ENTECH
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Novemeber 15, 2023

S R Land, LLC
20 Boulder Crescent, 1st Floor, Suite 100
Colorado Springs, Colorado 80903

Attn: Chaz Collins

Re: Pavement Design Recommendations – Revision 1
Homestead North at Sterling Ranch Filing No. 3
El Paso County, Colorado
Entech Job No. 230423

Dear Mr. Collins:

This revised letter supersedes previous versions of the report. As requested, Entech Engineering, Inc. (Entech) obtained samples of the pavement subgrade soils from the roadways in Homestead North at Sterling Ranch Subdivision, Filing No. 3, in El Paso County, Colorado, refer to Figure 1. This letter presents the results of the subsurface soil investigation, laboratory testing, and provides pavement recommendations for the roadway sections within the filing.

Project Description

The roadways for this project consist of a section of Aspen Valley Road and the full extents of William Downing Drive and associated cul-de-sac, David Rudabaugh Drive and associated cul-de-sacs, and Jesse Evans Drive and associated cul-de-sacs, all within Filing No. 3. The roadways are located within a proposed residential neighborhood.

Subsurface Explorations and Laboratory Testing

Subsurface conditions at the project site were explored by 13 test borings, designated, TB-1 through TB-13, on October 13, 2023. The locations of the test borings are shown on the Site and Exploration Plan, Figure 2. The borings were drilled to depths of 5 and 10 feet below the existing ground surface (bgs). The drilling was performed using a truck-mounted, continuous flight auger drill rig supplied and operated by Entech. Descriptive boring logs of the subsurface conditions encountered during drilling are presented in Appendix A. Groundwater levels were measured in each of the open boreholes at the conclusion of drilling.

Soil and bedrock samples were obtained from the borings utilizing the Standard Penetration Test (ASTM D1586) using a split-barrel California sampler. Results of the Standard Penetration Test (SPT) are included on the boring logs in terms of N-values expressed in blows per foot (bpf). Soil and bedrock samples recovered from the borings were visually classified and recorded on the boring logs. The soil and bedrock classifications were later verified utilizing laboratory testing and grouped by soil type. The soil and bedrock type numbers are included on the boring logs. It should be understood that the soil and bedrock descriptions shown on the boring logs may vary between boring location and sample depths. It should also be noted that the lines of stratigraphic separation shown on the boring logs represent approximate boundaries between soil and bedrock types and the actual stratigraphic transitions may be more gradual or variable with location.

Water content testing (ASTM D2216) was performed on the samples recovered from the borings, and the results are shown on the boring logs. Grain-Size Analysis (ASTM D422) and Atterberg Limits testing (ASTM D4318) were performed on selected samples to assist in classifying the materials encountered in the borings. Soluble sulfate testing was performed on select soil

samples to evaluate the potential for below grade degradation of concrete due to sulfate attack. The laboratory testing results are summarized on Table B-1 and are presented in Appendix B.

Subgrade Conditions

Subsurface conditions along the proposed roadways consisted of silty and clayey sand and sand with silt fill (Soil Type 1), native silty sand (Soil Type 2), and sandstone bedrock (Soil Type 3). When classified as a soil, the sandstone classified as very dense silty sand or sand. Soil type and corresponding AASHTO soil classification are listed below:

- Soil Type 1: A-1-b, A-2-4, and A-2-6
- Soil Type 2: A-1-b, and A-2-4
- Soil Type 3: A-2-4 (sandstone)

Groundwater was not encountered in the test borings. Laboratory test results are presented in Appendix B and are summarized in Table B-1.

California Bearing Ratio (CBR) testing was performed on a representative sample of Soil Type 1 from TB-10 to determine the support characteristic of the subgrade soils for the roadway sections. The results of the CBR testing, are presented in Appendix B and summarized as follows:

Exhibit 1: Subsurface Laboratory Testing Summary

Design Parameter	Value
Soil Type	1 – Silty Sand
CBR at 95%	20.02
Design CBR	10
Liquid Limit	NV
Plasticity Index	NP
Percent Passing 200	22.3
AASHTO Classification	A-1-b
Group Index	0
Unified Soils Classification	SM

Pavement Design

The CBR testing was used to determine the design subgrade modulus for the roadway. The pavement sections were determined utilizing the El Paso County Pavement Design Criteria Manual. Traffic data is not available for the local roadways within Homestead North Filing 3; however, the cul-de-sacs are classified as local low volume roadways and the remainder of the roads classify as local roads. The El Paso County Pavement Design Criteria and Report provides default 18-kip equivalent single axle loading (ESAL) based street classifications. For design, a default ESAL value of 36,500 and 292,000 was used for the local low volume and local roadway designations, respectively.

Alternative pavement sections for asphalt supported on aggregate base course (ABC) or recycled concrete, and asphalt supported on cement stabilized subgrade (CTS) are provided. Design parameters used in the pavement analysis are presented in Exhibit 2.

Exhibit 2: Pavement Design Parameters

Design Parameter	Value
Reliability	
Local Low Volume	80%
Local Road	80%
Standard Deviation	0.45
Serviceability Loss (Δ psi)	2.0
Design CBR	10
Resilient Modulus - Soil Type 1	15,000 psi
Structural Coefficients	
HMA	0.44
ABC	0.11
Recycled Concrete	0.11
CTS	0.11

The pavement design calculations are presented in Appendix C. Any additional grading may result in subgrade soils with different support characteristics. The following pavement sections should be re-evaluated if additional grading is performed. Pavement sections recommended for this phase of the filing are summarized in Exhibit 3.

Exhibit 3: Recommended Pavement Sections

Pavement Area	Design ESAL	Alternative
Low volume Local Roads	36,500	1. 3.0 inches HMA over 6.0 inches ABC
		2. 4.0 inches HMA over 10.0 inches of CTS
Local Roads	292,000	1. 3.0 inches HMA over 8.0 inches ABC
		2. 4.0 inches HMA over 10.0 inches of CTS

ABC = Aggregate Base Course; ESAL = equivalent single axle loads; HMA = Hot Mix Asphalt; CTS = Cement Treated Subgrade

Notes:

1. All pavement alternatives represent the minimum sections required per El Paso County Pavement Design Criteria Manual.
2. Full depth sections are not recommended by El Paso County.

Swelling Soils 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 classification of the subgrade soils, mitigation for expansive soils is not required on this site.

Roadway Construction – Full Depth Asphalt and Asphalt on Aggregate Basecourse Alternatives

If pavement section alternatives are selected utilizing ABC, the final subgrade surface should be scarified to a depth of 12 inches, moisture conditioned within +/-2% of the optimum water content, and recompacted to 95% of its maximum Modified Proctor dry density, ASTM D1557.

The compacted surface below pavements should be proof-rolled with a fully loaded, tandem-axle, 10-yard dump truck or equivalent. Any areas that are delineated to be soft, loose, or yielding during proof-rolling should be removed and reconditioned or replaced.

ABC materials shall conform to the Table D-6 from the El Paso County Pavement Design Criteria and Report. ABC materials should be compacted to a minimum of 95% of its maximum Modified Proctor Dry Density (ASTM D1557) at +/-2% of optimum moisture content.

Roadway Construction – Stabilized Subgrade Alternative

Prior to placement of the asphalt, the subgrade shall be stabilized by the addition of cement to a depth of at least 10 inches if CTS alternatives are selected. The amount of cement applied shall be a minimum of 2% (by weight) of the subgrade's maximum dry density as determined by the Modified Proctor Test (ASTM D1557) or by the Standard Proctor Test (ASTM D698). Local practice typically recommends that the design mix be increased by 1% in the field to account for waste and construction variability. The cement should be spread evenly on the subgrade surface and be thoroughly mixed into the subgrade over a 10-inch depth, as specified, such that a uniform blend of soil and cement is achieved. Prior to application or mixing of the cement the upper 10 inches of subgrade should be thoroughly moisture conditioned to the soil's optimum water content or as much as 2% more than the optimum water content as necessary to provide a compactable soil condition. Densification of the cement-stabilized subgrade should be completed to obtain a compaction of at least 95% of the subgrade maximum dry density as determined by the Modified Proctor Test (ASTM D1557) or by the Standard Proctor Test (ASTM D698). Satisfactory compaction of the subgrade shall occur within 90 minutes from the time of mixing the cement into the subgrade.

The following conditions shall be observed as part of the subgrade stabilization:

- Type I/II cement as supplied; a local supplier shall be used. All cement used for stabilization should come from the same source. If cement sources are changed a new laboratory mix design should be completed.
- Moisture conditioning of the subgrade and/or mixing of the cement into the subgrade shall not occur when soil temperatures are below 40° F. Cement-treated subgrades should be maintained at a temperature of 40° F or greater until the subgrade has been compacted as required.
- Cement placement, cement mixing, and compaction of the cement-treated subgrade should be observed by a qualified geotechnical engineer. The geotechnical engineer should complete in-situ compaction tests and construct representative compacted specimens of the treated subgrade material for subsequent laboratory quality assurance testing.
- Pending the results of the field density testing, microfracturing of the stabilized subgrade may be required. Soil strengths in excess of 275 psi require microfracturing.

In addition to the above guidance, the asphalt, cement, subgrade conditions, compaction of materials and roadway construction methods shall meet the El Paso County Pavement Design Criteria and the Pikes Peak Region Asphalt Paving 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
Geotechnical Engineering Staff

Reviewed by:

COLORADO LICENSED
JOSEPH C GOODE III
52381
PROFESSIONAL ENGINEER

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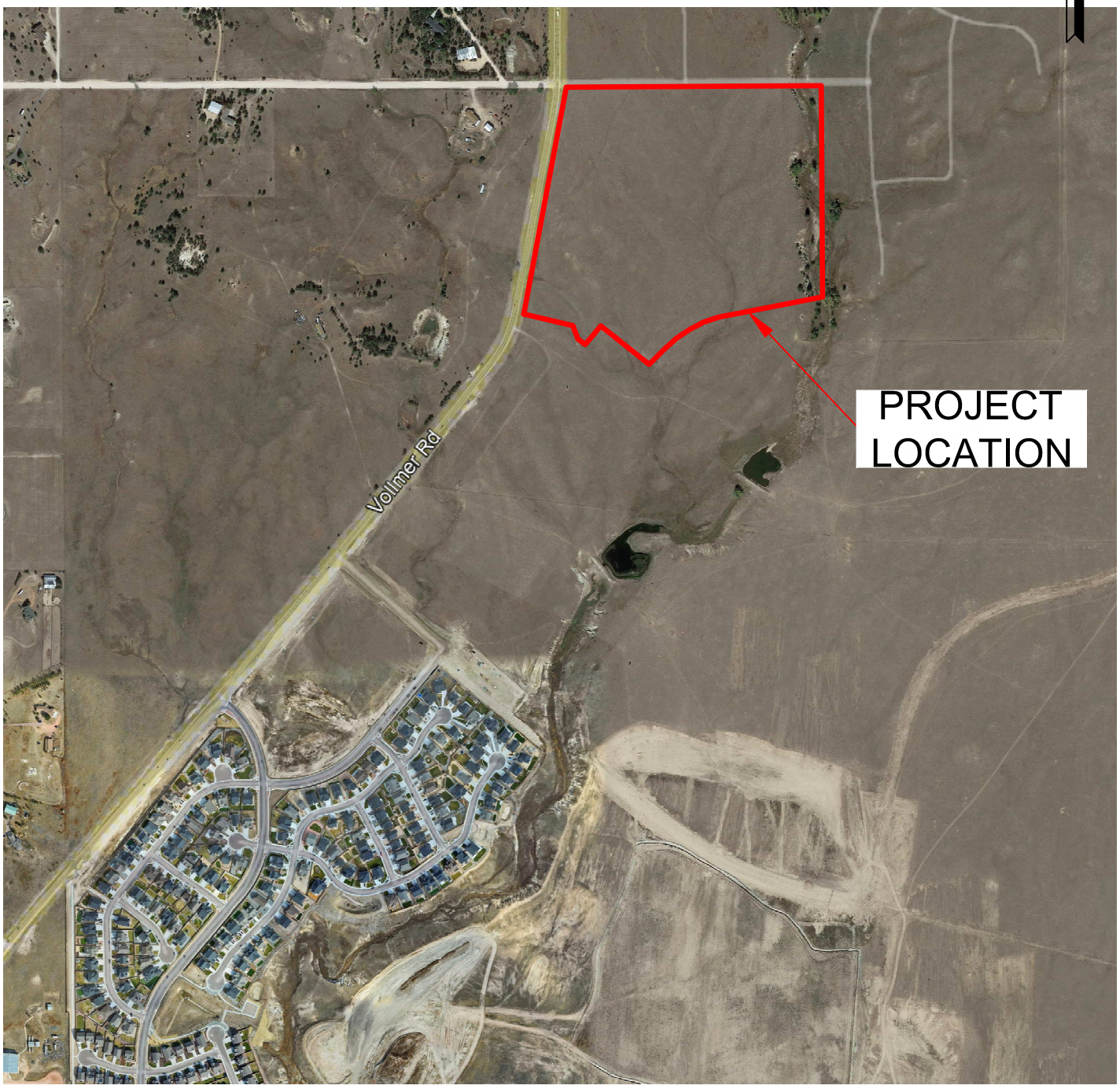
Date: 2023.11.15 10:04:35 -07'00'

Joseph C. Goode III, P.E.
Sr. Engineer

Encl.

SW:JCG/jcg
AAProjects/2023/230423/ssi



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VICINITY MAP

HOMESTEAD NORTH F3
SR LAND, LLC

JOB NO.
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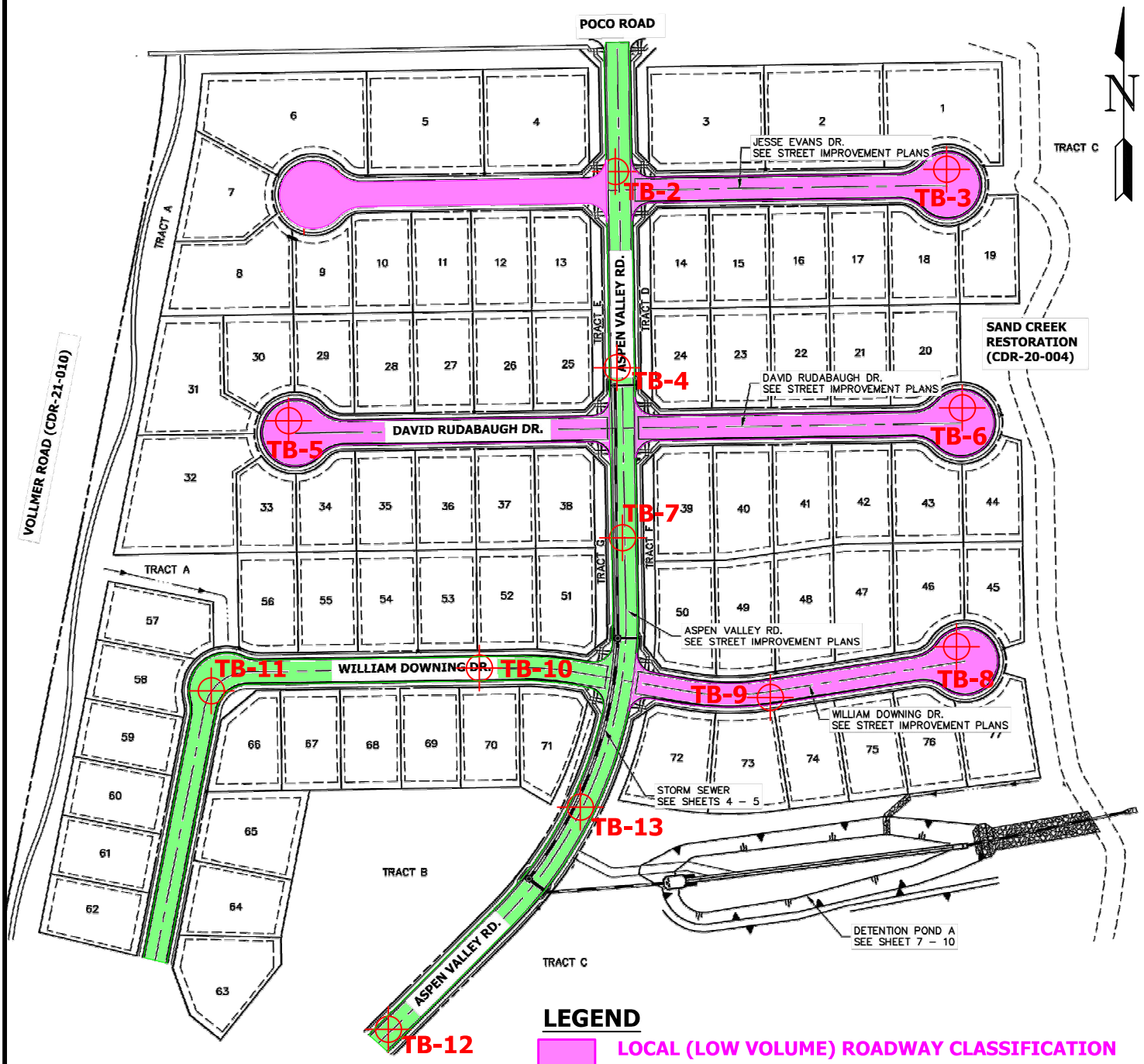
FIG. 1



LEGEND

LOCAL (LOW VOLUME) ROADWAY CLASSIFICATION
DESIGN 18-KIP ESAL=36,500
SOIL TYPE 1 (AASHTO A-1-b, A-2-4, & A-2-6)
PAVEMENT ALTERNATIVES 1) 3" HMA OVER 6" ABC
2) 4" HMA OVER 10" CTS

LOCAL ROADWAY CLASSIFICATION
DESIGN 18-KIP ESAL=292,000
SOIL TYPE 1 (AASHTO A-1-b, A-2-4, & A-2-6)
PAVEMENT ALTERNATIVES 1) 3" HMA OVER 8" ABC
2) 4" HMA OVER 10" CTS

TB- APPROXIMATE TEST BORING LOCATION AND NUMBER

ENTECH ENGINEERING, INC.

SITE AND EXPLORATION PLAN

HOMESTEAD NORTH F3
SR LAND, LLC

JOB NO.
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FIG. 2

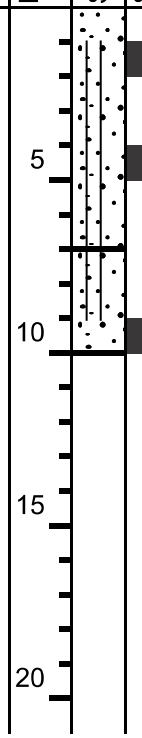
APPENDIX A: Test Boring Logs

TEST BORING 1
DATE DRILLED 10/13/2023

REMARKS

DRY TO 10', 10/13/23

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
FILL 0-7', SAND, SILTY, BROWN, MEDIUM DENSE, MOIST			20	6.3	1
5			20	6.1	1
SAND, SILTY, TAN, MEDIUM DENSE, MOIST					
10			24	6.9	2
15					
20					

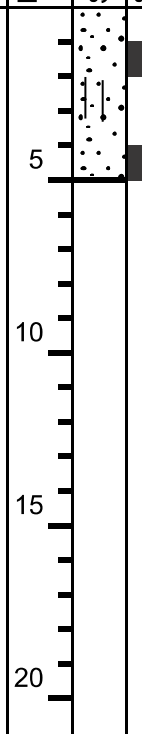


TEST BORING 2
DATE DRILLED 10/13/2023

REMARKS

DRY TO 5', 10/13/23

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
FILL 0-5', SAND, WITH SILT, BROWN, MEDIUM DENSE, MOIST			23	5.6	1
5			21	8.8	1
10					
15					
20					



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TEST BORING LOGS

HOMESTEAD NORTH, FILING No. 3
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FIG. A-1

TEST BORING 3
DATE DRILLED 10/13/2023

REMARKS

DRY TO 5', 10/13/23

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
FILL 0-5', SAND, WITH SILT, BROWN, MEDIUM DENSE, MOIST			27	8.8	1
5			24	7.7	1
10					
15					
20					

TEST BORING 4
DATE DRILLED 10/13/2023

REMARKS

DRY TO 10', 10/13/23

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
FILL 0-8', SAND, WITH SILT, BROWN, MEDIUM DENSE, MOIST			21	6.2	1
5			26	11.8	1
SAND, SILTY, TAN, DENSE, MOIST					
10			43	6.5	2
15					
20					

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TEST BORING LOGS

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FIG. A-2

TEST BORING 5
DATE DRILLED 10/13/2023

REMARKS

DRY TO 5', 10/13/23

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type	
			18	6.9	1	FILL 0-4', SAND, CLAYEY, BROWN, MEDIUM DENSE, MOIST
5			19	0.9	1	SAND, SILTY, TAN, MEDIUM DENSE, DRY
10						
15						
20						

TEST BORING 6
DATE DRILLED 10/13/2023

REMARKS

DRY TO 5', 10/13/23

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type	
			26	4.2	1	FILL 0-4', SAND, SILTY, BROWN, MEDIUM DENSE, MOIST
5			26	2.2	2	SAND, SILTY, TAN, MEDIUM DENSE, DRY
10						
15						
20						

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TEST BORING LOGS

HOMESTEAD NORTH, FILING No. 3
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FIG. A-3

TEST BORING 7
DATE DRILLED 10/13/2023

REMARKS

DRY TO 5', 10/13/23

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			13	9.1	1
5			12	10.0	1
10			19	18.5	2
15					
20					

FILL 0-9', SAND, CLAYEY, BROWN, MEDIUM DENSE, MOIST

SAND, SILTY, BROWN, MEDIUM DENSE, MOIST

TEST BORING 8
DATE DRILLED 10/13/2023

REMARKS

DRY TO 5', 10/13/23

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			19	2.4	1
5			13	3.0	1
10					
15					
20					

FILL 0-5', SAND, WITH SILT, BROWN, MEDIUM DENSE, DRY to MOIST

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TEST BORING LOGS

HOMESTEAD NORTH, FILING No. 3
SR LAND

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FIG. A-4

TEST BORING 9
DATE DRILLED 10/13/2023

REMARKS

DRY TO 5', 10/13/23

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			14	10.0	1
5			11	4.2	1
10					
15					
20					

FILL 0-5', SAND, WITH SILT, BROWN, MEDIUM DENSE, MOIST

TEST BORING 10
DATE DRILLED 10/13/2023

REMARKS

DRY TO 5', 10/13/23

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
			21	6.8	1
5			16	7.6	1
10					
15					
20					

FILL 0-5', SAND, WITH SILT, BROWN, MEDIUM DENSE, MOIST

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TEST BORING LOGS

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FIG. A-5

TEST BORING 11
DATE DRILLED 10/13/2023

REMARKS

DRY TO 5', 10/13/23

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
	FILL 0-4', SAND, SILTY, TAN, DENSE, MOIST		35	8.2	1
5	SANDSTONE, EXTREMELY WEAK, TAN, HIGHLY WEATHERED (SAND, SILTY, VERY DENSE, MOIST)		50/10"	6.2	3
10					
15					
20					

TEST BORING 12
DATE DRILLED 10/13/2023

REMARKS

DRY TO 10', 10/13/23

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
	FILL 0-8', SAND, SILTY, BROWN, MEDIUM DENSE to LOOSE, MOIST		11	7.2	1
5			9	8.2	1
10	SANDSTONE, EXTREMELY WEAK, TAN, HIGHLY WEATHERED (SAND, SILTY, VERY DENSE, MOIST)		50/10"	4.3	3
15					
20					

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TEST BORING LOGS

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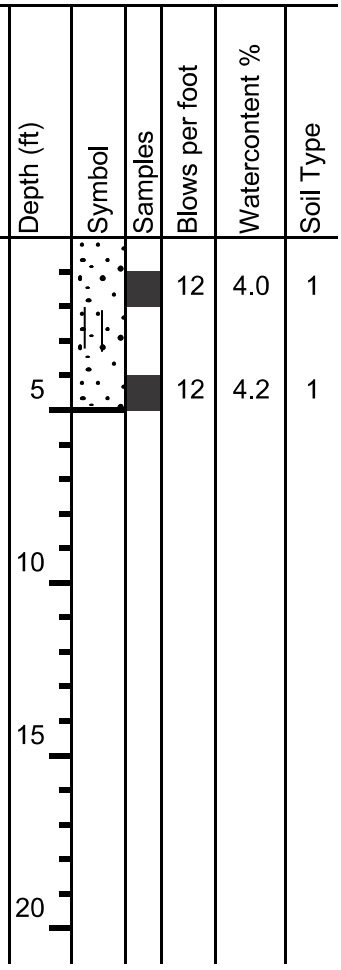
FIG. A-6

TEST BORING 13
DATE DRILLED 10/13/2023

REMARKS

DRY TO 5', 10/13/23



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TEST BORING LOGS

HOMESTEAD NORTH, FILING No. 3
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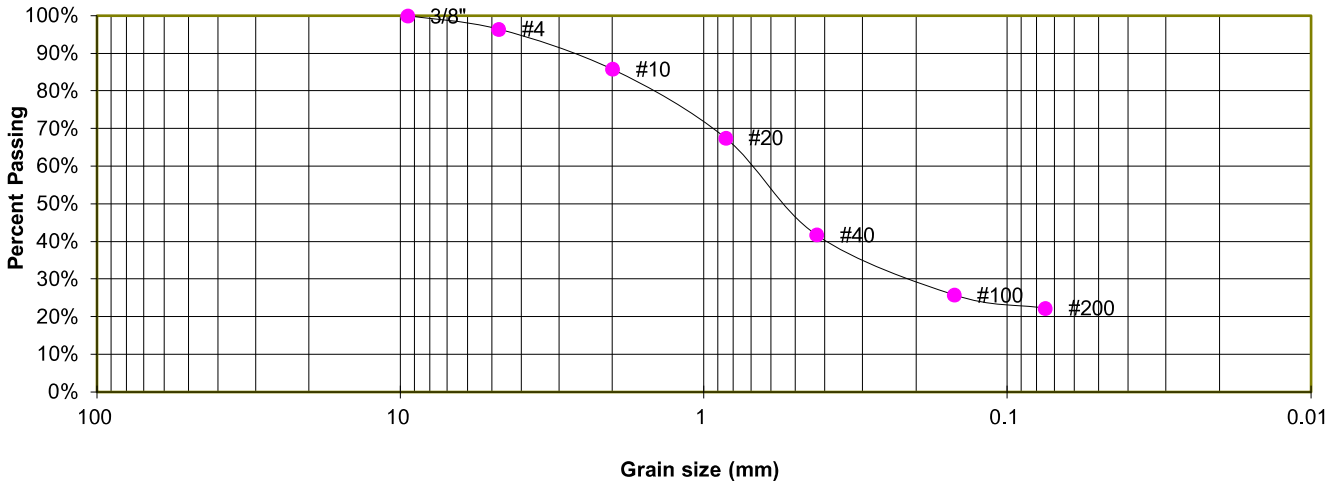
FIG. A-7

APPENDIX B: Laboratory Test Results

TABLE B-1
SUMMARY OF LABORATORY TEST RESULTS

SOIL TYPE	TEST BORING NO.	DEPTH (FT)	PASSING NO. 200 SIEVE (%)	LIQUID LIMIT	PLASTIC LIMIT	PLASTIC INDEX	SULFATE (WT %)	AASHTO CLASS.	USCS	SOIL DESCRIPTION
1, CBR	10	0-3	22.3	NV	NP	NP		A-1-b	SM	FILL, SANDY, SILTY
1	1	1-2	21.6	NV	NP	NP		A-1-b	SM	FILL, SANDY, SILTY
1	2	1-2	6.5	NV	NP	NP		A-1-b	SW-SM	FILL, SAND, WITH SILT
1	3	1-2	7.8	NV	NP	NP		A-1-b	SW-SM	FILL, SAND, WITH SILT
1	4	1-2	8.6	NV	NP	NP	<0.01	A-1-b	SW-SM	FILL, SAND, WITH SILT
1	5	1-2	21.7	31	18	13		A-2-6	SC	FILL, SANDY, CLAYEY
1	6	1-2	24.8	NV	NP	NP		A-1-b	SM	FILL, SANDY, SILTY
1	7	1-2	17.3	30	18	12	<0.01	A-2-6	SC	FILL, SANDY, CLAYEY
1	8	1-2	6.8	NV	NP	NP		A-1-b	SW-SM	FILL, SAND, WITH SILT
1	9	1-2	6.0	NV	NP	NP		A-1-b	SW-SM	FILL, SAND, WITH SILT
1	10	1-2	8.0	NV	NP	NP		A-1-b	SW-SM	FILL, SAND, WITH SILT
1	11	1-2	13.1	NV	NP	NP	0.03	A-2-4	SM	FILL, SANDY, SILTY
1	12	1-2	18.4	NV	NP	NP		A-1-b	SM	FILL, SANDY, SILTY
1	13	1-2	5.2	NV	NP	NP		A-1-b	SW-SM	FILL, SAND, WITH SILT

TEST BORING 10	SOIL DESCRIPTION FILL, SANDY, SILTY
DEPTH (FT) 0-3	SOIL TYPE 1, CBR



GRAIN SIZE ANALYSIS

U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	96.5%
10	85.8%
20	67.6%
40	41.7%
100	25.8%
200	22.3%

ATTERBERG LIMITS

Plastic Limit	NP
Liquid Limit	NV
Plastic Index	NP

SOIL CLASSIFICATION

USCS CLASSIFICATION:	SM
AASHTO CLASSIFICATION:	A-1-b
AASHTO GROUP INDEX:	0

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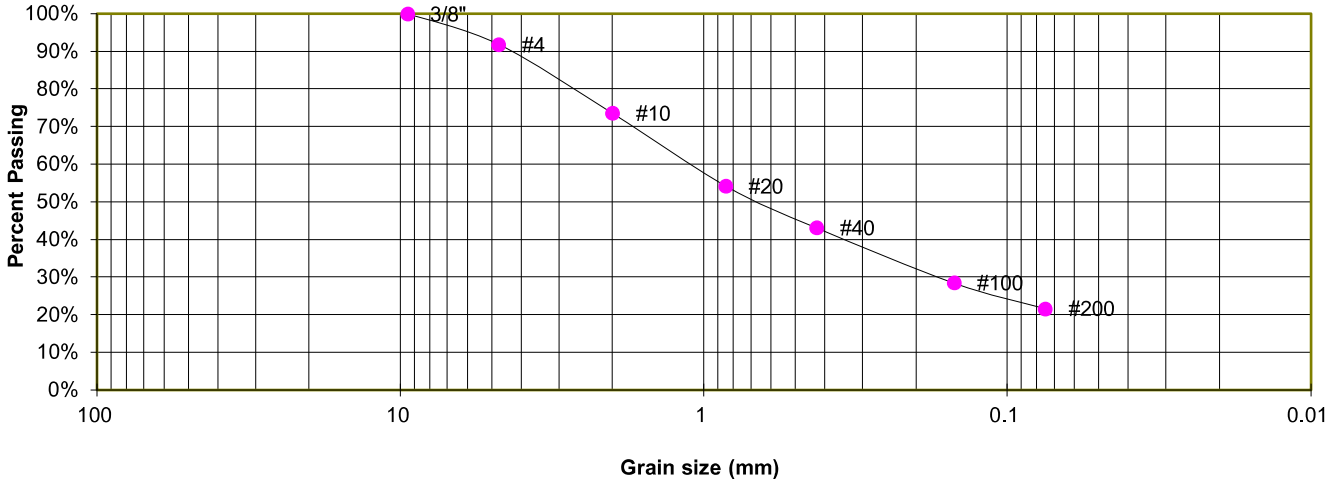
LABORATORY TEST RESULTS

HOMESTEAD NORTH, FILING No. 3
SR LAND

JOB NO. 230423

FIG. B-1

TEST BORING	1	SOIL DESCRIPTION	FILL, SANDY, SILTY
DEPTH (FT)	1-2	SOIL TYPE	1



GRAIN SIZE ANALYSIS

U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	91.8%
10	73.6%
20	54.3%
40	43.1%
100	28.5%
200	21.6%

ATTERBERG LIMITS

Plastic Limit	NP
Liquid Limit	NV
Plastic Index	NP

SOIL CLASSIFICATION

USCS CLASSIFICATION:	SM
AASHTO CLASSIFICATION:	A-1-b
AASHTO GROUP INDEX:	0

ENTECH ENGINEERING, INC.

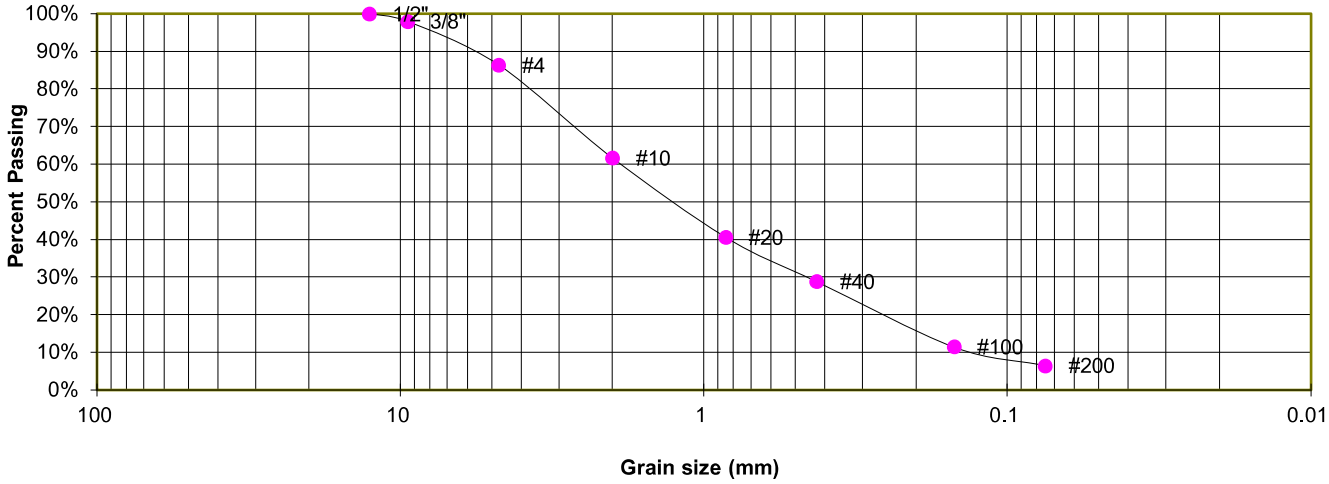
LABORATORY TEST RESULTS

HOMESTEAD NORTH, FILING No. 3
SR LAND

JOB NO. 230423

FIG. B-2

TEST BORING	2	SOIL DESCRIPTION	FILL, SAND, WITH SILT
DEPTH (FT)	1-2	SOIL TYPE	1



GRAIN SIZE ANALYSIS

U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	98.0%
4	86.4%
10	61.7%
20	40.6%
40	28.9%
100	11.5%
200	6.5%

ATTERBERG LIMITS

Plastic Limit	NP
Liquid Limit	NV
Plastic Index	NP

SOIL CLASSIFICATION

USCS CLASSIFICATION: SW-SM
AASHTO CLASSIFICATION: A-1-b
AASHTO GROUP INDEX: 0

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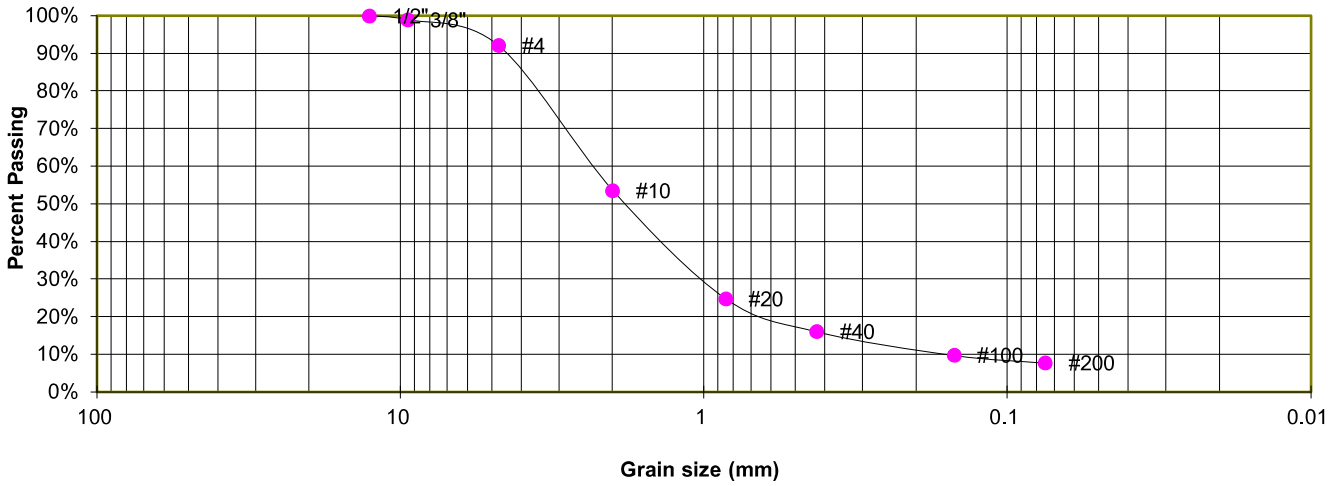
LABORATORY TEST RESULTS

HOMESTEAD NORTH, FILING No. 3
SR LAND

JOB NO. 230423

FIG. B-3

TEST BORING	3	SOIL DESCRIPTION	FILL, SAND, WITH SILT
DEPTH (FT)	1-2	SOIL TYPE	1



GRAIN SIZE ANALYSIS

U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	99.0%
4	92.1%
10	53.6%
20	24.8%
40	16.1%
100	9.8%
200	7.8%

ATTERBERG LIMITS

Plastic Limit	NP
Liquid Limit	NV
Plastic Index	NP

SOIL CLASSIFICATION

USCS CLASSIFICATION: SW-SM
AASHTO CLASSIFICATION: A-1-b
AASHTO GROUP INDEX: 0

ENTECH ENGINEERING, INC.

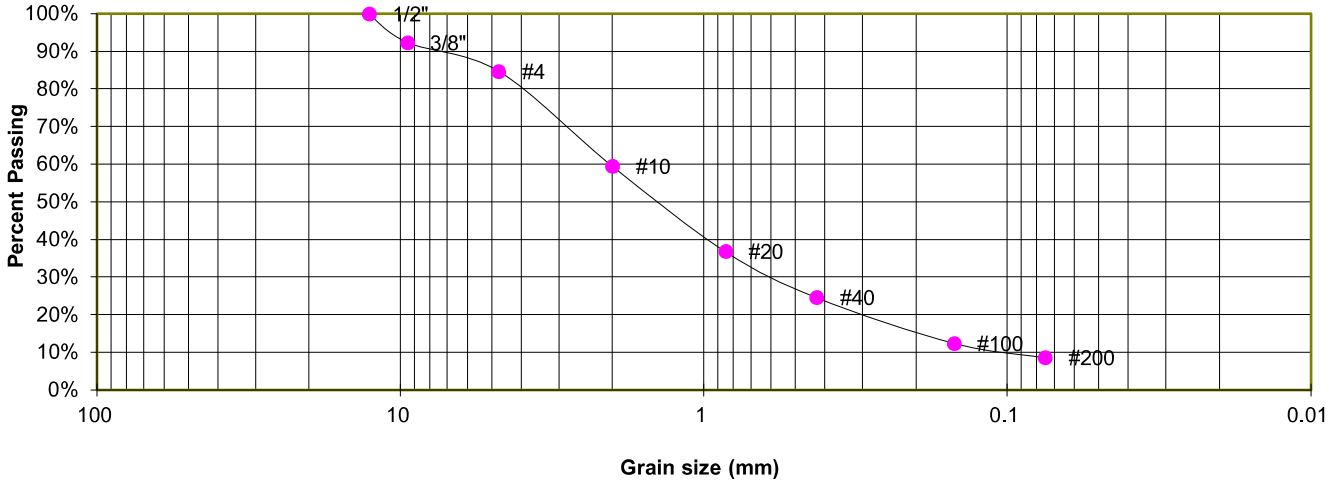
LABORATORY TEST RESULTS

HOMESTEAD NORTH, FILING No. 3
SR LAND

JOB NO. 230423

FIG. B-4

TEST BORING	4	SOIL DESCRIPTION	FILL, SAND, WITH SILT
DEPTH (FT)	1-2	SOIL TYPE	1



GRAIN SIZE ANALYSIS

U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	92.3%
4	84.7%
10	59.5%
20	36.8%
40	24.6%
100	12.4%
200	8.6%

ATTERBERG LIMITS

Plastic Limit	NP
Liquid Limit	NV
Plastic Index	NP

SOIL CLASSIFICATION

USCS CLASSIFICATION: SW-SM
AASHTO CLASSIFICATION: A-1-b
AASHTO GROUP INDEX: 0

ENTECH ENGINEERING, INC.

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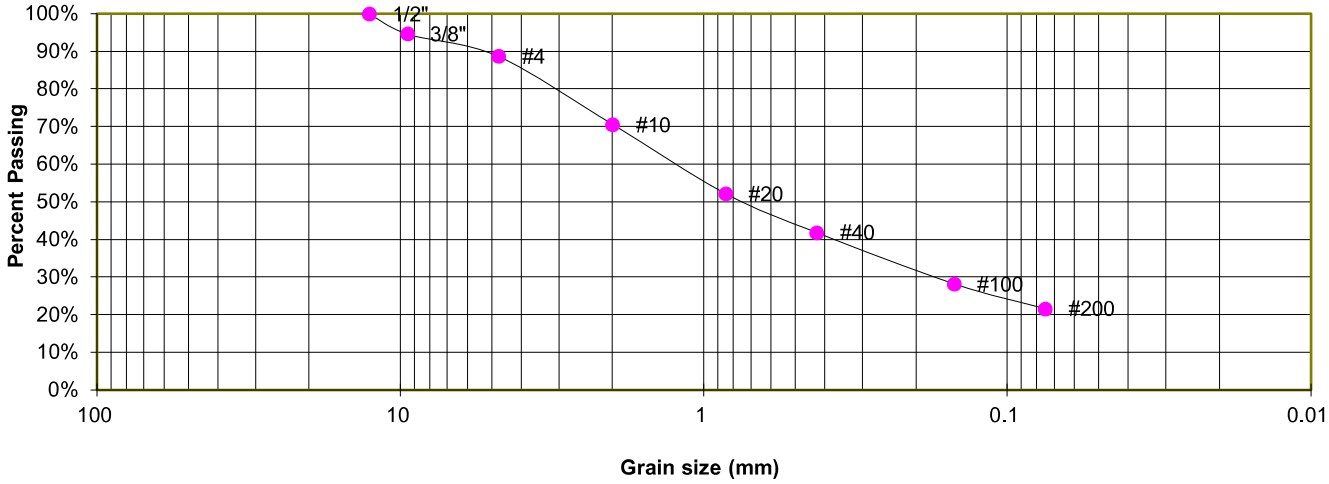
FIG. B-5

TEST BORING	5	SOIL DESCRIPTION	FILL, SANDY, CLAYEY
DEPTH (FT)	1-2	SOIL TYPE	1



GRAIN SIZE ANALYSIS

U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	94.7%
4	88.7%
10	70.6%
20	52.2%
40	41.9%
100	28.2%
200	21.7%

ATTERBERG LIMITS

Plastic Limit	18
Liquid Limit	31
Plastic Index	13

SOIL CLASSIFICATION

USCS CLASSIFICATION:	SC
AASHTO CLASSIFICATION:	A-2-6
AASHTO GROUP INDEX:	0

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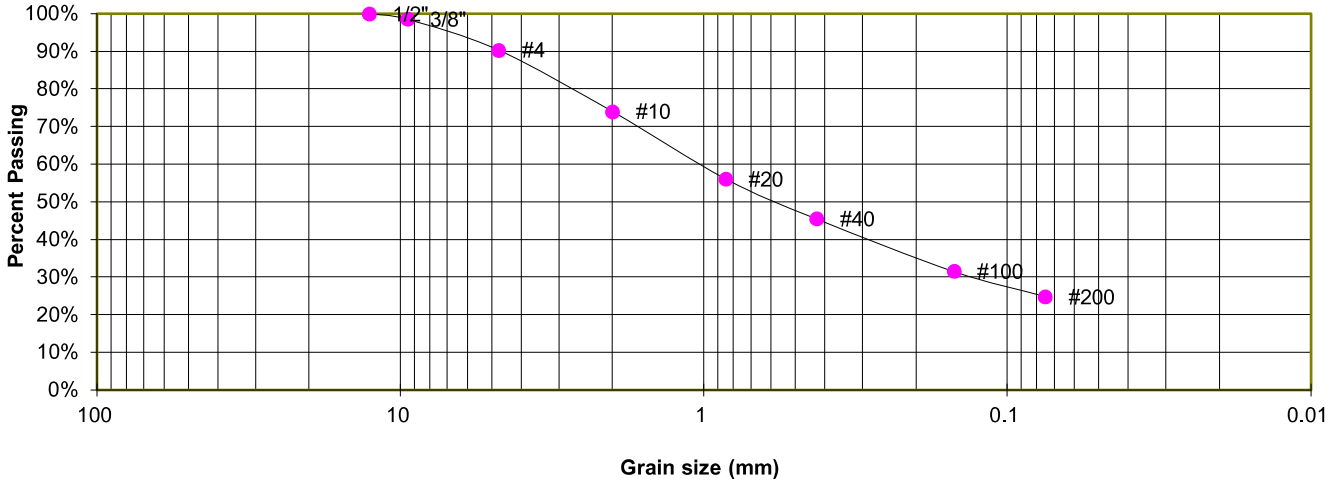
FIG. B-6

TEST BORING	6	SOIL DESCRIPTION	FILL, SANDY, SILTY
DEPTH (FT)	1-2	SOIL TYPE	1



GRAIN SIZE ANALYSIS

U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	98.6%
4	90.4%
10	74.0%
20	56.1%
40	45.5%
100	31.5%
200	24.8%

ATTERBERG LIMITS

Plastic Limit	NP
Liquid Limit	NV
Plastic Index	NP

SOIL CLASSIFICATION

USCS CLASSIFICATION:	SM
AASHTO CLASSIFICATION:	A-1-b
AASHTO GROUP INDEX:	0

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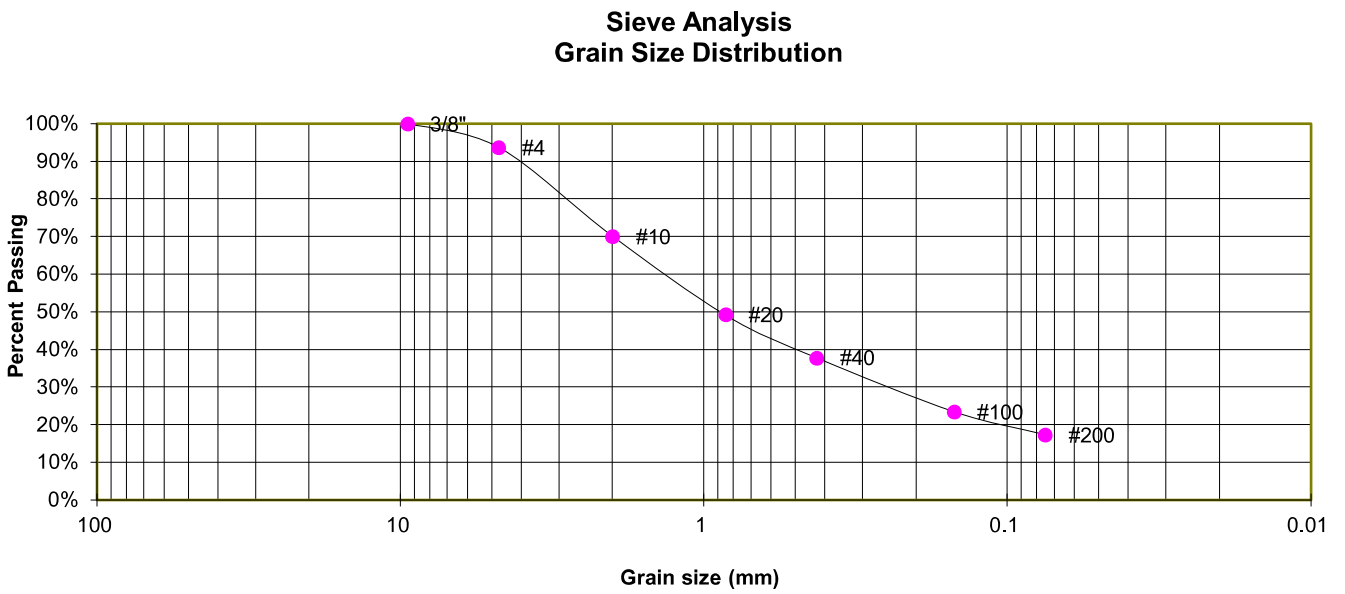
FIG. B-7

TEST BORING	7	SOIL DESCRIPTION	FILL, SANDY, CLAYEY
DEPTH (FT)	1-2	SOIL TYPE	1



GRAIN SIZE ANALYSIS

U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	93.7%
10	70.1%
20	49.2%
40	37.8%
100	23.5%
200	17.3%

ATTERBERG LIMITS

Plastic Limit	18
Liquid Limit	30
Plastic Index	12

SOIL CLASSIFICATION

USCS CLASSIFICATION:	SC
AASHTO CLASSIFICATION:	A-2-6
AASHTO GROUP INDEX:	0

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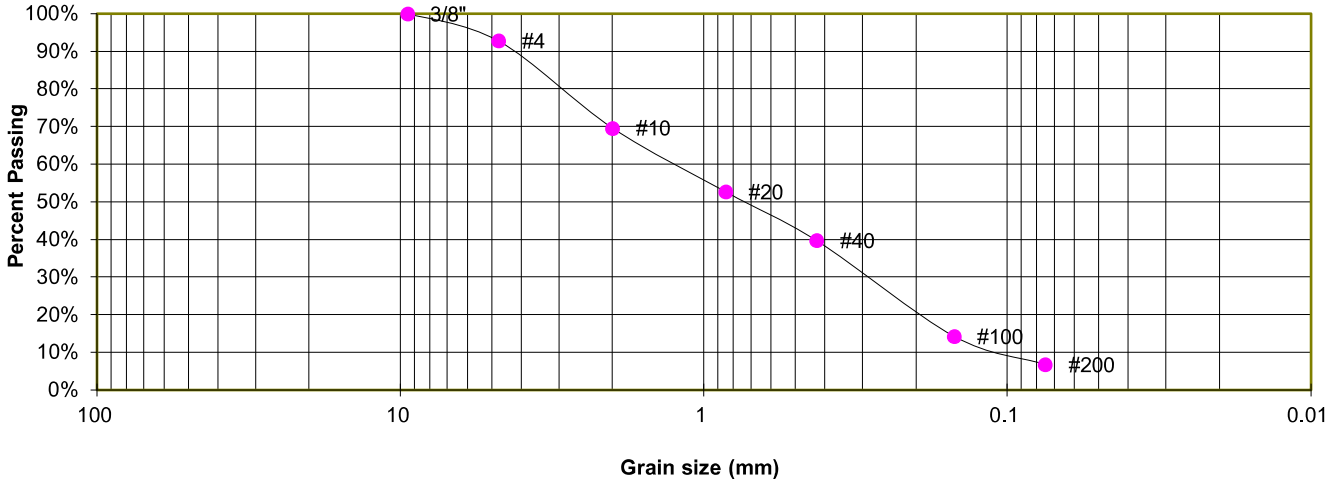
FIG. B-8

TEST BORING	8	SOIL DESCRIPTION	FILL, SAND, WITH SILT
DEPTH (FT)	1-2	SOIL TYPE	1



GRAIN SIZE ANALYSIS

U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	92.8%
10	69.6%
20	52.7%
40	39.7%
100	14.3%
200	6.8%

ATTERBERG LIMITS

Plastic Limit	NP
Liquid Limit	NV
Plastic Index	NP

SOIL CLASSIFICATION

USCS CLASSIFICATION: SW-SM
AASHTO CLASSIFICATION: A-1-b
AASHTO GROUP INDEX: 0

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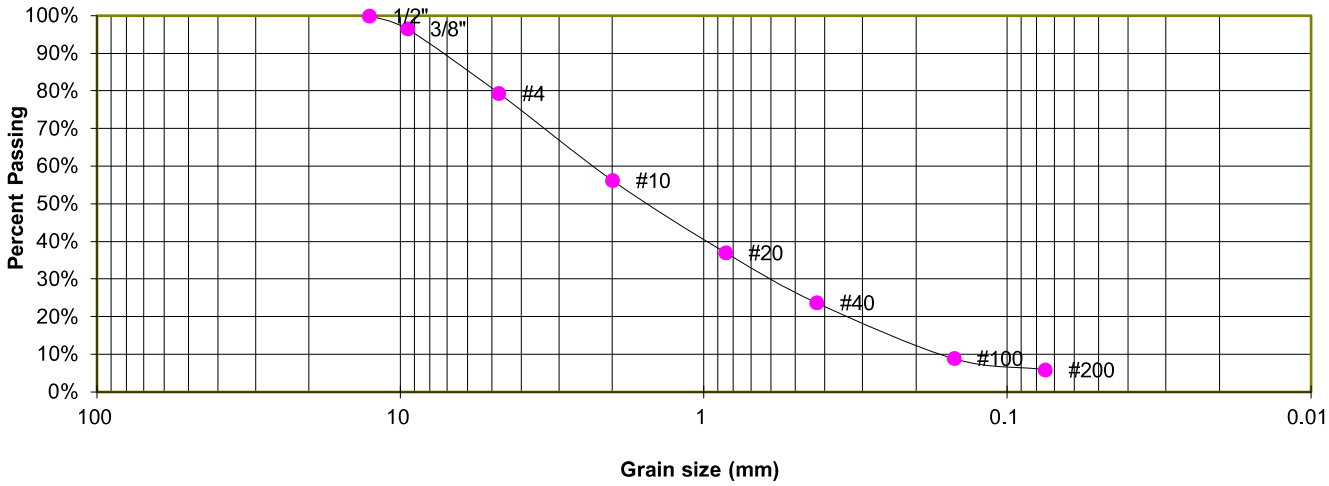
FIG. B-9

TEST BORING	9	SOIL DESCRIPTION	FILL, SAND, WITH SILT
DEPTH (FT)	1-2	SOIL TYPE	1



GRAIN SIZE ANALYSIS

U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	96.5%
4	79.4%
10	56.2%
20	37.1%
40	23.7%
100	8.9%
200	6.0%

ATTERBERG LIMITS

Plastic Limit	NP
Liquid Limit	NV
Plastic Index	NP

SOIL CLASSIFICATION

USCS CLASSIFICATION: SW-SM
AASHTO CLASSIFICATION: A-1-b
AASHTO GROUP INDEX: 0

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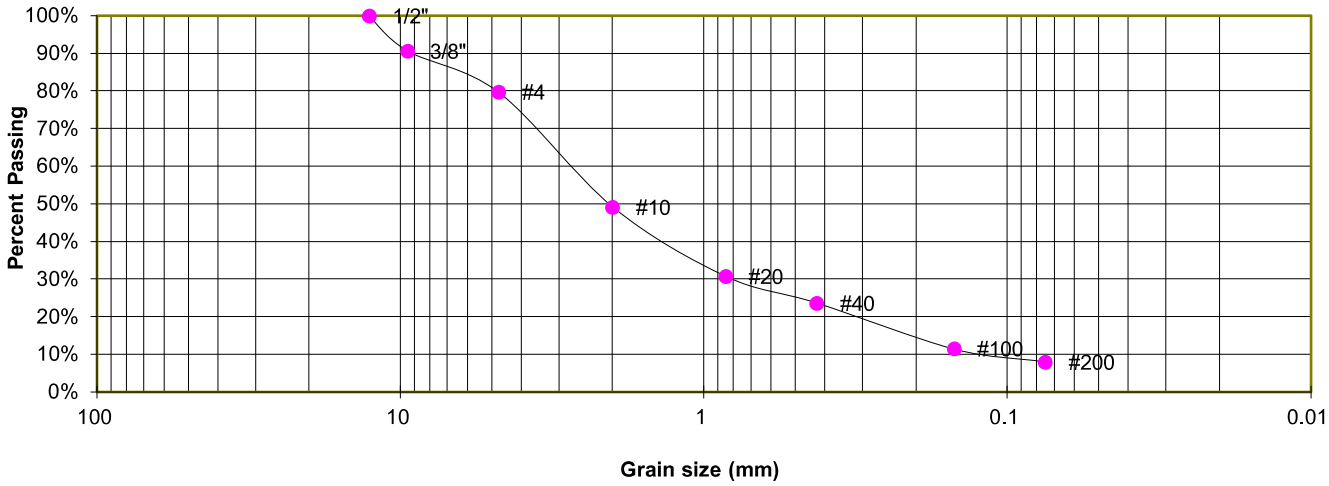
FIG. B-10

TEST BORING	10	SOIL DESCRIPTION	FILL, SAND, WITH SILT
DEPTH (FT)	1-2	SOIL TYPE	1



GRAIN SIZE ANALYSIS

U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	90.7%
4	79.7%
10	49.2%
20	30.8%
40	23.6%
100	11.5%
200	8.0%

ATTERBERG LIMITS

Plastic Limit	NP
Liquid Limit	NV
Plastic Index	NP

SOIL CLASSIFICATION

USCS CLASSIFICATION: SW-SM
AASHTO CLASSIFICATION: A-1-b
AASHTO GROUP INDEX: 0

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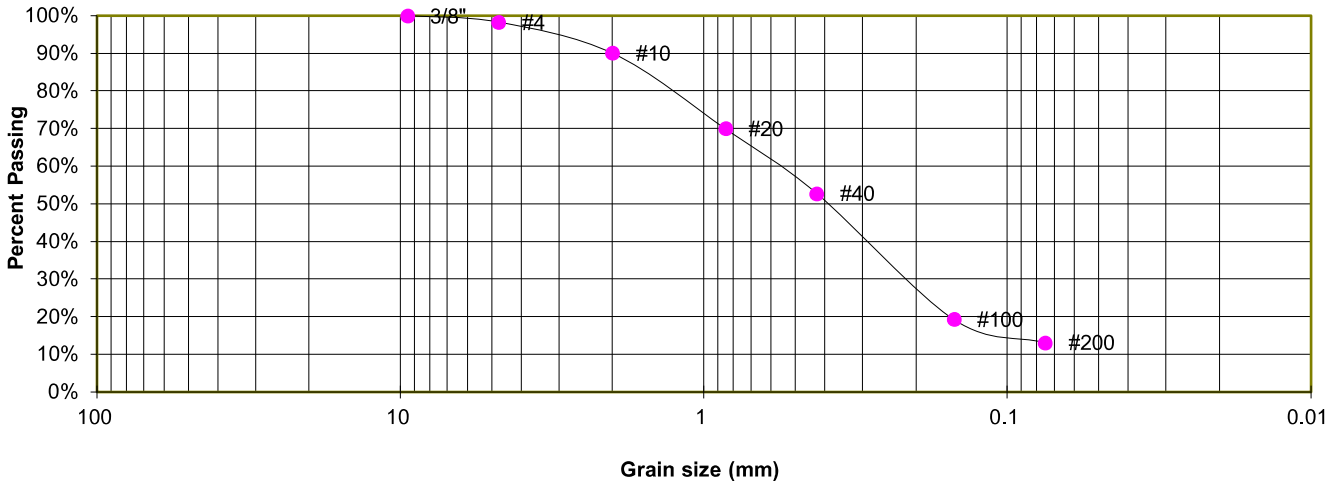
FIG. B-11

TEST BORING	11	SOIL DESCRIPTION	FILL, SANDY, SILTY
DEPTH (FT)	1-2	SOIL TYPE	1



GRAIN SIZE ANALYSIS

U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	98.3%
10	90.1%
20	70.0%
40	52.8%
100	19.3%
200	13.1%

ATTERBERG LIMITS

Plastic Limit	NP
Liquid Limit	NV
Plastic Index	NP

SOIL CLASSIFICATION

USCS CLASSIFICATION:	SM
AASHTO CLASSIFICATION:	A-2-4
AASHTO GROUP INDEX:	0

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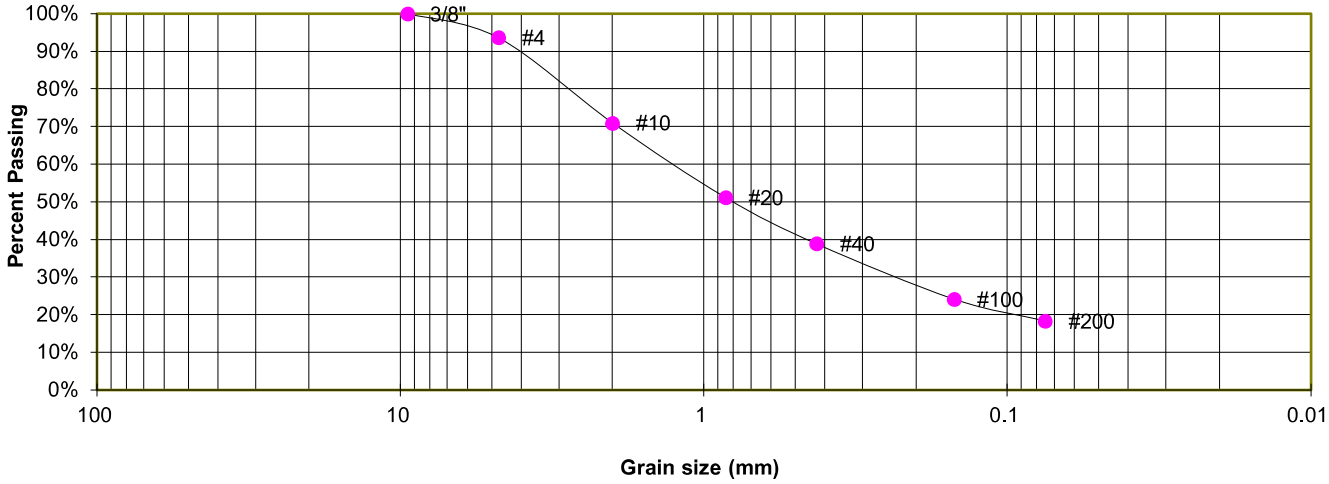
FIG. B-12

TEST BORING	12	SOIL DESCRIPTION	FILL, SANDY, SILTY
DEPTH (FT)	1-2	SOIL TYPE	1



GRAIN SIZE ANALYSIS

U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	93.7%
10	71.0%
20	51.2%
40	38.9%
100	24.2%
200	18.4%

ATTERBERG LIMITS

Plastic Limit	NP
Liquid Limit	NV
Plastic Index	NP

SOIL CLASSIFICATION

USCS CLASSIFICATION:	SM
AASHTO CLASSIFICATION:	A-1-b
AASHTO GROUP INDEX:	0

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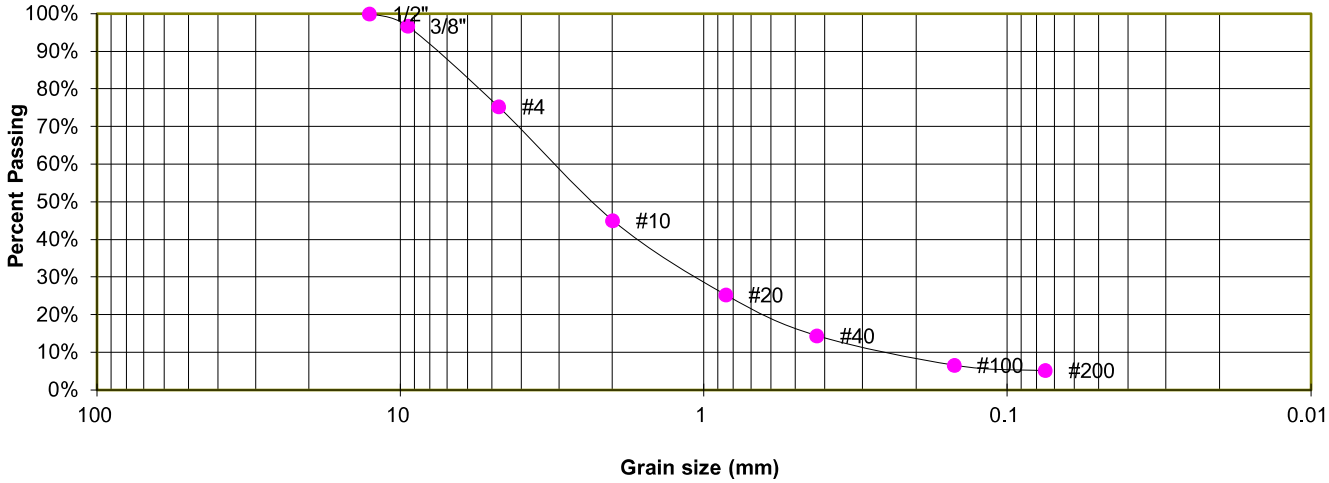
FIG. B-13

TEST BORING	13	SOIL DESCRIPTION	FILL, SAND, WITH SILT
DEPTH (FT)	1-2	SOIL TYPE	1



GRAIN SIZE ANALYSIS

U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	96.8%
4	75.3%
10	45.1%
20	25.4%
40	14.5%
100	6.6%
200	5.2%

ATTERBERG LIMITS

Plastic Limit	NP
Liquid Limit	NV
Plastic Index	NP

SOIL CLASSIFICATION

USCS CLASSIFICATION: SW-SM
AASHTO CLASSIFICATION: A-1-b
AASHTO GROUP INDEX: 0

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FIG. B-14

SAMPLE LOCATION TB-10 @ 0-3'	SOIL DESCRIPTION SAND, SILTY, BROWN
	SOIL TYPE 1

PROCTOR DATA

IDENTIFICATION:	SM
PROCTOR TEST #:	1
TEST BY:	DK
TEST DESIGNATION:	ASTM-1557-A
MAXIMUM DRY DENSITY (PCF):	128.9
OPTIMUM MOISTURE:	7.4

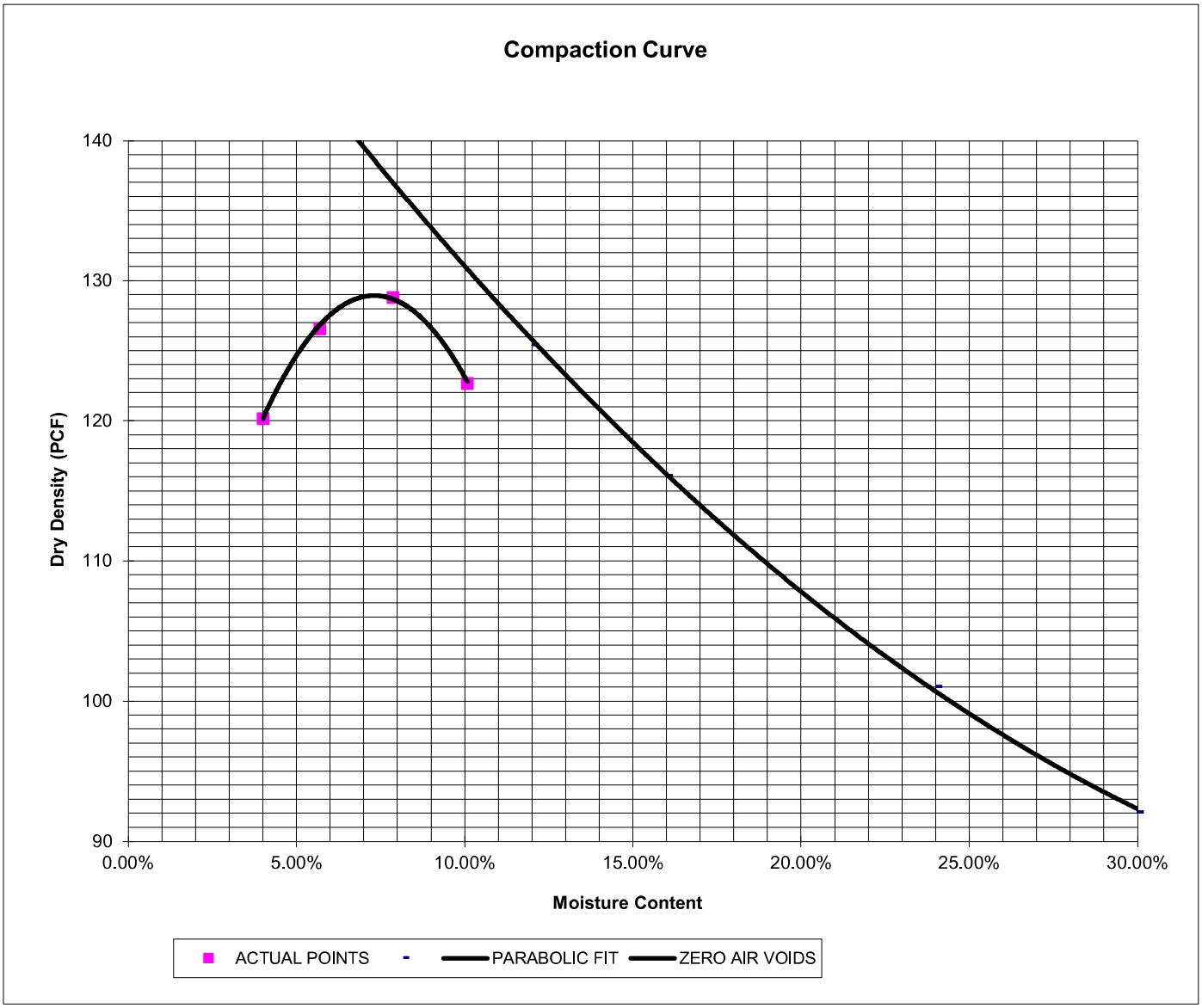

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FIG. B-15

SAMPLE LOCATION TB-10 @ 0-3' SOIL DESCRIPTION SAND, SILTY, BROWN
SOIL TYPE 1

CBR TEST LOAD DATA

Piston Diameter (cm): 4.958
Piston Area (in^2): 2.993

Penetration Depth (inches)	*10 BLOWS* Mold # 1 Load (lbs)	Stress (psi)	*25 BLOWS* Mold # 2 Load (lbs)	Stress (psi)	*56 BLOWS* Mold # 3 Load (lbs)	Stress (psi)
0.000	0	0.00	0	0.00	0	0.00
0.025	204	68.17	320	106.93	330	110.28
0.050	291	97.24	512	171.09	551	184.13
0.075	337	112.61	641	214.20	721	240.93
0.100	385	128.65	810	270.68	917	306.43
0.125	419	140.02	968	323.47	1103	368.59
0.150	455	152.05	1107	369.92	1311	438.09
0.175	497	166.08	1281	428.07	1478	493.90
0.200	527	176.11	1439	480.87	1659	554.38
0.300	668	223.22	2239	748.20	2587	864.49
0.400	794	265.33	2805	937.34	3261	1089.72
0.500	934	312.11	3417	1141.85	4181	1397.16

MOISTURE AND DENSITY DATA

	Mold # 1	Mold # 2	Mold # 3
Can #	399	351	351
Wt. Can	8.43	8.46	7.88
Wt. Can+Wet	282.49	212.43	201.52
Wt. Can+Dry	251.19	190.53	182.59
Wt. H20	31.3	21.9	18.93
Wt. Dry Soil	242.76	182.07	174.71
Moisture Content	12.89%	12.03%	10.84%
Wet Density (PCF)	127.1	135.8	139.1
Dry Density (PCF)	118.4	126.5	129.5
% Compaction	92%	98%	100%
CBR	12.87	27.07	30.64

PROCTOR DATA

Maximum Dry Density (pcf)	128.9
Optimum Moisture	7.4
90% of Max. Dry Density (pcf)	116.0
95% of Max. Dry Density (pcf)	122.5

CBR at 90% of Max. Density = 8.72	~ R VALUE 22
CBR at 95% of Max. Density = 20.02	~ R VALUE 71

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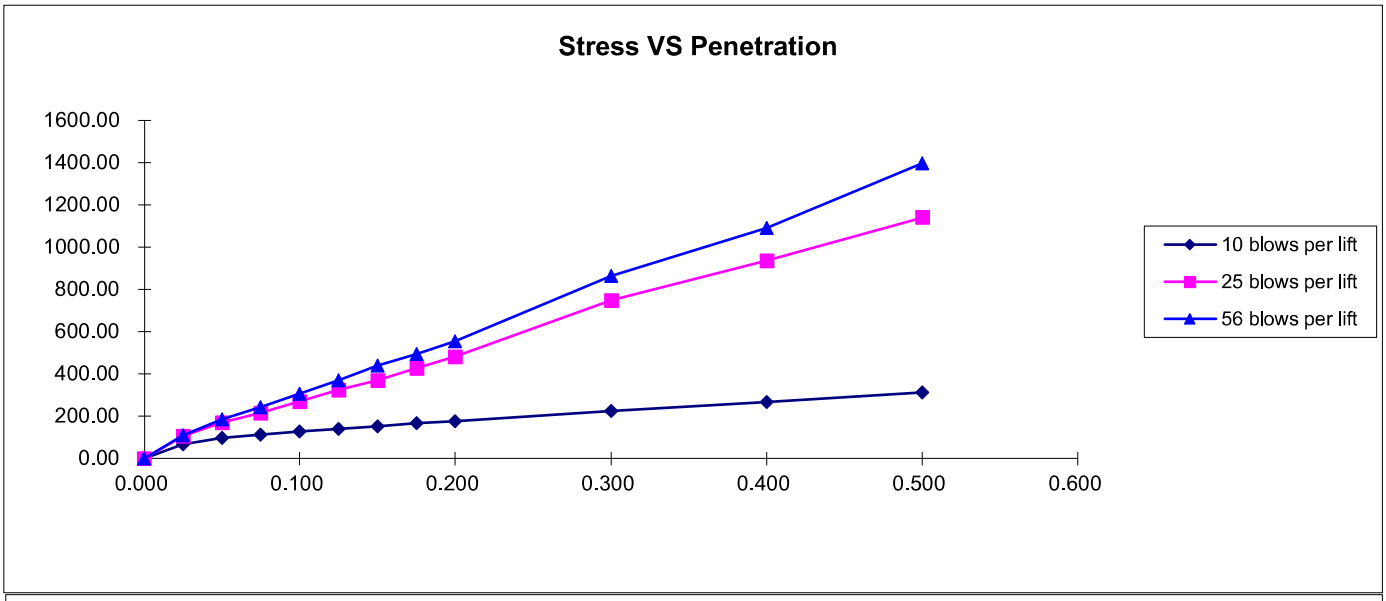
FIG. B-16

APPENDIX C: Pavement Design Calculations

SAMPLE LOCATION TB-10 @ 0-3'	SOIL DESCRIPTION SAND, SILTY, BROWN
DEPTH (FT) 0	SOIL TYPE 0



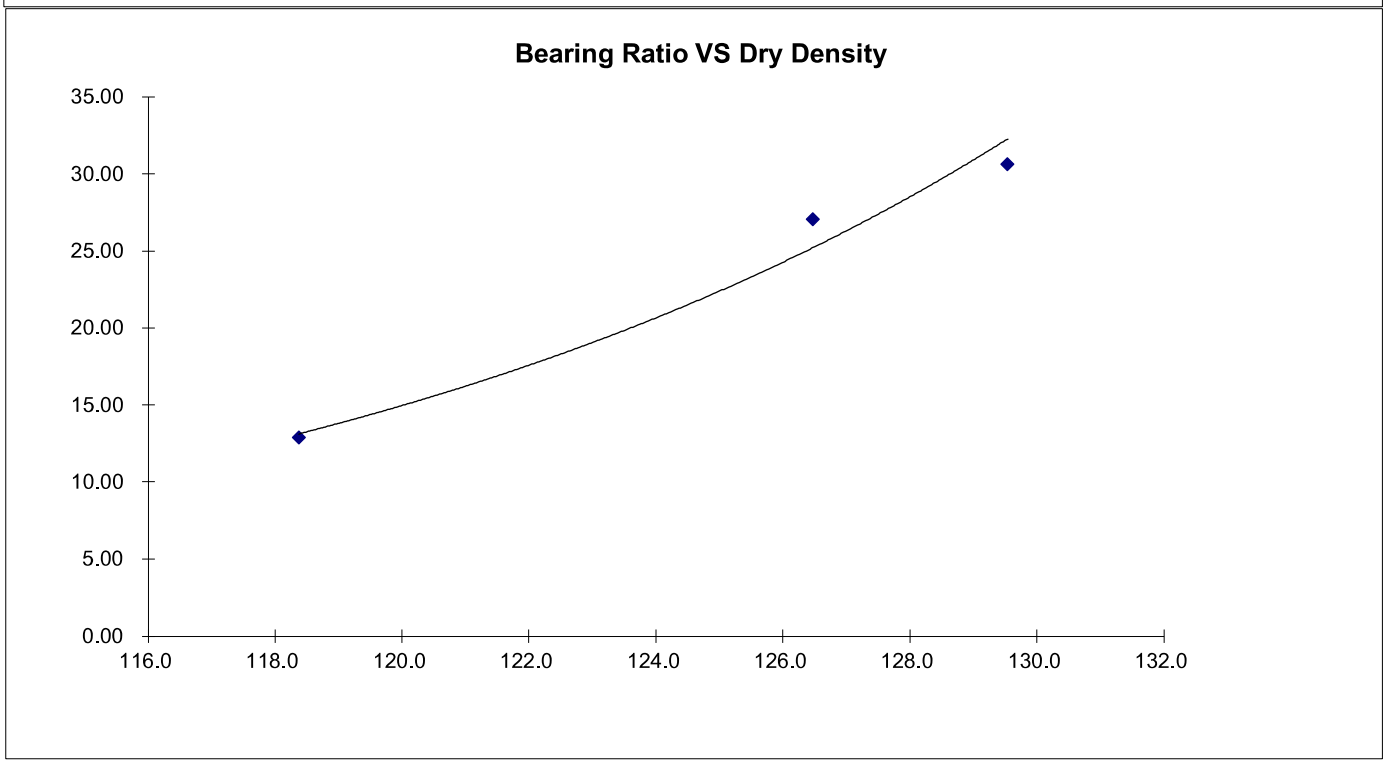


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FIG. B-17

FLEXIBLE PAVEMENT DESIGN

PROJECT DATA

Project Location Homestead North Filing 3 - Local Low Volume Road

Job Number: 230423

DESIGN DATA

Equivalent (18-kip) Single Axle Load Applications (ESAL):	ESAL (W_{18}) =	36,500
Design CBR	CBR =	10
Standard Deviation	S_o =	0.45
Loss in Serviceability	Δpsi =	2.0
Reliability	Reliability =	80
Reliability (z-statistic)	Z_R =	-0.84
Soil Resilient Modulus	M_R =	15,000 psi

Required Structural Number (SN): → SN = 1.38

DESIGN EQUATIONS

Resilient Modulus

If using CBR: M_R = (CBR) x 1,500

If using R-Value: $M_R = 10^{[(S_1 + 18.72) / 6.24]}$ where: S_1 = [(R-value - 5) / 11.29] + 3

Required Structural Number

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

Pavement Section Thickness

$SN^* = C_1D_1 + C_2D_2$ where: C_1 = Strength Coefficient - HMA

C_2 = Strength Coefficient - ABC

D_1 = Depth of HMA (inches)

D_2 = Depth of ABC (inches)

RECOMMENED THICKNESSES

Layer	Material	Coefficient	Thickness (D^*_i)	SN^*_i	SN
1	HMA	C_1 = 0.44	3.0 inches	1.320	-
2	ABC	C_2 = 0.11	6.0 inches	0.660	
			SN* = 1.980		1.38

Pavement SN > Required SN, Design is Acceptable

FIG. C-1

FLEXIBLE PAVEMENT DESIGN

PROJECT DATA

Project Location Homestead North Filing 3 - Local Low Volume Road

Job Number: 230423

DESIGN DATA

Equivalent (18-kip) Single Axle Load Applications (ESAL):	ESAL (W_{18}) =	36,500
Design CBR	CBR =	10
Standard Deviation	S_o =	0.45
Loss in Serviceability	Δpsi =	2.0
Reliability	Reliability =	80
Reliability (z-statistic)	Z_R =	-0.84
Soil Resilient Modulus	M_R =	15,000 psi

Required Structural Number (SN): → SN = 1.38

DESIGN EQUATIONS

Resilient Modulus

If using CBR: M_R = (CBR) x 1,500

If using R-Value: $M_R = 10^{[(S_1 + 18.72) / 6.24]}$ where: S_1 = [(R-value - 5) / 11.29] + 3

Required Structural Number

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

Pavement Section Thickness

$SN^* = C_1D_1 + C_2D_2$ where: C_1 = Strength Coefficient - HMA

C_2 = Strength Coefficient - CTS

D_1 = Depth of HMA (inches)

D_2 = Depth of CTS (inches)

RECOMMENED THICKNESSES

Layer	Material	Coefficient	Thickness (D^*_i)	SN^*_i	SN
1	HMA	C_1 = 0.44	4.0 inches	1.760	-
2	CTS	C_2 = 0.11	10.0 inches	1.100	
			SN^* = 2.860		1.38

Pavement SN > Required SN, Design is Acceptable

FIG. C-2

FLEXIBLE PAVEMENT DESIGN

PROJECT DATA

Project Location Homestead North Filing 3 - Local Road

Job Number: 230423

DESIGN DATA

Equivalent (18-kip) Single Axle Load Applications (ESAL):	ESAL (W_{18}) =	292,000
Design CBR	CBR =	10
Standard Deviation	S_o =	0.45
Loss in Serviceability	Δpsi =	2.0
Reliability	Reliability =	80
Reliability (z-statistic)	Z_R =	-0.84
Soil Resilient Modulus	M_R =	15,000 psi

Required Structural Number (SN): → SN = 1.99

DESIGN EQUATIONS

Resilient Modulus

If using CBR: M_R = (CBR) x 1,500

If using R-Value: $M_R = 10^{[(S_1 + 18.72) / 6.24]}$ where: S_1 = [(R-value - 5) / 11.29] + 3

Required Structural Number

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

Pavement Section Thickness

$SN^* = C_1D_1 + C_2D_2$ where: C_1 = Strength Coefficient - HMA

C_2 = Strength Coefficient - ABC

D_1 = Depth of HMA (inches)

D_2 = Depth of ABC (inches)

RECOMMENED THICKNESSES

Layer	Material	Coefficient	Thickness (D^*_i)	SN^*_i	SN
1	HMA	C_1 = 0.44	3.0 inches	1.320	-
2	ABC	C_2 = 0.11	8.0 inches	0.880	
			SN* = 2.200		1.99

Pavement SN > Required SN, Design is Acceptable

FIG. C-3

FLEXIBLE PAVEMENT DESIGN

PROJECT DATA

Project Location Homestead North Filing 3 - Local Road

Job Number: 230423

DESIGN DATA

Equivalent (18-kip) Single Axle Load Applications (ESAL):	ESAL (W_{18}) =	292,000
Design CBR	CBR =	10
Standard Deviation	S_o =	0.45
Loss in Serviceability	Δpsi =	2.0
Reliability	Reliability =	80
Reliability (z-statistic)	Z_R =	-0.84
Soil Resilient Modulus	M_R =	15,000 psi

Required Structural Number (SN): → SN = 1.99

DESIGN EQUATIONS

Resilient Modulus

If using CBR: $M_R = (CBR) \times 1{,}500$

If using R-Value: $M_R = 10^{[(S_1 + 18.72) / 6.24]}$ where: $S_1 = [(\text{R-value} - 5) / 11.29] + 3$

Required Structural Number

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

Pavement Section Thickness

$SN^* = C_1D_1 + C_2D_2$ where: C_1 = Strength Coefficient - HMA

C_2 = Strength Coefficient - CTS

D_1 = Depth of HMA (inches)

D_2 = Depth of CTS (inches)

RECOMMENED THICKNESSES

Layer	Material	Coefficient	Thickness (D^*_i)	SN^*_i	SN
1	HMA	C_1 = 0.44	4.0 inches	1.760	-
2	CTS	C_2 = 0.11	10.0 inches	1.100	
			SN^* = 2.860		1.99

Pavement SN > Required SN, Design is Acceptable

FIG. C-4