



ENTECH
ENGINEERING, INC.

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December 5, 2022
Revised December 16, 2022

Tech Contractors
3575 Kenyon Street, Suite 200
San Diego, California 92110

Attn: Raul Guzman

Re: Pavement Recommendations - Revised
The Estates at Rolling Hills Ranch at Meridian Ranch - Filing No. 2
El Paso County, Colorado
Entech Job No. 222155

Dear Mr. Guzman:

As requested, Entech Engineering, Inc. has obtained samples of the subgrade soils from sections of the roadways in the Estates at Rolling Hills Ranch at Meridian Ranch subdivision, Filing No. 2, in El Paso County, Colorado. Subsurface Soil Investigation and laboratory testing to determine the pavement support characteristics of the soils were performed. This letter presents the results of the laboratory testing and provides pavement recommendations for the roadways.

Project Description

The roadways in Filing No. 2 consist of sections of Sunrise Ridge Drive, Highland Crest Drive, Estate Ridge Drive, and Cypress Meadow Drive, along with the cul-de-sacs named Crescent Creek Drive, Cypress Meadow Drive, Sage Mesa Way and Estate Ridge Drive. The site layout and the locations of the test borings drilled at appropriate spacings are shown on the Test Boring Location Map, Figure 1.

Subgrade Conditions

Sixteen exploratory test borings were drilled in the roadways to depths of approximately 5 to 10 feet bgs. The Boring Logs are presented in Appendix A. Sieve Analysis and Atterberg Limit testing were performed on the subgrade soil samples obtained from the test borings for the purpose of classification. Two soil types and two bedrock types were encountered in the test borings. The soils encountered at subgrade depth consisted of three general soil types; Type 1; silty to clayey sand, Type 2; very clayey sand, Type 3; silty to very silty to clayey sandstone bedrock. The Type 4 soils consisted of sandy to very sandy claystone bedrock and were encountered at depths which are beneath the subgrade influence zone. Soil Types 1 and 3 were grouped into one soil category, (denoted as Soil Type 1/3), due to their similar characteristics. This report evaluates and presents recommendations for Type 1/3 and Type 2 soils for all of the roadway sections.

Sieve analyses performed on Type 1/3 soils indicated the percent passing the No. 200 sieve ranged from approximately 14 to 37 percent. Sieve analysis on the Type 2 soils ranged from approximately 37 to 43 percent. Atterberg Limit Tests performed on the Type 1/3 soils resulted in Liquid Limits ranging from no-value to 34 percent and Plastic Indexes of non-plastic to 18 percent. Atterberg Limit Tests performed on the Type 2 soils exhibited liquid limits of 31 to 38 percent and plastic indexes of 9 to 18 percent. The Type 1/3 subgrade soils classified as A-2-6, A-2-4, A-1-b

EPC Project No. SF - 2018

and the Type 2 Soils classify as A-6 and A-4 soils, based on the AASHTO classification system. The Type 1 and 3 soils have good pavement support characteristics. The Type 2 soils generally have poor pavement support characteristics. The Type 4 soils were encountered below the subgrade influence zone. Sulfate testing indicated that the soils exhibit a negligible potential for sulfate attack. Groundwater was not encountered in the test borings.

Swell testing was performed on several samples of the site subgrade soils, based on their Plastic Indexes. Volume changes of 0.0 to 1.0 percent indicate low expansion and consolidation potentials. Higher swells were encountered in the Type 4 claystone; however, the claystone was encountered below the subgrade influence zone. Based on the low volume changes of the subgrade soils, mitigation due to expansive soils is not required on this site. Laboratory test results are presented in Appendix B and are summarized on Table 1.

California Bearing Ratio (CBR) testing was performed on two samples of Soil Type 1/3 and Soil Type 2 to determine the support characteristic of the subgrade soils for the roadway sections. The results of the CBR testing, are presented in Appendix B and summarized as follows:

<u>Soil Type 1/3 – Clayey Sand</u>		<u>Soil Type 2 – Very Clayey Sand</u>	
<u>CBR #1</u>		<u>CBR #2</u>	
R @ 90% = 40.0		R @ 90% = 7.5	
R @ 95% = 71.0		R @ 95% = 10	
Use R = 50.0 for design		Use R = 10.0 for design	
<u>Classification Testing</u>		<u>Classification Testing</u>	
Liquid Limit	24	Liquid Limit	31
Plasticity Index	9	Plasticity Index	17*
Percent Passing 200	25.0	Percent Passing 200	42.5*
AASHTO Classification	A-2-4	AASHTO Classification	A-6
Group Index	0	Group Index	3
Unified Soils Classification	SC	Unified Soils Classification	SC

*Values in excess of the limits set forth per the El Paso County Pavement Design Criteria. Mitigation will be required. Mitigation specifics will follow

Pavement Design

The CBR testing was used to determine pavement sections for this site. The pavement sections were determined utilizing the El Paso County "Pavement Design Criteria and Report". ESAL values were obtained from the Traffic Impact Study performed by LSC Transportation Consultants, LLC dated June 28, 2020, LSC Job No. 204400. The recommended street classifications are also shown in Figure No. 1. The cul-de-sac portions of Crescent Drive, Cypress Meadow Drive, Sage Mesa Way and Estate Ridge Drive classified as an urban local (low-volume) roadways, which used an 18k ESAL value of 36,500 for design. Sunrise Ridge Drive, Highland Crest Drive and the remaining portions of Cypress Meadow Drive and Estate Ridge Drive classify as urban local roads, which used an 18K ESAL value of 292,000 for design. Pavement alternatives for asphalt over aggregate basecourse and cement stabilized subgrade sections are provided. Design parameters used in the pavement analysis are as follows:

Reliability,	
Urban Local Low Volume	80%
Urban Local	80%
Serviceability Index	
Urban Local Low Volume	2.0
Urban Local	2.0
Resilient Modulus Soil Type 1	13,168 psi
Resilient Modulus Soil Type 2	3,562 psi*
"R" Value Subgrade Soil Type 1	50.0
"R" Value Subgrade Soil Type 2	10.0*
Structural Coefficients:	
Hot Bituminous Pavement	0.44
Aggregate Basecourse	0.11
Cement Stabilized Subgrade	0.11

*All areas with Soil Type 2 at subgrade depth will be replaced with Type 1 soils. Designs are based on Type 1 values only.

Pavement calculations are attached in Appendix C. Pavement sections recommended for this phase of the filing are summarized as follows:

Pavement Sections – Soil Type 1/3

Urban Local (low volume) – ESAL = 36,500

Crescent Creek Drive, Cypress Meadow Drive and Sage Mesa Way, Estate Ridge Drive, cul-de-sac portions

<u>Alternative</u>	<u>Asphalt (in)</u>	<u>Basecourse (in)</u>	<u>Cement Stabilized Subgrade (in.)</u>
1. Asphalt Over Basecourse	3.0*	4.0*	--
2. Asphalt Over Cement Subgrade	4.0	--	8.0

Urban Local – ESAL = 292,000

Sunrise Ridge Drive, Highland Crest Drive, Cypress Meadow Drive, Estate Ridge Drive

<u>Alternative</u>	<u>Asphalt (in)</u>	<u>Basecourse (in)</u>	<u>Cement Stabilized Subgrade (in.)</u>
1. Asphalt Over Basecourse	3.0*	8.0*	--
2. Asphalt Over Cement Subgrade	4.0	--	8.0

* Minimum sections per the El Paso County Pavement Design Criteria – Full depth sections are not allowed.

Mitigation

El Paso County criteria requires mitigation of expansive soils for roadway subgrade that have a swell of 2 percent or greater with a 150 pound per square foot surcharge. Based on the swell testing, mitigation for expansive soils will not be required on this site.

The Type 2 soils do not meet the CTS Criteria for the Plasticity Index or for the sieve analysis. In the areas with Type 2 soils, it is recommended that 18 inches of the Type 2 soils be removed and replaced with Type 1 soils. The approximate extents of the Type 2 soils are shown in Figure No. 1. The approximate locations for mitigation will be field determined.

Roadway Construction - Full Depth Asphalt and Asphalt on Aggregate Basecourse Alternatives

Prior to placement of the asphalt, the subgrade should be proofrolled and compacted to a minimum of 95 percent of its maximum Modified Proctor Dry Density, ASTM D-1557 at ± 2 percent of optimum moisture content or to 95% of its Maximum Standard Proctor Dry Density, ASTM D-698 at 0 to 4 percent over optimum moisture content. Any loose or soft areas should be removed and replaced with suitable materials. Basecourse materials should be compacted to a minimum of 95 percent of its maximum Modified Proctor Dry Density, ASTM D-1557 at ± 2 percent of optimum moisture content. Special attention should be given to areas adjacent to manholes, inlet structures, and valves.

Roadway Construction – Cement Stabilized Subgrade Alternative

Prior to placement of the asphalt, the subgrade shall be stabilized by addition of cement to a depth of at least 8 inches, as determined by Roadway Classification. The depth of the required cement stabilized subgrade is shown in the previous table. The amount of cement applied shall be 2.0 percent (by weight) of the subgrade's maximum dry density as determined by the Modified Proctor Test (ASTM D-1557) and Maximum Standard Proctor Test (ASTM D-698) based on laboratory cement stabilization testing. The cement should be spread evenly on the subgrade surface and be thoroughly mixed into the subgrade over the appropriate 8-inch depth such that a uniform blend of soil and cement is achieved. Prior to application or mixing of the cement, the upper 8-inches of subgrade should be thoroughly moisture conditioned to the soil's optimum water content or as much as 2 percent more than the optimum water content as necessary to provide a compactable soil condition. Densification of the cement-stabilized subgrade should be completed to obtain a compaction of at least 95 percent of the subgrade maximum dry density as determined by the Modified Proctor Test (ASTM D-1557). Satisfactory compaction of the subgrade shall occur within 90 minutes from the time of mixing the cement into the subgrade.

The following conditions shall be observed as part of the subgrade stabilization:

- Type I/II cement as supplied. A local supplier shall be used. All cement used for stabilization should come from the same source. If cement sources are changed a new laboratory mix design should be completed.
- Moisture conditioning of the subgrade and/or mixing of the cement into the subgrade shall not occur when soil temperatures are below 40°F. Cement treated subgrades should be

maintained at a temperature of 40°F or greater until the subgrade has been compacted as required.

- Cement placement, cement mixing and compaction of the cement treated subgrade should be observed by a Soils Engineer. The Soils Engineer should complete in-situ compaction tests and construct representative compacted specimens of the treated subgrade material for subsequent laboratory quality assurance testing.
- Pending the results of the field density testing, microfracturing of the stabilized subgrade will likely be required. Soil strengths in excess of 200 psi require microfracturing.

If significant grading is performed, the soils at subgrade may change. Modification to the pavement sections should be evaluated after site grading is completed.

Based on the soils encountered, subgrade soil problem areas, if any, will be identified at proof roll. We do not anticipate issues with the subgrade in regards to shallow water, frost susceptible soils, groundwater or drainage conditions, soluble sulfates, or cold weather construction.

In addition to the above guidance, the asphalt, cement, subgrade conditions, compaction of materials and roadway construction methods shall meet the El Paso County specifications.

We trust that this has provided you with the information you required. If you have any questions or need additional information, please do not hesitate to contact us.

Respectfully Submitted,

ENTECH ENGINEERING, INC.

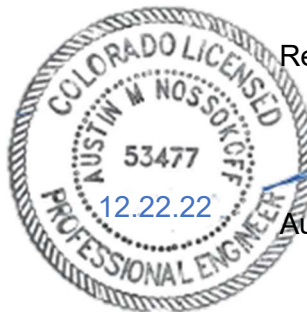


Daniel P. Stegman

DPS/lu

Encl.

Entech Job No. 222155
AAprojects/2022/222155 pr - rev



Reviewed by:



Austin M. Nossokoff, P.E.

TABLE

TABLE 1
SUMMARY OF LABORATORY TEST RESULTS

CLIENT TECH CONTRACTORS
PROJECT ESTATES, ROLLING HILLS, F-2
JOB NO. 222155

SOIL TYPE	TEST BORING NO.	DEPTH (FT)	WATER (%)	DRY DENSITY (PCF)	PASSING NO. 200 SIEVE (%)	LIQUID LIMIT (%)	PLASTIC INDEX (%)	SULFATE (WT %)	AASHTO CLASS.	SWELL/ CONSOL (%)	UNIFIED CLASSIFICATION	SOIL DESCRIPTION
1, CBR #1	9	0-3			25.0	24	9		A-2-4		SC	SAND, CLAYEY
1	2	1-2			19.1	NV	NP		A-2-4		SM	SAND, SILTY
1	4	1-2			24.9	29	9		A-2-4		SC	SAND, CLAYEY
1	5	1-2			14.6	NV	NP		A-1-b		SM	SAND, SILTY
1	6	1-2			17.7	NV	NP	<0.01	A-1-b		SM	SAND, SILTY
1	10	1-2			13.6	NV	NP		A-1-b		SM	SAND, SILTY
1	11	1-2			19.5	NV	NP	<0.01	A-1-b		SM	SAND, SILTY
1	12	1-2			15.2	NV	NP		A-1-b		SM	SAND, SILTY
1	14	1-2			18.3	NV	NP	<0.01	A-1-b		SM	SAND, SILTY
1	15	1-2	10.4	121.3	30.2	29	6		A-2-4	1.0	SM	SAND, SILTY
1	16	1-2			23.8	32	13		A-2-6		SC	SAND, CLAYEY
1	12	0-3			17.9						SM	SAND, SILTY
1	6	0-3			23.1						SM	SAND, SILTY
1	3	0-3			24.0						SM	SAND, SILTY
2, CBR #2	13	0-3	13.3	109.0	42.5	31	17		A-6	0.1	SC	SAND, VERY CLAYEY
2	1	1-2	7.5	116.5	37.2	38	18	0.00	A-6	0.0	SC	SAND, VERY CLAYEY
2	13	1-2	9.6	118.9	37.3	31	9		A-4	0.9	SC	SAND, VERY CLAYEY
3	3	1-2			20.7	NV	NP	<0.01	A-2-4		SM	SANDSTONE, SILTY
3	7	1-2			15.8	NV	NP		A-1-b		SM	SANDSTONE, SILTY
3	8	1-2			23.1	NV	NP	0.02	A-2-4		SM	SANDSTONE, SILTY
3	9	1-2			14.6	NV	NP		A-1-b		SM	SANDSTONE, SILTY
3	5	5			14.7	32	14		A-2-6		SC	SANDSTONE, CLAYEY
3	6	10			21.4	32	9		A-2-4		SM	SANDSTONE, SILTY
3	10	5			36.5	NV	NP	<0.01	A-4		SM	SANDSTONE, VERY SILTY
3	12	10			14.3	NV	NP		A-1-b		SM	SANDSTONE, SILTY
3	14	5			16.8	NV	NP	<0.01	A-1-b		SM	SANDSTONE, SILTY
3	16	5			21.4	34	18		A-2-6		SC	SANDSTONE, CLAYEY
4	13	5	12.4	107.4	74.9	38	14	0.00	A-6	3.9	CL	CLAYSTONE, SANDY
4	15	10	13.6	121.4	55.5	31	14		A-6	3.7	CL	CLAYSTONE, VERY SANDY

FIGURE

APPENDIX A: Test Boring Logs

TEST BORING NO. 1
 DATE DRILLED 11/2/2022
 Job # 222155

TEST BORING NO. 2
 DATE DRILLED 11/2/2022
 CLIENT TECH CONTRACTORS
 LOCATION ESTATES, ROLLING HILLS, F-2

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
DRY TO 5', 11/2/22						
SAND, VERY CLAYEY, FINE TO MEDIUM GRAINED, TAN, LOOSE, MOIST				8	11.7	2
	5			6	8.8	2
	10					
	15					
	20					

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
DRY TO 5', 11/2/22						
SAND, SILTY, FINE TO COARSE GRAINED, TAN, MEDIUM DENSE TO LOOSE, MOIST				14	5.5	1
	5			7	14.4	1
	10					
	15					
	20					



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TEST BORING LOG

DRAWN: DATE: CHECKED: *SW* DATE: *11-23-22*

JOB NO.: 222155
 FIG NO.: A- 1

TEST BORING NO. 3
 DATE DRILLED 11/2/2022
 Job # 222155

TEST BORING NO. 4
 DATE DRILLED 11/2/2022
 CLIENT TECH CONTRACTORS
 LOCATION ESTATES, ROLLING HILLS, F-2

REMARKS

DRY TO 10', 11/2/22

SAND, SILTY, TAN
 SANDSTONE, SILTY, FINE TO
 COARSE GRAINED, TAN, VERY
 DENSE, MOIST

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
1					1
3			50 11"	6.3	3
5			50 7"	3.7	3
10			50 6"	6.9	3
15					
20					

REMARKS

DRY TO 5', 11/2/22

SAND, CLAYEY, FINE TO MEDIUM
 GRAINED, TAN, MEDIUM DENSE,
 MOIST

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
1					
3			19	7.2	1
5			12	16.5	1
10					
15					
20					



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TEST BORING LOG

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DATE:

CHECKED: SW

DATE:

11-23-22

JOB NO.:
 222155

FIG NO.:
 A- 2

TEST BORING NO. 5
 DATE DRILLED 11/2/2022
 Job # 222155

TEST BORING NO. 6
 DATE DRILLED 11/2/2022
 CLIENT TECH CONTRACTORS
 LOCATION ESTATES, ROLLING HILLS, F-2

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
DRY TO 5', 11/2/22						
SAND, SILTY, FINE TO COARSE GRAINED, TAN, MEDIUM DENSE MOIST,				14	9.3	1
SANDSTONE, CLAYEY, FINE TO COARSE GRAINED, TAN, VERY DENSE, MOIST	5			50 9"	6.4	3
	10					
	15					
	20					

REMARKS	Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
DRY TO 5', 11/2/22						
SAND, SILTY, FINE TO COARSE GRAINED, TAN, DENSE, MOIST				37	8.8	1
SANDSTONE, SILTY, FINE TO COARSE GRAINED, TAN, VERY DENSE, MOIST	5			50 9"	7.9	3
	10			50 6"	9.1	3
	15					
	20					



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TEST BORING LOG

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DATE:

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11-23-22

JOB NO.:
 222155

FIG NO.:
 A- 3

TEST BORING NO. 7
DATE DRILLED 11/2/2022
Job # 222155

TEST BORING NO. 8
DATE DRILLED 11/2/2022
CLIENT TECH CONTRACTORS
LOCATION ESTATES, ROLLING HILLS, F-2

REMARKS

DRY TO 5', 11/2/22

SAND, SILTY, TAN
SANDSTONE, SILTY, FINE TO
COARSE GRAINED, TAN, VERY
DENSE, MOIST

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
1	11		50	8.0	1
3			8"		3
5			50	5.8	3
			6"		
10					
15					
20					

REMARKS

DRY TO 5', 11/2/22

SAND, SILTY, TAN
SANDSTONE, SILTY, FINE TO
COARSE GRAINED, TAN, VERY
DENSE, MOIST

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
1	11		50	10.3	1
3			7"		3
5			50	9.4	3
			6"		
10					
15					
20					



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TEST BORING LOG

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DATE:

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11-23-22

JOB NO.:
222155

FIG NO.:
A- 4

TEST BORING NO. 9
 DATE DRILLED 11/2/2022
 Job # 222155

TEST BORING NO. 10
 DATE DRILLED 11/2/2022
 CLIENT TECH CONTRACTORS
 LOCATION ESTATES, ROLLING HILLS, F-2

REMARKS

DRY TO 10', 11/2/22

SAND, SILTY, TAN
 SANDSTONE, SILTY, FINE TO
 COARSE GRAINED, TAN, VERY
 DENSE, MOIST

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
1					1
1.1			50	8.6	3
11"					
5			50	9.0	3
8"					
10			50	6.8	3
4"					
15					
20					

REMARKS

DRY TO 5', 11/2/22

SAND, SILTY, FINE TO COARSE
 GRAINED, TAN, MEDIUM DENSE,
 MOIST
 SANDSTONE, VERY SILTY, FINE
 TO COARSE GRAINED, TAN,
 VERY DENSE, MOIST

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
1					1
23			23	10.3	1
5			50	9.8	3
8"					
10					
15					
20					



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TEST BORING LOG

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DATE:

11-23-22

JOB NO.:
 222155

FIG NO.:
 A- 5

TEST BORING NO. 11
 DATE DRILLED 11/2/2022
 Job # 222155

TEST BORING NO. 12
 DATE DRILLED 11/2/2022
 CLIENT TECH CONTRACTORS
 LOCATION ESTATES, ROLLING HILLS, F-2

REMARKS

DRY TO 5', 11/2/22

SAND, SILTY, FINE TO COARSE
 GRAINED, TAN, MEDIUM DENSE
 TO LOOSE, MOIST

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
5			20	8.3	1
10			10	7.6	1
15					
20					

REMARKS

DRY TO 10', 11/2/22

SAND, SILTY, FINE TO COARSE
 GRAINED, TAN, LOOSE, MOIST

SANDSTONE, SILTY, FINE TO
 COARSE GRAINED, TAN, VERY
 DENSE, MOIST

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
5			8	6.1	1
10			6	6.2	1
15					
20					



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TEST BORING LOG

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DATE:

11-23-22

JOB NO.:
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FIG NO.:
 A- 6





TEST BORING NO. 13
 DATE DRILLED 11/2/2022
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TEST BORING NO. 14
 DATE DRILLED 11/2/2022
 CLIENT TECH CONTRACTORS
 LOCATION ESTATES, ROLLING HILLS, F-2

REMARKS

DRY TO 5', 11/2/22





SAND, VERY CLAYEY, FINE
 GRAINED, TAN, MEDIUM DENSE,
 MOIST
 CLAYSTONE, SANDY, GRAY
 BROWN, HARD, MOIST

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
5			23	12.6	2
5			50 6"	13.7	4
10					
15					
20					

REMARKS

DRY TO 5', 11/2/22

SAND, SILTY, FINE TO COARSE
 GRAINED, TAN, MEDIUM DENSE,
 MOIST

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
5			21	9.1	1
5			21	5.5	1
10					
15					
20					



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TEST BORING LOG

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DATE:

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JOB NO.:
 222155

FIG NO.:
 A- 7

TEST BORING NO. 15
 DATE DRILLED 11/2/2022
 Job # 222155

TEST BORING NO. 16
 DATE DRILLED 11/2/2022
 CLIENT TECH CONTRACTORS
 LOCATION ESTATES, ROLLING HILLS, F-2

REMARKS

DRY TO 5', 11/2/22

SAND, SILTY, FINE TO COARSE
 GRAINED, TAN, MEDIUM DENSE,
 MOIST

CLAYSTONE, VERY SANDY,
 BROWN, HARD, MOIST

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			25	18.2	1
5			50 10"	14.4	4
10			50 6"	12.9	4
15					
20					

REMARKS

DRY TO 5', 11/2/22

SAND, CLAYEY, FINE TO MEDIUM
 GRAINED, TAN, MEDIUM DENSE,
 MOIST

SANDSTONE, CLAYEY, FINE TO
 MEDIUM GRAINED, TAN, VERY
 DENSE, MOIST

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			21	8.3	1
5			50 6"	9.0	3
10					
15					
20					



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11-23-22

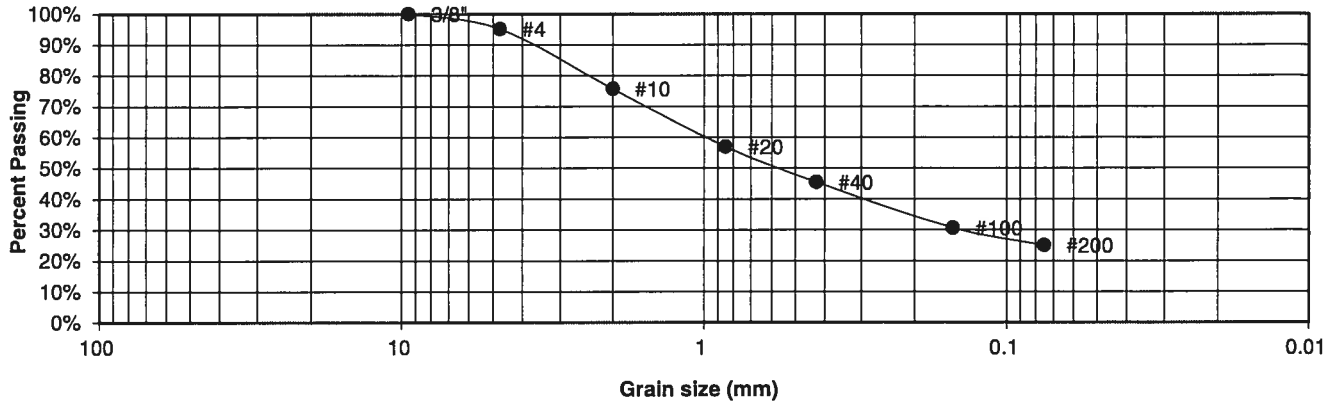
JOB NO.:
 222155

FIG NO.:
 A- 8

APPENDIX B: Laboratory Test Results

<u>UNIFIED CLASSIFICATION</u>	SC	<u>CLIENT</u>	TECH CONTRACTORS
<u>SOIL TYPE #</u>	1, CBR #1	<u>PROJECT</u>	ESTATES, ROLLING HILLS, F-2
<u>TEST BORING #</u>	9	<u>JOB NO.</u>	222155
<u>DEPTH (FT)</u>	0-3	<u>TEST BY</u>	BL
<u>AASHTO CLASSIFICATION</u>	A-2-4	<u>GROUP INDEX</u>	0

**Sieve Analysis
Grain Size Distribution**



<u>U.S. Sieve #</u>	<u>Percent Finer</u>
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	95.2%
10	75.7%
20	57.0%
40	45.5%
100	30.6%
200	25.0%

<u>Atterberg Limits</u>	
Plastic Limit	15
Liquid Limit	24
Plastic Index	9

<u>Swell</u>	
Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	



**ENTECH
ENGINEERING, INC.**

505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

**LABORATORY TEST
RESULTS**

DRAWN:	DATE:	CHECKED: <i>SW</i>	DATE: <i>11-23-22</i>
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JOB NO.:

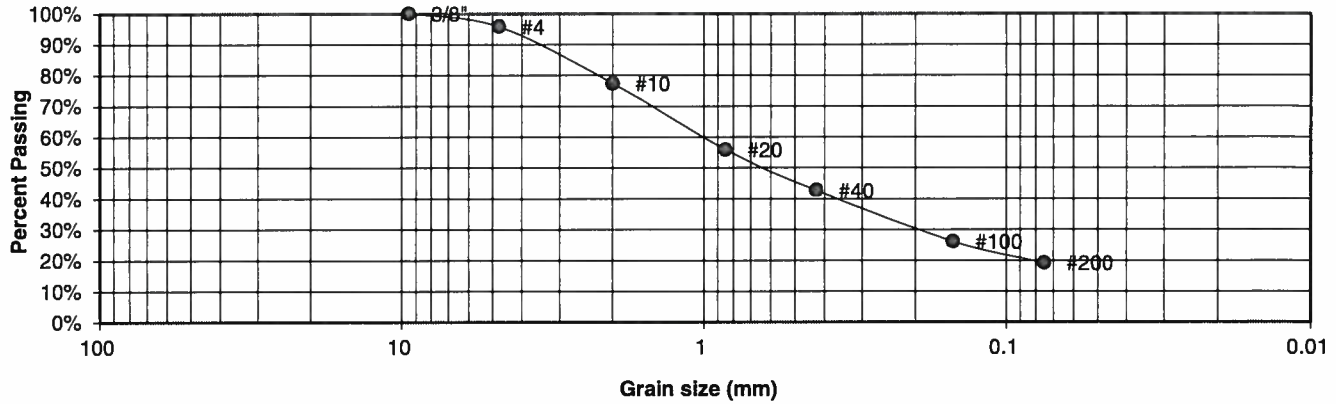
222155
FIG NO.:

B-1

UNIFIED CLASSIFICATION SM
SOIL TYPE # 1
TEST BORING # 2
DEPTH (FT) 1-2
AASHTO CLASSIFICATION A-2-4

CLIENT TECH CONTRACTORS
PROJECT ESTATES, ROLLING HILLS, F-2
JOB NO. 222155
TEST BY BL
GROUP INDEX 0

Sieve Analysis Grain Size Distribution



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	95.8%
10	77.4%
20	55.9%
40	42.7%
100	26.1%
200	19.1%

**Atterberg
Limits**
 Plastic Limit NP
 Liquid Limit NV
 Plastic Index NP

Swell
 Moisture at start
 Moisture at finish
 Moisture increase
 Initial dry density (pcf)
 Swell (psf)



**ENTECH
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505 ELKTON DRIVE
 COLORADO SPRINGS, COLORADO 80907

LABORATORY TEST RESULTS

DRAWN:

DATE:

CHECKED: SW

DATE:

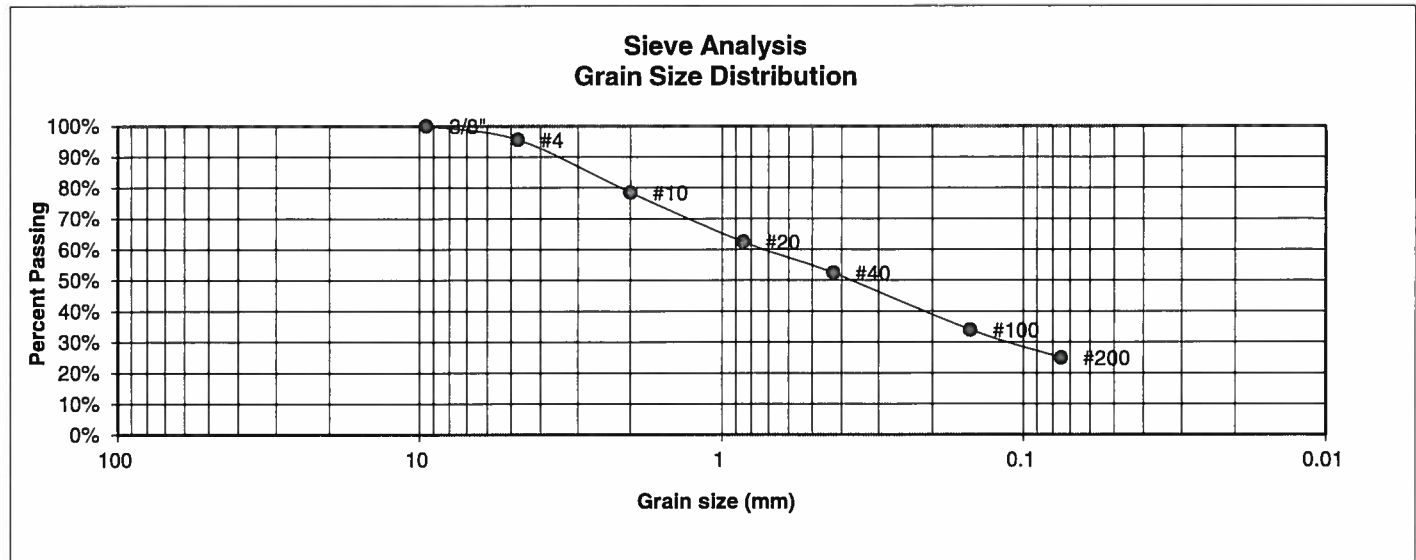
11-23-22

JOB NO.:

222155
 FIG NO.:

B-2

<u>UNIFIED CLASSIFICATION</u>	SC	<u>CLIENT</u>	TECH CONTRACTORS
<u>SOIL TYPE #</u>	1	<u>PROJECT</u>	ESTATES, ROLLING HILLS, F-2
<u>TEST BORING #</u>	4	<u>JOB NO.</u>	222155
<u>DEPTH (FT)</u>	1-2	<u>TEST BY</u>	BL
<u>AASHTO CLASSIFICATION</u>	A-2-4	<u>GROUP INDEX</u>	0



<u>U.S. Sieve #</u>	<u>Percent Finer</u>
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	95.6%
10	78.5%
20	62.4%
40	52.4%
100	33.9%
200	24.9%

<u>Atterberg Limits</u>	
Plastic Limit	20
Liquid Limit	29
Plastic Index	9

<u>Swell</u>	
Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	



**ENTECH
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505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

LABORATORY TEST RESULTS

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DATE:

CHECKED: *SW*

DATE: *11-23-22*

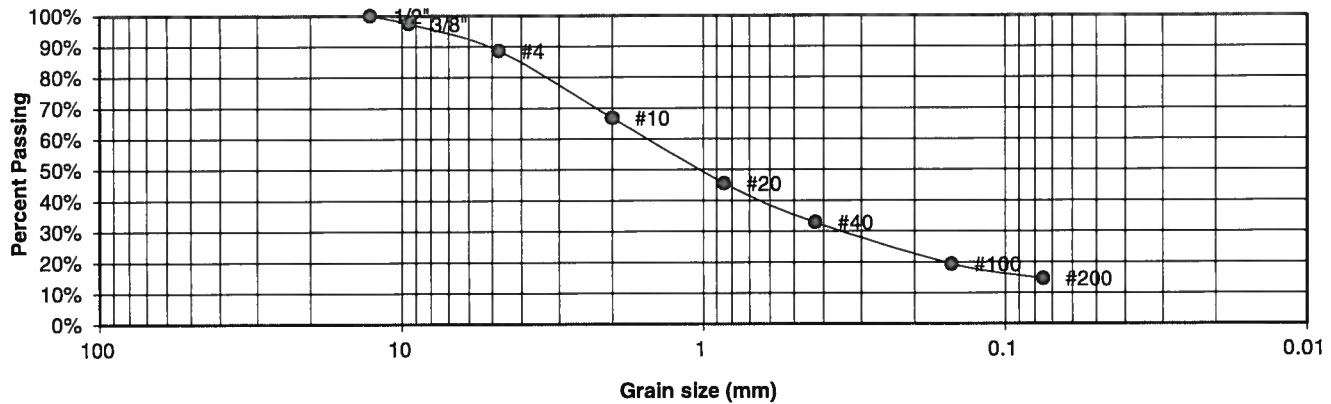
JOB NO.:

222155
FIG NO.:

B-3

<u>UNIFIED CLASSIFICATION</u>	SM	<u>CLIENT</u>	TECH CONTRACTORS
<u>SOIL TYPE #</u>	1	<u>PROJECT</u>	ESTATES, ROLLING HILLS, F-2
<u>TEST BORING #</u>	5	<u>JOB NO.</u>	222155
<u>DEPTH (FT)</u>	1-2	<u>TEST BY</u>	BL
<u>AASHTO CLASSIFICATION</u>	A-1-b	<u>GROUP INDEX</u>	0

**Sieve Analysis
Grain Size Distribution**



<u>U.S. Sieve #</u>	<u>Percent Finer</u>
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	97.4%
4	88.6%
10	66.8%
20	45.5%
40	32.9%
100	19.3%
200	14.6%

<u>Atterberg Limits</u>	
Plastic Limit	NP
Liquid Limit	NV
Plastic Index	NP

<u>Swell</u>	
Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	



**ENTECH
ENGINEERING, INC.**

505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

**LABORATORY TEST
RESULTS**

DRAWN:	DATE:	CHECKED: <i>SW</i>	DATE: <i>11-23-22</i>
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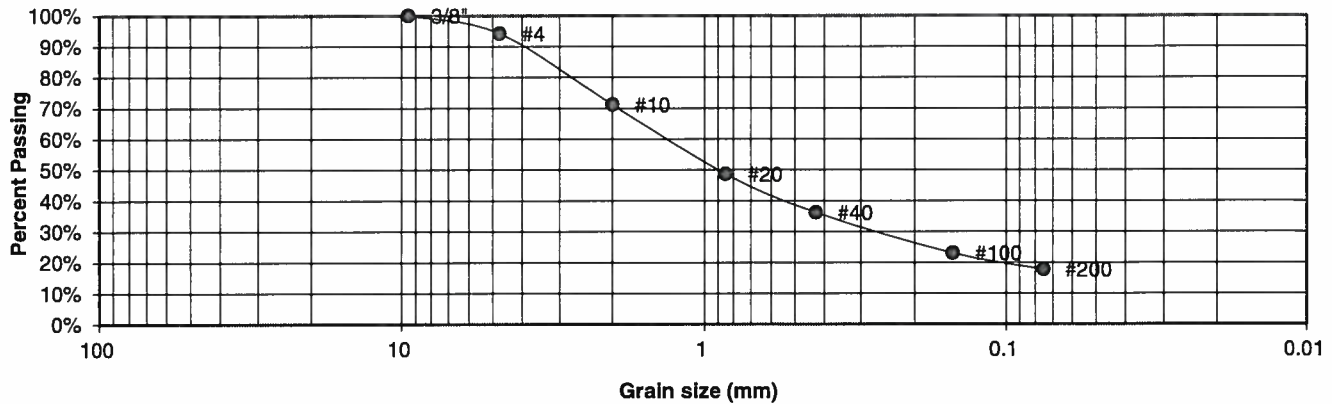
JOB NO.:

222155
FIG NO.:

B-4

<u>UNIFIED CLASSIFICATION</u>	SM	<u>CLIENT</u>	TECH CONTRACTORS
<u>SOIL TYPE #</u>	1	<u>PROJECT</u>	ESTATES, ROLLING HILLS, F-2
<u>TEST BORING #</u>	6	<u>JOB NO.</u>	222155
<u>DEPTH (FT)</u>	1-2	<u>TEST BY</u>	BL
<u>AASHTO CLASSIFICATION</u>	A-1-b	<u>GROUP INDEX</u>	0

**Sieve Analysis
Grain Size Distribution**



<u>U.S. Sieve #</u>	<u>Percent Finer</u>
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	94.2%
10	71.1%
20	48.6%
40	36.2%
100	23.0%
200	17.7%

<u>Atterberg Limits</u>	
Plastic Limit	NP
Liquid Limit	NV
Plastic Index	NP

<u>Swell</u>	
Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	



**ENTECH
ENGINEERING, INC.**

505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

**LABORATORY TEST
RESULTS**

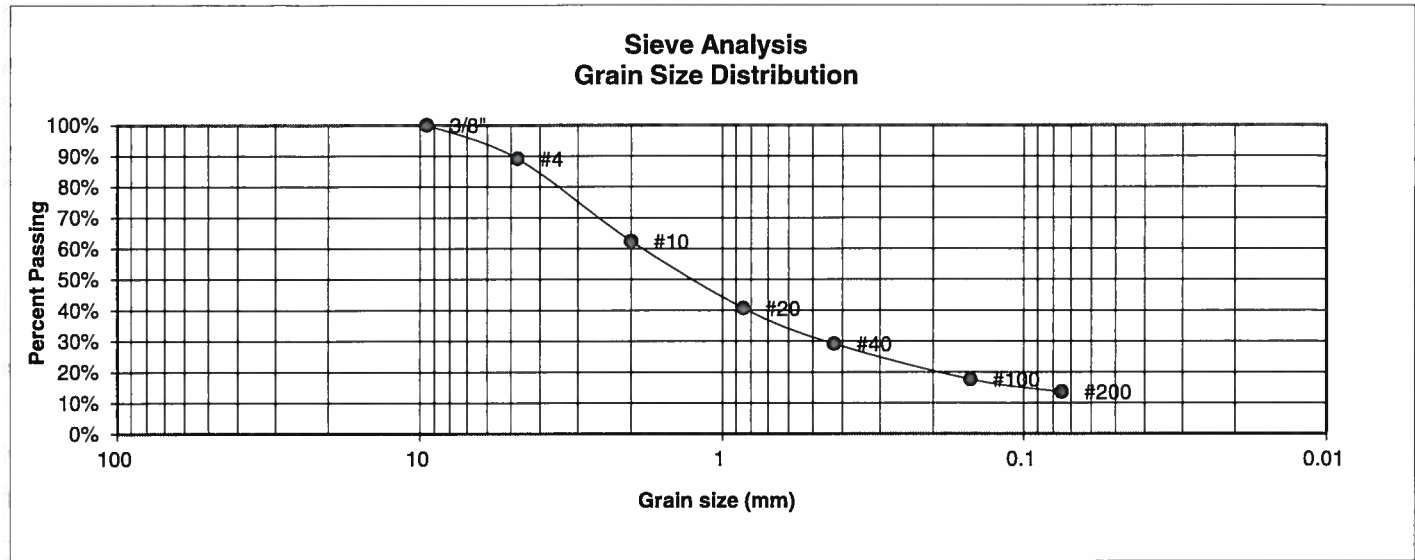
<u>DRAWN:</u>	<u>DATE:</u>	<u>CHECKED:</u> SW	<u>DATE:</u> 11-23-22
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JOB NO.:

222155
FIG NO.:

B-5

<u>UNIFIED CLASSIFICATION</u>	SM	<u>CLIENT</u>	TECH CONTRACTORS
<u>SOIL TYPE #</u>	1	<u>PROJECT</u>	ESTATES, ROLLING HILLS, F-2
<u>TEST BORING #</u>	10	<u>JOB NO.</u>	222155
<u>DEPTH (FT)</u>	1-2	<u>TEST BY</u>	BL
<u>AASHTO CLASSIFICATION</u>	A-1-b	<u>GROUP INDEX</u>	0



<u>U.S. Sieve #</u>	<u>Percent Finer</u>
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	89.1%
10	62.4%
20	40.7%
40	29.1%
100	17.6%
200	13.6%

<u>Atterberg Limits</u>	
Plastic Limit	NP
Liquid Limit	NV
Plastic Index	NP

Swell
 Moisture at start
 Moisture at finish
 Moisture increase
 Initial dry density (pcf)
 Swell (psf)



**ENTECH
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505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

**LABORATORY TEST
RESULTS**

DRAWN:

DATE:

CHECKED: *SW*

DATE: *11-23-22*

JOB NO.:

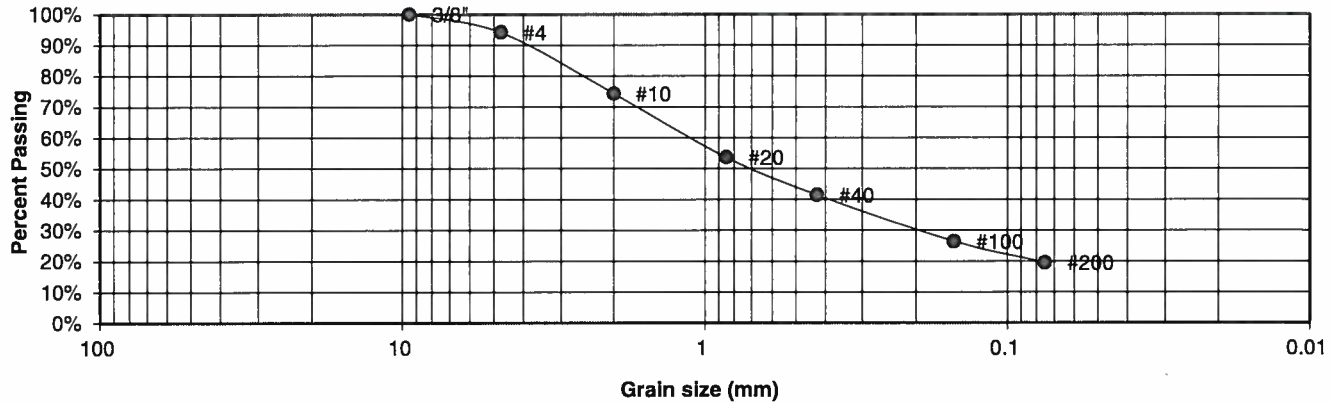
222155
FIG NO.:

B-6

UNIFIED CLASSIFICATION SM
SOIL TYPE # 1
TEST BORING # 11
DEPTH (FT) 1-2
AASHTO CLASSIFICATION A-1-b

CLIENT TECH CONTRACTORS
PROJECT ESTATES, ROLLING HILLS, F-2
JOB NO. 222155
TEST BY BL
GROUP INDEX 0

**Sieve Analysis
Grain Size Distribution**



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	94.2%
10	74.3%
20	53.6%
40	41.4%
100	26.4%
200	19.5%

Atterberg
Limits
 Plastic Limit NP
 Liquid Limit NV
 Plastic Index NP

Swell
 Moisture at start
 Moisture at finish
 Moisture increase
 Initial dry density (pcf)
 Swell (psf)



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**LABORATORY TEST
RESULTS**

DRAWN:

DATE:

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DATE: *11-23-22*

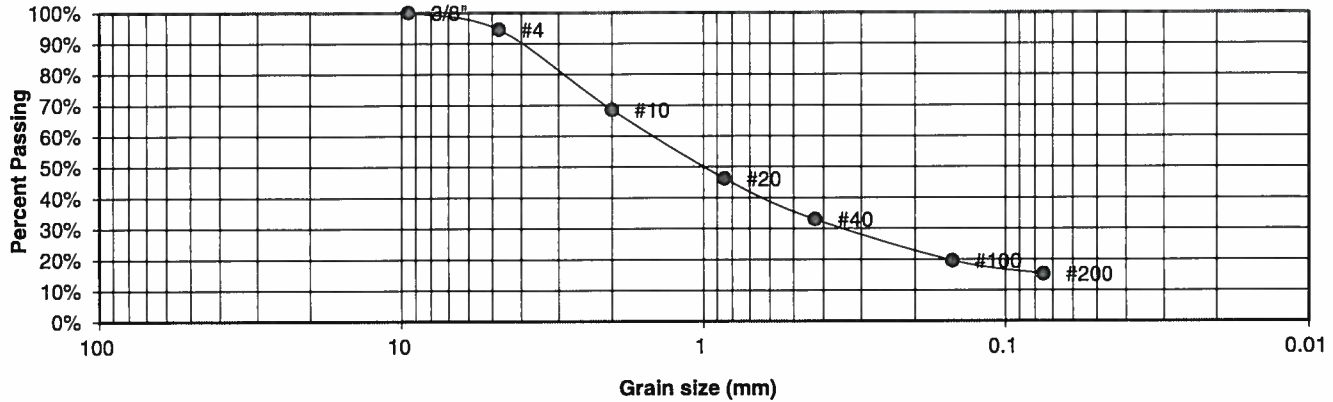
JOB NO.:

222155
 FIG NO.:

B-7

<u>UNIFIED CLASSIFICATION</u>	SM	<u>CLIENT</u>	TECH CONTRACTORS
<u>SOIL TYPE #</u>	1	<u>PROJECT</u>	ESTATES, ROLLING HILLS, F-2
<u>TEST BORING #</u>	12	<u>JOB NO.</u>	222155
<u>DEPTH (FT)</u>	1-2	<u>TEST BY</u>	BL
<u>AASHTO CLASSIFICATION</u>	A-1-b	<u>GROUP INDEX</u>	0

**Sieve Analysis
Grain Size Distribution**



<u>U.S. Sieve #</u>	<u>Percent Finer</u>
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	94.5%
10	68.5%
20	46.2%
40	32.9%
100	19.5%
200	15.2%

<u>Atterberg Limits</u>	
Plastic Limit	NP
Liquid Limit	NV
Plastic Index	NP

<u>Swell</u>	
Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	



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**LABORATORY TEST
RESULTS**

<u>DRAWN:</u>	<u>DATE:</u>	<u>CHECKED:</u> SW	<u>DATE:</u> 11-23-22
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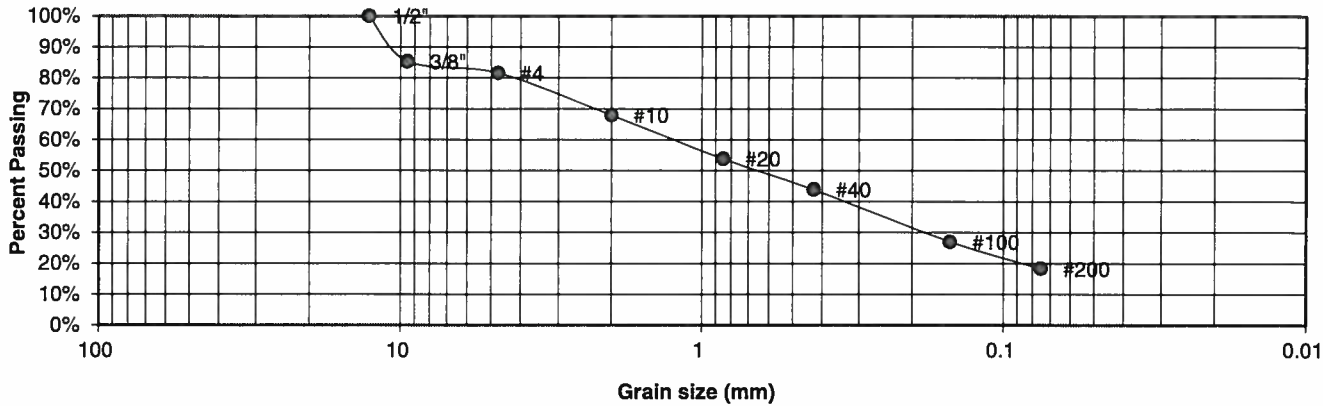
JOB NO.:

222155
FIG NO.:

B-8

<u>UNIFIED CLASSIFICATION</u>	SM	<u>CLIENT</u>	TECH CONTRACTORS
<u>SOIL TYPE #</u>	1	<u>PROJECT</u>	ESTATES, ROLLING HILLS, F-2
<u>TEST BORING #</u>	14	<u>JOB NO.</u>	222155
<u>DEPTH (FT)</u>	1-2	<u>TEST BY</u>	BL
<u>AASHTO CLASSIFICATION</u>	A-1-b	<u>GROUP INDEX</u>	0

Sieve Analysis
Grain Size Distribution



<u>U.S. Sieve #</u>	<u>Percent Finer</u>
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	85.3%
4	81.6%
10	67.9%
20	53.8%
40	43.9%
100	27.0%
200	18.3%

<u>Atterberg Limits</u>	
Plastic Limit	NP
Liquid Limit	NV
Plastic Index	NP

<u>Swell</u>
Moisture at start
Moisture at finish
Moisture increase
Initial dry density (pcf)
Swell (psf)



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505 ELKTON DRIVE
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LABORATORY TEST
RESULTS

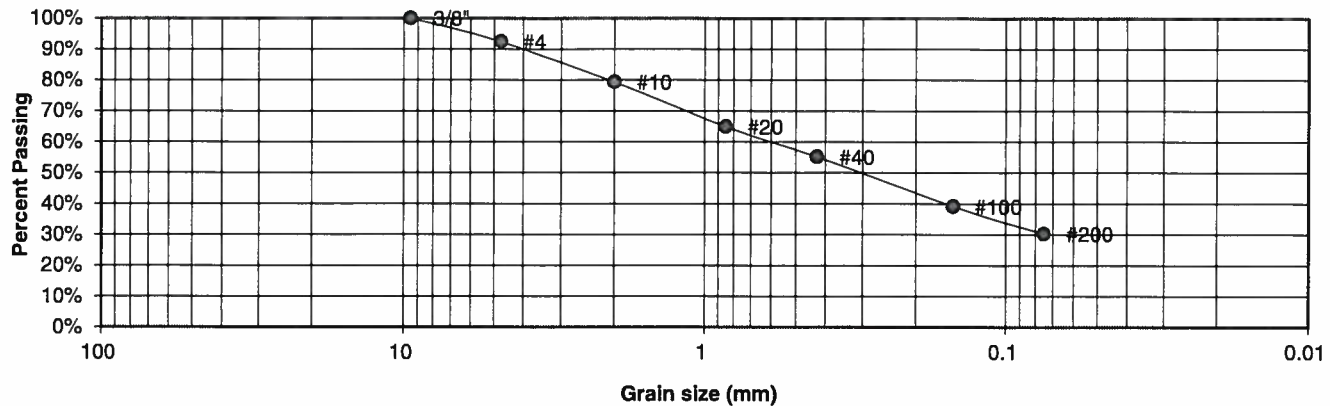
DRAWN:	DATE:	CHECKED: <i>SW</i>	DATE: <i>11-23-22</i>
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JOB NO.:
222155
FIG NO.:
B-9

UNIFIED CLASSIFICATION SM
SOIL TYPE # 1
TEST BORING # 15
DEPTH (FT) 1-2
AASHTO CLASSIFICATION A-2-4

CLIENT TECH CONTRACTORS
PROJECT ESTATES, ROLLING HILLS, F-2
JOB NO. 222155
TEST BY BL
GROUP INDEX 0

Sieve Analysis Grain Size Distribution



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	92.4%
10	79.3%
20	64.9%
40	55.1%
100	39.1%
200	30.2%

**Atterberg
Limits**
 Plastic Limit 23
 Liquid Limit 29
 Plastic Index 6

Swell
 Moisture at start
 Moisture at finish
 Moisture increase
 Initial dry density (pcf)
 Swell (psf)



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LABORATORY TEST RESULTS

DRAWN:

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DATE:

11-23-22

JOB NO.:

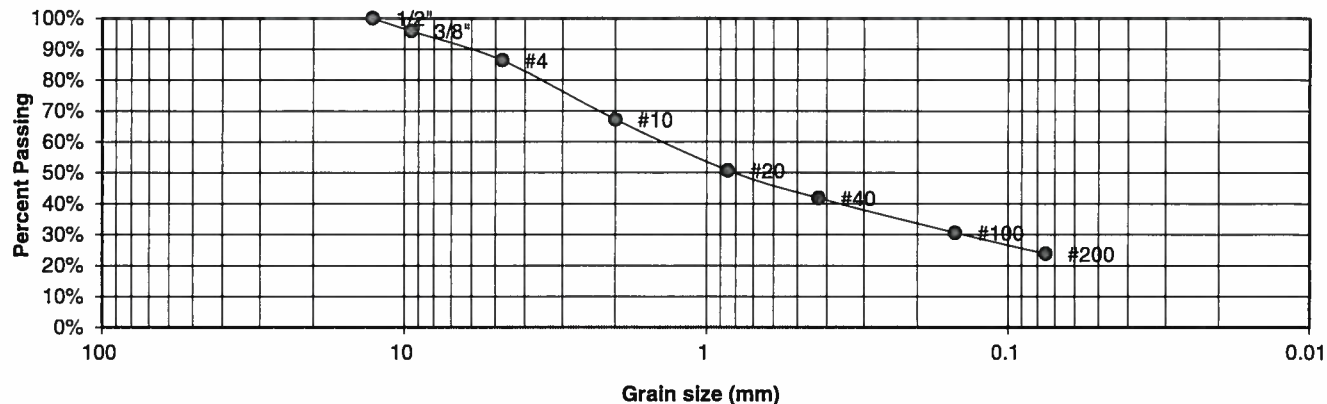
222155

FIG NO.:

B-10

<u>UNIFIED CLASSIFICATION</u>	SC	<u>CLIENT</u>	TECH CONTRACTORS
<u>SOIL TYPE #</u>	1	<u>PROJECT</u>	ESTATES, ROLLING HILLS, F-2
<u>TEST BORING #</u>	16	<u>JOB NO.</u>	222155
<u>DEPTH (FT)</u>	1-2	<u>TEST BY</u>	BL
<u>AASHTO CLASSIFICATION</u>	A-2-6	<u>GROUP INDEX</u>	0

**Sieve Analysis
Grain Size Distribution**



<u>U.S. Sieve #</u>	<u>Percent Finer</u>
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	95.8%
4	86.4%
10	67.2%
20	50.8%
40	41.8%
100	30.6%
200	23.8%

<u>Atterberg Limits</u>	
Plastic Limit	19
Liquid Limit	32
Plastic Index	13

<u>Swell</u>	
Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	



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**LABORATORY TEST
RESULTS**

<u>DRAWN:</u>	<u>DATE:</u>	<u>CHECKED:</u> <i>SW</i>	<u>DATE:</u> <i>11-23-22</i>
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JOB NO.:

222155

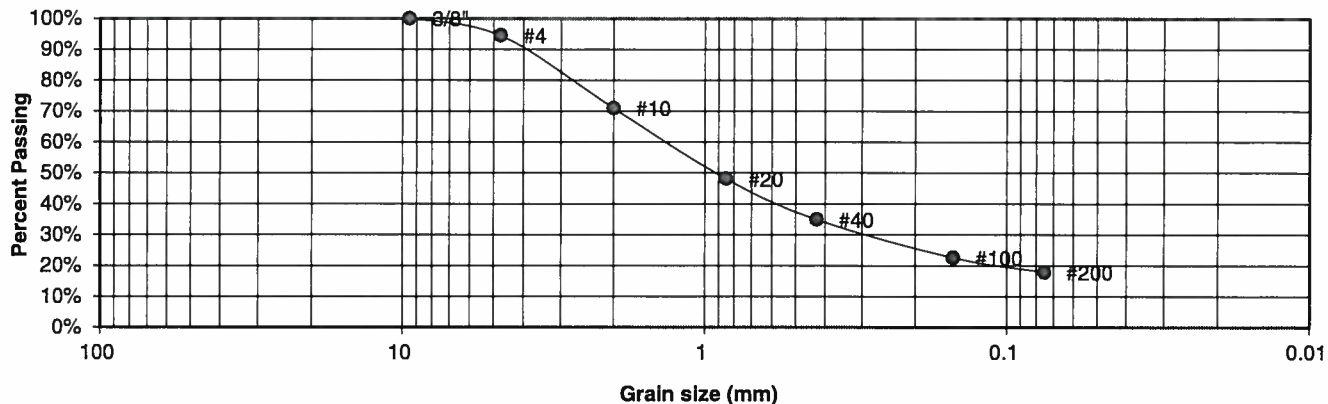
FIG NO.:

B-11

UNIFIED CLASSIFICATION SM
SOIL TYPE # 1
TEST BORING # 12
DEPTH (FT) 0-3
AASHTO CLASSIFICATION

CLIENT TECH CONTRACTORS
PROJECT ESTATES, ROLLING HILLS, F-2
JOB NO. 222155
TEST BY BL
GROUP INDEX

Sieve Analysis Grain Size Distribution



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	94.5%
10	70.9%
20	48.1%
40	34.9%
100	22.5%
200	17.9%

**Atterberg
Limits**
 Plastic Limit
 Liquid Limit
 Plastic Index

Swell
 Moisture at start
 Moisture at finish
 Moisture increase
 Initial dry density (pcf)
 Swell (psf)



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CHECKED: SW

DATE:

11-23-22

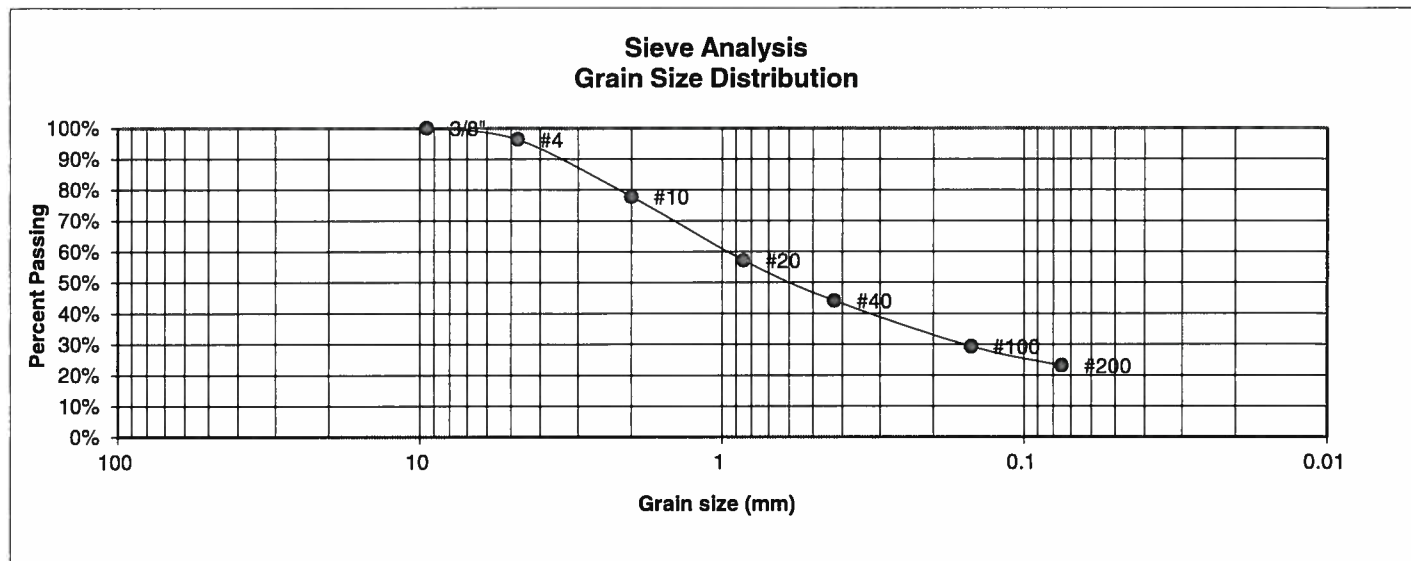
JOB NO.:

222155

FIG NO.:

B-12

UNIFIED CLASSIFICATION	SM	CLIENT	TECH CONTRACTORS
SOIL TYPE #	1	PROJECT	ESTATES, ROLLING HILLS, F-2
TEST BORING #	6	JOB NO.	222155
DEPTH (FT)	0-3	TEST BY	BL
AASHTO CLASSIFICATION		GROUP INDEX	



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	96.3%
10	77.8%
20	57.2%
40	44.1%
100	29.2%
200	23.1%

Atterberg
Limits
Plastic Limit
Liquid Limit
Plastic Index

Swell
Moisture at start
Moisture at finish
Moisture increase
Initial dry density (pcf)
Swell (psf)



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COLORADO SPRINGS, COLORADO 80907

LABORATORY TEST RESULTS

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CHECKED: *SW*

DATE: *11-23-22*

JOB NO.:

222155

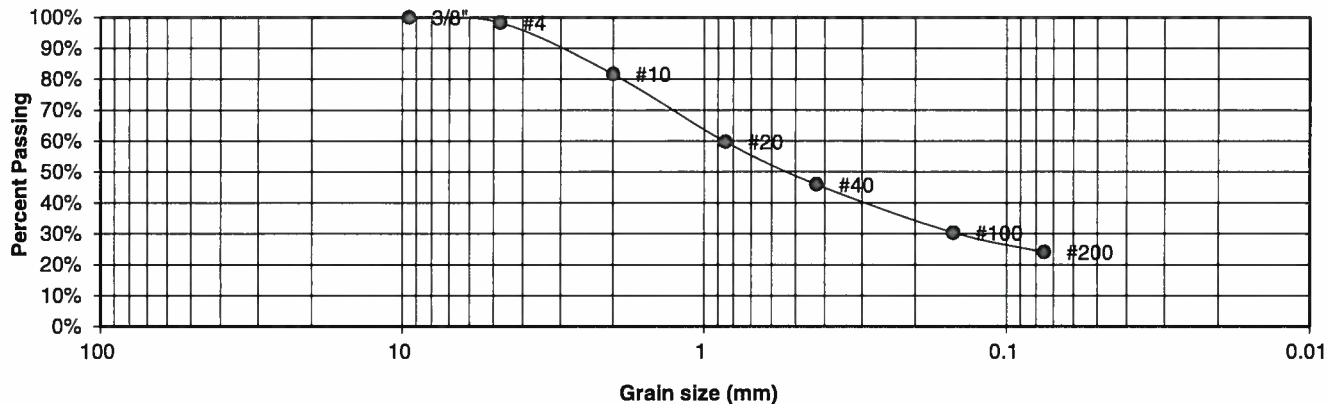
FIG NO.:

B-13

UNIFIED CLASSIFICATION SM
SOIL TYPE # 1
TEST BORING # 3
DEPTH (FT) 0-3
AASHTO CLASSIFICATION

CLIENT TECH CONTRACTORS
PROJECT ESTATES, ROLLING HILLS, F-2
JOB NO. 222155
TEST BY BL
GROUP INDEX

Sieve Analysis Grain Size Distribution



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	98.3%
10	81.6%
20	59.7%
40	45.9%
100	30.3%
200	24.0%

Atterberg
Limits
 Plastic Limit
 Liquid Limit
 Plastic Index

Swell
 Moisture at start
 Moisture at finish
 Moisture increase
 Initial dry density (pcf)
 Swell (psf)



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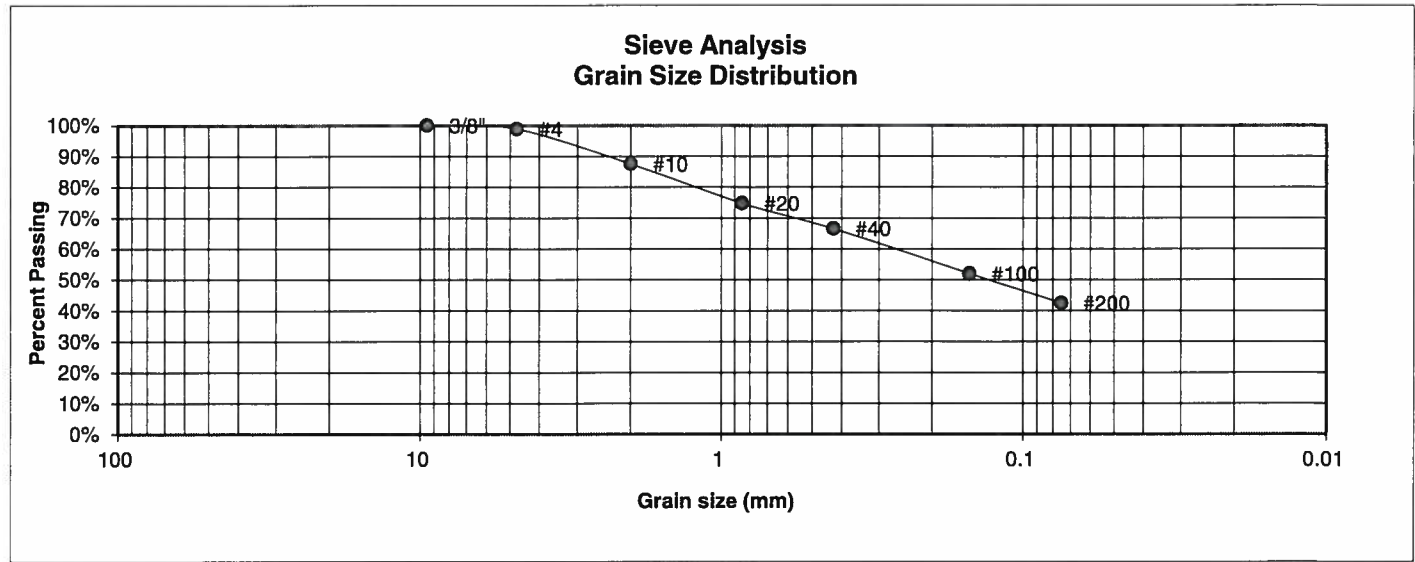
JOB NO.:

222155

FIG NO.:

B-14

<u>UNIFIED CLASSIFICATION</u>	SC	<u>CLIENT</u>	TECH CONTRACTORS
<u>SOIL TYPE #</u>	2, CBR #2	<u>PROJECT</u>	ESTATES, ROLLING HILLS, F-2
<u>TEST BORING #</u>	13	<u>JOB NO.</u>	222155
<u>DEPTH (FT)</u>	0-3	<u>TEST BY</u>	BL
<u>AASHTO CLASSIFICATION</u>	A-6	<u>GROUP INDEX</u>	3



<u>U.S. Sieve #</u>	<u>Percent Finer</u>
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	98.9%
10	87.5%
20	74.8%
40	66.6%
100	52.0%
200	42.5%

<u>Atterberg Limits</u>	
Plastic Limit	14
Liquid Limit	31
Plastic Index	17

<u>Swell</u>	
Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	



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**LABORATORY TEST
RESULTS**

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DATE:

CHECKED: *SW*

DATE: *11-23-22*

JOB NO.:

222155

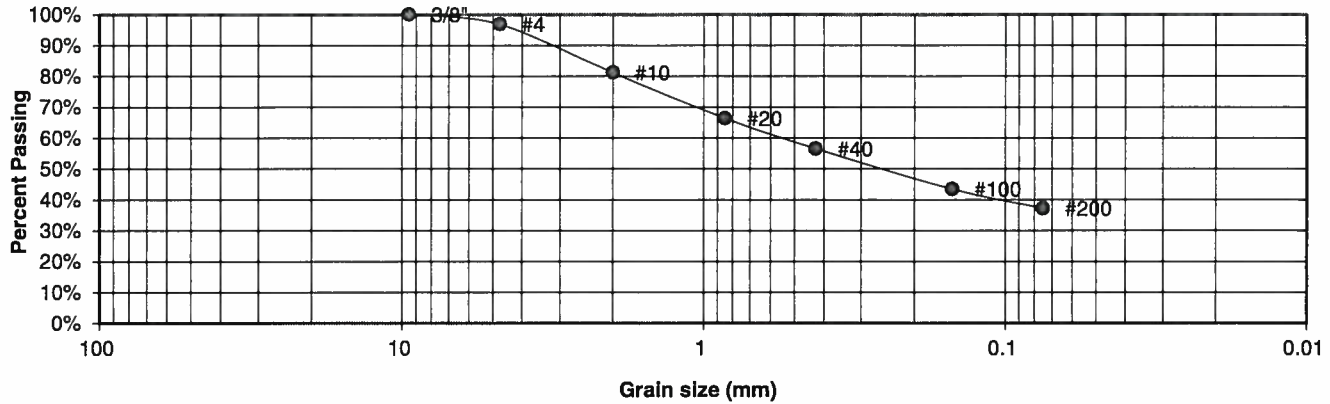
FIG NO.:

B-15

UNIFIED CLASSIFICATION	SC
SOIL TYPE #	2
TEST BORING #	1
DEPTH (FT)	1-2
AASHTO CLASSIFICATION	A-6

CLIENT	TECH CONTRACTORS
PROJECT	ESTATES, ROLLING HILLS, F-2
JOB NO.	222155
TEST BY	BL
GROUP INDEX	2

Sieve Analysis Grain Size Distribution



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	96.9%
10	81.2%
20	66.4%
40	56.6%
100	43.4%
200	37.2%

<u>Atterberg Limits</u>	
Plastic Limit	19
Liquid Limit	38
Plastic Index	18

<u>Swell</u>	
Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	



**ENTECH
ENGINEERING, INC.**

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LABORATORY TEST RESULTS

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JOB NO.:

222155

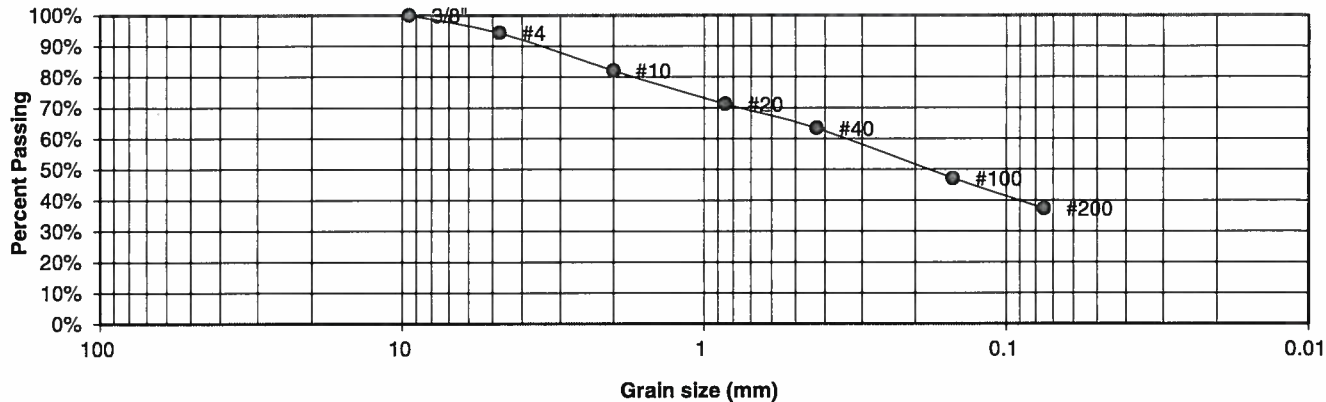
FIG NO.:

B-16

UNIFIED CLASSIFICATION SC
SOIL TYPE # 2
TEST BORING # 13
DEPTH (FT) 1-2
AASHTO CLASSIFICATION A-4

CLIENT TECH CONTRACTORS
PROJECT ESTATES, ROLLING HILLS, F-2
JOB NO. 222155
TEST BY BL
GROUP INDEX 0

**Sieve Analysis
Grain Size Distribution**



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	94.3%
10	82.1%
20	71.2%
40	63.3%
100	47.1%
200	37.3%

**Atterberg
Limits**
 Plastic Limit 22
 Liquid Limit 31
 Plastic Index 9

Swell
 Moisture at start
 Moisture at finish
 Moisture increase
 Initial dry density (pcf)
 Swell (psf)



**ENTECH
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505 ELKTON DRIVE
 COLORADO SPRINGS, COLORADO 80907

**LABORATORY TEST
RESULTS**

DRAWN:

DATE:

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DATE: *11-23-22*

JOB NO.:

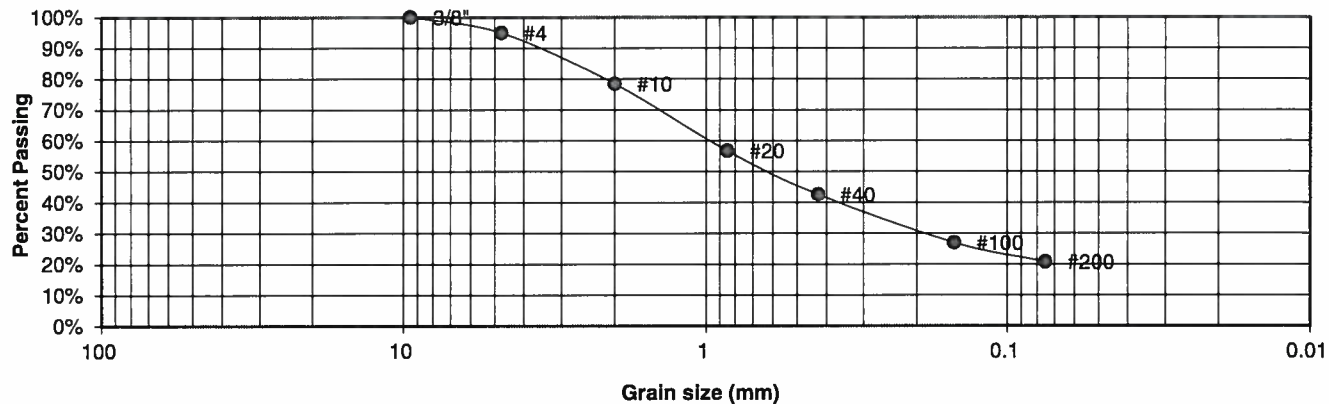
222155

FIG NO.:

B-17

<u>UNIFIED CLASSIFICATION</u>	SM	<u>CLIENT</u>	TECH CONTRACTORS
<u>SOIL TYPE #</u>	3	<u>PROJECT</u>	ESTATES, ROLLING HILLS, F-2
<u>TEST BORING #</u>	3	<u>JOB NO.</u>	222155
<u>DEPTH (FT)</u>	1-2	<u>TEST BY</u>	BL
<u>AASHTO CLASSIFICATION</u>	A-2-4	<u>GROUP INDEX</u>	0

**Sieve Analysis
Grain Size Distribution**



<u>U.S. Sieve #</u>	<u>Percent Finer</u>
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	94.9%
10	78.4%
20	56.7%
40	42.5%
100	26.9%
200	20.7%

<u>Atterberg Limits</u>	
Plastic Limit	NP
Liquid Limit	NV
Plastic Index	NP

<u>Swell</u>
Moisture at start
Moisture at finish
Moisture increase
Initial dry density (pcf)
Swell (psf)



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505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

**LABORATORY TEST
RESULTS**

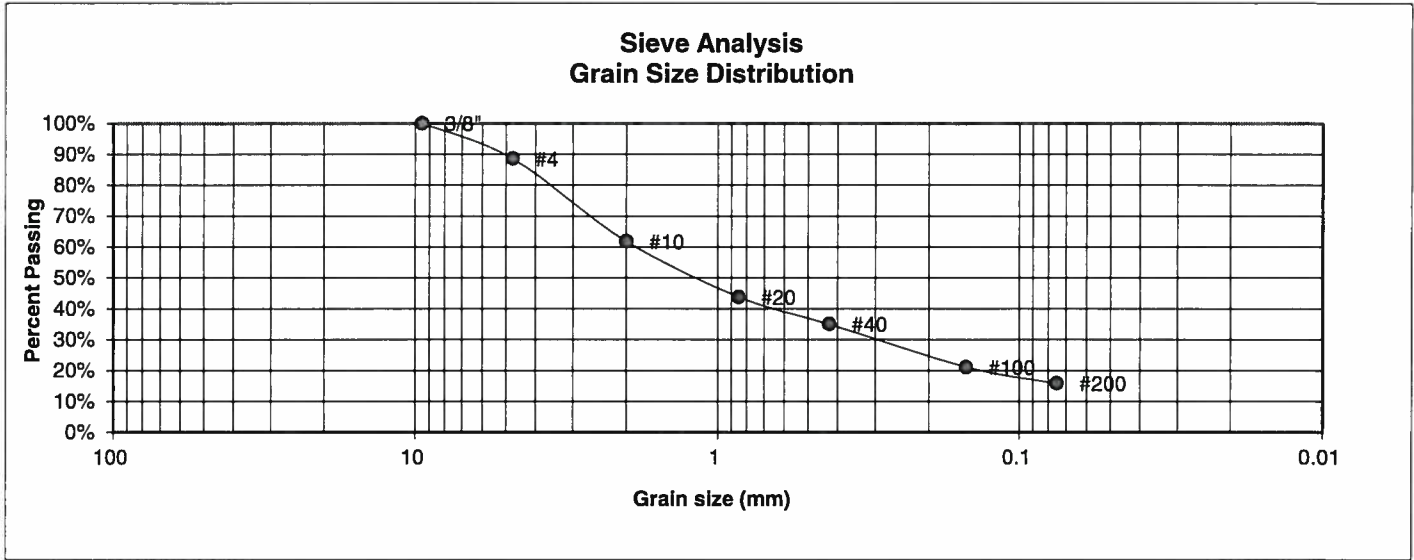
DRAWN:	DATE:	CHECKED: <i>SW</i>	DATE: <i>11-23-22</i>
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JOB NO.:

222155
FIG NO.:

B-18

<u>UNIFIED CLASSIFICATION</u>	SM	<u>CLIENT</u>	TECH CONTRACTORS
<u>SOIL TYPE #</u>	3	<u>PROJECT</u>	ESTATES, ROLLING HILLS, F-2
<u>TEST BORING #</u>	7	<u>JOB NO.</u>	222155
<u>DEPTH (FT)</u>	1-2	<u>TEST BY</u>	BL
<u>AASHTO CLASSIFICATION</u>	A-1-b	<u>GROUP INDEX</u>	0



<u>U.S. Sieve #</u>	<u>Percent Finer</u>
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	88.5%
10	61.8%
20	43.8%
40	35.0%
100	21.1%
200	15.8%

<u>Atterberg Limits</u>	
Plastic Limit	NP
Liquid Limit	NV
Plastic Index	NP
<u>Swell</u>	
Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	



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**LABORATORY TEST
RESULTS**

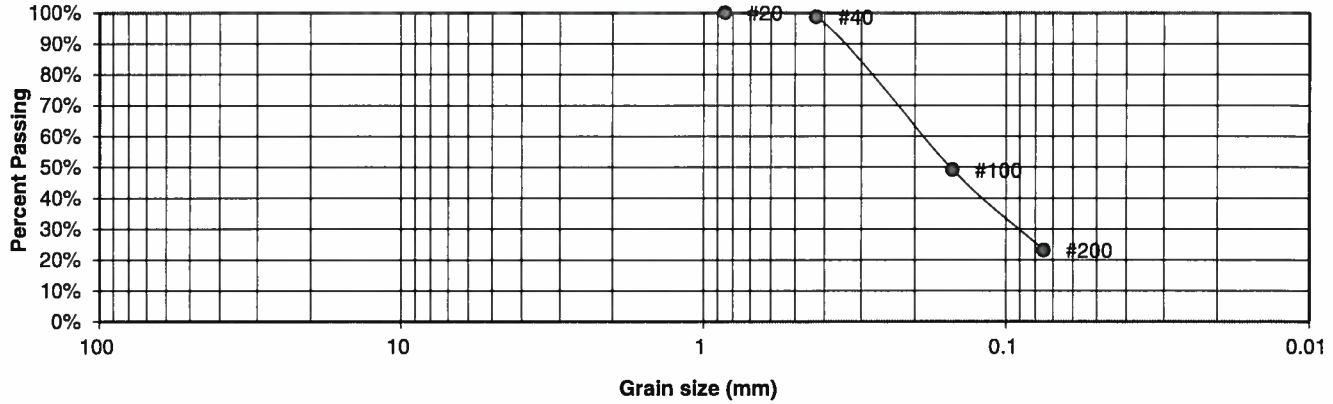
DRAWN:	DATE:	CHECKED: <i>SW</i>	DATE: <i>11-23-22</i>
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JOB NO.:
222155
FIG NO.:
B-19

UNIFIED CLASSIFICATION	SM
SOIL TYPE #	3
TEST BORING #	8
DEPTH (FT)	1-2
AASHTO CLASSIFICATION	A-2-4

CLIENT	TECH CONTRACTORS
PROJECT	ESTATES, ROLLING HILLS, F-2
JOB NO.	222155
TEST BY	BL
GROUP INDEX	0

**Sieve Analysis
Grain Size Distribution**



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	
10	
20	100.0%
40	98.7%
100	49.1%
200	23.1%

**Atterberg
Limits**

Plastic Limit	NP
Liquid Limit	NV
Plastic Index	NP

Swell

Moisture at start

Moisture at finish

Moisture increase

Initial dry density (pcf)

Swell (psf)



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505 ELKTON DRIVE
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**LABORATORY TEST
RESULTS**

DRAWN:

DATE:

CHECKED: *SW*

DATE: *11-23-22*

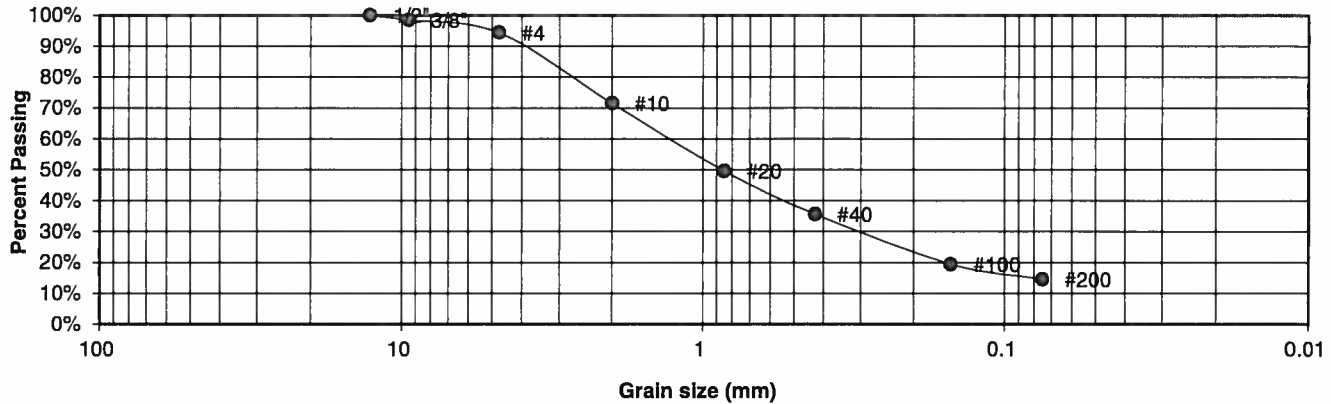
JOB NO.:

222155
FIG NO.:

B-20

<u>UNIFIED CLASSIFICATION</u>	SM	<u>CLIENT</u>	TECH CONTRACTORS
<u>SOIL TYPE #</u>	3	<u>PROJECT</u>	ESTATES, ROLLING HILLS, F-2
<u>TEST BORING #</u>	9	<u>JOB NO.</u>	222155
<u>DEPTH (FT)</u>	1-2	<u>TEST BY</u>	BL
<u>AASHTO CLASSIFICATION</u>	A-1-b	<u>GROUP INDEX</u>	0

Sieve Analysis Grain Size Distribution



<u>U.S. Sieve #</u>	<u>Percent Finer</u>
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	98.5%
4	94.4%
10	71.4%
20	49.6%
40	35.6%
100	19.4%
200	14.6%

<u>Atterberg Limits</u>	
Plastic Limit	NP
Liquid Limit	NV
Plastic Index	NP

<u>Swell</u>
Moisture at start
Moisture at finish
Moisture increase
Initial dry density (pcf)
Swell (psf)



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LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED: SW	DATE: 11-23-22
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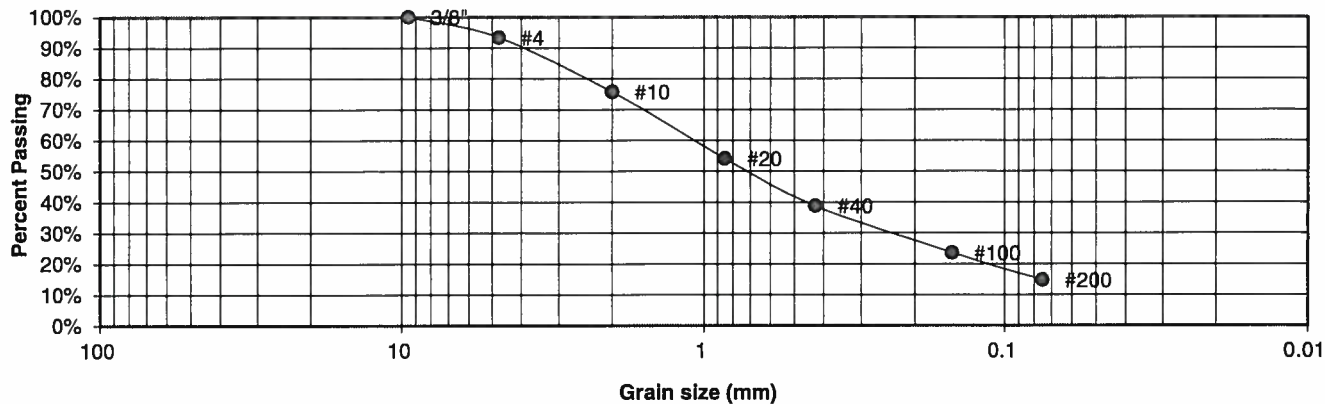
JOB NO.:

222155
FIG NO.:

B-21

<u>UNIFIED CLASSIFICATION</u>	SC	<u>CLIENT</u>	TECH CONTRACTORS
<u>SOIL TYPE #</u>	3	<u>PROJECT</u>	ESTATES, ROLLING HILLS, F-2
<u>TEST BORING #</u>	5	<u>JOB NO.</u>	222155
<u>DEPTH (FT)</u>	5	<u>TEST BY</u>	BL
<u>AASHTO CLASSIFICATION</u>	A-2-6	<u>GROUP INDEX</u>	0

Sieve Analysis Grain Size Distribution



<u>U.S. Sieve #</u>	<u>Percent Finer</u>
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	93.4%
10	75.8%
20	54.1%
40	38.8%
100	23.6%
200	14.7%

<u>Atterberg Limits</u>	
Plastic Limit	18
Liquid Limit	32
Plastic Index	14

<u>Swell</u>	
Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	



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LABORATORY TEST RESULTS

DRAWN:

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DATE:

11-23-22

JOB NO.:

222155

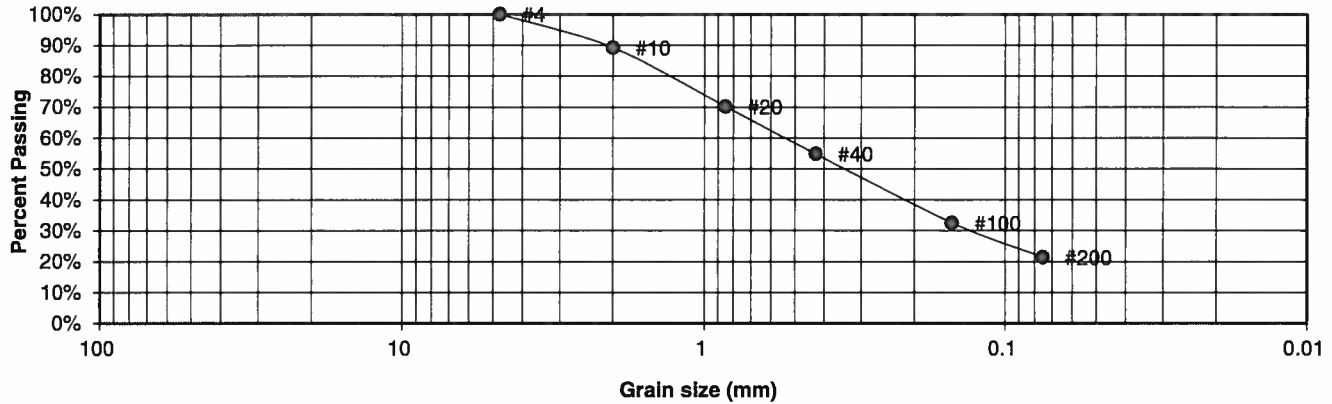
FIG NO.:

B-22

UNIFIED CLASSIFICATION SM
SOIL TYPE # 3
TEST BORING # 6
DEPTH (FT) 10
AASHTO CLASSIFICATION A-2-4

CLIENT TECH CONTRACTORS
PROJECT ESTATES, ROLLING HILLS, F-2
JOB NO. 222155
TEST BY BL
GROUP INDEX 0

Sieve Analysis Grain Size Distribution



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	100.0%
10	89.3%
20	70.1%
40	54.9%
100	32.5%
200	21.4%

Atterberg Limits	
Plastic Limit	23
Liquid Limit	32
Plastic Index	9

Swell	
Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	



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LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED: SW	DATE: 11-23-22
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JOB NO.:

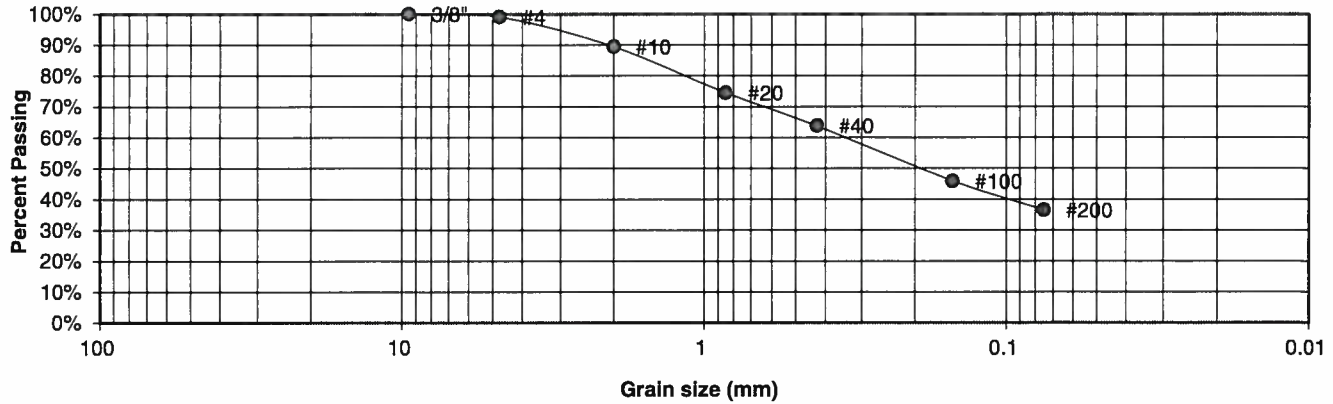
222155
 FIG NO.:

B-23

UNIFIED CLASSIFICATION SM
 SOIL TYPE # 3
 TEST BORING # 10
 DEPTH (FT) 5
 AASHTO CLASSIFICATION A-4

CLIENT TECH CONTRACTORS
 PROJECT ESTATES, ROLLING HILLS, F-2
 JOB NO. 222155
 TEST BY BL
 GROUP INDEX 0

Sieve Analysis Grain Size Distribution



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	99.1%
10	89.4%
20	74.5%
40	63.8%
100	45.9%
200	36.5%

Atterberg
 Limits
 Plastic Limit NP
 Liquid Limit NV
 Plastic Index NP

Swell
 Moisture at start
 Moisture at finish
 Moisture increase
 Initial dry density (pcf)
 Swell (psf)



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LABORATORY TEST RESULTS

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DATE: *11-23-22*

JOB NO.:

222155

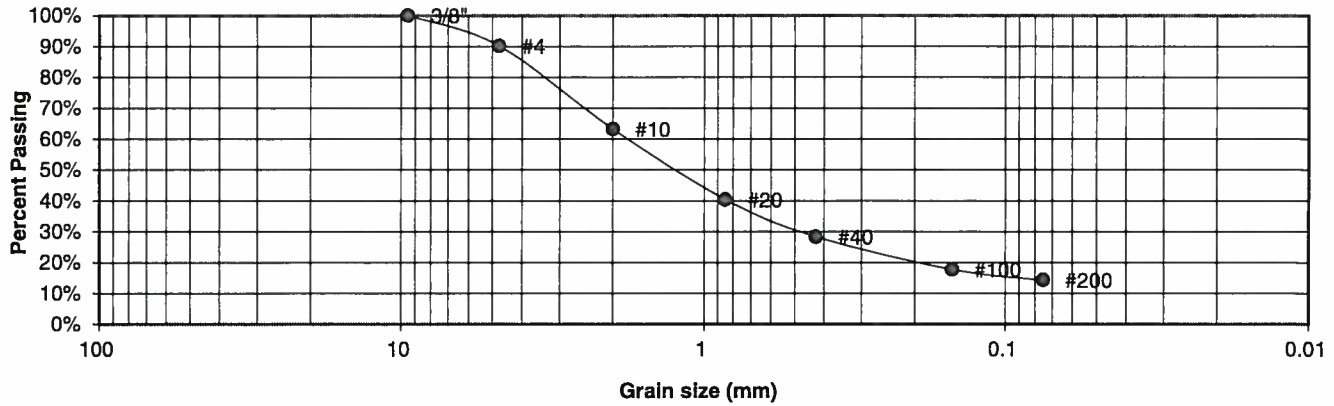
FIG NO.:

B-24

UNIFIED CLASSIFICATION SM
SOIL TYPE # 3
TEST BORING # 12
DEPTH (FT) 10
AASHTO CLASSIFICATION A-1-b

CLIENT TECH CONTRACTORS
PROJECT ESTATES, ROLLING HILLS, F-2
JOB NO. 222155
TEST BY BL
GROUP INDEX 0

Sieve Analysis Grain Size Distribution



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	90.2%
10	63.2%
20	40.3%
40	28.3%
100	17.7%
200	14.3%

Atterberg Limits
 Plastic Limit NP
 Liquid Limit NV
 Plastic Index NP

Swell
 Moisture at start
 Moisture at finish
 Moisture increase
 Initial dry density (pcf)
 Swell (psf)



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JOB NO.:

222155

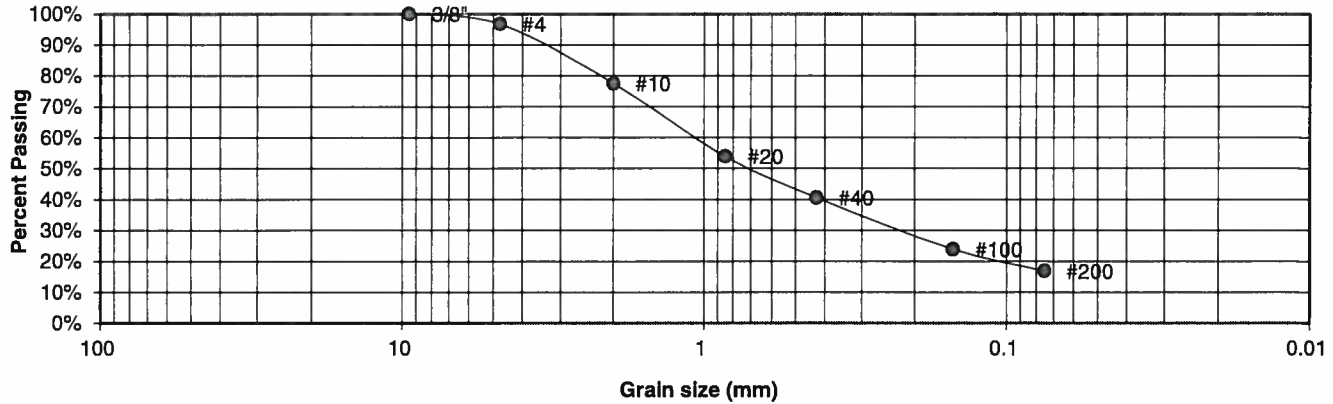
FIG NO.:

B-25

UNIFIED CLASSIFICATION SM
 SOIL TYPE # 3
 TEST BORING # 14
 DEPTH (FT) 5
 AASHTO CLASSIFICATION A-1-b

CLIENT TECH CONTRACTORS
 PROJECT ESTATES, ROLLING HILLS, F-2
 JOB NO. 222155
 TEST BY BL
 GROUP INDEX 0

Sieve Analysis Grain Size Distribution



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	96.8%
10	77.5%
20	53.9%
40	40.6%
100	23.9%
200	16.8%

Atterberg
Limits
 Plastic Limit NP
 Liquid Limit NV
 Plastic Index NP

Swell
 Moisture at start
 Moisture at finish
 Moisture increase
 Initial dry density (pcf)
 Swell (psf)



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LABORATORY TEST RESULTS

DRAWN:

DATE:

CHECKED: SW

DATE: 11-23-22

JOB NO.:

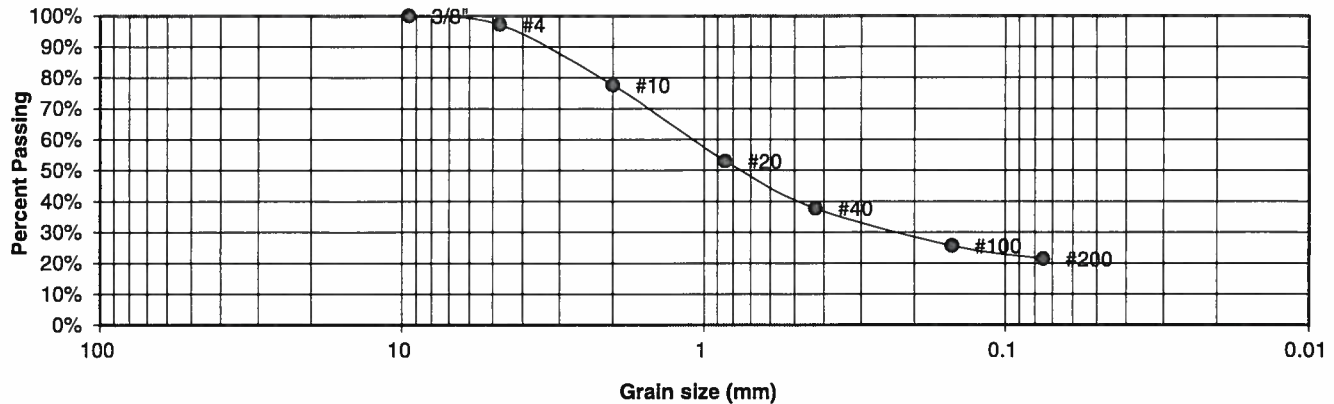
222155

FIG NO.:

B-26

<u>UNIFIED CLASSIFICATION</u>	SC	<u>CLIENT</u>	TECH CONTRACTORS
<u>SOIL TYPE #</u>	3	<u>PROJECT</u>	ESTATES, ROLLING HILLS, F-2
<u>TEST BORING #</u>	16	<u>JOB NO.</u>	222155
<u>DEPTH (FT)</u>	5	<u>TEST BY</u>	BL
<u>AASHTO CLASSIFICATION</u>	A-2-6	<u>GROUP INDEX</u>	1

**Sieve Analysis
Grain Size Distribution**



<u>U.S. Sieve #</u>	<u>Percent Finer</u>
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	97.2%
10	77.6%
20	53.0%
40	37.7%
100	25.6%
200	21.4%

<u>Atterberg Limits</u>	
Plastic Limit	16
Liquid Limit	34
Plastic Index	18

<u>Swell</u>	
Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	



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**LABORATORY TEST
RESULTS**

<u>DRAWN:</u>	<u>DATE:</u>	<u>CHECKED:</u> SW	<u>DATE:</u> 11-23-22
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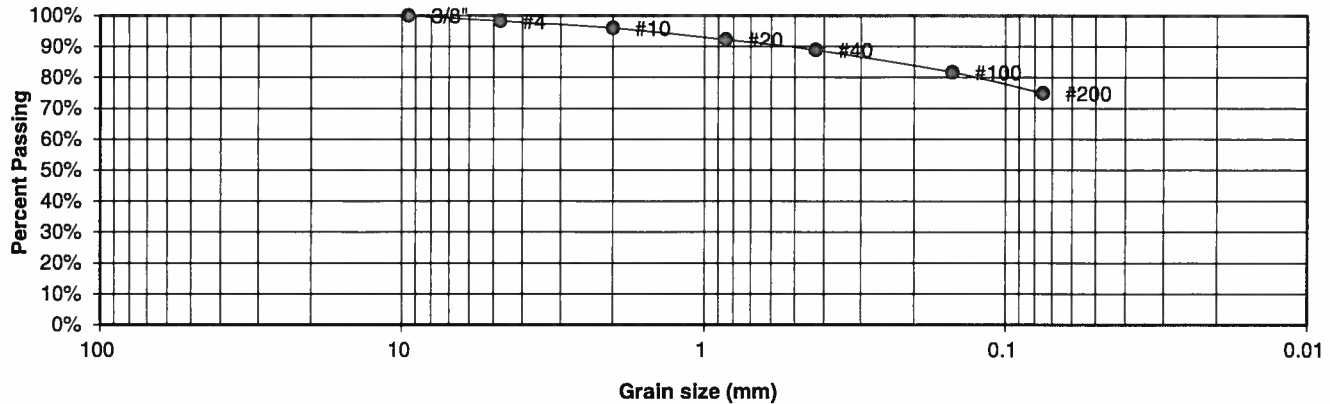
JOB NO.:

222155
FIG NO.:

B-27

<u>UNIFIED CLASSIFICATION</u>	CL	<u>CLIENT</u>	TECH CONTRACTORS
<u>SOIL TYPE #</u>	4	<u>PROJECT</u>	ESTATES, ROLLING HILLS, F-2
<u>TEST BORING #</u>	13	<u>JOB NO.</u>	222155
<u>DEPTH (FT)</u>	5	<u>TEST BY</u>	BL
<u>AASHTO CLASSIFICATION</u>	A-6	<u>GROUP INDEX</u>	10

Sieve Analysis Grain Size Distribution



<u>U.S. Sieve #</u>	<u>Percent Finer</u>
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	98.2%
10	96.0%
20	92.2%
40	88.9%
100	81.7%
200	74.9%

<u>Atterberg Limits</u>	
Plastic Limit	24
Liquid Limit	38
Plastic Index	14

<u>Swell</u>	
Moisture at start	
Moisture at finish	
Moisture increase	
Initial dry density (pcf)	
Swell (psf)	



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LABORATORY TEST RESULTS

<u>DRAWN:</u>	<u>DATE:</u>	<u>CHECKED:</u> SW	<u>DATE:</u> 11-23-22
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JOB NO.:

222155

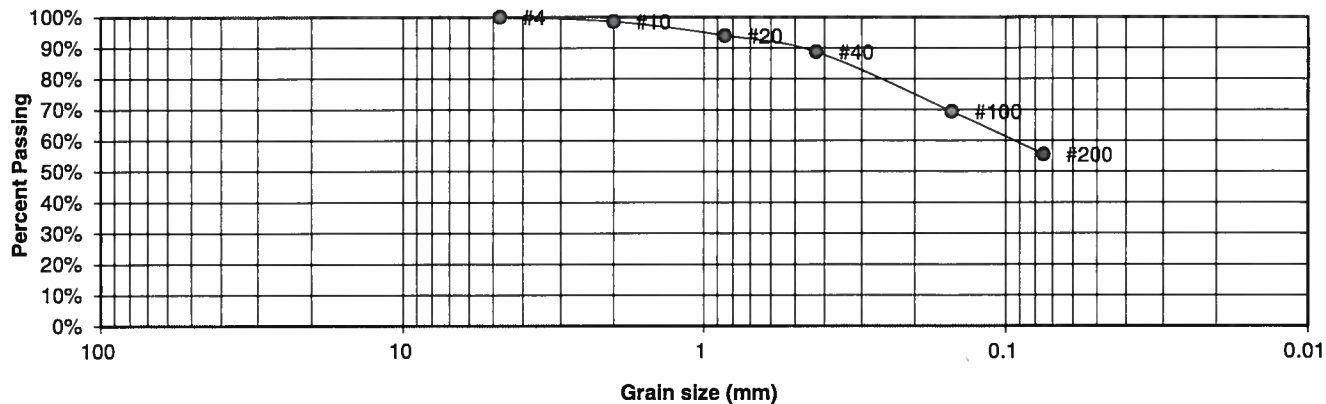
FIG NO.:

B-28

UNIFIED CLASSIFICATION CL
SOIL TYPE # 4
TEST BORING # 15
DEPTH (FT) 10
AASHTO CLASSIFICATION A-6

CLIENT TECH CONTRACTORS
PROJECT ESTATES, ROLLING HILLS, F-2
JOB NO. 222155
TEST BY BL
GROUP INDEX 5

**Sieve Analysis
Grain Size Distribution**



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	
4	100.0%
10	98.6%
20	94.0%
40	88.7%
100	69.4%
200	55.5%

**Atterberg
Limits**
 Plastic Limit 17
 Liquid Limit 31
 Plastic Index 14

Swell
 Moisture at start
 Moisture at finish
 Moisture increase
 Initial dry density (pcf)
 Swell (psf)



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**LABORATORY TEST
RESULTS**

DRAWN:	DATE:	CHECKED: SW	DATE: 11-23-22
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JOB NO.:

222155
 FIG NO.:

B-29

CONSOLIDATION TEST RESULTS

TEST BORING #	1	DEPTH(ft)	1-2
DESCRIPTION	SC	SOIL TYPE	2
NATURAL UNIT DRY WEIGHT (PCF)	117		
NATURAL MOISTURE CONTENT	7.5%		
SWELL/CONSOLIDATION (%)	0.0%		

JOB NO. 222155
CLIENT TECH CONTRACTORS
PROJECT ESTATES, ROLLING HILLS, F-2



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SWELL CONSOLIDATION TEST RESULTS

DRAWN:

DATE:

CHECKED:

DATE:

SW 11-23-22

JOB NO.:

222155

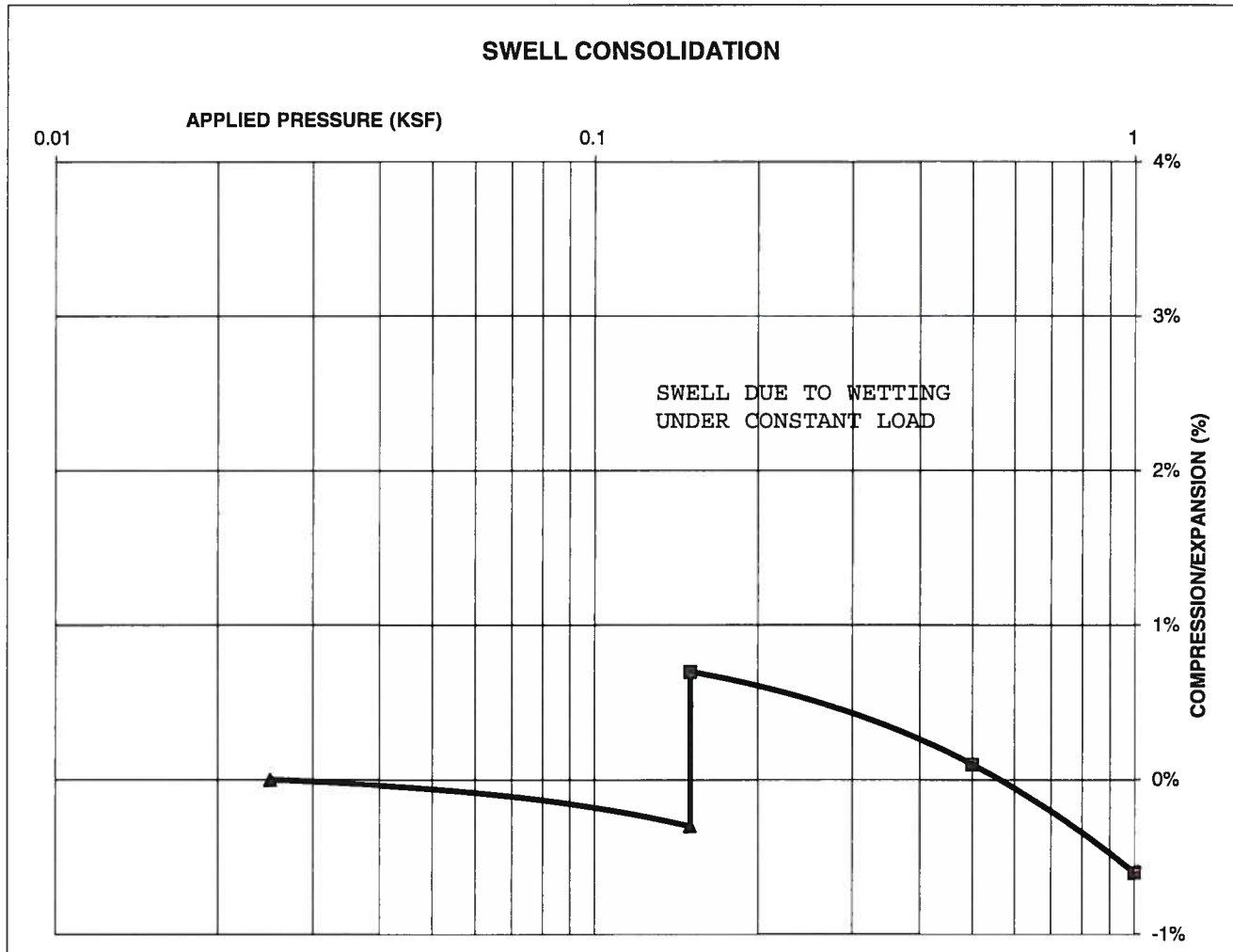
FIG NO.:

B-30

CONSOLIDATION TEST RESULTS

TEST BORING #	15	DEPTH(ft)	1-2
DESCRIPTION	SM	SOIL TYPE	1
NATURAL UNIT DRY WEIGHT (PCF)	121		
NATURAL MOISTURE CONTENT	10.4%		
SWELL/CONSOLIDATION (%)	1.0%		

JOB NO. 222155
CLIENT TECH CONTRACTORS
PROJECT ESTATES, ROLLING HILLS, F-2



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SWELL CONSOLIDATION TEST RESULTS

DRAWN:

DATE:

CHECKED: *SW*

DATE: *11-23-22*

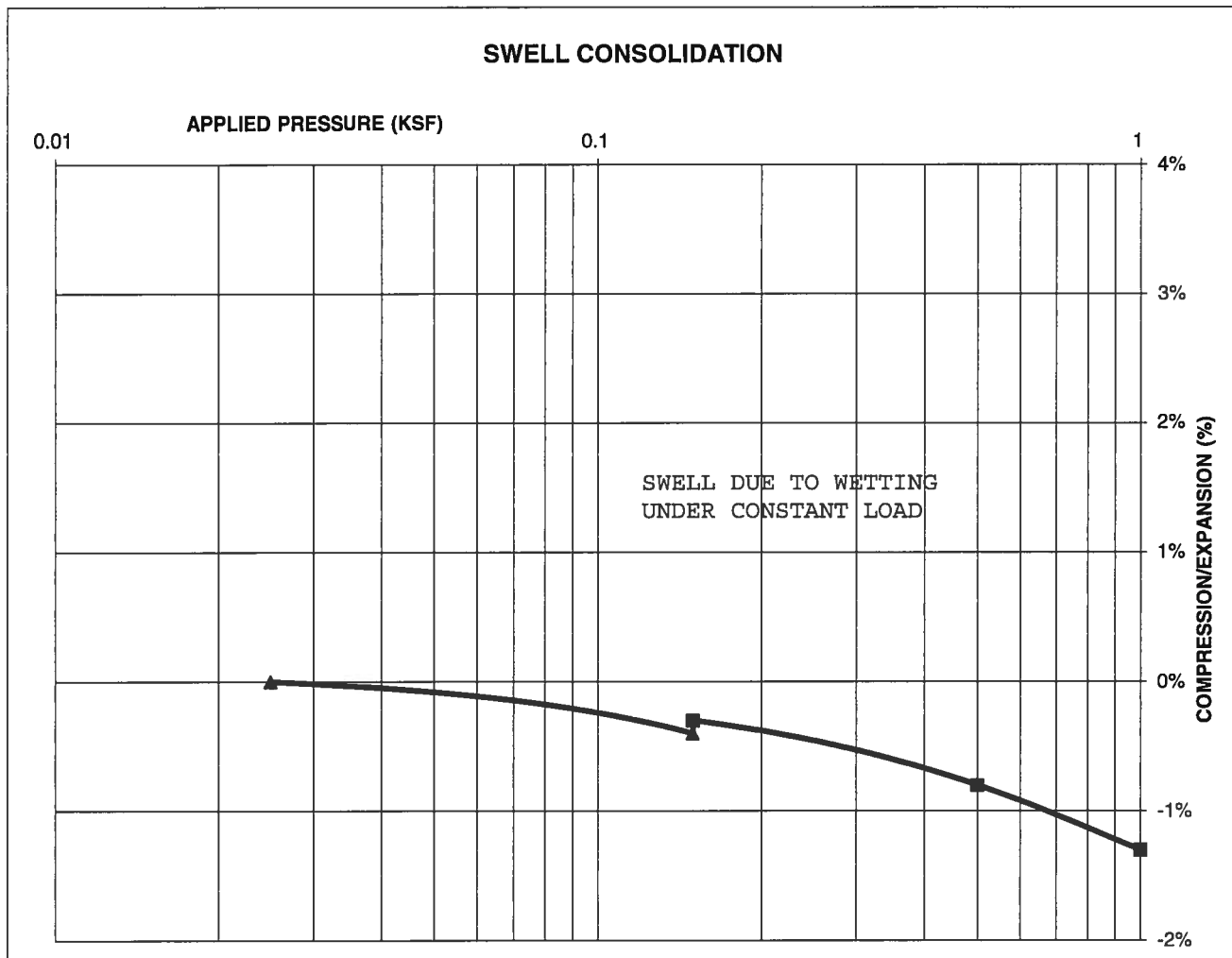
JOB NO.:
222155

FIG NO.:
B-31

CONSOLIDATION TEST RESULTS

TEST BORING #	13	DEPTH(ft)	0-3
DESCRIPTION	SC	SOIL TYPE	2, CBR
NATURAL UNIT DRY WEIGHT (PCF)	109		
NATURAL MOISTURE CONTENT	13.3%		
SWELL/CONSOLIDATION (%)	0.1%		

JOB NO.	222155
CLIENT	TECH CONTRACTORS
PROJECT	ESTATES, ROLLING HILLS, F-2



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505 ELKTON DRIVE
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SWELL CONSOLIDATION TEST RESULTS

DRAWN:

DATE:

CHECKED:

DATE:

SW 11-23-22

JOB NO.:
222155

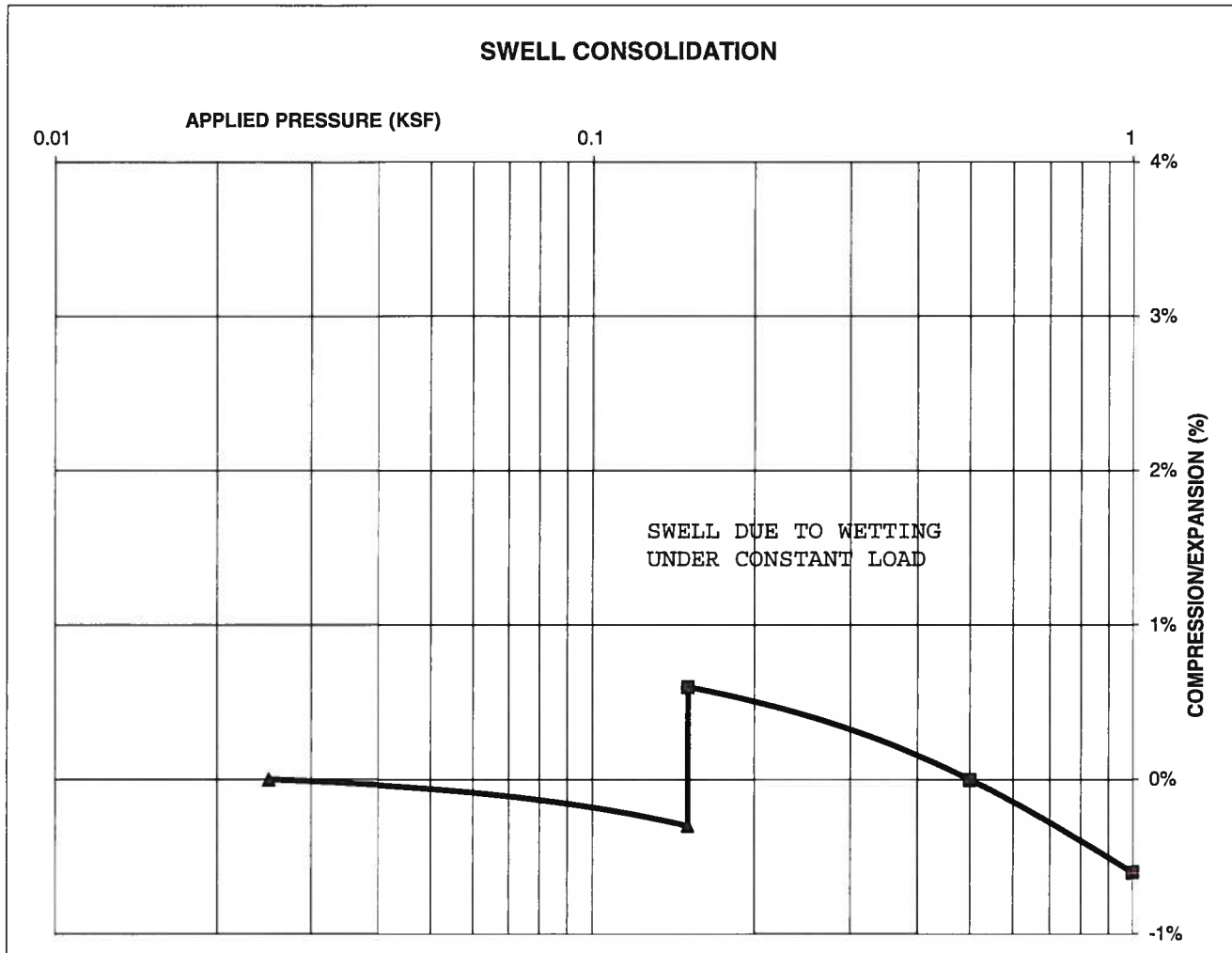
FIG NO.:

B-32

CONSOLIDATION TEST RESULTS

TEST BORING #	13	DEPTH(ft)	1-2
DESCRIPTION	SC	SOIL TYPE	2
NATURAL UNIT DRY WEIGHT (PCF)	119		
NATURAL MOISTURE CONTENT	9.6%		
SWELL/CONSOLIDATION (%)	0.9%		

JOB NO. 222155
CLIENT TECH CONTRACTORS
PROJECT ESTATES, ROLLING HILLS, F-2



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SWELL CONSOLIDATION TEST RESULTS

DRAWN:

DATE:

CHECKED: *SW*

DATE: *11-23-22*

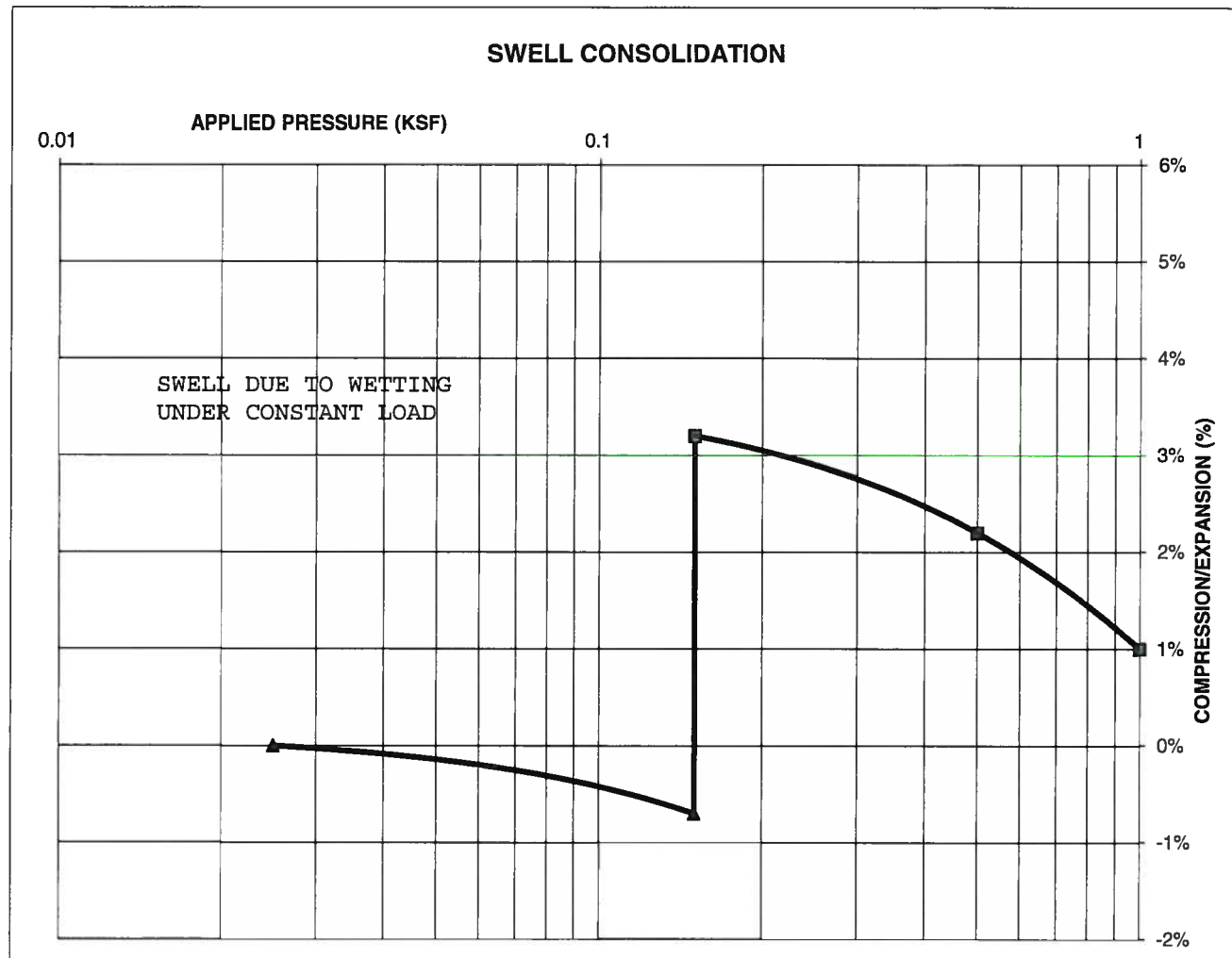
JOB NO.:
222155

FIG NO.:
B-33

CONSOLIDATION TEST RESULTS

TEST BORING #	13	DEPTH(ft)	5
DESCRIPTION	CL	SOIL TYPE	2
NATURAL UNIT DRY WEIGHT (PCF)	107		
NATURAL MOISTURE CONTENT	12.4%		
SWELL/CONSOLIDATION (%)	3.9%		

JOB NO. 222155
 CLIENT TECH CONTRACTORS
 PROJECT ESTATES, ROLLING HILLS, F-2



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SWELL CONSOLIDATION TEST RESULTS

DRAWN:

DATE:

CHECKED: *SW*

DATE: *11-23-22*

JOB NO.:

222155

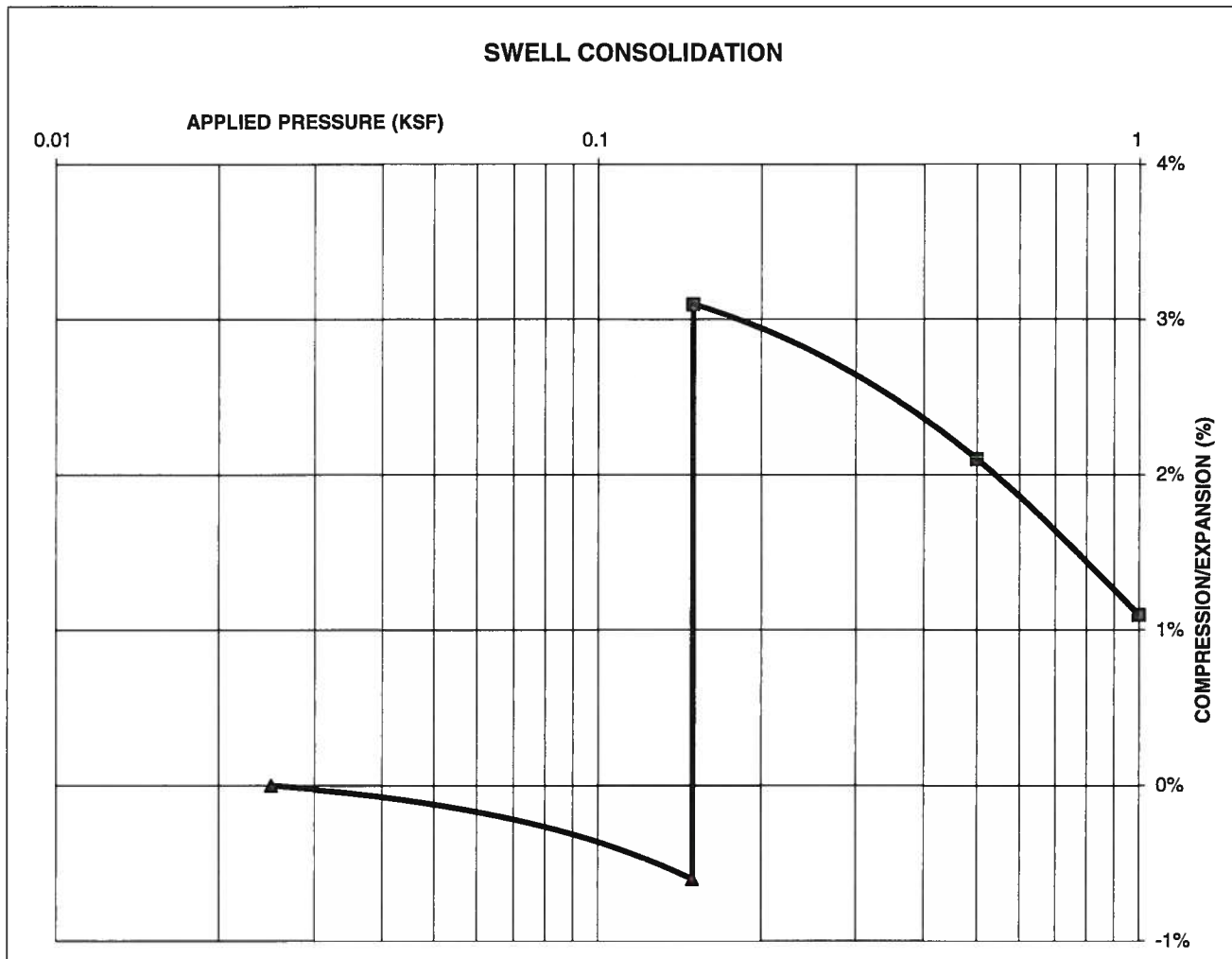
FIG NO.:

B-34

CONSOLIDATION TEST RESULTS

TEST BORING #	15	DEPTH(ft)	10
DESCRIPTION	CL	SOIL TYPE	2
NATURAL UNIT DRY WEIGHT (PCF)	121		
NATURAL MOISTURE CONTENT	13.6%		
SWELL/CONSOLIDATION (%)	3.7%		

JOB NO. 222155
 CLIENT TECH CONTRACTORS
 PROJECT ESTATES, ROLLING HILLS, F-2



**ENTECH
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505 ELKTON DRIVE
 COLORADO SPRINGS, COLORADO 80907

SWELL CONSOLIDATION TEST RESULTS

DRAWN:

DATE:

CHECKED:

DATE:

SW 11-23-22

JOB NO.:

222155

FIG NO.:

B-35

CLIENT	TECH CONTRACTORS	JOB NO.	222155
PROJECT	ESTATES, ROLLING HILLS, F-2	DATE	11/17/2022
LOCATION	ESTATES, ROLLING HILLS, F-2	TEST BY	BL

BORING NUMBER	DEPTH, (ft)	SOIL TYPE NUMBER	UNIFIED CLASSIFICATION	WATER SOLUBLE SULFATE, (wt%)
TB-1	1-2	1	SC	0.00
TB-3	1-2	3	SM	<0.01
TB-6	1-2	1	SM	<0.01
TB-8	1-2	3	SM	0.02
TB-10	5	3	SM	<0.01
TB-11	1-2	1	SM	<0.01
TB-13	5	4	CL	0.00
TB-14	1-2	1	SM	<0.01
TB-14	5	3	SM	<0.01

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COLORADO SPRINGS, COLORADO 80907

**LABORATORY TEST
SULFATE RESULTS**

DRAWN:

DATE:

CHECKED:

DATE:

SW

11-23-22

JOB NO.:

222155

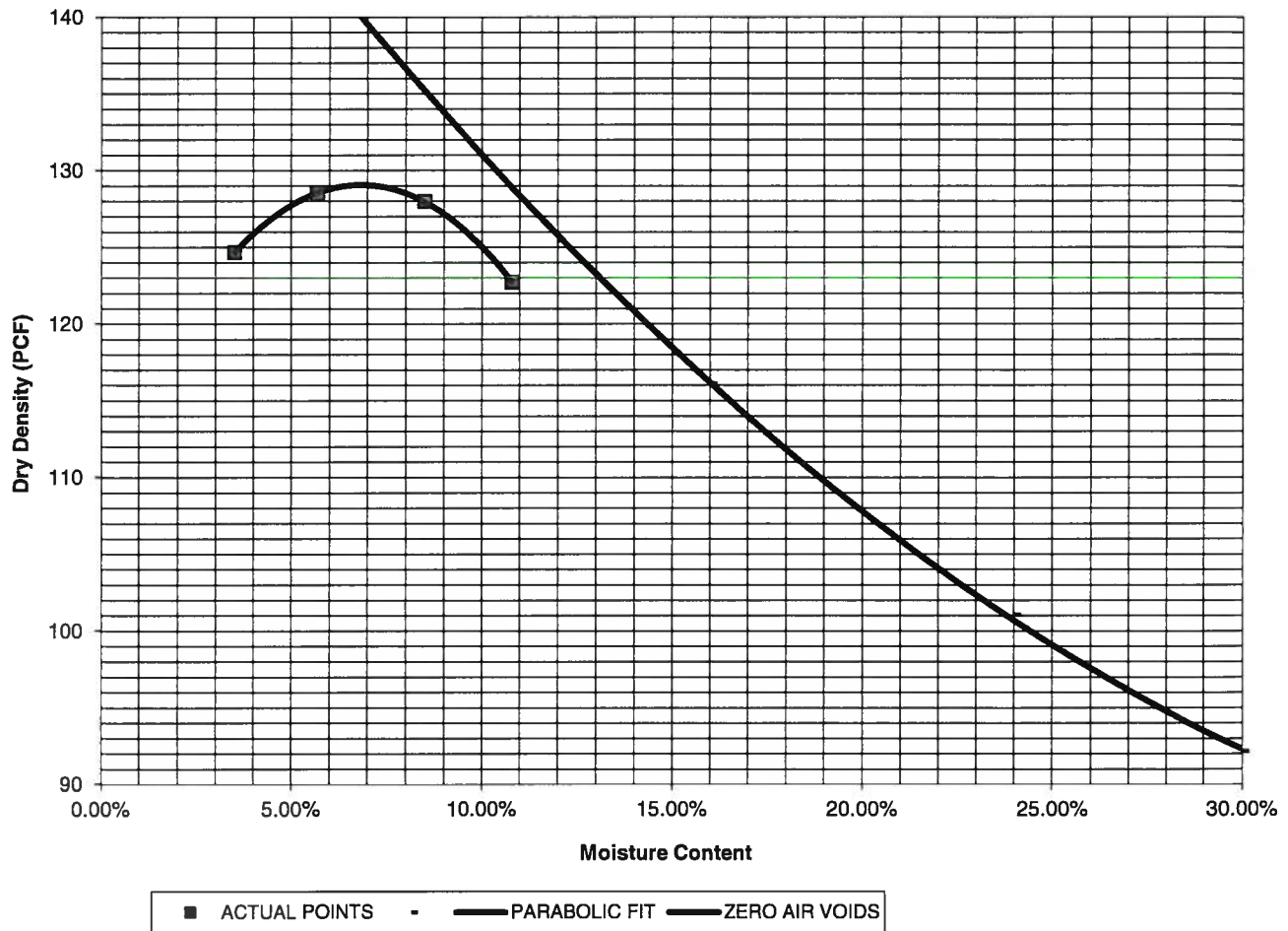
FIG NO.:

B-36

<u>PROJECT</u>	ESTATES, ROLLING HILLS, F-2	<u>CLIENT</u>	TECH CONTRACTORS
<u>SAMPLE LOCATION</u>	TB-9 @ 0-3'	<u>JOB NO.</u>	222155
<u>SOIL DESCRIPTION</u>	SAND, CLAYEY, BROWN	<u>DATE</u>	11/07/22

<u>IDENTIFICATION</u>	SC	<u>COMPACTION TEST #</u>	1, SOIL TYPE #1
<u>TEST DESIGNATION / METHOD</u>	ASTM D-1557-A	<u>TEST BY</u>	AL
<u>MAXIMUM DRY DENSITY (PCF)</u>	129.1	<u>OPTIMUM MOISTURE</u>	6.9%

Compaction Curve



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ENGINEERING, INC.**

505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

MOISTURE DENSITY RELATION

DRAWN:

DATE:

CHECKED:

DATE:

SW

11-23-22

JOB NO.:

222155

FIG NO.:

B-37

CBR TEST LOAD DATA

JOB NO: 222155
 CLIENT: TECH CONTRACTORS
 PROJECT: ESTATES, ROLLING HILLS, F-2
 SOIL TYPE: 1, CBR #1

PISTON DIAMETER (cm) 4.958	PISTON AREA (in ²) 2.993						
		10 BLOWS		25 BLOWS		56 BLOWS	
		MOLD # 1		MOLD # 2		MOLD # 3	
PENETRATION DEPTH (INCHES)		LOAD(LBS) (LBS)	STRESS (PSI)	LOAD(LBS) (LBS)	STRESS (PSI)	LOAD(LBS) (LBS)	STRESS (PSI)
0.000		0	0.00	0	0.00	0	0.00
0.025		68	22.72	136	45.45	246	82.21
0.050		194	64.83	387	129.32	694	231.91
0.075		254	84.88	508	169.76	970	324.14
0.100		324	108.27	648	216.54	1057	353.22
0.125		481	160.73	962	321.47	1296	433.08
0.150		617	206.18	1233	412.03	1571	524.98
0.175		797	266.33	1535	512.95	1786	596.82
0.200		958	320.13	1915	639.93	2291	765.58
0.300		1348	450.46	2697	901.25	3522	1176.94
0.400		1648	550.71	3295	1101.08	4661	1557.56
0.500		1898	634.25	3796	1268.50	5871	1961.90

FINAL MOISTURE CONTENT

	MOLD # 1	MOLD # 2	MOLD # 3
CAN #	303	340	361
WT. CAN	8.18	8.57	8.45
WT. CAN+WET	187.15	188.96	161.91
WT. CAN+DRY	180.21	171.41	145.9
WT. H2O	6.94	17.55	16.01
WT. DRY SOIL	172.03	162.84	137.45
MOISTURE CONTENT	4.03%	10.78%	11.65%

WET DENSITY (PCF)	121.8	131.7	137.8
DRY DENSITY (PCF)	113.9	123.2	128.9

BEARING RATIO 10.83 21.65 35.32

90% OF DRY DENSITY 116.2

95% OF DRY DENSITY 122.6

BEARING RATIO AT 90% OF MAX	13.49 ~ R VALUE	40
BEARING RATIO AT 95% OF MAX	21.05 ~ R VALUE	71



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505 ELKTON DRIVE
 COLORADO SPRINGS, COLORADO 80907

CBR TEST DATA

DRAWN:

DATE:

CHECKED:

DATE:

SW

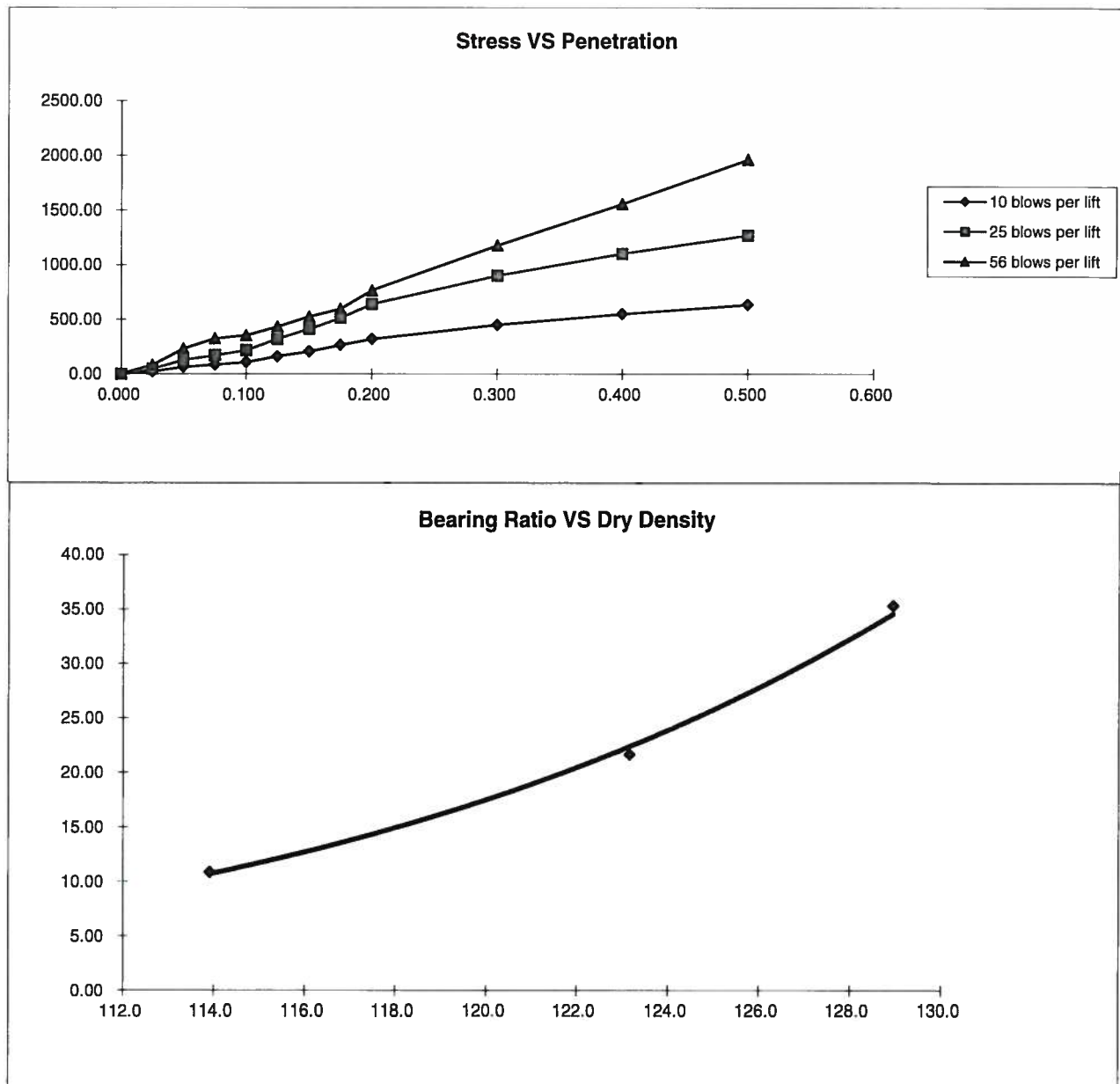
11-23-22

JOB NO.:

222155

FIG NO.:

B-38



BEARING RATIO AT 90% OF MAX	13.49 ~ R VALUE	40.00
BEARING RATIO AT 95% OF MAX	21.05 ~ R VALUE	71.00

JOB NO: 222155
SOIL TYPE: I, CBR #1



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CALIFORNIA BEARING RATIO

DRAWN:

DATE:

CHECKED:

SW

DATE:

11-23-22

JOB NO.:

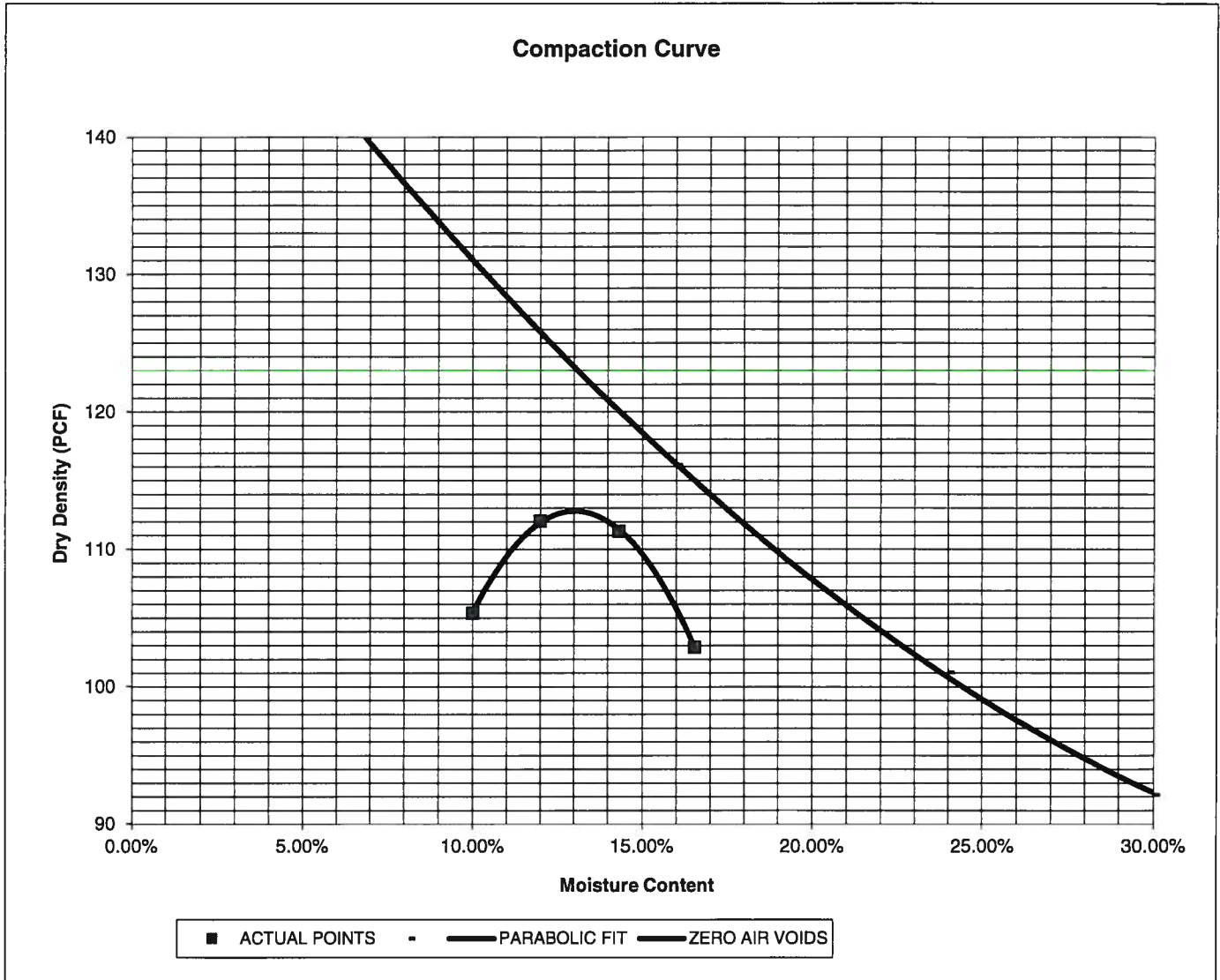
222155

FIG NO.:

B-39

<u>PROJECT</u>	ESTATES, ROLLING HILLS, F-2	<u>CLIENT</u>	TECH CONTRACTORS
<u>SAMPLE LOCATION</u>	TB-13 @ 0-3'	<u>JOB NO.</u>	222155
<u>SOIL DESCRIPTION</u>	SAND, VERY CLAYEY, BROWN	<u>DATE</u>	11/06/22

<u>IDENTIFICATION</u>	SC	<u>COMPACTION TEST #</u>	2, SOIL TYPE #2
<u>TEST DESIGNATION / METHOD</u>	ASTM D-698-A	<u>TEST BY</u>	AL
<u>MAXIMUM DRY DENSITY (PCF)</u>	112.9	<u>OPTIMUM MOISTURE</u>	13.2%



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505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

MOISTURE DENSITY RELATION

DRAWN:

DATE:

CHECKED:

DATE:

SW

11-23-22

JOB NO.:

222155

FIG NO.:

B-40

CBR TEST LOAD DATA

JOB NO: 222155
 CLIENT: TECH CONTRACTORS
 PROJECT: ESTATES, ROLLING HILLS, F-2
 SOIL TYPE: 2, CBR #2

PISTON DIAMETER (cm) 4.958	PISTON AREA (in ²) 2.993						
		10 BLOWS		25 BLOWS		56 BLOWS	
		MOLD # 1		MOLD # 2		MOLD # 3	
PENETRATION DEPTH (INCHES)		LOAD(LBS) (LBS)	STRESS (PSI)	LOAD(LBS) (LBS)	STRESS (PSI)	LOAD(LBS) (LBS)	STRESS (PSI)
0.000		0	0.00	0	0.00	0	0.00
0.025		33	11.03	66	22.06	84	28.07
0.050		52	17.38	104	34.75	130	43.44
0.075		60	20.05	120	40.10	145	48.45
0.100		67	22.39	133	44.44	159	53.13
0.125		75	25.06	149	49.79	177	59.15
0.150		80	26.73	160	53.47	180	60.15
0.175		84	28.07	168	56.14	189	63.16
0.200		89	29.74	177	59.15	202	67.50
0.300		99	33.08	197	65.83	250	83.54
0.400		108	36.09	216	72.18	269	89.89
0.500		115	38.43	237	79.20	299	99.92

FINAL MOISTURE CONTENT

	MOLD # 1	MOLD # 2	MOLD # 3
CAN #	315	351	340
WT. CAN	8.16	7.83	8.57
WT. CAN+WET	128.96	154.45	162.53
WT. CAN+DRY	114.21	130.97	141.29
WT. H2O	14.75	23.48	21.24
WT. DRY SOIL	106.05	123.14	132.72
MOISTURE CONTENT	13.91%	19.07%	16.00%

WET DENSITY (PCF)	110.0	118.3	130.5
DRY DENSITY (PCF)	97.2	104.5	115.3

BEARING RATIO 2.24 4.44 5.31

90% OF DRY DENSITY 101.6

95% OF DRY DENSITY 107.3

BEARING RATIO AT 90% OF MAX	3.57 ~ R VALUE	7.5
BEARING RATIO AT 95% OF MAX	4.66 ~ R VALUE	10



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 COLORADO SPRINGS, COLORADO 80907

CBR TEST DATA

DRAWN:

DATE:

CHECKED:

DATE:

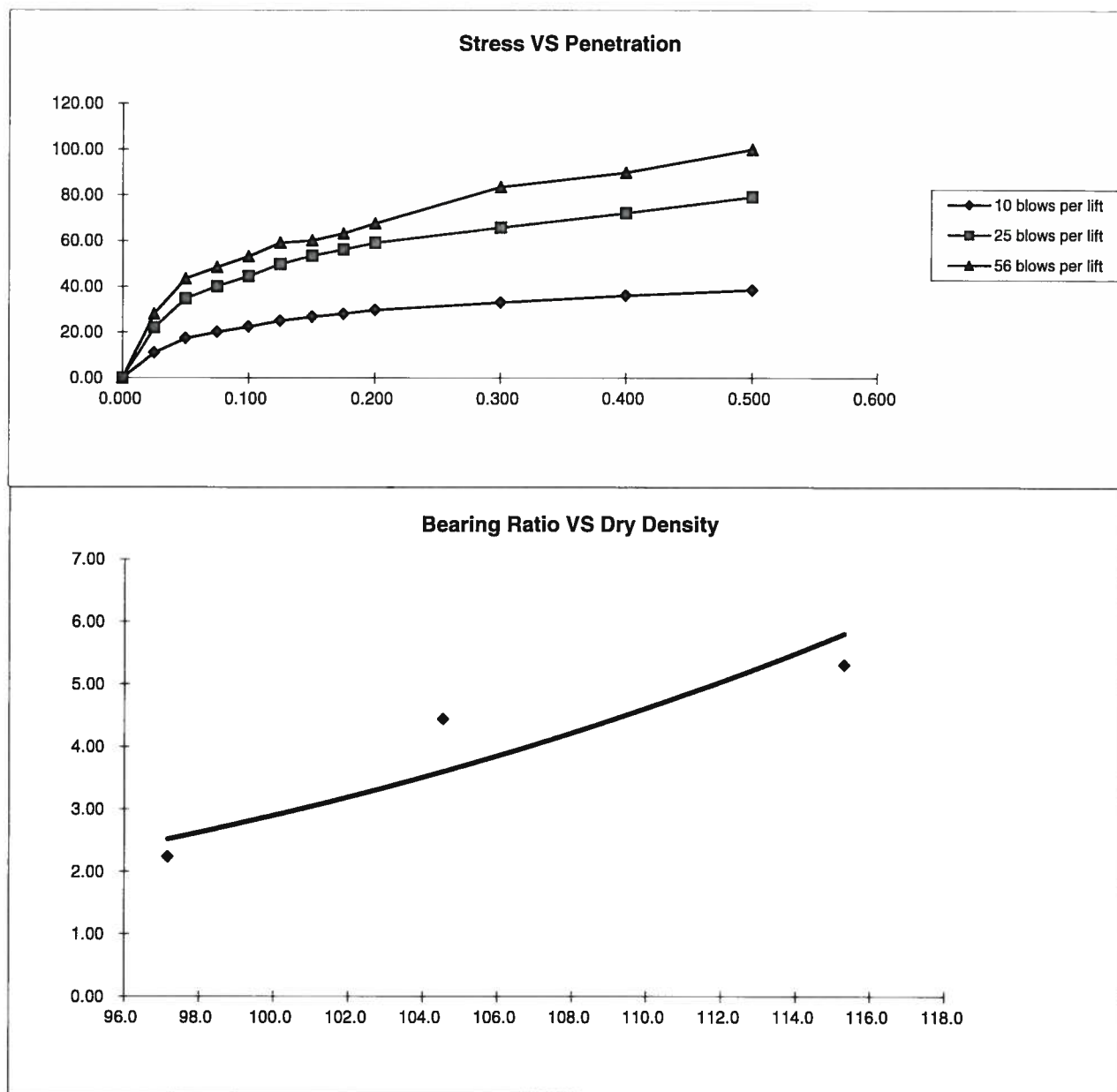
SW

11-23-22

JOB NO.:
 222155

FIG NO.:

B-41



BEARING RATIO AT 90% OF MAX	3.57 ~ R VALUE	7.50
BEARING RATIO AT 95% OF MAX	4.66 ~ R VALUE	10.00

JOB NO: 222155
SOIL TYPE: 2, CBR #2



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COLORADO SPRINGS, COLORADO 80907

CALIFORNIA BEARING RATIO

DRAWN:

DATE:

CHECKED:

DATE:

5W 11-23-22

JOB NO:
222155

FIG NO:

B-42

APPENDIX C: Pavement Design Calculations

FLEXIBLE PAVEMENT DESIGN

DESIGN DATA

ESTATES AT ROLLING HILLS RANCH FILING NO.2
URBAN LOCAL (LOW VOLUME) SOIL TYPE 1

Equivalent (18 kip) Single Axle Load Applications (ESAL):	ESAL (W_{18}) =	36,500
Hveem Stabilometer (R Value) Results:	R =	50
Standard Deviation	S_o =	0.44
Loss in Serviceability	$\Delta\psi$ =	2.0
Reliability	Reliability =	80
Reliability (z-statistic)	Z_R =	-0.84
Soil Resilient Modulus	M_R =	13168

Weighted Structural Number (WSN): ➔ WSN = 1.46

DESIGN TABLES AND EQUATIONS

$$S_1 = [(R - 5) / 11.29] + 3$$

$$M_R = 10^{[(S_1 + 18.72) / 6.24]}$$

$$k = M_R / 19.4$$

Where:

M_R = resilient modulus (psi)

S_1 = the soil support value

R = R-value obtained from the Hveem stabilometer

CBR = California Bearing Ratio

Reliability (%) Z_R (z-statistic)

80	-0.84
85	-1.04
90	-1.28
93	-1.48
94	-1.56
95	-1.65
96	-1.75
97	-1.88
98	-2.05
99	-2.33
99.9	-3.09
99.99	-3.75

$$\log_{10} W_{18} = Z_R \cdot S_o + 9.36 \cdot \log_{10} (SN+1) - 0.20 + \frac{\log_{10} \left[\frac{\Delta \text{PSI}}{4.2 - 1.5} \right]}{0.40 + \frac{1094}{(SN+1)^{5.19}}} + 2.32 \cdot \log_{10} M_R - 8.07$$

Left	Right	Difference
4.56	4.56	0.0

Job No. 222155
Fig. No. C-1

DESIGN CALCULATIONS

DESIGN DATA

ESTATES AT ROLLING HILLS RANCH FILING NO.2
URBAN LOCAL (LOW VOLUME) SOIL TYPE 1

Equivalent (18 kip) Single Axle Load Applications (ESAL):	ESAL =	36,500
Hveem Stabilometer (R Value) Results:	R =	50
Weighted Structural Number (WSN):	WSN =	1.46

DESIGN EQUATION

$$WSN = C_1 D_1 + C_2 D_2$$

$C_1 = 0.44$ Strength Coefficient - Hot Bituminous Asphalt

$C_2 = 0.11$ Strength Coefficient - Aggregate Base Course

D_1 = Depth of Asphalt (inches)

D_2 = Depth of Base Course (inches)

FOR FULL DEPTH ASPHALT SECTION (CURRENTLY NOT ALLOWED)

$D_1 = (WSN)/C_1 = 3.3$ inches of Full Depth Asphalt
Use N/A inches Full Depth

FOR ASPHALT + AGGREGATE BASE COURSE SECTION

Asphalt Thickness (t) = 3 inches

$D_2 = ((WSN) - (t)(C_1))/C_2 = 1.3$ inches of Aggregate
Base Course, use 4.0 inches

RECOMMENDED ALTERNATIVES

1. 3.0 inches of Asphalt + 4.0 inches of Aggregate Base Course, or
2. N/A inches of Full Depth Asphalt

Job No. 222155

Fig. No. C-2

DESIGN CALCULATIONS

CEMENT TREATED SECTIONS

DESIGN DATA:

ESTATES AT ROLLING HILLS RANCH FILING NO.2

URBAN LOCAL (LOW VOLUME) SOIL TYPE 1

Equivalent (18 kip) Single Axle Load Applications (ESAL):	ESAL =	36,500
Hveem Stabilometer (R Value) Results:	R =	50
Weighted Structural Number (WSN):	WSN =	1.46

DESIGN EQUATION

$$WSN = C_1 D_1 + C_2 D_2$$

$C_1 = 0.44$ Strength Coefficient - Hot Bituminous Asphalt

$C_2 = 0.11$ Strength Coefficient - Cement Treated Subgrade.

D_1 = Depth of Asphalt (inches)

D_2 = Depth of Cement Treated Subgrade (inches)

FOR FULL DEPTH ASPHALT SECTION - (CURRENTLY NOT ALLOWED)

$D_1 = (WSN)/C_1 = 3.3$ inches of Full Depth Asphalt
Use N/A inches Full Depth

FOR ASPHALT + CEMENT TREATED SUBGRADE SECTION

Asphalt Thickness (t) = 4 inches

$D_2 = ((WSN) - (t)(C_1))/C_2 = -2.7$ inches

Use 8.0 inches of Cement Treated Subgrade.

RECOMMENDED ALTERNATIVES

1. 4.0 inches of Asphalt + 8 inches of Cement Treated Subgrade.
2. N/A inches of Full Depth Asphalt

Job No. 222155

Fig. No. C-3

FLEXIBLE PAVEMENT DESIGN

DESIGN DATA

ESTATES AT ROLLING HILLS RANCH FILING NO.2

ALL URBAN LOCAL ROADWAY SOIL TYPE 1

Equivalent (18 kip) Single Axle Load Applications (ESAL):	ESAL (W_{18}) =	292,000
Hveem Stabilometer (R Value) Results:	R =	50
Standard Deviation	S_o =	0.44
Loss in Serviceability	$\Delta\psi$ =	2.0
Reliability	Reliability =	80
Reliability (z-statistic)	Z_R =	-0.84
Soil Resilient Modulus	M_R =	13168

Weighted Structural Number (WSN):  WSN = 2.09

DESIGN TABLES AND EQUATIONS

$$S_1 = [(R - 5) / 11.29] + 3$$

$$M_R = 10^{[(S_1 + 18.72) / 6.24]}$$

$$k = M_R / 19.4$$

Where:

M_R = resilient modulus (psi)

S_1 = the soil support value

R = R-value obtained from the Hveem stabilometer

CBR = California Bearing Ratio

Reliability (%) Z_R (z-statistic)

80	-0.84
85	-1.04
90	-1.28
93	-1.48
94	-1.56
95	-1.65
96	-1.75
97	-1.88
98	-2.05
99	-2.33
99.9	-3.09
99.99	-3.75

$$\log_{10} W_{18} = Z_R \cdot S_o + 9.36 \cdot \log_{10} (SN+1) - 0.20 + \frac{\log_{10} \left[\frac{\Delta \text{PSI}}{4.2 - 1.5} \right]}{0.40 + \frac{1094}{(SN+1)^{5.19}}} + 2.32 \cdot \log_{10} M_R - 8.07$$

Left	Right	Difference
5.47	5.47	0.0

Job No. 222155

Fig. No. C-4

DESIGN CALCULATIONS

DESIGN DATA

ESTATES AT ROLLING HILLS RANCH FILING NO.2

ALL URBAN LOCAL SOIL TYPE 1

Equivalent (18 kip) Single Axle Load Applications (ESAL):	ESAL = 292,000
Hveem Stabilometer (R Value) Results:	R = 50
Weighted Structural Number (WSN):	WSN = 2.09

DESIGN EQUATION

$$WSN = C_1 D_1 + C_2 D_2$$

$C_1 = 0.44$ Strength Coefficient - Hot Bituminous Asphalt

$C_2 = 0.11$ Strength Coefficient - Aggregate Base Course

D_1 = Depth of Asphalt (inches)

D_2 = Depth of Base Course (inches)

FOR FULL DEPTH ASPHALT SECTION (CURRENTLY NOT ALLOWED)

$D_1 = (WSN)/C_1 = 4.7$ inches of Full Depth Asphalt
Use N/A inches Full Depth

FOR ASPHALT + AGGREGATE BASE COURSE SECTION

Asphalt Thickness (t) = inches

$D_2 = ((WSN) - (t)(C_1))/C_2 = 7.0$ inches of Aggregate
Base Course, use 8.0 inches

RECOMMENDED ALTERNATIVES

1. 3.0 inches of Asphalt + 8.0 inches of Aggregate Base Course, or
2. N/A inches of Full Depth Asphalt

Job No.222155
Fig. No. C-5

DESIGN CALCULATIONS

CEMENT TREATED SECTIONS

DESIGN DATA:

ESTATES AT ROLLING HILLS RANCH FILING NO.2
ALL URBAN LOCAL ROADWAYS SOIL TYPE 1
Equivalent (18 kip) Single Axle Load Applications (ESAL): ESAL = 292,000
Hveem Stabilometer (R Value) Results: R = 50
Weighted Structural Number (WSN): WSN = 2.09

DESIGN EQUATION

$$WSN = C_1 D_1 + C_2 D_2$$

$C_1 = 0.44$ Strength Coefficient - Hot Bituminous Asphalt

$C_2 = 0.11$ Strength Coefficient - Cement Treated Subgrade.

D_1 = Depth of Asphalt (inches)

D_2 = Depth of Cement Treated Subgrade (inches)

FOR FULL DEPTH ASPHALT SECTION - (CURRENTLY NOT ALLOWED)

$D_1 = (WSN)/C_1 = 4.8$ inches of Full Depth Asphalt

Use N/A inches Full Depth

FOR ASPHALT + CEMENT TREATED SUBGRADE SECTION

Asphalt Thickness (t) = 4 inches

$D_2 = ((WSN) - (t)(C_1))/C_2 = 3.0$ inches

Use 8.0 inches of Cement Treated Subgrade.

RECOMMENDED ALTERNATIVES

1. 4.0 inches of Asphalt + 8.0 inches of Cement Treated Subgrade.
2. N/A inches of Full Depth Asphalt

Job No. 222155

Fig. No. C-6