ENTECH
ENGINEERING, INC.
505 ELKTON DRIVE
COLORADO SPRINGS, CO 80907
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Revised September 22, 2022
September 8, 2022

Phill's Boys Falcon, LLC
6547 North Academy Boulevard
Colorado Springs, CO 80918

Attn: Teddy McDonald

Re: Pavement Recommendations – Revision
Range Flower Way
14010 Judge Orr Road
El Paso County, Colorado
Entech Job No. 212526

Dear Mr. McDonald:

As requested, Entech Engineering, Inc. has obtained samples of the pavement subgrade soils from portions of Range Flower Way in the RV Park and Storage Facility located at 14010 Judge Orr Road. This letter presents the results of the laboratory testing and pavement recommendations for the roadway sections.

Project Description

The roadway for this project is Range Flower Way which is located at the west edge of the RV park in northeast El Paso County. Subsurface Soil Investigation and laboratory testing was performed in order to determine the pavement support characteristics of the soils. The limits of this investigation and the approximate locations of the test borings are presented in the Site/Test Boring Location Map, Figure 1.

Subgrade Conditions

Four test borings were drilled along the above referenced roadway to depths of approximately 5 to 10 feet below the existing subgrade surface. The borings were placed at approximately 500-foot spacings. The Test Boring Logs are presented in Appendix A. Sieve Analyses and Atterberg Limit testing were performed on the soil samples obtained from the test borings for the purpose of classification. The percent passing the No. 200 sieve for the soils at subgrade depth ranged from approximately 3 to 46 percent. The soils at the subgrade depth consisted of clayey sand to silty sand fill, native very clayey sand, and native clean sand. Based on the results of the laboratory testing, two general subgrade soil types were determined for the roadway sections at subgrade depths; clean sand to clayey sand fill to silty sand fill (Soil Type 1) and very clayey sand fill (Soil Type 2). Both the Type 1 and Type 2 Soil were utilized for the pavement design. The sections of both the Type 1 and Type 2 soils are shown in the Site/Test Boring Location Map. The Type 1 soils classify as A-2-4 and A-1-b, and the Type 2 soils classify as A-6, based on the AASHTO Classification System. Swell/Consolidation Tests indicated volume changes of 0.5% and 0.6%, which are in the low expansion range for a samples of very clayey sand fill from Test Boring No. 3 at depths of 0 to 3 feet and 1 to 2 feet, respectively. Based on the swells, mitigation of the subgrade is not required for this site. Groundwater was not encountered in any of the test borings. Water soluble sulfate testing indicates a negligible potential for sulfate attack.

California Bearing Ratio (CBR) testing was performed on representative samples of both the Type 1 and Type 2 subgrade soils. The results of the CBR and classification testing are presented as follows and in Appendix B and on Table 1, attached. Based on the results of the classification and CBR testing, the Type 1 soils exhibit good pavement support characteristics and the Type 2 soils exhibit poor to fair pavement support characteristics. The results of the CBR testing, classification testing, and Swell/Consolidation test are presented in Appendix B and are summarized as follows:

Soil Type 1 – Clayey Sand		Soil Type 2 – Very Clayey Sand	
R @ 90% = 65.0		R @ 90% = 10.0	
R @ 95% = 71.0		R @ 95% = 17.0	
Use R = 50.0 for design		Use R = 17.0 for design	
Classification Testing		Classification Testing	
Liquid Limit	26	Liquid Limit	33
Plasticity Index	10	Plasticity Index	15
Percent Passing 200	33	Percent Passing 200	45.7
AASHTO Classification	A-2-4	AASHTO Classification	A-6
Group Index	0	Group Index	3
Unified Soils Classification	SC	Unified Soils Classification	SC

Pavement Design

CBR testing was used to determine pavement sections for the roadway sections. Pavement sections were determined utilizing Pavement Design Criteria for El Paso County. Range Flower Way classifies as Urban Nonresidential Collector, which used a 18K ESAL value of 821,000 for design. Pavement sections were determined for asphalt supported on aggregate base course. The source and locations are provided in the report.

Design parameters used in the pavement analysis for the roadway section are as follows:

Reliability	85%
Standard Deviation	0.45
Resilient Modulus:	
Soil Type 1	13,168 psi
Soil Type 2	4,478 psi
Δpsi	2.5
"R" Value Subgrade Soil Type 1	50
"R" Value Subgrade Soil Type 2	17
Structural Coefficients:	
Hot Bituminous Asphalt	0.44
Aggregate Basecourse	0.11

The pavement design calculations are presented in Appendix C. Pavement section alternatives for the roadway sections are presented below. Additional grading may result in subgrade soils with different support characteristics. The following pavement sections should be re-evaluated if additional grading is performed.

Range Flower Way – Urban Nonresidential Collector

Soil Type 1

Composite Sections	Asphalt (in)	Basecourse (in)
1. Asphalt Over Base Course	4.0	8.0

Soil Type 2

Composite Sections	Asphalt (in)	Basecourse (in)
1. Asphalt Over Base Course	5.5	11.0

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.

Roadway Construction

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

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.

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, subgrade conditions, compaction of materials and roadway construction methods shall meet the El Paso County specifications.

We trust that this report contains the information you require. If you have questions or need additional information, please contact us.

Respectfully Submitted,

ENTECH ENGINEERING, INC.

Daniel P. Stegman

Reviewed by:

COLORADO LICENSED
ROBERT PAUL JAQUET
58495
9/22/22
PROFESSIONAL ENGINEER

Robert P. Jaquet, P.E.

RPJ/jr

Encl.
AAprojects/2021/212526 – pr

TABLE

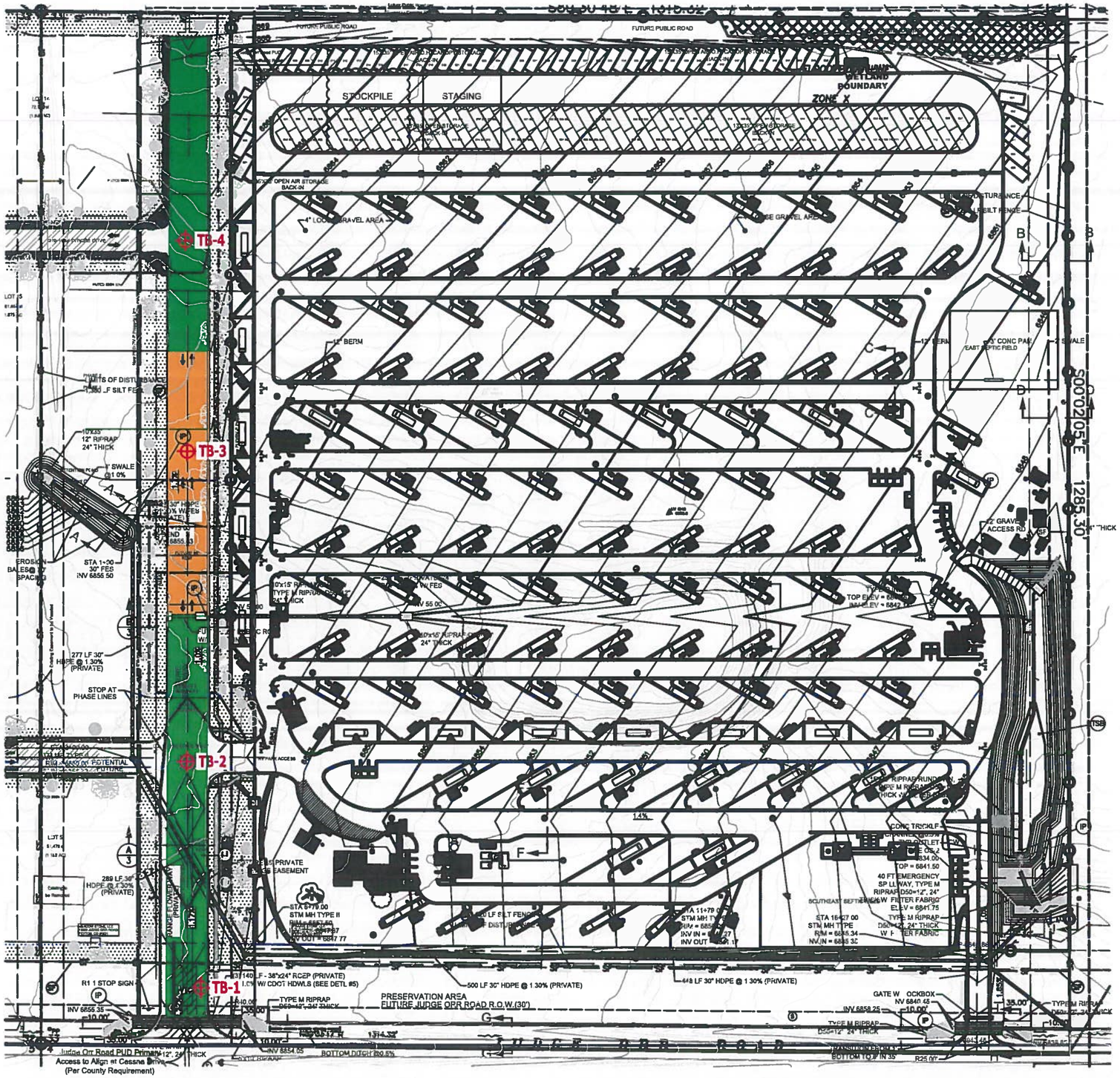
TABLE 1

SUMMARY OF LABORATORY TEST RESULTS

CLIENT PHILS BOYS FALCON
PROJECT 14010 JUDGE ORR ROAD
JOB NO. 212526

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	1-2			33.0	26	10	0.00	A-2-4		SC	FILL, SAND, CLAYEY
1	2	0-3			15.6	NV	NP		A-1-b		SM	FILL, SAND, SILTY
1	2	1-2			15.7	NV	NP	<0.01	A-2-4		SM	FILL, SAND, SILTY
1	4	1-2			3.4	NV	NP	<0.01	A-1-b		SW	FILL, SAND
2, CBR	3	0-3	16.8	107.7	45.7	33	15		A-6	0.5	SC	FILL, SAND, VERY CLAYEY
2	3	1-2	12.8	109.5	42.1	32	12		A-6	0.6	SC	FILL, SAND, VERY CLAYEY

FIGURE



LEGEND

SOIL TYPE NO. 1 PAVEMENT SECTIONS:

1. 4" ASPHALT OVER 8" AGGREGATE BASE COURSE

SOIL TYPE NO. 2 PAVEMENT SECTIONS:

1. 5.5" ASPHALT OVER 11" AGGREGATE BASE COURSE

- SOIL TRANSITIONS SHOULD BE FIELD DETERMINED

TB-#- APPROXIMATE TEST BORING LOCATION AND NUMBER

35' 140'
70' 210'
1"=140'

N

REVISION	BY
9/22/2022	RPJ

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SITE/TEST BORING LOCATION MAP
14010 JUDGE ORR ROAD
EL PASO COUNTY, CO.
FOR: PHILS BOYS FALCON

DRAWN	JHR
CHECKED	RPJ
DATE	9/7/22
SCALE	1"=145'
JOB NO.	212526
FIGURE No.	1

APPENDIX A: Test Boring Logs

TEST BORING NO. 1
DATE DRILLED 8/12/2022
Job # 212526

REMARKS

DRY TO 5', 8/12/22

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type	
						FILL 0-5', SAND, CLAYEY, FINE TO COARSE GRAINED, BROWN, MEDIUM DENSE, MOIST TO DRY
			29	4.6	1	
5			27	1.7	1	
10						
15						
20						

TEST BORING NO. 2
DATE DRILLED 8/12/2022
CLIENT PHILS BOYS FALCON
LOCATION 14010 JUDGE ORR ROAD

REMARKS

DRY TO 5', 8/12/22

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type	
						FILL 0-5', SAND, SILTY, FINE TO COARSE GRAINED, BROWN, MEDIUM DENSE TO DENSE, DRY TO MOIST
			26	1.8	1	
5			47	3.3	1	
10						
15						
20						

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TEST BORING LOG

DRAWN:	DATE:	CHECKED: JHR	DATE: 8/31/22

JOB NO.: 212526
FIG NO.: A- 1

TEST BORING NO. 3
DATE DRILLED 8/12/2022
Job # 212526

REMARKS

DRY TO 10', 8/12/22

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type	
						FILL 0-10', SAND, VERY CLAYEY, FINE TO COARSE GRAINED, TAN TO GRAY BROWN, MEDIUM DENSE TO VERY DENSE, MOIST
			25	5.3	2	
5			50/11"	10.9	2	
10			37	14.6	2	
15						
20						

TEST BORING NO. 4
DATE DRILLED 8/12/2022
CLIENT PHILS BOYS FALCON
LOCATION 14010 JUDGE ORR ROAD

REMARKS

DRY TO 5', 8/12/22

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type	
						FILL 0-5', SAND, FINE TO COARSE GRAINED, BROWN, MEDIUM DENSE TO DENSE, DRY
			28	0.7	1	
5			32	2.6	1	
10						
15						
20						

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TEST BORING LOG

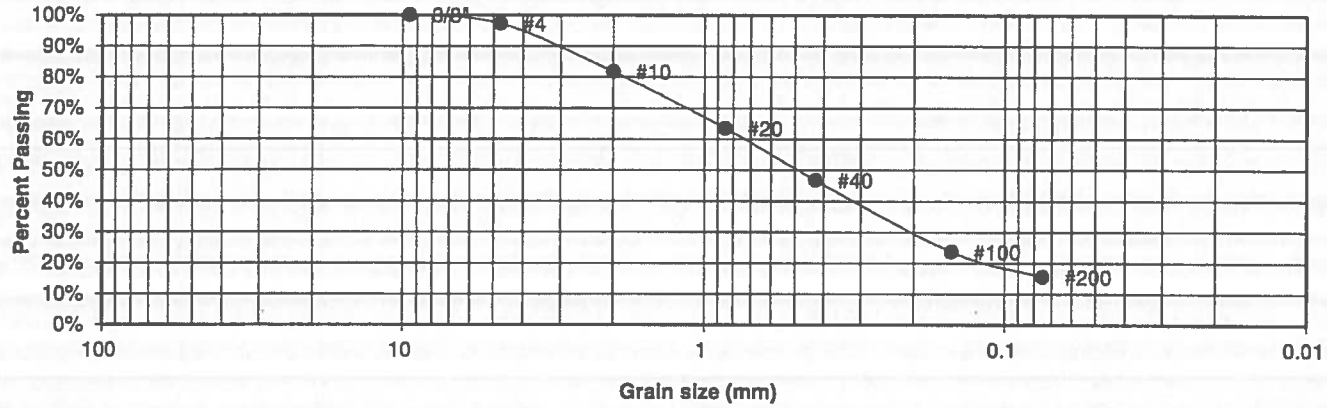
DRAWN:	DATE:	CHECKED:	DATE:
		SUL	8/31/22

JOB NO.: 212526
FIG NO.: A- 2

APPENDIX B: Laboratory Testing Results

UNIFIED CLASSIFICATION	SM	CLIENT	PHILS BOYS FALCON
SOIL TYPE #	1, CBR	PROJECT	14010 JUDGE ORR ROAD
TEST BORING #	2	JOB NO.	212526
DEPTH (FT)	0-3	TEST BY	BL
AASHTO CLASSIFICATION	A-1-b	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	97.2%
10	81.7%
20	63.5%
40	46.8%
100	23.6%
200	15.6%

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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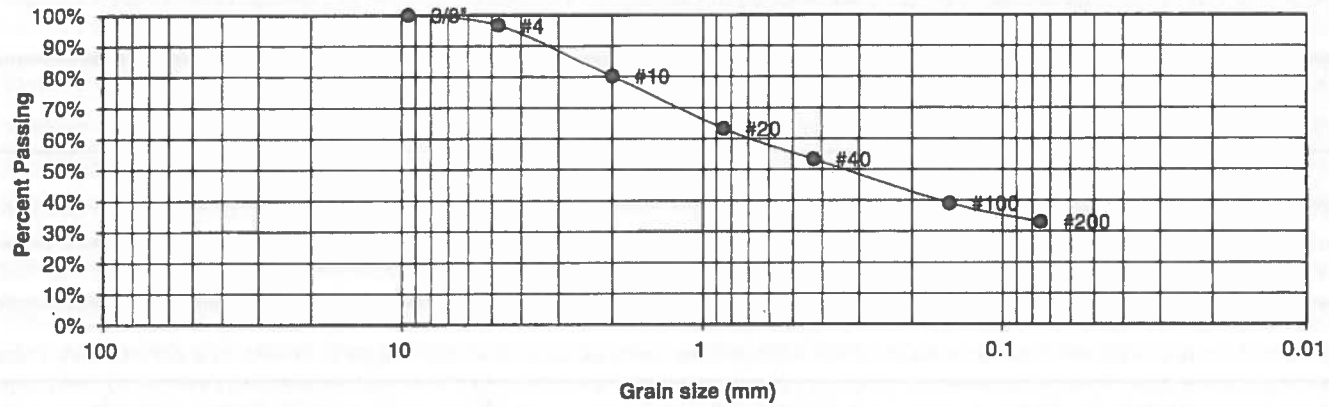
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		JHR	9-7-22

JOB NO.: 212526
FIG NO.: B-1

UNIFIED CLASSIFICATION	SC	CLIENT	PHILS BOYS FALCON
SOIL TYPE #	1	PROJECT	14010 JUDGE ORR ROAD
TEST BORING #	1	JOB NO.	212526
DEPTH (FT)	1-2	TEST BY	BL
AASHTO CLASSIFICATION	A-2-4	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	96.6%
10	80.2%
20	63.2%
40	53.3%
100	39.0%
200	33.0%

Atterberg Limits

Plastic Limit	16
Liquid Limit	26
Plastic Index	10

Swell

Moisture at start

Moisture at finish

Moisture increase

Initial dry density (pcf)

Swell (psf)

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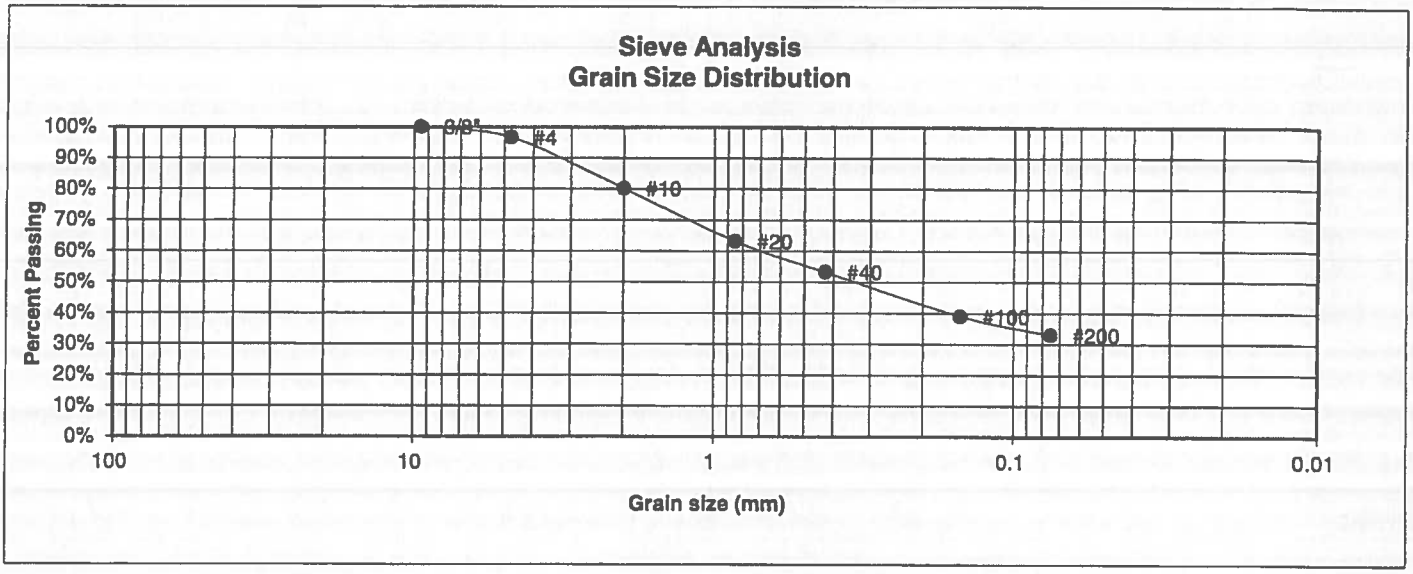
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		JHR	9-7-22

JOB NO.: 212526
FIG NO.: B-2

UNIFIED CLASSIFICATION	SC	CLIENT	PHILS BOYS FALCON
SOIL TYPE #	1	PROJECT	14010 JUDGE ORR ROAD
TEST BORING #	1	JOB NO.	212526
DEPTH (FT)	1-2	TEST BY	BL
AASHTO CLASSIFICATION		GROUP INDEX	0



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	96.6%
10	80.2%
20	63.2%
40	53.3%
100	39.0%
200	33.0%

Atterberg Limits	
Plastic Limit	16
Liquid Limit	27
Plastic Index	11

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

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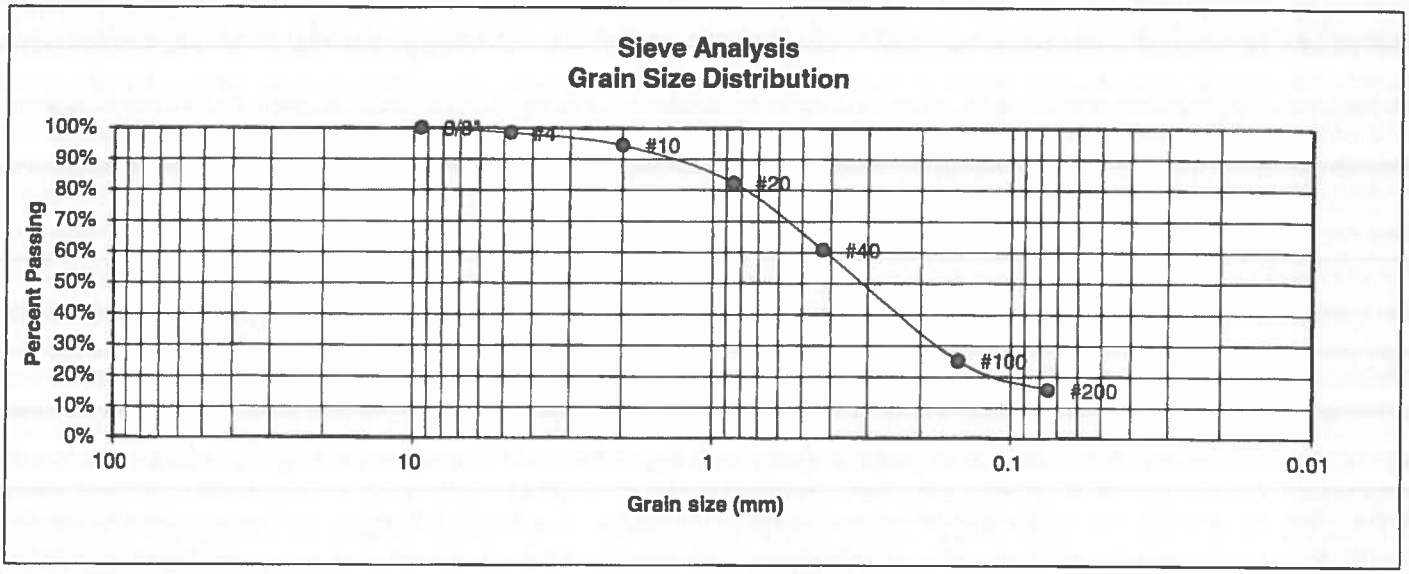
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		JHR	8/31/22

JOB NO.: 212526
FIG NO.: B-3

UNIFIED CLASSIFICATION	SM	CLIENT	PHILS BOYS FALCON
SOIL TYPE #	1	PROJECT	14010 JUDGE ORR ROAD
TEST BORING #	2	JOB NO.	212526
DEPTH (FT)	1-2	TEST BY	BL
AASHTO CLASSIFICATION	A-2-4	GROUP INDEX	0



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	98.4%
10	94.5%
20	82.4%
40	60.8%
100	25.1%
200	15.7%

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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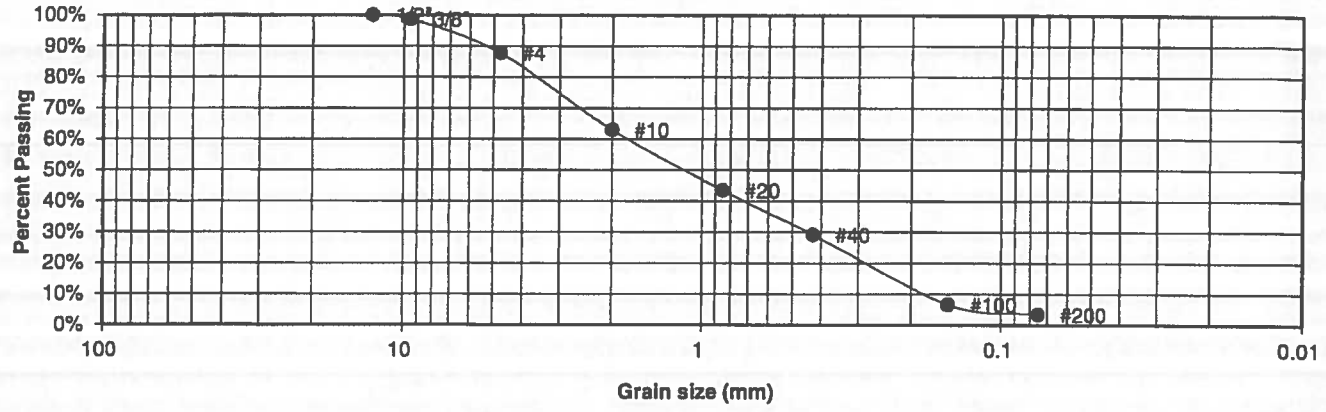
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		JHR	8/31/22

JOB NO.: 212526
FIG NO.: B-4

UNIFIED CLASSIFICATION	SW	CLIENT	PHILS BOYS FALCON
SOIL TYPE #	1	PROJECT	14010 JUDGE ORR ROAD
TEST BORING #	4	JOB NO.	212526
DEPTH (FT)	1-2	TEST BY	BL
AASHTO CLASSIFICATION	A-1-b	GROUP INDEX	0

Sieve Analysis
Grain Size Distribution



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	98.6%
4	87.8%
10	63.0%
20	43.5%
40	29.2%
100	6.6%
200	3.4%

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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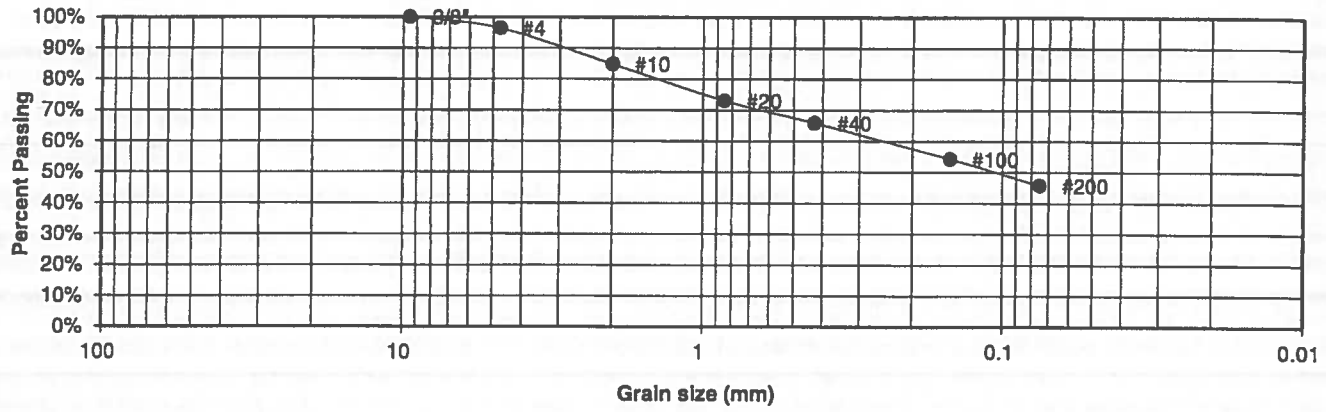
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		JHR	8/31/22

JOB NO.: 212526
FIG NO.: B-5

UNIFIED CLASSIFICATION	SC	CLIENT	PHILS BOYS FALCON
SOIL TYPE #	2, CBR	PROJECT	14010 JUDGE ORR ROAD
TEST BORING #	3	JOB NO.	212526
DEPTH (FT)	0-3	TEST BY	BL
AASHTO CLASSIFICATION	A-6	GROUP INDEX	3

Sieve Analysis
Grain Size Distribution



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	96.4%
10	84.9%
20	73.1%
40	65.9%
100	54.3%
200	45.7%

Atterberg Limits	
Plastic Limit	18
Liquid Limit	33
Plastic Index	15

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

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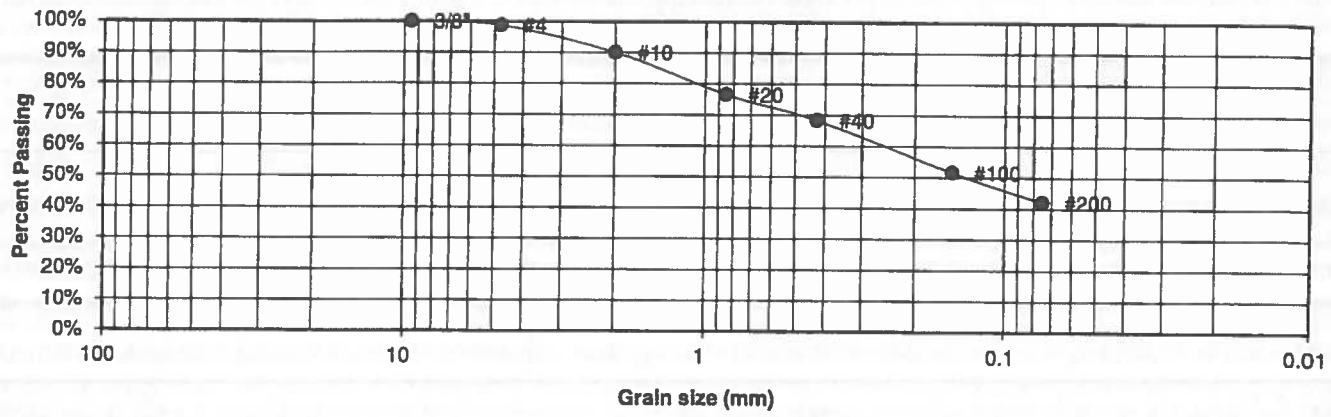
LABORATORY TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		JHR	8/31/22

JOB NO.: 212526
FIG NO.: B-6

UNIFIED CLASSIFICATION	SC	CLIENT	PHILS BOYS FALCON
SOIL TYPE #	2	PROJECT	14010 JUDGE ORR ROAD
TEST BORING #	3	JOB NO.	212526
DEPTH (FT)	1-2	TEST BY	BL
AASHTO CLASSIFICATION	A-6	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	98.8%
10	90.0%
20	76.6%
40	68.3%
100	51.6%
200	42.1%

Atterberg Limits

Plastic Limit	20
Liquid Limit	32
Plastic Index	12

Swell

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

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LABORATORY TEST RESULTS

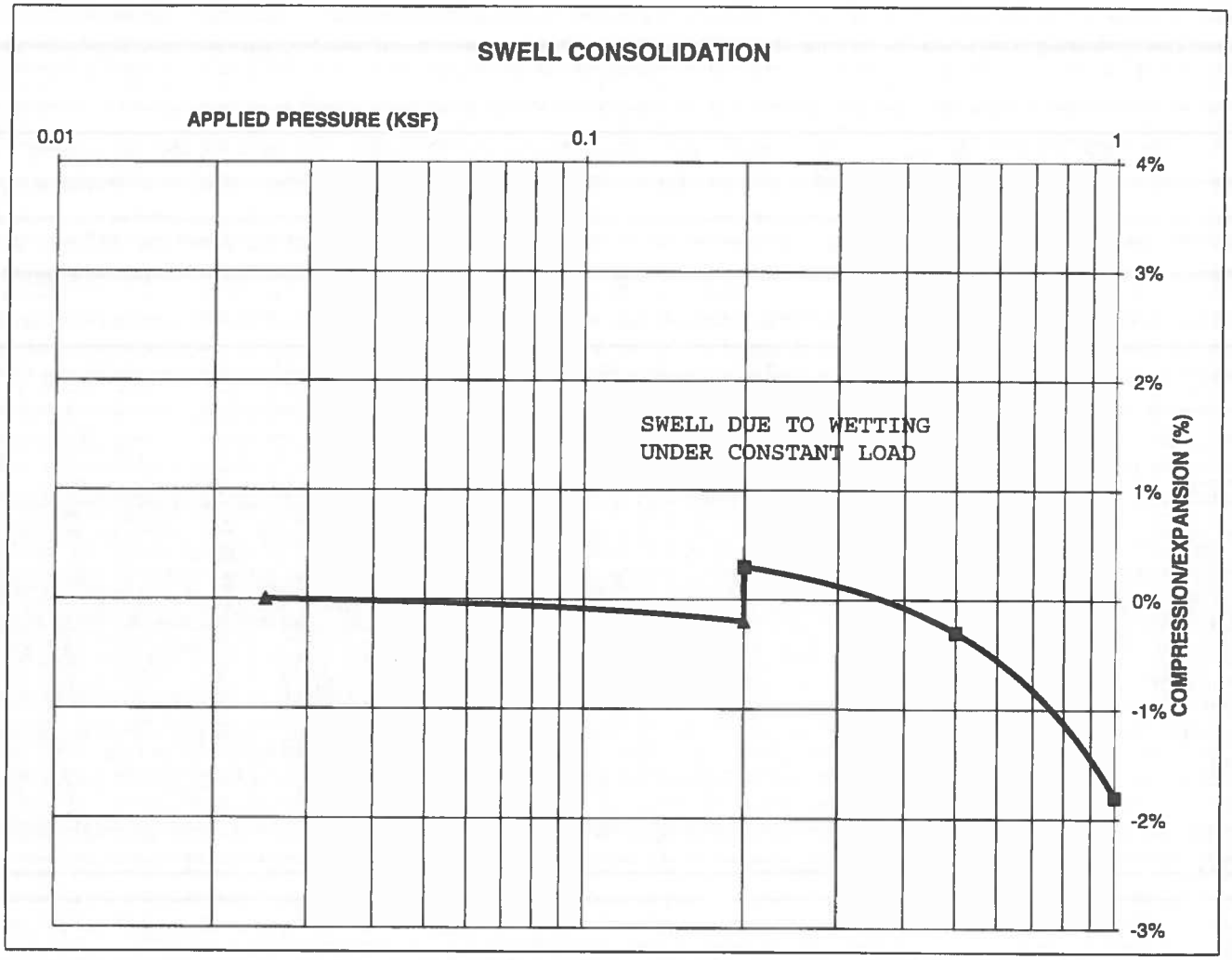
DRAWN:	DATE:	CHECKED:	DATE:
		SHR	8/31/22

JOB NO.: 212526
FIG NO.: B-7

CONSOLIDATION TEST RESULTS

TEST BORING #	3	DEPTH(ft)	0-3
DESCRIPTION	SC	SOIL TYPE	2
NATURAL UNIT DRY WEIGHT (PCF)			108
NATURAL MOISTURE CONTENT			16.8%
SWELL/CONSOLIDATION (%)			0.5%

JOB NO. 212526
CLIENT PHILS BOYS FALCON
PROJECT 14010 JUDGE ORR ROAD



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SWELL CONSOLIDATION
TEST RESULTS

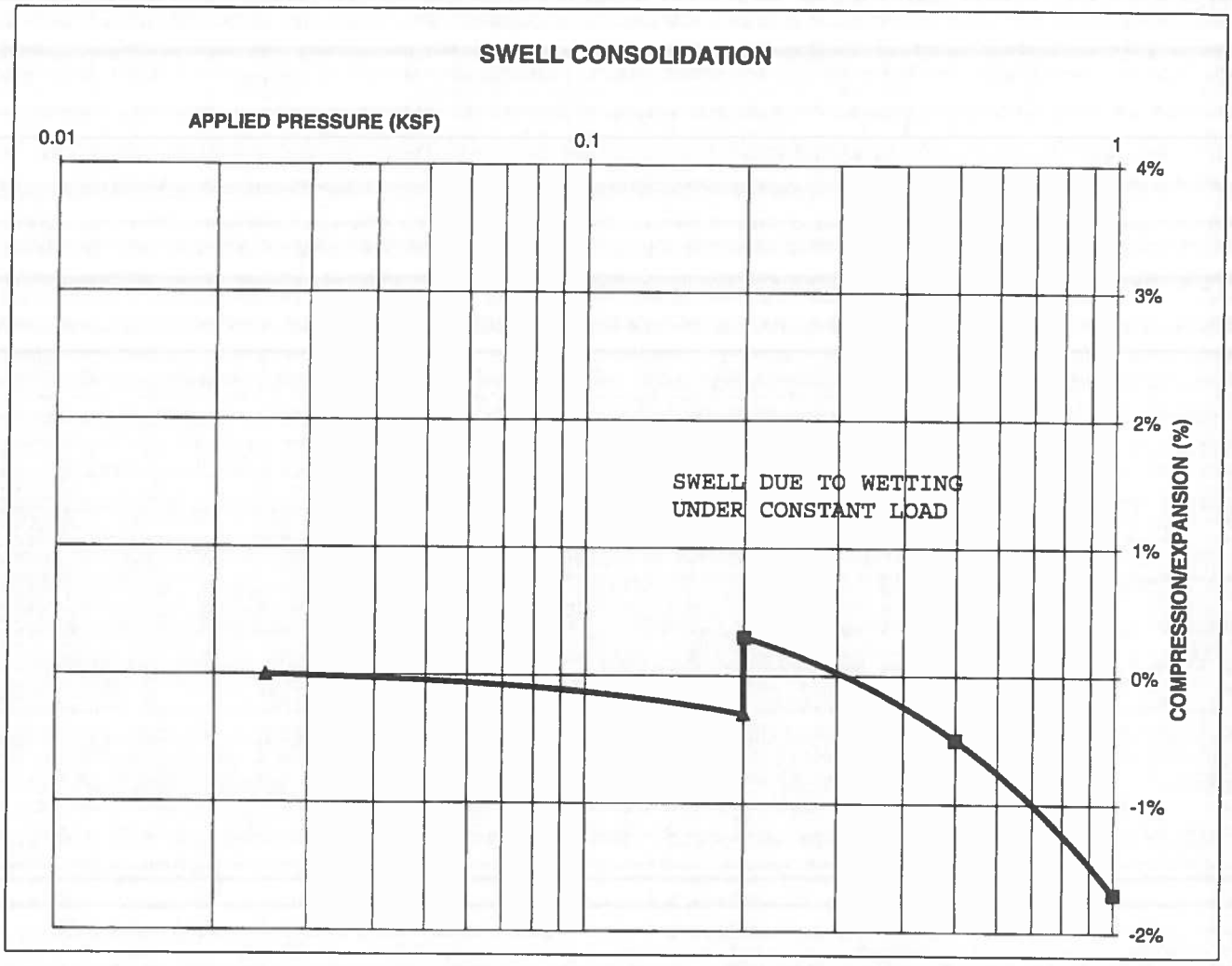
DRAWN:	DATE:	CHECKED:	DATE:
		JHR	8/31/22

JOB NO.: 212526
FIG NO.: B-8

CONSOLIDATION TEST RESULTS

TEST BORING #	3	DEPTH(ft)	1-2
DESCRIPTION	SC	SOIL TYPE	2
NATURAL UNIT DRY WEIGHT (PCF)			109
NATURAL MOISTURE CONTENT			12.8%
SWELL/CONSOLIDATION (%)			0.6%

JOB NO. 212526
CLIENT PHILS BOYS FALCON
PROJECT 14010 JUDGE ORR ROAD



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SWELL CONSOLIDATION
TEST RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		JHR	8/31/22

JOB NO.: 212526
FIG NO.: B-9

CLIENT	PHILS BOYS FALCON	JOB NO.	212526
PROJECT	14010 JUDGE ORR ROAD	DATE	8/18/2022
LOCATION	14010 JUDGE ORR ROAD	TEST BY	BL

BORING NUMBER	DEPTH, (ft)	SOIL TYPE NUMBER	UNIFIED CLASSIFICATION	WATER SOLUBLE SULFATE, (wt%)
TB-1	1-2	1	SC	0.01
TB-2	1-2	1	SM	<0.01
TB-4	1-2	1	SW	<0.01

QC BLANK PASS

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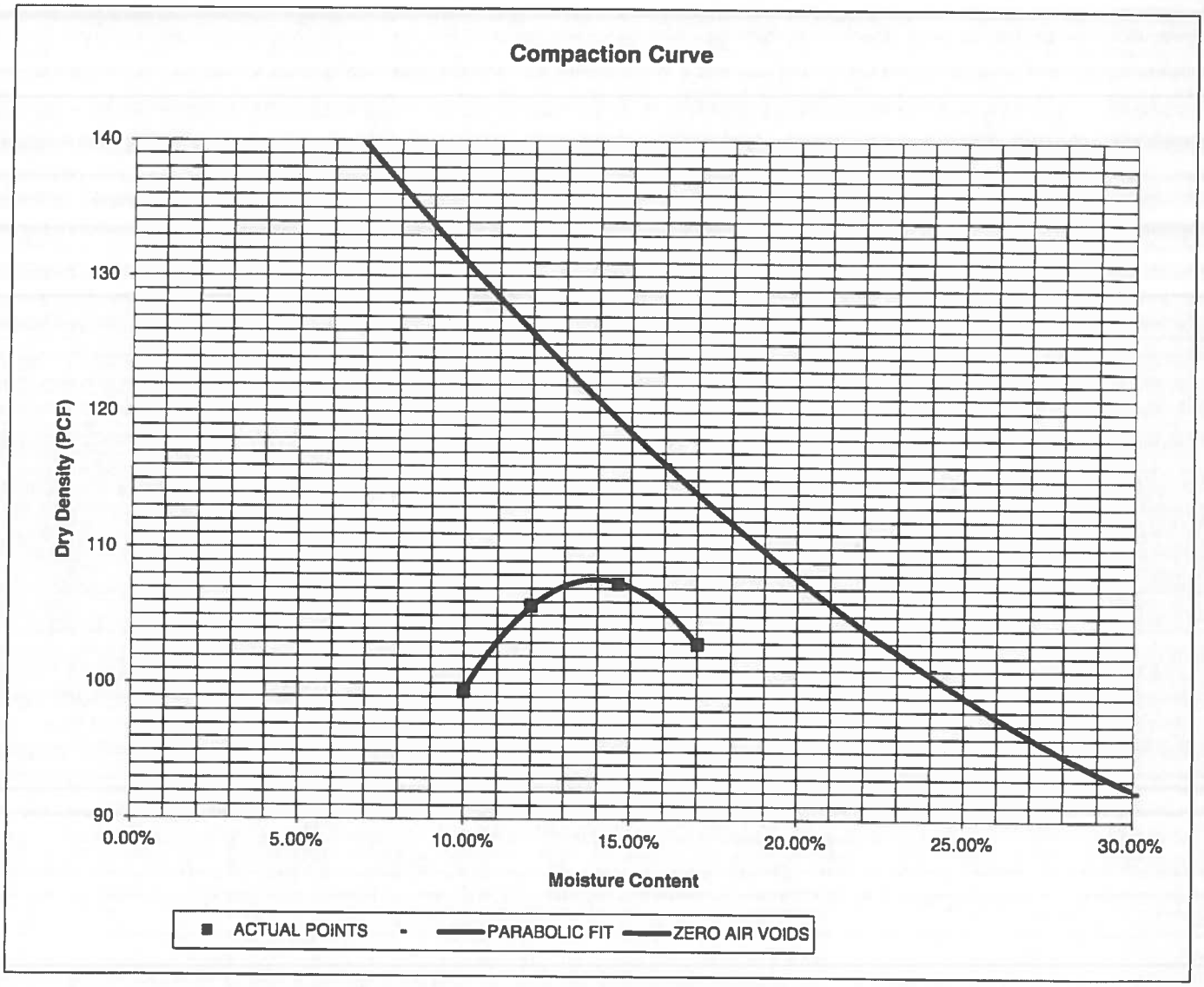
LABORATORY TEST
SULFATE RESULTS

DRAWN:	DATE:	CHECKED:	DATE:
		JAF	8/31/22

JOB NO.: 212526
FIG NO.: B-10

PROJECT	14010 JUDGE ORR ROAD	CLIENT	PHILS BOYS FALCON
SAMPLE LOCATION	TB-3 @ 1-2'	JOB NO.	212526
SOIL DESCRIPTION	SAND, VERY CLAYEY, BROWN	DATE	08/18/22

IDENTIFICATION	SC	COMPACTION TEST #	1, SOIL TYPE #2
TEST DESIGNATION / METHOD	ASTM D-698-A	TEST BY	
MAXIMUM DRY DENSITY (PCF)	107.9	OPTIMUM MOISTURE	14.0%



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MOISTURE DENSITY RELATION

DRAWN:	DATE:	CHECKED:	DATE:
		JHR	8/31/22

JOB NO.: 212526
FIG NO.: B-11

CBR TEST LOAD DATA

JOB NO: 212526
CLIENT: PHILS BOYS FALCON
PROJECT: 14010 JUDGE ORR ROAD
SOIL TYPE: 2

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	53	17.71	105	35.09	154	51.46
0.050	77	25.73	154	51.46	229	76.52
0.075	91	30.41	182	60.82	370	123.64
0.100	101	33.75	202	67.50	407	136.01
0.125	116	38.76	230	76.86	447	149.37
0.150	119	39.77	237	79.20	458	153.05
0.175	128	42.77	254	84.88	470	157.06
0.200	135	45.11	269	89.89	480	160.40
0.300	147	49.12	292	97.58	532	177.78
0.400	158	52.80	314	104.93	601	200.83
0.500	201	67.17	339	113.28	628	209.86

FINAL MOISTURE CONTENT

	MOLD # 1	MOLD # 2	MOLD # 3
CAN #	303	117	350
WT. CAN	8.48	8.73	7.86
WT. CAN+WET	154.71	120.87	132.29
WT. CAN+DRY	137.59	100.69	113.42
WT. H20	17.12	20.18	18.87
WT. DRY SOIL	129.11	91.96	105.56
MOISTURE CONTENT	13.26%	21.94%	17.88%

WET DENSITY (PCF)	113.8	122.6	129.9
DRY DENSITY (PCF)	99.8	107.5	114.0

BEARING RATIO	3.38	6.75	13.60

90% OF DRY DENSITY	102.6
95% OF DRY DENSITY	108.3

BEARING RATIO AT 90% OF MAX	4.57	~ R VALUE	10
BEARING RATIO AT 95% OF MAX	7.52	~ R VALUE	17

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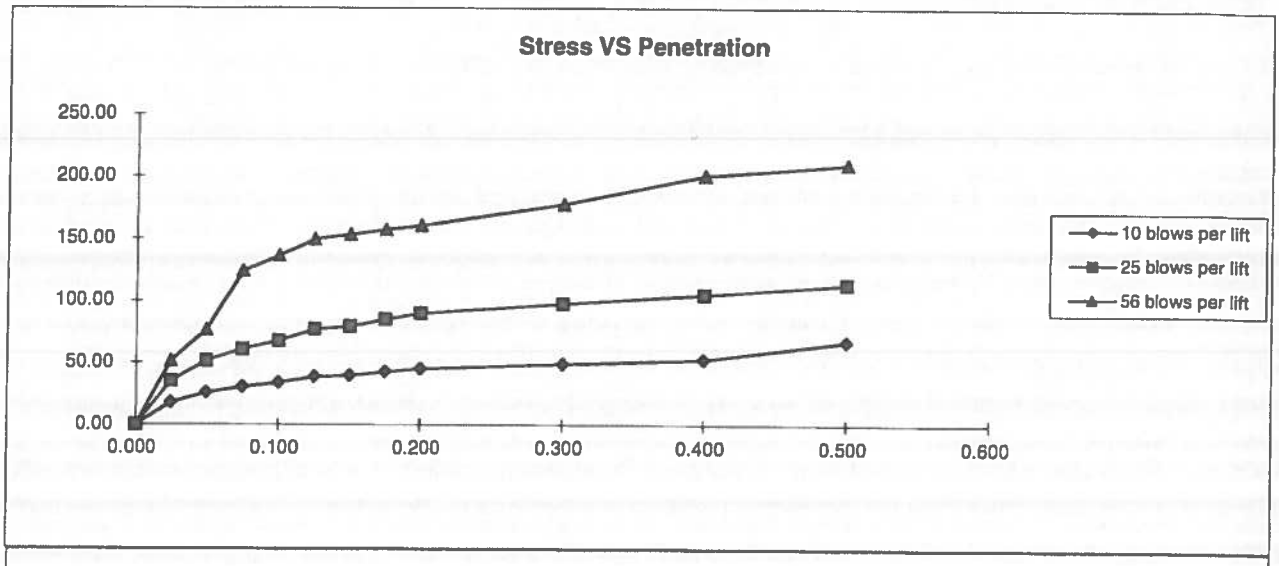
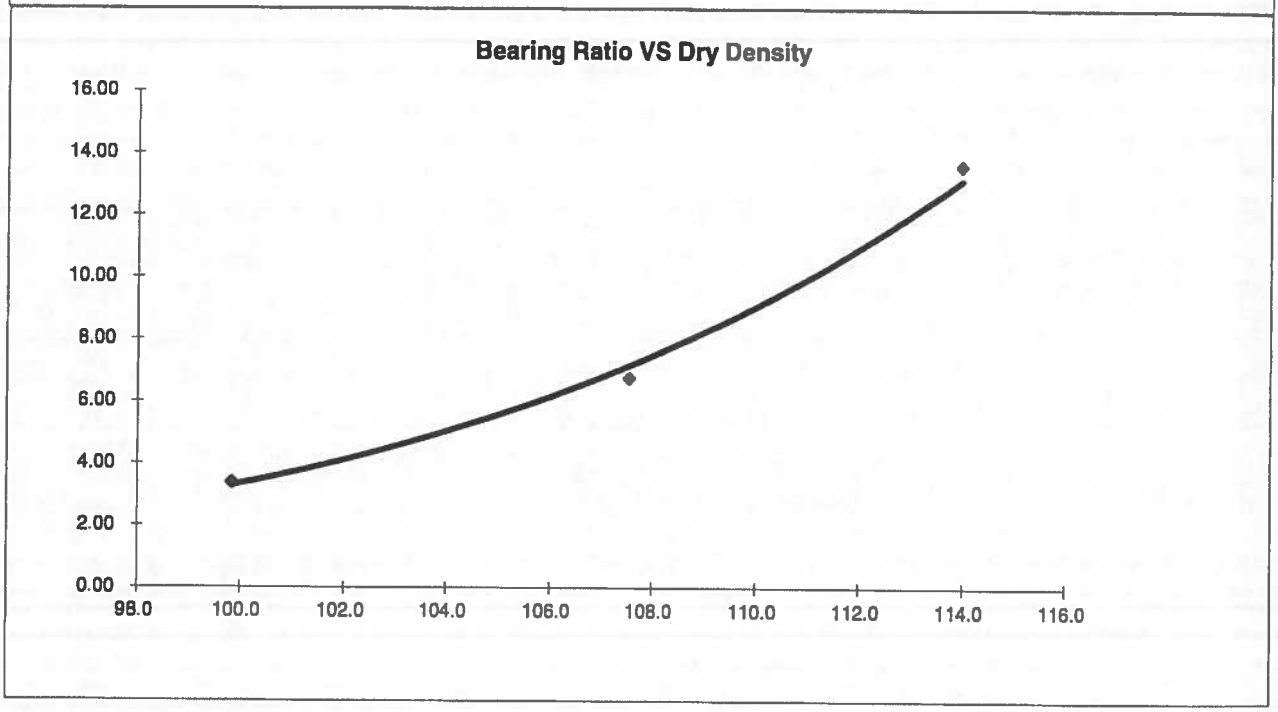
CBR TEST DATA

DRAWN:	DATE:	CHECKED:	DATE:
		DS	8/30/22

JOB NO.: 212526
FIG NO.: B-12





BEARING RATIO AT 90% OF MAX	4.57 ~ R VALUE	10.00
BEARING RATIO AT 95% OF MAX	7.52 ~ R VALUE	17.00

JOB NO: 212526
SOIL TYPE: 2

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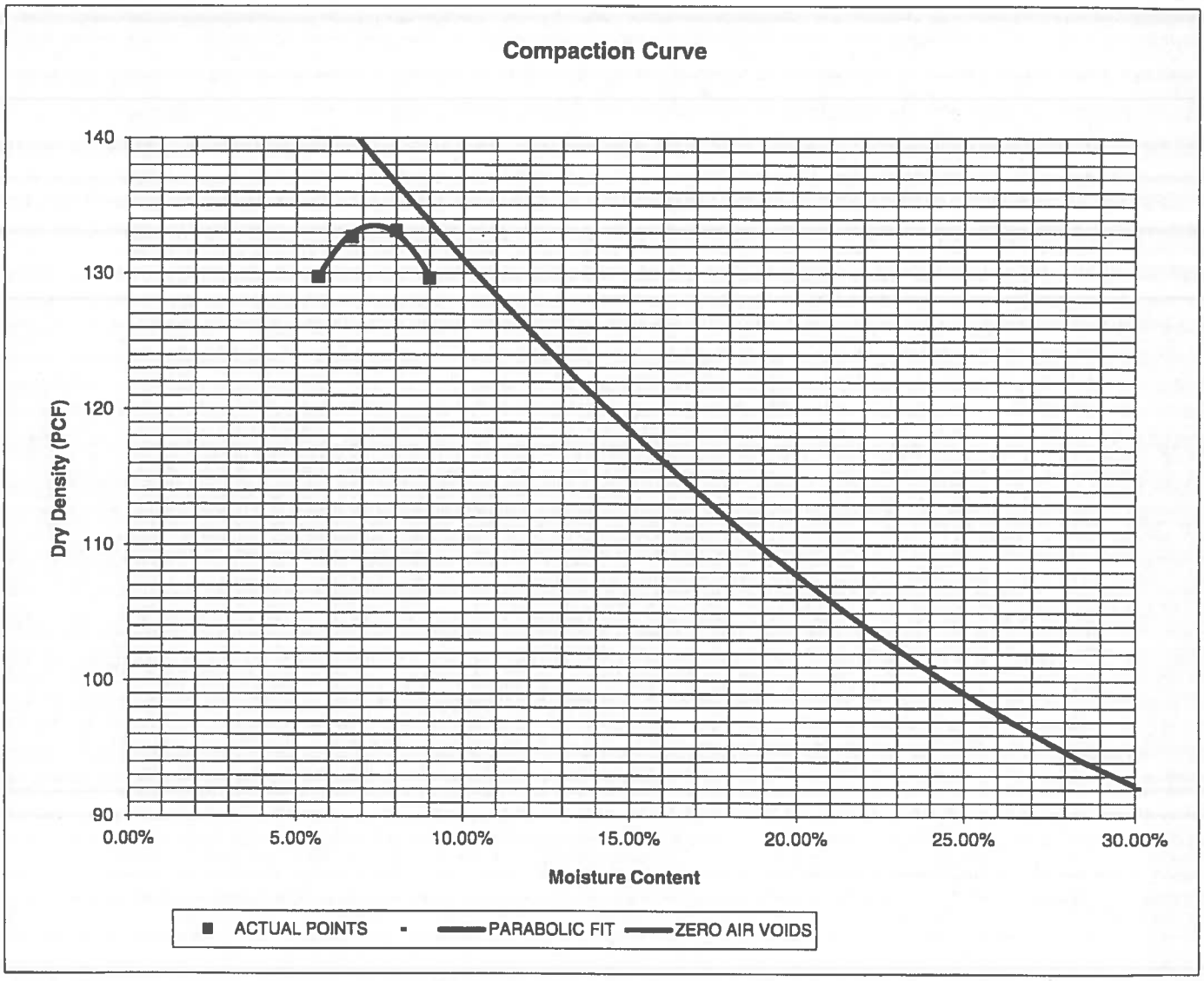
CALIFORNIA BEARING RATIO

DRAWN:	DATE:	CHECKED:	DATE:
		JHA	8/31/22

JOB NO.: 212526
FIG NO.: B-13

PROJECT	14010 JUDGE ORR ROAD	CLIENT	PHILS BOYS FALCON
SAMPLE LOCATION	TB-2 @ 0-3'	JOB NO.	212526
SOIL DESCRIPTION	SAND, SILTY, BROWN	DATE	08/18/22

IDENTIFICATION	SM	COMPACTION TEST #	1, SOIL TYPE #1
TEST DESIGNATION / METHOD	ASTM D-1557-A	TEST BY	
MAXIMUM DRY DENSITY (PCF)	133.6	OPTIMUM MOISTURE	7.3%



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MOISTURE DENSITY RELATION

DRAWN:	DATE:	CHECKED:	DATE:
		JHR	9-7-22

JOB NO.: 212526
FIG NO.: B-14

CBR TEST LOAD DATA

JOB NO: 212526
CLIENT: PHILS BOYS FALCON
PROJECT: 14010 JUDGE ORR ROAD
SOIL TYPE: 1

PISTON DIAMETER (cm)	PISTON AREA (in^4)
4.958	2.993

	10 BLOWS		*25 BLOWS*		*56 BLOWS*	
PENETRATION	MOLD # 1		MOLD # 2		MOLD # 3	
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	91	30.41	157	52.46	177	59.15
0.050	219	73.18	330	110.28	418	139.68
0.075	484	161.74	506	169.09	757	252.96
0.100	576	192.48	680	227.23	1086	362.91
0.125	800	267.33	970	324.14	1531	511.61
0.150	923	308.44	1393	465.50	1966	656.97
0.175	1083	361.90	1656	553.38	2289	764.91
0.200	1196	399.66	2096	700.42	2718	908.27
0.300	1659	554.38	3901	1303.59	4493	1501.42
0.400	1820	608.19	4751	1587.63	5978	1997.65
0.500	2122	709.10	5501	1838.26	6000	2005.01

FINAL MOISTURE CONTENT

	MOLD # 1	MOLD # 2	MOLD # 3
CAN #	345	357	106
WT. CAN	6.8	6.7	9.34
WT. CAN+WET	170.43	197.03	176.21
WT. CAN+DRY	148.42	175.42	160.62
WT. H20	22.01	21.61	15.59
WT. DRY SOIL	141.62	168.72	151.28
MOISTURE CONTENT	15.54%	12.81%	10.31%

WET DENSITY (PCF)	130.2	135.8	141.8
DRY DENSITY (PCF)	121.4	126.5	132.1

BEARING RATIO	19.25	22.72	36.29

90% OF DRY DENSITY	120.2
95% OF DRY DENSITY	126.9

BEARING RATIO AT 90% OF MAX	18.47	~ R VALUE	65
BEARING RATIO AT 95% OF MAX	23.65	~ R VALUE	71

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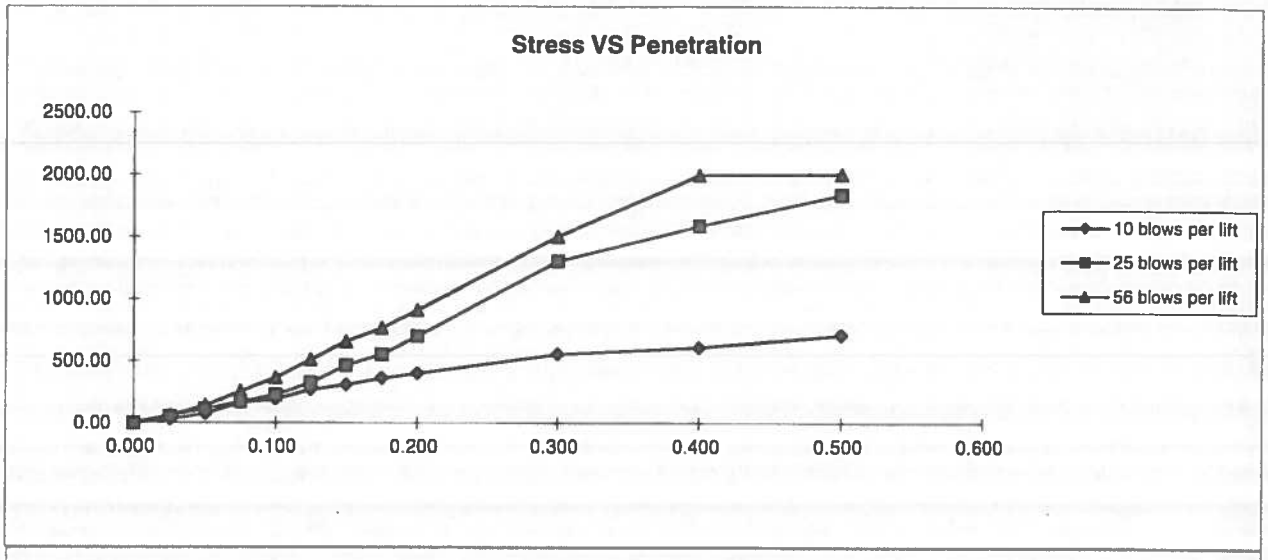
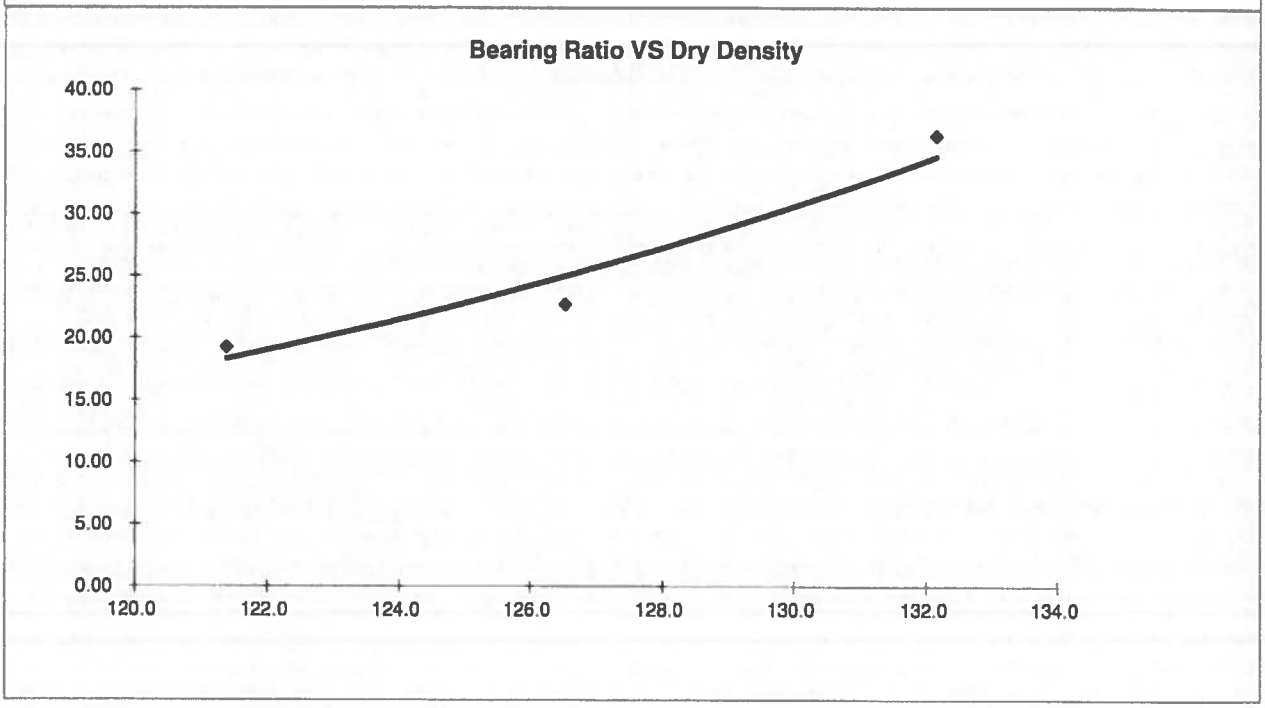
CBR TEST DATA

DRAWN:	DATE:	CHECKED:	DATE:
		JHR	9-7-22

JOB NO: 212526
FIG NO: B-15





BEARING RATIO AT 90% OF MAX	18.47	~ R VALUE	65.00
BEARING RATIO AT 95% OF MAX	23.65	~ R VALUE	71.00

JOB NO: 212526
SOIL TYPE: 1

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CALIFORNIA BEARING RATIO

DRAWN:	DATE:	CHECKED:	DATE:
		JHF	9-7-22

JOB NO: 212526
FIG NO: B-16

APPENDIX C: Pavement Design Calculations

FLEXIBLE PAVEMENT DESIGN

DESIGN DATA — PHILLS BOYS - URBAN NONRESIDENTIAL COLLECTOR) - SOIL TYPE 1
14010 JUDGE ORR ROAD

Equivalent (18 kip) Single Axle Load Applications (ESAL):	ESAL (W_{18}) =	821,000
Hveem Stabilometer (R Value) Results:	R =	50
Standard Deviation	S_o =	0.45
Loss in Serviceability	Δpsi =	2.5
Reliability	Reliability =	85
Reliability (z-statistic)	Z_R =	-1.04
Soil Resilient Modulus	M_R =	13168

Weighted Structural Number (WSN): → WSN = 2.52

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

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

Left	Right	Difference
5.91	5.91	0.0

Job No. 212526
Fig. No. C-1

DESIGN CALCULATIONS

AGGREGATE BASE COURSE

DESIGN DATA PHILLS BOYS - URBAN NONRESIDENTIAL COLLECTOR) - SOIL TYPE 1 14010 JUDGE ORR ROAD

Equivalent (18 kip) Single Axle Load Applications (ESAL):	ESAL =	821,000
Hveem Stabilometer (R Value) Results:	R =	50
Weighted Structural Number (WSN):	WSN =	2.52

DESIGN EQUATION

$$WSN = C_1D_1 + C_2D_2$$

C_1 = 0.44 Strength Coefficient - Hot Bituminous Asphalt
C_2 = 0.11 Strength Coefficient - Existing Aggregate Base Course

D_1 = Depth of Asphalt (inches)
D_2 = Depth of Base Course (inches)

FOR FULL DEPTH ASPHALT SECTION

$D_1 = (WSN)/C_1$ = 5.7 inches of Full Depth Asphalt
Use 6.0 inches Full Depth *Not Allowed

FOR ASPHALT + AGGREGATE BASE COURSE SECTION

Asphalt Thickness (t) = [4] inches
$D_2 = ((WSN) - (t)(C_1))/C_2$ = 6.9 inches of Aggregate
Base Course, use 8.0 inches

RECOMMENDED ALTERNATIVES

1. 4.0 inches of Asphalt + 8.0 inches of Aggregate Base Course, or
3. 6.0 inches of Asphalt

Job No. 212526
Fig. No. C-2

FLEXIBLE PAVEMENT DESIGN

DESIGN DATA — PHILLS BOYS - URBAN NONRESIDENTIAL COLLECTOR - SOIL TYPE 2
14010 JUDGE ORR ROAD

Equivalent (18 kip) Single Axle Load Applications (ESAL):	ESAL (W_{18}) =	821,000
Hveem Stabilometer (R Value) Results:	R =	17
Standard Deviation	S_o =	0.45
Loss in Serviceability	Δpsi =	2.5
Reliability	Reliability =	85
Reliability (z-statistic)	Z_R =	-1.04
Soil Resilient Modulus	M_R =	4478

Weighted Structural Number (WSN): → WSN = 3.62

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

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

Left	Right	Difference
5.91	5.91	0.0

Job No. 212526
Fig. No. C-3

DESIGN CALCULATIONS

AGGREGATE BASE COURSE

DESIGN DATA PHILLS BOYS - URBAN NONRESIDENTIAL COLLECTOR - SOIL TYPE 2 14010 JUDGE ORR ROAD

Equivalent (18 kip) Single Axle Load Applications (ESAL):	ESAL =	821,000
Hveem Stabilometer (R Value) Results:	R =	17
Weighted Structural Number (WSN):	WSN =	3.62

DESIGN EQUATION

$$WSN = C_1D_1 + C_2D_2$$

C_1 = 0.44 Strength Coefficient - Hot Bituminous Asphalt
C_2 = 0.11 Strength Coefficient - Existing Aggregate Base Course

D_1 = Depth of Asphalt (inches)
D_2 = Depth of Base Course (inches)

FOR FULL DEPTH ASPHALT SECTION

$D_1 = (WSN)/C_1$ = 8.2 inches of Full Depth Asphalt
Use 8.5 inches Full Depth

FOR ASPHALT + AGGREGATE BASE COURSE SECTION

Asphalt Thickness (t) = 5.5 inches
$D_2 = ((WSN) - (t)(C_1))/C_2$ = 10.9 inches of Aggregate
Base Course, use 11.0 inches

RECOMMENDED ALTERNATIVES

1. 5.5 inches of Asphalt + 11.0 inches of Aggregate Base Course, or
3. 8.5 inches of Asphalt

Job No. 212526
Fig. No. C-4