ARCHITECTS RMG ENGINEERS

ROCKY MOUNTAIN GROUP

Approved, EN
09/19/2017

PAVEMENT DESIGN REPORT

Paint Brush Hills, Filing No. 13B & 13C
El Paso County, Colorado

PREPARED FOR:

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

JOB NO. 156158

Revised September 18, 2017
September 8, 2017

Respectfully Submitted,
RMG – Rocky Mountain Group

Reviewed by

COLORADO LICENSED GEOFF WEBSTER 45046 PROFESSIONAL ENGINEER

09/18/2017

for

Kelli Zigler, P.G.
Project Geologist

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

Filing 13 B: SF 14-002
Filing 13 C: SF 16-015

TABLE OF CONTENTS

GENERAL SITE AND PROJECT DESCTIPTION

Location

Paint Brush Hills, Filing No. 13B and Filing No. 13C are located at the northwest intersection of Towner Avenue and Londonderry Drive 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. Curb and gutter had not 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.

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 Right-of Ways. Urban Local streets have two 15-foot travel lanes, while Urban Local-Low Volume has two 12-foot travel lanes. In Filing 13B Witherbee Drive is classified as Urban Local and Sherwen Court is classified as Urban Local-Low Volume. In Filing 13C Witherbee Drive, Beckham Street, and Jagger Way are classified Urban Local, while Exeter Trail and Aberdeen Terrace and classified Urban Local-Low Volume.

FIELD INVESTIGATION AND SUBSURFACE CONDITIONS

Drilling

The subsurface conditions on the site were investigated by drilling seventeen 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 12.

Subsurface Materials

The subsurface materials encountered in the test borings consisted of fairly well-graded clayey sand overlying sandstone. Combined bulk samples of the material classified as SW-SM, well-graded silty sand 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 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 13. Soil Classification Data are presented in Figures 14 through 17.

A combined bulk sample of A-2-6 soil was tested to determine the optimum moisture-density relationship in accordance with ASTM D1557 (Modified Proctor compaction test). California Bearing Ratio, CBR tests were performed at varying densities with moisture content near optimum. At 95% of the maximum Modified Proctor density, the CBR of the bulk sample was 16. The Moisture-Density Relation Curves are presented in Figure 18. The CBR Test Results are presented in Figures 19 and 20.

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 Modified 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	12.5660	105	1057.6	1060.4	84
1B	7	2.82	12.566	107	1077.7	1080.5	86
1C	7	2.82	12.566	108	1087.8	1090.6	87
2A	7	2.82	12.566	280	2820.2	2823.0	225
2B	7	2.82	12.566	239	2407.2	2410.0	192
2C	7	2.82	12.566	287	2890.7	2893.5	230
3A	7	2.82	12.566	396	3988.5	3991.3	318
3B	7	2.82	12.566	422	4250.4	4253.2	338
3C	7	2.82	12.566	364	3666.2	3669.0	292

The data values were then plotted as a function of "7-day Compressive Strength versus Percent Cement by Weight" (attached in Appendix A). 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 percent cement is recommended to maintain strengths below the 275 psi threshold stipulated in the Engineering Criteria Manual.

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) Witherbee Drive, Beckham Street, Jagger Way
   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 = 16 x 1500 = 24,000 psi

4) Structural number (SN) = 1.80 (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 = $D_2 = \{SN – (D_1 \times a_1)\} / a_2 = \{1.80 – (3 \times 0.44)\} / 0.11 = 4.4$ inches
Minimum CTS thickness = 8 inches (Table D-2)
SN = (3 x 0.44) + (8 x 0.11) = 2.20 > 1.80 (Min. SN required)
Use minimum HMA thickness = 3.5 inches (Paragraph D.4.1-F: base course thickness cannot exceed 2.5 times the HMA thickness)

Street Classification – Urban Local-Low Volume

1) Exeter Trail, Aberdeen Terrace
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 = 16 x 1500 = 24,000 psi

4) Structural number (SN) = 1.20 (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 = $D_2 = \{SN – (D_1 \times a_1)\} / a_2 = \{1.2 – (3 \times 0.44)\} / 0.11 < 0$ inches
Minimum CTS thickness = 8 inches (Table D-2)
SN = (3 x 0.44) + (8 x 0.11) = 2.20 > 1.20 (Min. SN required)
Use minimum HMA thickness = 3.5 inches (Paragraph D.4.1-F: base course thickness cannot exceed 2.5 times the HMA thickness)

Pavement Thickness

Based on the design calculations, the recommended pavement section is presented below and on Figure 2.

Recommended Pavement Sections

Witherbee Drive, Beckham Street, Jagger Way	3.5” HMA	8" CTS
Sherwen Court, Exeter Trail, Aberdeen Terrace	3.5" HMA	8” CTS
Optimal CTS Percent Cement by Weight = 3%		

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 PDCM notes that mitigation measures may be required for expansive soils, shallow ground water, subgrade instability, etc. Based on the AASHTO classification of 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 13B and 13C 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% 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

NOT TO SCALE

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SITE VICINITY MAP

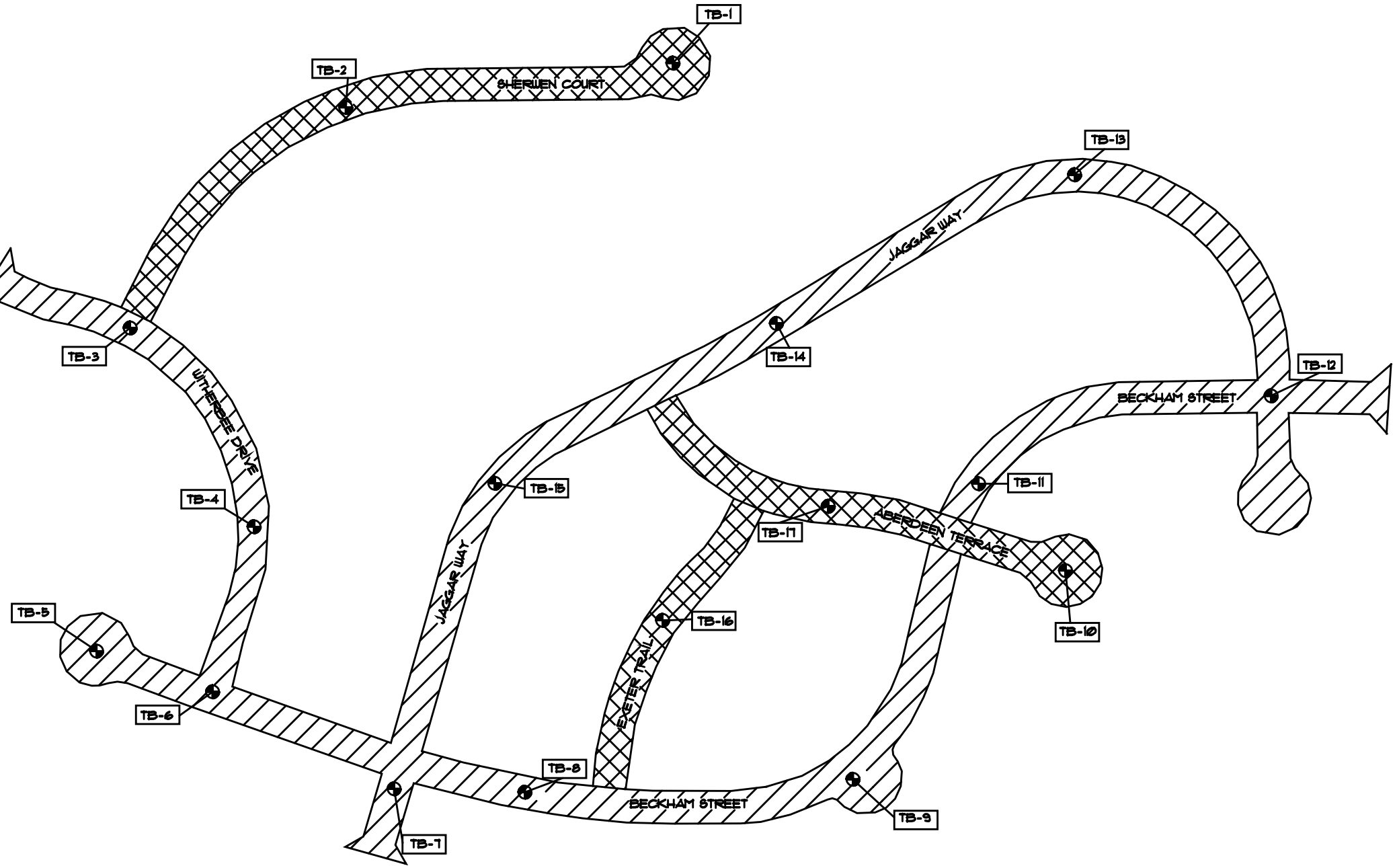
PAINT BRUSH HILLS, FILING NO.
13B AND 13C
EL PASO COUNTY, COLORADO
LANDHUIS COMPANY

JOB No. 156158

FIG No. 1

DATE 9-8-2017

Filing 13B Streets: Witherbee Drive to Sherwen Court, Sherwen Court



Filing 13C Streets: Witherbee Drive, Beckham Street, Jaggar Way, Exeter Trail, Aberdeen Terrace

URBAN LOCAL
3.5'' HMA OVER 8'' CTS

URBAN LOCAL - LOW VOLUME
3.5'' HMA OVER 8'' CTS

20 SCALE 1" = 200'

DENOTES APPROXIMATE LOCATION OF TEST BORINGS

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EL PASO COUNTY, COLORADO
LANDHUIS COMPANY

ENGINEER:	GW
DRAWN BY:	KZ
CHECKED BY:	GW
ISSUED:	9-15-2017

REVISION:	DATE: JOB #:

TEST BORING LOCATION PLAN

SHEET No.
FIG-2

SOILS DESCRIPTION

FILL: SAND, SILTY TO CLAYEY

SANDSTONE

UNLESS NOTED OTHERWISE, ALL LABORATORY
TESTS PRESENTED HEREIN WERE PERFORMED BY:
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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 AT TIME OF DRILLING

FREE WATER TABLE AT REFERENCED DATE

DEPTH AT WHICH BORING CAVED

BULK — DISTURBED BULK SAMPLE

4.5 — WATER CONTENT (%)

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EXPLANATION OF TEST BORING LOGS

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FIGURE No. 3

DATE 9/8/17

TEST BORING: **Bulk 01**
DATE DRILLED:
8/12/17
REMARKS:
NO GROUNDWATER ON

DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
FILL: SAND, SILTY, with gravel, tan to brown, loose to medium dense, moist				
			15	--
			20	--
5				

TEST BORING: **Bulk 02**
DATE DRILLED:
8/12/17
REMARKS:
NO GROUNDWATER ON

DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
FILL: SAND, SILTY, with gravel, tan to brown, loose to medium dense, moist				
			22	--
			17	--
5				
SANDSTONE, SILTY, with gravel, gray to brown, firm, moist				
			48	--
10				

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TEST BORING LOGS

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FIGURE No. 4

DATE 9/8/17

TEST BORING: **Bulk 03** DATE DRILLED: 8/12/17 REMARKS: NO GROUNDWATER ON	DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
FILL: SAND, SILTY TO CLAYEY, with gravel, tan to brown, medium dense, moist				22	--
				29	--
	5				

TEST BORING: **Bulk 04** DATE DRILLED: 8/12/17 REMARKS: NO GROUNDWATER ON	DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
FILL: SAND, SILTY, with gravel, tan to brown, loose to medium dense, moist				15	--
				19	--
	5				

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TEST BORING LOGS

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FIGURE No. 5

DATE 9/8/17

TEST BORING: **Bulk 05**
DATE DRILLED:
8/12/17
REMARKS:
NO GROUNDWATER ON

DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
			43	--
			50/11"	--
5				
			50/5"	--
10				

FILL: SAND, SILTY, with gravel, tan to brown, medium dense, moist

SANDSTONE, SILTY, tan, medium dense, moist

TEST BORING: **Bulk 06**
DATE DRILLED:
8/12/17
REMARKS:
NO GROUNDWATER ON

DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
			15	--
			5	--
5				

FILL: SAND, SILTY TO CLAYEY, tan to brown, very loose to loose, moist

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TEST BORING LOGS

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FIGURE No. 6

DATE 9/8/17

TEST BORING: **Bulk 07** DATE DRILLED: 8/12/17 REMARKS: NO GROUNDWATER ON	DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
FILL: SAND, SILTY, with gravel, tan to brown, very loose, moist				5	--
				6	--
	5				

TEST BORING: **Bulk 08** DATE DRILLED: 8/12/17 REMARKS: NO GROUNDWATER ON	DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
FILL: SAND, SILTY, brown, loose, moist				12	--
				13	--
	5				
SANDSTONE, SILTY, brown, firm, moist				46	--
	10				

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TEST BORING LOGS

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FIGURE No. 7

DATE 9/8/17

TEST BORING: **Bulk 09**
DATE DRILLED:
8/12/17
REMARKS:
NO GROUNDWATER ON

DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
			14	--
			41	--
5				

FILL: SAND, SILTY, with gravel, tan to brown, loose, moist

SANDSTONE, SILTY, with gravel, brown, firm, moist

TEST BORING: **Bulk 10**
DATE DRILLED:
8/12/17
REMARKS:
NO GROUNDWATER ON

DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
			44	--
			50	--
5				

SANDSTONE, SILTY TO CLAYEY, brown, firm to medium hard, moist

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TEST BORING LOGS

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FIGURE No. 8

DATE 9/8/17

TEST BORING: **Bulk 11**
DATE DRILLED:
8/12/17
REMARKS:
NO GROUNDWATER ON

DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
			50/11"	--
			50/10"	--
5				

SANDSTONE, SILTY TO CLAYEY, tan to brown, medium hard, moist

TEST BORING: **Bulk 12**
DATE DRILLED:
8/12/17
REMARKS:
NO GROUNDWATER ON

DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
			18	--
			15	--
5				
			50/10"	--
10				

FILL: SAND, SILTY, with gravel, tan to brown, loose, moist

SANDSTONE, SILTY, brown, medium hard, moist

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FIGURE No. 9

DATE 9/8/17

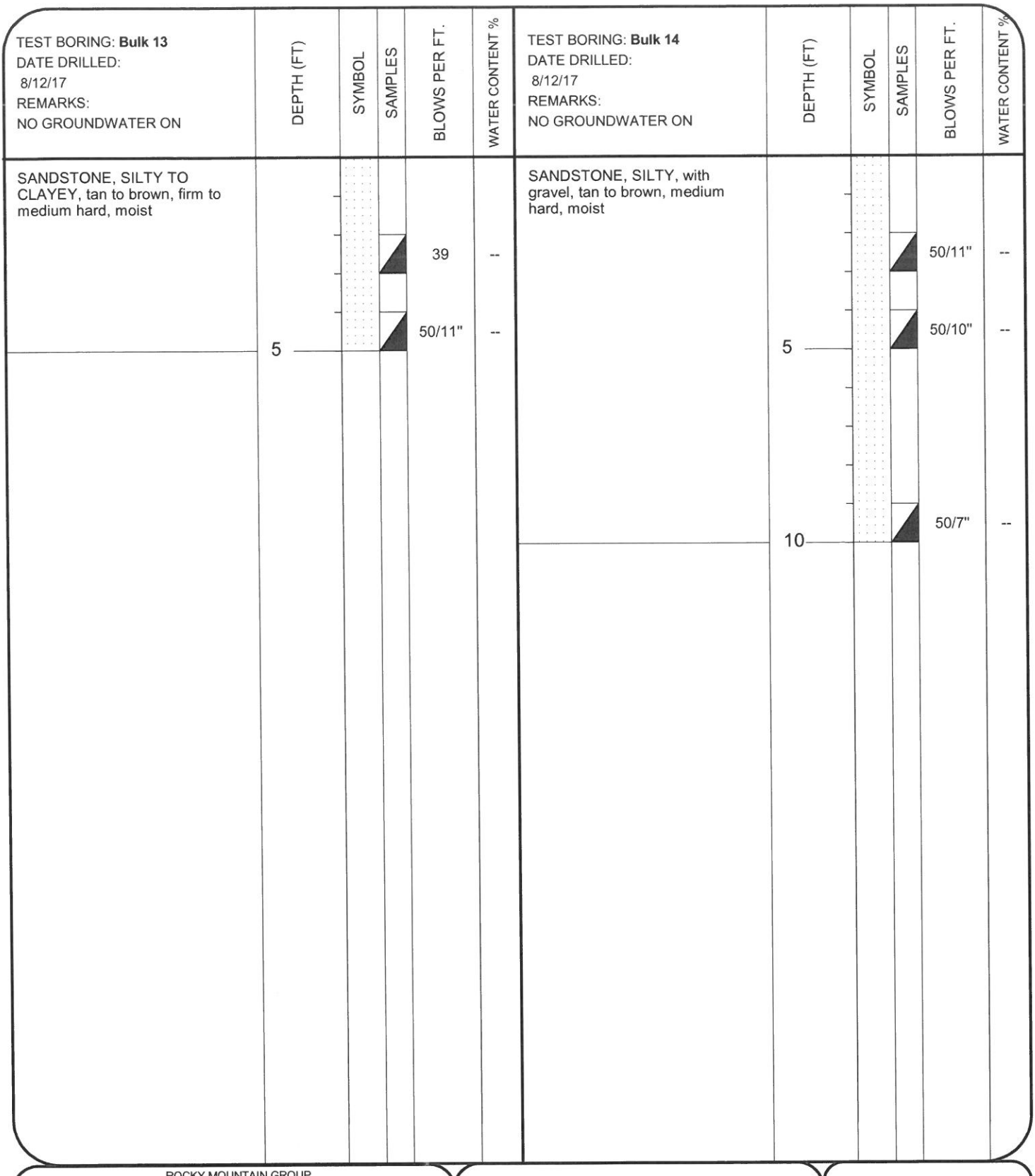

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FIGURE No. 10

DATE 9/8/17

TEST BORING: **Bulk 15** DATE DRILLED: 8/12/17 REMARKS: NO GROUNDWATER ON	DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
FILL: SAND, SILTY TO CLAYEY, brown, loose, moist				12	--
				15	--
	5				

TEST BORING: **Bulk 16** DATE DRILLED: 8/12/17 REMARKS: NO GROUNDWATER ON	DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
FILL: SAND, SILTY TO CLAYEY, tan to brown, loose, moist				7	--
				12	--
	5				

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TEST BORING LOGS

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FIGURE No. 11

DATE 9/8/17

TEST BORING: **Bulk 17**
DATE DRILLED:
8/12/17
REMARKS:
NO GROUNDWATER ON

DEPTH (FT)	SYMBOL	SAMPLES	BLOWS PER FT.	WATER CONTENT %
FILL: SAND, SILTY TO CLAYEY, tan to brown, loose, moist				
			16	-
			8	-
5				

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TEST BORING LOGS

JOB No. 156158

FIGURE No. 12

DATE 9/8/17

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
Bulk 01	1.0	8.8		36	23	22.2	49.4	27.7		A-2-6 (2)
Bulk 02	1.0	6.7		36	22	28.3	60.2	22.2		A-2-6 (1)
Bulk 03	1.0	7.9		33	20	26.5	57.4	23.8		A-2-6 (1)
Bulk 04	1.0	6.4		35	21	25.4	55.3	25.9		A-2-6 (1)
Bulk 05	1.0	12.9		36	24	18.8	41.9	29.3		A-2-6 (2)
Bulk 06	1.0	8.1		33	19	26.8	54.2	27.4		A-2-6 (1)
Bulk 07	1.0	6.9		38	24	25.6	55.4	26.4		A-2-6 (2)
Bulk 08	1.0	6.0		34	21	29.4	59.6	23.2		A-2-6 (1)
Bulk 09	1.0	7.7		NP	NP	38.0	67.4	16.3		A-1-b (0)
Bulk 10	1.0	9.0		38	26	27.7	60.1	22.7		A-2-6 (1)
Bulk 11	1.0	6.7		40	28	23.8	59.9	24.0		A-2-6 (2)
Bulk 12	1.0	5.9		32	20	30.1	59.1	22.1		A-2-6 (1)
Bulk 13	1.0	6.5		40	26	27.5	57.7	24.3		A-2-6 (1)
Bulk 14	1.0	7.3		33	19	22.3	57.2	22.8		A-2-6 (1)
Bulk 15	1.0	5.8		31	19	27.1	55.6	25.1		A-2-6 (1)
Bulk 16	1.0	9.3		35	22	23.3	51.8	27.7		A-2-6 (2)
Bulk 17	1.0	7.5		35	22	23.7	50.8	29.4		A-2-6 (2)

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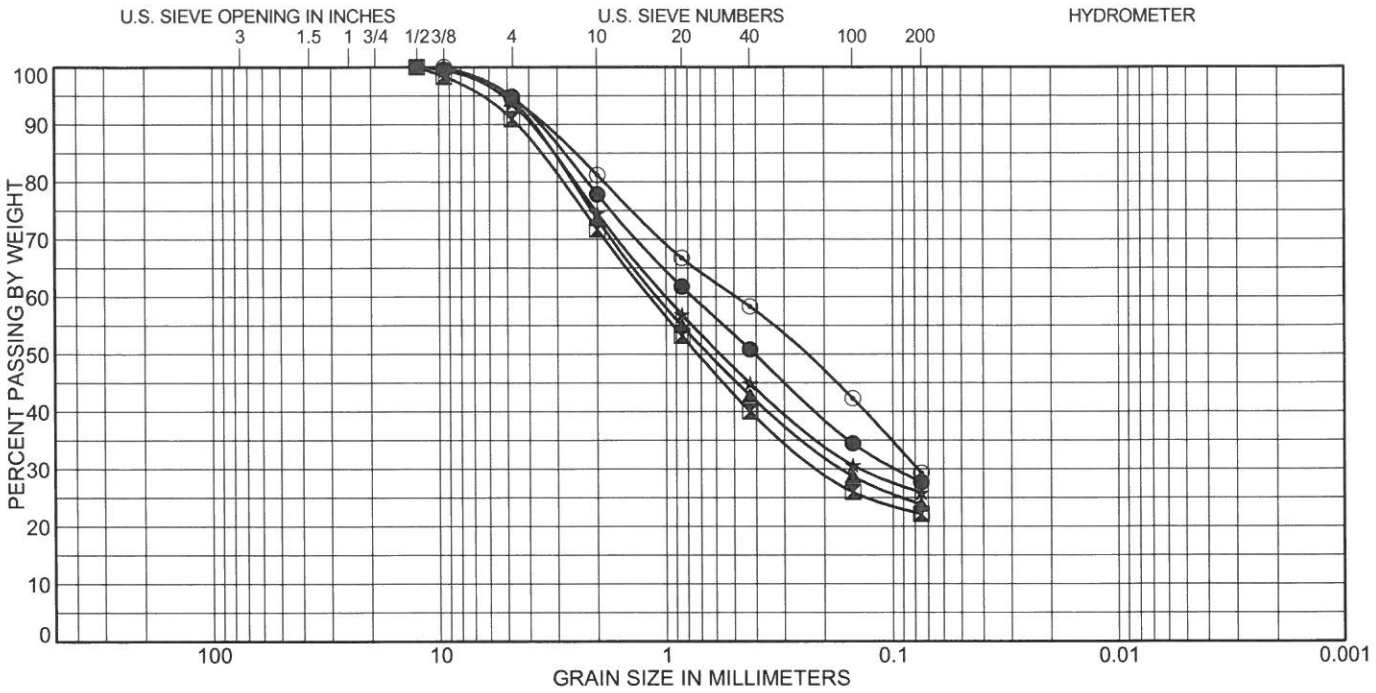
SUMMARY OF LABORATORY TEST RESULTS

JOB No. 156158
FIGURE No. 13
PAGE 1 OF 1
DATE 9/8/17



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Test Boring		Depth (ft)	Classification	LL	PL	PI	Cc	Cu
●	Bulk 01	1.0	A-2-6 (2)	36	13	23		
⊠	Bulk 02	1.0	A-2-6 (1)	36	14	22		
▲	Bulk 03	1.0	A-2-6 (1)	33	13	20		
★	Bulk 04	1.0	A-2-6 (1)	35	14	21		
⊙	Bulk 05	1.0	A-2-6 (2)	36	12	24		

Test Boring		Depth (ft)	%Gravel	%Sand	%Silt	%Clay
●	Bulk 01	1.0	5.1	67.2	27.7	
⊠	Bulk 02	1.0	9.0	68.8	22.2	
▲	Bulk 03	1.0	5.7	70.5	23.8	
★	Bulk 04	1.0	6.3	67.8	25.9	
⊙	Bulk 05	1.0	5.5	65.2	29.3	

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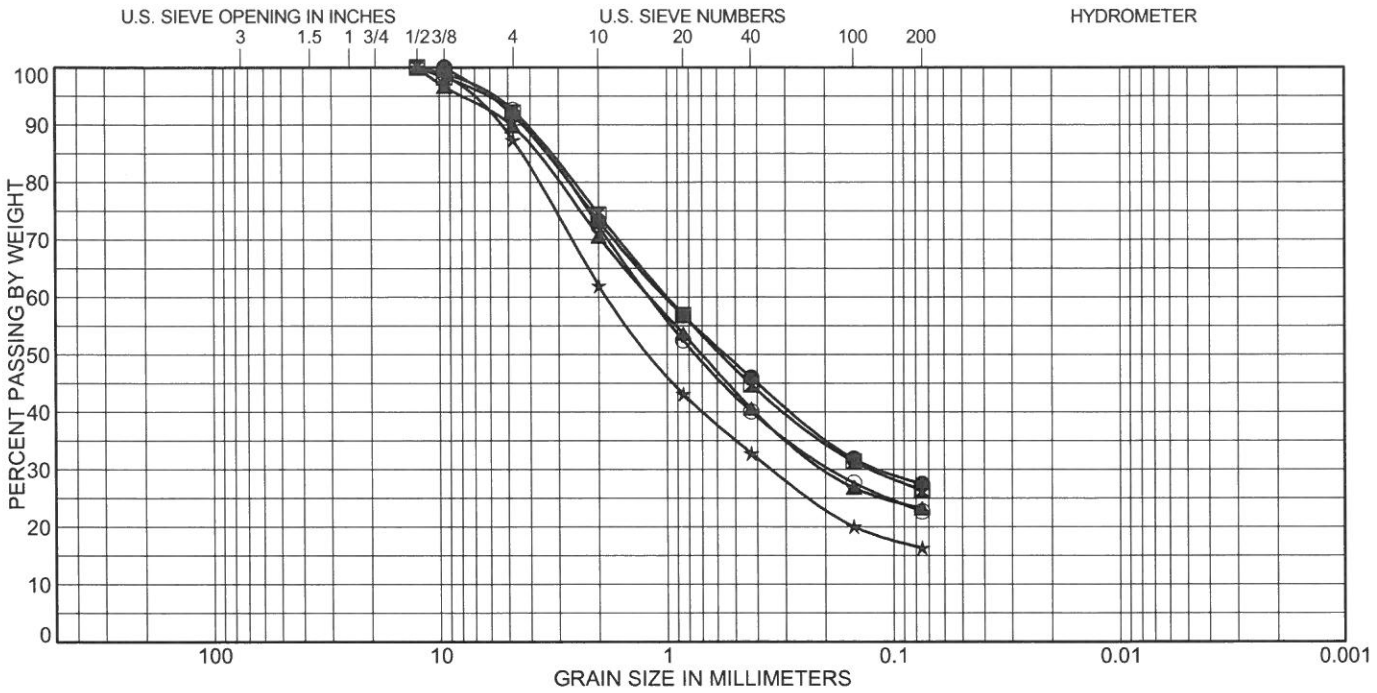
SOIL CLASSIFICATION DATA

JOB No. 156158

FIGURE No. 14

DATE 9/8/17



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Test Boring		Depth (ft)	Classification	LL	PL	PI	Cc	Cu
●	**Bulk 06**	**1.0**	**A-2-6 (1)**	**33**	**14**	**19**		
⊠	**Bulk 07**	**1.0**	**A-2-6 (2)**	**38**	**14**	**24**		
▲	**Bulk 08**	**1.0**	**A-2-6 (1)**	**34**	**13**	**21**		
★	**Bulk 09**	**1.0**	**A-1-b (0)**	**NP**	**NP**	**NP**		
⊙	**Bulk 10**	**1.0**	**A-2-6 (1)**	**38**	**12**	**26**		

Test Boring		Depth (ft)	%Gravel	%Sand	%Silt	%Clay
●	**Bulk 06**	**1.0**	**8.3**	**64.3**	**27.4**	
⊠	**Bulk 07**	**1.0**	**7.8**	**65.8**	**26.4**	
▲	**Bulk 08**	**1.0**	**10.2**	**66.6**	**23.2**	
★	**Bulk 09**	**1.0**	**12.7**	**71.0**	**16.3**	
⊙	**Bulk 10**	**1.0**	**7.4**	**69.9**	**22.7**	

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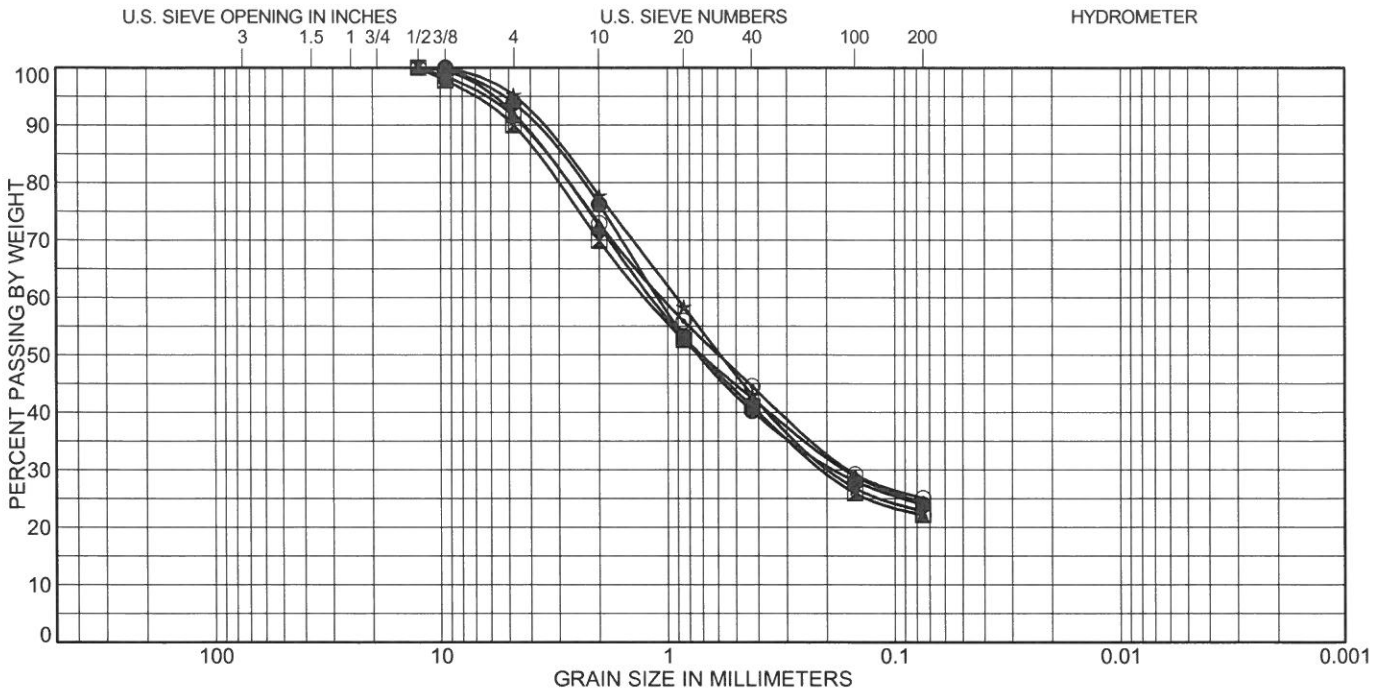
SOIL CLASSIFICATION DATA

JOB No. 156158

FIGURE No. 15

DATE 9/8/17



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Test Boring		Depth (ft)	Classification	LL	PL	PI	Cc	Cu
●	**Bulk 11**	**1.0**	**A-2-6 (2)**	**40**	**12**	**28**		
⊠	**Bulk 12**	**1.0**	**A-2-6 (1)**	**32**	**12**	**20**		
▲	**Bulk 13**	**1.0**	**A-2-6 (1)**	**40**	**14**	**26**		
★	**Bulk 14**	**1.0**	**A-2-6 (1)**	**33**	**14**	**19**		
⊙	**Bulk 15**	**1.0**	**A-2-6 (1)**	**31**	**12**	**19**		

Test Boring		Depth (ft)	%Gravel	%Sand	%Silt	%Clay
●	**Bulk 11**	**1.0**	**6.1**	**69.9**	**24.0**	
⊠	**Bulk 12**	**1.0**	**10.0**	**67.9**	**22.1**	
▲	**Bulk 13**	**1.0**	**8.4**	**67.3**	**24.3**	
★	**Bulk 14**	**1.0**	**4.8**	**72.4**	**22.8**	
⊙	**Bulk 15**	**1.0**	**7.9**	**67.0**	**25.1**	

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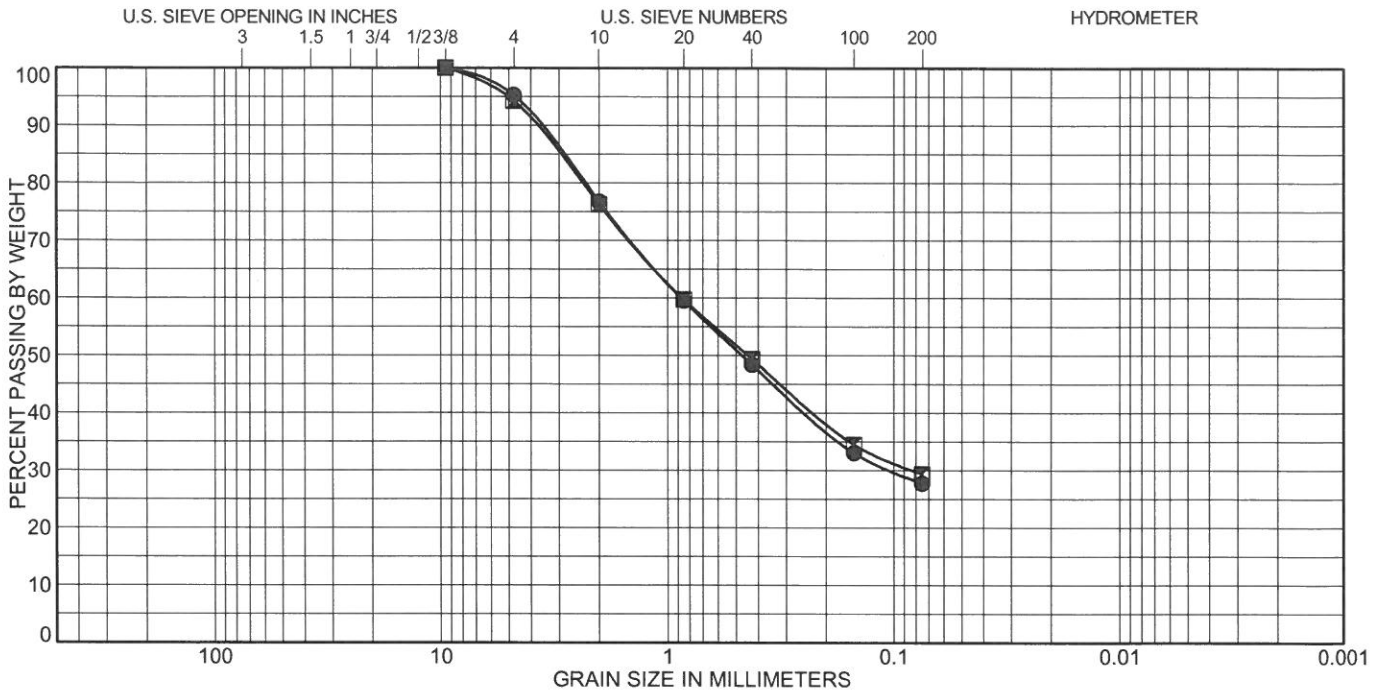
SOIL CLASSIFICATION DATA

JOB No. 156158

FIGURE No. 16

DATE 9/8/17



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Test Boring		Depth (ft)	Classification	LL	PL	PI	Cc	Cu
●	**Bulk 16**	**1.0**	**A-2-6 (2)**	**35**	**13**	**22**		
⊠	**Bulk 17**	**1.0**	**A-2-6 (2)**	**35**	**13**	**22**		

Test Boring		Depth (ft)	%Gravel	%Sand	%Silt	%Clay
●	**Bulk 16**	**1.0**	**4.7**	**67.5**	**27.7**	
⊠	**Bulk 17**	**1.0**	**5.7**	**64.9**	**29.4**	

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SOIL CLASSIFICATION DATA

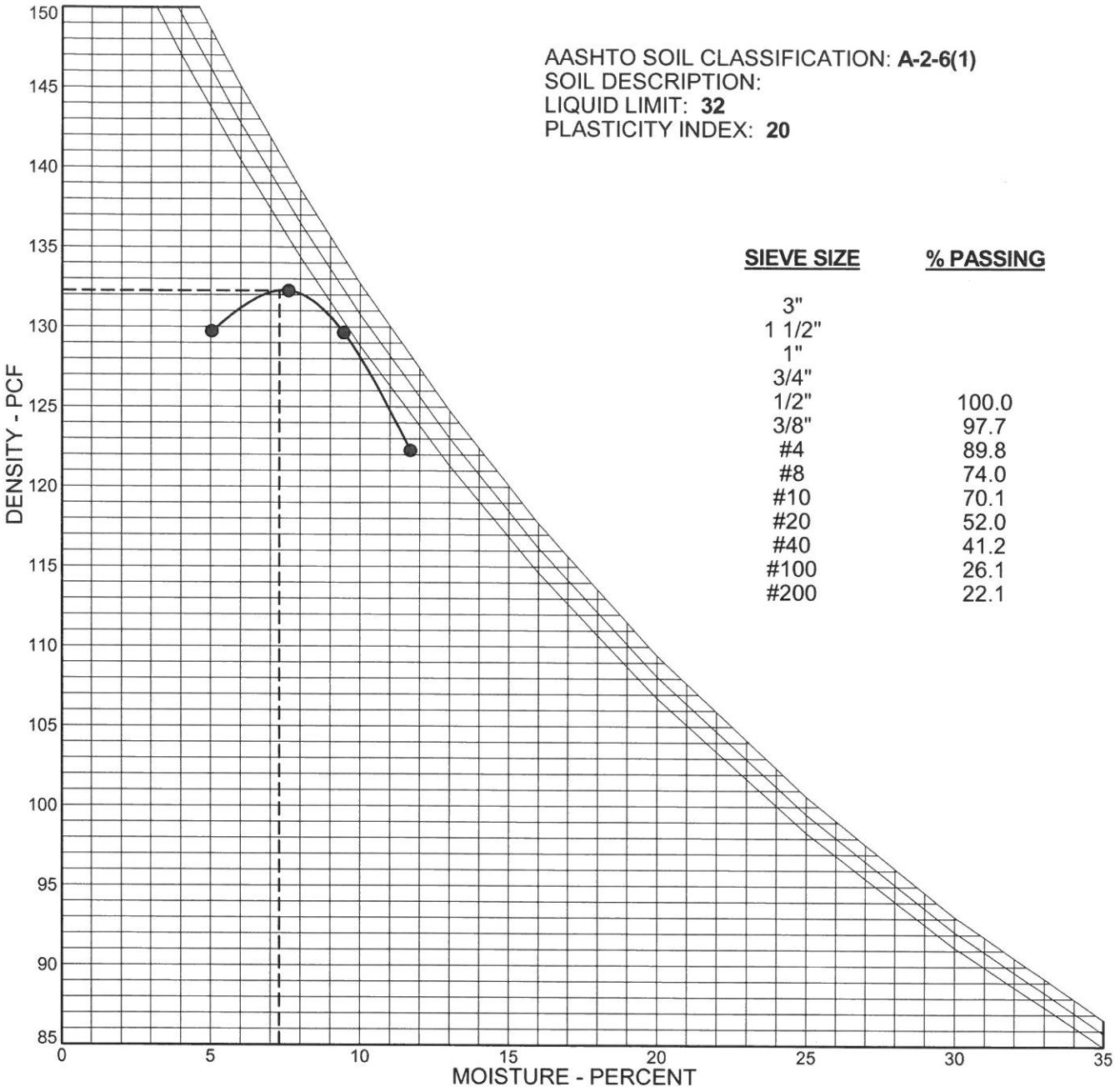
JOB No. 156158

FIGURE No. 17

DATE 9/8/17

CLIENT: **Landhuis Company** SAMPLE NUMBER: **Proctor 4**

PROJECT: Paint Brush Hills, El Paso County, Colorado



AASHTO SOIL CLASSIFICATION: **A-2-6(1)**
SOIL DESCRIPTION:
LIQUID LIMIT: **32**
PLASTICITY INDEX: **20**

SIEVE SIZE	% PASSING
3"	
1 1/2"	
1"	
3/4"	
1/2"	100.0
3/8"	97.7
#4	89.8
#8	74.0
#10	70.1
#20	52.0
#40	41.2
#100	26.1
#200	22.1

DESIGNATION **AASHTO 1557A**
MAX. DRY DENSITY **132.2 pcf**
OPTIMUM MOISTURE **7.3 %**
FRACTION USED **No. 4**
MOLD VOLUME **0.0326 cu.ft.**

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

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MOISTURE-DENSITY RELATION CURVE

JOB No. 156158

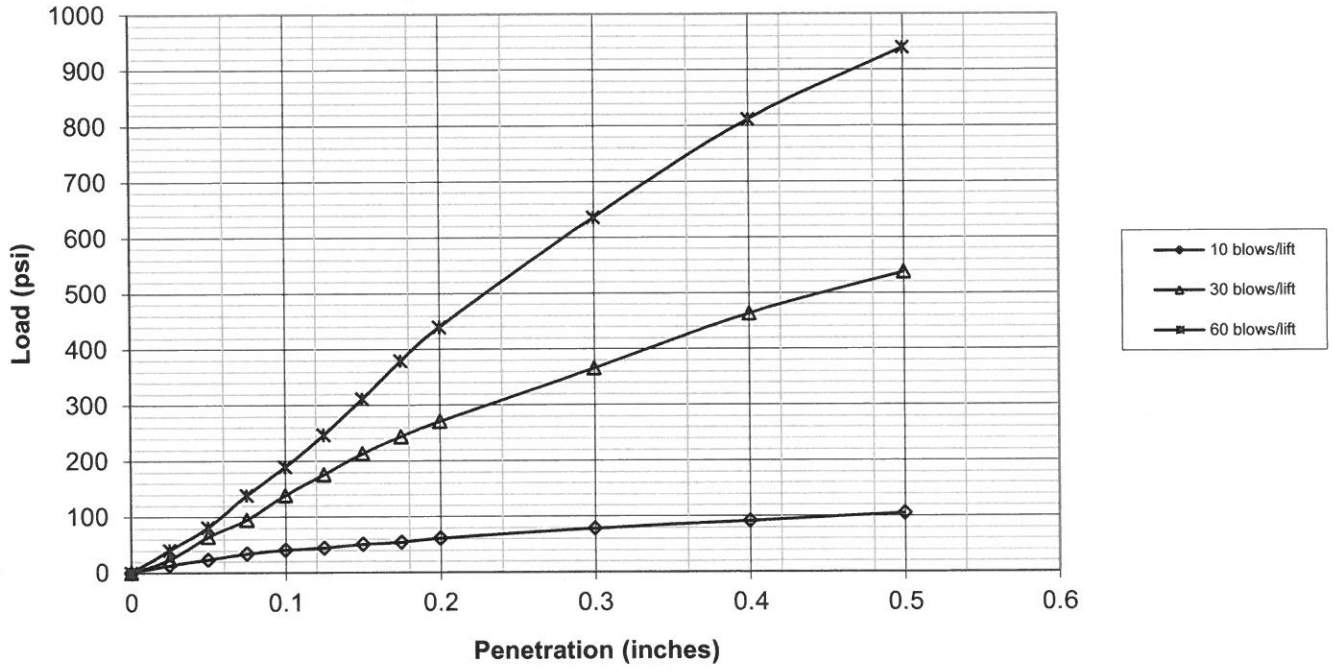
FIGURE No. 18

DATE 9/8/17

CALIFORNIA BEARING RATIO TEST RESULTS

PROJECT:	Paint Brush Hills Filing 13B and 13C
JOB NUMBER:	156158 TEST DATE: 9/1/2017
AASHTO	A-2-6
SAMPLE NUMBER:	CBR
SAMPLE LOCATION:	Combination sample from Test Borings TB-1 through TB-17
SOIL DESCRIPTION:	Low-plasticity sand

Penetration (in)	10 blows/lift Load (psi)	30 blows/lift Load (psi)	60 blows/lift Load (psi)
0.000	0.0	0.0	0.0
0.025	13.5	23.7	40.6
0.050	23.7	64.2	81.1
0.075	33.8	94.6	138.6
0.100	40.6	138.6	189.3
0.125	43.9	175.8	246.8
0.150	50.7	213.0	311.0
0.175	54.1	243.4	378.6
0.200	60.8	270.4	439.4
0.300	77.7	365.1	635.5
0.400	91.3	463.1	811.3
0.500	104.8	537.5	939.7



Corrected Penetration (in)	10 blows/lift Corrected Load (psi)	30 blows/lift Corrected Load (psi)	60 blows/lift Corrected Load (psi)
0.1	4.1	13.9	18.9
0.2	4.1	18.0	29.3

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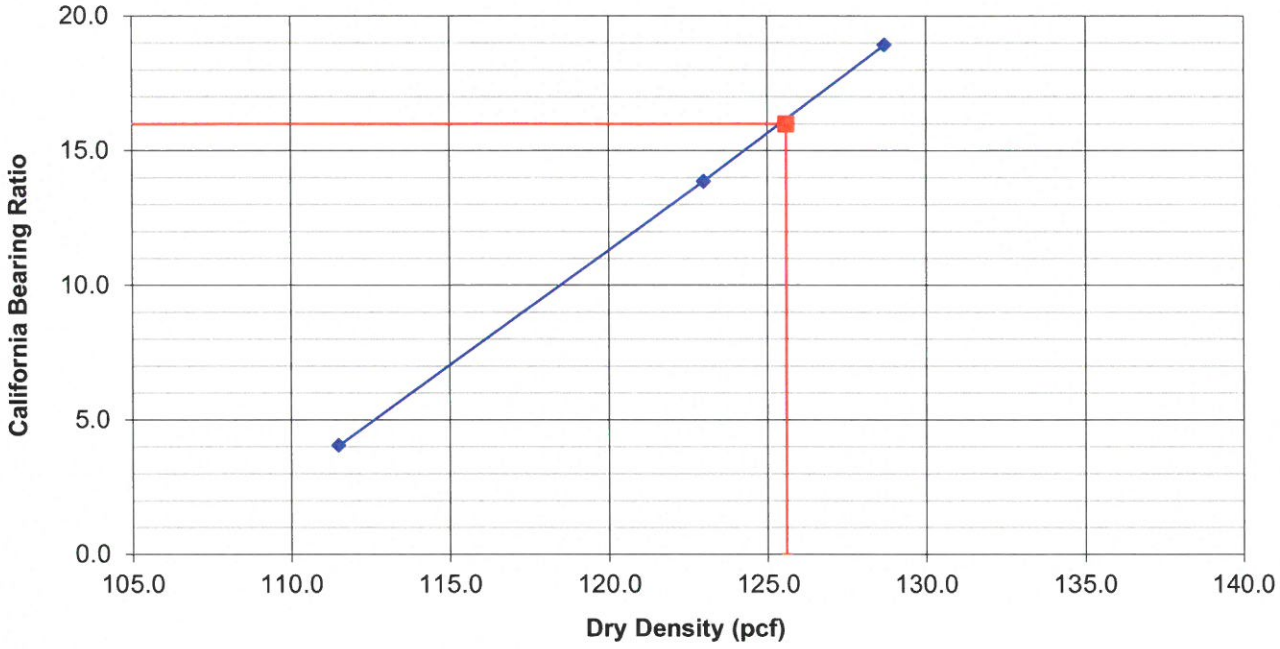
Figure No. 19

CALIFORNIA BEARING RATIO TEST RESULTS

PROJECT:	Paint Brush Hills Filing 13B and 13C
JOB NUMBER:	156158 TEST DATE: 9/1/2017
AASHTO CLASSIFICATION:	A-2-6
SAMPLE NUMBER:	CBR
SAMPLE LOCATION:	Combination sample from Test Borings TB-1 through TB-17
SOIL DESCRIPTION:	Low-plasticity sand

	10 blows/lift	30 blows/lift	60 blows/lift
Corrected California Bearing Ratio	4.1	13.9	18.9
Dry Density (pcf)	111.5	123.0	128.7
Percent Compaction	84	93	97
Percent Moisture After Soaking	12.5	11.6	11.5
Percent Expansion/Compression	0.0	0.0	0.0
Surcharge Weight (lbs)	12.572	12.582	12.612



California Bearing Ratio	16.0
Dry Density (pcf)	132.2
Percent Compaction	95.00%
Target Dry Density	125.6
Compaction Test Method	ASTM D-1557
Condition of sample	Soaked

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Figure No. 20

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}): 292000

2. Reliability

Reliability Level in percent (R): 85

Combined Standard Error (S_0): 0.5

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	24000	N/A

OUTPUT

1. Calculation Parameters

Standard Normal Deviate (z_R): -1.037

ΔPSI: 2.5

Design Structural Number (SN): 1.795

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

Surface: 4.5

Total SN based on layer depths: 1.98

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}): 36500

2. Reliability

Reliability Level in percent (R): 85

Combined Standard Error (S_0): 0.5

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	24000	N/A

OUTPUT

1. Calculation Parameters

Standard Normal Deviate (z_R): -1.037

ΔPSI: 2.5

Design Structural Number (SN): 1.195

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

Surface: 3

Total SN based on layer depths: 1.32

See Solution Details

Comments

Calculate

Compressive Strength vs. Cement Content
Paint Brush Hills Filing 13B and 13C
RMG Job No. 156158
CTS Mix Design Target Values