Architecture
Structural
Geotechnical

Materials Testing
Forensic
Civil/Planning

ROCKY MOUNTAIN GROUP
EMPLOYEE OWNED

PAVEMENT DESIGN REPORT

Paint Brush Hills Filing No. 13E – West Phase
El Paso County, Colorado

SF-189

PREPARED FOR:

Landhuis Company
212 N. Wahsatch Ave. Ste 301
Colorado Springs, CO

JOB NO. 165451

February 22, 2019

Respectfully Submitted,

RMG – Rocky Mountain Group

Brian Griffith, E.I.
Geotechnical Staff Engineer

Reviewed by,

RMG – Rocky Mountain Group

Geoff Webster, P.E.
Sr. Geotechnical Project Manager

COLORADO LICENSED
GEOFF WEBSTER
2/22/19
45046
PROFESSIONAL ENGINEER

TABLE OF CONTENTS

GENERAL SITE AND PROJECT DESCTIPTION 3
Location 3
Existing Conditions 3
Project Description 3
FIELD INVESTIGATION AND SUBSURFACE CONDITIONS 3
Drilling 3
Subsurface Materials 4
Groundwater 4
LABORATORY TESTING 4
Laboratory Testing 4
PAVEMENT DESIGN 6
Pavement Thickness 7
Pavement Materials 7
Soil Mitigation 7
Subgrade Preparation 8
Surface Drainage 8
Subgrade Observations and Testing 8
CLOSING 9

FIGURES
Site Vicinity Map 1
Test Boring Location Plan 2
Recommended Pavement Sections 2.1
Explanation of Test Boring Logs 3
Test Boring Logs 4-8
Summary of Laboratory Test Results 9
Soil Classification Data 10-11
Moisture-Density Relation Curve 12
California Bearing Ratio Test Results 13-14

APPENDIX A

Paintbrush Hills Filing No. 13E, AASHTO Empirical Equation for Flexible Pavements – Local
Paintbrush Hills Filing No. 13E, AASHTO Empirical Equation for Flexible Pavements – Local (Low Volume)

GENERAL SITE AND PROJECT DESCTIPTION

Location

Paint Brush Hills, Filing No. 13E is located north and west of the intersection of Londonderry Drive and Meridian Road in El Paso County, Colorado. The location of the site is shown on the Site Vicinity Map, Figure 1.

Existing Conditions

At the time of our field investigation, the proposed streets were close to grade and utility mains and services had been installed.

Project Description

This Pavement Design Report was performed to determine the subsurface conditions present along the roadway alignments and to develop recommendations for the design and construction of the proposed flexible pavements in the West Phase of Filing No. 13E.

The proposed streets included in this investigation are shown on Figure 2. The streets considered below are classified as either Urban Local or Urban Local-Low Volume. All streets have 50-foot or 60-foot Right-of Ways. Urban Local streets have two 15-foot travel lanes, while Urban Local-Low Volume streets have two 12-foot travel lanes. In Filing No. 13E, Keating Drive is classified as Urban Local with a 60-foot Right-of-Way. Devoncove Drive is classified as Urban Local with a 50-foot Right-of-Way. Hillandale Way and Wingfiel Lane are classified as Urban Local-Low Volume with 50-foot Right-of-Ways.

FIELD INVESTIGATION AND SUBSURFACE CONDITIONS

Drilling

The subsurface conditions on the site were investigated by drilling nine (9) exploratory test borings. The approximate locations of the test borings are presented in the Test Boring Location Plan (Figure 2).

The test borings were advanced with a power-driven, continuous-flight auger drill rig to depths of about 5 to 10 feet below the existing ground surface. Samples were obtained in general accordance with ASTM D-3550 utilizing a 2½-inch OD modified California sampler. Representative bulk samples of subsurface materials were obtained from each boring at a depth of approximately 0 to 2 feet below the existing ground surface. An Explanation of Test Boring Logs is presented in Figure 3. The Test Boring Logs are presented in Figures 4 through 8.

Subsurface Materials

The subsurface materials generally consisted of clayey sand to sandy clay fill overlaying native clayey sand or clayey sandstone. In test borings where fill was encountered, fill extended to depths of 2.5 to 7 feet below the existing ground surface. Clayey sandstone was encountered at the existing ground surface in Test Borings 6 and 8. Combined bulk samples of material - collected from the top two feet of the soil profile in the areas of interest - classified as clayey sand (SC) according to the Unified Classification System. For pavement design purposes the combined bulk soil samples classified as A-2-6 in accordance with the American Association of State Highway and Transportation Officials (ASSHTO) classification system. This soil classification is considered "excellent to good" as pavement subgrade material.

Groundwater

Groundwater was not encountered in the test borings at the time of drilling. Groundwater is not expected to affect the construction of the pavements. Fluctuations in groundwater and subsurface moisture conditions may occur due to variations in precipitation and other factors not readily apparent at this time. Development of the property and adjacent properties may also affect groundwater levels.

LABORATORY TESTING

Laboratory Testing

The moisture content for the recovered samples was obtained in the laboratory. Grain-size analysis and Atterberg Limits tests were performed on selected samples for purposes of classification and to develop pertinent engineering properties. A Summary of Laboratory Test Results is presented in Figure 9. Soil Classification Data are presented in Figures 10 through 11.

A combined bulk sample of A-2-6 soil was tested to determine the optimum moisture-density relationship in accordance with ASTM D698 (Standard Proctor compaction test). The Moisture-Density Relation Curve is presented in Figure 12. California Bearing Ratio, CBR tests were performed at varying densities with moisture content near optimum. At 95% of the maximum Standard Proctor density, the CBR of the bulk sample was 6.0. The CBR Test Results are presented in Figures 13 and 14.

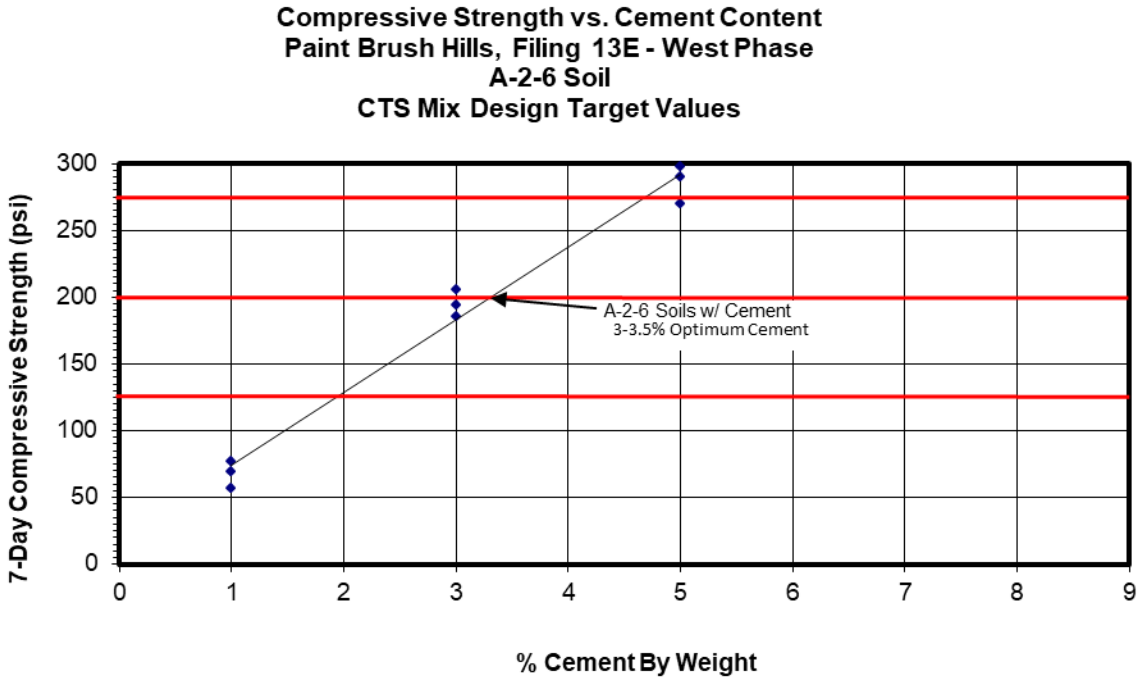
The developer intends to install a composite roadway section consisting of Hot Mix Asphalt over Cement-Treated Subgrade (CTS). RMG performed a Mix Design for this composite section.

Specimens of soil composed of the on-site A-2-6 subgrade materials and Portland Cement were prepared by varying the "percent cement by weight" at target values of 1, 3, and 5 percent cement. Three specimens (pucks) were prepared for each target cement value, compacted to 95% of the maximum Standard Proctor density and cured in a saturated condition for 7-days. The compressive strength of each specimen was then determined upon completion of the 7-day curing process. The compressive strengths are presented in the table below:

Calculations

CTS Puck	Age/Day	Cap & Plate	Area of Sample	Dial Reading	Load LBF	Total Load	PSI
1A	7	2.82	12.56	70	708	711	57
1B	7	2.82	12.56	85	860	863	69
1C	7	2.82	12.56	95	961	964	77
2A	7	2.82	12.56	255	2580	2583	206
2B	7	2.82	12.56	241	2438	2441	194
2C	7	2.82	12.56	230	2327	2330	185
3A	7	2.82	12.56	335	3389	3392	270
3B	7	2.82	12.56	360	3642	3645	290
3C	7	2.82	12.56	370	3743	3746	298

The data values were then plotted as a function of "7-day Compressive Strength versus Percent Cement by Weight." In accordance with the El Paso County Engineering Criteria Manual, the target "percent cement by weight" was selected to obtain strengths in the lower Strength Coefficient (SC) categories (SC = 0.11, 125-200 psi; SC = 0.12, 200-275 psi). A target SC = 0.11 is used for CTS soil in the pavement design procedure presented below. Based upon an evaluation of the test data, a target range of 3.0 to 3.5-percent cement is recommended to maintain strengths below the 275 psi threshold stipulated in the Engineering Criteria Manual. Graphical representations of the results are presented below:



PAVEMENT DESIGN

The discussion presented below is based on the subsurface conditions encountered in the test borings, laboratory test results and the project characteristics previously described. If the subsurface conditions are different from those described in this report or the project characteristics change, RMG should be retained to review our recommendations and modify them, if necessary. The conclusions and recommendations presented in this report should be verified by RMG during construction.

The pavement design was performed using the El Paso County Engineering Criteria Manual, Appendix D. The pavement design parameters and design calculations are presented below.

Street Classification – Urban Local

1) Keating Drive and Devoncove Drive
   ESAL = 292,000 (Table D-2)
   Serviceability Index = 2.0 (Table D-1)

2) Strength coefficients (Table D-3)
   Asphalt (HMA): $a_1 = 0.44$
   Cement Stabilized Subgrade: $a_2 = 0.11$

3) Subgrade
   M_r = CBR x 1500 = 6 x 1500 = 9,000 psi

4) Structural number (SN) = 2.4 (per 1993 AASHTO Empirical Equation for Flexible Pavements, presented in Appendix A)

5) Composite asphalt/base course section
   Minimum HMA thickness = D_1 = 3 inches (Table D-2)
   CTS thickness = $D_2 = \{SN – (D_1 \times a_1)\} / a_2 = \{2.4 – (3 \times 0.44)\} / 0.11 = 9.8$ inches
   Use CTS thickness = 10 inches
   SN = (3 x 0.44) + (10 x 0.11) = 2.42 > 2.40 (Min. SN required)
   Per, paragraph D.4.1-F: base course thickness cannot exceed 2.5 times the HMA thickness
   Use HMA thickness = 3.5 inches
   CTS thickness = $D_2 = \{SN – (D_1 \times a_1)\} / a_2 = \{2.4 – (3.5 \times 0.44)\} / 0.11 = 7.8$ inches
   Use CTS thickness = 8 inches
   SN = (3.5 x 0.44) + (8.0 x 0.11) = 2.42 > 2.40 (Min. SN required)

Street Classification – Urban Local – Low Volume

1) Hillandale Way and Wingfiel Lane
   ESAL = 36,500 (Table D-2)
   Serviceability Index = 2.0 (Table D-1)

2) Strength coefficients (Table 6)
   Asphalt (HMA): $a_1 = 0.44$
   Cement Stabilized Subgrade: $a_2 = 0.11$

3) Subgrade
   M_r = CBR x 1500 = 6 x 1500 = 9,000 psi

4) Structural number (SN) = 1.7 (per 1993 AASHTO Empirical Equation for Flexible Pavements, presented in Appendix A)

5) Composite asphalt/base course section
   Minimum HMA thickness = D_1 = 3 inches (Table D-2)
   CTS thickness = $D_2 = \{SN – (D_1 \times a_1)\} / a_2 = \{1.7 – (3 \times 0.44)\} / 0.11 = 3.5$ inches
   Minimum CTS thickness = 4 inches (Table D-2)
   SN = (3 x 0.44) + (4 x 0.11) = 1.76 > 1.7 (Min. SN required)

Pavement Thickness

Based on the design calculations, the recommended pavement section is presented below and on Figure 2.1.

Recommended Pavement Sections

Keating Drive and Devoncove Drive	3.5” HMA	8" CTS
Hillandale Way and Wingfiel Lane	3” HMA	4" CTS
Optimal CTS Percent Cement by Weight = 3-3.5%		

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.

Soil Mitigation

The El Paso County Engineering Criteria Manual notes that mitigation measures may be required for expansive soils, shallow ground water, subgrade instability, etc. Based on the AASHTO classification for the soils in the subdivision, the subgrade soils evaluated for this pavement design can be expected to be nonexpansive. 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 Filing No. 13E (West Phase) roadways shall be Cement Treated Subgrade (CTS) composed of a mixture 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 cement shall be by weight as a percentage of the dry weight of the soil as specified herein (3 to 3.5% optimum), and should be applied uniformly on the soil 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.

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 pond on the pavement or at 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.

CLOSING

This report has been prepared for the exclusive purpose of providing geotechnical engineering information and recommendations for development described in this report. RMG should be retained to review the final construction documents prior to construction to verify our findings, conclusions and recommendations have been appropriately implemented.

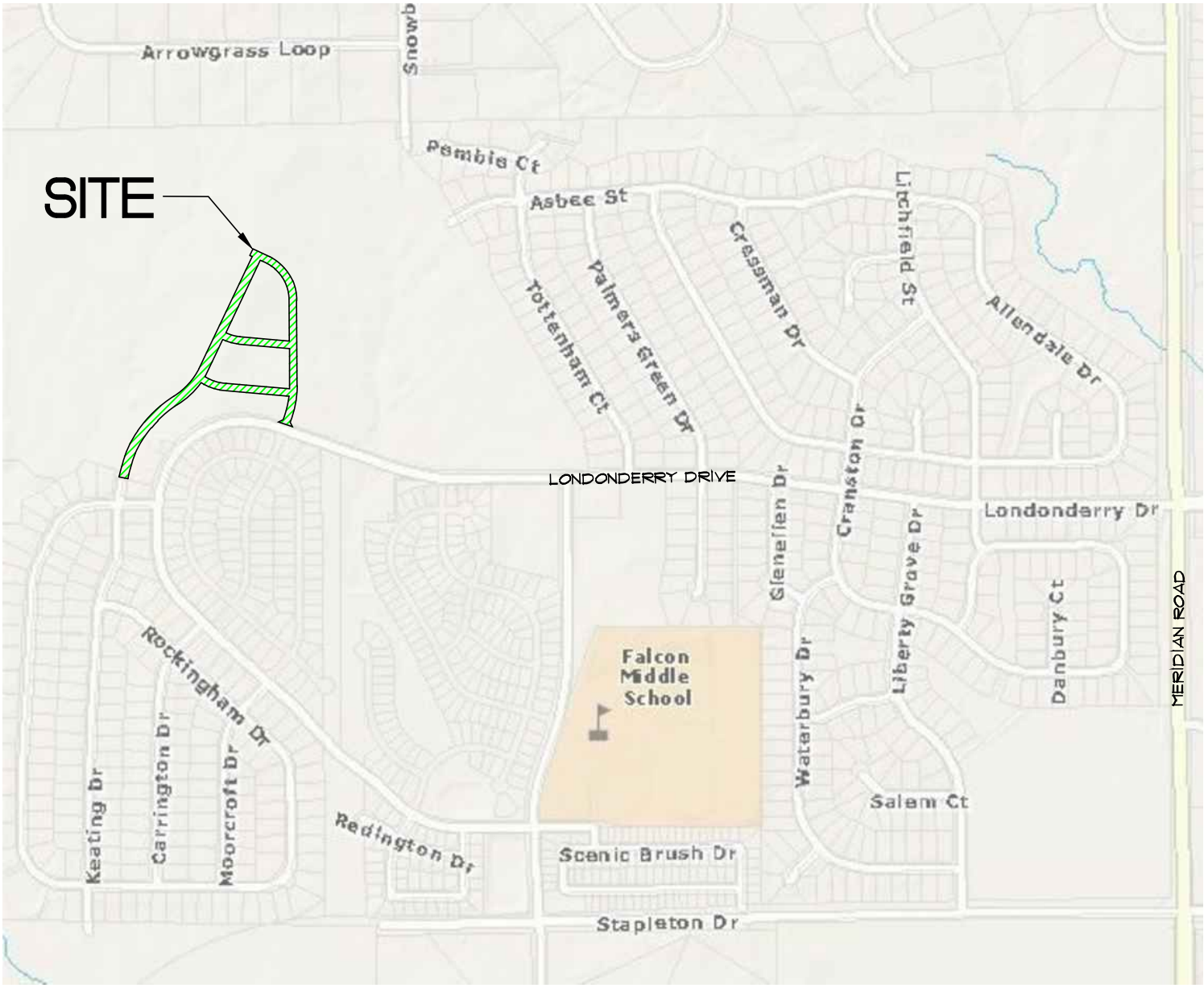
This report has been prepared for the exclusive use by the **Landhuis Company** for application as an aid in the design and construction of the proposed development in accordance with generally accepted geotechnical engineering practices. The analyses and recommendations in this report are based in part upon data obtained from test borings, 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 review the recommendations presented in this report considering the varied condition, and either verify or modify them in writing.

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 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 by the preparation of this report. Third parties reviewing this report should draw their own conclusions regarding site conditions and specific construction techniques to be used on this project.

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



REFERENCE
NOT TO SCALE

ARCHITECTS RMG ENGINEERS
ROCKY MOUNTAIN GROUP

Southern Office
Colorado Springs,CO
80918
(719) 548-0600
Central Office:
Englewood, CO 80112
(303) 688-9475
Northern Office:
Greeley / Evans, CO 80620
(970) 330-1071

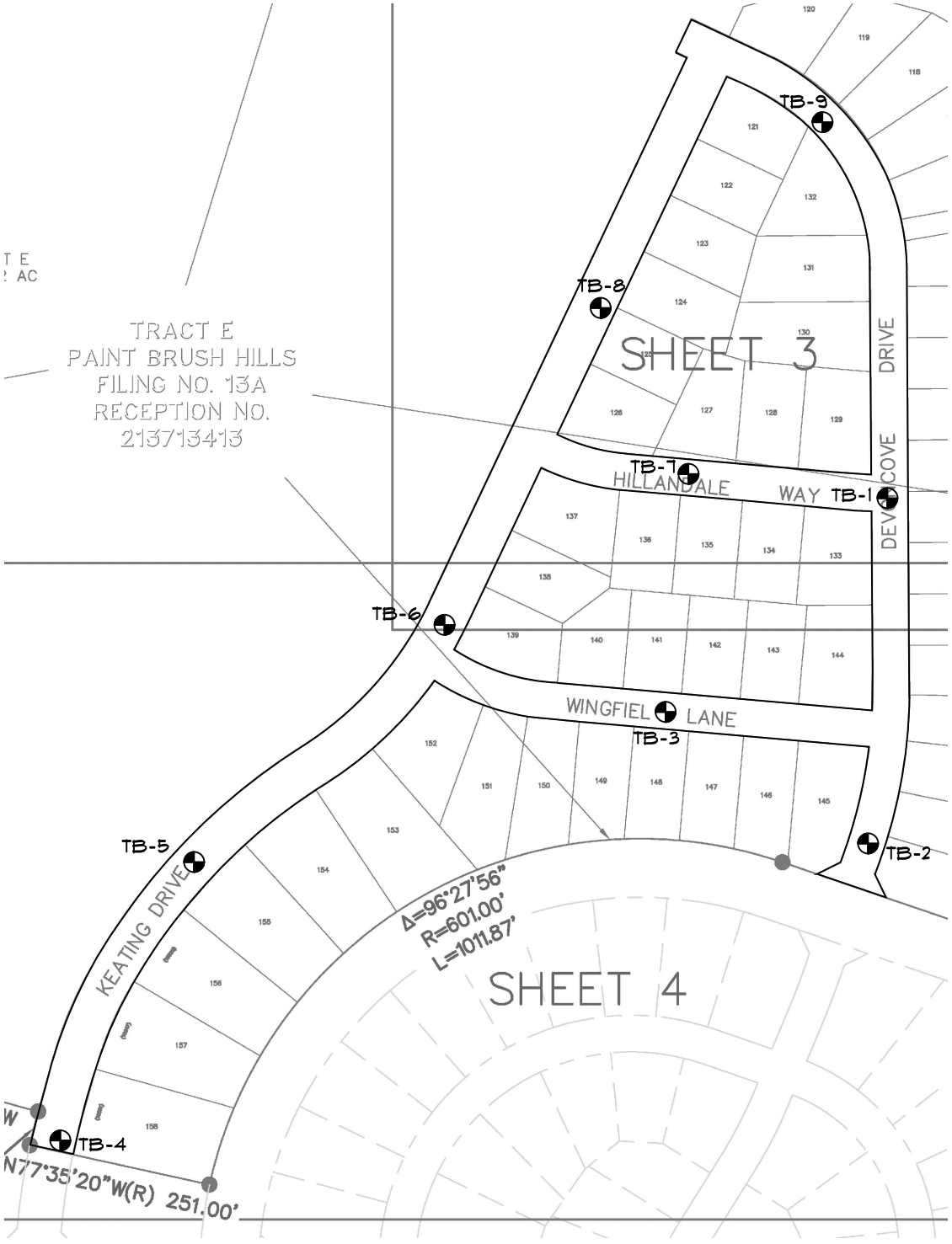
SITE VICINITY MAP

PAINT BRUSH HILLS
FILING NO. 13E, WEST PHASE
EL PASO COUNTY, CO
LANDHUIS COMPANY

JOB No. 165451

FIG No. 1

DATE 2-22-2019



REFERENCE SCALE 0 500 FT

DENOTES APPROXIMATE LOCATION OF TEST BORINGS

ARCHITECTS RMG ENGINEERS
ROCKY MOUNTAIN GROUP

Southern Office
Colorado Springs,CO 80918
(719) 548-0600
Central Office:
Englewood, CO 80112
(303) 688-9475
Northern Office:
Greeley / Evans, CO 80620
(970) 330-1071

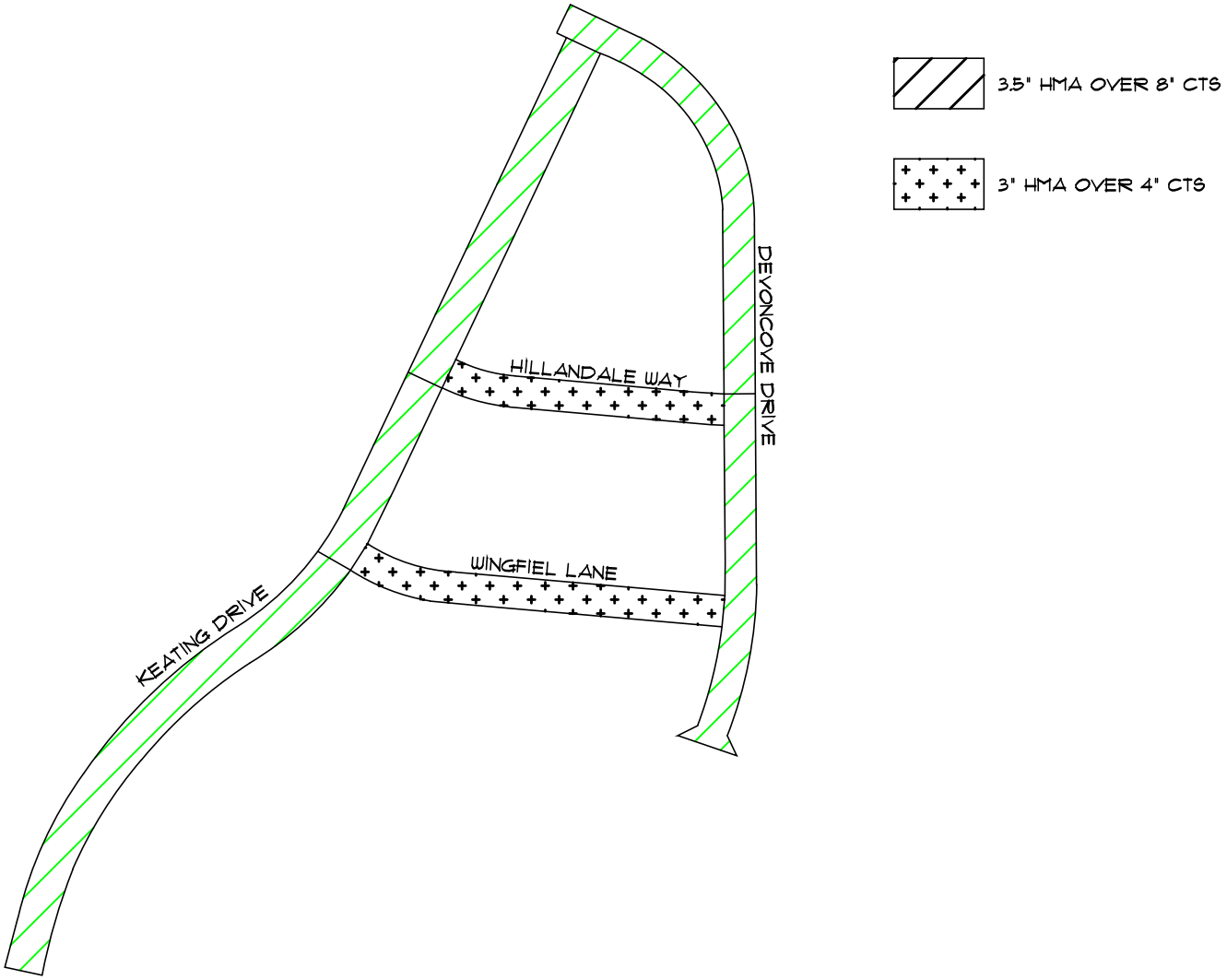
TEST BORING LOCATION PLAN

PAINT BRUSH HILLS
FILING NO. 13E, WEST PHASE
EL PASO COUNTY, CO
LANDHUIS COMPANY

JOB No. 165451

FIG No. 2

DATE 2-22-2019



REFERENCE
NOT TO SCALE

ARCHITECTS RMG ENGINEERS
ROCKY MOUNTAIN GROUP

Southern Office
Colorado Springs,CO 80918
(719) 548-0600
Central Office:
Englewood, CO 80112
(303) 688-9475
Northern Office:
Greeley / Evans, CO 80620
(970) 330-1071

PAVEMENT DESIGN

PAINT BRUSH HILLS
FILING NO. 13E, WEST PHASE
EL PASO COUNTY, CO
LANDHUIS COMPANY

JOB No. 165451

FIG No. 2.1

DATE 2-22-2019

SOILS DESCRIPTION


CLAYEY SAND


FILL: SAND, SILTY TO CLAYEY


FILL: CLAY, SANDY


SANDSTONE

UNLESS NOTED OTHERWISE, ALL LABORATORY
TESTS PRESENTED HEREIN WERE PERFORMED BY:
RMG - ROCKY MOUNTAIN GROUP
2910 AUSTIN BLUFFS PARKWAY
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 (%)

ROCKY MOUNTAIN GROUP

Architectural
Structural
Forensics

ARCHITECTS RMG ENGINEERS

Geotechnical
Materials Testing
Civil, Planning

Colorado Springs: (Corporate Office)
2910 Austin Bluffs Parkway
Colorado Spings, CO 80918
(719) 548-0600
SOUTHERN COLORADO, DENVER METRO, NORTHERN COLORADO

EXPLANATION OF TEST BORING LOGS

JOB No. 165451

FIGURE No. 3

DATE 2/22/19

TEST BORING: **1** DATE DRILLED: 11/2/18 ELEVATION (FT): NO GROUNDWATER ON 11/2/18	DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
FILL: SAND, CLAYEY, brown to olive, medium dense, moist				23	7.0
				24	6.3
	5				

TEST BORING: **2** DATE DRILLED: 11/2/18 ELEVATION (FT): NO GROUNDWATER ON 11/2/18	DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
FILL: SAND, CLAYEY, brown to olive, loose to medium dense, moist				21	9.3
				10	7.0
	5				

ROCKY MOUNTAIN GROUP

Architectural
Structural
Forensics

ARCHITECTS RMG ENGINEERS

Geotechnical
Materials Testing
Civil, Planning

Colorado Springs: (Corporate Office)
2910 Austin Bluffs Parkway
Colorado Spings, CO 80918
(719) 548-0600
SOUTHERN COLORADO, DENVER METRO, NORTHERN COLORADO

TEST BORING LOG

JOB No. 165451

FIGURE No. 4

DATE 2/22/19

TEST BORING: **3** DATE DRILLED: 11/2/18 ELEVATION (FT): NO GROUNDWATER ON 11/2/18	DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
FILL: SAND, CLAYEY, brown to olive, loose, moist				17	1.6
SAND, CLAYEY, with gravel, tan to brown, medium dense, moist				47	3.5
	5				

TEST BORING: **4** DATE DRILLED: 12/19/18 ELEVATION (FT): NO GROUNDWATER ON 12/19/18	DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
FILL: CLAYEY SAND TO SANDY CLAY, tan to olive, loose, moist				15	9.5
FILL: CLAY, SANDY, light brown to light olive, medium stiff, moist				6	11.0
	5				

ROCKY MOUNTAIN GROUP

Architectural
Structural
Forensics

ARCHITECTS RMG ENGINEERS

Geotechnical
Materials Testing
Civil, Planning

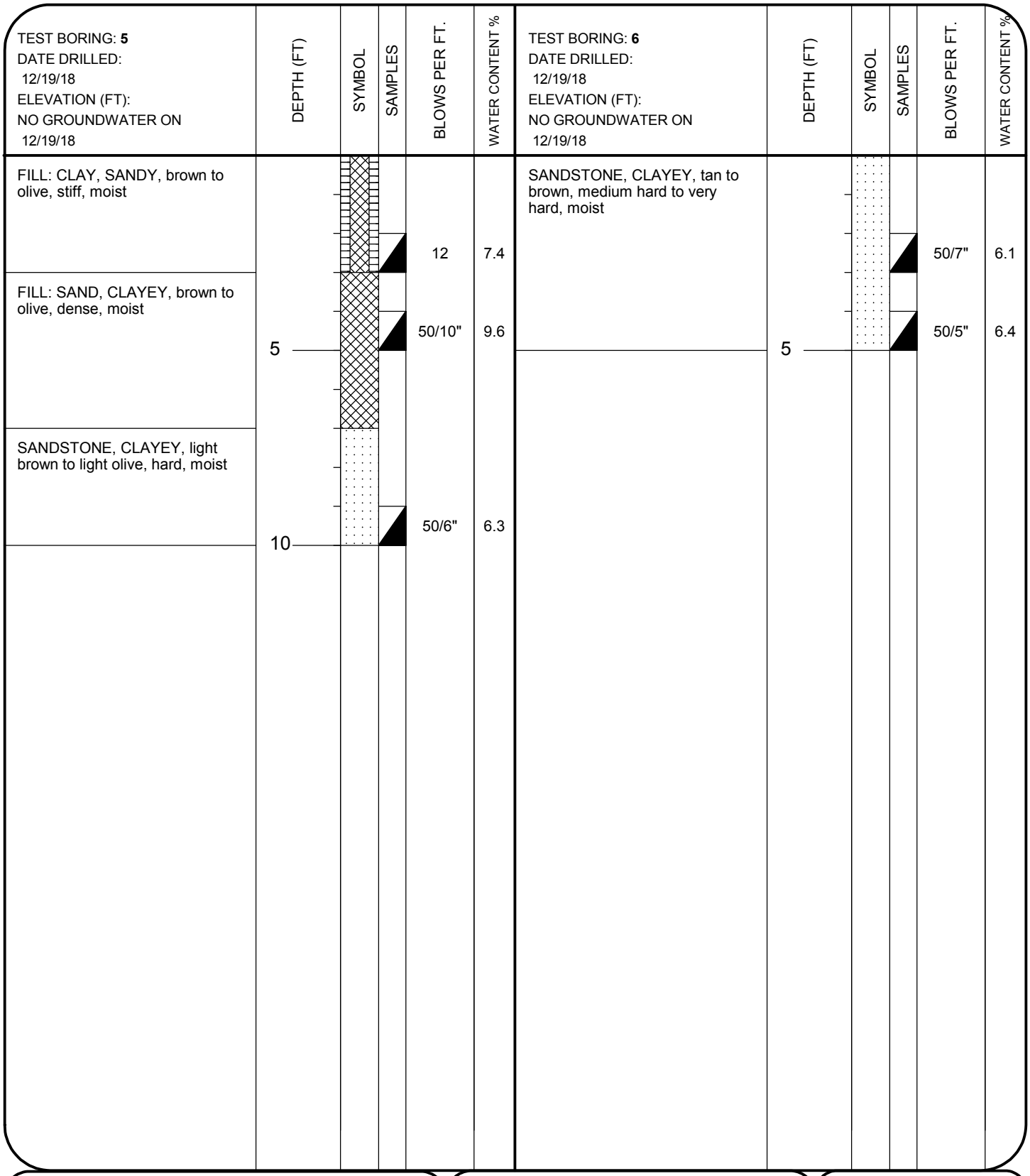
Colorado Springs: (Corporate Office)
2910 Austin Bluffs Parkway
Colorado Spings, CO 80918
(719) 548-0600
SOUTHERN COLORADO, DENVER METRO, NORTHERN COLORADO

TEST BORING LOG

JOB No. 165451

FIGURE No. 5

DATE 2/22/19



ROCKY MOUNTAIN GROUP

ARCHITECTS RMG ENGINEERS

Architectural
Structural
Forensics

Geotechnical
Materials Testing
Civil, Planning

Colorado Springs: (Corporate Office)
2910 Austin Bluffs Parkway
Colorado Spings, CO 80918
(719) 548-0600
SOUTHERN COLORADO, DENVER METRO, NORTHERN COLORADO

TEST BORING LOG

JOB No. 165451

FIGURE No. 6

DATE 2/22/19

TEST BORING: **7** DATE DRILLED: 12/19/18 ELEVATION (FT): NO GROUNDWATER ON 12/19/18	DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
FILL: CLAY, SANDY, brown and reddish brown to olive, very stiff, moist					
				21	6.9
				29	7.4
	5				

TEST BORING: **8** DATE DRILLED: 12/19/18 ELEVATION (FT): NO GROUNDWATER ON 12/19/18	DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
SANDSTONE, CLAYEY, light brown to light olive, medium hard to hard, moist					
				50/7"	12.5
				50/6"	9.8
	5				

ROCKY MOUNTAIN GROUP

Architectural
Structural
Forensics

ARCHITECTS RMG ENGINEERS

Geotechnical
Materials Testing
Civil, Planning

Colorado Springs: (Corporate Office)
2910 Austin Bluffs Parkway
Colorado Spings, CO 80918
(719) 548-0600
SOUTHERN COLORADO, DENVER METRO, NORTHERN COLORADO

TEST BORING LOG

JOB No. 165451

FIGURE No. 7

DATE 2/22/19

TEST BORING: **9**
DATE DRILLED:
12/19/18
ELEVATION (FT):
NO GROUNDWATER ON
12/19/18

DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
FILL: CLAY, SANDY, brown to olive, stiff, moist			13	9.8
			10	11.1
5				
SANDSTONE, CLAYEY, tan to light olive, very hard, moist			50/5"	6.4
10				

ROCKY MOUNTAIN GROUP

Architectural
Structural
Forensics

ARCHITECTS RMG ENGINEERS

Geotechnical
Materials Testing
Civil, Planning

Colorado Springs: (Corporate Office)
2910 Austin Bluffs Parkway
Colorado Spings, CO 80918
(719) 548-0600
SOUTHERN COLORADO, DENVER METRO, NORTHERN COLORADO

TEST BORING LOG

JOB No. 165451

FIGURE No. 8

DATE 2/22/19

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	1.0	0.7								
1	2.0	7.0		37	22	39.9	70.7	16.0		A-2-6 (0)
1	4.0	6.3								
2	1.0	0.9								
2	2.0	9.3		39	26	41.7	70.7	16.3		A-2-6 (0)
2	4.0	7.0								
3	1.0	1.1								
3	2.0	1.6		44	28	31.8	58.3	27.7		A-2-7 (2)
3	4.0	3.5								
4	1.0	5.8								
4	2.0	9.5		34	19	28.0	54.3	25.7		A-2-6 (1)
4	4.0	11.0								
5	1.0	4.6								
5	2.0	7.4		34	18	30.9	59.1	20.6		A-2-6 (0)
5	4.0	9.6								
5	9.0	6.3								
6	1.0	4.9								
6	2.0	6.1		37	23	26.0	54.1	26.6		A-2-6 (2)
6	4.0	6.4								
7	1.0	4.3								
7	2.0	6.9		39	24	26.6	54.3	23.8		A-2-6 (1)
7	4.0	7.4								
8	1.0	8.0								
8	2.0	12.5		35	14	18.1	48.1	21.5		A-2-6 (0)
8	4.0	9.8								
9	1.0	4.8								
9	2.0	9.8		39	23	32.6	57.8	24.1		A-2-6 (1)
9	4.0	11.1								
9	9.0	6.4								

ROCKY MOUNTAIN GROUP

Architectural
Structural
Forensics

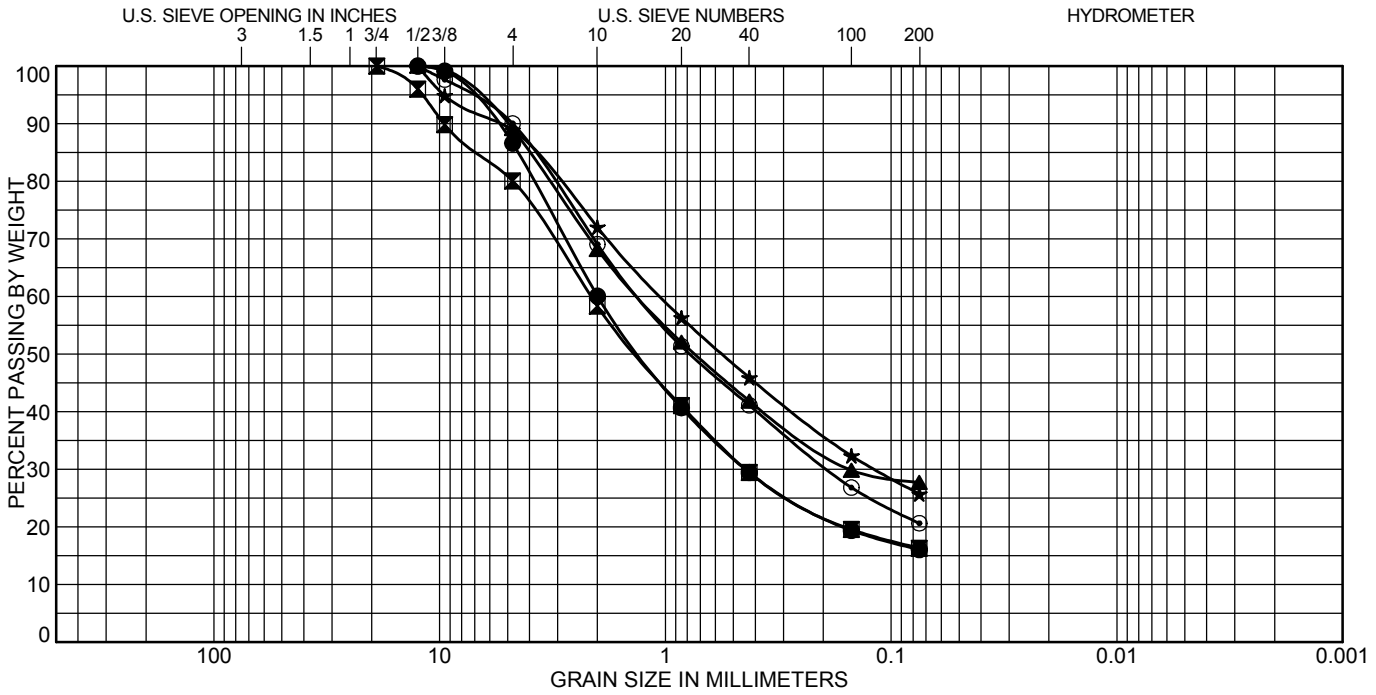
ARCHITECTS RMG ENGINEERS

Geotechnical
Materials Testing
Civil, Planning

Colorado Springs: (Corporate Office)
2910 Austin Bluffs Parkway
Colorado Spings, CO 80918
(719) 548-0600
SOUTHERN COLORADO, DENVER METRO, NORTHERN COLORADO

SUMMARY OF LABORATORY TEST RESULTS

JOB No. 165451
FIGURE No. 9
PAGE 1 OF 1
DATE 2/22/19



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Test Boring		Depth (ft)	Classification	LL	PL	PI	Cc	Cu
●	1	2.0	A-2-6 (0)	37	15	22		
⧓	2	2.0	A-2-6 (0)	39	13	26		
▲	3	2.0	A-2-7 (2)	44	16	28		
★	4	2.0	A-2-6 (1)	34	15	19		
⊙	5	2.0	A-2-6 (0)	34	16	18		

Test Boring		Depth (ft)	%Gravel	%Sand	%Silt	%Clay
●	1	2.0	13.4	70.6	16.0	
⧓	2	2.0	19.9	63.8	16.3	
▲	3	2.0	10.8	61.4	27.7	
★	4	2.0	11.1	63.1	25.7	
⊙	5	2.0	10.0	69.4	20.6	

ROCKY MOUNTAIN GROUP

Architectural
Structural
Forensics

ARCHITECTS RMG ENGINEERS

Geotechnical
Materials Testing
Civil, Planning

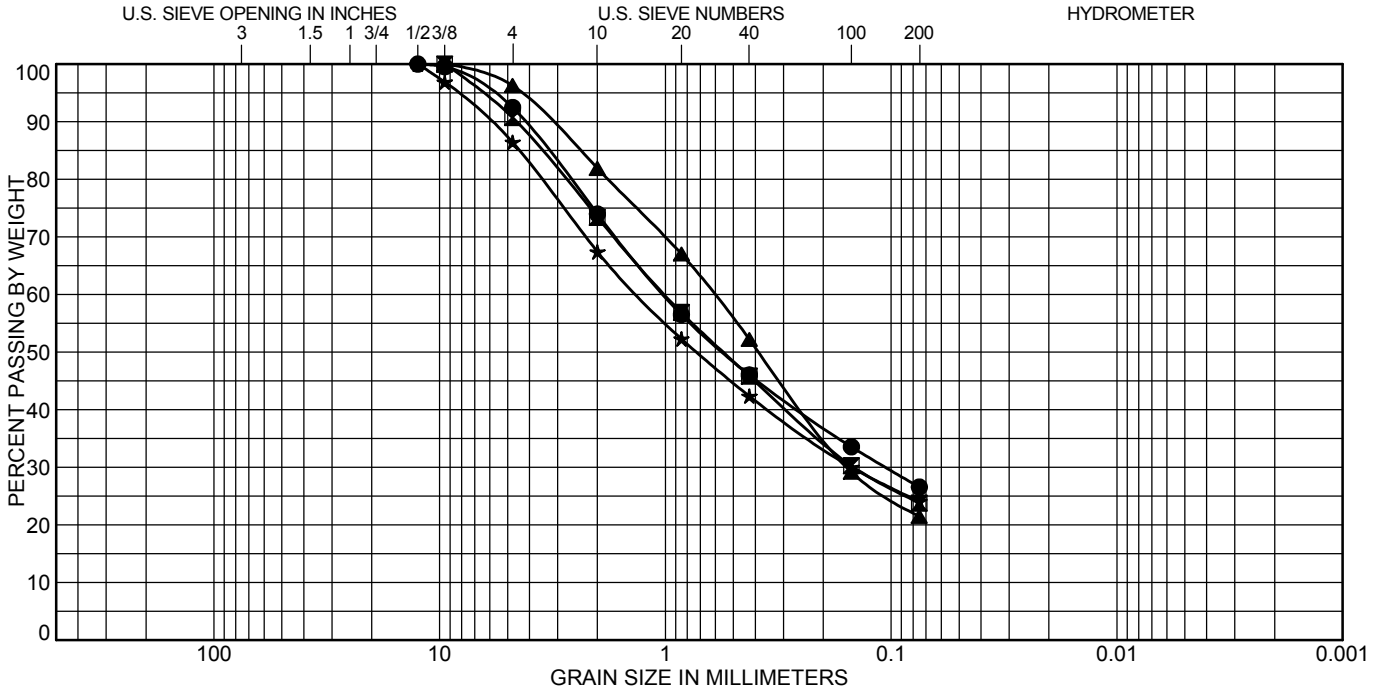
Colorado Springs: (Corporate Office)
2910 Austin Bluffs Parkway
Colorado Spings, CO 80918
(719) 548-0600
SOUTHERN COLORADO, DENVER METRO, NORTHERN COLORADO

SOIL CLASSIFICATION DATA

JOB No. 165451

FIGURE No. 10

DATE 2/22/19



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Test Boring		Depth (ft)	Classification	LL	PL	PI	Cc	Cu
●	6	2.0	A-2-6 (2)	37	14	23		
⧓	7	2.0	A-2-6 (1)	39	15	24		
▲	8	2.0	A-2-6 (0)	35	21	14		
★	9	2.0	A-2-6 (1)	39	16	23		

Test Boring		Depth (ft)	%Gravel	%Sand	%Silt	%Clay
●	6	2.0	7.5	65.9	26.6	
⧓	7	2.0	9.3	66.9	23.8	
▲	8	2.0	3.7	74.8	21.5	
★	9	2.0	13.6	62.4	24.1	

ROCKY MOUNTAIN GROUP

Architectural
Structural
Forensics

ARCHITECTS RMG ENGINEERS

Geotechnical
Materials Testing
Civil, Planning

Colorado Springs: (Corporate Office)
2910 Austin Bluffs Parkway
Colorado Spings, CO 80918
(719) 548-0600
SOUTHERN COLORADO, DENVER METRO, NORTHERN COLORADO

SOIL CLASSIFICATION DATA

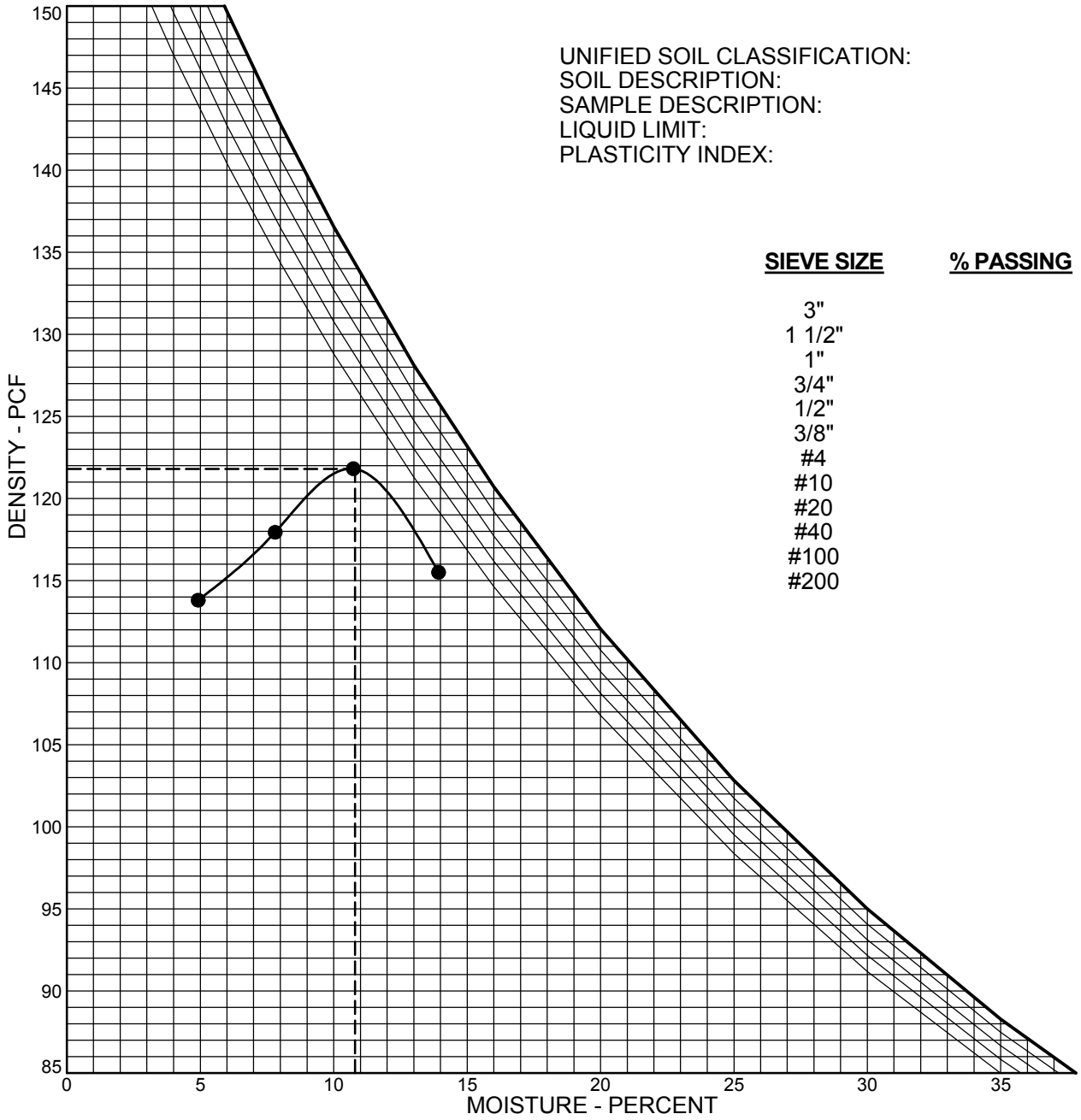
JOB No. 165451

FIGURE No. 11

DATE 2/22/19

CLIENT: Landhuis Company **SAMPLE NUMBER:** PROCTOR 1

PROJECT: **Paint Brush Hills, Filing No. 13E West, El Paso County, Colorado**



UNIFIED SOIL CLASSIFICATION:
SOIL DESCRIPTION:
SAMPLE DESCRIPTION:
LIQUID LIMIT:
PLASTICITY INDEX:

SIEVE SIZE	% PASSING
3"	
1 1/2"	
1"	
3/4"	
1/2"	
3/8"	
#4	
#10	
#20	
#40	
#100	
#200	

DESIGNATION **ASTM D-698A**
MAX. DRY DENSITY **121.9 pcf**
OPTIMUM MOISTURE **10.8 %**
FRACTION USED **#4**
MOLD VOLUME **0.0333 cu.ft.**

NOTE: ZERO AIR VOIDS CURVES PLOTTED FOR:
Gs = 2.60
Gs = 2.65
Gs = 2.70
Gs = 2.75
Gs = 2.80

ROCKY MOUNTAIN GROUP
Architectural Structural Forensics
ARCHITECTS RMG ENGINEERS
Geotechnical Materials Testing Civil, Planning
Colorado Springs: (Corporate Office)
2910 Austin Bluffs Parkway
Colorado Spings, CO 80918
(719) 548-0600
SOUTHERN COLORADO, DENVER METRO, NORTHERN COLORADO

MOISTURE-DENSITY RELATION CURVE

JOB No. 165451

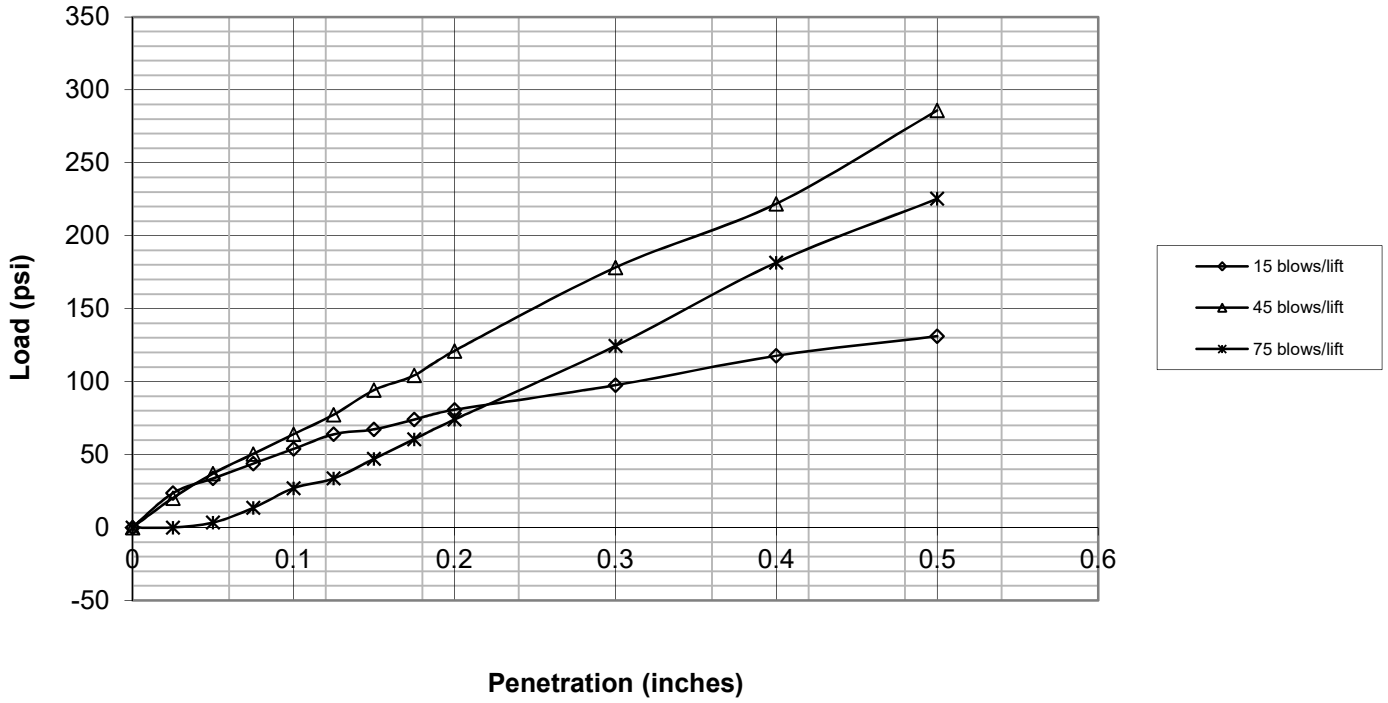
FIGURE No. 12

DATE 2/22/19

CALIFORNIA BEARING RATIO TEST RESULTS

PROJECT: Paint Brush Hills, Filing No. 13E - West
JOB NUMBER: 165451 TEST DATE: 1/25/2019
AASHTO A-2-6
SAMPLE NUMBER: CBR
SAMPLE LOCATION: Combination bulk sample from A-2 Test Borings
SOIL DESCRIPTION: Clayey Sand (SC)

	15 blows/lift	45 blows/lift	75 blows/lift
Penetration (in)	Load (psi)	Load (psi)	Load (psi)
0.000	0.0	0.0	0.0
0.025	23.5	20.2	0.0
0.050	33.6	37.0	3.4
0.075	43.7	50.4	13.5
0.100	53.8	63.9	26.9
0.125	63.9	77.3	33.6
0.150	67.3	94.2	47.1
0.175	74.0	104.3	60.5
0.200	80.7	121.1	74.0
0.300	97.5	178.2	124.4
0.400	117.7	222.0	181.6
0.500	131.2	285.9	225.3



	15 blows/lift	45 blows/lift	75 blows/lift
Corrected Penetration (in)	Corrected Load (psi)	Corrected Load (psi)	Corrected Load (psi)
0.1	5.4	6.4	2.7
0.2	5.4	8.1	4.9

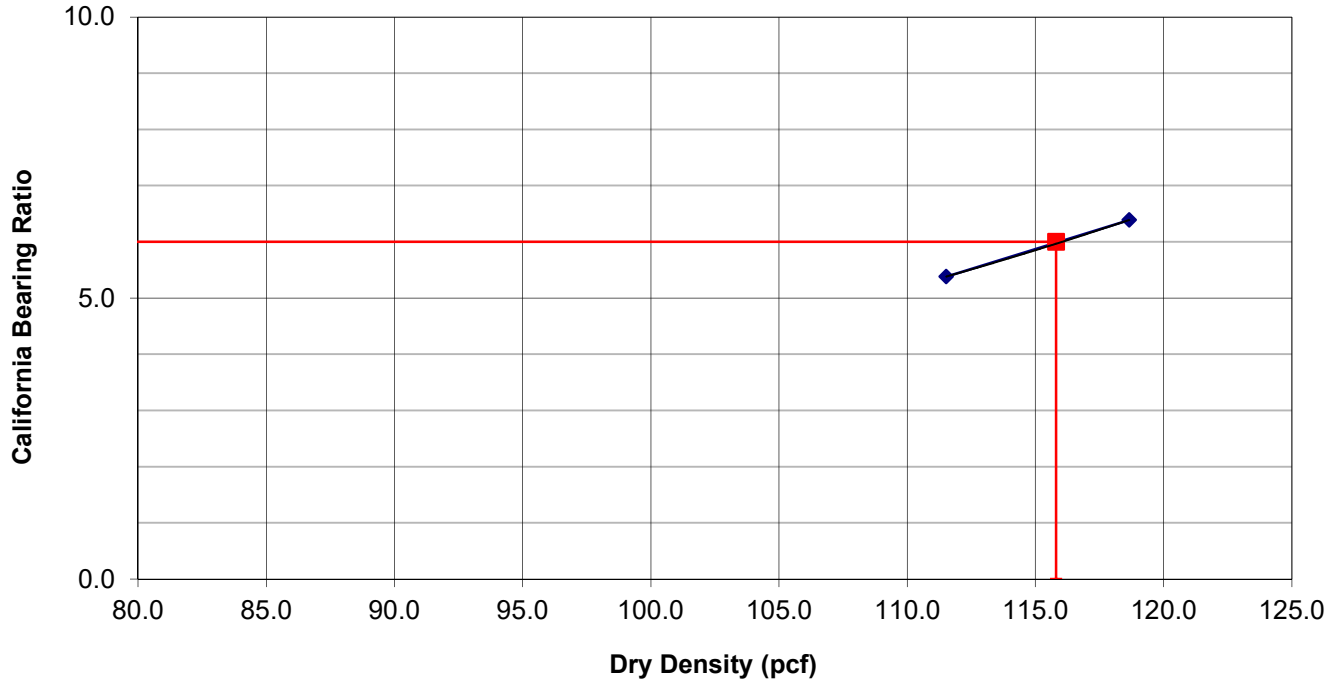
Structural • Geotechnical RMG ENGINEERS

Figure No. 13

CALIFORNIA BEARING RATIO TEST RESULTS

PROJECT:	Paint Brush Hills, Filing No. 13E - West
JOB NUMBER:	165451 TEST DATE: 1/25/2019
AASHTO CLASSIFICATION:	A-2-6
SAMPLE NUMBER:	CBR
SAMPLE LOCATION:	Combination bulk sample from A-2 Test Borings
SOIL DESCRIPTION:	Clayey Sand (SC)

	15 blows/lift	45 blows/lift	75 blows/lift
Corrected California Bearing Ratio	5.4	6.4	2.7
Dry Density (pcf)	111.5	118.7	121.8
Percent Compaction	91	97	99
Percent Moisture After Soaking	16.0	11.5	10.7
Percent Expansion/Compression	0.3	0.4	0.3
Surcharge Weight (lbs)	12.61	12.60	12.64



California Bearing Ratio	**6.0**
Dry Density (pcf)	121.9
Percent Compaction	95.00%
Target Dry Density	115.8
Compaction Test Method	ASTM D-698
Condition of sample	Soaked

Structural • Geotechnical
RMG ENGINEERS

Figure No. 14

APPENDIX A

1993 AASHTO Empirical Equation for Flexible Pavements

Equation Solver | Variable Descriptions and Typical Values | Precautions

Type in data in the grey boxes and click the calculate button to see the output. To make additional calculations, change the desired input data and click the calculate button again. Click on the text descriptions of the input or output variables for more information.

INPUT

1. Loading

Total Design ESALs (W_{18}): 36500

2. Reliability

Reliability Level in percent (R): 80

Combined Standard Error (S_0): 0.44

3. Serviceability

Initial Serviceability Index (p_i): 4.5

Terminal Serviceability Index (p_t): 2

4. Layer Parameters

Number of Base Layers: 0

	a	m	M_R	Min. Depth
Surface	0.44	1.0	N/A	0
Subgrade	N/A	N/A	9000	N/A

OUTPUT

1. Calculation Parameters

Standard Normal Deviate (z_R): -0.841

ΔPSI: 2.5

Design Structural Number (SN): 1.745

2. Layer Depths (to the nearest 1/2 inch)

Surface: 4

Total SN based on layer depths: 1.76

See Solution Details

Comments

Calculate

1993 AASHTO Empirical Equation for Flexible Pavements

Equation Solver | Variable Descriptions and Typical Values | Precautions

Type in data in the grey boxes and click the calculate button to see the output. To make additional calculations, change the desired input data and click the calculate button again. Click on the text descriptions of the input or output variables for more information.

INPUT

1. Loading

Total Design ESALs (W_{18}): 292000

2. Reliability

Reliability Level in percent (R): 80

Combined Standard Error (S_0): 0.44

3. Serviceability

Initial Serviceability Index (p_i): 4.5

Terminal Serviceability Index (p_t): 2

4. Layer Parameters

Number of Base Layers: 0

	a	m	M_R	Min. Depth
Surface	0.44	1.0	N/A	0
Subgrade	N/A	N/A	9000	N/A

OUTPUT

1. Calculation Parameters

Standard Normal Deviate (z_R): -0.841

ΔPSI: 2.5

Design Structural Number (SN): 2.445

2. Layer Depths (to the nearest 1/2 inch)

Surface: 6

Total SN based on layer depths: 2.64

See Solution Details

Comments

Calculate