ENTECH
ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, CO 80907
PHONE (719) 531-5599
FAX (719) 531-5238

September 1, 2021

Classic Communities
2138 Flying Horse Club Drive
Colorado Springs, Colorado 80921

Attn: Adam Doyle

Re: Pavement Recommendations
Midtown at Hannah Ridge, Filing No. 2
El Paso County, Colorado

Dear Mr. Doyle:

As requested, Entech Engineering, Inc. obtained samples of the pavement subgrade soil from the proposed roadways within the above referenced filing. Laboratory testing was performed in order to determine the pavement support characteristics of the soil at proposed subgrade. This letter presents the results of the laboratory testing and pavement recommendations for the local residential roadways within the filing.

Project Description

The project will consist of the paving of sections of Pony Club Lane, Ghost Rider Heights, and Zorro Heights in the Midtown at Hannah Ridge, Filing No. 2. Pony Club Lane is public; Ghost Rider Heights and Zorro Heights are private. Subsurface Soil Investigation and laboratory testing was performed to determine the pavement support characteristics on the soil. The general layout of the site is presented in the Test Boring Location Map, Figure 1.

Subgrade Conditions

Four test borings were drilled in the roadways in this filing, not exceeding 500 feet between each test boring. The test boring locations are shown in Figure No. 1. The Test Boring Logs are presented in Appendix A. A representative bulk sample of the subgrade soils was obtained from Test Boring No. 2 at the anticipated subgrade elevation. Soils encountered in the test borings consisted of very sandy clay fill and very clayey sand fill. The surficial soils were classified into one soil type (Soil Type 1).

Sieve Analyses were performed on the subgrade soils for the purpose of classification. The Sieve Analyses on the Type 1 soils indicated that approximately 39 to 60 percent of the soil particles passed the No. 200 sieve. The Type 1 soils classify as A-6 soils using the AASHTO classification system. The Type 1 soils typically provide poor pavement support characteristics. Water soluble sulfate tests indicated that the soils exhibited a negligible potential for below grade sulfate attack. Groundwater was not encountered in the test borings during or subsequent to drilling. The results of laboratory testing are presented Appendix B.

Swell/Consolidation testing on the site soils was required due to their plastic indexes. The testing resulted in swells of 0.7 to 3.3 percent. Mitigation in the higher swell areas may be required. Specific mitigation recommendations will be provided in this report.

California Bearing Ratio (CBR) testing was performed on a sample of the Type 1 subgrade soils. The results of the CBR and classification testing are summarized in Table 1 and presented in the following tables, and in Appendix B, attached.

Soil Type 1 – Very Sandy Clay Fill

R @ 90% = 7.5
R @ 95% = 14.0
Use R = 14.0 for design

Classification Testing

Liquid Limit	37
Plasticity Index	16
Percent Passing 200	60.4
AASHTO Classification	A-6
Group Index	7
Unified Soils Classification	CL

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". The roadways classify as local (low volume) roadways, which used an 18K ESAL value of 36,500 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 Local (Low Volume)	80%
Serviceability Index Local (Low Volume)	2.0
"R" Value Subgrade - Soil Type 1	14.0
Resilient Modulus - Soil Type 1	4,060 psi
Structural Coefficients:	
Hot Bituminous Pavement	0.44
Aggregate Basecourse	0.11
Cement Stabilized Subgrade	0.11

Pavement calculations are attached in Appendix C. Pavement sections recommended for the site are summarized as follows:

Pavement Sections – Soil Type 1
Local (Low Volume) – ESAL = 36,500

Alternative	Asphalt (in)	Basecourse (in)	Cement Stabilized Subgrade (in.)
1. Asphalt Over Basecourse	4.0	5.5	--
2. Cement Stabilized Subgrade	4.0*	--	10.0

* Minimum sections required per the El Paso County "Pavement Design Criteria and Report".

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. One sample resulted in a volume change of 3.3 percent. The roadway subgrade soils were initially moisture conditioned and processed during utility installation. Portions of the subgrade were conditioned and compacted to specified requirements during the utility installations. Prior to paving, the subgrade should be evaluated for proper moisture conditions. In areas that need additional moisture-conditioning, we recommend that the top 12-inches of the subgrade be scarified and moisture-conditioned to 0 to 4 percent over optimum moisture content and be recompacted. Specific areas requiring mitigation should be field determined. The subgrade soils should be observed and tested by Entech personnel prior to paving.

Roadway Construction - 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 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 10 inches. The amount of cement applied shall be 2.0 percent (by weight) of the subgrade's maximum dry density as determined by the 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 a 10-inch depth such that a uniform blend of soil and cement is achieved. Prior to application or mixing of the cement, the upper 10-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 Standard Proctor Test (ASTM D-698). 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.

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

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/bs

Encl.

Entech Job No. 212277
AAprojects/2021/212277 pr

COLORADO LICENSED
MARK HOWARD HAUSCHILD
35140
9/2/2021
PROFESSIONAL ENGINEER

Reviewed by:

Mark H. Hauschild, P.E.
Senior Engineer

TABLE

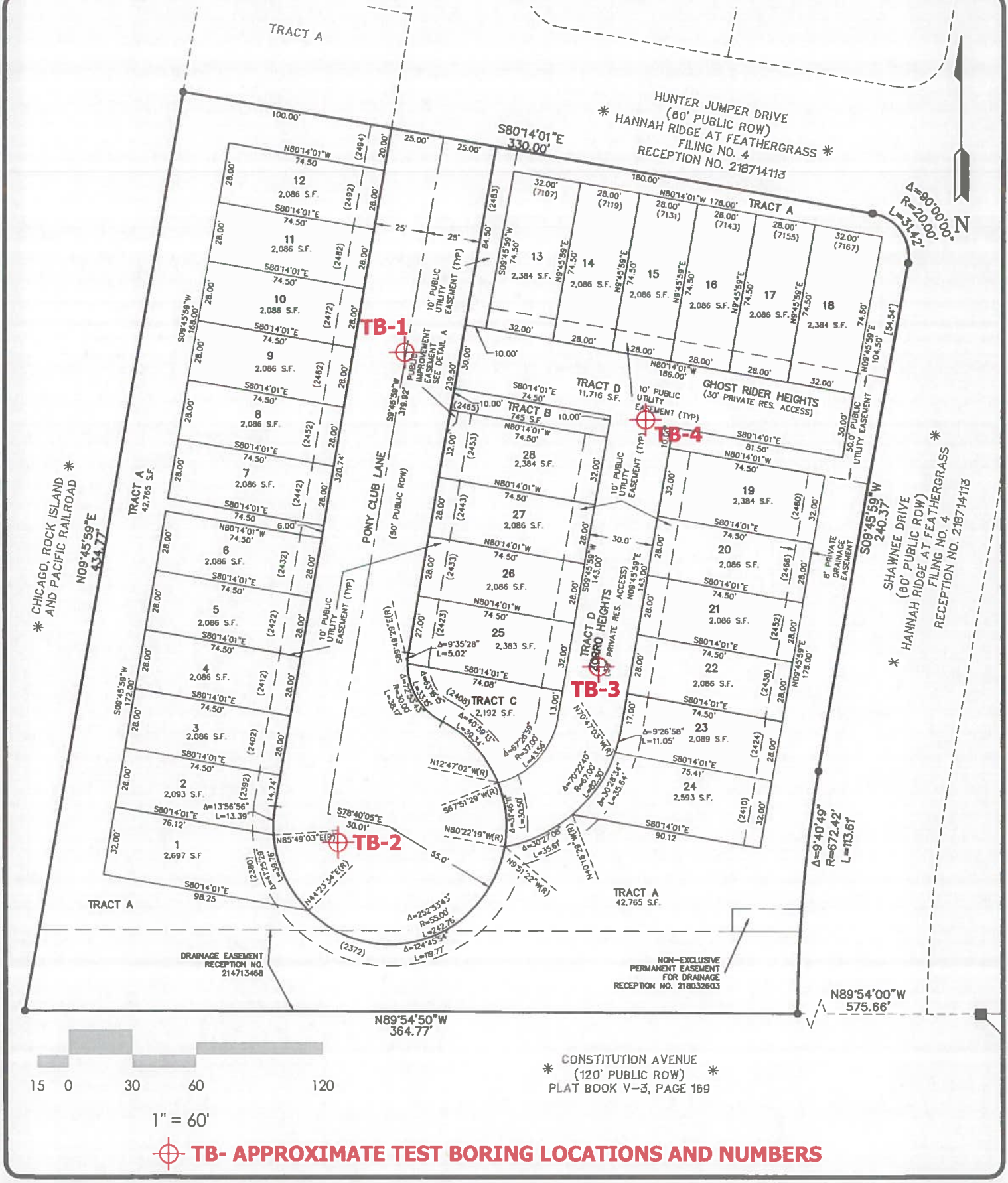
TABLE 1

SUMMARY OF LABORATORY TEST RESULTS

CLIENT CLASSIC COMMUNITIES
PROJECT MIDTOWN, HANNAH RIDGE, F-2
JOB NO. 212277

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	2	0-3	12.2	113.9	60.4	37	16		A-6	0.7	CL	FILL, CLAY, VERY SANDY
1	1	1-2	11.3	107.8	55.3	36	17		A-6	3.3	CL	FILL, CLAY, VERY SANDY
1	2	1-2	17.8	109.3	38.5	38	17		A-6	1.0	SC	FILL, SAND, VERY CLAYEY
1	3	1-2	12.3	113.7	55.4	35	18	<0.01	A-6	2.0	CL	FILL, CLAY, VERY SANDY
1	4	1-2	14.5	116.4	46.7	34	16		A-6	1.0	SC	FILL, SAND, VERY CLAYEY
1	4	0-3			48.5						SC	FILL, SAND, VERY CLAYEY

FIGURE



TB- APPROXIMATE TEST BORING LOCATIONS AND NUMBERS

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TEST BORING LOCATION MAP
MIDTOWN AT HANNAH RIDGE
COLORADO SPRINGS, COLORADO
For: CLASSIC COMMUNITIES

DRAWN:	DATE:	CHECKED:	DATE:
JAC	09/01/21	DPS	09/01/21

JOB NO.: 212277

FIG NO.: 1

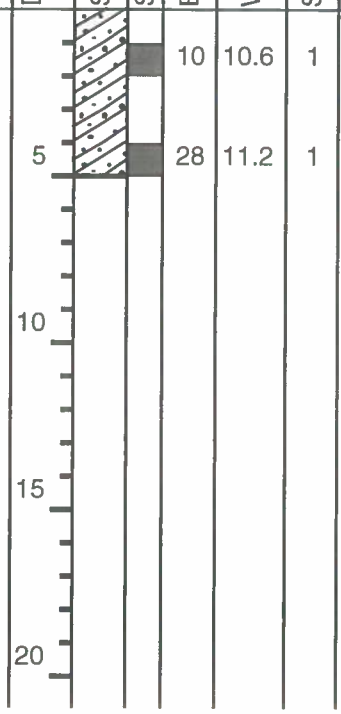
APPENDIX A: Test Boring Logs

TEST BORING NO. 1
DATE DRILLED 8/18/2021
Job # 212277

REMARKS

DRY TO 5', 8/18/21

FILL 0-5', CLAY, VERY SANDY, TAN, FIRM TO STIFF, MOIST



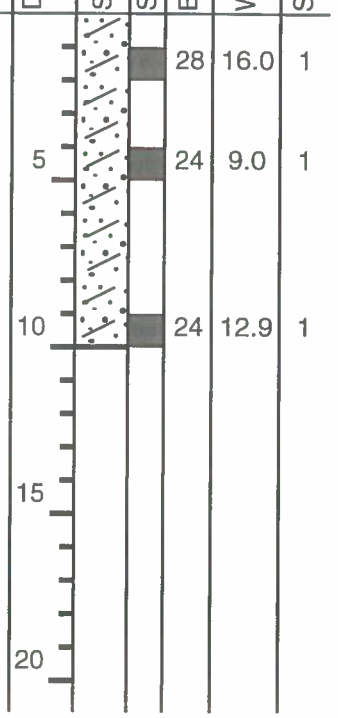
Blows per foot	Watercontent %	Soil Type
10	10.6	1
28	11.2	1

TEST BORING NO. 2
DATE DRILLED 8/18/2021
CLIENT CLASSIC COMMUNITIES
LOCATION MIDTOWN, HANNAH RIDGE, F-2

REMARKS

DRY TO 10', 8/18/21

FILL 0-10', SAND, VERY CLAYEY, FINE GRAINED, BROWN, MEDIUM DENSE, MOIST



Blows per foot	Watercontent %	Soil Type
28	16.0	1
24	9.0	1
24	12.9	1

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TEST BORING LOG

DRAWN:	DATE:	CHECKED:	DATE:
		DS	9/1/21

JOB NO.: 212277
FIG NO.: A- 1

TEST BORING NO. 3
DATE DRILLED 8/18/2021
Job # 212277

REMARKS

DRY TO 5', 8/18/21

FILL 0-5', CLAY, VERY SANDY, TAN, FIRM TO STIFF, MOIST

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			18	11.9	1
5			8	13.9	1
10					
15					
20					

TEST BORING NO. 4
DATE DRILLED 8/18/2021
CLIENT CLASSIC COMMUNITIES
LOCATION MIDTOWN, HANNAH RIDGE, F-2

REMARKS

DRY TO 5', 8/18/21

FILL, 0-5', SAND, VERY CLAYEY, FINE GRAINED, BROWN, MEDIUM DENSE TO LOOSE, MOIST

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			22	11.8	1
5			8	12.3	1
10					
15					
20					

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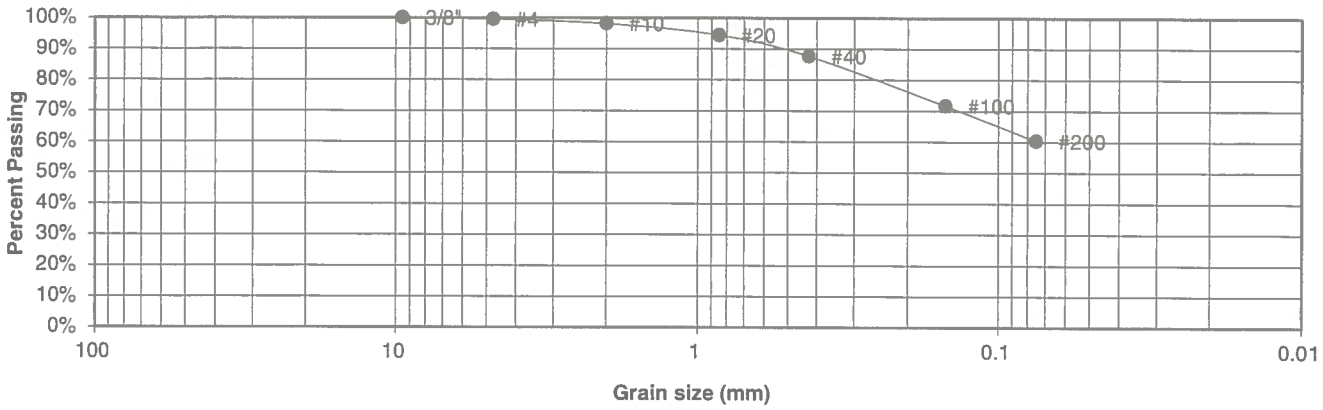
TEST BORING LOG

DRAWN:	DATE:	CHECKED:	DATE:
		DS	9/1/21

JOB NO.: 212277
FIG NO.: A- 2

APPENDIX B: Laboratory Test Results

UNIFIED CLASSIFICATION	CL	CLIENT	CLASSIC COMMUNITIES
SOIL TYPE #	1, CBR	PROJECT	MIDTOWN, HANNAH RIDGE, F-2
TEST BORING #	2	JOB NO.	212277
DEPTH (FT)	0-3	TEST BY	BL
AASHTO CLASSIFICATION	A-6	GROUP INDEX	7



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	99.5%
10	98.1%
20	94.5%
40	87.7%
100	71.7%
200	60.4%

Atterberg Limits	
Plastic Limit	21
Liquid Limit	37
Plastic Index	16

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

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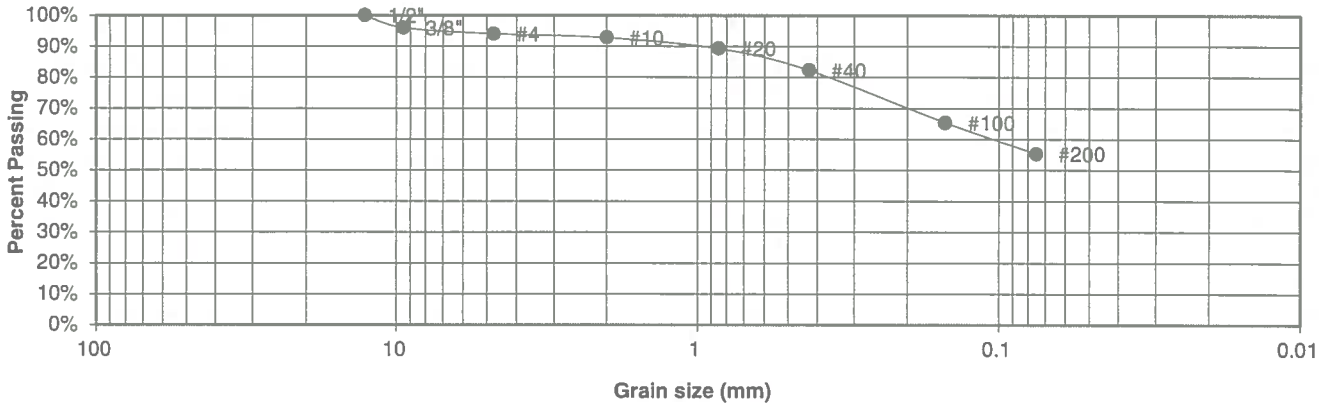
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		DS	9/1/21

JOB NO.: 212277
FIG NO.: B-1

UNIFIED CLASSIFICATION	CL	CLIENT	CLASSIC COMMUNITIES
SOIL TYPE #	1	PROJECT	MIDTOWN, HANNAH RIDGE, F-2
TEST BORING #	1	JOB NO.	212277
DEPTH (FT)	1-2	TEST BY	BL
AASHTO CLASSIFICATION	A-6	GROUP INDEX	7



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	96.0%
4	94.0%
10	92.8%
20	89.3%
40	82.3%
100	65.4%
200	55.3%

Atterberg Limits	
Plastic Limit	19
Liquid Limit	36
Plastic Index	17

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

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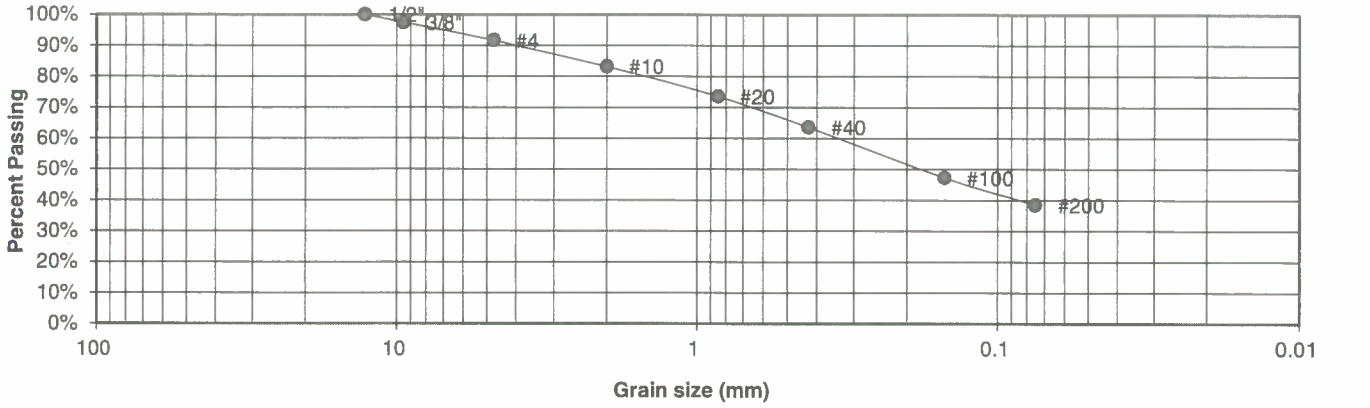
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		DS	9/1/21

JOB NO.: 212277
FIG NO.: B-2

UNIFIED CLASSIFICATION	SC	CLIENT	CLASSIC COMMUNITIES
SOIL TYPE #	1	PROJECT	MIDTOWN, HANNAH RIDGE, F-2
TEST BORING #	2	JOB NO.	212277
DEPTH (FT)	1-2	TEST BY	BL
AASHTO CLASSIFICATION	A-6	GROUP INDEX	2



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	97.5%
4	91.7%
10	83.2%
20	73.6%
40	63.6%
100	47.3%
200	38.5%

Atterberg Limits	
Plastic Limit	21
Liquid Limit	38
Plastic Index	17

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

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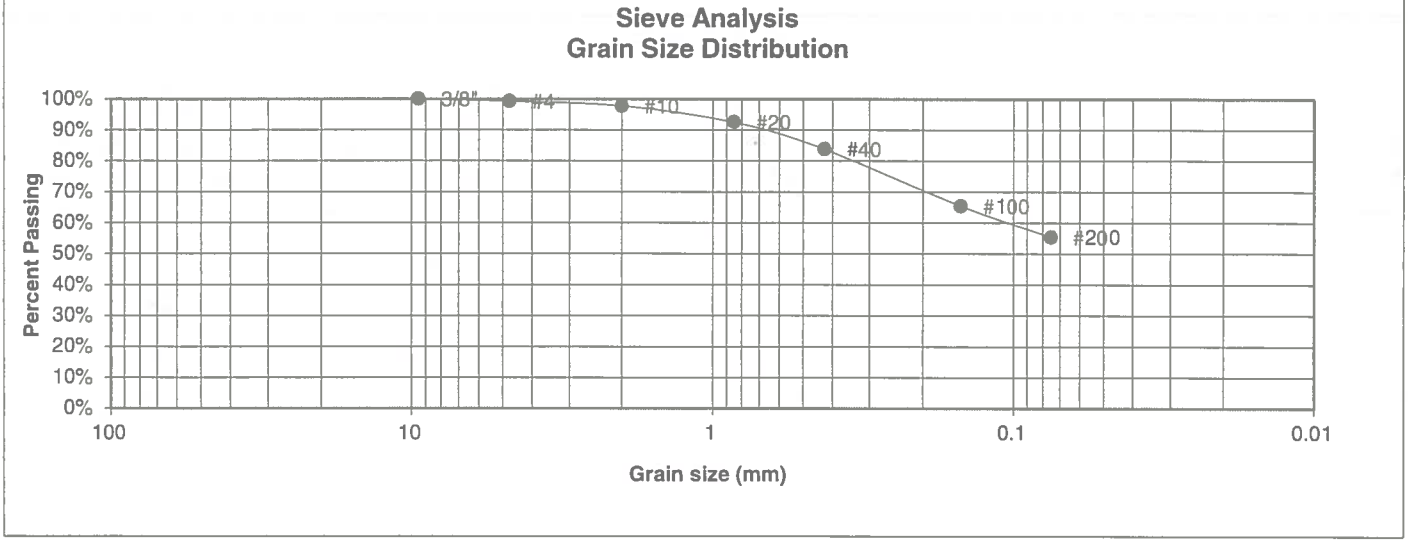
COLORADO SPRINGS, COLORADO 80907

LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		DS	9/11/21

JOB NO.: 212277
FIG NO.: B-3

UNIFIED CLASSIFICATION	CL	CLIENT	CLASSIC COMMUNITIES
SOIL TYPE #	1	PROJECT	MIDTOWN, HANNAH RIDGE, F-2
TEST BORING #	3	JOB NO.	212277
DEPTH (FT)	1-2	TEST BY	BL
AASHTO CLASSIFICATION	A-6	GROUP INDEX	7



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	99.3%
10	97.7%
20	92.5%
40	83.9%
100	65.4%
200	55.4%

Atterberg Limits	
Plastic Limit	17
Liquid Limit	35
Plastic Index	18

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

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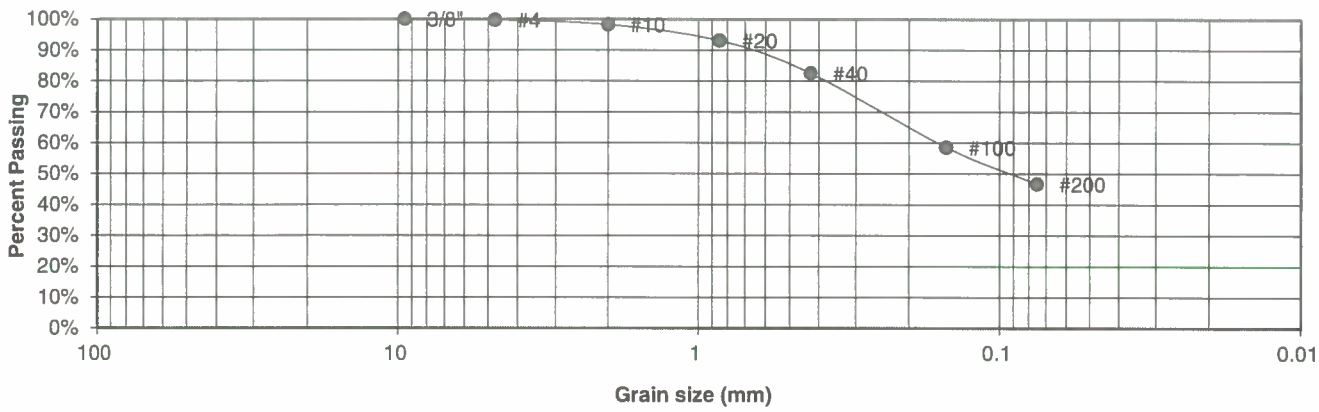
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		DS	9/1/21

JOB NO.: 212277
FIG NO.: B-4

UNIFIED CLASSIFICATION	SC	CLIENT	CLASSIC COMMUNITIES
SOIL TYPE #	1	PROJECT	MIDTOWN, HANNAH RIDGE, F-2
TEST BORING #	4	JOB NO.	212277
DEPTH (FT)	1-2	TEST BY	BL
AASHTO CLASSIFICATION	A-6	GROUP INDEX	4



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	99.7%
10	98.3%
20	93.1%
40	82.5%
100	58.5%
200	46.7%

Atterberg Limits

Plastic Limit	18
Liquid Limit	34
Plastic Index	16

Swell

Moisture at start

Moisture at finish

Moisture increase

Initial dry density (pcf)

Swell (psf)

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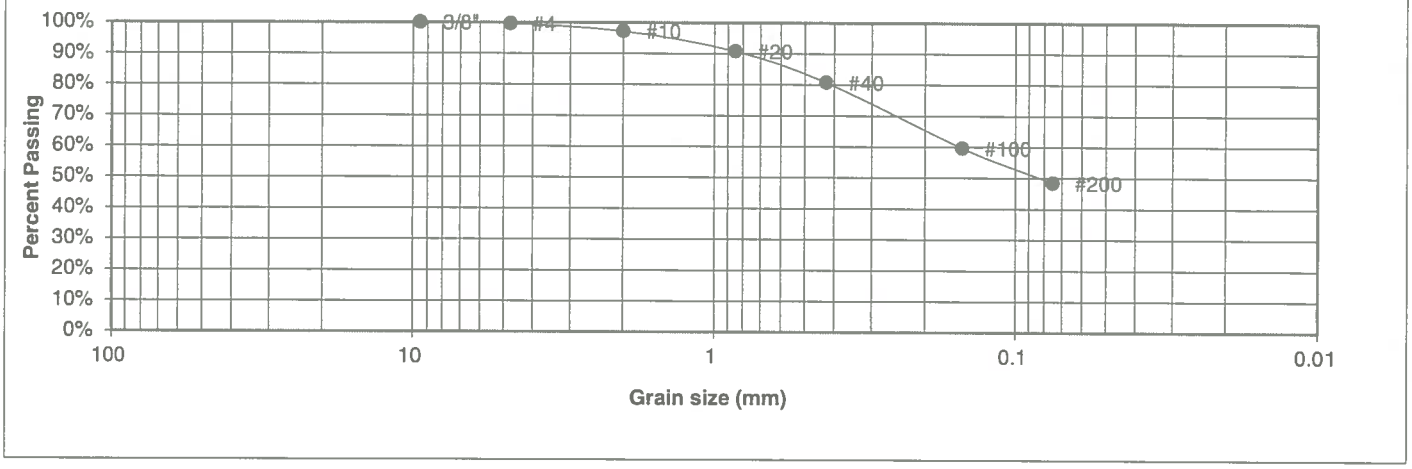
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		DS	9/1/21

JOB NO.: 212277
FIG NO.: B-5

UNIFIED CLASSIFICATION	SC	CLIENT	CLASSIC COMMUNITIES
SOIL TYPE #	1	PROJECT	MIDTOWN, HANNAH RIDGE, F-2
TEST BORING #	4	JOB NO.	212277
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	99.6%
10	97.2%
20	90.8%
40	80.7%
100	59.6%
200	48.5%

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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LABORATORY TEST RESULTS

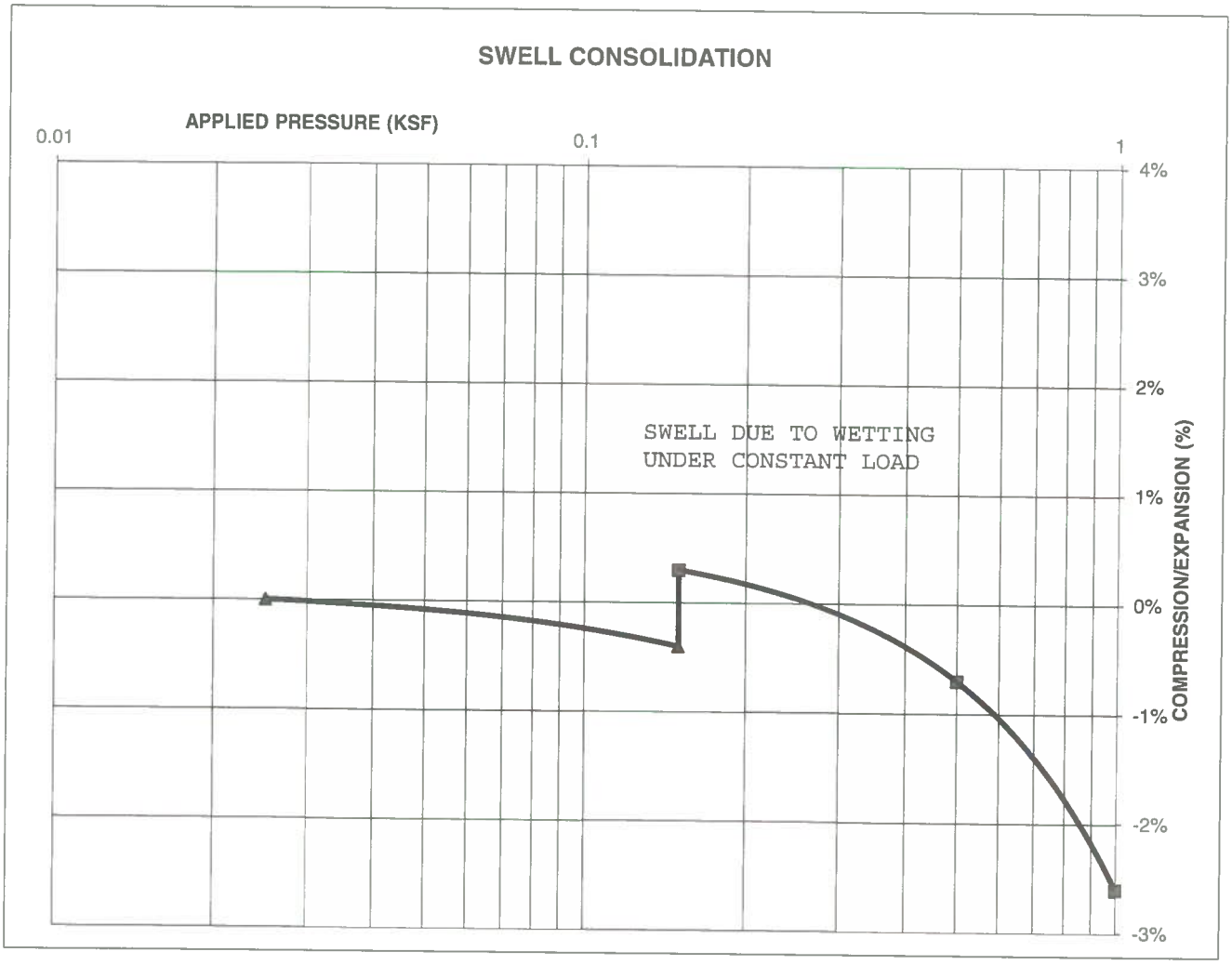
DRAWN:	DATE:	CHECKED:	DATE:
		DS	9/11/24

JOB NO.: 212277
FIG NO.: B-6

CONSOLIDATION TEST RESULTS

TEST BORING #	2	DEPTH(ft)	0-3
DESCRIPTION	CL	SOIL TYPE	1, CBR
NATURAL UNIT DRY WEIGHT (PCF)			114
NATURAL MOISTURE CONTENT			12.2%
SWELL/CONSOLIDATION (%)			0.7%

JOB NO. 212277
CLIENT CLASSIC COMMUNITIES
PROJECT MIDTOWN, HANNAH RIDGE, F-2



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SWELL CONSOLIDATION
TEST RESULTS

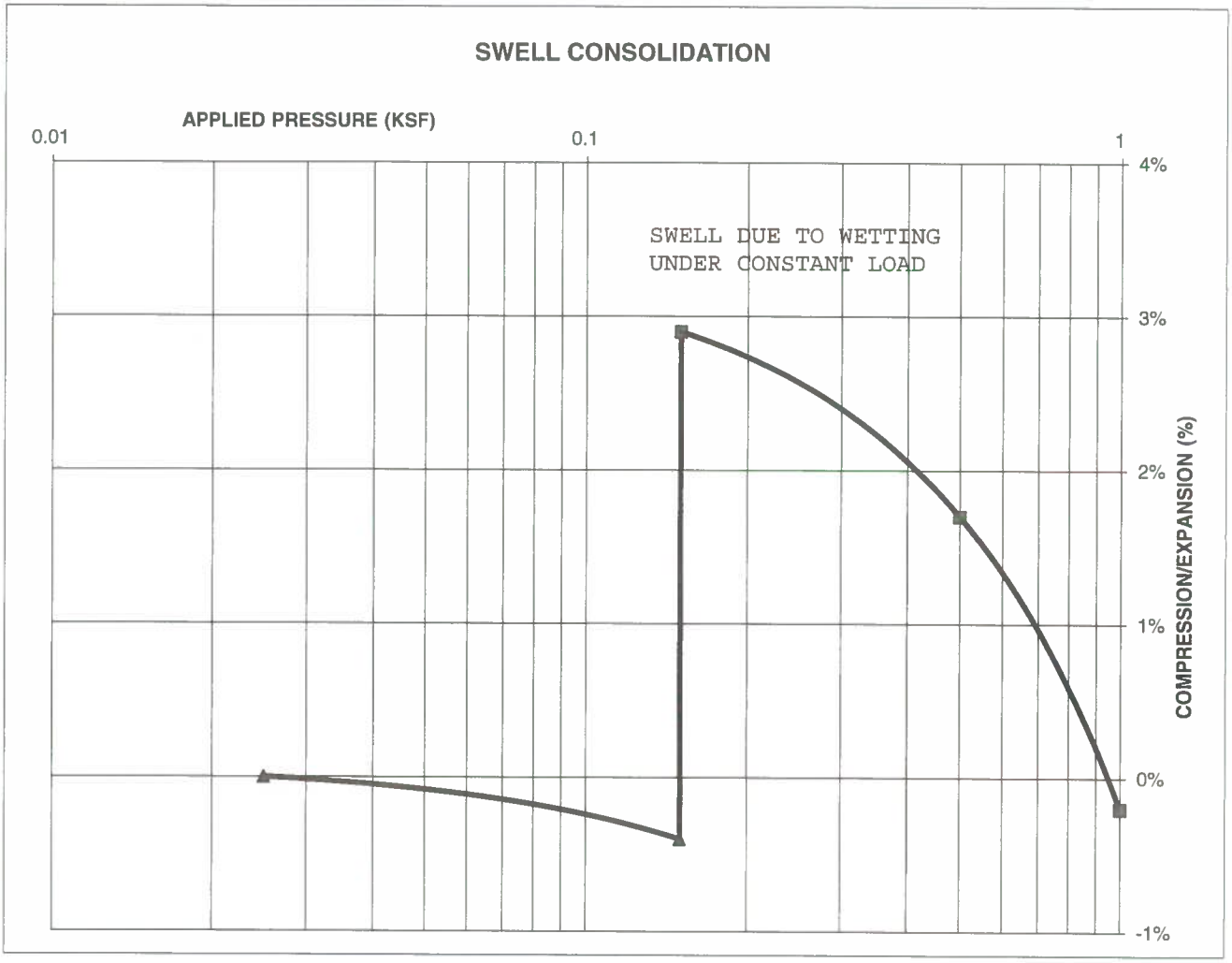
DRAWN:	DATE:	CHECKED:	DATE:
		DS	9/11/14

JOB NO.: 212277
FIG NO.: B-7

CONSOLIDATION TEST RESULTS

TEST BORING #	1	DEPTH(ft)	1-2
DESCRIPTION	CL	SOIL TYPE	1
NATURAL UNIT DRY WEIGHT (PCF)			108
NATURAL MOISTURE CONTENT			11.3%
SWELL/CONSOLIDATION (%)			3.3%

JOB NO. 212277
CLIENT CLASSIC COMMUNITIES
PROJECT MIDTOWN, HANNAH RIDGE, F-2



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SWELL CONSOLIDATION
TEST RESULTS

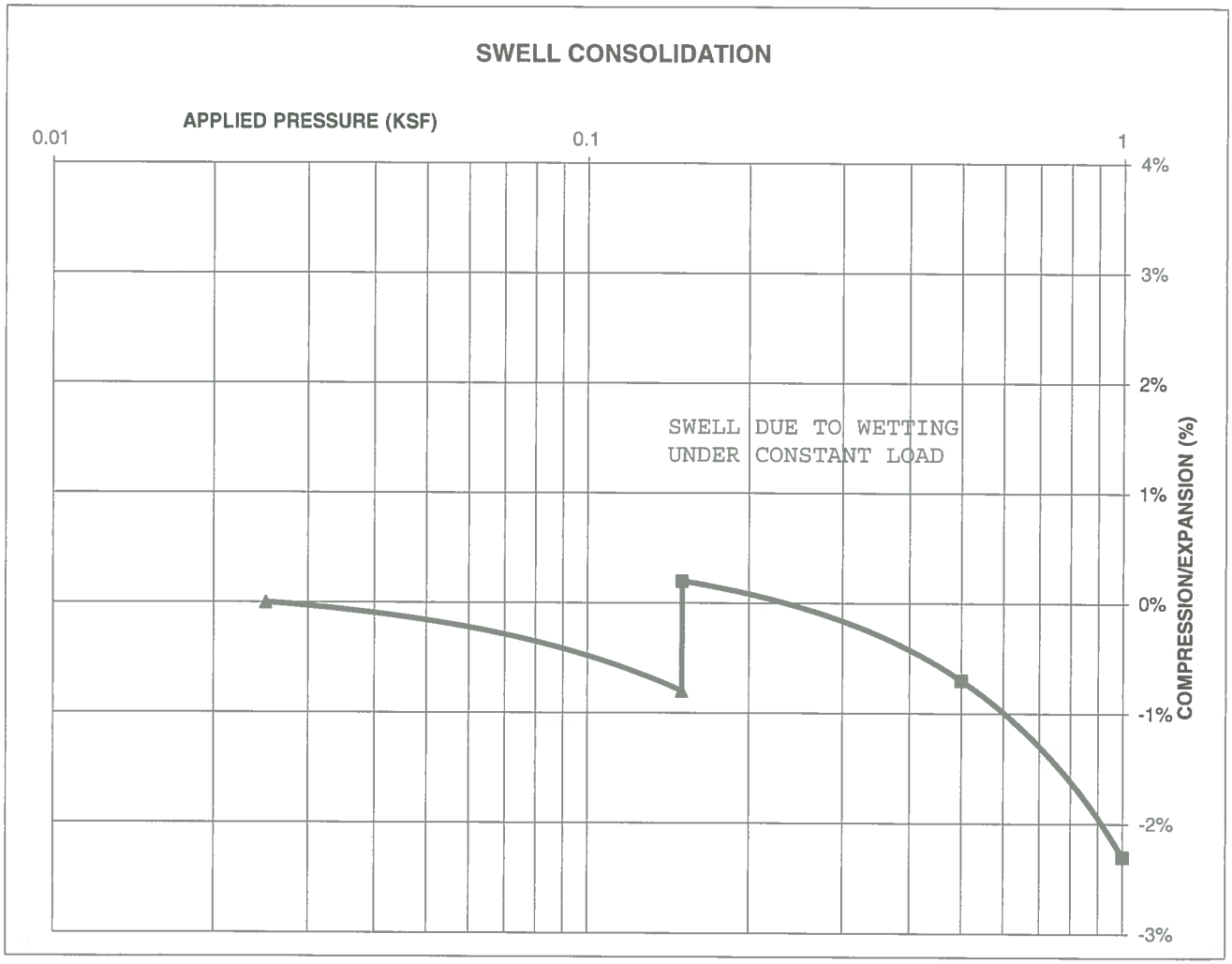
DRAWN:	DATE:	CHECKED:	DATE:
		DS	9/17/21

JOB NO.: 212277
FIG NO.: B-8

CONSOLIDATION TEST RESULTS

TEST BORING #	2	DEPTH(ft)	1-2
DESCRIPTION	SC	SOIL TYPE	1
NATURAL UNIT DRY WEIGHT (PCF)			109
NATURAL MOISTURE CONTENT			17.8%
SWELL/CONSOLIDATION (%)			1.0%

JOB NO. 212277
CLIENT CLASSIC COMMUNITIES
PROJECT MIDTOWN, HANNAH RIDGE, F-2



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COLORADO SPRINGS, COLORADO 80907

SWELL CONSOLIDATION
TEST RESULTS

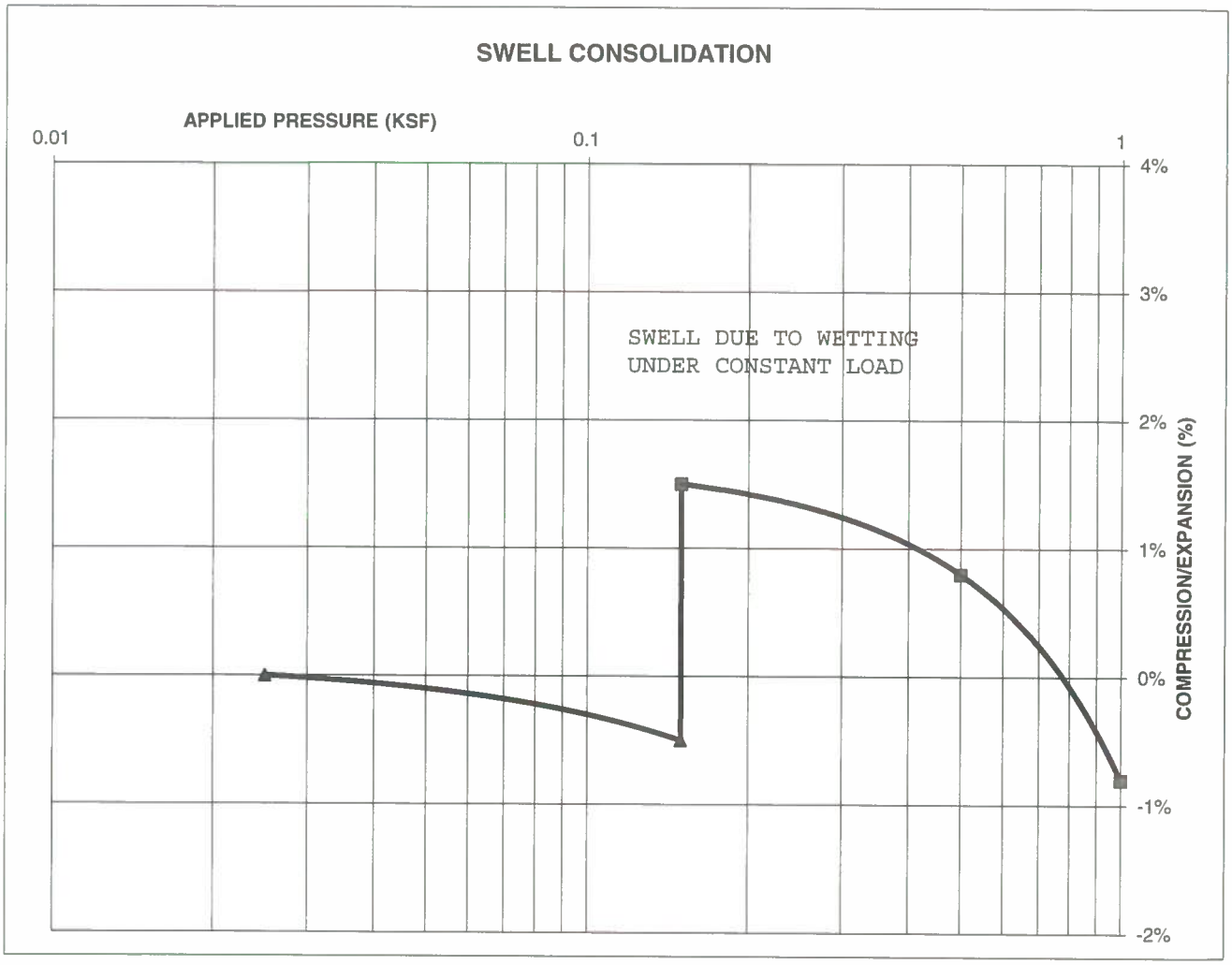
DRAWN:	DATE:	CHECKED:	DATE:
		BS	9/11/24

JOB NO.: 212277
FIG NO.: B9

CONSOLIDATION TEST RESULTS

TEST BORING #	3	DEPTH(ft)	1-2
DESCRIPTION	CL	SOIL TYPE	1
NATURAL UNIT DRY WEIGHT (PCF)			114
NATURAL MOISTURE CONTENT			12.3%
SWELL/CONSOLIDATION (%)			2.0%

JOB NO. 212277
CLIENT CLASSIC COMMUNITIES
PROJECT MIDTOWN, HANNAH RIDGE, F-2



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SWELL CONSOLIDATION
TEST RESULTS

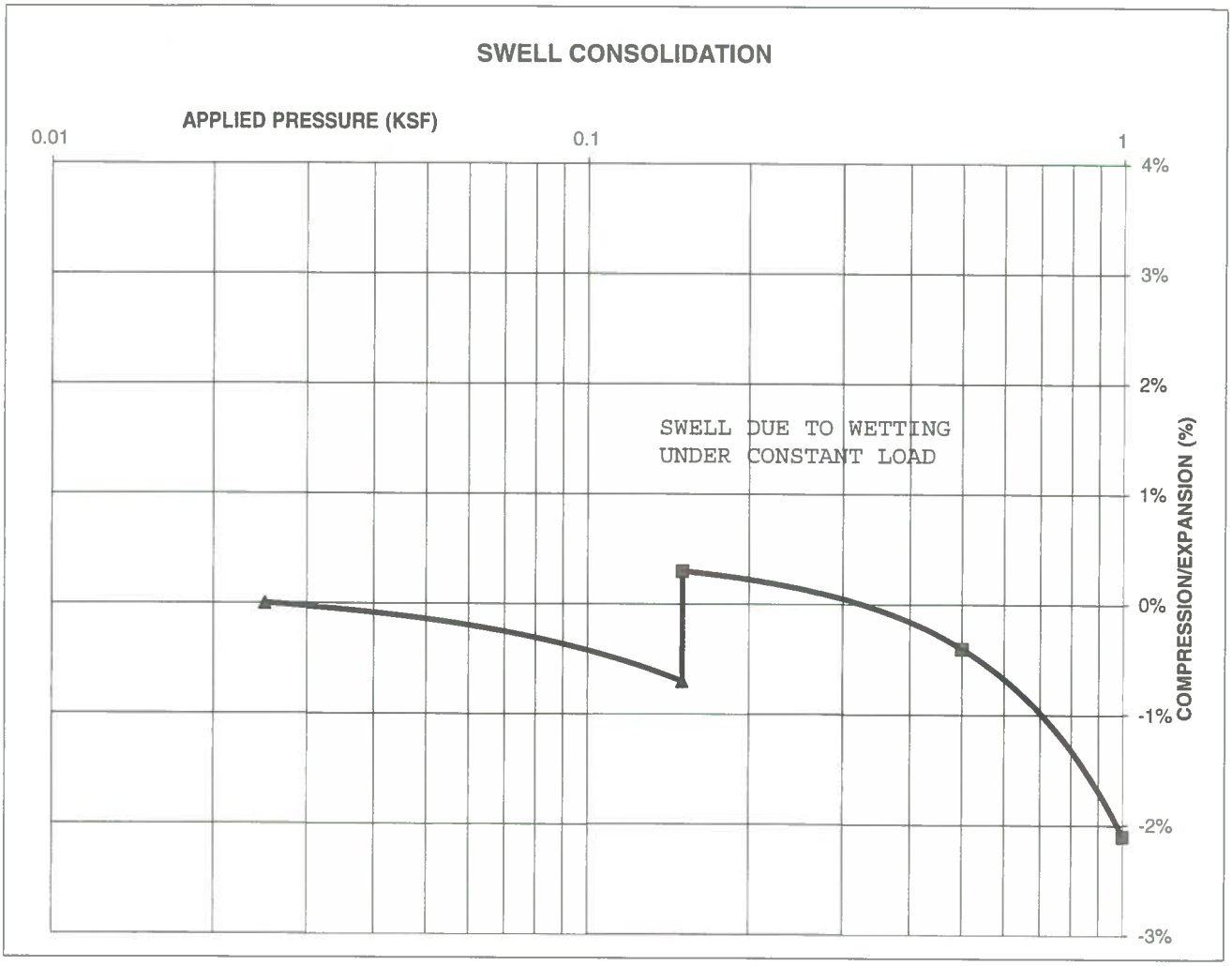
DRAWN:	DATE:	CHECKED:	DATE:
		DS	9/11/21

JOB NO.: 212277
FIG NO.: B-10

CONSOLIDATION TEST RESULTS

TEST BORING #	4	DEPTH(ft)	1-2
DESCRIPTION	SC	SOIL TYPE	1
NATURAL UNIT DRY WEIGHT (PCF)			116
NATURAL MOISTURE CONTENT			14.5%
SWELL/CONSOLIDATION (%)			1.0%

JOB NO. 212277
CLIENT CLASSIC COMMUNITIES
PROJECT MIDTOWN, HANNAH RIDGE, F-2



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SWELL CONSOLIDATION
TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		DJ	9/1/21

JOB NO.: 212277
FIG NO.: B 11

CLIENT	CLASSIC COMMUNITIES	JOB NO.	212277
PROJECT	MIDTOWN, HANNAH RIDGE, F-2	DATE	8/26/2021
LOCATION	MIDTOWN, HANNAH RIDGE, F-2	TEST BY	BL

BORING NUMBER	DEPTH, (ft)	SOIL TYPE NUMBER	UNIFIED CLASSIFICATION	WATER SOLUBLE SULFATE, (wt%)
TB-3	1-2	1	CL	<0.01

QC BLANK PASS

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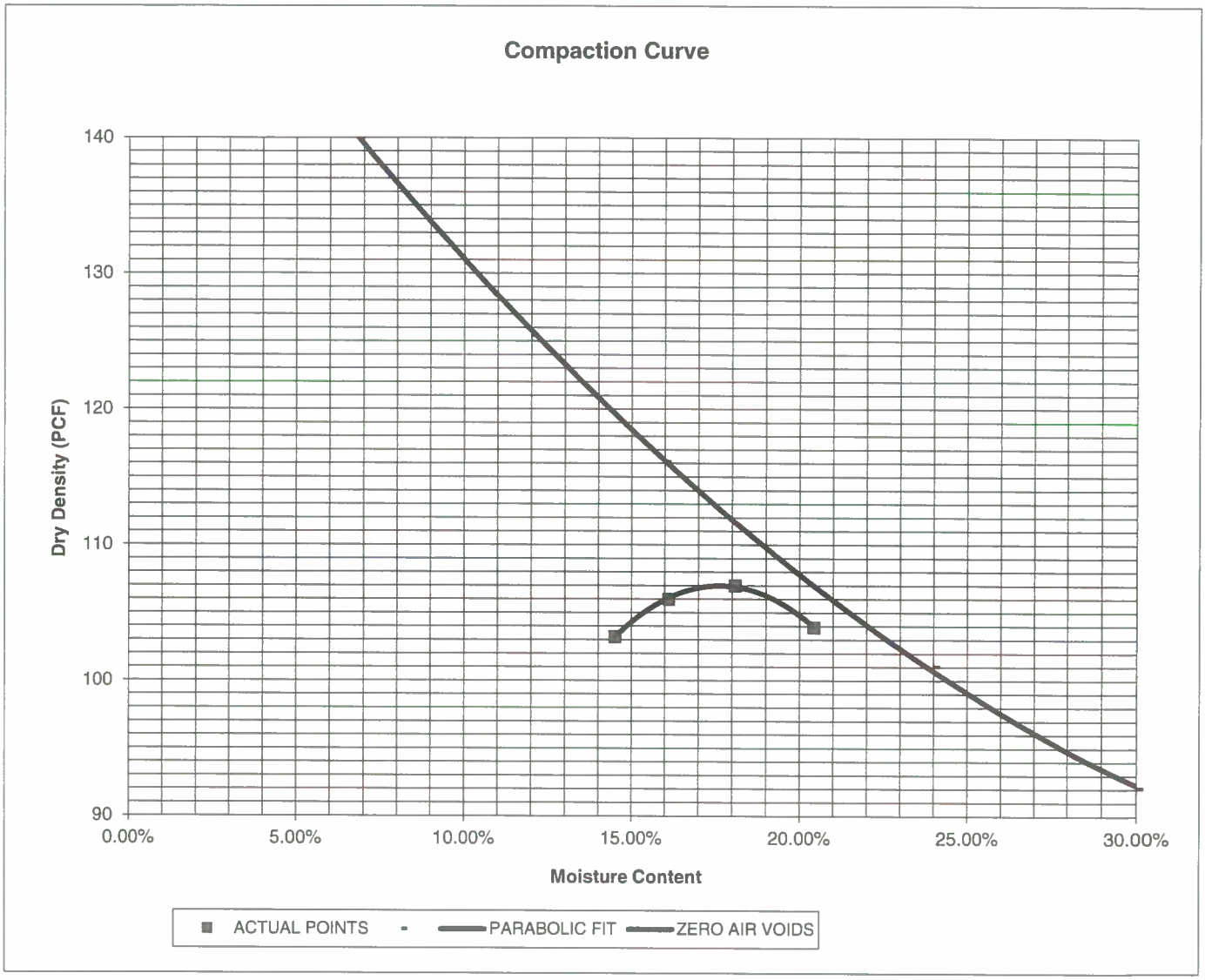
LABORATORY TEST
SULFATE RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		DS	9/1/21

JOB NO.: 212277
FIG NO.: B-12

PROJECT	MIDTOWN, HANNAH RIDGE, F-2	CLIENT	CLASSIC COMMUNITIES
SAMPLE LOCATION	TB-2 @ 0-3'	JOB NO.	212277
SOIL DESCRIPTION	FILL, CLAY, VERY SANDY, BROWN	DATE	08/26/21

IDENTIFICATION	CL	COMPACTION TEST #	1
TEST DESIGNATION / METHOD	ASTM D-698-A	TEST BY	BL
MAXIMUM DRY DENSITY (PCF)	106.9	OPTIMUM MOISTURE	17.7%



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MOISTURE DENSITY RELATION

DRAWN:	DATE:	CHECKED:	DATE:
		DS	9/1/21

JOB NO.: 212277
FIG NO.: B-13

CBR TEST LOAD DATA

JOB NO: 212277
CLIENT: CLASSIC COMMUNITIES
PROJECT: MIDTOWN, HANNAH RIDGE, F-2
SOIL TYPE: 1

PISTON DIAMETER (cm)	PISTON AREA (in^2)
4.958	2.993

PENETRATION DEPTH (INCHES)	*10 BLOWS* MOLD # 1 LOAD(LBS) (LBS)	STRESS (PSI)	*25 BLOWS* MOLD # 2 LOAD(LBS) (LBS)	STRESS (PSI)	*56 BLOWS* MOLD # 3 LOAD(LBS) (LBS)	STRESS (PSI)
0.000	0	0.00	0	0.00	0	0.00
0.025	15	5.01	30	10.03	59	19.72
0.050	28	9.36	56	18.71	111	37.09
0.075	38	12.70	75	25.06	154	51.46
0.100	45	15.04	89	29.74	182	60.82
0.125	51	17.04	101	33.75	201	67.17
0.150	56	18.71	111	37.09	216	72.18
0.175	61	20.38	120	40.10	239	79.87
0.200	64	21.39	127	42.44	251	83.88
0.300	66	22.06	130	43.44	256	85.55
0.400	72	24.06	142	47.45	276	92.23
0.500	85	28.40	165	55.14	297	99.25

FINAL MOISTURE CONTENT

	MOLD # 1	MOLD # 2	MOLD # 3
CAN #			
WT. CAN			
WT. CAN+WET			
WT. CAN+DRY			
WT. H20	#VALUE!	#VALUE!	#VALUE!
WT. DRY SOIL	#VALUE!	#VALUE!	#VALUE!
MOISTURE CONTENT	#VALUE!	#VALUE!	#VALUE!

WET DENSITY (PCF)	108.3	112.6	119.5
DRY DENSITY (PCF)	92.0	95.7	101.5
BEARING RATIO	1.50	2.97	6.08

90% OF DRY DENSITY	96.2
95% OF DRY DENSITY	101.6

BEARING RATIO AT 90% OF MAX	3.25	~ R VALUE	7.5
BEARING RATIO AT 95% OF MAX	6.11	~ R VALUE	14

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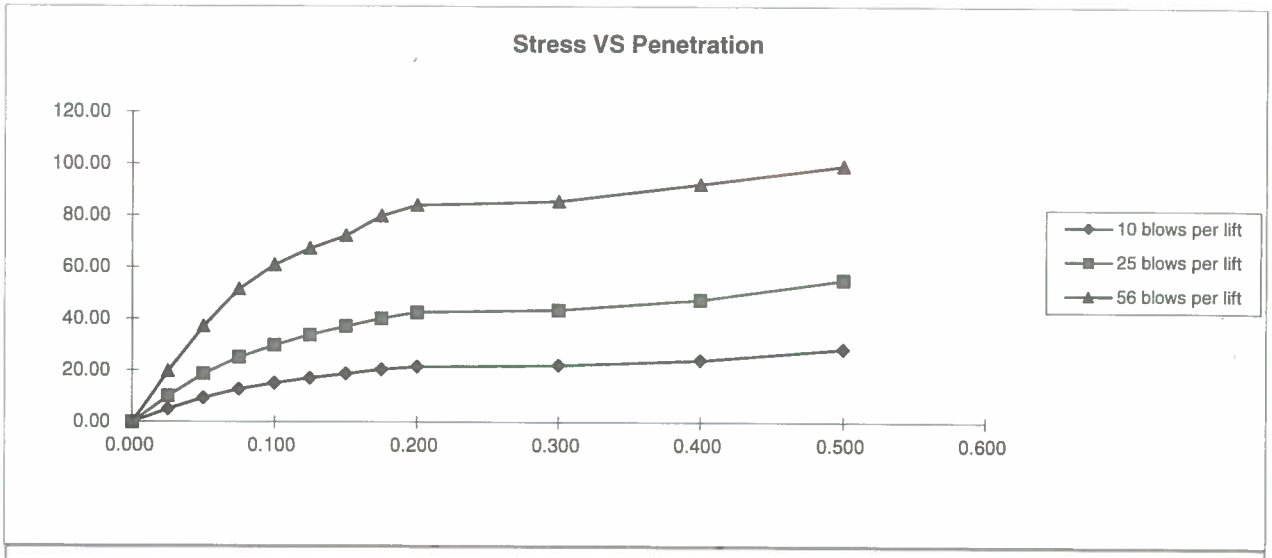
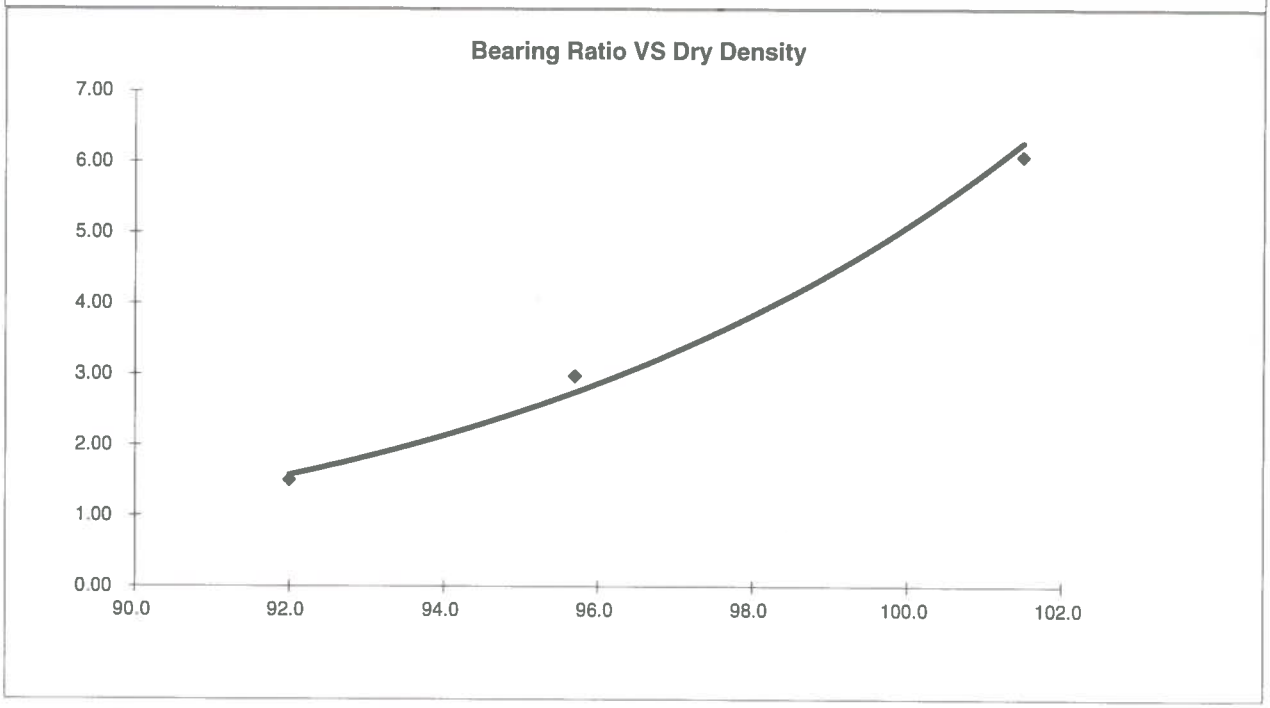
CBR TEST DATA

DRAWN:	DATE:	CHECKED:	DATE:
		DS	9/11/21

JOB NO.: 212277
FIG NO.: B-14





BEARING RATIO AT 90% OF MAX	3.25	~ R VALUE	7.50
BEARING RATIO AT 95% OF MAX	6.11	~ R VALUE	14.00

JOB NO: 212277
SOIL TYPE: 1

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CALIFORNIA BEARING RATIO

DRAWN:	DATE:	CHECKED:	DATE:
		DJ	9/1/21

JOB NO.: 212277
FIG NO.: B-15

APPENDIX C: Pavement Design Calculations

FLEXIBLE PAVEMENT DESIGN

DESIGN DATA — CLASSIC COMMUNITIES - MIDTOWN AT HANNAH RIDGE, F2
URBAN LOCAL LOW VOLUME ROADS - SOIL TYPE 1
PONY CLUB LANE, GHOST RIDER HEIGHTS AND ZORRO HEIGHTS

Equivalent (18 kip) Single Axle Load Applications (ESAL):	ESAL (W_{18}) =	36,500
Hveem Stabilometer (R Value) Results:	R =	14
Standard Deviation	S_o =	0.45
Loss in Serviceability	Δpsi =	2.0
Reliability	Reliability =	80
Reliability (z-statistic)	Z_R =	-0.841
Soil Resilient Modulus	M_R =	4060

Weighted Structural Number (WSN): → WSN = 2.33

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)
60	-0.253
70	-0.524
75	-0.674
80	-0.841
85	-1.036
90	-1.282
95	-1.65
97	-1.88
98	-2.05
99	-2.33
99.9	-3.09
99.99	-3.75

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

Left	Right	Difference
4.56	4.56	0.0

Job No. 212277
Fig. No. C-1

DESIGN CALCULATIONS

DESIGN DATA — CLASSIC COMMUNITIES - MIDTOWN AT HANNAH RIDGE, F2
URBAN LOCAL LOW VOLUME ROADS - SOIL TYPE 1
PONY CLUB LANE, GHOST RIDER HEIGHTS, AND ZORRO HEIGHTS

Equivalent (18 kip) Single Axle Load Applications (ESAL):	ESAL =	36,500
Hveem Stabilometer (R Value) Results:	R =	14
Weighted Structural Number (WSN):	WSN =	2.33

DESIGN EQUATION

$$WSN = C_1D_1 + C_2D_2$$

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

$D_1 = (WSN)/C_1$ = 5.3 inches of Full Depth Asphalt
Use 5.5 inches Full Depth

FOR ASPHALT + AGGREGATE BASE COURSE SECTION

Asphalt Thickness (t) = 4 inches
$D_2 = ((WSN) - (t)(C_1))/C_2$ = 5.2 inches of Aggregate
Base Course, use 5.5 inches

RECOMMENDED ALTERNATIVES

1. 4.0 inches of Asphalt + 5.5 inches of Aggregate Base Course, or
2. 5.5 inches of Asphalt

Job No. 212277
Fig. No. C-2

DESIGN CALCULATIONS

CEMENT SECTIONS

DESIGN DATA CLASSIC COMMUNITIES - MIDTOWN AT HANNAH RIDGE, F2
URBAN LOCAL LOW VOLUME ROADS - SOIL TYPE 1
PONY CLUB LANE, GHOST RIDER HEIGHTS, AND ZORRO HEIGHTS

Equivalent (18 kip) Single Axle Load Applications (ESAL):	ESAL =	36,500
Hveem Stabilometer (R Value) Results:	R =	14
Weighted Structural Number (WSN):	WSN =	2.33

DESIGN EQUATION

$$WSN = C_1D_1 + C_2D_2$$

C_1 = 0.44 Strength Coefficient - Hot Bituminous Asphalt
C_2 = 0.11 Strength Coefficient - Cement Stabilized Subgrade

D_1 = Depth of Asphalt (inches)
D_2 = Depth of Cement Stabilized Subgrade (inches)

FOR FULL DEPTH ASPHALT SECTION

$D_1 = (WSN)/C_1$ = 5.3 inches of Full Depth Asphalt
Use [5.5] inches Full Depth

FOR ASPHALT + CEMENT STABILIZED SUBGRADE SECTION

Asphalt Thickness (t) = [4] inches
$D_2 = ((WSN) - (t)(C_1))/C_2$ = 5.2 inches of Cement Stabilized Subgrade
Use [10.0] inches

RECOMMENDED ALTERNATIVES

1. 4.0 inches of Asphalt + 10.0 inches of Cement Stabilized Subgrade, or
2. 5.5 inches of Asphalt

Job No. 212277
Fig. No. C-3