

GEOTECHNICAL DATA REPORT (REVISED)

12TH STREET OUTFALL

GREELEY, COLORADO



MAY 7, 2019

Engineering

from the ground down



May 7, 2019 Project No. 18026 2625 Redwing Road, Suite 160 Fort Collins, Colorado 80526 970-373-3195 www.LithosEng.com

HDR 5555 Tech Center Drive, Suite 310 Colorado Springs, Colorado 80919

Attention: Ms. Liz Staten, PE Project Manager

Regarding: Geotechnical Data Report (Revised) 12th Street Outfall Greeley, Colorado

Ms. Staten,

The following Geotechnical Data Report presents data collected for the 12th Street Outfall project. This study was conducted in general accordance with our contract dated July 10, 2018. Contained herein are discussions of the general subsurface conditions.

If you have any questions regarding the contents of this report, please contact the undersigned.

Sincerely, Lithos Engineering

dyt

Dylan Fawaz, El Staff Engineer

Robin Dornfest, PG, CPG President



Lance Heyer, PE Associate



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1 INTRODUCTION

The Owner of the 12th Street Outfall Project (Project) is the City of Greeley. The lead Engineer, HDR Engineering Inc. (HDR) retained Lithos Engineering (Lithos) as the Project's Geotechnical and Tunnel Engineer. The Project generally consists of a storm sewer expansion that will extend from approximately 16th Avenue to 2nd Avenue along 12th Street and will discharge into the Poudre River through an outfall structure near the intersection of 2nd Avenue and 10th Street. As part of this project, a sanitary sewer and waterline will require relocation and proposed to be tunneled under Highway 85. The purpose of this Project is to provide additional storm sewer capacitance to prevent future flooding similar to what has been observed in the past.

The Project has been broken down into several design phases. The current design phase will advance the Project to 30-percent. The purpose of this report is to document subsurface conditions identified during our geotechnical exploration along the proposed alignment and near the proposed outfall structure.

2 **PROJECT BACKGROUND**

The following sections describe the Project site and the proposed construction. Figure 1 presents the locations of the open-cut alignment, proposed tunnels, and our geotechnical borings.

2.1 Site Description

The Project site is located in eastern Greeley, Colorado. The alignment generally extends along 12th Street from approximately 16th Avenue to 2nd Avenue. At the intersection of 2nd Avenue and 12th Street, the alignment proceeds north along 2nd Avenue to the proposed outfall structure location approximately 220-feet northeast of the intersection of 2nd Avenue and 10th Street.

Generally, 12th Street and 2nd Avenue are approximately 50-foot wide roadways with both on-street diagonal and parallel parking. The proposed alignment will cross 15 roadways. Crossed roadways include (City of Greeley, 2011):

- Local Streets: 2nd, 3rd, 4th, 5th, 12th, 13th, 15th, 16th Avenue
- Collectors: 10th, 9th, 7th, and 6th Avenue
- Minor Arterials: 14th and 11th Avenue
- Major Arterial: 8th Avenue

The crossed collectors and arterials range from two to four-lane roadways. Out of the 15 total crossed roadways, six of them, including: 16th, 14th, 13th, 10th, 9th, and 7th Avenues, contain 5-foot wide bike lanes on both the east and west sides of the road.

The alignment crosses four, parallel Union Pacific Railroad tracks between 6th and 7th Avenue and the Greeley No. 3 Canal between 15th and 16th Avenue. Three out of the four Union Pacific Railroad tracks are currently in service; the far western track appears to be unused. Numerous utilities exist within the Project vicinity and run parallel and perpendicular to the proposed alignment. Utilities will be investigated and documented by HDR.



2.2 Proposed Construction

As mentioned above, the proposed storm sewer will serve to provide additional capacity and protect the immediate area surrounding the proposed alignment against 10-year flood events. Open-cut installation will be the primary construction method for the storm sewer. The storm sewer will generally consist of 7-foot by 4-foot reinforced concrete boxes to 54-inch diameter reinforced concrete pipe. Two of the tunnel installations will be located at the Union Pacific Railroad and the Greeley No. 3 Canal.

The Union Pacific Railroad crossing is proposed as twin, 72-inch steel casing pipes extending approximately 255 linear feet. The Greeley No. 3 Canal is proposed as 54-inch reinforced concrete pipe extending approximately 330 linear feet. The alignment was modified during this design phase, ultimately eliminating a crossing of US Highway 85 in this particular location

In order to construct the storm sewer alignment, a sanitary sewer and waterline will require relocation away from a planned water quality pond at the northern end of the proposed alignment. The proposed sanitary sewer relocation will cross US Highway 85 and extend to the City of Greeley Water Treatment Facility. The new sanitary sewer construction will require use of tunneling methods to pass beneath US 85. The Sanitary Sewer tunnel is a proposed 48-inch HOBAS pipe extending approximately 230 feet across US 85. Relocation of an 8-inch diameter waterline is also proposed and would cross Highway 85 at a location approximately 250 feet south of 10th Street. The proposed waterline installation will require use of tunneling methods to pass beneath US 85. The sanitary sever to pass beneath US 85. The sance and would cross Highway 85 at a location approximately 250 feet south of 10th Street. The proposed waterline installation will require use of tunneling methods to pass beneath US 85. The waterline is a proposed 8-inch unspecified carrier pipe cased in a 230-foot long, 16-inch steel casing.

3 GEOTECHNICAL INVESTIGATION

The geotechnical investigation included a subsurface investigation and a subsequent geotechnical laboratory testing program. Subsurface information from the geotechnical investigation is presented in Section 4. The subsurface investigation was competed in three phases: storm sewer tunnel subsurface investigation, storm sewer open-cut subsurface investigation, and sanitary sewer relocation tunnel subsurface investigation. The storm sewer tunnel subsurface investigation was subcontracted to Elite Drilling Services, the open-cut storm sewer and sanitary sewer relocation subsurface investigations were subcontracted to Drilling Engineers.

The storm sewer tunnel subsurface investigation phase was performed from July 26th to 27th, 2018. The open-cut subsurface investigation phase was performed from September 24th to 25th, 2018. The sanitary sewer subsurface investigation was performed on April 10, 2019. During all subsurface investigations, Lithos provided oversight of subsurface material sampling and classified subsurface conditions encountered.

3.1 Subsurface Investigation

A total of 14 geotechnical borings were drilled to identify subsurface materials along the storm sewer alignment. Six borings were drilled at proposed crossing locations and extended to depths of 30 and 40 feet. Six borings were drilled along the proposed open-cut alignment relatively evenly spaced and extended to depths of 20 and 25 feet. Two borings were drilled along the proposed sanitary sewer alignment immediately east of the proposed Water Quality Pond and extended to a depth of 35 feet.



Geotechnical drilling was performed utilizing a Central Mining Equipment (CME) 55 truck-mounted drilling rig. Drilling and sampling procedures were conducted in general accordance with ASTM D1586 – *Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils* and ASTM D3550 – *Standard Practice for Thick Wall, Ring-Lined, Split Barrel, Drive Sampling of Soils*. Continuous-flight hollow-stem augers were used to advance borings below the existing ground surface. During drilling, Split-Spoon samples (1.4-inch inner diameter) and Modified California (2.0-inch inner diameter) were obtained at 2.5-foot intervals within the pipe envelope of the tunnel crossings, and 5-foot intervals elsewhere. The Split-Spoon sampler was used to obtain relatively disturbed samples of non-cohesive soils. The Modified California sampler was used to obtain relatively undisturbed samples of cohesive soils. The number of blows by a 140-pound hammer falling 30-inches required for 12 inches of sampler penetration (recorded in 6-inch increments) are presented on the boring logs (Appendix A).

3.2 Geotechnical Laboratory Testing

A geotechnical laboratory testing program was selected by Lithos and conducted by Terracon Consultants on representative samples collected during the subsurface investigation. A laboratory summary table and graphical testing results are provided in Appendix B. Laboratory tests conducted in general accordance with associated ASTM standards are presented in the table, below.

Geotechnical and Corrosion Laboratory Testing					
Geotechnical Test	Standard				
Grain Size Distribution	ASTM D 422				
#200 Sieve Wash	ASTM D1140				
Unconfined Compressive Strength	ASTM D2166				
In Place Moisture and Density	ASTM D 2937				
Atterberg Limits	ASTM D4318				
Water Soluble Sulfates	ASTM D4327				
One-Dimensional Swell or Collapse of Soils	ASTM D4546				

If field characterized soil and bedrock descriptions differed from results indicated by laboratory classification testing, the boring logs presented in Appendix A were amended to reflect laboratory testing results. Geotechnical laboratory testing results were utilized in identifying the site geology presented in this report.

4 SUBSURFACE CONDITIONS

Subsurface conditions were assessed based on the findings of the geotechnical investigation described in the previous section. Soil descriptions noted on the boring logs and below are in general accordance with ASTM D 2487 – *Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)* and D 2488 – *Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)*. Boring logs and a supplementary boring log key explaining boring log details are provided in Appendix A.



4.1 Subsurface Materials

Primary materials encountered during the subsurface investigation include: pavement section, fine alluvium, coarse alluvium, and bedrock.

4.1.1 Pavement Section

A pavement section was encountered in all borings except LE-12, LE-13 OW, and LE-14. The pavement section included an asphalt and a base course section. Asphalt thickness varied from 2 to 9-inches thick and base course thickness varied from 2 to 6-inches thick.

4.1.2 Fine Alluvium

Fine alluvium was encountered in boring LE-7 a depth of 14-feet below existing ground surface and extended to a depth of 19-feet below existing ground surface. Encountered fine alluvium was classified as the following in accordance with the Unified Soil Classification System (USCS):

• Sandy Lean Clay (CL)

Fine alluvium contained particle sizes ranging from clay to medium sand. Blow counts of encountered fine alluvium was 11 blows per foot of sampler penetration. Based on blow counts, the consistency of encountered fine alluvium was stiff. Fine alluvium was additionally described as brown and moist.

4.1.3 Coarse Alluvium

Coarse alluvium was encountered in all 14 borings at depths ranging from the ground surface or immediately beneath the pavement section to 9-feet below ground surface. Coarse alluvium extended to the maximum depth of exploration (20 to 40-feet below ground surface) in all borings except LE-9, where bedrock was encountered at 18-feet below ground surface. Encountered coarse alluvium was classified as the following in accordance with USCS:

- Poorly Graded Sand (SP)
- Poorly Graded Sand with Gravel (SP)
- Poorly Graded Sand with Silt (SP-SM)
- Poorly Graded Sand with Silt and Gravel (SP-SM)
- Poorly Graded Sand with Clay and Gravel (SP-SC)

- Well Graded Sand (SW)
- Well Graded Sand with Gravel (SW)
- Silty Sand (SM)
- Clayey Sand (SC)
- Poorly Graded Gravel with Clay and Sand (GP-GC)

Coarse alluvium classified as a Well Graded Sand contained fine to coarse sand with trace to little fine to coarse gravel. Coarse alluvium classified as a Poorly Graded Sand contained mostly fine to coarse sand with trace to few fines and trace to some fine to coarse gravel. Encountered Poorly Graded Gravel contained mostly fine to coarse gravel with some fine to coarse sand with little fines. Encountered Silty Sand and Clayey Sand contained mostly fine to medium sand and some fines with trace gravel. Blow counts of encountered coarse alluvium ranged from 3 blows per foot of sampler penetration to 50 blows for 5-inches of sampler penetration. Based on blow counts, the density of encountered coarse alluvium was very loose to very dense. Coarse alluvium was further described as tan to light brown to red-brown to brown and dry to wet. Auger chatter or grinding was noted in LE-6 and LE-8 and could indicates larger sized particles.



4.2 Claystone Bedrock

Claystone bedrock of the Laramie Formation was encountered at LE-9 at a depth of 18-feet below the existing ground surface. Encountered bedrock was described as completely weathered, very soft, very fine grained, olive gray, moist and contained iron oxide staining.

One representative sample of bedrock was tested for expansive behavior. Upon inundation and under a pressure of 500 psf the selected sample of bedrock expanded 2.4 percent, and a swell pressure of 2,250 psf was calculated.

4.3 Groundwater

Groundwater was encountered during the subsurface investigation in all borings except LE-5, LE-6, and LE-7 at depths ranging from 16.4 to 24 feet beneath the ground surface. Temporary monitoring, observation wells were installed in six out of the 14 borings as identified by "OW" following the boring number. The table below presents initial groundwater levels in the borings and groundwater fluctuations in the monitoring wells as measured after drilling.

Groundwater Depth [ft.] ¹						
Dering	Date					
Boring	Initial	8/23/2018				
LE-1	23.7					
LE-2 OW	22.8	25.8				
LE-3	17.8					
LE-4 OW	18.6	21.0				
LE-5 OW	Not Encountered	30.7				
LE-6 Not Encountered						
LE-7 OW ¹	Not Encountered					
LE-8	23.0					
LE-9 OW ¹	15.2					
LE-10	18.5					
LE-11	20.2					
LE-12 17.0						
LE-13 OW	16.4					
LE-14 17.0						

¹Additional groundwater depth data has not been provided

Fluctuations in groundwater levels may occur due to variations in the water level of the Poudre River or the Greeley No. 3 Canal, rainfall, temperature, site development and other factors not evident at the time that these measurements were made.



5 **LIMITATIONS**

This study was conducted in accordance with generally accepted geotechnical engineering and engineering geologic practices and principals; no warranty, express or implied is made. The subsurface conditions described in this report were based on data obtained from exploratory borings and geotechnical laboratory testing. The boring logs presented in this report only depict the subsurface conditions at the actual boring and locations. Subsurface conditions are typically variable, both laterally and vertically, and the nature and extent of the subsurface variations across the site may not become evident until construction. The boundaries between different soil types and bedrock presented in this report are approximate and may be abrupt or gradational. Groundwater levels may vary with time, precipitation, and changes to the hydrogeological conditions at or surrounding the project site.

An environmental assessment was not included in Lithos Engineering scope of work for this project. Any statements regarding the absence or presence of hazardous and/or toxic substances presented herein are only intended for informational purposes. If the client is concerned about the environmental conditions at the site, Lithos Engineering recommends the client and/or owner retain a qualified environmental firm to conduct an environmental site assessment.

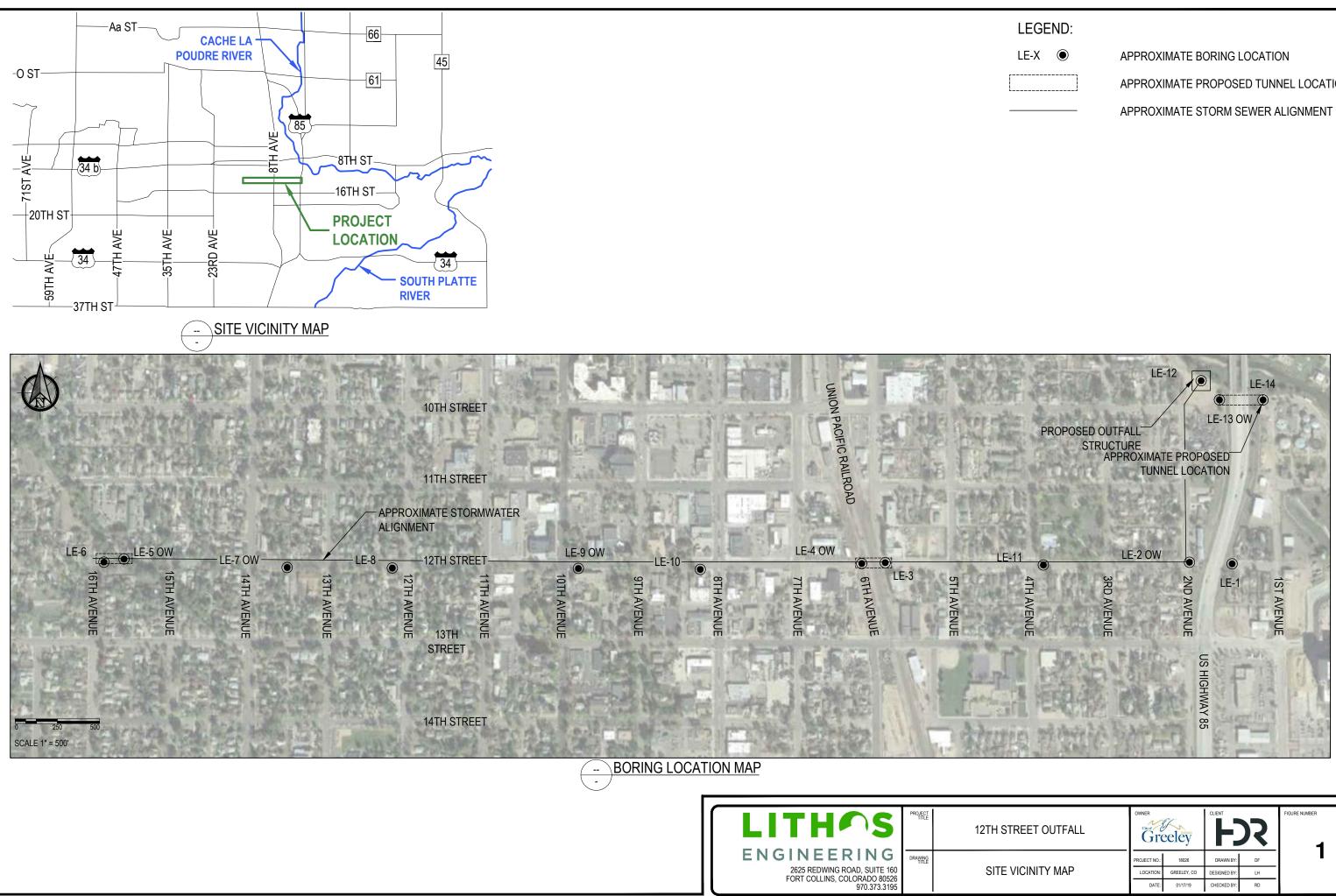
REFERENCES

- ASTM Standards, ASTM International, West Conshohocken, PA (2012).
- Geologic Map of the Boulder-Fort Collins-Greeley Area, Colorado by Roger Colton, 1978
- Greeley 2035 Comprehensive Transportation Plan, City of Greeley, May, 3 2011



FIGURES





LEGE	ND:
LE-X	۲
]

APPROXIMATE PROPOSED TUNNEL LOCATION

STREET OUTFALL	OWNER Clived C	eeley		R	FIGURE NUMBER	
	PROJECT NO .:	18026	DRAWN BY:	DF	•	
E VICINITY MAP	LOCATION:	GREELEY, CO	DESIGNED BY:	LH		
	DATE:	01/17/19	CHECKED BY:	RD		





Boring Logs

BORING LOG KEY STANDARD GEOTECHNICAL DRILLING

Soil Classifications:

	Clear Square Sieve Openings				U.S. Standard Series Sieve Sizes				
12	2"	3"	3/4"	4	ļ	10	40	2	00
Boulders	Cobbles	Coarse	Gravel	Fine	Coarse		and dium	Fine	Silts and Clays
300	mm 7	'5mm	19mm	4.75		2.0mm	0.42mm		5mm

Gradation Estim	ates by Field	Relative I	Relative Density or Consistency of Non-cohesive and Cohesive Soils					
Observ	ation	Nor	Non-cohesive Soils			Cohesive Soils		
Description	Quantity (%)	Classificat	Classification Blows per 12 in			Blows per 12 in		
Trace	<5	Very Loos	se 0 to	o 4	Very Soft	0 to 2		
Few 5 to 10		Loose	4 to	10	Soft	2 to 4		
Little	15 to 25	Medium De	ense 10 to	o 30	Stiff	8 to 16		
Some	30 to 45	Dense	30 to	o 50	Very Stiff	16 to 32		
Mostly > 50		Very Den	se >5	50	Hard	>32		

Color: Sample colors are in general accordance with basic brown, red, yellow, and gray combinations

Description of Moisture						
Criteria						
Absence of moisture, dusty, dry to the touch						
Damp but no visible water						
Visible free water, usually soil below the groundwater table						
Di()-/(
Plasticity						
Criteria						
A $\frac{1}{8}$ " diameter thread cannot be rolled						
A $\frac{1}{8}$ " in diameter thread can be rolled with difficulty; a lump						
cannot be formed at a moisture lower than the plastic limit						
A $\frac{1}{8}$ " in diameter thread can be rolled easily; a crumbly lump						
can be formed at a moisture lower than the plastic limit						
A_{8}^{1} in diameter thread can be rolled very easily; a lump can						
be formed at a moisture lower than the plastic limit						

	Description of Odor					
Description	Criteria					
No Organic Odor	Organic odor is not present					
Trace	Mild organic odor; mixture of soil					
Organic Odor	and organics Prominent organic odor; sample is					
Strong	Prominent organic odor; sample is					
Organic Odor	primarily organic					
Cementation						

Cementation							
Description	Description Criteria						
Weak	Crumbles with light finger pressure						
Moderate	Crumbles with considerable finger						
wouerate	pressure						
Strong	Will not crumble with finger						
Strong	pressure						

Rock Descriptions:

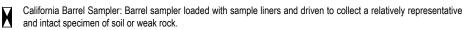
	Weathering
Description	Criteria
Fresh	No visible sign of rock material weathering: perhaps slight discoloration on major discontinuity surfaces.
Slightly Weathered	Discoloration of rock material on discontinuity surfaces.
Moderately Weathered	Less than half of the rock material is decomposed and/or disintegrated to soil. Fresh or discolored rock is present either as a continuous framework or as corestones.
Highly Weathered	More than half of the rock material is decompsed and/or disintegrated to a soil. Fresh or discolored rock is present either as a discontinuous framework or as corestones
Completely Weathered	All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact.

	Texture		Field Hardness
Description	Criteria	Description	Criteria
Very Fine Grained	Grains not individually visible to the unaided eye	Very Hard	Cannot be scratched with a knife or sharp pick
Fine Grained	Grains barely visible to the unaided eye, up to $\frac{1}{16}$ " diameter	Hard	Can be scratched with a knife or pick only with difficulty
Medium Grained	Grain diameter between $\frac{1}{16}$ " and $\frac{3}{16}$ "	Medium	Can be gouged ¹ / ₁₆ " deep by firm pressure on knife or pick point
Coarse Grained	Grains diameter between $\frac{3}{16}$ " and $\frac{1}{4}$ "	Soft	Can be grooved or gouged readily with knife of pick point
Very Coarse Grained	Grains larger than $\frac{1}{4}$ " in diameter	Very Soft	Can be carved with knife and scratched readil by fingernail

Geologic Interpretation:

A Geologic Interpretation of encountered soil and bedrock units is provided for each specific Visual Material Description. Examples of geologic interpretations for soil that may be presented include: FILL, ALLUVIUM, AEOLIAN, AND GLACIAL TILL, AND RESIDUUM. Rock geologic interpretations are referenced based on a combination of field classifications and applicable geologic maps.

Sample Graphics and Descriptions:



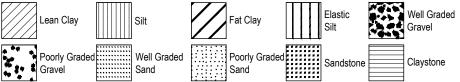
Split-Spoon Sampler: Split-barrel sampler driven in accordance with ASTM D1586 used to provide visual material descriptions and collect a disturbed specimen.

Shelby Tube Sampler: Thin wall tube hydraulically pushed into the subsurface to collect a representative and intact specimen of soil.

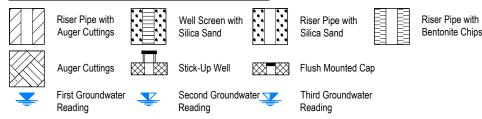
R Bulk Sample: Bulk or bagged sample taken from auger cuttings.

Boring Graphics:





Groundwater Monitoring Well Graphics:





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Depth (ft)	Elevation (ft)	Sample Identification	Blow Count/6 in	Rec. (in) / RQD (%) / Rate (min)	Geologic Graphic	USCS Classification (gr color,	Soil: EOLOGIC INTERPRETATION- roup symbol), particle sizes, density or consistency, moisture, odor, other descriptions Rock: EOLOGIC INTERPRETATION- ion, hardness, weather, color, texture, joint size, other descriptions	Groundwater Denth /	Monitoring Well Configuration	Moisture Content (%)	Dry Unit Weight (pcf)	Water Soluble Sulfates (%)	Gravel Content (%)	Sand Content (%)		Limit (%)	Plasticity Index (%)	UCS (psf)	Swell Pressure (psf)	Swell Percent (%)
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30 —	- - 4620 -		8 13 15	16			(SW), mostly fine to coarse sand, trace imum particle size 1.5 inches, medium wet													
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				(min)			Soil:		E		State			Ind	ex D	ata			ressit	
				/ Rate (min)			EOLOGIC INTERPRETATION- oup symbol), particle sizes, density or consistency,		juratio			s (%)								
		ation		/ (%)			moisture, odor, other descriptions	oth /	Config	t (%)	(pcf)	ulfate	(%				(%		osf)	
	t)	ntifice	:/6 in	gg	raphic		Rock:	er Del	Well (onteni	eight	ble St	tent (ent (%	ent (%	(%)) xəpi		nre (I	ent (%
(ft)	tion (f	le Ide	Count	(in) / RQD	gic G	-GE	EOLOGIC INTERPRETATION-	dwate	oring	ure C	nit W	Solu	Con	Conte	Cont	Limit	city Ir	(psf)	Press	Perce
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	- 4608																			
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S	amp	ling	Dat	a			Visu	al Material Description Laboratory Testing	Results Strength &
Depth (ft)	Elevation (ft)	Sample Identification	Blow Count/6 in	Rec. (in) / RQD (%) / Rate (min)		Geologic Graphic	USCS Classification (g color,	Soil: EOLOGIC INTERPRETATION- oup symbol), particle sizes, density or consistency, moisture, odor, other descriptions	Combined (%) UCS (psf) Combined (%) Swell Pressure (psf) Swell Pressure (psf) Swell Percent (%) Combined (%)
	- 4680 - 4674		2 2 2 2 3 2 4 4 4 3	18 12 12 10		- 76 N S	brown, moist As above except tr inches, loose, trace As above As above except tr	ches 1.0 ft 9 110 29 JM JM 9 110 9 110 Jostly medium sand, little silt, very loose, acce gravel, maximum particle size 0.75 9 110 29 Acce gravel, maximum particle size 0.75 9 110 32 NP ace clay 11 116 32 32	NP
12 -	- 4668		6 6 7 8	10			As above As above		
- 24 -	- 4656	H	7 14	12			As above		
30	-4650		8 10 13	18			Poorly Graded Sar medium dense, ligi END OF EXPLOR	31.0 ft.	
	ener 1) 2) 3)	So So Th	il cla ils fo e m	assif or Er axim	ngir num	neerir parti	g Purposes (Unified Soil	Classification System) naterial description is dependent on sampler dimensions. ¥ 07/27/18 15 min √ 07/27/18 1 hour	ta: pth to Groundwater N/A N/A

Pro Clie Ow Dril Lith	ject l ent's ner's lling nos R	Nam Num Nan Sub Sub	ne: nber ne: me: cont eser	12th 12th 12th HDI City tract		Outfall eering eeley ious Drilling Subs an Fawaz	Drill Make Drilling Me Bit Type: Casing De Hammer W Sampler T	and Model: <u>(</u> ethod: <u>Hollov</u> <u>Cutting Hea</u> escription: <u>Ho</u> Veight (Ibs)/Fa	w-Stem Auge ad ollow-Stem Au Ill (in): <u>140 lbs</u> Spoon / Calif	r uger s. / 30 in.	— — Ba — Ba — Ba	oring oring otes:	E N Loca Eleva	tion: ation: ing e	<u>We</u> : <u>46</u> eleva	NI est o 684.5 ation	f Ca 51-fe dat	E R anal eet ta ta	ken	S N G	j	ey
S	amp	ling	Dat			Visu		ial Descri	iption				In-Si State	tu	abora		· Tes ex D				ength	
Depth (ft)	Elevation (ft)	Sample Identification	Blow Count/6 in	Rec. (in) / RQD (%) / Rate (min)	Geologic Graphic	USCS Classification (g color,	EOLOGIC IN group symbol) , moisture, od R EOLOGIC IN tion, hardness	dor, other desc cock: ITERPRETAT	s, density or con criptions		Groundwater Depth / Monitoring Well Configuration	Moisture Content (%)		Water Soluble Sulfates (%)	Gravel Content (%)	Sand Content (%)	Fines Content (%)	Liquid Limit (%)	Plasticity Index (%)	UCS (psf)	Swell Pressure (psf)	Swell Percent (%)
0		M	3	12		PAVEMENT SECT Asphalt - 9 inches Base Course - 3 in	-			1.0 ft		7					29					
	- 4680	X	2 2	12		COARSE ALLUVI Silty Sand (SM), m moist As above except v	nostly mediu	um sand, littl	le silt, loose, b									NP	NP			
6-		X	2 2	12		As above except tr material	race clay, tr	ace coarse s	sand, trace or	rganic		6	111							108		
	- 4674	X	5 8	12		As above except n	nedium den	ISE						0.0115	5							
12 -		X	5 8	12		As above																
	- 4668	X	4 12	10		Well Graded Sand gravel, maximum p brown, moist																
-	- 4662		24 33 18	14	0000 0000 0000 0000 0000 0000 0000 0000 0000	Well Graded Sand sand, few to little c inches, dense, ligh	coarse grave	el, maximum														
24 -			6 12 21	14	0.000000000000000000000000000000000000	As above except 4 Auger chatter	inch Silty S	Sand lense ir	n sampler sho	De												
30 - -	-4656		27 15 17	12	22 22 22 22 22 22 22 22 22 22 22 22 22	Poorly Graded Sar gravel, maximum p End of Exploratio	particle size															
	- 4650][
	ener 1) 2) 3)	So So Th	il cla ils fo e ma	assifi or Er axim	ngineerin ium partio	are in general accordanc g Purposes (Unified Soil cle size identified in the r on is provided on the Bo	l Classification material desc	n System) ription is depe				¥_0 ¥	[)7/27	Date: 7/18	Elap	psed 0 mi	Time	er Da	ata: epth t	to Grou N/A		ater:

						E-7 OW	Drilling and Sampling Methods					Ī	7	•				S		
Proje Proje			_		Street 8026	Outfall	Drill Make and Model: <u>Truck Mount / CME 55</u> Drilling Method: Hollow-Stem Auger	_				_	_					NG		
					R Engin		Bit Type: Cutting-Head Casing Description: Hollow-Stem Auger		Ba										,	
					y of Gre or: <u>Vari</u>	ous Drilling Subs	Hammer Weight (lbs)/Fall (in): 140 lbs. / 30 in.			-		tion: ation:				411	Ave	:		
					/e: <u>Dyla</u> 09/24/20	n Fawaz	Sampler Type(s): <u>Split Spoon / California</u> Sampler Diameter(s): 1.4 in. / 2.0 in.			tes: rth.	Bor	ing e	eleva	ation	s ta	ken	fron	n Goo	ogle	_
			Dat				al Material Description					La	bora	tory	Tes	sting	Res	ults		-
		-		Ê		VISU					n-Sit	tu		-	ex D				ength	
				te (min)		-GE	Soil: OLOGIC INTERPRETATION-		ation		State	(%)						Comp	ressii	
		c		(%) / Rate			oup symbol), particle sizes, density or consistency,		ifigura		(J	tes (%								
		icatio	in	(%)	jc.	COIOF, I	moisture, odor, other descriptions	epth		ent (%	nt (pc	Sulfa	t (%)	(%)	(%)	((%) >		e (psf)	(%)
	E	dentif	Count/6 i	(in) / RQD	Grapl		Rock:	ater D	g We	Conte	Weigh	luble	onten	ntent	ntent	nit (%	(apul	(ssure	cent
Depth (ft)	Elevation (tt)	Sample Identification	v Col	(in)	Geologic Graphic	-	EOLOGIC INTERPRETATION- on, hardness, weather, color, texture, joint size,	Groundwater Depth	Monitoring Well Configuration	Moisture Content (%)	Dry Unit Weight (pcf)	Water Soluble Sulfates	Gravel Content (%)	Sand Content (%)	Fines Content (%)	Liquid Limit (%)	Plasticity Index (%)	UCS (psf)	Swell Pressure (psf)	Swell Percent (%)
Dep	Еle	San	Blow	Rec.	Geo		other descriptions	0 U	Mor	Moi	Dry	Wat	Gra	San	Fine	Liqu	Plas	NC:	Swe	Swe
-4	675				$\sim C \otimes C$	Asphalt - 5 inches		E	Ē											
-						Base Course - 3 inc	0.7 ft.													
-						COARSE ALLUVIL	JM	8												
Ť		X	2 3	10		Poorly Graded San sand, loose, red-bro	d (SP), mostly medium sand, trace coarse	8		3										
5-	670					sand, loose, red-bit	JWN, MOISE	0												
Ţ	070																			
-								4												
-			4	10	~ <i>~,</i> ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	Clayey Sand (SC),	mostly medium sand, trace coarse sand,	И							39					
10 —		X	5	10		some clay, loose, re		8							39					
-4	665					As above except m	ostly fine to medium sand, brown	И												
Ī			4 5 5	12			usity line to mean sand, brown	И												
I							14.0 ft.	И												
15 -		M	3 8	10		FINE ALLUVIUM Sandy Lean Clay (0	CL), some fine to medium sand, stiff, brown,			15	117				61	26	8			
-4	660					moist														
-																				
ł																				
20		X	7 12	8		COARSE ALLUVIL														
	655	_				sand, trace coarse	d (SP), mostly medium sand, trace coarse gravel, maximum particle size 1 inch,													
-						medium dense, red	20.0 ft.	-												
-						END OF EXPLORA	ATION													
Ŧ																				
25 —																				
-4	650																			
Ī																				
30			040														-			
Gei 1)		So	otes il cla	Issifi	cations a	are in general accordance g Purposes (Unified Soil (with ASTM D2487 Standard Practice for Classifica	tion	of	L 01	D 2/24	Date:	Elap	bund bsed 20 m	Time	er Da e: Da	ata: epth i	to Gro N/A		ater:
2) 3)		Th	e ma	axim	um partic	cle size identified in the m on is provided on the Bori	aterial description is dependent on sampler dimens	sions		≓_ <u>0</u> ; ⊈	<u>ə, 24</u>	/ 10		.0 10		+		IN/F	۱ <u> </u>	

Pro Clie Ow Dril Lith	ject l ent's ner's ling los R	Nam Num Nan Nai Sub	ie: iber: ne: me: cont	12th <u>18</u> HDI City ract	026 R Engineering of Greeley or: Various Drilling Subs e: Dylan Fawaz	Drilling and Sampling Methods Drill Make and Model: <u>Truck Mount / CME 55</u> Drilling Method: <u>Hollow-Stem Auger</u> Bit Type: <u>Cutting-Head</u> Casing Description: <u>Hollow-Stem Auger</u> Hammer Weight (Ibs)/Fall (in): <u>140 lbs. / 30 in.</u> Sampler Type(s): <u>Split Spoon / California</u>		Boriı Note	E ng Lo ng Ele s: <u>B</u>	N C cation evation oring	5 : <u>12</u> n: <u>46</u> cave	N th S 573- ed w	EI t & feet hen	EF 12th	R I Ave	ng HS	A .	
	Date(s) of Drilling: 09/24/2018 Sampler Diameter(s): 1.4 in. / 2.0 in. Boring elevations taken from Google Earth. Sampling Data Visual Material Description Laboratory Testing Results 0																	
	unp	ing	Dat			Soil:				Situ						Stre		
Depth (ft)	Elevation (ft)	Sample Identification	Blow Count/6 in	(in) / RQD	USCS Classification (gro color, m	up symbol), particle sizes, density or consistency, ioisture, odor, other descriptions Rock: DLOGIC INTERPRETATION- n, hardness, weather, color, texture, joint size,	Groundwater Depth /		Moisture Content (%)	Water Soluble Sulfates (%)	Gravel Content (%)	Sand Content (%)	Fines Content (%)	Liquid Limit (%)		UCS (psf)	Swell Pressure (psf)	Swell Percent (%)
5	- 4670	X	2 4	6	Asphalt - 6 inches Base Course - 6 inch FINE ALLUVIUM Sandy Silt (ML), som	nes1.0 ft.	-		10				50	NP	NP			
	- 4665	X	7 9	8	COARSE ALLUVIUI Silty Sand (SM), mos moist	9.0 ft. M stly medium sand, little silt, loose, brown,	-						29					
15-	- 4660	X	5 15	10	to coarse sand, som	with Silt and Gravel (SP-SM), mostly fine e fine gravel, trace silt, maximum particle dium dense, light brown, moist			2		34	61	5					
-	- 4655		12 25 28	12	ස්දේශී trace coarse sand, fe	with Gravel (SP), mostly medium sand, w fine gravel, maximum particle size 0.25 ight brown, moist, auger chatter												
20-			20 50/6"	10	Auger Chatter		(23.0 f	t.)										
25-	- 4650		12 10 20	10	As above except we	25.5 ft.	Ţ											
	- 4645																	
 G	ener										<u> </u>	ounc	d <u>w</u> at	ter D	ata:			<u> </u>
	1) <u>2)</u> 3)	So Th	ils fo e ma	r Er xim	aineerina Purposes (Unified Soil C	terial description is dependent on sampler dimens.			09/2	Date 24/18	: Ela	psed 0 m	Tim	e: D	epth	to Gro 23.0-f		ater:

Pro Clie Owr Dril Lith	iect nt's ner's ling os F	Nam Num Nam Sub Sub Repr	ne: nber: ne: me: conf eser	12th 12th HDI Cit ract	n Street 3026 R Engin y of Gre or: Vari ve: Dyla	eering eley ious Drilling Subs an Fawaz	Drilling and Sampling Methods Drill Make and Model: <u>Truck Mount / CME 55</u> Drilling Method: <u>Hollow-Stem Auger</u> Bit Type: <u>Cutting-Head</u> Casing Description: <u>Hollow-Stem Auger</u> Hammer Weight (Ibs)/Fall (in): <u>140 lbs. / 30 in.</u> Sampler Type(s): <u>Split Spoon / California</u>		Boi Not	ring I ring I tes:	E N Loca Eleva	IG tion: ation:	<u>12t</u> 46	N th St 64-f	E E t & 1 eet	E R	R I I Ave		5	
				_	09/25/20		Sampler Diameter(s): <u>1.4 in. / 2.0 in.</u>		Ea	rth.					-		_			=
58	amp	ling	Dat			Visu	al Material Description				n-Sit		bora				Res		ength	&
				(%) / Rate (min)			Soil: OLOGIC INTERPRETATION- oup symbol), particle sizes, density or consistency,		guration		State	s (%)		Ind	ex D	ata		Comp		
	0	Sample Identification	/6 in	RQD (%) /	Geologic Graphic		moisture, odor, other descriptions	Groundwater Depth /	Monitoring Well Configuration	Moisture Content (%)	Dry Unit Weight (pcf)	Water Soluble Sulfates	Gravel Content (%)	Sand Content (%)	Fines Content (%)	(%)	dex (%)		Swell Pressure (psf)	Swell Percent (%)
(ft)	ion (fl	e Idei	Count/6	(in) / RQD	gic Gr	-GE	Rock: OLOGIC INTERPRETATION-	dwate	oring \	ure Co	nit We	Solut	Cont	Conte	Conte	Limit	sity In	psf)	Press	Perce
Depth (ft)	Elevation (ft)	Sampl	Blow (Rec. (Geolog	Bedrock Classification	on, hardness, weather, color, texture, joint size, other descriptions	Groun	Monito	Moistu	Dry U	Water	Grave	Sand (Fines	Liquid Limit (%)	Plasticity Index	UCS (psf)	Swell	Swell
				H		PAVEMENT SECT Asphalt - 6 inches Base Course - 3 inc COARSE ALLUVIL	ION ches0.8 ft.			_							-			
5-	4660	X	3 5	8		Silty Sand (SM), mo moist	ostly fine sand, little silt, loose, light brown,			4					19					
 10	4655	X	5 15 11	10		coarse sand, trace medium dense, ligh distribution with der	d (SP), mostly fine to medium sand, trace coarse gravel, maximum particle size 1 inch, t brown, moist, increasing particle size oth d with Silt and Gravel (SP-SM), mostly					0.0067								
	4650		27 25	12	P	medium to coarse s particle size 1 inch,	and, some fine gravel, few silt, maximum very dense, light brown, moist with Gravel (SW), mostly fine to coarse						36	55	9					
15-			15 40 46	10			aximum particle size 1.25 inches, light													
20 -	4645	X	7 15	8	20	LARAMIE FORMA Claystone, complet olive-brown, moist, END OF EXPLORA	ely weathered, very soft, very fine grained, iron oxide staining20.0 ft.			22	105					56	18	9050	2250	2.4
 25 	4640																			
	4635																			
 General Notes: Soil classifications are in general accordance with ASTM D24 Soils for Engineering Purposes (Unified Soil Classification Sy The maximum particle size identified in the material description Additional information is provided on the Boring Log Key. 							Classification System) aterial description is dependent on sampler dimens		of	09	[9/25)ate: /18	Elap	bund bsed 20 m	Time	er Da e: De	epth f	to Gro 15.2-f		ater:

Pro Clie Ow Dri Lith	oject ent's ner's Iling hos F	Nam Num Nan Nan Sub Repr	ne: nber ne: me: cont eser	12th 18 HDI Cit ract	n Street 3026 R Engin y of Gre or: <u>Var</u> i	eering eley ious Drilling Subs an Fawaz	Drilling and Sampling Method Drill Make and Model: <u>Truck Mount / CME 55</u> Drilling Method: <u>Hollow-Stem Auger</u> Bit Type: <u>Cutting-Head</u> Casing Description: <u>Hollow-Stem Auger</u> Hammer Weight (Ibs)/Fall (in): <u>140 lbs. / 30 in</u> Sampler Type(s): <u>Split Spoon / California</u> Sampler Diameter(s): <u>1.4 in. / 2.0 in.</u>	5	_ Bo _ No	ring ring	E N Loca Eleva	N C ation:	5 <u>12</u> : <u>46</u>	N th S 563-	EI t&a feet	EF Bth /	R I Ave	N C	ò	
S	amp	ling	Dat			Visu	al Material Description				In-Si	tu	abora		/ Te: lex D		g Res		ength	
⊲ Depth (ft)	Elevation (ft)	Sample Identification	Blow Count/6 in	Rec. (in) / RQD (%) / Rate (min)	Geologic Graphic	USCS Classification (g color,	Soil: EOLOGIC INTERPRETATION- roup symbol), particle sizes, density or consistency moisture, odor, other descriptions Rock: EOLOGIC INTERPRETATION- tion, hardness, weather, color, texture, joint size, other descriptions	·, -	Groundwater Depth / Monitoring Well Configuration	Moisture Content (%)	Dry Unit Weight (pcf)	Water Soluble Sulfates (%)	Gravel Content (%)	Sand Content (%)	Fines Content (%)	Liquid Limit (%)	Plasticity Index (%)	OCS (psf)	Swell Pressure (psf)	Swall Parcant (%)
- - - 5	- - - - -	X	25	10		Asphalt - 6 inches Base Course - 3 in COARSE ALLUVI	ches0.8 f			9	108				47	NP	NP			
	- 4655 - - - - - 4650		5 10 8	12		coarse sand, trace	nd (SP), mostly medium sand, trace to few to few coarse gravel, maximum particle size n dense, light brown, moist, fractured	9												
	-		13 17 14	12		medium to coarse	nd with Silt and Gravel (SP-SM), mostly sand, some fine gravel, few silt, maximum , dense, light brown, moist						31	61	8					
20 -	- 4645 - -	X	4 28	6		As above, except v	wet	(18.5 ft.)	10			29	61	11					
	- 4640 - -		3 5 8	12		As above except n	25.5 f	t												
-	- 4635																			
	iener 1) 2) 3)	So	il cla	issifi	ications and ingineering ium partic	are in general accordanc g Purposes (Unified Soil cle size identified in the Ro	e with ASTM D2487 Standard Practice for Classific Classification System) naterial description is dependent on sampler dimen ring Log Key.	atio nsior	n of	<mark>¥_0</mark> ¥	[9/25	Date: /18	Ela	ouno psed 0 m	lim	er D	epth	to Gro 18.5-f		ater

Pro Clie Ow Dri Litl	oject ent's /ner' Iling hos I	Nan Nun Nar S Na Sub Repr	ne: nber ne: me: ocon resei	12th : <u>18</u> <u>HD</u> <u>Cit</u> tract	n Street 8026 R Engin y of Gre tor: <u>Var</u> i	eering eley ious Drilling Subs an Fawaz	Drilling and Sampling Method Drill Make and Model: Truck Mount / CME 55 Drilling Method: Hollow-Stem Auger Bit Type: Cutting-Head Casing Description: Hollow-Stem Auger Hammer Weight (Ibs)/Fall (in): 140 lbs. / 30 in Sampler Type(s): Split Spoon / California Sampler Diameter(s): 1.4 in. / 2.0 in.	5	Bo	ring ring tes:	E N Loca Eleva	N C ation: ation	<u>12</u> 12	N th S [*] 51.5	E E	E F 4th / eet	R I	S N C	Ì	ey
S	amp	oling	Dat			Visu	ual Material Description				In-Si		abora		/ Te : ex D		Res	Stre	ength	
Depth (ft)	Elevation (ft)	Sample Identification	Blow Count/6 in	Rec. (in) / RQD (%) / Rate (min)	Geologic Graphic	USCS Classification (g color -G Bedrock Classifica	Soil: GEOLOGIC INTERPRETATION- group symbol), particle sizes, density or consistency. , moisture, odor, other descriptions Rock: GEOLOGIC INTERPRETATION- tion, hardness, weather, color, texture, joint size, other descriptions	, , , , , , , , , , , , , , , , , , ,	Groundwater Deptn / Monitoring Well Configuration	Moisture Content (%)	Dry Unit Weight (pcf)	Water Soluble Sulfates (%)	Gravel Content (%)	Sand Content (%)	Fines Content (%)	Liquid Limit (%)	Plasticity Index (%)	UCS (psf)	Swell Pressure (psf)	Swell Percent (%)
5	- - 4650 - - - - - 4645 -	X	4 8	12			nches 0.8 ft IUM nd with Silt (SP-SM), mostly medium sand, ravel, maximum particle size 0.75 inches,	t					10	82	8					
	- - - 4640 - -	X	5 12 6 15 18	10			naximum particle size 2 inches race gravel, maximum particle size 1 inch,													
20 -	- - - - - - 4630		11 14 16	14		As above except r	no gravel	`	20.2 ft.)						7					
25 -	- - - 4625 -		6 22 21	14	u - r na c in r 0 4 6 6 6 4 1 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7		I (SW), mostly fine to coarse sand, trace particle size 1.5 inches, dense, red-brown, 25.5 ft ATION	t												
<u>30</u> G	iene	ral N	lote	 s:									Gre	ounc	lwat	er D	ata:			
	1) 2) 3)	Sc Sc Th	oil cla oils fo ne m	assif or Ei axim	ngineerin num partio	g Purposes (Unified Soi	material description is dependent on sampler dimen		1S.	¥_0 ¥	[9/25	Date: /18	Ela	osed 0 m	Tim	e: D	epth	to Gro 20.2-f		ater:

Pro Clie Ow Dri	oject ent's mer's Iling	Nam Nun Nar SNa Sub	ne: nber ne: me: con	<u>12th</u> : <u>18</u> HD <u>Cit</u> tract	n Street 3026 R Engin y of Gre tor: <u>Vari</u>	eering eley ous Drilling Subs	Drilling and Sampling Method Drill Make and Model: <u>Truck Mount / CME 55</u> Drilling Method: <u>Hollow-Stem Auger</u> Bit Type: <u>Cutting-Head</u> Casing Description: <u>Hollow-Stem Auger</u> Hammer Weight (Ibs)/Fall (in): <u>140 lbs. / 30 in</u>	5	11	oring	E N Loca		5 <u>Ou</u>	N Itfall	E E	E F	S I	S N G		
					ve: <u>Dyla</u> 09/25/20	n Fawaz 018	Sampler Type(s): <u>Split Spoon / California</u> Sampler Diameter(s): 1.4 in. / 2.0 in.			tes: arth.	Bor	ing e	eleva	atior	ns ta	aken	fror	n Goo	ogle	
S	amp	ling	Dat	a		Visı	ual Material Description	T					bora	atory	/ Te	sting	l Res			<u> </u>
				min)			Soil:		c		In-Sit State			Ind	ex D)ata		Comp	ength ressi	
		cation	_	(%) / Rate (min)	.2	USCS Classification (g	EOLOGIC INTERPRETATION- group symbol), particle sizes, density or consistency , moisture, odor, other descriptions	, / 4tuo	epun / Configuratio	nt (%)	t (pcf)	Sulfates (%)	(%)	(%	(%)		(%)		(psf)	(%)
Depth (ft)	Elevation (ft)	Sample Identification	Blow Count/6 in	Rec. (in) / RQD (%) /	Geologic Graphic		Rock: BEOLOGIC INTERPRETATION- tion, hardness, weather, color, texture, joint size, other descriptions	Croundwator D	Monitoring Well Configuration	Moisture Content (%)	Dry Unit Weight (pcf)	Water Soluble Sulfates (%)	Gravel Content (%)	Sand Content (%)	Fines Content (%)	Liquid Limit (%)	Plasticity Index	UCS (psf)	Swell Pressure (psf)	Swell Percent (%)
	4650 - - - - - 4645		563	8	U	sand, trace fine to	1					>					H		05	
-	-	X	3 6	10		loose, light brown As above														
	- - 4640 -	X	11 30	10		As above except d	Iry					0.0061								
	- - 4635 - -	X	8 14	4		medium to coarse	nd with Silt and Gravel (SP-SM), mostly sand, some fine gravel, few silt, maximum ches, medium dense, light brown, wet		7.0 ft.)				39	51	10					
20-	- - 4630 - -		7 35 37	14		As above except v	very dense						39	51	10					
25 -	- - 4625 -		21 25 20	14	1116 1416 1416 1416 1416 1416 1416 1416	As above except d	25.5 ft	t					39	51	10					
	- - - - - - - - - - - - - - - - - - -	Sc	il cla	assif	naineerin	rre in general accordanc	e with ASTM D2487 Standard Practice for Classific			₹	[9/25	Date: //18	Ela	ounc psed 0 mi	Tim	er D	epth	to Gro 17.0-f		ater:

Pro Clie	ject ent's	Nam Num Nan	ne: _ nber: ne: _	12th 18 HDF	Street 026 R Engine	eering	Drilling and Sampling Methods Drill Make and Model: <u>Truck Mount / CME 55</u> Drilling Method: <u>Hollow-Stem Auger</u> Bit Type: <u>Cutting-Head</u>	; 	Des	E	ΞŅ	10	51	Ν	E	EF	R I	N	3	Ct
Dri Liti	ling Ios R	Sub Repr	cont esen	racto tativ	re: A. R	ing Engineers	Casing Description: Hollow-Stem Auger Hammer Weight (lbs)/Fall (in): 140 lbs. / 30 in. Sampler Type(s): Split Spoon	_	Bor Not	ing l es:	E leva Bori	a tion ing e	: <u>4</u> e	640 ′atio	ft.			201 ·		
				-	04/10/19)	Sampler Diameter(s): 1.4 in.		and	d Pr	ofile			•	_		_			_
S	amp	ling	Dat	a		Visu	al Material Description				n-Sit				-			sults Str	ength	&
		ц		D (%)		USCS Classification (gr	Soil: EOLOGIC INTERPRETATION- roup symbol), particle sizes, density or consistency, moisture, odor, other descriptions	/	nfiguration	5	State	s (%)						Comp	pressi	
ו (ft)	Elevation (ft)	Sample Identification	Blow Count/6 in	Recovery (in) / RQD	Geologic Graphic	-GI	Rock: EOLOGIC INTERPRETATION-	Groundwater Depth	Monitoring Well Configuration	Moisture Content (%)	Dry Unit Weight (pcf)	Water Soluble Sulfates	Gravel Content (%)	Sand Content (%)	Fines Content (%)	Liquid Limit (%)	Plasticity Index (%)	UCS (psf)	Swell Pressure (psf)	Swell Percent (%)
Depth (ft)	Eleva	Samp	3low	Reco	Geolo	Bedrock Classificati	on, hardness, weather, color, texture, joint size, other descriptions	Groun	Aonit	Aoist	Jry U	Vater	Grave	Sand	lines	-iquid	lasti	JCS	Swell	Swell
				<u> </u>)		JM vel (SM), mostly fine to medium sand with gravel up to 2 inches, loose, dark brown to			_		1)				F			0,
7-	-4634		8 9 8	14		As above														
-	- 4627		5 9 15	12		Poorly Graded San to 1.5 inches, loos	d (SP), mostly fine sand with trace gravel up e, tan, dry													
14 -			8 17 13	10			d with Gravel (SP), mostly fine to coarse avel up to 1.5 inches, medium dense, tan,		Ht.)											
21 -	- 4620		6 8 16	8		to coarse gravel wi	vel with Clay and Sand (GP-GC), mostly fine th some fine to coarse sand and little clay, o to 1.75 inches, loose, brown, wet													
	-4613		9 13 13	14		As above, except n	nedium dense		•••											
-			16 19 24	15			d with Clay and Gravel (SP-SC), mostly ome gravel up to 1.5 inches and few clay, wn, wet		•••											
35-	-4606		19 24 36	18	/. /// 2 //		d with Gravel (SP), mostly fine to coarse el up to 2 inches, medium dense, brown, wet 35.0 ft- ATION													
	- 4599																			
Soils for Engineering Purposes (Unified Soil Class							aterial description is dependent on sampler dimension		f	04	D 1/10/)ate: /19	Gr Ela	roun apsec 0 m	d Tim	ter C	epth)	to Gro 16.4		vater:

Pro Clie Ow Dril Lith	ject I ent's ner's Iling S nos R	Nam Num Nam Nar Subo	e: _1 ber: le: _l ne: conti esen	12th 18 HDF City racto	Street (026 R Engine v of Gree	eering eley ng Engineers istuccia	Drilling and Sampling Methods Drill Make and Model: <u>Truck Mount / CME 55</u> Drilling Method: <u>Hollow-Stem Auger</u> Bit Type: <u>Cutting-Head</u> Casing Description: <u>Hollow-Stem Auger</u> Hammer Weight (Ibs)/Fall (in): <u>140 lbs. / 30 in.</u> Sampler Type(s): <u>Split Spoon</u> Sampler Diameter(s): <u>1.4 in.</u>	5	Bo	ring ring	E N Loca Eleva Bor	tion: ation	5 : <u>No</u> :: <u>40</u> elev	N orthy 639 ratio	E wes ft.	E F	R I	N Of W	G /ater	
S	amp	ling	Data	a		Visu	ual Material Description				n-Sit	u			-	estin ATA	-		rength	
(ft) ר	Elevation (ft)	Sample Identification	Count/6 in	Recovery (in) / RQD (%)	Geologic Graphic	USCS Classification (g color	Soil: EOLOGIC INTERPRETATION- group symbol), particle sizes, density or consistency, , moisture, odor, other descriptions Rock: EOLOGIC INTERPRETATION-	',	Groundwater Depth / Monitoring Well Configuration	Moisture Content (%)	Dry Unit Weight (pcf)	Soluble Sulfates (%)	el Content (%)	Sand Content (%)	Content (%)	Liquid Limit (%)	Plasticity Index (%)		Swell Pressure (psf)	Swell Percent (%)
Depth (ft)	Eleval - - - - -	Samp	4 3 4	۵ Recov	Ceolo	COARSE ALLUVI Silty Sand with Gra gravel up to 0.75 in caliche stain, dry to Poorly Graded San	avel (SM), mostly sand with some silt and little nches, very loose, dark brown mottled with		Groun	Moist	Dry U	Water	Gravel	Sand	Fines (Liquid	Plasti	UCS (psf)	Swell	Swell
7 -	- - - - 4627 -		4 8 8	10		little gravel up to 0	nd with Gravel (SP), mostly fine sand with .75 inches, loose, tan, moist													
21 -	- - - 4620 -		10 22 22 15 50/6	11		clay and trace graved wet Bottom 7 inches:P fine sand with little moist Poorly Graded Gra to coarse gravel up	vey Sand (SC), mostly fine sand with some vel up to 0.5 inches, medium dense, brown, oorly Graded Sand with Gravel (SP), mostly e gravel up to 2 inches, medium dense, tan, avel with Clay and Sand (GP-GC), mostly fine p to 2 inches with some fine to coarse sand by, dense, brown, wet		(17.0 ft.)											
28 -	- 		14 23 16	12		As above, except i	medium dense													
	- - - 4606		0 3 4	12		Silty Sand (SM), m wet	nostly fine sand with some silt, very loose, tan	n,												
35 -	- - - - 4599		15 9 24	12			nd with Gravel (SP), mostly medium to coarse avel up to 2.5 inches and trace silt, dense, 35.0 ft ATION													
	ener	al N	otes	: ,									<u> </u>	oun	d <u>w</u> a	ter [) Data:	to Gr		<u> </u>
	1) 2) 3)	Soi	ls fo	r Fn	aineerina	Purposes (Unified Soil	e with ASTM D2487 Standard Practice for Classifica Classification System) naterial description is dependent on sampler dimens ring Log Key.			04	L 4/10			on 0 m			Jepth	17 f		vater:

APPENDIX – B



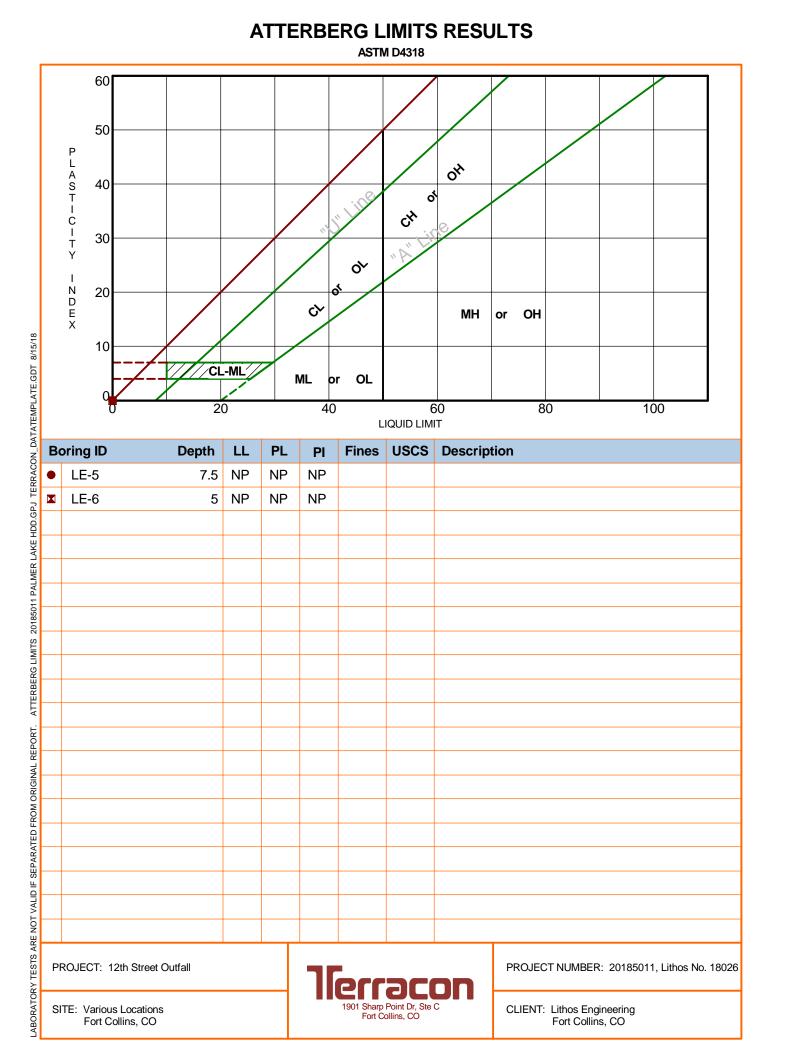
Geotechnical Laboratory Testing

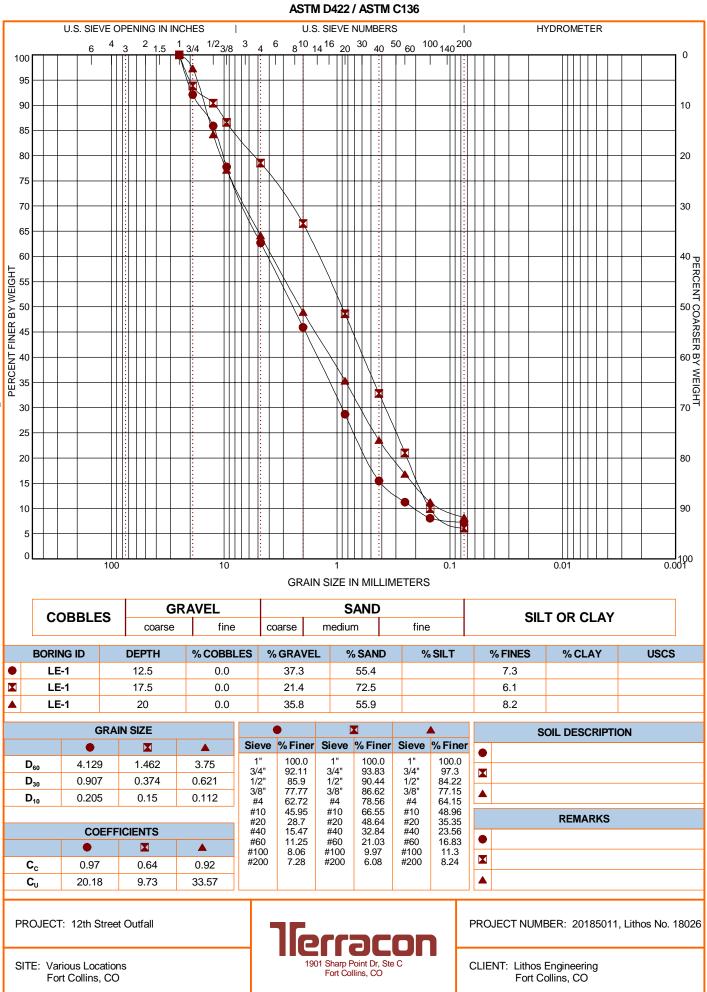
								G	eotec <u>hnica</u>	l Laboratory T	esting Results					
Sam	ple	In-Place	States		Material	Classification	on and Index	Testing				C	11			
Boring	Sample Depth	Moisture	Dry Density	At Liauid	terberg Lin Plastic	nits Plasticity		Size Distri		Innundation Pressure	Swell Percent (%)	Swell Pressure	Unconfined Compressive	Water Soluble	USCS ^{1,2}	Description ¹
0	(ft)	Content (%)	(pcf)	Limit	Limit	Index	Gravel (%)	Sand (%)	Fines (%)	(psf)	. ,	(psf)	Strength (psf)	Sulfate (%)		
LE-1	12.5						37	56	7						SP-SM	Poorly Graded Sand with Silt and Gravel
LE-1	15													0.003	SP-SM	Poorly Graded Sand with Silt and Gravel
LE-1	17.5						21	73	6						SP-SM	Poorly Graded Sand with Silt and Gravel
LE-1	20						36	56	8						SP-SM	Poorly Graded Sand with Silt and Gravel
LE-2	10								23						SM	Silty Sand
LE-2	15						28	65	8						SP-SM	Poorly Graded Sand with Silt and Gravel
LE-2	17.5	7	112				19	75	7						SP-SM	Poorly Graded Sand with Silt and Gravel
LE-3	12.5	2					38	56	6						SP-SM	Poorly Graded Sand with Silt and Gravel
LE-3	15	3							5						SP-SM	Poorly Graded Sand with Silt and Gravel
LE-3	17.5						9	86	5						SP-SM	Poorly Graded Sand with Silt
LE-3	20	16	115												SW	Well Graded Sand
LE-4	10	2					41	53	6						SP-SM	Poorly Graded Sand with Silt and Gravel
LE-4	15						22	72	6						SP-SM	Poorly Graded Sand with Silt and Gravel
LE-4	17.5	4													SW	Well Graded Sand
LE-5	5	9	110						29						SM	Silty Sand
LE-5	7.5			NP	NP	NP									SM	Silty Sand
LE-5	10	11	116						32						SM	Silty Sand
LE-5	12.5	6	99												SM	Silty Sand
LE-6	2.5	7							29						SM	Silty Sand
LE-6	5			NP	NP	NP									SM	Silty Sand
LE-6	7.5	6	111										108		SM	Silty Sand
LE-6	10													0.0115	SM	Silty Sand
LE-7	5	3													SP	Poorly Graded Sand
LE-7	10								39						SC	Clayey Sand
LE-7	15	15	117	26	18	8			61						CL	Sandy Clay
LE-8	5	10		NP	NP	NP			50						ML	Sandy Silt
LE-8	10								29						SM	Silty Sand
LE-8	15A	2					34	61	5						SP-SM	Poorly Graded Sand with Silt and Gravel
LE-8	15B	2					18	76	5						SP-SM	Poorly Graded Sand with Silt and Gravel
LE-9	5	4							19						SP-SM	Poorly Graded Sand with Silt and Gravel
LE-9	10													0.0067	SP	Poorly Graded Sand
LE-9	12.5						36	55	9						SP-SM	Poorly Graded Sand with Silt and Gravel
LE-9	20A	22	105	56	38	18		-					9,050		-	Claystone
LE-9	20B	5	119			-				500	2.4	2,250	- /		-	Claystone
LE-10	5	9	108	NP	NP	NP			47			,			SM	Silty Sand
LE-10	15						31	61	8						SP-SM	Poorly Graded Sand with Silt and Gravel
LE-10	20	10					29	61	11						SP-SM	Poorly Graded Sand with Silt and Gravel
LE-11	5 A&B						10	82	8						SP-SM	Poorly Graded Sand with Silt
LE-11	20								7						SP-SM	Poorly Graded Sand with Silt
LE-12	10													0.0061	SP	Poorly Graded Sand
LE-12	15,20,25						39	51	10					1.5001	SP-SM	Poorly Graded Sand with Silt and Gravel

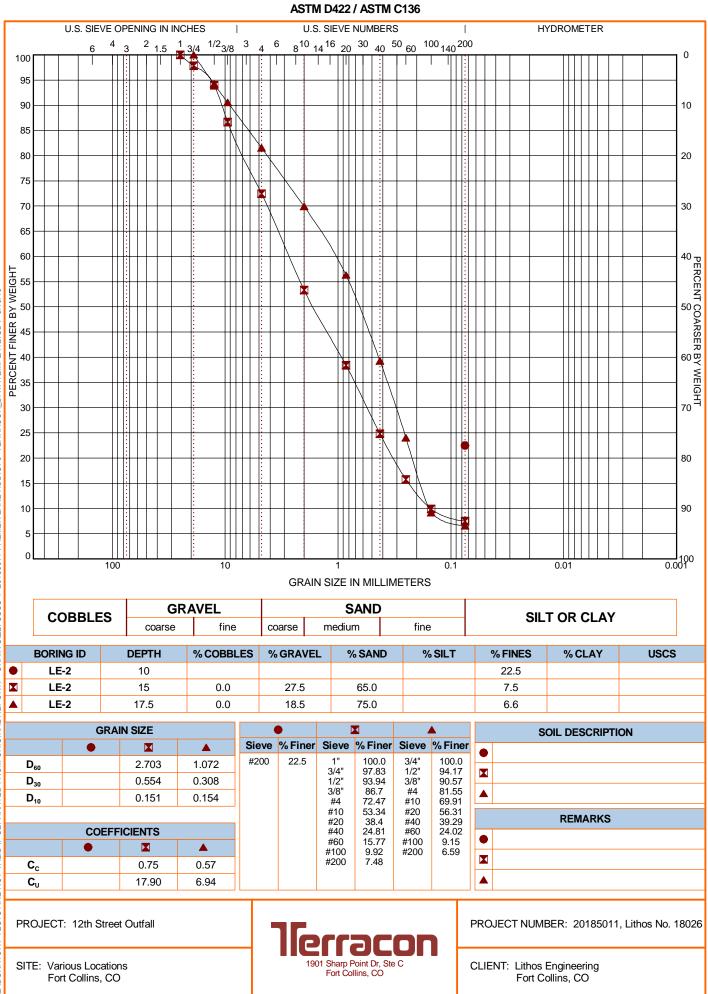
¹ Where Atterberg Limits, Sieve Analysis, and Fines Content testing was not performed, USCS classifications were visually determined in the field during the subsurface investigation

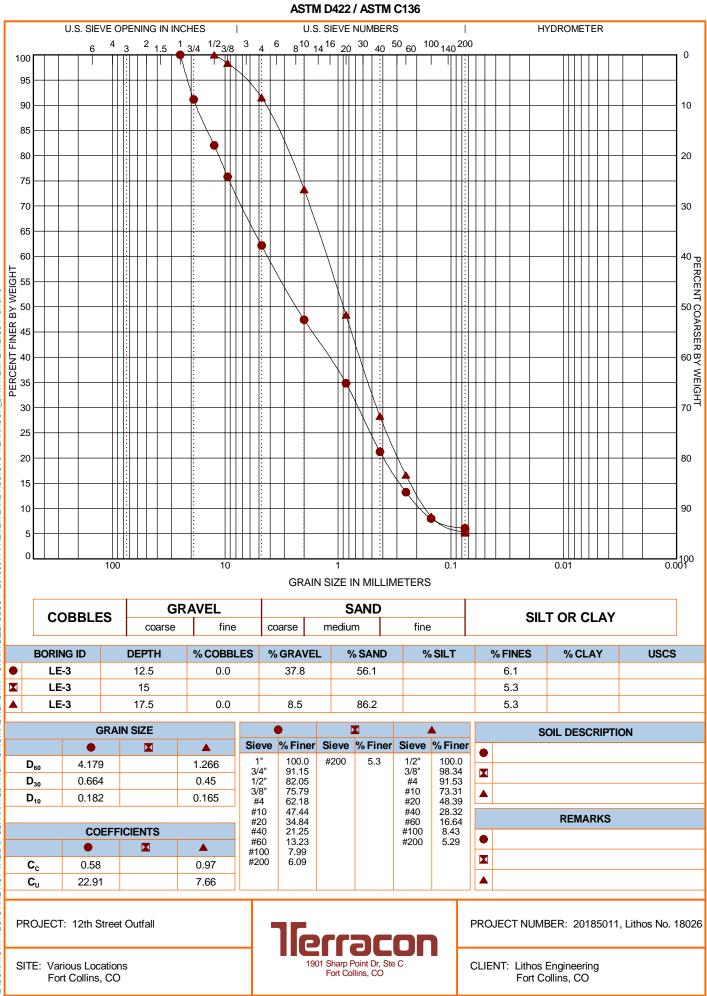
²Hyphens are used in place of USCS classifications for bedrock

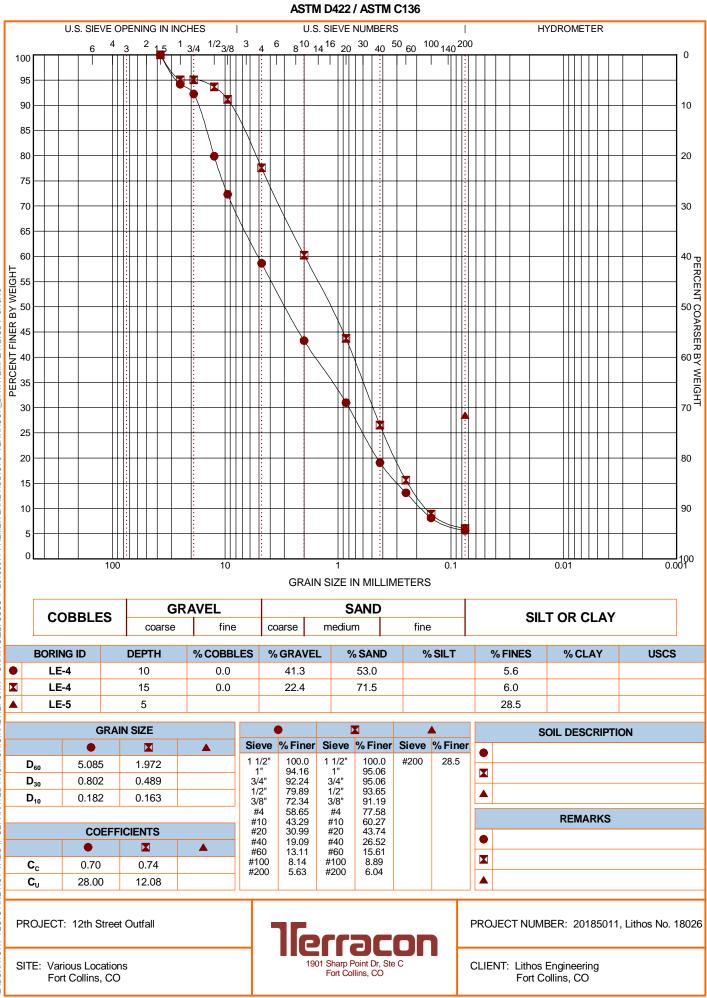


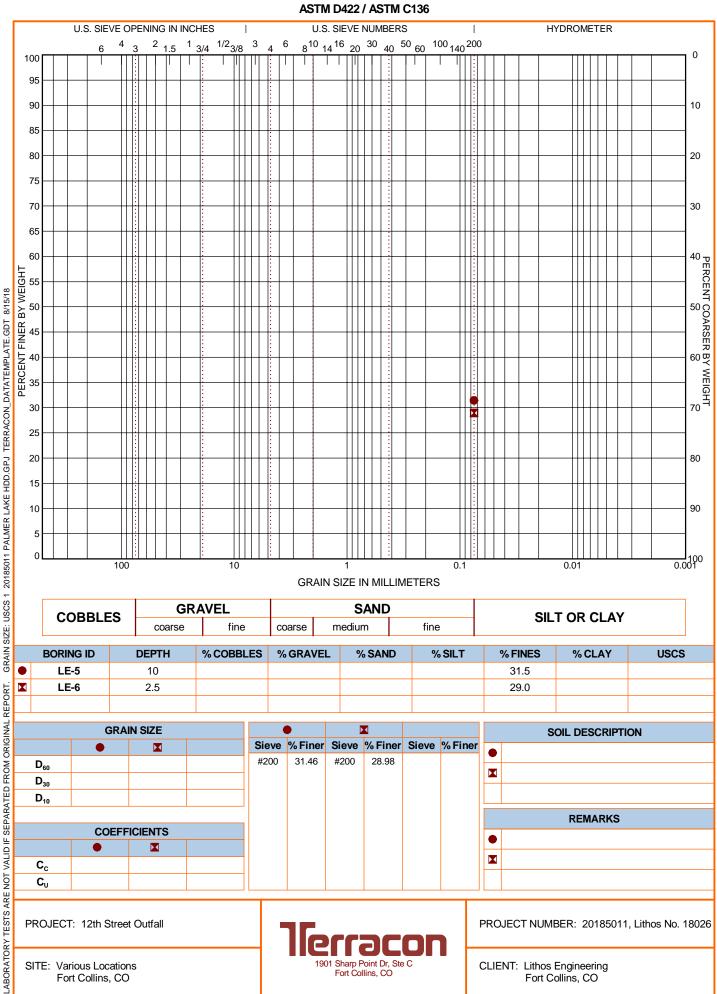


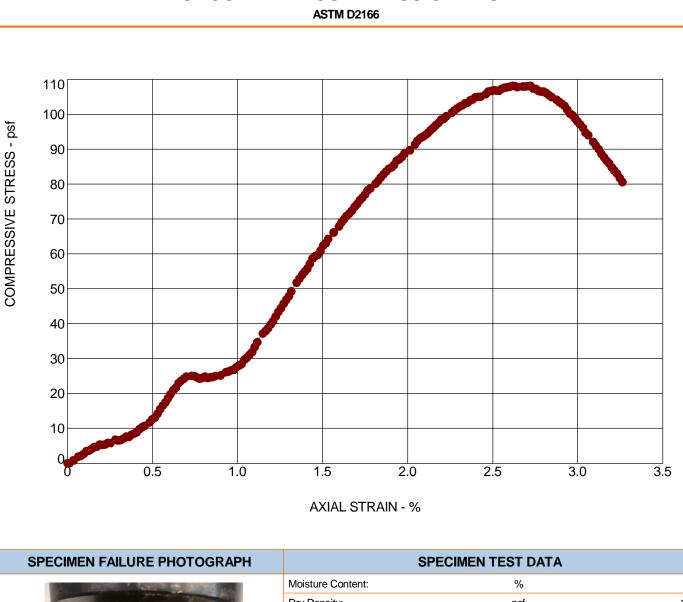












SPECIMEN FAILURE PHOTOGRAPH			SPEC	CIMEN TEST D	ATA
	Moisture Cor	ntent:		%	6
	Dry Density:			pcf	15
	Diameter:			in.	5.24
	Height:			in.	3.99
	Height / Dian	neter Ratio:			0.76
	Calculated S	aturation:		%	
	Calculated V	oid Ratio:			
	Assumed Sp	ecific Gravity:			
	Failure Strain	ו:		%	2.61
	Unconfined (Compressive S	Strength	(psf)	108
	Undrained S	near Strength:		(psf)	54
	Strain Rate:			in/min	
	Remarks:				
AMPLE TYPE: CA RING SAMPLER		SAMPLE LC	CATION:	LE-6 @ 7.5 fe	eet
DESCRIPTION:		LL	PL	PI	Percent < #200 Sieve
PROJECT: 12th Street Outfall	lerr	arn	n	PROJECT NUME	BER: 20185011, Lithos No. 18026
SITE: Various Locations Fort Collins, CO	1901 Sharp P Fort Col	oint Dr, Ste C		CLIENT: Lithos I Fort Co	Engineering ollins, CO

UNCONFINED COMPRESSION TEST

CHEMICAL LABORATORY TEST REPORT

 Project Number:
 20185011

 Service Date:
 08/09/18

 Report Date:
 08/14/18

 Task:



Lithos Engineering

Project

12th Street Outfall

Sample Submitted By: Terracon (20)

Date Received: 8/8/2018

Lab No.: 18-0987

Results of Corrosion Analysis

Sample Number		
Sample Location	LE-1	LE-6
Sample Depth (ft.)	15.0	10.0
Water Soluble Sulfate (SO4), ASTM C 1580 (mg/kg)	30	115

Analyzed By: Trisha Campo

Chemist

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

