

PAVEMENT DESIGN REPORT

**Village Center
Village at Lorson Ranch, Filing No. 1
El Paso County, Colorado**

PREPARED FOR:

**Eagle Development
212 N. Wahsatch Ave
Colorado Springs, CO 80903**

JOB NO. 197432

**April 28, 2025
Revised: July 9, 2025**

Respectfully Submitted,

RMG Engineers



**Jared McElmeel, E.I.
Geotechnical Staff Engineer**

Reviewed by,

RMG Engineers

**Tony Munger, P.E.
Sr. Geotechnical Project Manager**



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APPENDIX A

1993 AASHTO Empirical Equation for Flexible Pavements

GENERAL SITE AND PROJECT DESCRIPTION

Location

Village at Lorson Ranch, Filing No. 1 is generally located north of Fontaine Blvd and east of Marksheffel Road in the southwestern portion of El Paso County, Colorado. The location of the site is shown on the Site Vicinity Map, Figure 1.

Existing Site Conditions

At the time of our investigation the project site was overlot graded, the roadways were rough graded and the deepest utilities had been installed. Curb and gutter had not been installed.

Project Description

Village at Lorson Ranch, Filing No. 1 is a continuation of the PUD Development Plan dated October 30, 2018, and PCD project number SF248, Village at Lorson Ranch. This pavement design includes the proposed street Center Village, classified as an Urban Local Road. The turn lanes from Marksheffel Road are to be designed and submitted for approval to the City of Colorado Springs.

FIELD INVESTIGATION AND LABORATORY TESTING

Drilling

The field exploration was conducted by drilling five borings at the locations shown on Figure 2. The borings were drilled on March 7, 2025 with a truck mounted drill rig powering 4-inch diameter, solid stem augers. The borings extended to depths of 5 and 10 feet. The borings were logged by a representative of RMG. Samples of the subsurface materials were obtained with 2 ½ inch O.D. modified California samplers in accordance with ASTM D3550. Depths at which the samples were taken and the penetration resistance values are shown on the Test Boring Logs. Bulk samples were also obtained from each boring from a depth of about 0 to 2 feet in each boring and returned to our laboratory for review and testing. An explanation of Test Boring Logs is presented in Figure 3. Test Boring Logs are presented in Figures 4 through 6.

Laboratory Testing

Grain-size analyses and Atterberg limits tests were performed on the combined samples obtained from the borings for purposes of classification and obtaining pertinent engineering parameters. A moisture-density relationship curve and a California Bearing Ratio (CBR) test were performed on a composite bulk sample obtained from two Test Borings, TB-3 and TB-4. A Summary of Laboratory Test Results is presented in Figure 7. Soil Classification Data are presented in Figures 8 and 9. The Swell/Consolidation Test Results are presented in Figures 10 and 11. The Moisture Density Relationship Curve is presented in Figure 12. The CBR Test Results are presented in Figures 13 and 14.

SUBSURFACE CONDITIONS

Subsurface Materials

The soil encountered in the upper 4 feet of all the borings, TB-1 through TB-5, consisted of sandy clay fill. These soils classify as CL in accordance with the Unified Soil Classification System. For pavement design purposes, the soil classifies as A-7-6 with group index ranging between 14 and 22 in accordance with the American Association of State Highway and Transportation Officials (AASHTO) classification system.

A composite bulk sample from the Test Borings TB-3 and TB-4 was tested to determine its moisture-density relationship curve in accordance with ASTM D698 (Standard Proctor compaction test). Maximum Dry Density proved to be 108.2 pcf at 16.7 percent moisture. A CBR test was performed at varying densities at moisture content near optimum. At 95% of the maximum Modified Proctor density, 102.8 pcf, the CBR of the bulk sample was 2.33.

	Liquid Limit	Plasticity Index	Percent passing #200 Sieve
Composite Bulk Sample	40	19	76.5

Groundwater

Groundwater was not encountered in the test borings during field exploration. While groundwater is not expected to be a factor in pavement construction on this site, fluctuations in groundwater and subsurface moisture conditions may occur due to variations in rainfall and other factors not readily apparent at this time. Development of the property and adjacent properties may also affect groundwater levels.

PAVEMENT DESIGN

The following pavement design is based on the subsurface conditions encountered in the test borings and on the project characteristics previously described. If conditions are different from those described in this report or the project characteristics change, RMG should be retained to review our recommendations and adjust them, if necessary.

Pavement Design

This pavement design was prepared in accordance with the El Paso County Pavement Design Criteria Manual. Pavement design is based on A-7-6 soil as gathered from TB-3 and TB-4.

Private Roadway: Center Village

- 1) Street classification = Urban Local (Table D-1)
ESAL = 292,000 (Table D-2)
Reliability = 80% (Table D-1)

Standard Deviation = 0.45 (Section D.4.1.C)
 Serviceability Loss = 2.0 (Table D-1)

2) Strength coefficients (Table D-3)

Asphalt (HMA): $a_1 = 0.44$

Cement Treated Subgrade (CTS): $a_2 = 0.11$

3) Subgrade

$M_r = \text{CBR} \times 1500 = 2.33 \times 1500 = 3,495 \text{ psi}$

4) Design Structural number (SN) = 3.42 (per 1993 AASHTO Empirical Equation for Flexible Pavements; See Appendix A, this report).

does not appear to be included.

5) Composite asphalt/base course section

Minimum HMA thickness = $D_1 = 3 \text{ inches}$ (Table D-2)

CTS thickness = $D_2 = \{ \text{SN} - (D_1 \times a_1) \} / a_2 = \{ 3.42 - (3 \times 0.44) \} / 0.11 = 19.6 \text{ inches}$

3 inches of HMA over 10 inches of ABC > a ratio of 2.5 - use 4.75 inches of HMA

Minimum CTS thickness = 6 inches (Table D-2)

Calculated SN: $(4.75 \times 0.44) + (11.5 \times 0.12) = 3.47 \geq 3.42 \rightarrow \text{OK}$

Pavement Thickness

Based on the design calculations, the recommended pavement sections are presented below and on Figure 2.

Street	Sample	Required SN	HMA (in.)	ABC (in.)	CTS (in.)	Calculated SN	OK
Center Village	Combined 3&4	3.42	4.75	0	11.5	3.47	Y
Optimal CTS Percent Cement by Weight = 4%							

Pavement Materials

Pavement materials should be selected, prepared, and placed in accordance with El Paso County specifications and the *Pikes Peak Region Asphalt Paving Specifications*. Tests should be performed in accordance with the applicable procedures presented in the specifications.

Expansive Soil Mitigation

The PDCM notes that mitigation measures may be required for expansive soils, shallow ground water, subgrade instability, etc. Based on review of the compaction records of subgrade soils in the area and swell/compaction testing of the existing subgrade soils, the subgrade soils evaluated for this pavement design are expected to be low-expansive. Groundwater or wet and unstable soils

were not encountered in the borings. Therefore, special mitigation measures do not appear to be necessary for subgrade preparation.

Subgrade Preparation

Subgrade for Center Village shall be Cement Treated Subgrade (CTS) consisting of local soil, water, and Portland cement compacted at optimum moisture. Prior to CTS construction the existing soil should be proof-rolled to a firm and unyielding condition. Areas which deform under wheel loads should be removed and replaced. The soil should then be scarified, pulverized, mixed with cement and water, compacted, finished and cured in lengths that allow the full roadway width to be completed in not more than 4 hours from the time that cement is exposed to water.

The quantity of CTS to be placed shall be determined by the results of the testing shall be included in the report, include what different percentages of CTS were trialed. The quantity of CTS shall be determined by the amount of the soil as specified herein (4% optimum moisture) to create a cement and water mixture for the full design width and depth. Mixing should be continuous until the mixture is at optimum moisture and ready for compacting and finishing. Compaction should begin within 30 minutes of mixing. CTS should be maintained in a moist condition during the curing process, and all traffic except for necessary construction equipment should be kept off the CTS for a minimum of 7 days or until the final pavement structure layers are placed.

Please specify the type of cement to be used.

CTS testing shall be in accordance with the El Paso County Engineering Criteria Manual. CTS compressive strength test results shall be submitted to the County prior to the placement of the asphalt, in part to confirm the requirement for micro fracturing (MF). Micro fracturing of the CTS shall be performed when 7-day compressive strength test results indicate CTS strength in excess of 275 psi. The subgrade should be kept in a moist cured condition for 48 to 72 hours before any micro fracturing is performed by a heavy (12-ton) steel drum vibratory roller operating at maximum amplitude. After satisfactory completion of micro fracturing the subgrade should continue to be moist cured by sprinkling or other means.

Surface Drainage

Surface drainage is important for the satisfactory performance of pavement. Wetting of the subgrade soils or base course will cause a loss of strength which can result in pavement distress. Surface drainage should provide for efficient removal of storm-water runoff. Water should not be allowed to pond on the pavement or along the edges of the pavement.

Subgrade Observations and Testing

The pavement thicknesses presented above assume pavement construction is completed in accordance with El Paso County specifications and the *Pikes Peak Region Asphalt Paving Specifications*. RMG should be present at the site during subgrade preparation, placement of fill, and construction of pavements to perform site observations and testing.

The use of CTS requires a deviation request. Deviation is from ECM D.4.1.F. The deviation request shall address the eight points included in the Use of CTS for Paving Season document.

results of the testing shall be included in the report, include what different percentages of CTS were trialed.

Sulfate testing shall be included when using CTS. Please include test results

please also include reference to section 305 – CHEMICALLY TREATED SUBGRADE

CLOSING

Our field exploration was conducted to provide geotechnical information for pavement thickness design. Variations in subsurface conditions not indicated by the borings may be encountered. This report has been prepared for **Eagle Development** for application as an aid in the design of the proposed development in accordance with generally accepted geotechnical engineering practices. The analyses and recommendations in this report are based in part upon data obtained from exploratory borings and test pits, site observations and the information presented in referenced reports. The nature and extent of variations may not become evident until construction. If variations then become evident, RMG should be retained to re-evaluate the recommendations of this report, if necessary.

Our professional services were performed using that degree of care and skill ordinarily exercised, under similar circumstances, by geotechnical engineers practicing in this or similar localities. RMG Engineers does not warrant the work of regulatory agencies or other third parties supplying information which may have been used during the preparation of this report. No warranty, express or implied is made. Any contractor reviewing this report for bidding purposes must draw his own conclusions regarding site conditions and specific construction techniques to be used on this project.

This report is for the exclusive purpose of providing geotechnical information and pavement thickness design recommendations. The scope of services for this project does not include, either specifically or by implication, environmental assessment of the site or identification of contaminated or hazardous materials or conditions. Development of recommendations for the mitigation of environmentally related conditions, including but not limited to biological or toxicological issues, are beyond the scope of this report. If the Client desires investigation into the potential for such contamination or conditions, other studies should be undertaken.

If we can be of further assistance in discussing the contents of this report or analysis of the proposed development, from a geotechnical engineering point-of-view, please feel free to contact us.

FIGURES

APPENDIX A



NOT TO SCALE

Structural
Geotechnical



Materials Testing
Forensics

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(719) 548-0600 ~ WWW.RMGENGINEERS.COM
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SITE VICINITY MAP

VILLAGE AT LORSON RANCH
FILING NO. 1
COLORADO SPRINGS, COLORADO
EAGLE DEVELOPMENT

JOB No. 197432

FIG No. 1

DATE 4-28-2025



Structural
Geotechnical

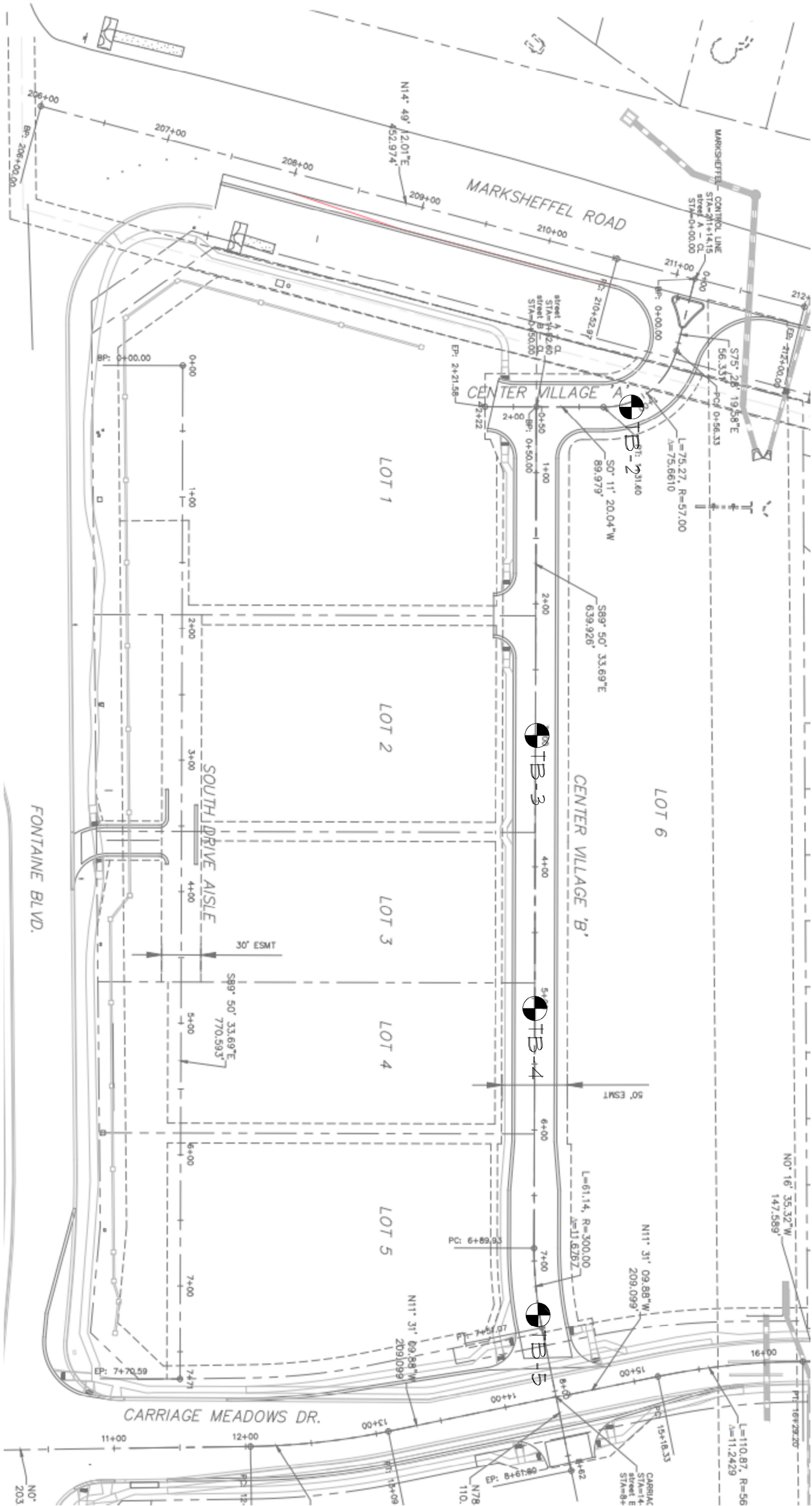
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VILLAGE AT LORSON RANCH
FILING NO. 1
COLORADO SPRINGS, COLORADO
EAGLE DEVELOPMENT

ENGINEER:	TJ
DRAWN BY:	JM
CHECKED BY:	TJ
ISSUED:	4-28-2025

TEST BORING
LAYOUT PLAN

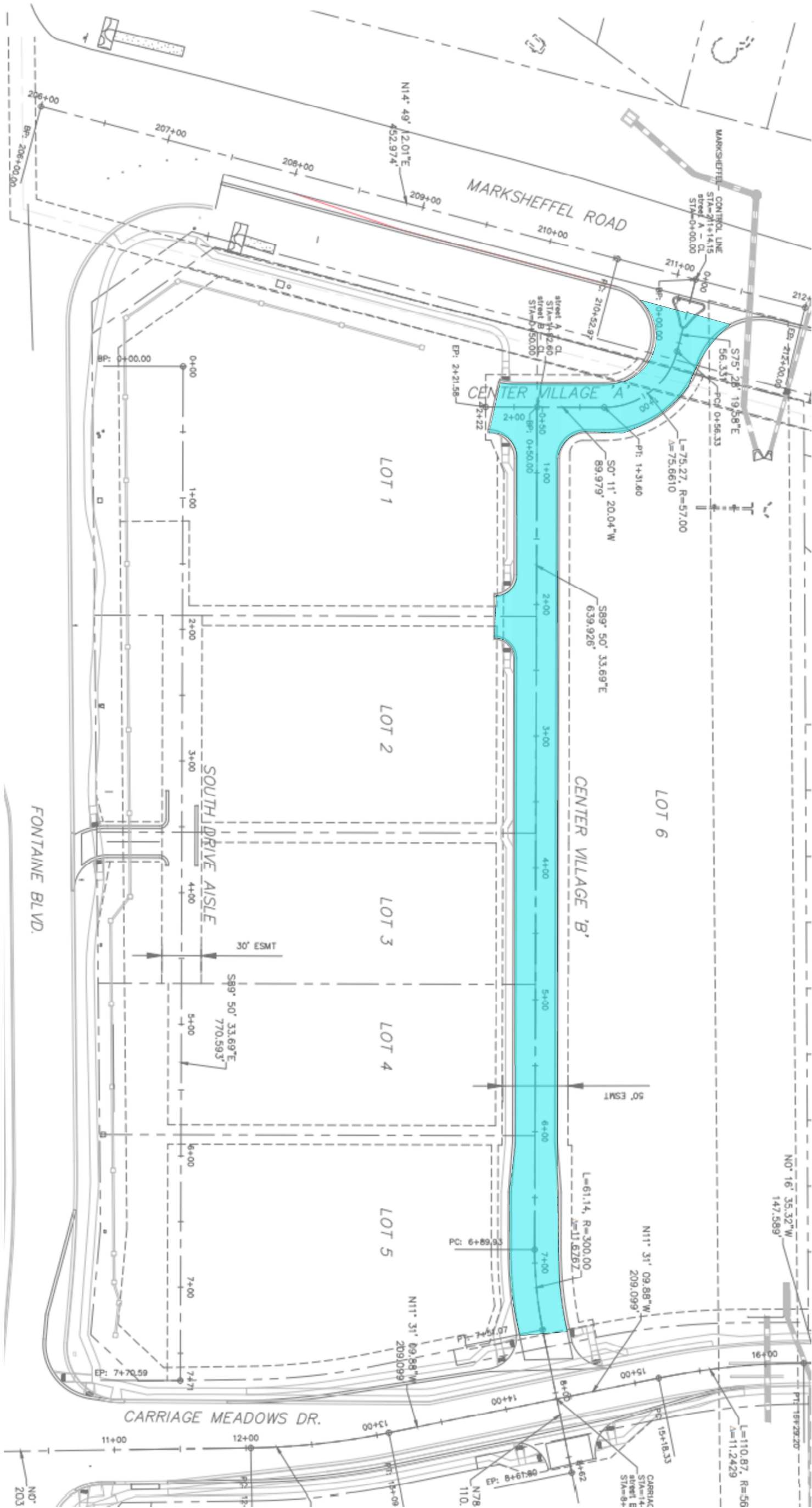
SHEET NO.
FIG-2.1



NOT TO SCALE



● DENOTES APPROXIMATE
LOCATIONS WHERE TEST
BORINGS WERE PERFORMED



4.75' HMA OVER 11.5' CTS



NOT TO SCALE

VILLAGE AT LORSON RANCH
FILING NO. 1
COLORADO SPRINGS, COLORADO
EAGLE DEVELOPMENT

ENGINEER:	TM
DRAWN BY:	JM
CHECKED BY:	TM
DESIGNED:	4-28-2025
REVISION:	1-9-2025

RECOMMENDED
PAVEMENT
SECTIONS

SHEET NO.
FIG-2.2

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Materials Testing
Forensics

SOILS DESCRIPTION



CLAYEY SAND



FILL: CLAY, SANDY



SANDY CLAY

UNLESS NOTED OTHERWISE, ALL LABORATORY
TESTS PRESENTED HEREIN WERE PERFORMED BY:
RMG - ROCKY MOUNTAIN GROUP
5085 LIST DRIVE, SUITE 200
COLORADO SPRINGS, COLORADO

SYMBOLS AND NOTES



XX

STANDARD PENETRATION TEST - MADE BY DRIVING A SPLIT-BARREL SAMPLER INTO THE SOIL BY DROPPING A 140 LB. HAMMER 30", IN GENERAL ACCORDANCE WITH ASTM D-1586. NUMBER INDICATES NUMBER OF HAMMER BLOWS PER FOOT (UNLESS OTHERWISE INDICATED).



XX

UNDISTURBED CALIFORNIA SAMPLE - MADE BY DRIVING A RING-LINED SAMPLER INTO THE SOIL BY DROPPING A 140 LB. HAMMER 30", IN GENERAL ACCORDANCE WITH ASTM D-3550. NUMBER INDICATES NUMBER OF HAMMER BLOWS PER FOOT (UNLESS OTHERWISE INDICATED).



FREE WATER TABLE



DEPTH AT WHICH BORING CAVED



BULK DISTURBED BULK SAMPLE



AUG AUGER "CUTTINGS"

4.5

WATER CONTENT (%)

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Geotechnical



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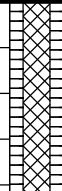

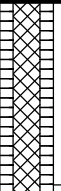

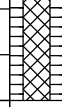

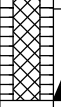

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EXPLANATION OF TEST BORING LOGS

JOB No. 197432

FIGURE No. 3

DATE Apr/28/2025

TEST BORING: 1	DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %	TEST BORING: 2	DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
DATE DRILLED: 3/7/25 NO GROUNDWATER ON 3/7/25						DATE DRILLED: 3/7/25 NO GROUNDWATER ON 3/7/25					
FILL: CLAY, SANDY, brown, very stiff, moist	2.5			19	17.9	FILL: CLAY, SANDY, brown, medium stiff, moist	2.5			9	14.0
	5.0			25	16.8		5.0			7	12.0

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TEST BORING LOG

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FIGURE No. 4

DATE Apr/28/2025

TEST BORING: 3	DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %	TEST BORING: 4	DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
DATE DRILLED: 3/7/25 NO GROUNDWATER ON 3/7/25						DATE DRILLED: 3/7/25 NO GROUNDWATER ON 3/7/25					
FILL: CLAY, SANDY, brown, very stiff, moist	2.5			19	16.6	FILL: CLAY, SANDY, brown, stiff to very stiff, moist	2.5			11	28.5
SAND, CLAYEY, tan, loose, moist	5.0			13	8.3		5.0			20	18.4
	7.5										
CLAY, SANDY, brown, stiff, moist	10.0			12	15.3						

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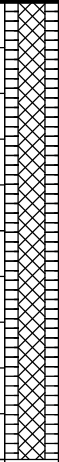

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TEST BORING LOG

JOB No. 197432

FIGURE No. 5

DATE Apr/28/2025

<p>TEST BORING: 5</p> <p>DATE DRILLED: 3/7/25</p> <p>NO GROUNDWATER ON 3/7/25</p>	DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %	
<p>FILL: CLAY, SANDY, brown, very stiff, moist</p>	<p>2.5</p> <p>5.0</p>			<p>40</p> <p>38</p>	<p>8.3</p> <p>10.0</p>	

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TEST BORING LOG

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FIGURE No. 6

DATE Apr/28/2025

Test Boring No.	Depth	Water Content (%)	Dry Density (pcf)	Liquid Limit	Plasticity Index	% Retained No.10 Sieve	% Retained No.40 Sieve	% Passing No. 200 Sieve	% Swell @ 100 psf	AASHTO Classification
1	0.0					6.4	13.8	66.9		
1	2.0	17.9	108.1						0.5	
1	4.0	16.8								
2	0.0			37	22	1.2	3.6	74.8		A-6 (15)
2	2.0	14.0	101.5						- 0.8	
2	4.0	12.0								
3	0.0			43	22	2.2	10.9	69.1		A-7-6 (14)
3	2.0	16.6								
3	4.0	8.3								
3	9.0	15.3						49.8		
4	0.0			46	26	0.5	2.3	83.2		A-7-6 (22)
4	2.0	28.5								
4	4.0	18.4		47	20					
5	0.0			38	18	3.5	21.9	48.3		A-6 (5)
5	2.0	8.3	87.5						- 2.3	
5	4.0	10.0								
BULK	0.0			40	19	1.2	5.9	76.5		A-6 (14)

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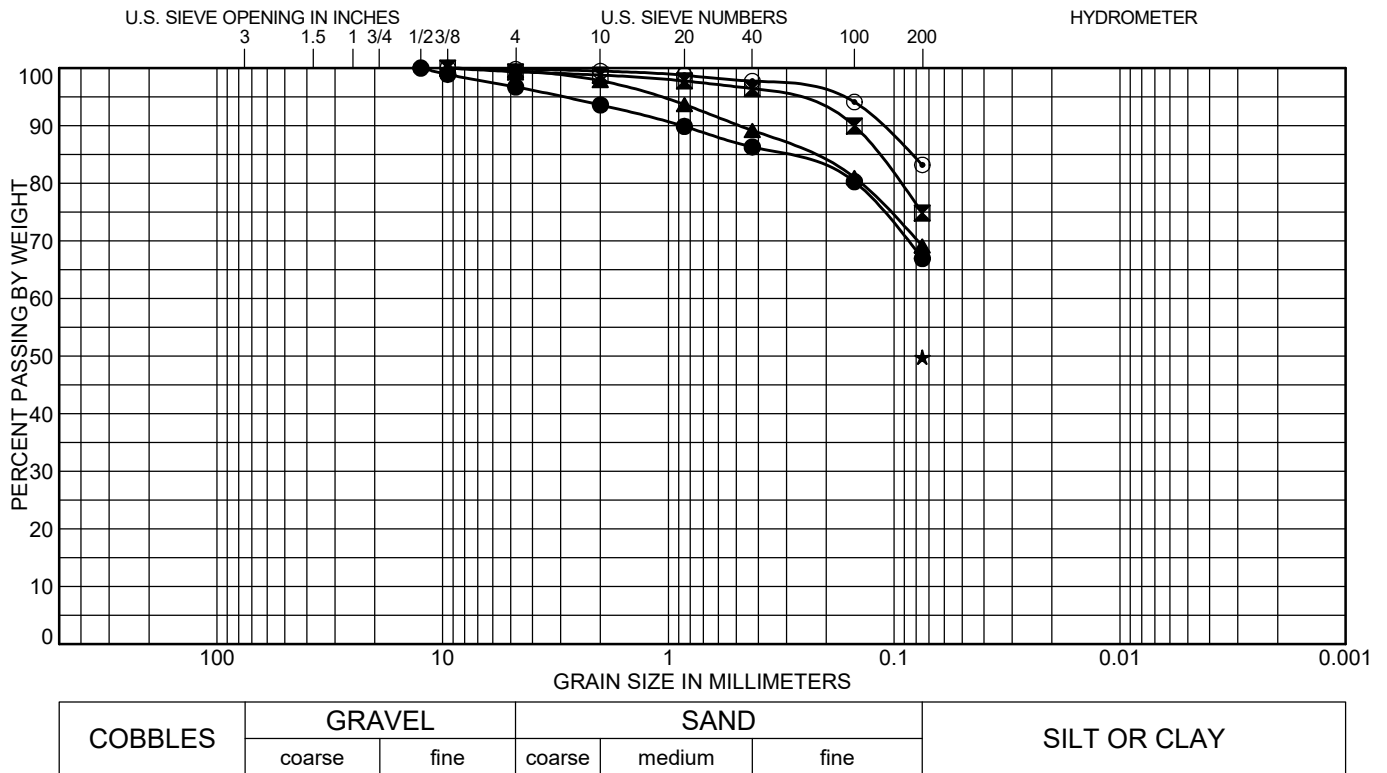
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Materials Testing
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SUMMARY OF LABORATORY TEST RESULTS

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FIGURE No. 7
PAGE 1 OF 1
DATE Apr/28/2025



Test Boring	Depth (ft)	Classification				LL	PL	PI
● 1	0.0	SANDY LEAN CLAY(CL)				37	15	22
☒ 2	0.0	LEAN CLAY with SAND(CL)				37	15	22
▲ 3	0.0	SANDY LEAN CLAY(CL)				43	21	22
★ 3	9.0							
⊙ 4	0.0	LEAN CLAY with SAND(CL)				46	20	26
Test Boring	Depth (ft)	%Gravel	%Sand	%Silt	%Clay			
● 1	0.0	3.3	29.8	66.9				
☒ 2	0.0	0.6	24.5	74.8				
▲ 3	0.0	0.5	30.4	69.1				
★ 3	9.0			49.8				
⊙ 4	0.0	0.2	16.6	83.2				

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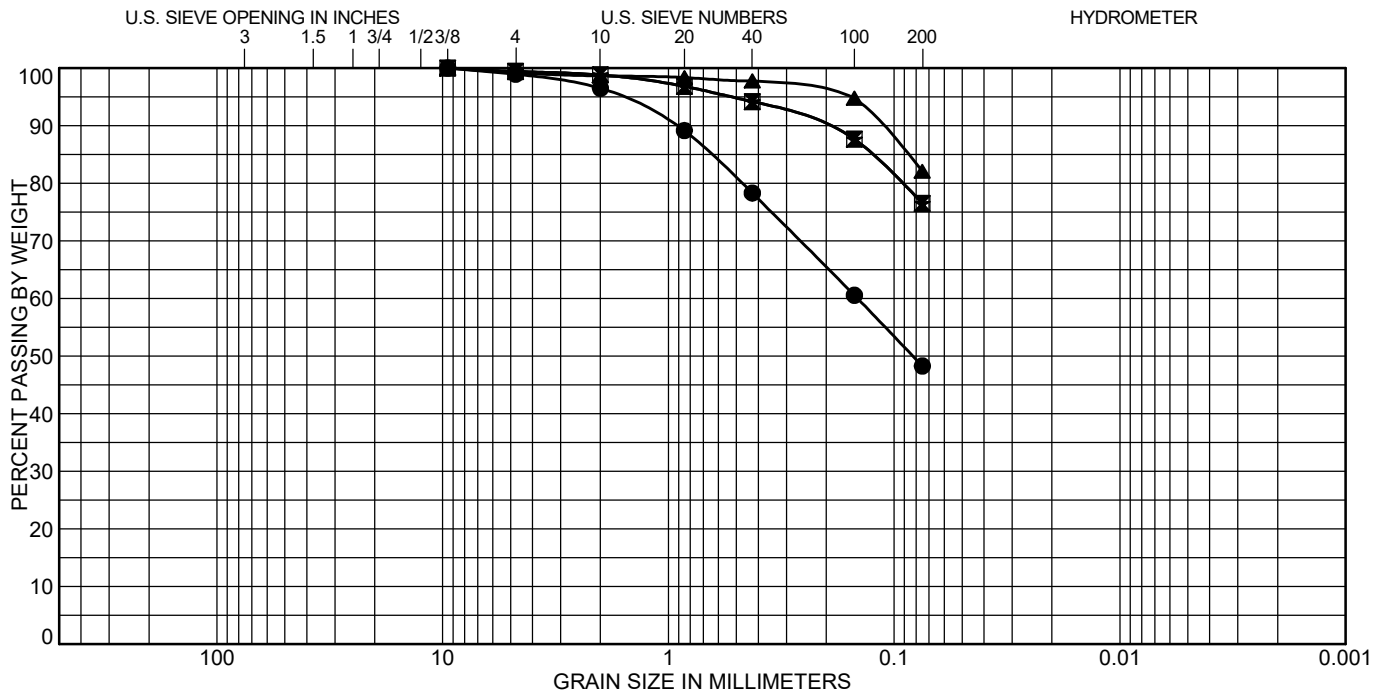
Materials Testing
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SOIL CLASSIFICATION DATA

JOB No. 197432

FIGURE No. 8

DATE Apr/28/2025



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Test Boring	Depth (ft)	Classification	LL	PL	PI
● 5	0.0	CLAYEY SAND(SC)	38	20	18
☒ BULK 3&4	0.0	LEAN CLAY with SAND(CL)	40	21	19
▲ Bulk 6	0.0	LEAN CLAY with SAND(CL)	40	19	21
★ Combined 3&4	0.0	LEAN CLAY with SAND(CL)	40	21	19

Test Boring	Depth (ft)	%Gravel	%Sand	%Silt	%Clay
● 5	0.0	1.1	50.6	48.3	
☒ BULK 3&4	0.0	0.6	22.9	76.5	
▲ Bulk 6	0.0	0.8	17.1	82.1	
★ Combined 3&4	0.0	0.6	22.9	76.5	

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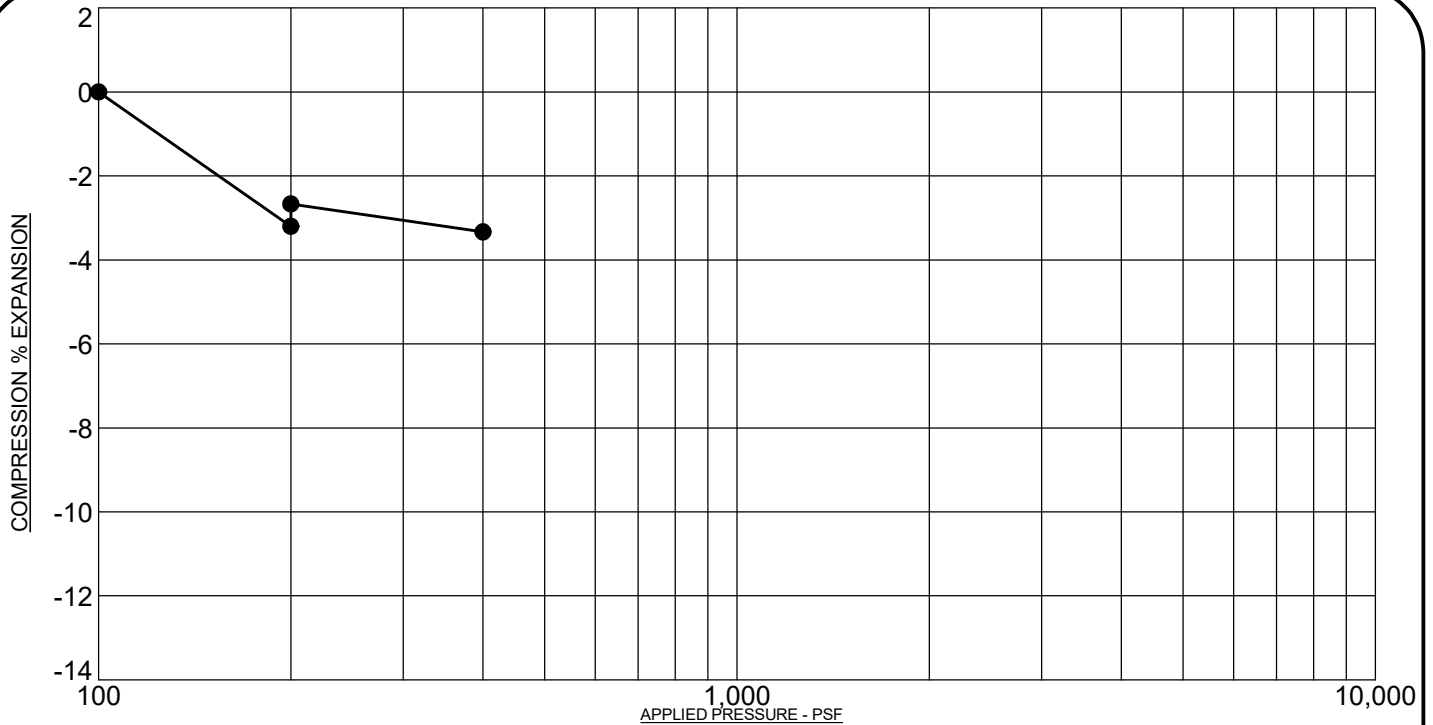
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SOIL CLASSIFICATION DATA

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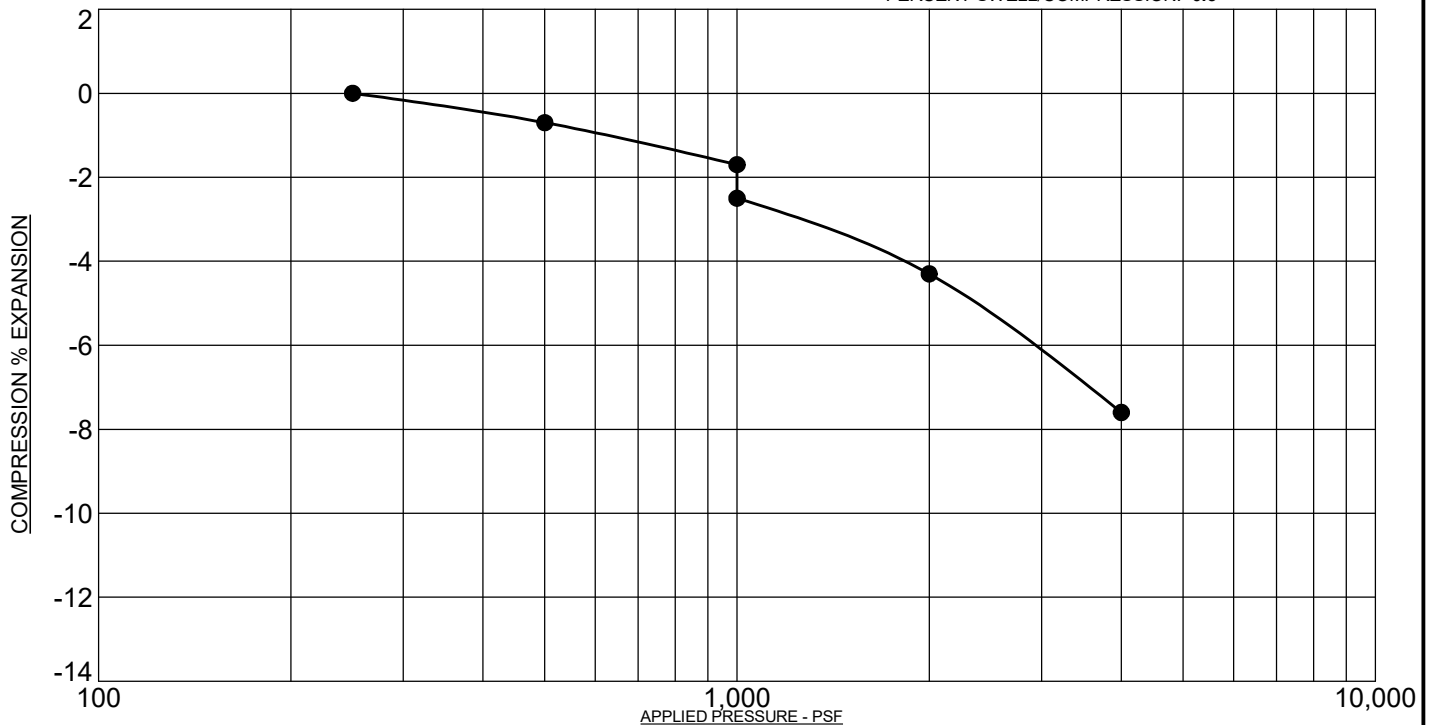
FIGURE No. 9

DATE Apr/28/2025



PROJECT: Carriage Meadows El Paso County, Colorado
 SAMPLE DESCRIPTION: FILL: CLAY, SANDY
 NOTE: SAMPLE WAS INUNDATED WITH WATER AT 200 PSF

SAMPLE LOCATION: 1 @ 2 FT
 NATURAL DRY UNIT WEIGHT: 108.1 PCF
 NATURAL MOISTURE CONTENT: 17.9%
 PERCENT SWELL/COMPRESSION: 0.5



PROJECT: Carriage Meadows El Paso County, Colorado
 SAMPLE DESCRIPTION: FILL: CLAY, SANDY
 NOTE: SAMPLE WAS INUNDATED WITH WATER AT 1,000 PSF

SAMPLE LOCATION: 2 @ 2 FT
 NATURAL DRY UNIT WEIGHT: 101.5 PCF
 NATURAL MOISTURE CONTENT: 14.0%
 PERCENT SWELL/COMPRESSION: - 0.8

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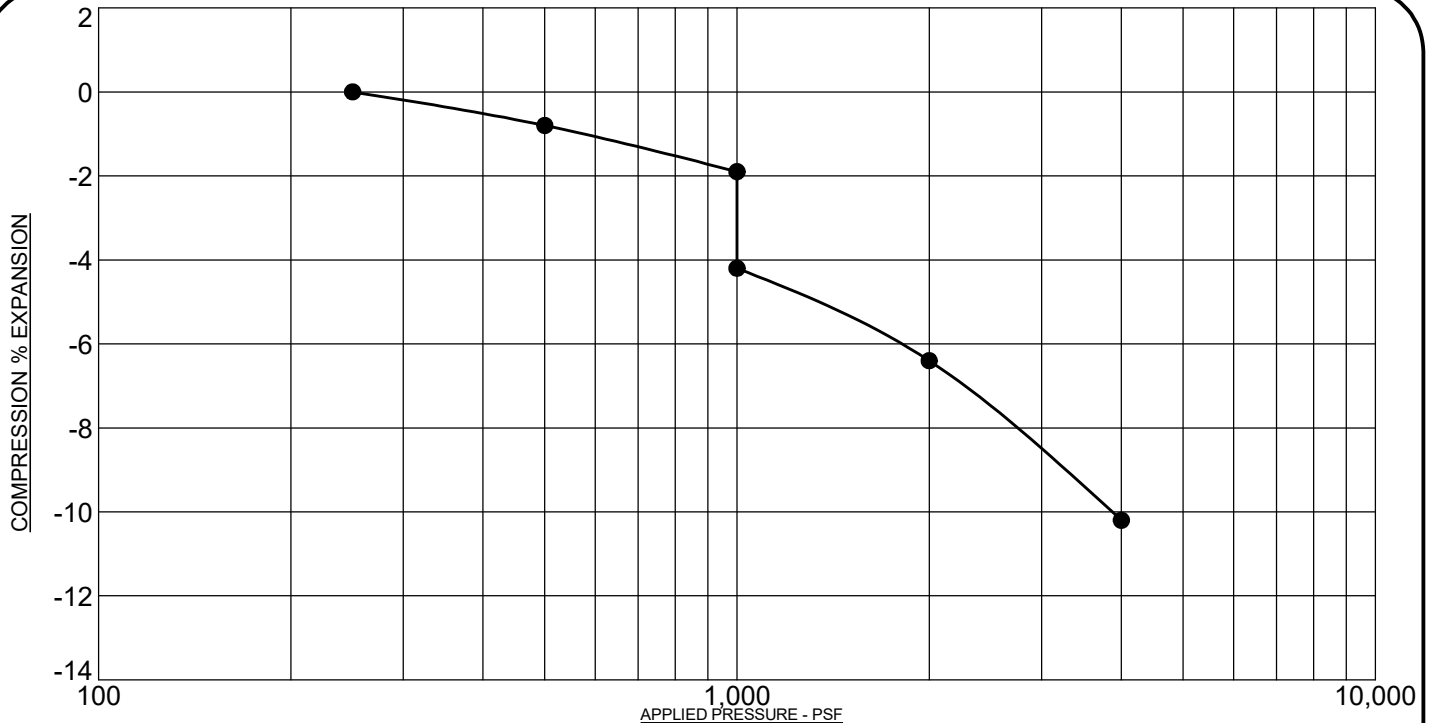
Materials Testing
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SWELL/CONSOLIDATION TEST RESULTS

JOB No. 197432

FIGURE No. 10

DATE Apr/28/2025



PROJECT: Carriage Meadows El Paso County, Colorado
 SAMPLE DESCRIPTION: FILL: CLAY, SANDY
 NOTE: SAMPLE WAS INUNDATED WITH WATER AT 1,000 PSF

SAMPLE LOCATION: 5 @ 2 FT
 NATURAL DRY UNIT WEIGHT: 87.5 PCF
 NATURAL MOISTURE CONTENT: 8.3%
 PERCENT SWELL/COMPRESSION: - 2.3

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 5085 List Drive, Suite 200
 Colorado Springs, CO 80918
 (719) 548-0600

SOUTHERN COLORADO, DENVER METRO, NORTHERN COLORADO

Materials Testing
Forensic

SWELL/CONSOLIDATION TEST RESULTS

JOB No. 197432

FIGURE No. 11

DATE Apr/28/2025

CLIENT: Eagle Development

SAMPLE NUMBER: Combined 3&4

PROJECT: Carriage Meadows, El Paso County, Colorado

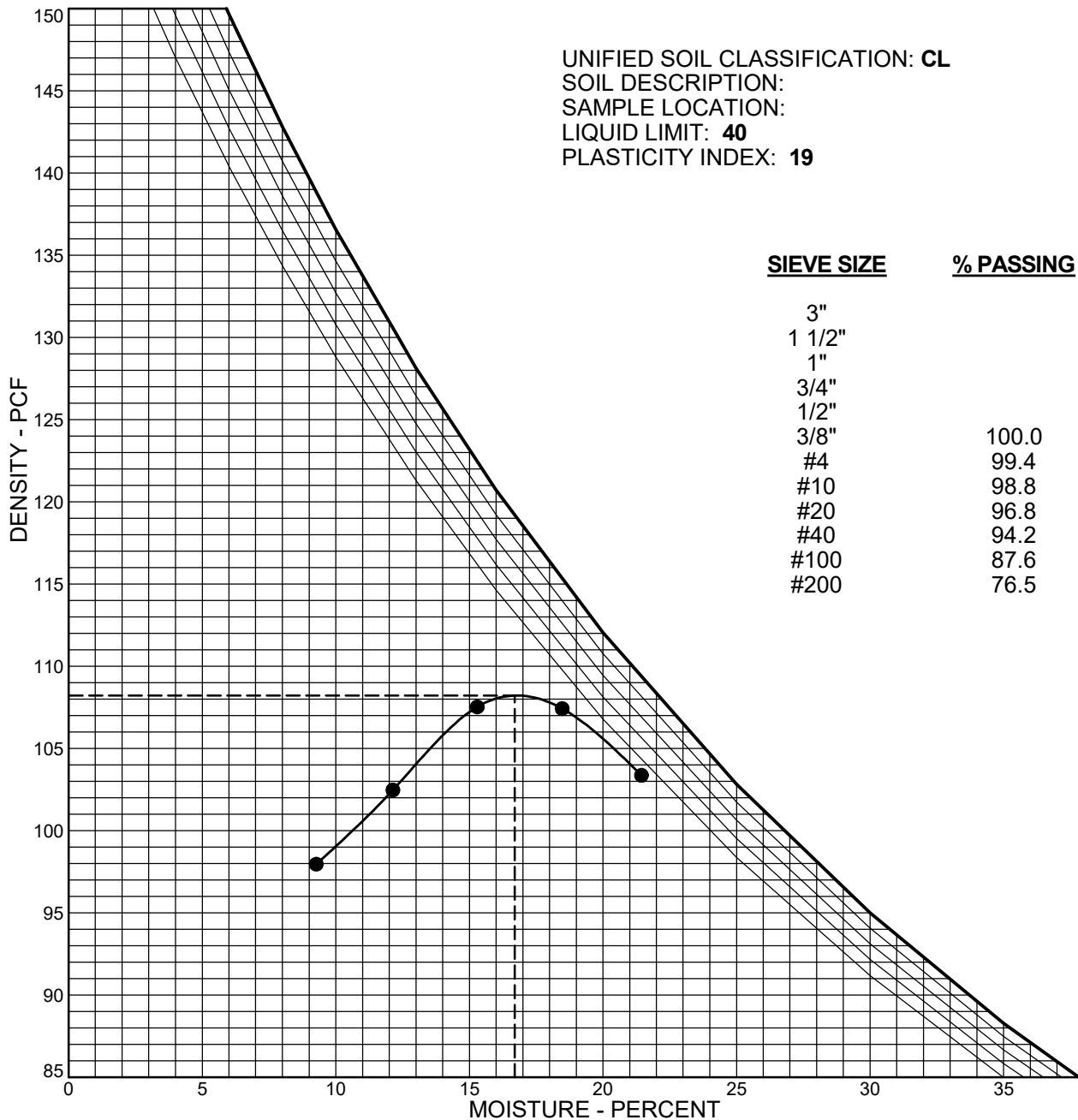
UNIFIED SOIL CLASSIFICATION: CL

SOIL DESCRIPTION:

SAMPLE LOCATION:

LIQUID LIMIT: 40

PLASTICITY INDEX: 19



ROCKY MOUNTAIN GROUP

Structural
Geotechnical



Materials Testing
Forensic

MOISTURE-DENSITY RELATION CURVE

JOB No. 197432

FIGURE No. 12

DATE Apr/28/2025

Colorado Springs, (Corporate Office)

5085 List Drive, Suite 200

Colorado Springs, CO 80919

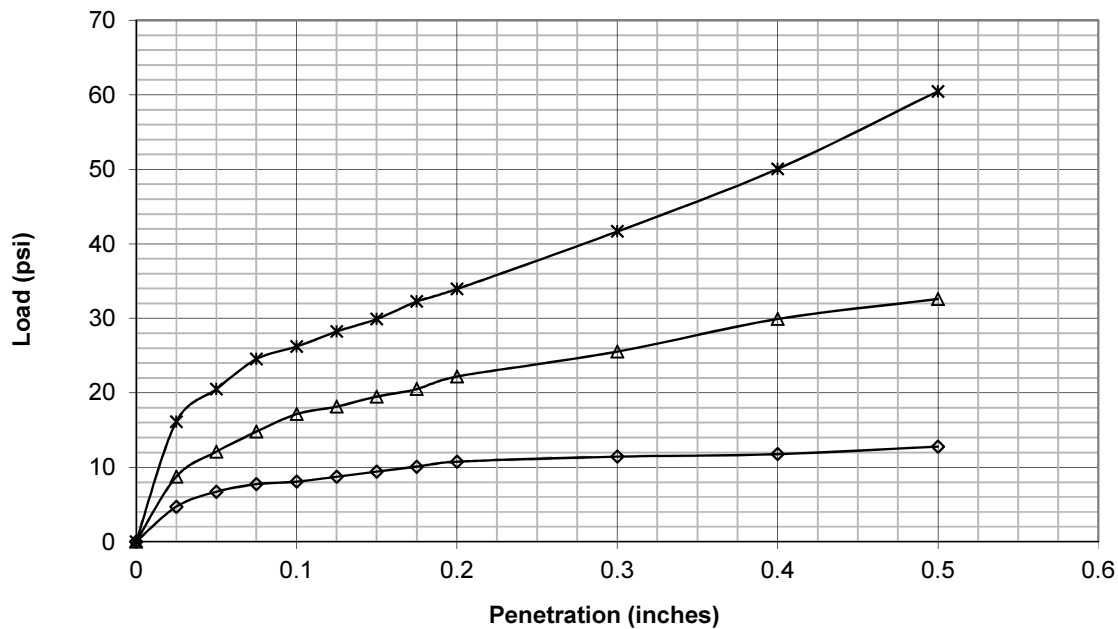
(719) 548-0600

SOUTHERN COLORADO, DENVER METRO, NORTHERN COLORADO

CALIFORNIA BEARING RATIO TEST RESULTS

Project: Carriage Meadows, El Paso County, Colorado
 Job No.: 197432
 AASHTO Classification: A-6 (14)
 Sample Description: Combined 3&4
 Sample Location: Combined Bulk Sample
 Soil Description: Clay Fill

	10 blows/lift	25 blows/lift	56 blows/lift
Penetration (in)	Load (psi)	Load (psi)	Load (psi)
0.000	0.0	0.0	0.0
0.025	4.7	8.7	16.1
0.050	6.7	12.1	20.5
0.075	7.7	14.8	24.5
0.100	8.1	17.1	26.2
0.125	8.7	18.1	28.2
0.150	9.4	19.5	29.9
0.175	10.1	20.5	32.2
0.200	10.7	22.2	33.9
0.300	11.4	25.5	41.7
0.400	11.8	29.9	50.1
0.500	12.8	32.6	60.5



	Corrected Penetration (in)	Corrected Load (psi)
10 blows/lift	0.100	0.8
25 blows/lift	0.100	1.7
56 blows/lift	0.100	2.6

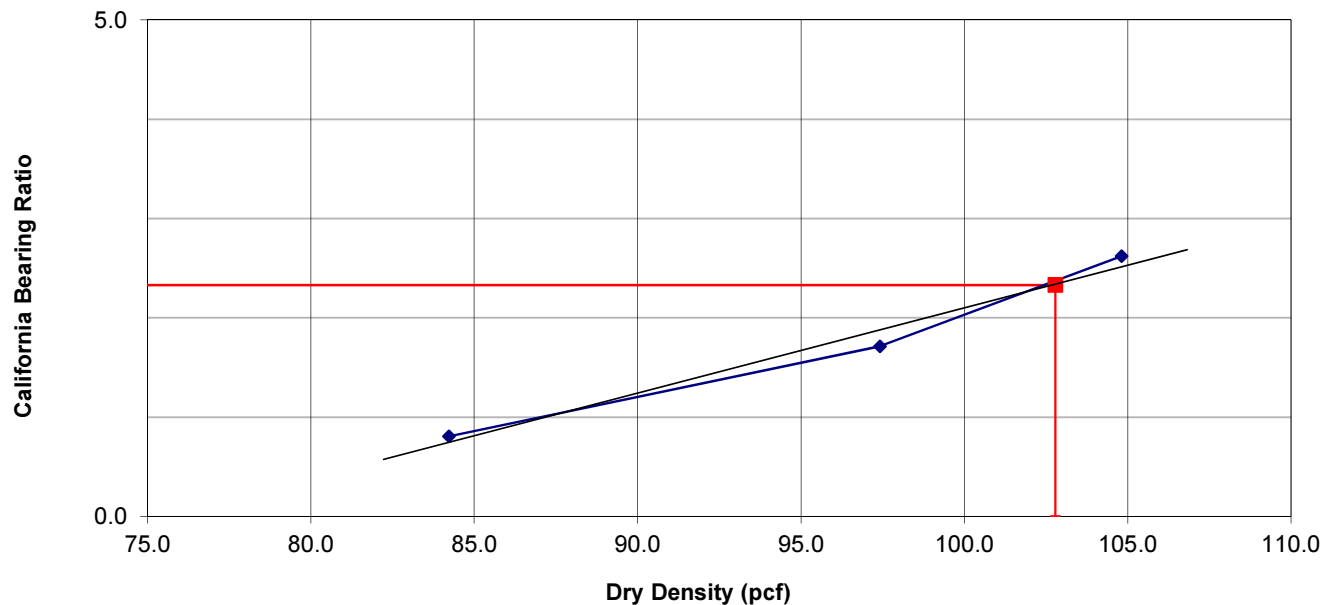


Figure No. 13

CALIFORNIA BEARING RATIO TEST RESULTS

Project: Carriage Meadows, El Paso County, Colorado
 Job No.: 197432
 AASHTO Classification" A-6 (14)
 Sample Description: Combined 3&4
 Sample Location: Combined Bulk Sample
 Soil Description: Clay Fill

	10 blows/lift	25 blows/lift	56 blows/lift
Corrected California Bearing Ratio	0.8	1.7	2.6
Dry Density (pcf)	84.2	97.4	104.8
Percent Compaction	78	90	97
Percent Moisture After Soaking	34.0	32.2	28.1
Percent Expansion (+) / Compression (-)	0.6%	2.0%	2.0%
Surcharge Weight (lbs)	12.61	12.61	12.61



California Bearing Ratio	2.3
Dry Density (pcf)	108.2
Percent Compaction	95%
Target Dry Density	102.8
Compaction Test Method	ASTM D-698A
Condition of sample	Soaked



Figure No. 14