PAO[}•°∣æ≱o• 〕JËFÎÎ ÔÁÚ@æ•^ÁODQ =GJ ■ĴEODEF EŠ		70000000 70000000 70000000 70000000 7000000	ÓUÜQEŐÁPU ÖÒÚVP ÙŒEÚŠÒÁPU ÖŒVÒÁÙŒEU ÖÒÙÔÜQÚV(jĖ jŠ JŠÒÖ DIÞ	ÓËI€Ĩ ÏÈEEĨË TÔËH FFBPĨ¦ ð]^¦	ÁQE ÉC	
			Lidera Á		Tes	t Paramete	ers				
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Unconfined Compressive Strength ASTM D2166 (After Picture)

ÔŠØÞV RUÓÆUÈ ÚÜURÒÔV ÚÜURÒÔVÆUÈ ŠUÔŒ/ØJÞ ÖŒ/ÒÁ/ÒÙVÒÖ VÒÔPÞØØŒÞ	ÜRPÁÔ[}•` æa)o• GÎÏJËFÎÎ VRÔÁÚ@æe^ÁOOQ GFFGJ ËË FGEPÎEQEF ÔCUŠ	₩₩₩₩ΌUÜΦ₽ÕÁ₽UÈ ₩₩₩₩ÖĊÚVP ₩₩₩₩ÛCETÚŠÒÁ₽UÈ ₩₩₩₩ÖCEVÒÁÙCETÚŠÒÖ ₩₩₩₩ÖĊÙÔÜŴVØ₽	ÓË΀ÏÁCE ÏÈEËÎĚĽC TÔËH FFBFÏEDSECF ð}^¦
ÞUVÖÜ	CLIENT ATT JOB NO. BORING DEPTH SAMPLE NO. TEST TYPE CONFINING ASTM DESIGN	RTH Zu79-I46 B-607A 7.0-725' MC-3 UCS TIRESS D2I66	
Úa&c'¦^Á⊘a≱^K Øã†^Ájæ{^K	GÎÏJËFÎÎ ∕ÓË΀ό GÎÏJFÎÎ ∕′WÔÙÁŒÙN	ÔĦ WÔÙRƯÕ MÖGFÎδHÈ¢ •{	

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RUÓÁÞUÈ	ĠĨJËĨÎ	Á ÓÓÚVP	ÏÈ€EËËĖC
ÚÜURÒÔV	VRÔÁÚ@æ•^ÁCCQ	Á Ú Í Í Í Í Í Í Í Í Í Í Í Í Í Í Í Í Í Í	ΤÔËΗ
ÚÜU RÒÔVÁÞ U È	GFFGJ	ÁXXXXXXXÖOE/ÒÁÙOET ÚŠÒÖ	FFÐFÏED€€GF
ŠUÔŒVQUÞ	Ë	Á₩₩₩₩₩ÖÒÙÔÜŴVQJÞ	ā _^
ÖQE/ÒÁ/ÒÙ/\ÒÖ	FŒPÊEŒF		
VÒÔPÞÔÔ0₽₽	ÔŒŠ		

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€È€JIÍ	€È∃€	FÈÏ	ΙĚÌ	Ï€	HFH	CCF€	F€Î
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€ÈÉÍ FH	€ÌÌI	GÈJ	ΙĒΊΙ	ÌН	HÏ€	G Ì Í	FG
€ÈÍÏÏ	€È€F	HÈEG	ΙĒΊΙ	ÌI	ΗΪΙ	Ĝ FF	FG
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€ÈÌII	€ÈÎÌ	HÈÈÍ	ΙĒΪ	ÌJ	ЮÏ	ĠĬF	FHG
€ÈÌJI	€ÈÈÌF	HÈËÍ	ΙĒΪ	J€	I€F	GÜJ	FHH
€ÈJIÌ	€ÈJÍ	HÈÌ	ΙĒÌ	JF	I€Í	<u> G</u> 11	FH
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ÔŠÒØÞ∨	ÜR₽ÁÔ[}•ઁ œa}o•	////////UÜO¢ÕÁ≂UÈ	ÓËÍ€ÏÁCE
RUÓÁÞUÈ	ĠĨJËĨÎ	AMMMMÖÒÚVP	ÏÈ€EËËÉC
ÚÜURÒÔV	VRÔÁÚ@æ•^Á@Q	/₩₩₩₩₩₩ÛŒETÚŠÒÁÞUÈ	ΤÔËΗ
ÚÜURÒÔVÆ UÈ	GFFGJ	ÁXXXXXXXÖCE/ÒÁUCET ÚŠÒÖ	FFÐFÏED€€GF
ŠUÔŒƯ∕QUÞ	Ë	/////WWWWOÒÙÔÜŴV@Þ	ą^¦
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€EG+F€	€≣II	IEI	IEF	JI 	IG	GJH	FI F
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€EG FF	€EFG	IEI	IEG	JI	1 H	GUIG	FI G
€EGIIF	€EG	IEI	IEH	JI	1 H	GJI H	FIH
€EG FH	€⊞H		IEH	JJ	ΙHJ	H€€G	FLI
€EGIII	€⊞IF	I EE	IEI	JJ	IIF	H€FI	FLI
€EG G	€⊞II	IŒJ	I E I	F€€	IIH	H€G	FLI
€EGÏÏÏ	€Ëİ€	ÍÉGJ	IËİ	F€F		H€IJ	FIÏ
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€ÈHGÌ	FÈEJJ	ÌĚÎ	IÈG	FFÎ	Í FÏ	H€H	FÎ H
€ÈHIJ	FÈFFG	ÌÈÎ	IÈG	FFÏ	Í FÌ	H€	FÎ H
€ÈIH€	FÈEGÍ	ÌËÎ	ΙÈΗ	FFÏ	ÍŒ	H FH	FÎ H

ÔŠÒÒÞ∨	ÜR₽ÁÔ[}•ઁ œa}o•	<i>ЖЖЖЖ</i> О́UÜФ́О́А́рUÈ	ÓËÍ€ÏÁCE
RUÓÁÞUÈ	ĠĨJĦĨĨ	Á₩₩₩₩₩ÖÒÚVP	ÏÈ€EËËÉC
ÚÜU RÒÔV	VRÔÁÚ@æe.^ÁCCQ	ÁWWWWWÜUCET ÚŠÒÁÞUÈ	ΤÔËΗ
ÚÜU RÒÔVÁÞ UÈ	GFFGJ	ÁXXXXXXÖOE/ÒÁÙOET ÚŠÒÖ	FFÐFÏED€€GF
ŠUÔŒŀ∕QUÞ	Ë	₩₩₩₩₩ÖÒÙÔÜŴVQJÞ	āj ^
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€⊞IIJ	FÆJF	JEJ		FFI	I G Í đ	HG	FII eî.
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€⊞IJI	FEEFI	JEI		FFI	I G Í ď	нн	FII eî.
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€ELG€I	FHHGG	F€⊞€	lb€F	FFJ	IH€	HGH	FII =î.
€⊞GI	⊦⊞∎∎ ≂÷•ì	⊦€ <u>H</u> €	IL€G	FFJ	IH€	HIFJ	FII =î.
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€⊞IG€	Fttl I	F€⊞G	<u>L</u> E]	FFJ	IH€	H€J	FI H
€ ⊞	FEUF	F€⊞H		FFJ	IH€	H€	FIH
€⊞IG	F⊞ €I	F€IJH	<u>E</u> EI (→ *	FFJ	IH€	HHUJ	FIH T
€⊞IIJ	FE FI	FF E H		FFJ	l GJ	HHJ€	FI G
€EEIH€	FEH€	FFEFI		FFJ	l GJ		FI G
€⊞	FH11	FFEG	<u>H</u> EI	FFJ	l GJ		FI G
€⊞IH	FEII	FFEH		FFJ	l GJ	HHI I	FIG
€ ⊞	F⊞l€	FFE I		FFJ	l GJ	HI€	FI F
€⊞IH	FEIH	FFE I		FFJ	l GJ		FI F
€⊞III	FE JI	FFE I	I E€J	FFJ	l GJ		FI F
€EEJHJ	FEE€J	FFEI	I⊞€	FFJ	l GJ	HHI H	FI F
€⊞JJH	FE GG	FFEI	I⊞€	FFJ	l GJ	HHI I	FI F
€EE€I	FE H	FFBI	I EFF	FFJ	l GJ	HHI	FI F
€EE€JI	FEII	FGE€	I ⊞F	FFJ	l GJ	HHI J	FI€
€EFII	FEIF	FŒEI	IEEG	FFJ	I GJ	HHI I	FI€
€EFJJ	FEII	FŒE	I EFH	FFJ	I GJ	HH€	FI€
€≣GI	FEIJ	FŒH	I EFH	FFJ	IG	HHGJ	FIJ
€EEH€J	FEE€G	FŒEI		FFJ	IG	HHG	FIJ
€⊞HG	FE FI	FGEI		FFJ	IG	HHFJ	FI J
€⊞IFG	FEG	FGËÍ	I EFÍ	FFJ	IG	HHFÏ	FIJ
€⊞IÏİ	FEIG	FGËJ	I ⊞Ĩ	FFJ	IĞ	HF€	FLÍ
€ËİFÏ	FËİİ	FGĒJ	I ĒĪ	FFJ	İĞ	HH€Ï	FÍÍ
€ËÍÏ€	FĒÎJ	FGÈJ	ÍÈÏ	FFÌ	ÍĞ	HGJJ	FĺÌ
€ÈÎGG	FÈÌG	FHÈE€	ÍÈÌ	FFÌ	ÍĞ	HGJÏ	FĺÌ
ÌÏÎÍ	FËJÍ	FHÈG€	ÍÈÌ	FFÌ	ÍĜ	HCÌJ	FÍΪ

CLIENT	RJH Consultants	BORING NO.	B-607 A
JOB NO.	2679-166	DEPTH	7.0-7.5'
PROJECT	TJC Phase III	SAMPLE NO.	MC-3
PROJECT NO.	21129	DATE SAMPLED	11/17/2021
LOCATION		DESCRIPTION	liner
DATE TESTED	12/16/21		
TECHNICIAN	CAL		

Displacement (in)	Displacement (cm)	Strain (%)	Average Cross Sectional Area (in ²)	Load (Ibs)	Load (N)	Stress (psf)	Stress (kPa)
0.6725	1.708	13.30	5.19	118	526	3280	157
0.6778	1.722	13.41	5.19	118	526	3276	157
0.6829	1.735	13.51	5.20	118	526	3272	157
0.6880	1.748	13.61	5.21	118	525	3266	156
0.6932	1.761	13.71	5.21	118	525	3260	156
0.6984	1.774	13.81	5.22	118	524	3249	156
0.7051	1.791	13.95	5.23	118	524	3245	155
0.7101	1.804	14.04	5.23	117	523	3233	155
0.7152	1.817	14.15	5.24	118	523	3230	155
0.7205	1.830	14.25	5.24	117	522	3220	154
0.7256	1.843	14.35	5.25	117	521	3210	154
0.7307	1.856	14.45	5.26	117	519	3197	153
0.7358	1.869	14.55	5.26	116	518	3185	153
0.7415	1.883	14.67	5.27	116	516	3168	152
0.7465	1.896	14.76	5.28	116	515	3162	151
0.7516	1.909	14.87	5.28	116	514	3150	151
0.7566	1.922	14.96	5.29	115	512	3131	150
0.7618	1.935	15.07	5.30	115	511	3123	150
0.7669	1.948	15.17	5.30	114	508	3105	149