ENTECH
ENGINEERING, INC.

505 ELKTON DRIVE
COLORADO SPRINGS, CO 80907
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July 20, 2021

Tech Contractors
3575 Kenyon Street, Suite 200
San Diego, California 92110



Attn: Raul Guzman

Re: Pavement Recommendations
Rolling Hills at Meridian Ranch Filing No.1, Phase 2
El Paso County, Colorado

Dear Mr. Guzman:

As requested, Entech Engineering, Inc. has obtained samples of the subgrade soils from sections of the roadways in the Rolling Hills at Meridian Ranch, Filing No.1, Phase 2, in El Paso County, Colorado. Laboratory testing to determine the pavement support characteristics of the soils was performed. This letter presents the results of the laboratory testing and provides pavement recommendations for the roadways.

## Project Description

The roadways in this project consist of sections of Rolling Peaks Drive, Parkland Drive, Rolling Mesa Drive, Evening Creek Drive, and Cuatro Caminos Drive. The site layout and the locations of the test borings, drilled at approximate 500-foot intervals, are shown on the Test Boring Location Map, Figure 1.

## Subgrade Conditions

Twelve exploratory test borings were drilled in the roadways to depths of approximately 5 to 10 feet. The Boring Logs are presented in Appendix A. Sieve Analysis and Atterberg Limit testing were performed on the subgrade soil samples obtained from the test borings for the purpose of classification. Three soil types were encountered in the test borings. The soils encountered at subgrade depth consisted of one general soil type; Soil Type 1; silty to clayey sand fill and native clayey sand. Soil Types 2 and 3 were encountered at depths below the subgrade influence zone. This report evaluates and presents recommendations for the Type 1 Soils for all of the roadway sections.

Sieve analyses performed on Type 1 soils indicated the percent passing the No. 200 sieve ranged from approximately 11 to 32 percent. Atterberg Limit Tests performed on the samples resulted in Liquid Limits ranging from no-value to 31 and Plastic Indexes of non-plastic to 18. Soil Type 1 consisted of silty to clayey sand fill and native clayey sand, which classified as A-2-6, A-2-4, and A-1-b soils based on the AASHTO classification system. These soils have good pavement support characteristics. Sulfate testing of the subgrade indicated that the soils exhibit a negligible potential for sulfate attack. Groundwater was not encountered in the test borings.

Swell testing was performed on several samples of the site soils based on their Plastic Indexes. Volume changes of 0.1 to 1.6 percent were measured. Based on the low volume changes, mitigation is not required. Laboratory test results are presented in Appendix B and are summarized on Table 1.

California Bearing Ratio (CBR) testing was performed on a sample of Soil Type 1 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:

Soil Type1 – Clayey Sand Fill

R @ 90% = 17.0
R @ 95% = 70.0
Use R = 50.0 for design

Classification Testing

| | |
|---|---|
| Liquid Limit | 31 |
| Plasticity Index | 18 |
| Percent Passing 200 | 22.5 |
| AASHTO Classification | A-2-6 |
| Group Index | 1 |
| Unified Soils Classification | SC |

**Pavement Design**

The CBR testing was used to determine pavement sections for this site. The pavement sections were determined utilizing the El Paso County "Pavement Design Criteria and Report". The following classifications and ESAL values were used for this portion of the filing. The cul-de-sac portion of Rolling Peaks Drive classifies as an urban local (low-volume) roadway, which used an 18k ESAL value of 36,500 for design. Rolling Peaks Drive, Parkland Drive, Rolling Mesa Drive, Cuatro Caminos Drive, and Evening Creek Drive classify as urban local roads, which used an 18K ESAL value of 292,000 for design. The roadway classifications are shown in Figure No. 1. Pavement alternatives for asphalt over aggregate basecourse and cement stabilized subgrade sections are provided. Full depth asphalt sections are not allowed, per El Paso County. Design parameters used in the pavement analysis are as follows:

| | |
|---|---|
| Reliability, Local Low Volume + Local | 80% |
| Serviceability Index, Local Low Volume + Local | 2.0 |
| Resilient Modulus | 13,168 psi |
| "R" Value Subgrade | 50.0 |
| **Structural Coefficients:** | |
| Hot Bituminous Pavement | 0.44 |
| Aggregate Base Course | 0.11 |
| Cement Stabilized Subgrade | 0.12 |

Pavement calculations are attached in Appendix C. Pavement sections recommended for this phase of the filing are summarized as follows:

**Pavement Sections – Soil Type 1**

Urban Local (low volume) – ESAL = 36,500

| Alternative | Asphalt (in) | Base Course (in) | Cement Stabilized Subgrade (in.) |
|---|---|---|---|
| 1. Asphalt + Base Course | 3.0* | 4.0* | -- |
| 2. Asphalt + Cement Subgrade | 4.0 | -- | 8.0 |

Urban Local – ESAL = 292,000

| Alternative | Asphalt (in) | Base Course (in) | Cement Stabilized Subgrade (in.) |
|---|---|---|---|
| 1. Asphalt + Base Course | 3.0* | 8.0* | -- |
| 2. Asphalt + Cement Subgrade | 4.0 | -- | 8.0 |

Full depth sections are not allowed.
* Minimum sections required by the El Paso County Pavement Design Criteria and Report.

**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. The Type 2 soils exhibited low swell potentials which did not exceed the threshold. Mitigation is not required.

**Roadway Construction - Asphalt on Aggregate Base Course Alternatives**

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

**Roadway Construction – Cement Stabilized Subgrade Alternative**

Prior to placement of the asphalt, the subgrade shall be stabilized by addition of cement to a depth of 8 inches, as determined by Roadway Classification. The depth of the required cement stabilized subgrade is shown in the previous table. The amount of cement applied shall be 2.0 percent (by weight) of the subgrade's maximum dry density as determined by the Modified Proctor Test (ASTM D-1557) based on laboratory cement stabilization testing. The cement should be spread evenly on the subgrade surface and be thoroughly mixed into the subgrade over the appropriate 8-inch depth such that a uniform blend of soil and cement is achieved. Prior to application or mixing of the cement, the upper 8 inches of subgrade should be thoroughly moisture conditioned to the soil's optimum water content or as much as 2 percent 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 percent of the subgrade maximum dry density as determined by the Modified Proctor Test (ASTM D-1557). 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 Soils Engineer. The Soils 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 will likely be required. Soil strengths in excess of 200 psi require microfracturing.

If significant grading is performed, the soils at subgrade may change. Modification to the pavement sections should be evaluated after site grading is completed.

In addition to the above guidance, the asphalt, cement, subgrade conditions, compaction of materials and roadway construction methods shall meet the El Paso County specifications.

We trust that this has provided you with the information you required. If you have any questions or need additional information, please do not hesitate to contact us.

Respectfully Submitted,

ENTECH ENGINEERING, INC.

Daniel P. Stegman

DPS/am
Encl.

Entech Job No. 210527
AAprojects/2021/210527 pr phase 2

Reviewed by:

Joseph C. Goodie, Jr., P.E.
President

COLORADO LICENSED
JOSEPH COLLIN GOODIE JR.
23725
PROFESSIONAL ENGINEER
2/10/22

# TABLE

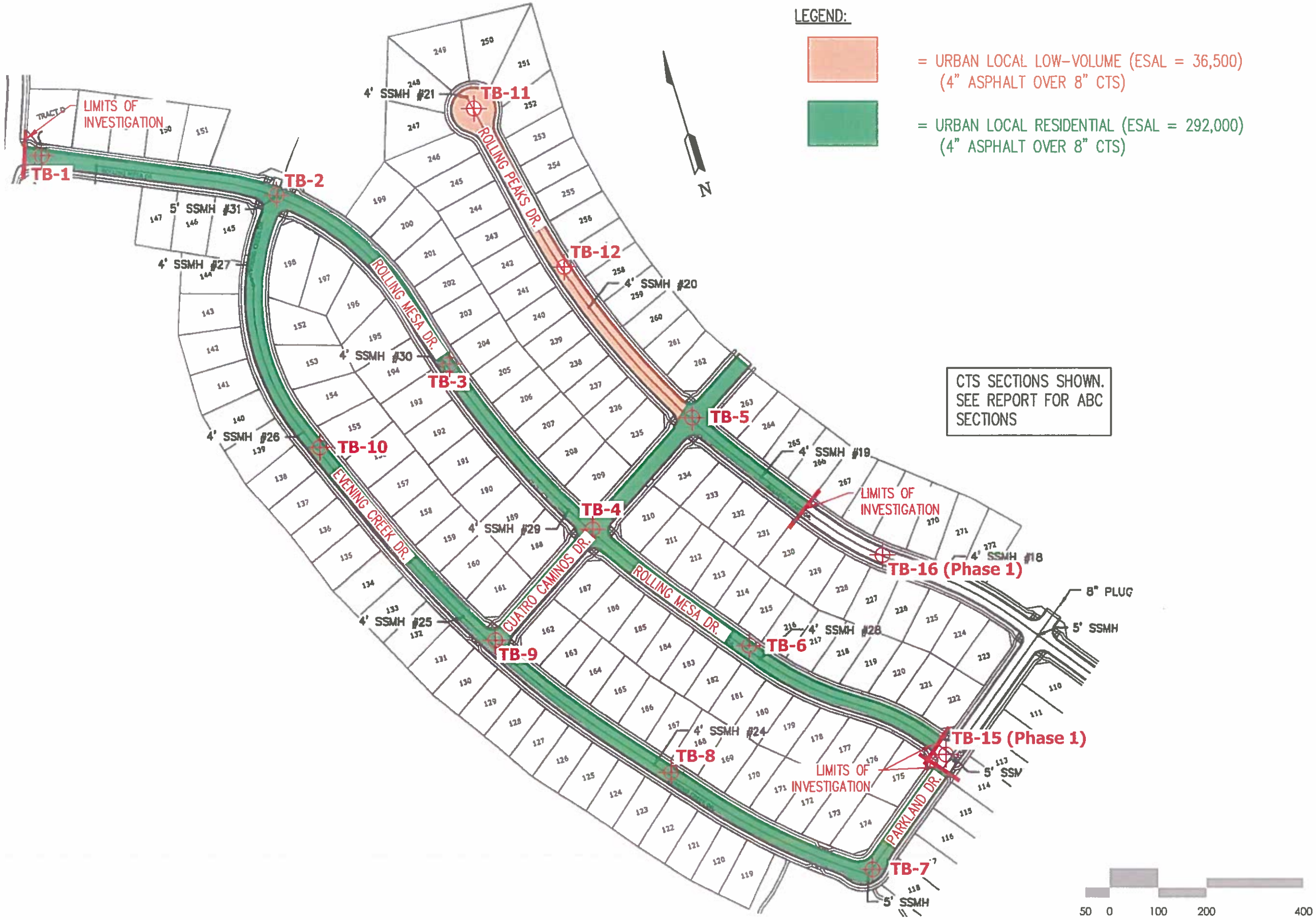
# TABLE 1

## SUMMARY OF LABORATORY TEST RESULTS

CLIENT TECH CONTRACTORS
PROJECT ROLLING HILLS, F-1, P-2
JOB NO. 210527

| SOIL TYPE | TEST BORING NO. | DEPTH (FT) | WATER (%) | DRY DENSITY (PCF) | PASSING NO. 200 SIEVE (%) | LIQUID LIMIT (%) | PLASTIC INDEX (%) | SULFATE (WT %) | AASHTO CLASS. | SWELL/ CONSOL (%) | UNIFIED CLASSIFICATION | SOIL DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1, CBR | 6 | 0-3 | 9.2 | 121.3 | 22.5 | 31 | 18 | | A-2-6 | 1.6 | SC | FILL, SAND, CLAYEY |
| 1 | 1 | 1-2 | 8.7 | 118.0 | 32.4 | 30 | 12 | | A-2-6 | 0.6 | SC | FILL, SAND, CLAYEY |
| 1 | 2 | 1-2 | | | 11.5 | NV | NP | <0.01 | A-1-b | | SM-SW | FILL, SAND, SLIGHTLY SILTY |
| 1 | 3 | 1-2 | | | 15.8 | NV | NP | | A-1-b | | SM | FILL, SAND, SILTY |
| 1 | 4 | 1-2 | | | 20.6 | NV | NP | | A-1-b | | SM | FILL, SAND, SILTY |
| 1 | 5 | 1-2 | | | 13.0 | NV | NP | <0.01 | A-1-b | | SM | FILL, SAND, SILTY |
| 1 | 6 | 1-2 | | | 17.8 | NV | NP | | A-1-b | | SM | FILL, SAND, SILTY |
| 1 | 7 | 1-2 | | | 19.4 | 26 | 8 | | A-2-4 | | SC | FILL, SAND, CLAYEY |
| 1 | 8 | 1-2 | | | 10.5 | NV | NP | | A-1-b | | SM-SW | FILL, SAND, SLIGHTLY SILTY |
| 1 | 9 | 1-2 | | | 16.9 | NV | NP | <0.01 | A-1-b | | SM | FILL, SAND, SILTY |
| 1 | 10 | 1-2 | | | 18.6 | NV | NP | | A-1-b | | SM | FILL, SAND, SILTY |
| 1 | 11 | 1-2 | | | 21.8 | 27 | 8 | | A-2-4 | | SC | SAND, CLAYEY |
| 1 | 12 | 1-2 | | | 23.2 | 30 | 10 | | A-2-4 | | SC | SAND, CLAYEY |
| 2 | 1 | 5 | 11.2 | 119.3 | 22.0 | 48 | 27 | 0.01 | A-2-7 | 0.1 | SC | SAND, CLAYEY |
| 2 | 4 | 10 | 7.0 | 122.1 | 34.1 | 49 | 30 | | A-2-7 | 0.1 | SC | SAND, CLAYEY |
| 2 | 8 | 10 | | | 11.4 | NV | NP | <0.01 | A-1-b | | SM-SW | SAND, SLIGHTLY SILTY |
| 3 | 1 | 10 | | | 10.6 | NV | NP | <0.01 | A-1-b | | SM-SW | SANDSTONE, SLIGHTLY SILTY |

FIGURE




TB- APPROXIMATE TEST BORING LOCATIONS AND NUMBERS

| REVISION | BY |
|---|---|
| | |

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TEST BORING LOCATION MAP
ROLLING HILLS RANCH, F1, PH2
EL PASO COUNTY, COLORADO
FOR: TECH CONTRACTORS

| | |
|---|---|
| DRWN | ZAC |
| CHECKED | DPS |
| DATE | 07/15/21 |
| SCALE | 1" = 200' |
| JOB NO. | 210527 |
| FIGURE No. | 1 |

# APPENDIX A: Test Boring Logs

TEST BORING NO. 1
DATE DRILLED 6/4/2021
Job # 210527

REMARKS

DRY TO 10', 6/4/21

| Depth (ft) | Symbol | Samples | Blows per foot | Watercontent % | Soil Type |
|---|---|---|---|---|---|
| | | | | | |
| FILL 0-4', SAND, CLAYEY, FINE TO MEDIUM GRAINED, BROWN, MEDIUM DENSE, MOIST | | | 29 | 6.1 | 1 |
| 5 | | | 47 | 9.0 | 2 |
| SAND, CLAYEY, FINE TO MEDIUM GRAINED, TAN, DENSE, MOIST | | | | | |
| SANDSTONE, SLIGHTLY SILTY, FINE TO COARSE GRAINED, TAN, VERY DENSE, MOIST | | | | | |
| 10 | | | 50/8" | 5.2 | 3 |
| 15 | | | | | |
| 20 | | | | | |

TEST BORING NO. 2
DATE DRILLED 6/10/2021
CLIENT TECH CONTRACTORS
LOCATION ROLLING HILLS, F-1, P-2

REMARKS

DRY TO 5', 6/10/21

| Depth (ft) | Symbol | Samples | Blows per foot | Watercontent % | Soil Type |
|---|---|---|---|---|---|
| | | | | | |
| FILL 0-5', SAND, SLIGHTLY SILTY, FINE TO COARSE GRAINED, BROWN, MEDIUM DENSE, DRY TO MOIST | | | 15 | 1.8 | 1 |
| 5 | | | 27 | 5.9 | 1 |
| 10 | | | | | |
| 15 | | | | | |
| 20 | | | | | |

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TEST BORING LOG

| DRAWN: | DATE: | CHECKED: | DATE: |
|---|---|---|---|
| | | | 7/8/21 |

JOB NO: 210527
FIG NO: A- 1

TEST BORING NO. 3
DATE DRILLED 6/10/2021
Job # 210527

REMARKS

DRY TO 5', 6/10/21

| Depth (ft) | Symbol | Samples | Blows per foot | Watercontent % | Soil Type | |
|---|---|---|---|---|---|---|
| | | | 15 | 5.4 | 1 | FILL 0-5', SAND, SILTY, FINE TO COARSE GRAINED, BROWN, MEDIUM DENSE, MOIST |
| 5 | | | 12 | 5.0 | 1 | |
| 10 | | | | | | |
| 15 | | | | | | |
| 20 | | | | | | |

TEST BORING NO. 4
DATE DRILLED 6/10/2021
CLIENT TECH CONTRACTORS
LOCATION ROLLING HILLS, F-1, P-2

REMARKS

DRY TO 10', 6/10/21

| Depth (ft) | Symbol | Samples | Blows per foot | Watercontent % | Soil Type | |
|---|---|---|---|---|---|---|
| | | | 7 | 9.6 | 1 | FILL 0-8', SAND, SILTY, FINE TO COARSE GRAINED, BROWN, LOOSE, MOIST |
| 5 | | | 5 | 9.9 | 1 | |
| 10 | | | 29 | 11.7 | 2 | SAND, CLAYEY, FINE TO MEDIUM GRAINED, TAN, MEDIUM DENSE, MOIST |
| 15 | | | | | | |
| 20 | | | | | | |

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**TEST BORING LOG**

| DRAWN: | DATE: | CHECKED: | DATE: |
|---|---|---|---|
| | | | 7/8/21 |

JOB NO. 210527
FIG NO. A- 2

TEST BORING NO. 5
DATE DRILLED 6/10/2021
Job # 210527

REMARKS

DRY TO 5', 6/10/21

FILL 0-5', SAND, SILTY, FINE TO COARSE GRAINED, BROWN, LOOSE TO MEDIUM DENSE, MOIST

| Depth (ft) | Symbol | Samples | Blows per foot | Watercontent % | Soil Type |
|---|---|---|---|---|---|
| | | | 8 | 10.8 | 1 |
| 5 | | | 12 | 6.5 | 1 |
| 10 | | | | | |
| 15 | | | | | |
| 20 | | | | | |

TEST BORING NO. 6
DATE DRILLED 6/10/2021
CLIENT TECH CONTRACTORS
LOCATION ROLLING HILLS, F-1, P-2

REMARKS

DRY TO 5', 6/10/21

FILL 0-5', SAND, SILTY, FINE TO COARSE GRAINED, BROWN, MEDIUM DENSE TO LOOSE, MOIST

| Depth (ft) | Symbol | Samples | Blows per foot | Watercontent % | Soil Type |
|---|---|---|---|---|---|
| | | | 12 | 5.7 | 1 |
| 5 | | | 7 | 5.2 | 1 |
| 10 | | | | | |
| 15 | | | | | |
| 20 | | | | | |

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TEST BORING LOG

| DRAWN: | DATE | CHECKED: | DATE: 7/6/21 |
|---|---|---|---|

JOB NO. 210527
FIG NO. A- 3

TEST BORING NO. 7
DATE DRILLED 6/10/2021
Job # 210527

REMARKS

DRY TO 5', 6/10/21

| Depth (ft) | Symbol | Samples | Blows per foot | Watercontent % | Soil Type |
|---|---|---|---|---|---|
| | | | | | |
| | | | 10 | 7.3 | 1 |
| 5 | | | 11 | 6.0 | 1 |
| 10 | | | | | |
| 15 | | | | | |
| 20 | | | | | |

FILL 0-5', SAND, CLAYEY, FINE GRAINED, BROWN, MEDIUM DENSE, MOIST

TEST BORING NO. 8
DATE DRILLED 6/10/2021
CLIENT TECH CONTRACTORS
LOCATION ROLLING HILLS, F-1, P-2

REMARKS

DRY TO 10', 6/10/21

| Depth (ft) | Symbol | Samples | Blows per foot | Watercontent % | Soil Type |
|---|---|---|---|---|---|
| | | | 15 | 5.5 | 1 |
| 5 | | | 11 | 6.2 | 1 |
| 10 | | | 46 | 8.1 | 2 |
| 15 | | | | | |
| 20 | | | | | |

FILL 0-9', SAND, SILTY, FINE TO COARSE GRAINED, BROWN, MEDIUM DENSE, MOIST

SAND, SLIGHTLY SILTY, FINE TO COARSE GRAINED, TAN, DENSE, MOIST

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**TEST BORING LOG**

| DRAWN: | DATE: | CHECKED: | DATE: |
|---|---|---|---|
| | | | 7/8/21 |

JOB NO. 210527
FIG NO. A- 4

TEST BORING NO. 9
DATE DRILLED 6/10/2021
Job # 210527

REMARKS

DRY TO 5', 6/10/21

| Depth (ft) | Symbol | Samples | Blows per foot | Watercontent % | Soil Type |
|---|---|---|---|---|---|
| | FILL 0-5', SAND, SILTY, FINE TO COARSE GRAINED, BROWN, LOOSE, MOIST | | 7 | 8.2 | 1 |
| 5 | | | 6 | 12.8 | 1 |
| 10 | | | | | |
| 15 | | | | | |
| 20 | | | | | |

TEST BORING NO. 10
DATE DRILLED 6/10/2021
CLIENT TECH CONTRACTORS
LOCATION ROLLING HILLS, F-1, P-2

REMARKS

DRY TO 10', 6/10/21

| Depth (ft) | Symbol | Samples | Blows per foot | Watercontent % | Soil Type |
|---|---|---|---|---|---|
| | FILL 0-10', SAND, SILTY, FINE TO COARSE GRAINED, BROWN, MEDIUM DENSE, MOIST | | 14 | 7.1 | 1 |
| 5 | | | 27 | 7.6 | 1 |
| 10 | | | 11 | 6.3 | 1 |
| 15 | | | | | |
| 20 | | | | | |

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**TEST BORING LOG**

| DRAWN: | DATE: | CHECKED: | DATE: |
|---|---|---|---|
| | | | 7/8/21 |

JOB NO.: 210527
FIG NO.: A- 5

TEST BORING NO. 11
DATE DRILLED 7/15/2021
Job # 210527

REMARKS

DRY TO 10', 7/15/21

| Depth (ft) | Symbol | Samples | Blows per foot | Watercontent % | Soil Type | |
|---|---|---|---|---|---|---|
| | | | | | | FILL 0-10', SAND, CLAYEY, FINE TO MEDIUM GRAINED, BROWN, MEDIUM DENSE TO DENSE, MOIST |
| | | | 12 | 7.9 | 1 | |
| 5 | | | 42 | 6.8 | 1 | |
| 10 | | | 12 | 8.0 | 1 | |
| 15 | | | | | | |
| 20 | | | | | | |

TEST BORING NO. 12
DATE DRILLED 7/15/2021
CLIENT TECH CONTRACTORS
LOCATION ROLLING HILLS, F-1, P-2

REMARKS

DRY TO 5', 7/15/21

| Depth (ft) | Symbol | Samples | Blows per foot | Watercontent % | Soil Type | |
|---|---|---|---|---|---|---|
| | | | | | | FILL 0-5', SAND, CLAYEY, FINE TO MEDIUM GRAINED, BROWN, MEDIUM DENSE TO LOOSE, MOIST |
| | | | 14 | 6.3 | 1 | |
| 5 | | | 8 | 5.2 | 1 | |
| 10 | | | | | | |
| 15 | | | | | | |
| 20 | | | | | | |

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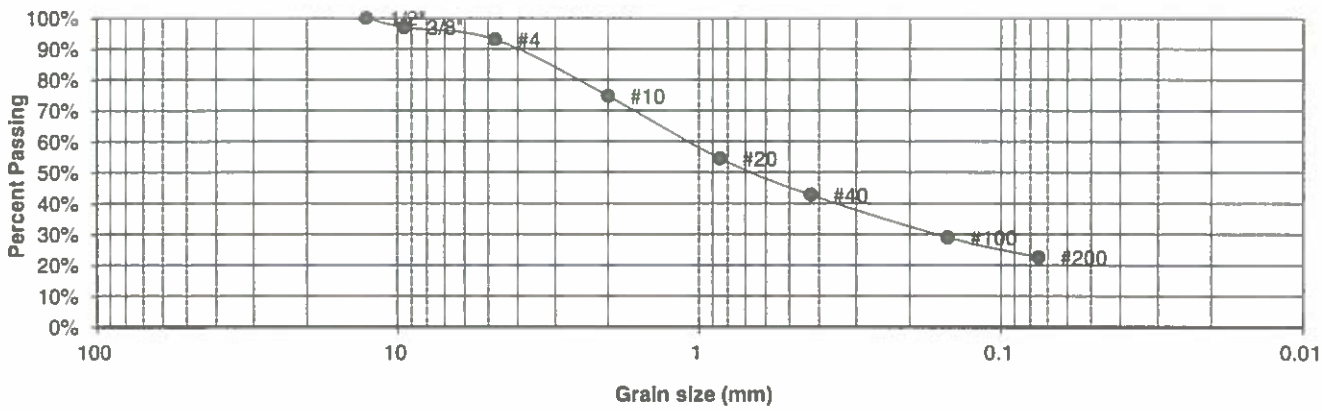
**TEST BORING LOG**

| DRAWN: | DATE: | CHECKED: | DATE: |
|---|---|---|---|
| | | | |

JOB NO.: 210527
FIG NO.: A- 6

# APPENDIX B: Laboratory Test Results

| | | | |
|---|---|---|---|
| UNIFIED CLASSIFICATION | SC | CLIENT | TECH CONTRACTORS |
| SOIL TYPE # | 1, CBR | PROJECT | ROLLING HILLS, F-1, P-2 |
| TEST BORING # | 6 | JOB NO. | 210527 |
| DEPTH (FT) | 0-3 | TEST BY | BL |
| AASHTO CLASSIFICATION | A-2-6 | GROUP INDEX | 1 |




| U.S. Sieve # | Percent Finer |
|---|---|
| 3" | |
| 1 1/2" | |
| 3/4" | |
| 1/2" | 100.0% |
| 3/8" | 97.0% |
| 4 | 93.0% |
| 10 | 74.7% |
| 20 | 54.5% |
| 40 | 42.7% |
| 100 | 29.0% |
| 200 | 22.5% |

| Atterberg Limits | |
|---|---|
| Plastic Limit | 13 |
| Liquid Limit | 31 |
| Plastic Index | 18 |

| Swell | |
|---|---|
| Moisture at start | |
| Moisture at finish | |
| Moisture increase | |
| Initial dry density (pcf) | |
| Swell (psf) | |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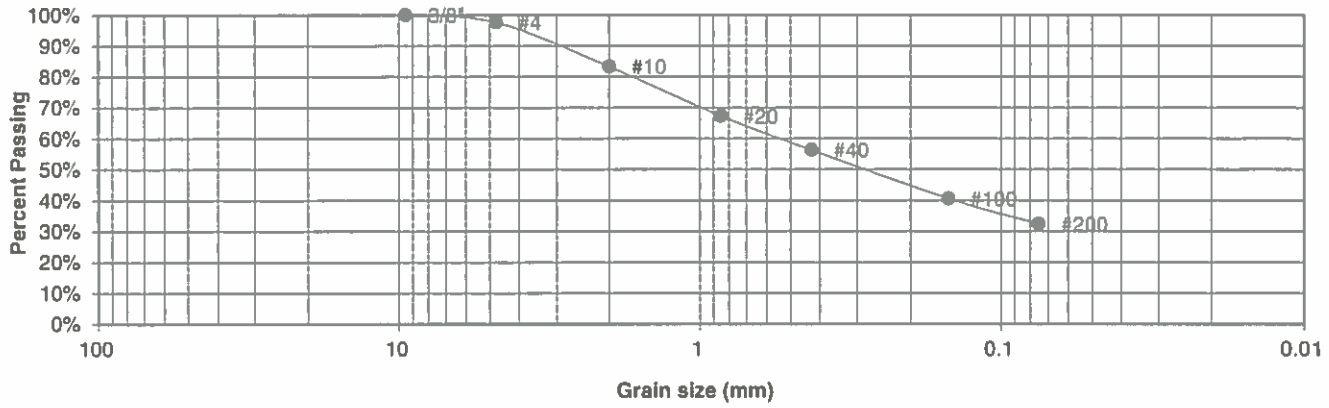
LABORATORY TEST RESULTS

| DRAWN: | DATE: | CHECKED | DATE: |
|---|---|---|---|
| | | | 7/8/21 |

JOB NO.: 210527
FIG NO.: B-1

| | | | |
|---|---|---|---|
| UNIFIED CLASSIFICATION | SC | CLIENT | TECH CONTRACTORS |
| SOIL TYPE # | 1 | PROJECT | ROLLING HILLS, F-1, P-2 |
| TEST BORING # | 1 | JOB NO. | 210527 |
| DEPTH (FT) | 1-2 | TEST BY | BL |
| AASHTO CLASSIFICATION | A-2-6 | GROUP INDEX | 0 |

**Sieve Analysis**
**Grain Size Distribution**




| U.S. Sieve # | Percent Finer |
|---|---|
| 3" | |
| 1 1/2" | |
| 3/4" | |
| 1/2" | |
| 3/8" | 100.0% |
| 4 | 97.6% |
| 10 | 83.3% |
| 20 | 67.3% |
| 40 | 56.3% |
| 100 | 40.6% |
| 200 | 32.4% |

| Atterberg Limits | |
|---|---|
| Plastic Limit | 18 |
| Liquid Limit | 30 |
| Plastic Index | 12 |

| Swell | |
|---|---|
| Moisture at start | |
| Moisture at finish | |
| Moisture increase | |
| Initial dry density (pcf) | |
| Swell (psf) | |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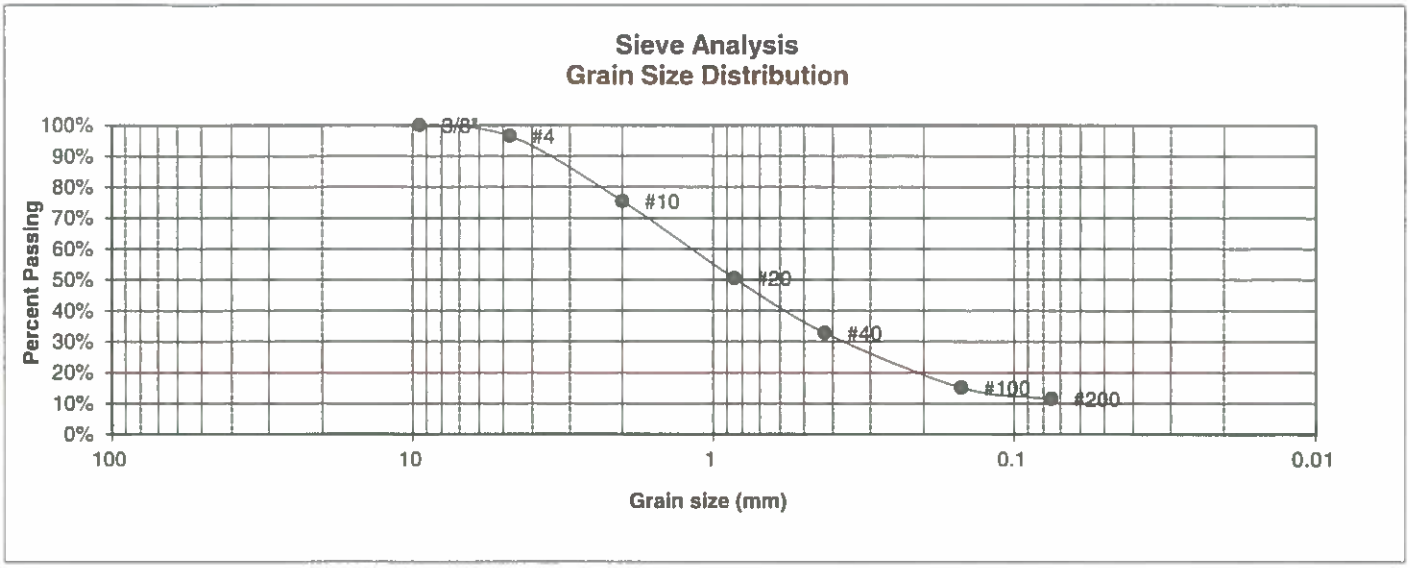
LABORATORY TEST RESULTS

| DRAWN | DATE | CHECKED | DATE |
|---|---|---|---|
| | | L | 7/8/21 |

JOB NO.: 210527
FIG NO.: B-2

| | | | |
|---|---|---|---|
| UNIFIED CLASSIFICATION | SM-SW | CLIENT | TECH CONTRACTORS |
| SOIL TYPE # | 1 | PROJECT | ROLLING HILLS, F-1, P-2 |
| TEST BORING # | 2 | JOB NO. | 210527 |
| DEPTH (FT) | 1-2 | TEST BY | BL |
| AASHTO CLASSIFICATION | A-1-b | GROUP INDEX | 0 |




| U.S. Sieve # | Percent Finer |
|---|---|
| 3" | |
| 1 1/2" | |
| 3/4" | |
| 1/2" | |
| 3/8" | 100.0% |
| 4 | 96.6% |
| 10 | 75.4% |
| 20 | 50.5% |
| 40 | 32.8% |
| 100 | 15.1% |
| 200 | 11.5% |

Atterberg Limits

| | |
|---|---|
| Plastic Limit | NP |
| Liquid Limit | NV |
| Plastic Index | NP |

Swell

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


**ENTECH ENGINEERING, INC.**
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

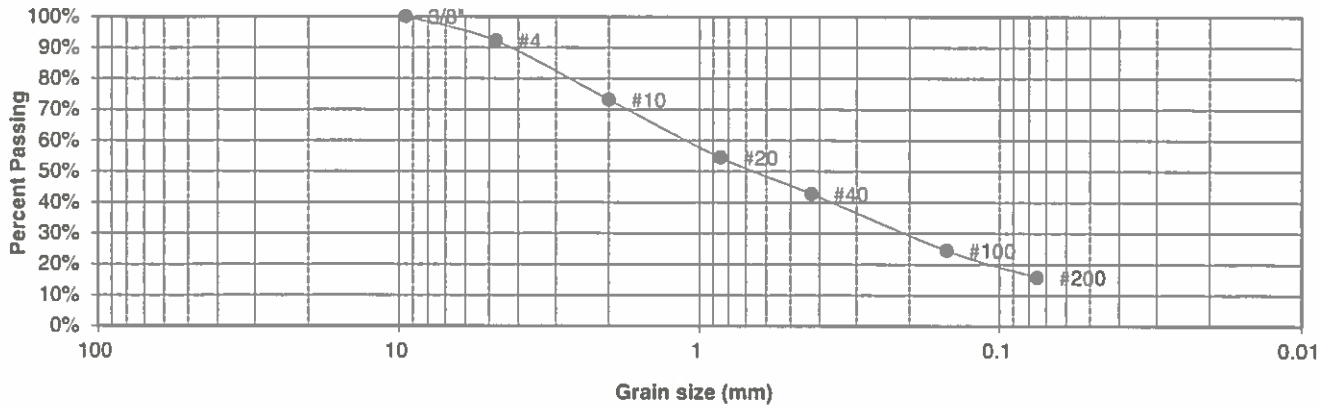

LABORATORY TEST RESULTS

| DRAWN: | DATE: | CHECKED: | DATE: 7/8/21 |
|---|---|---|---|

JOB NO. 210527
FIG NO. B-3

| | | | |
|---|---|---|---|
| UNIFIED CLASSIFICATION | SM | CLIENT | TECH CONTRACTORS |
| SOIL TYPE # | 1 | PROJECT | ROLLING HILLS, F-1, P-2 |
| TEST BORING # | 3 | JOB NO. | 210527 |
| DEPTH (FT) | 1-2 | TEST BY | BL |
| AASHTO CLASSIFICATION | A-1-b | GROUP INDEX | 0 |

**Sieve Analysis**
**Grain Size Distribution**




| U.S. Sieve # | Percent Finer |
|---|---|
| 3" | |
| 1 1/2" | |
| 3/4" | |
| 1/2" | |
| 3/8" | 100.0% |
| 4 | 92.2% |
| 10 | 73.2% |
| 20 | 54.4% |
| 40 | 42.8% |
| 100 | 24.5% |
| 200 | 15.8% |

Atterberg Limits

| | |
|---|---|
| Plastic Limit | NP |
| Liquid Limit | NV |
| Plastic Index | NP |

Swell

Moisture at start

Moisture at finish

Moisture increase

Initial dry density (pcf)

Swell (psf)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**ENGINEERING, INC.**
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

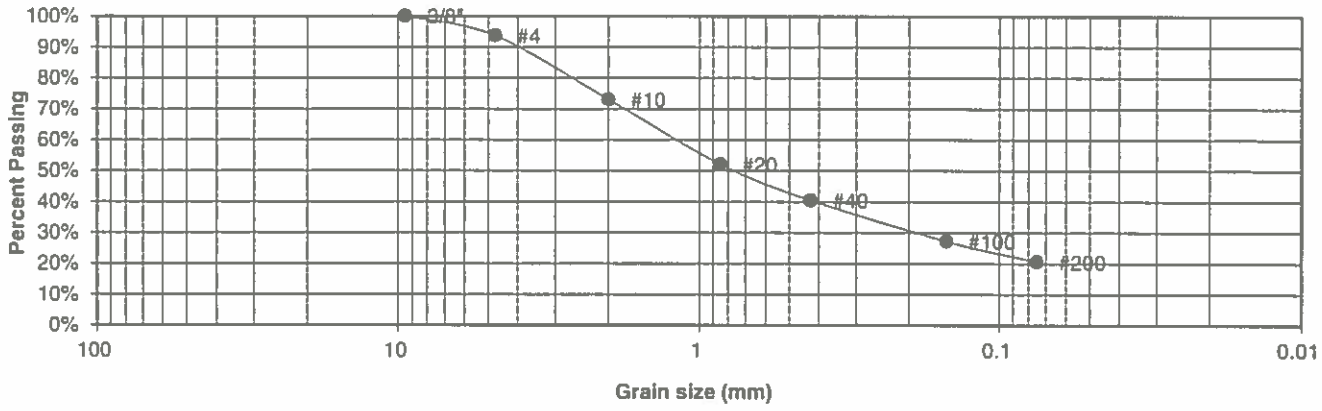

LABORATORY TEST RESULTS

| DRAWN: | DATE: | CHECKED: | DATE: |
|---|---|---|---|
| | | | 7/8/21 |

JOB NO.: 210527
FIG NO.: B-4

| | | | |
|---|---|---|---|
| UNIFIED CLASSIFICATION | SM | CLIENT | TECH CONTRACTORS |
| SOIL TYPE # | 1 | PROJECT | ROLLING HILLS, F-1, P-2 |
| TEST BORING # | 4 | JOB NO. | 210527 |
| DEPTH (FT) | 1-2 | TEST BY | BL |
| AASHTO CLASSIFICATION | A-1-b | GROUP INDEX | 0 |

**Sieve Analysis**
**Grain Size Distribution**




| U.S. Sieve # | Percent Finer |
|---|---|
| 3" | |
| 1 1/2" | |
| 3/4" | |
| 1/2" | |
| 3/8" | 100.0% |
| 4 | 93.7% |
| 10 | 73.1% |
| 20 | 52.1% |
| 40 | 40.5% |
| 100 | 27.3% |
| 200 | 20.6% |

Atterberg Limits

| | |
|---|---|
| Plastic Limit | NP |
| Liquid Limit | NV |
| Plastic Index | NP |

Swell

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


**ENTECH ENGINEERING, INC.**
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

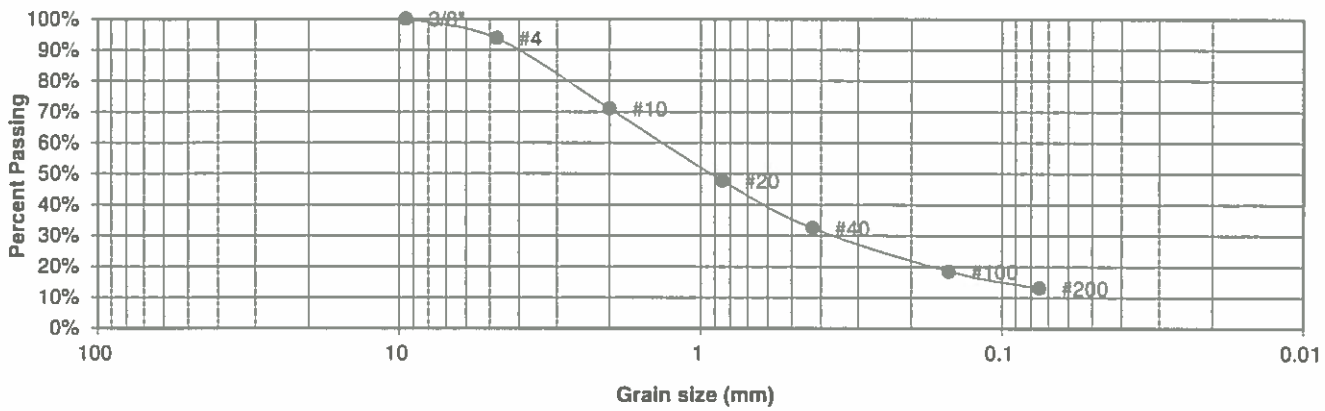

LABORATORY TEST RESULTS

| DRAWN: | DATE: | CHECKED: | DATE: |
|---|---|---|---|
| | | | 7/22/21 |

JOB NO.: 210527
FIG NO.: B-5

| | | | |
|---|---|---|---|
| UNIFIED CLASSIFICATION | SM | CLIENT | TECH CONTRACTORS |
| SOIL TYPE # | 1 | PROJECT | ROLLING HILLS, F-1, P-2 |
| TEST BORING # | 5 | JOB NO. | 210527 |
| DEPTH (FT) | 1-2 | TEST BY | BL |
| AASHTO CLASSIFICATION | A-1-b | GROUP INDEX | 0 |

**Sieve Analysis**
**Grain Size Distribution**




| U.S. Sieve # | Percent Finer |
|---|---|
| 3" | |
| 1 1/2" | |
| 3/4" | |
| 1/2" | |
| 3/8" | 100.0% |
| 4 | 93.8% |
| 10 | 71.0% |
| 20 | 47.7% |
| 40 | 32.4% |
| 100 | 18.5% |
| 200 | 13.0% |

Atterberg Limits

| | |
|---|---|
| Plastic Limit | NP |
| Liquid Limit | NV |
| Plastic Index | NP |

Swell

Moisture at start

Moisture at finish

Moisture increase

Initial dry density (pcf)

Swell (psf)


**ENTECH ENGINEERING, INC.**
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

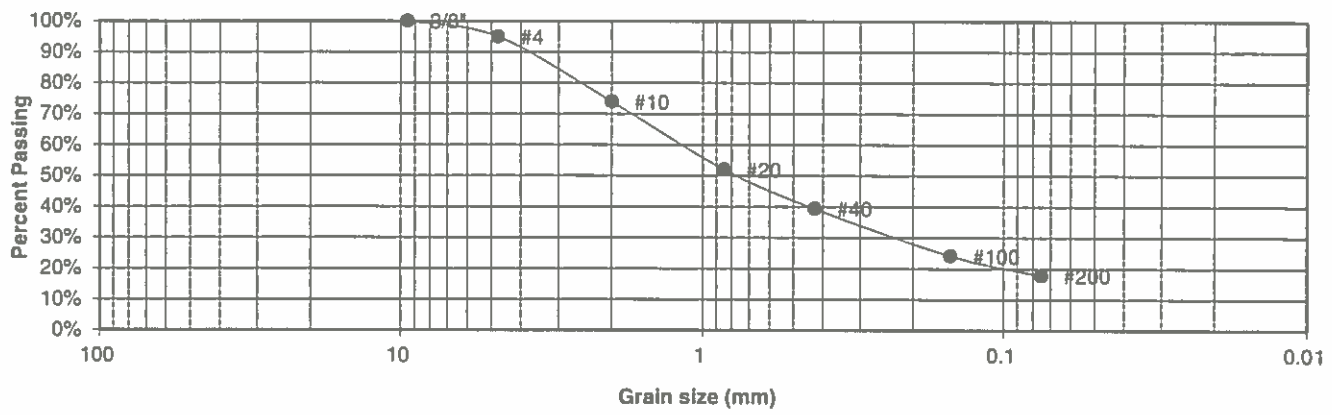

LABORATORY TEST RESULTS

| DRAWN: | DATE: | CHECKED: | DATE: |
|---|---|---|---|
| | | | 7/8/21 |

JOB NO.: 210527
FIG NO.: B-L

| | | | |
|---|---|---|---|
| UNIFIED CLASSIFICATION | SM | CLIENT | TECH CONTRACTORS |
| SOIL TYPE # | 1 | PROJECT | ROLLING HILLS, F-1, P-2 |
| TEST BORING # | 6 | JOB NO. | 210527 |
| DEPTH (FT) | 1-2 | TEST BY | BL |
| AASHTO CLASSIFICATION | A-1-b | GROUP INDEX | 0 |

**Sieve Analysis**
**Grain Size Distribution**




| U.S. Sieve # | Percent Finer |
|---|---|
| 3" | |
| 1 1/2" | |
| 3/4" | |
| 1/2" | |
| 3/8" | 100.0% |
| 4 | 95.0% |
| 10 | 73.9% |
| 20 | 52.0% |
| 40 | 39.4% |
| 100 | 24.1% |
| 200 | 17.8% |

Atterberg Limits

| | |
|---|---|
| Plastic Limit | NP |
| Liquid Limit | NV |
| Plastic Index | NP |

Swell

| | |
|---|---|
| Moisture at start | |
| Moisture at finish | |
| Moisture increase | |
| Initial dry density (pcf) | |
| Swell (psf) | |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505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

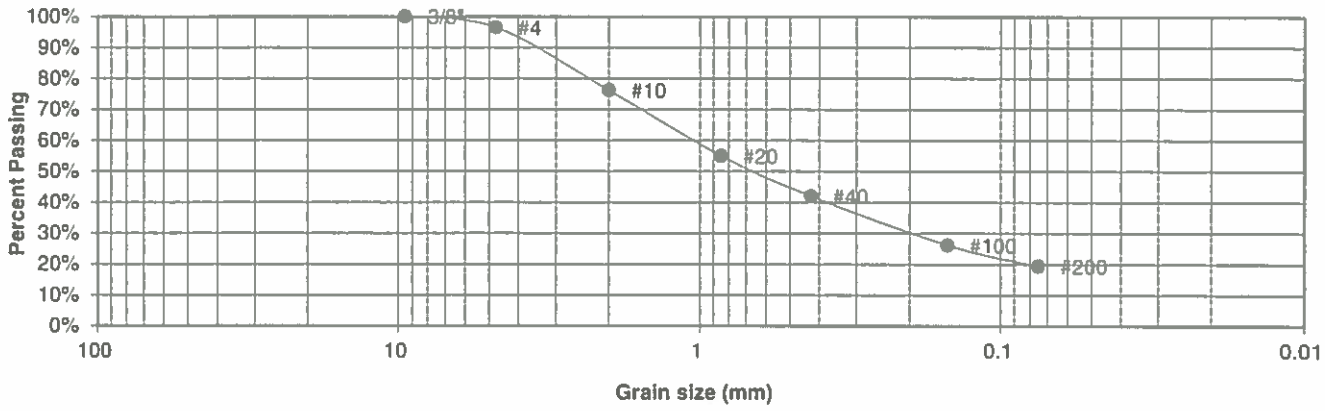

LABORATORY TEST RESULTS

| DRAWN: | DATE: | CHECKED: | DATE: |
|---|---|---|---|
| | | | 7/8/21 |

JOB NO.: 210527
FIG NO.: B-7

| | | | |
|---|---|---|---|
| UNIFIED CLASSIFICATION | SC | CLIENT | TECH CONTRACTORS |
| SOIL TYPE # | 1 | PROJECT | ROLLING HILLS, F-1, P-2 |
| TEST BORING # | 7 | JOB NO. | 210527 |
| DEPTH (FT) | 1-2 | TEST BY | BL |
| AASHTO CLASSIFICATION | A-2-4 | GROUP INDEX | 0 |

**Sieve Analysis**
**Grain Size Distribution**




| U.S. Sieve # | Percent Finer |
|---|---|
| 3" | |
| 1 1/2" | |
| 3/4" | |
| 1/2" | |
| 3/8" | 100.0% |
| 4 | 96.5% |
| 10 | 76.2% |
| 20 | 55.0% |
| 40 | 42.0% |
| 100 | 26.2% |
| 200 | 19.4% |

| Atterberg Limits | |
|---|---|
| Plastic Limit | 18 |
| Liquid Limit | 26 |
| Plastic Index | 8 |

| Swell | |
|---|---|
| Moisture at start | |
| Moisture at finish | |
| Moisture increase | |
| Initial dry density (pcf) | |
| Swell (psf) | |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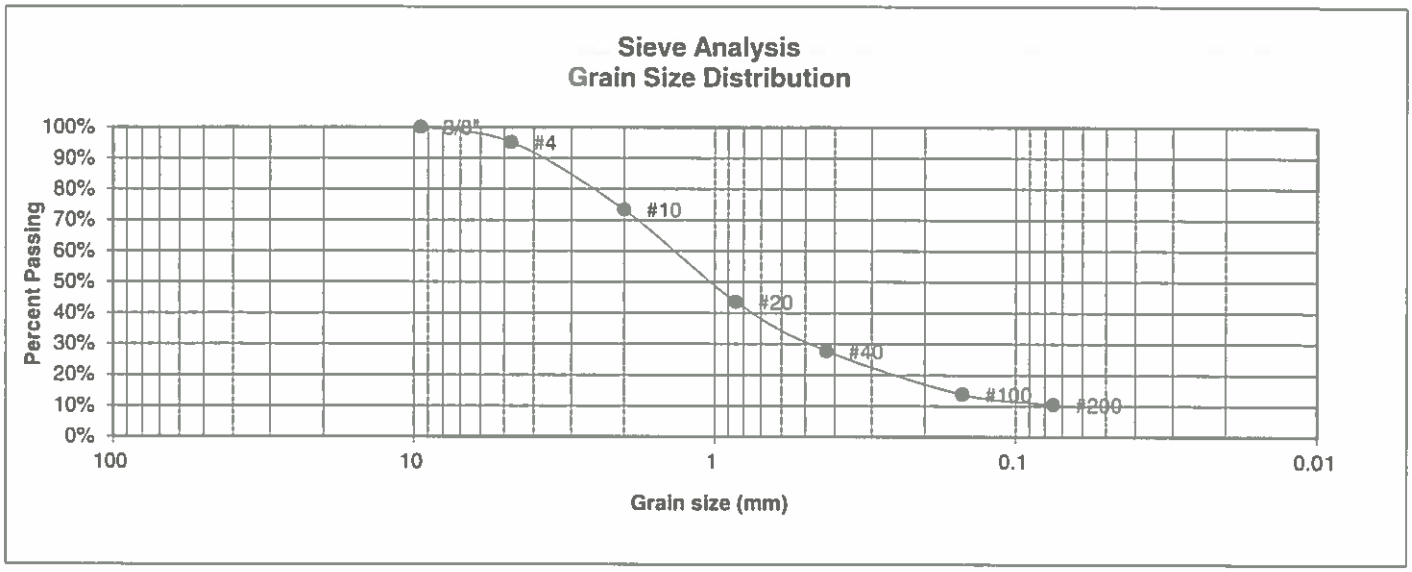
LABORATORY TEST RESULTS

| DRAWN: | DATE: | CHECKED: | DATE: 7/8/21 |
|---|---|---|---|

JOB NO. 210527
FIG NO. B-8

| | | | |
|---|---|---|---|
| UNIFIED CLASSIFICATION | SM-SW | CLIENT | TECH CONTRACTORS |
| SOIL TYPE # | 1 | PROJECT | ROLLING HILLS, F-1, P-2 |
| TEST BORING # | 8 | JOB NO. | 210527 |
| DEPTH (FT) | 1-2 | TEST BY | BL |
| AASHTO CLASSIFICATION | A-1-b | GROUP INDEX | 0 |




| U.S. Sieve # | Percent Finer |
|---|---|
| 3" | |
| 1 1/2" | |
| 3/4" | |
| 1/2" | |
| 3/8" | 100.0% |
| 4 | 95.1% |
| 10 | 73.3% |
| 20 | 43.6% |
| 40 | 27.7% |
| 100 | 13.8% |
| 200 | 10.5% |

Atterberg Limits

| | |
|---|---|
| Plastic Limit | NP |
| Liquid Limit | NV |
| Plastic Index | NP |

Swell

Moisture at start

Moisture at finish

Moisture increase

Initial dry density (pcf)

Swell (psf)


**ENTECH ENGINEERING, INC.**
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907


LABORATORY TEST RESULTS

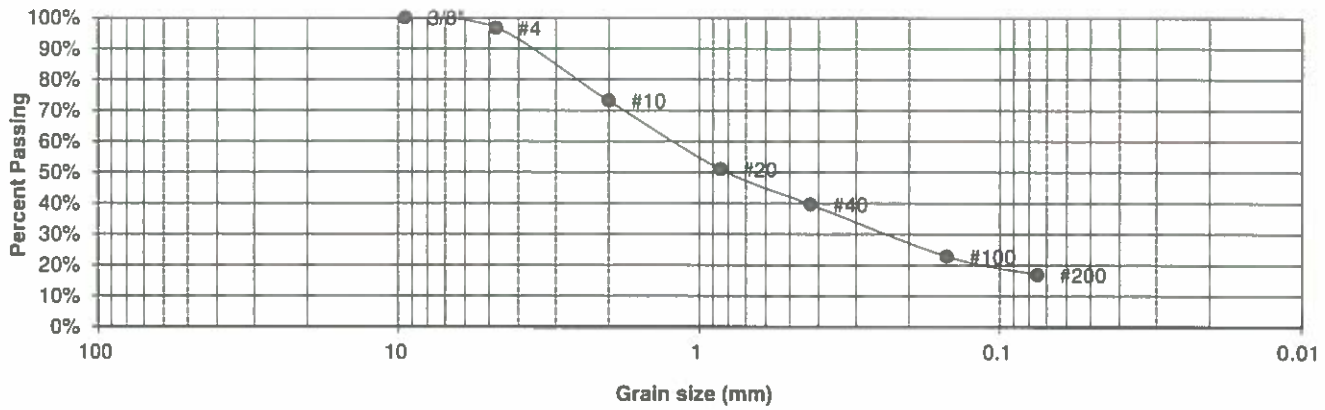
| DRAWN: | DATE: | CHECKED: | DATE: 7/8/21 |
|---|---|---|---|

JOB NO.: 210527

FIG NO.: B-9

| | | | |
|---|---|---|---|
| UNIFIED CLASSIFICATION | SM | CLIENT | TECH CONTRACTORS |
| SOIL TYPE # | 1 | PROJECT | ROLLING HILLS, F-1, P-2 |
| TEST BORING # | 9 | JOB NO. | 210527 |
| DEPTH (FT) | 1-2 | TEST BY | BL |
| AASHTO CLASSIFICATION | A-1-b | GROUP INDEX | 0 |

**Sieve Analysis**
**Grain Size Distribution**




| U.S. Sieve # | Percent Finer |
|---|---|
| 3" | |
| 1 1/2" | |
| 3/4" | |
| 1/2" | |
| 3/8" | 100.0% |
| 4 | 96.7% |
| 10 | 73.1% |
| 20 | 51.0% |
| 40 | 39.6% |
| 100 | 22.8% |
| 200 | 16.9% |

Atterberg Limits

| | |
|---|---|
| Plastic Limit | NP |
| Liquid Limit | NV |
| Plastic Index | NP |

Swell

| | |
|---|---|
| Moisture at start | |
| Moisture at finish | |
| Moisture increase | |
| Initial dry density (pcf) | |
| Swell (psf) | |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505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

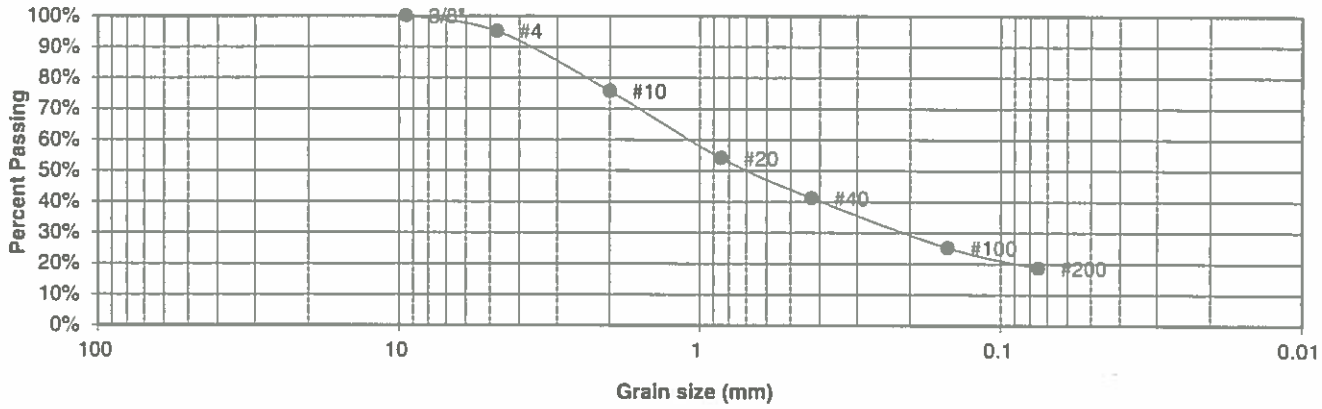

LABORATORY TEST RESULTS

| DRAWN | DATE | CHECKED | DATE |
|---|---|---|---|
| | | | 7/8/21 |

JOB NO.: 210527
FIG NO.: B-15

| | | | |
|---|---|---|---|
| UNIFIED CLASSIFICATION | SM | CLIENT | TECH CONTRACTORS |
| SOIL TYPE # | 1 | PROJECT | ROLLING HILLS, F-1, P-2 |
| TEST BORING # | 10 | JOB NO. | 210527 |
| DEPTH (FT) | 1-2 | TEST BY | BL |
| AASHTO CLASSIFICATION | A-1-b | GROUP INDEX | 0 |

**Sieve Analysis**
**Grain Size Distribution**




| U.S. Sieve # | Percent Finer |
|---|---|
| 3" | |
| 1 1/2" | |
| 3/4" | |
| 1/2" | |
| 3/8" | 100.0% |
| 4 | 95.1% |
| 10 | 75.7% |
| 20 | 54.1% |
| 40 | 41.2% |
| 100 | 25.2% |
| 200 | 18.6% |

Atterberg Limits

| | |
|---|---|
| Plastic Limit | NP |
| Liquid Limit | NV |
| Plastic Index | NP |

Swell

| | |
|---|---|
| Moisture at start | |
| Moisture at finish | |
| Moisture increase | |
| Initial dry density (pcf) | |
| Swell (psf) | |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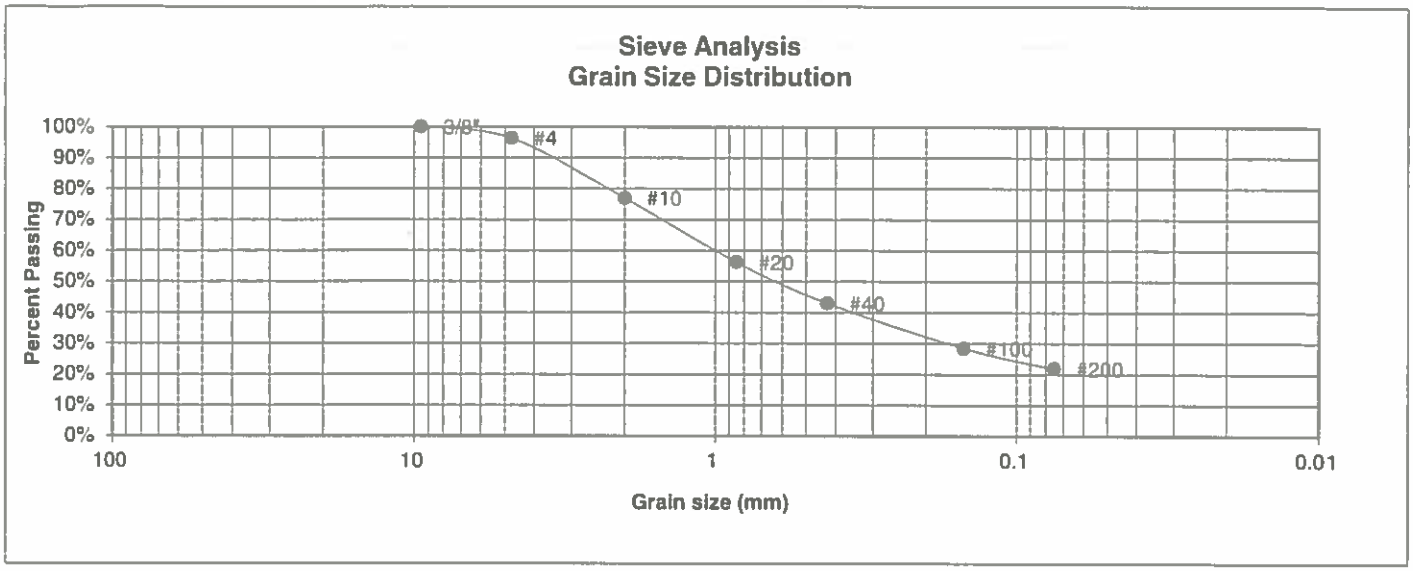
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907


LABORATORY TEST RESULTS

| DRAWN: | DATE: | CHECKED: | DATE: |
|---|---|---|---|
| | | | 7/8/21 |

JOB NO.: 210527
FIG NO.: B-11

| | | | |
|---|---|---|---|
| UNIFIED CLASSIFICATION | SC | CLIENT | TECH CONTRACTORS |
| SOIL TYPE # | 1 | PROJECT | ROLLING HILLS, F-1, P-2 |
| TEST BORING # | 11 | JOB NO. | 210527 |
| DEPTH (FT) | 1-2 | TEST BY | BL |
| AASHTO CLASSIFICATION | A-2-4 | GROUP INDEX | 0 |




| U.S. Sieve # | Percent Finer |
|---|---|
| 3" | |
| 1 1/2" | |
| 3/4" | |
| 1/2" | |
| 3/8" | 100.0% |
| 4 | 96.3% |
| 10 | 77.0% |
| 20 | 56.3% |
| 40 | 43.0% |
| 100 | 28.4% |
| 200 | 21.8% |

| Atterberg Limits | |
|---|---|
| Plastic Limit | 19 |
| Liquid Limit | 27 |
| Plastic Index | 8 |

| Swell | |
|---|---|
| Moisture at start | |
| Moisture at finish | |
| Moisture increase | |
| Initial dry density (pcf) | |
| Swell (psf) | |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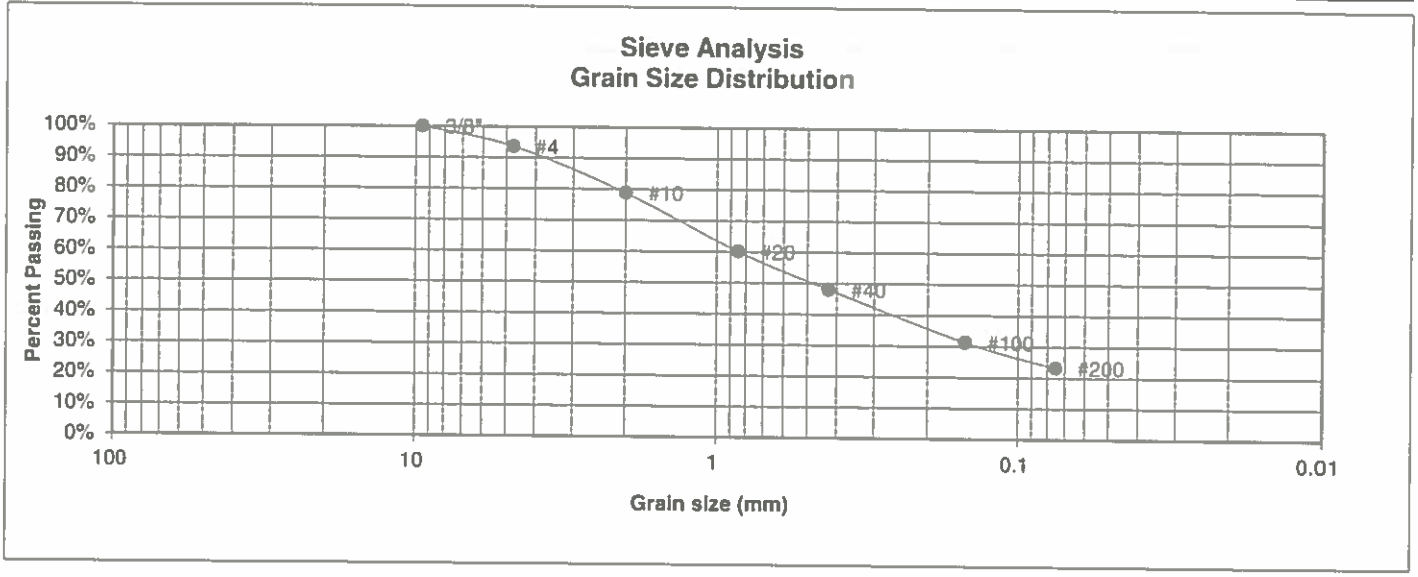
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907


LABORATORY TEST RESULTS

| DRAWN: | DATE: | CHECKED: | DATE: |
|---|---|---|---|
| | | DS | 7/19/21 |

JOB NO.: 210527
FIG NO.: B-12

| | | | |
|---|---|---|---|
| UNIFIED CLASSIFICATION | SC | CLIENT | TECH CONTRACTORS |
| SOIL TYPE # | 1 | PROJECT | ROLLING HILLS, F-1, P-2 |
| TEST BORING # | 12 | JOB NO. | 210527 |
| DEPTH (FT) | 1-2 | TEST BY | BL |
| AASHTO CLASSIFICATION | A-2-4 | GROUP INDEX | 0 |




| U.S. Sieve # | Percent Finer |
|---|---|
| 3" | |
| 1 1/2" | |
| 3/4" | |
| 1/2" | |
| 3/8" | 100.0% |
| 4 | 93.6% |
| 10 | 78.8% |
| 20 | 60.1% |
| 40 | 48.0% |
| 100 | 31.3% |
| 200 | 23.2% |

| Atterberg Limits | |
|---|---|
| Plastic Limit | 20 |
| Liquid Limit | 30 |
| Plastic Index | 10 |

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


**ENTECH ENGINEERING, INC.**
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

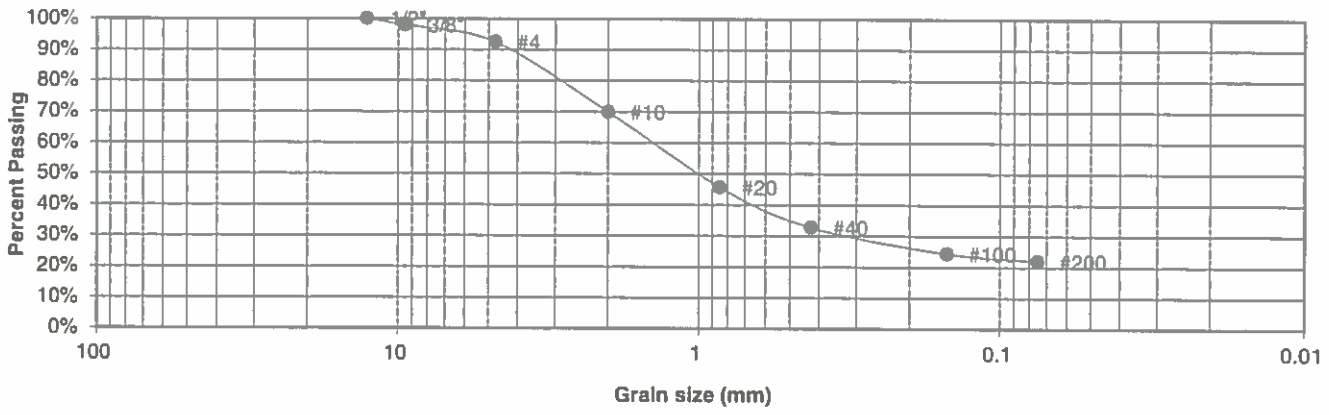

LABORATORY TEST RESULTS

| DRAWN: | DATE: | CHECKED: | DATE: |
|---|---|---|---|
| | | DS | 7/19/21 |

JOB NO.: 210527
FIG NO.: B-13

| | | | |
|---|---|---|---|
| UNIFIED CLASSIFICATION | SC | CLIENT | TECH CONTRACTORS |
| SOIL TYPE # | 2 | PROJECT | ROLLING HILLS, F-1, P-2 |
| TEST BORING # | 1 | JOB NO. | 210527 |
| DEPTH (FT) | 5 | TEST BY | BL |
| AASHTO CLASSIFICATION | A-2-7 | GROUP INDEX | 1 |

**Sieve Analysis**
**Grain Size Distribution**




| U.S. Sieve # | Percent Finer |
|---|---|
| 3" | |
| 1 1/2" | |
| 3/4" | |
| 1/2" | 100.0% |
| 3/8" | 97.9% |
| 4 | 92.5% |
| 10 | 70.0% |
| 20 | 45.7% |
| 40 | 32.8% |
| 100 | 24.3% |
| 200 | 22.0% |

Atterberg Limits

| | |
|---|---|
| Plastic Limit | 21 |
| Liquid Limit | 48 |
| Plastic Index | 27 |

Swell

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


**ENTECH ENGINEERING, INC.**
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

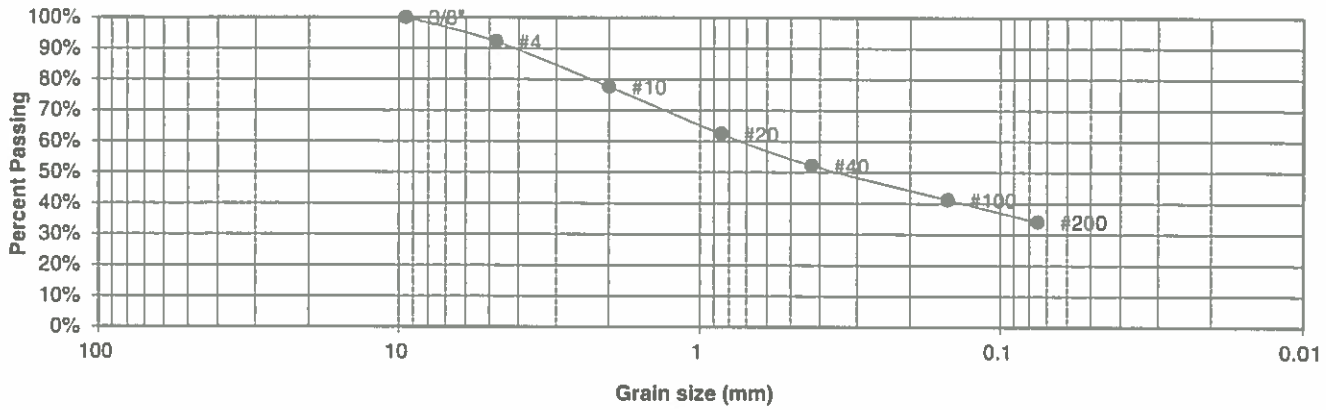

LABORATORY TEST RESULTS

| DRAWN | DATE | CHECKED | DATE |
|---|---|---|---|
| | | | 7/8/21 |

JOB NO. 210527
FIG NO. B-14

| | | | |
|---|---|---|---|
| UNIFIED CLASSIFICATION | SC | CLIENT | TECH CONTRACTORS |
| SOIL TYPE # | 2 | PROJECT | ROLLING HILLS, F-1, P-2 |
| TEST BORING # | 4 | JOB NO. | 210527 |
| DEPTH (FT) | 10 | TEST BY | BL |
| AASHTO CLASSIFICATION | A-2-7 | GROUP INDEX | 4 |

**Sieve Analysis**
**Grain Size Distribution**




| U.S. Sieve # | Percent Finer |
|---|---|
| 3" | |
| 1 1/2" | |
| 3/4" | |
| 1/2" | |
| 3/8" | 100.0% |
| 4 | 92.2% |
| 10 | 77.6% |
| 20 | 62.4% |
| 40 | 52.2% |
| 100 | 41.2% |
| 200 | 34.1% |

| Atterberg Limits | |
|---|---|
| Plastic Limit | 19 |
| Liquid Limit | 49 |
| Plastic Index | 30 |

| Swell | |
|---|---|
| Moisture at start | |
| Moisture at finish | |
| Moisture increase | |
| Initial dry density (pcf) | |
| Swell (psf) | |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505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

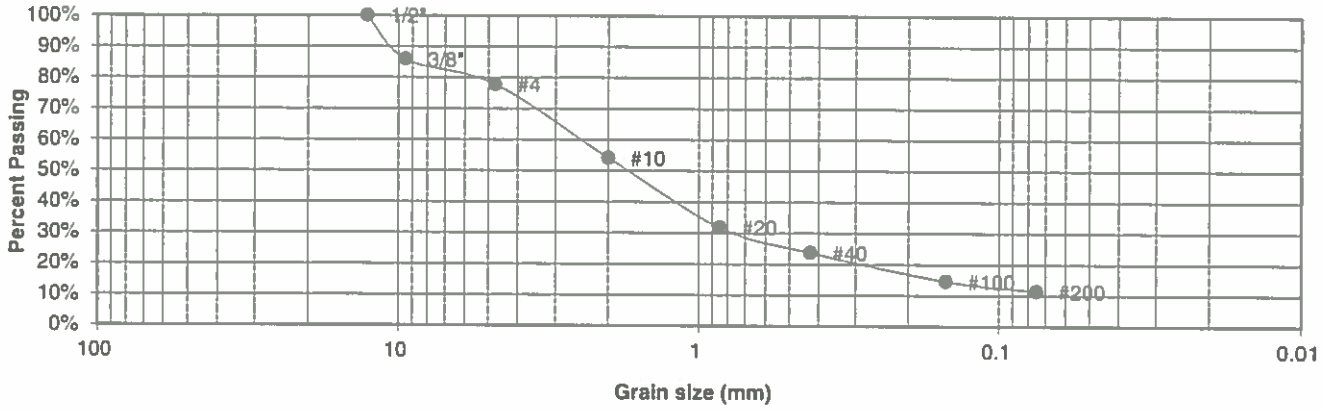

LABORATORY TEST RESULTS

| DRAWN: | DATE: | CHECKED: | DATE: 7/8/21 |
|---|---|---|---|

JOB NO.: 210527
FIG NO.: B-5

| | | | |
|---|---|---|---|
| UNIFIED CLASSIFICATION | SM-SW | CLIENT | TECH CONTRACTORS |
| SOIL TYPE # | 2 | PROJECT | ROLLING HILLS, F-1, P-2 |
| TEST BORING # | 8 | JOB NO. | 210527 |
| DEPTH (FT) | 10 | TEST BY | BL |
| AASHTO CLASSIFICATION | A-1-b | GROUP INDEX | 0 |

**Sieve Analysis**
**Grain Size Distribution**




| U.S. Sieve # | Percent Finer |
|---|---|
| 3" | |
| 1 1/2" | |
| 3/4" | |
| 1/2" | 100.0% |
| 3/8" | 85.8% |
| 4 | 77.8% |
| 10 | 54.1% |
| 20 | 31.8% |
| 40 | 23.7% |
| 100 | 14.6% |
| 200 | 11.4% |

Atterberg Limits

| | |
|---|---|
| Plastic Limit | NP |
| Liquid Limit | NV |
| Plastic Index | NP |

Swell

Moisture at start

Moisture at finish

Moisture increase

Initial dry density (pcf)

Swell (psf)

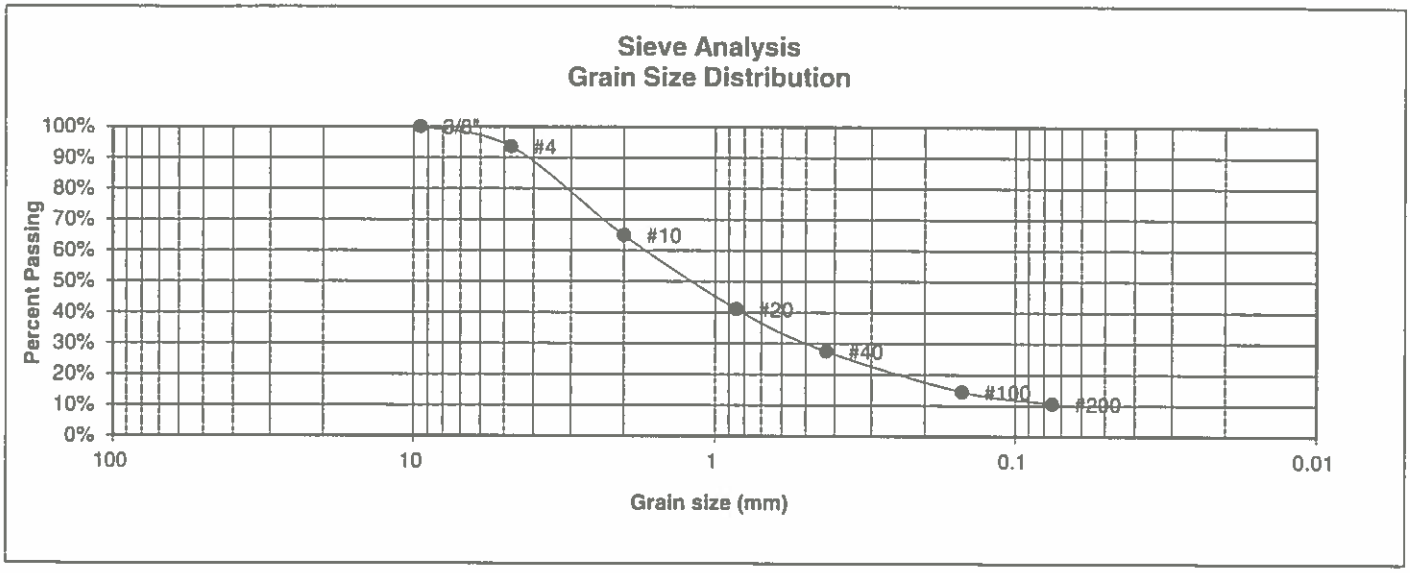

**ENTECH**
**ENGINEERING, INC.**
505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907


LABORATORY TEST RESULTS

| DRAWN | DATE | CHECKED | DATE |
|---|---|---|---|
| | | | 2/8/21 |

JOB NO. 210527
FIG NO. B-16

| | | | |
|---|---|---|---|
| UNIFIED CLASSIFICATION | SM-SW | CLIENT | TECH CONTRACTORS |
| SOIL TYPE # | 3 | PROJECT | ROLLING HILLS, F-1, P-2 |
| TEST BORING # | 1 | JOB NO. | 210527 |
| DEPTH (FT) | 10 | TEST BY | BL |
| AASHTO CLASSIFICATION | A-1-b | GROUP INDEX | 0 |




| U.S. Sieve # | Percent Finer |
|---|---|
| 3" | |
| 1 1/2" | |
| 3/4" | |
| 1/2" | |
| 3/8" | 100.0% |
| 4 | 93.6% |
| 10 | 64.9% |
| 20 | 41.1% |
| 40 | 27.5% |
| 100 | 14.4% |
| 200 | 10.6% |

Atterberg Limits

| | |
|---|---|
| Plastic Limit | NP |
| Liquid Limit | NV |
| Plastic Index | NP |

Swell

Moisture at start

Moisture at finish

Moisture increase

Initial dry density (pcf)

Swell (psf)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COLORADO SPRINGS, COLORADO 80907


LABORATORY TEST RESULTS

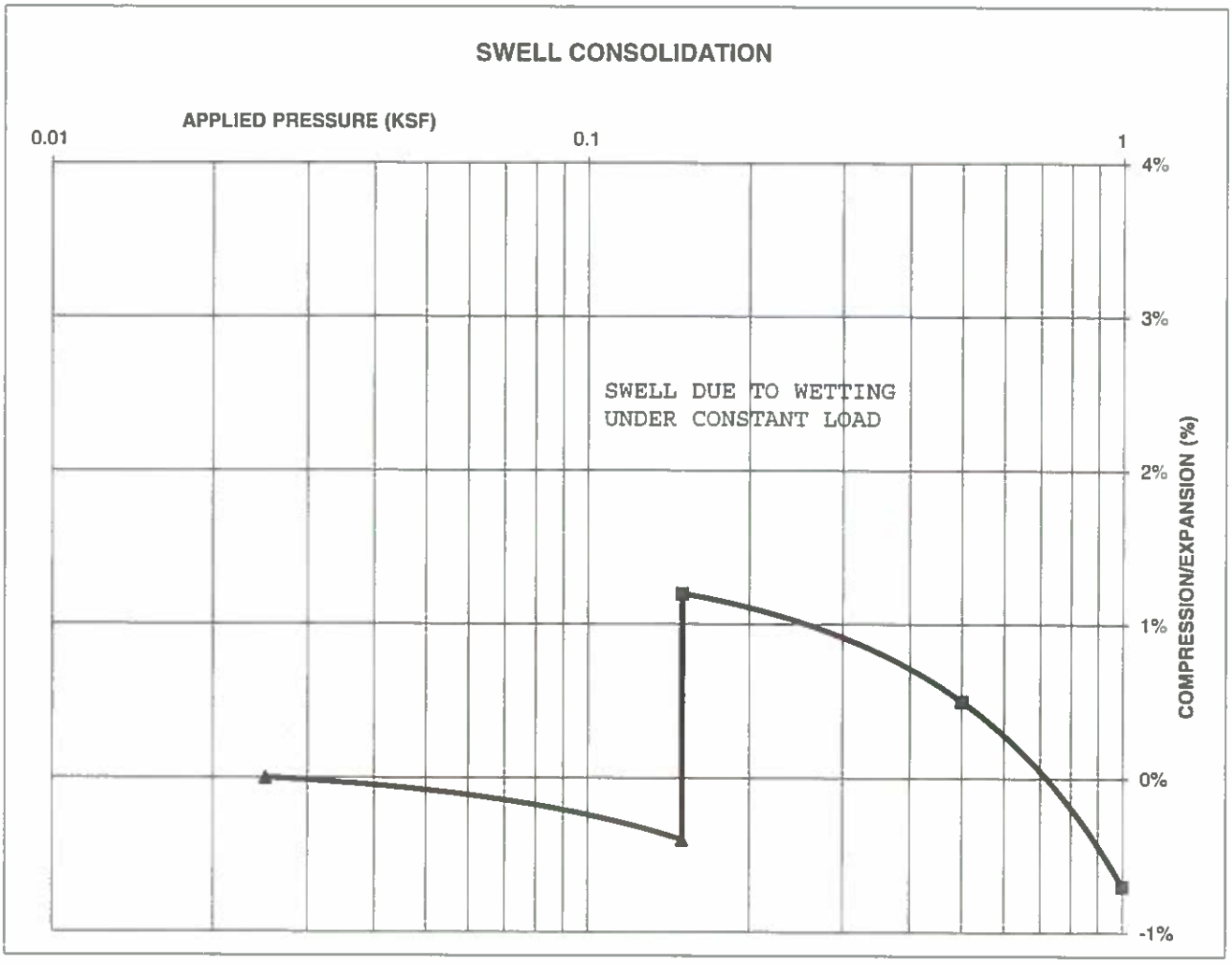
| DRAWN: | DATE: | CHECKED: | DATE: |
|---|---|---|---|
| | | | 7/8/21 |

JOB NO. 210527
FIG NO. B-7

***CONSOLIDATION TEST RESULTS***

| | | | |
|---|---|---|---|
| TEST BORING # | 6 | DEPTH(ft) | 0-3 |
| DESCRIPTION | SC | SOIL TYPE | 1, CBR |
| NATURAL UNIT DRY WEIGHT (PCF) | | | 121 |
| NATURAL MOISTURE CONTENT | | | 9.2% |
| SWELL/CONSOLIDATION (%) | | | 1.6% |

JOB NO. 210527
CLIENT TECH CONTRACTORS
PROJECT ROLLING HILLS, F-1, P-2





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COLORADO SPRINGS, COLORADO 80907


SWELL CONSOLIDATION
TEST RESULTS

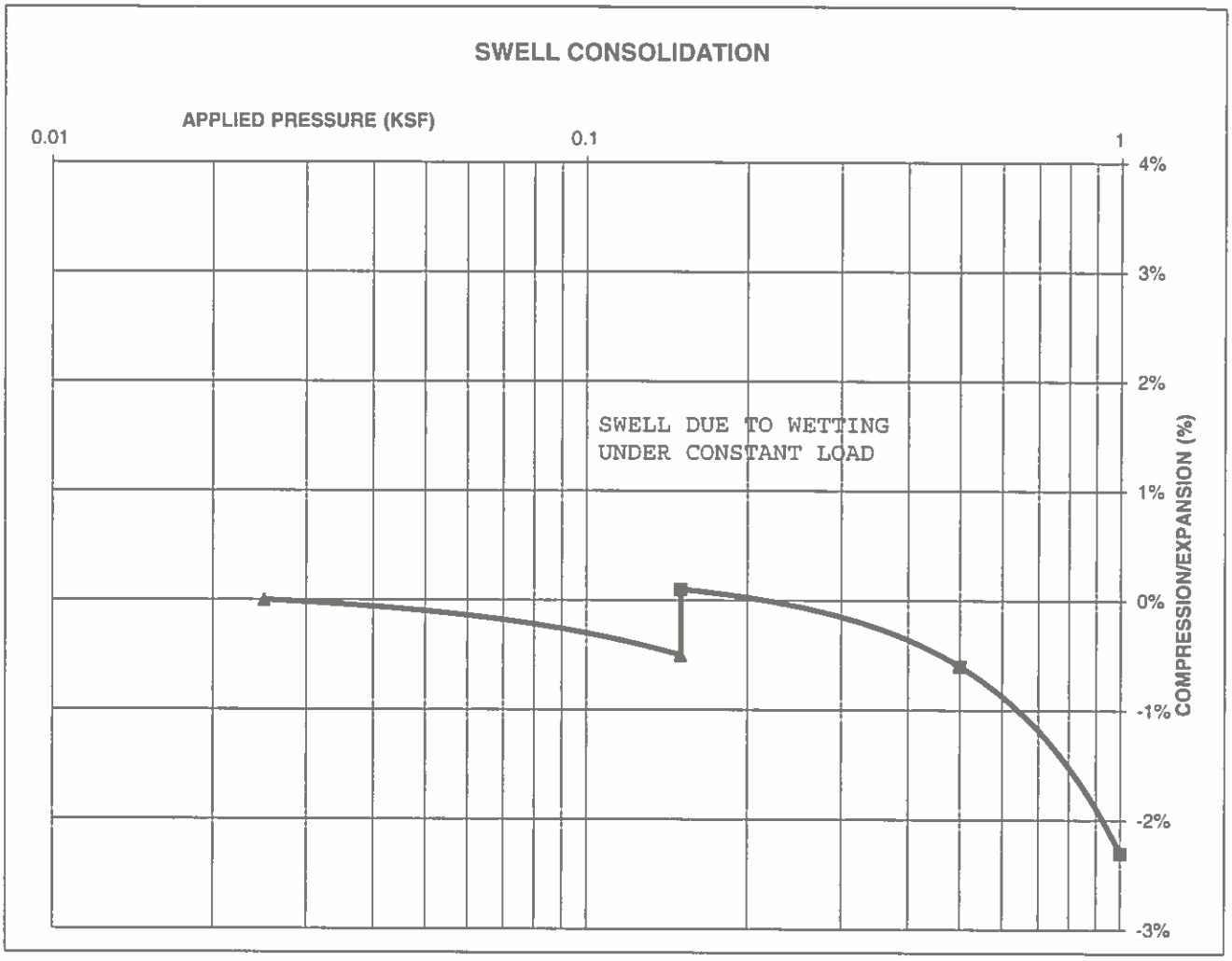
| DRAWN: | DATE: | CHECKED: | DATE: 7/8/21 |
|---|---|---|---|

JOB NO. 210527
FIG NO. B-12

***CONSOLIDATION TEST RESULTS***

| | | | |
|---|---|---|---|
| TEST BORING # | 1 | DEPTH(ft) | 1-2 |
| DESCRIPTION | SC | SOIL TYPE | 1 |
| NATURAL UNIT DRY WEIGHT (PCF) | | | 118 |
| NATURAL MOISTURE CONTENT | | | 8.7% |
| SWELL/CONSOLIDATION (%) | | | 0.6% |

JOB NO. 210527
CLIENT TECH CONTRACTORS
PROJECT ROLLING HILLS, F-1, P-2

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SWELL CONSOLIDATION
TEST RESULTS

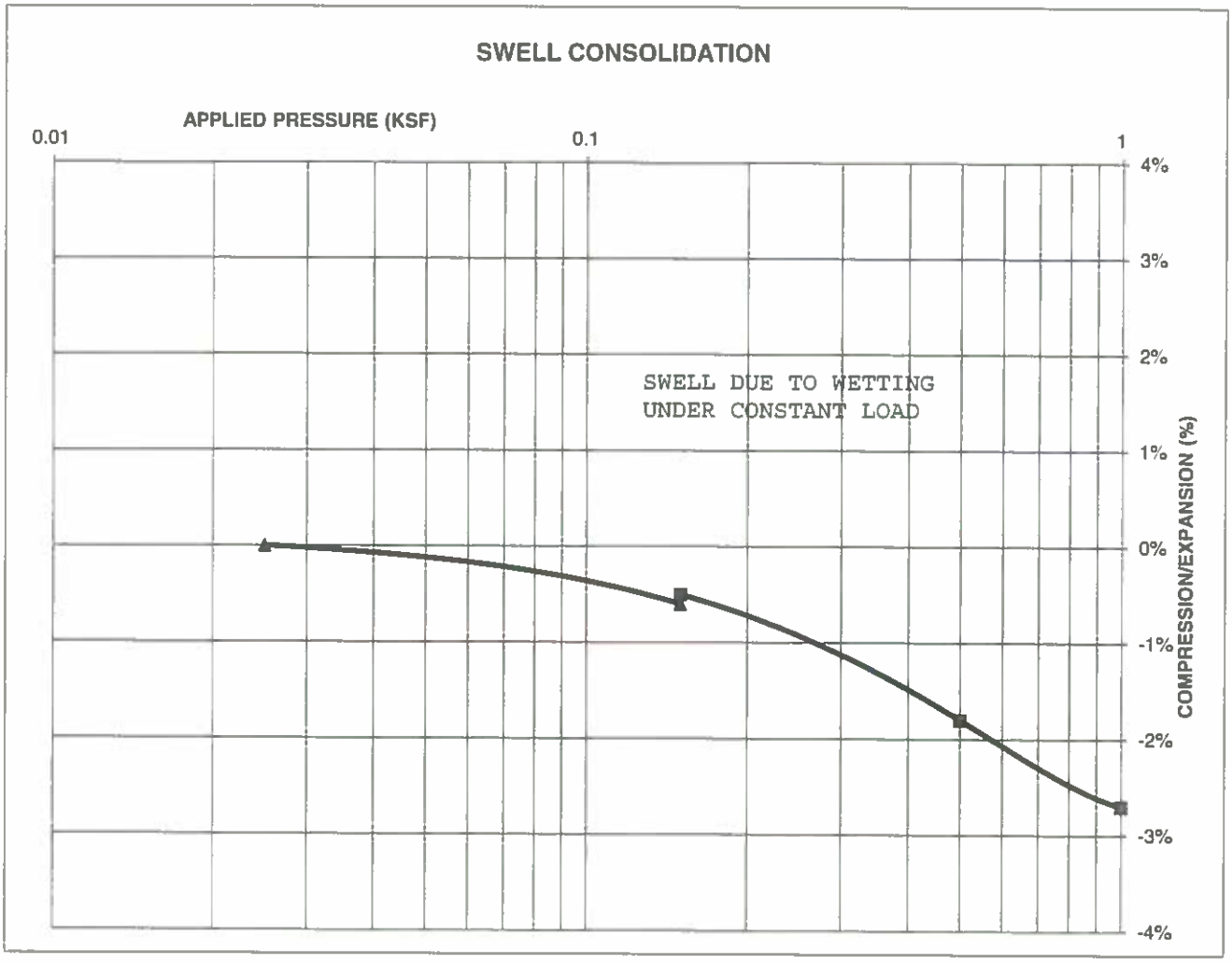
| DRAWN: | DATE | CHECKED: | DATE |
|---|---|---|---|
| | | | 7/8/19 |

JOB NO. 210527
FIG NO. B-19

## *CONSOLIDATION TEST RESULTS*

| | | | |
|---|---|---|---|
| TEST BORING # | 1 | DEPTH(ft) | 5 |
| DESCRIPTION | SC | SOIL TYPE | 2 |
| NATURAL UNIT DRY WEIGHT (PCF) | | | 119 |
| NATURAL MOISTURE CONTENT | | | 11.2% |
| SWELL/CONSOLIDATION (%) | | | 0.1% |

JOB NO. 210527
CLIENT TECH CONTRACTORS
PROJECT ROLLING HILLS, F-1, P-2

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SWELL CONSOLIDATION
TEST RESULTS

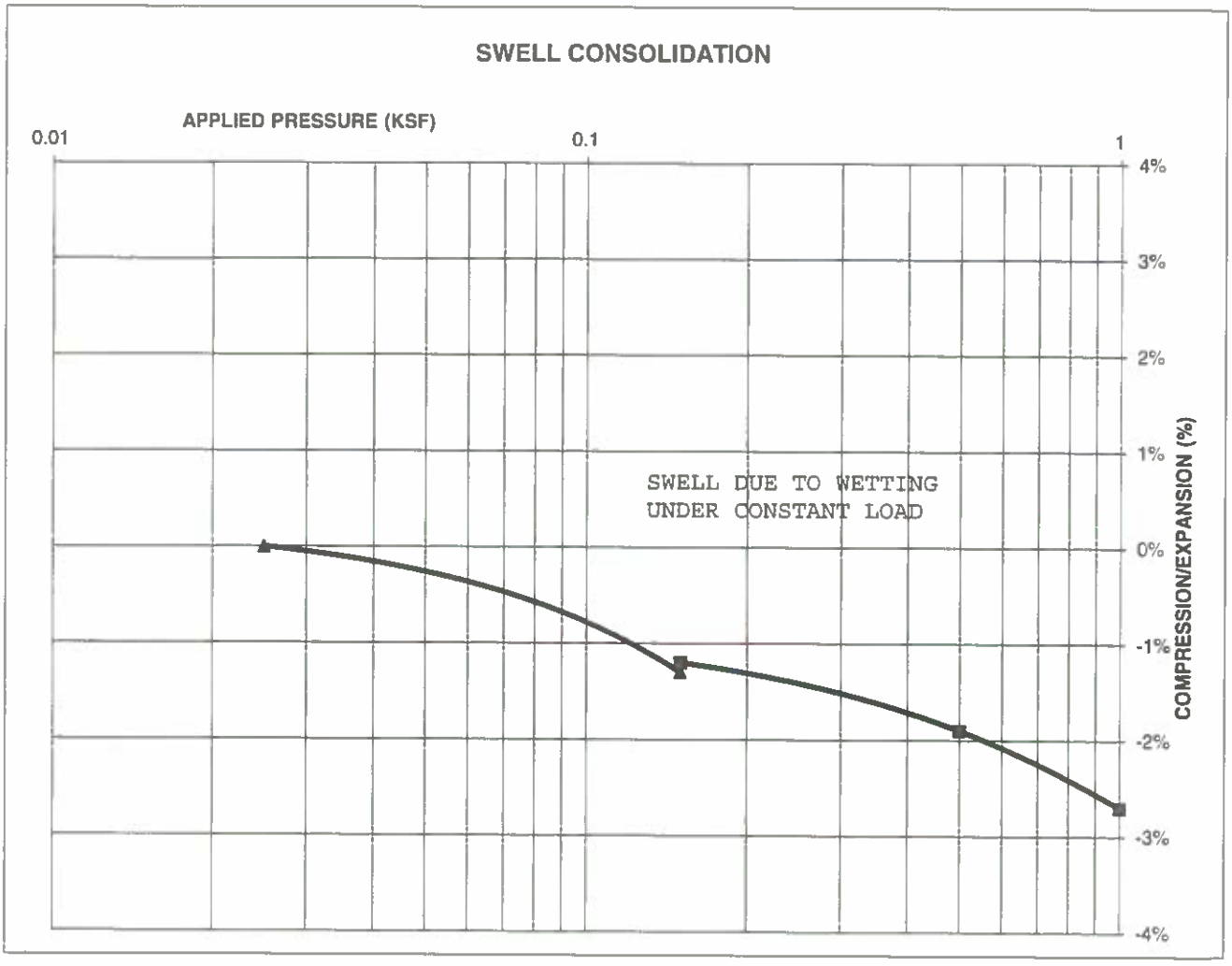
| DRAWN | DATE | CHECKED | DATE |
|---|---|---|---|
| | | | 7/6/21 |

JOB NO: 210527
FIG NO: B-20

***CONSOLIDATION TEST RESULTS***

| | | | |
|---|---|---|---|
| TEST BORING # | 4 | DEPTH(ft) | 10 |
| DESCRIPTION | SC | SOIL TYPE | 2 |
| NATURAL UNIT DRY WEIGHT (PCF) | | | 122 |
| NATURAL MOISTURE CONTENT | | | 7.0% |
| SWELL/CONSOLIDATION (%) | | | 0.1% |

JOB NO. 210527
CLIENT TECH CONTRACTORS
PROJECT ROLLING HILLS, F-1, P-2

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SWELL CONSOLIDATION
TEST RESULTS

| DRAWN: | DATE: | CHECKED: | DATE: |
|---|---|---|---|
| | | | 7/8/21 |

JOB NO.: 210527
FIG NO.: B24

| | | | |
|---|---|---|---|
| CLIENT | TECH CONTRACTORS | JOB NO. | 210527 |
| PROJECT | ROLLING HILLS, F-1, P-2 | DATE | 6/17/2021 |
| LOCATION | ROLLING HILLS, F-1, P-2 | TEST BY | BL |

| BORING NUMBER | DEPTH, (ft) | SOIL TYPE NUMBER | UNIFIED CLASSIFICATION | WATER SOLUBLE SULFATE, (wt%) |
|---|---|---|---|---|
| TB-1 | 5 | 2 | SC | 0.01 |
| TB-1 | 10 | 3 | SM-SW | <0.01 |
| TB-2 | 1-2 | 1 | SM-SW | <0.01 |
| TB-5 | 1-2 | 1 | SM | <0.01 |
| TB-8 | 10 | 2 | SM-SW | <0.01 |
| TB-9 | 1-2 | 1 | SM | <0.01 |
| | | | | |
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QC BLANK PASS

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505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

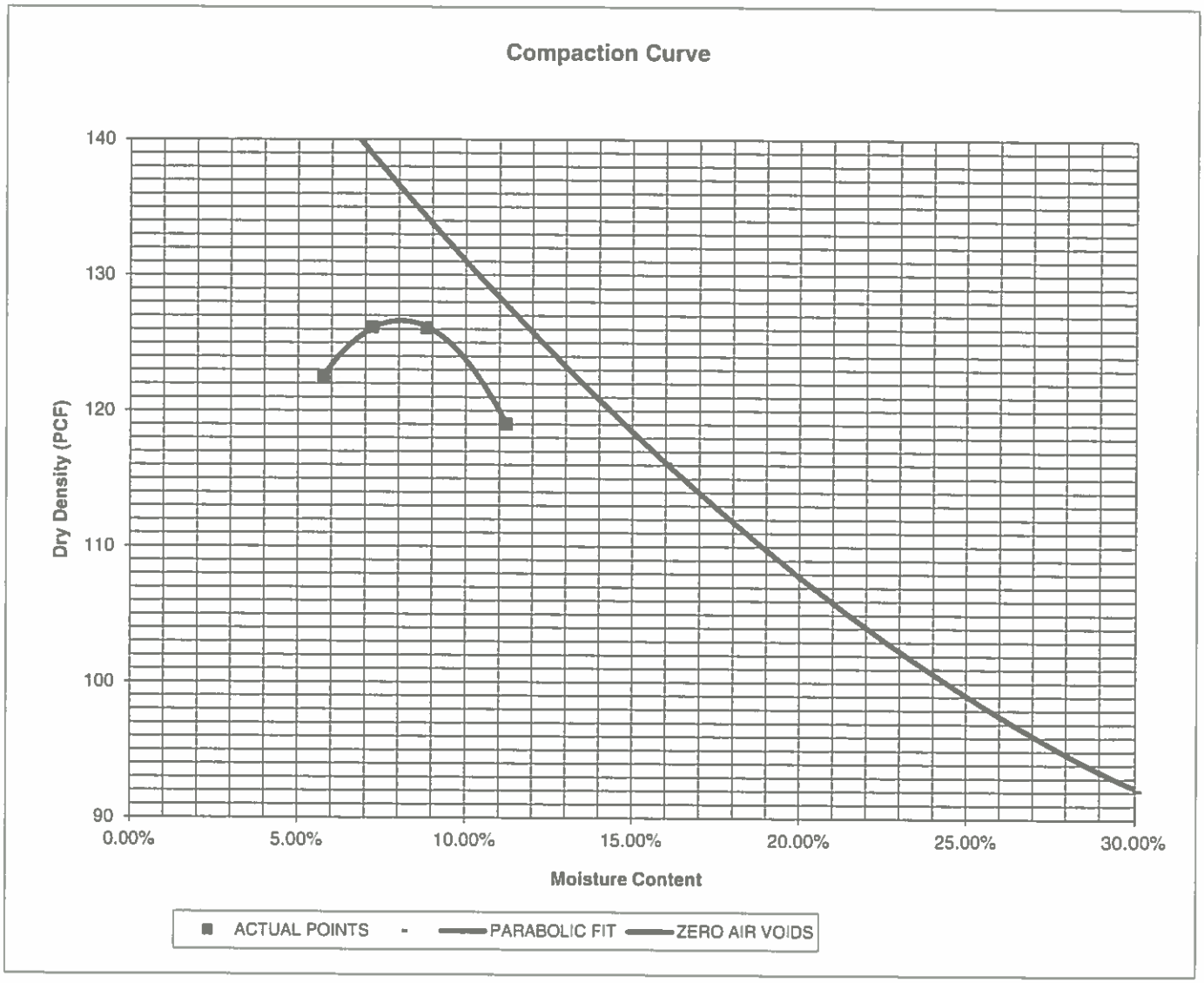
LABORATORY TEST
SULFATE RESULTS

| DRAWN: | DATE: | CHECKED: | DATE: 7/8/21 |
|---|---|---|---|

JOB NO.: 210527
FIG NO.: B-22

| | | | |
|---|---|---|---|
| PROJECT | ROLLING HILLS, F-1, P-2 | CLIENT | TECH CONTRACTORS |
| SAMPLE LOCATION | TB-6 @ 0-3' | JOB NO. | 210527 |
| SOIL DESCRIPTION | FILL, SAND, CLAYEY, BROWN | DATE | 06/17/21 |

| | | | |
|---|---|---|---|
| IDENTIFICATION | SC | COMPACTION TEST # | 1 |
| TEST DESIGNATION / METHOD | ASTM D-1557-A | TEST BY | BL |
| MAXIMUM DRY DENSITY (PCF) | 126.6 | OPTIMUM MOISTURE | 8.2% |





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505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907


MOISTURE DENSITY RELATION

| DRAWN: | DATE: | CHECKED: | DATE: |
|---|---|---|---|
| | | | 7/8/21 |

JOB NO.: 210527

FIG NO.: B-23

## CBR TEST LOAD DATA

JOB NO: 210527
CLIENT: TECH CONTRACTORS
PROJECT: ROLLING HILLS, F-1, P-2
SOIL TYPE: 1

| PISTON DIAMETER (cm) | PISTON AREA ($in^2$) |
|---|---|
| 4.958 | 2.993 |

| PENETRATION DEPTH (INCHES) | 10 BLOWS MOLD # 1 LOAD(LBS) (LBS) | 10 BLOWS MOLD # 1 STRESS (PSI) | 25 BLOWS MOLD # 2 LOAD(LBS) (LBS) | 25 BLOWS MOLD # 2 STRESS (PSI) | 56 BLOWS MOLD # 3 LOAD(LBS) (LBS) | 56 BLOWS MOLD # 3 STRESS (PSI) |
|---|---|---|---|---|---|---|
| 0.000 | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 |
| 0.025 | 53 | 17.71 | 115 | 38.43 | 288 | 96.24 |
| 0.050 | 80 | 26.73 | 194 | 64.83 | 575 | 192.15 |
| 0.075 | 95 | 31.75 | 286 | 95.57 | 780 | 260.65 |
| 0.100 | 105 | 35.09 | 348 | 116.29 | 1011 | 337.84 |
| 0.125 | 113 | 37.76 | 385 | 128.65 | 1207 | 403.34 |
| 0.150 | 120 | 40.10 | 425 | 142.02 | 1411 | 471.51 |
| 0.175 | 126 | 42.11 | 453 | 151.38 | 1613 | 539.01 |
| 0.200 | 135 | 45.11 | 484 | 161.74 | 1820 | 608.19 |
| 0.300 | 163 | 54.47 | 577 | 192.81 | 2496 | 834.08 |
| 0.400 | 184 | 61.49 | 655 | 218.88 | 3058 | 1021.88 |
| 0.500 | 206 | 68.84 | 743 | 248.29 | 3304 | 1104.09 |

## FINAL MOISTURE CONTENT

| | MOLD # 1 | MOLD # 2 | MOLD # 3 |
|---|---|---|---|
| CAN # | 102 | 110 | 101 |
| WT. CAN | 9.25 | 9.23 | 9.14 |
| WT. CAN+WET | 294.91 | 275.24 | 326.08 |
| WT. CAN+DRY | 259.23 | 245.22 | 299.64 |
| WT. H20 | 35.68 | 30.02 | 26.44 |
| WT. DRY SOIL | 249.98 | 235.99 | 290.5 |
| MOISTURE CONTENT | 14.27% | 12.72% | 9.10% |
| WET DENSITY (PCF) | 119.7 | 126.4 | 136.7 |
| DRY DENSITY (PCF) | 110.7 | 116.8 | 126.3 |
| BEARING RATIO | 3.51 | 11.63 | 33.78 |

| | |
|---|---|
| 90% OF DRY DENSITY | 113.9 |
| 95% OF DRY DENSITY | 120.3 |

| | | | |
|---|---|---|---|
| BEARING RATIO AT 90% OF MAX | 7.82 | ~ R VALUE | 17 |
| BEARING RATIO AT 95% OF MAX | 19.66 | ~ R VALUE | 70 |

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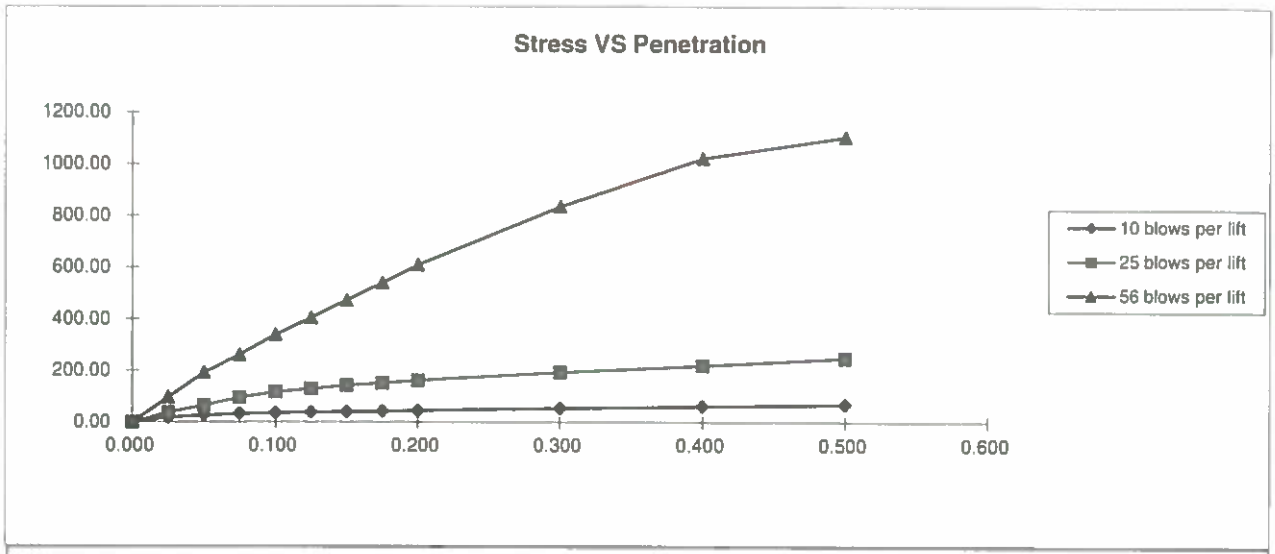
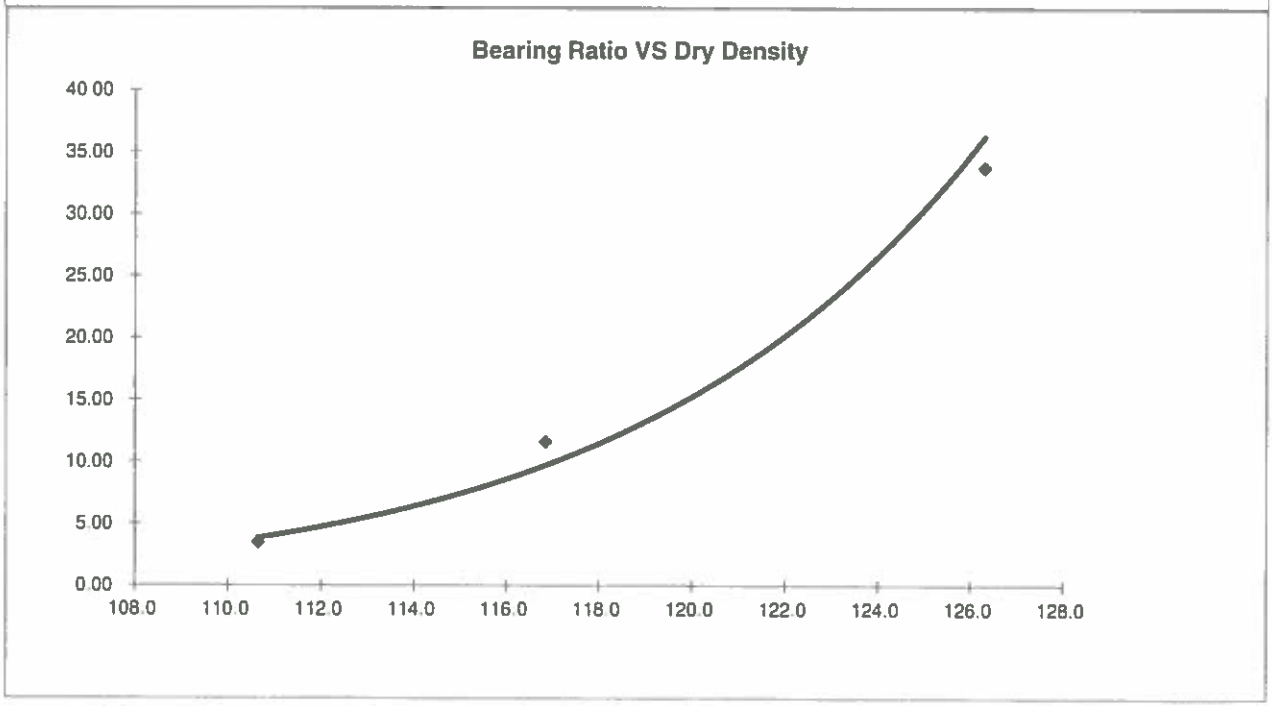
COLORADO SPRINGS, COLORADO 80907

CBR TEST DATA

| DRAWN: | DATE: | CHECKED: | DATE: |
|---|---|---|---|
| | | | 7/8/21 |

JOB NO. 210527
FIG NO. B-24




| | | | |
|---|---|---|---|
| BEARING RATIO AT 90% OF MAX | 7.82 | ~ R VALUE | 17.00 |
| BEARING RATIO AT 95% OF MAX | 19.66 | ~ R VALUE | 70.00 |

JOB NO: 210527
SOIL TYPE: 1

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505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

CALIFORNIA BEARING RATIO

| DRAWN: | DATE: | CHECKED: | DATE: |
|---|---|---|---|
| | | | 9/6/21 |

JOB NO: 210527
FIG NO: B-25

# APPENDIX C: Pavement Design Calculations

# FLEXIBLE PAVEMENT DESIGN

## DESIGN DATA

ROLLING HILLS AT MERIDIAN RANCH FILING 1, PHASE 2
URBAN LOCAL LOW-VOLUME

| | | |
|---|---|---|
| Equivalent (18 kip) Single Axle Load Applications (ESAL): | ESAL ($W_{18}$) = | 36,500 |
| Hveem Stabilometer (R Value) Results: | R = | 50 |
| 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 | $M_R$ = | 13168 |

Weighted Structural Number (WSN): → WSN = 1.46

## DESIGN TABLES AND EQUATIONS

$S_1 = [(R - 5) / 11.29] + 3$

$M_R = 10^{[(S_1 + 18.72) / 6.24]}$

$k = M_R / 19.4$

Where:

$M_R$ = resilient modulus (psi)

$S_1$ = the soil support value

R = R-value obtained from the Hveem stabilometer

CBR = California Bearing Ratio

| Reliability (%) | $Z_R$ (z-statistic) |
|---|---|
| 80 | -0.84 |
| 85 | -1.04 |
| 90 | -1.28 |
| 93 | -1.48 |
| 94 | -1.56 |
| 95 | -1.65 |
| 96 | -1.75 |
| 97 | -1.88 |
| 98 | -2.05 |
| 99 | -2.33 |
| 99.9 | -3.09 |
| 99.99 | -3.75 |

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

| Left | Right | Difference |
|---|---|---|
| 4.56 | 4.56 | 0.0 |

Job No. 210527
Fig. No. C-1

# DESIGN CALCULATIONS

## DESIGN DATA

ROLLING HILLS AT MERIDIAN RANCH FILING 1, PHASE 2
URBAN LOCAL LOW-VOLUME

| | | |
|---|---|---|
| Equivalent (18 kip) Single Axle Load Applications (ESAL): | ESAL = | 36,500 |
| Hveem Stabilometer (R Value) Results: | R = | 50 |
| Weighted Structural Number (WSN): | WSN = | 1.46 |

## DESIGN EQUATION

$$WSN = C_1D_1 + C_2D_2$$

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

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

## FOR FULL DEPTH ASPHALT SECTION (CURRENTLY NOT ALLOWED)

$D_1 = (WSN)/C_1$ = 3.3 inches of Full Depth Asphalt
Use 4.0 inches Full Depth

## FOR ASPHALT + AGGREGATE BASE COURSE SECTION

Asphalt Thickness (t) = [ 3 ] inches
$D_2 = ((WSN) - (t)(C_1))/C_2$ = 1.3 inches of Aggregate Base Course, use 4.0 inches

## RECOMMENDED ALTERNATIVES

1. 3.0 inches of Asphalt + 4.0 inches of Aggregate Base Course, or
2. 4.0 inches of Full Depth Asphalt

Job No. 210527
Fig. No. C-2

# DESIGN CALCULATIONS

CEMENT TREATED SECTIONS

DESIGN DATA:

ROLLING HILLS AT MERIDIAN RANCH FILING 1, PHASE 2
URBAN LOCAL LOW-VOLUME

| | | |
|---|---|---|
| Equivalent (18 kip) Single Axle Load Applications (ESAL): | ESAL = | 36,500 |
| Hveem Stabilometer (R Value) Results: | R = | 50 |
| Weighted Structural Number (WSN): | WSN = | 1.46 |

DESIGN EQUATION

$$WSN = C_1D_1 + C_2D_2$$

$C_1$ = 0.44 Strength Coefficient - Hot Bituminous Asphalt
$C_2$ = 0.12 Strength Coefficient - Cement Treated Subgrade.

$D_1$ = Depth of Asphalt (inches)
$D_2$ = Depth of Cement Treated Subgrade (inches)

FOR FULL DEPTH ASPHALT SECTION - (CURRENTLY NOT ALLOWED)

$D_1 = (WSN)/C_1$ = 3.3 inches of Full Depth Asphalt
Use 4.0 inches Full Depth

FOR ASPHALT + CEMENT TREATED SUBGRADE SECTION

Asphalt Thickness (t) = 4 inches
$D_2 = ((WSN) - (t)(C_1))/C_2$ = -2.5 inches
Use 8.0 inches of Cement Treated Subgrade.

RECOMMENDED ALTERNATIVES

1. 4.0 inches of Asphalt + 8 inches of Cement Treated Subgrade.
2. 4.0 inches of Full Depth Asphalt

Job No. 210527
Fig. No. C-3

# FLEXIBLE PAVEMENT DESIGN

## DESIGN DATA

ROLLING HILLS AT MERIDIAN RANCH FILING 1, PHASE 2
URBAN LOCAL

| | | |
|---|---|---|
| Equivalent (18 kip) Single Axle Load Applications (ESAL): | ESAL ($W_{18}$) = | 292,000 |
| Hveem Stabilometer (R Value) Results: | R = | 50 |
| 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 | $M_R$ = | 13168 |

Weighted Structural Number (WSN): → WSN = 2.09

## DESIGN TABLES AND EQUATIONS

$S_1 = [(R - 5) / 11.29] + 3$

$M_R = 10^{[(S_1 + 18.72) / 6.24]}$

$k = M_R / 19.4$

Where:

$M_R$ = resilient modulus (psi)

$S_1$ = the soil support value

R = R-value obtained from the Hveem stabilometer

CBR = California Bearing Ratio

| Reliability (%) | $Z_R$ (z-statistic) |
|---|---|
| 80 | -0.84 |
| 85 | -1.04 |
| 90 | -1.28 |
| 93 | -1.48 |
| 94 | -1.56 |
| 95 | -1.65 |
| 96 | -1.75 |
| 97 | -1.88 |
| 98 | -2.05 |
| 99 | -2.33 |
| 99.9 | -3.09 |
| 99.99 | -3.75 |

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

| Left | Right | Difference |
|---|---|---|
| 5.47 | 5.46 | 0.0 |

Job No. 210527
Fig. No. C-4

# DESIGN CALCULATIONS

## DESIGN DATA

ROLLING HILLS AT MERIDIAN RANCH FILING 1, PHASE 2
URBAN LOCAL

| | | |
|---|---|---|
| Equivalent (18 kip) Single Axle Load Applications (ESAL): | ESAL = | 292,000 |
| Hveem Stabilometer (R Value) Results: | R = | 50 |
| Weighted Structural Number (WSN): | WSN = | 2.09 |

## DESIGN EQUATION

$$WSN = C_1D_1 + C_2D_2$$

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

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

## FOR FULL DEPTH ASPHALT SECTION (CURRENTLY NOT ALLOWED)

$D_1 = (WSN)/C_1$ = 4.8 inches of Full Depth Asphalt
Use 5.0 inches Full Depth

## FOR ASPHALT + AGGREGATE BASE COURSE SECTION

Asphalt Thickness (t) = [ 3 ] inches
$D_2 = ((WSN) - (t)(C_1))/C_2$ = 7.0 inches of Aggregate
Base Course, use 8.0 inches

## RECOMMENDED ALTERNATIVES

1. 3.0 inches of Asphalt + 8.0 inches of Aggregate Base Course, or
2. 5.0 inches of Full Depth Asphalt

Job No. 210527
Fig. No. C-5

# DESIGN CALCULATIONS

CEMENT TREATED SECTIONS

DESIGN DATA:

ROLLING HILLS AT MERIDIAN RANCH FILING 1, PHASE 2
URBAN LOCAL

| | | |
|---|---|---|
| Equivalent (18 kip) Single Axle Load Applications (ESAL): | ESAL = | 292,000 |
| Hveem Stabilometer (R Value) Results: | R = | 50 |
| Weighted Structural Number (WSN): | WSN = | 2.09 |

DESIGN EQUATION

$$WSN = C_1D_1 + C_2D_2$$

$C_1$ = 0.44 Strength Coefficient - Hot Bituminous Asphalt
$C_2$ = 0.12 Strength Coefficient - Cement Treated Subgrade.

$D_1$ = Depth of Asphalt (inches)
$D_2$ = Depth of Cement Treated Subgrade (inches)

FOR FULL DEPTH ASPHALT SECTION - (CURRENTLY NOT ALLOWED)

$D_1 = (WSN)/C_1$ = 4.8 inches of Full Depth Asphalt
Use 5.0 inches Full Depth

FOR ASPHALT + CEMENT TREATED SUBGRADE SECTION

Asphalt Thickness (t) = 4 inches
$D_2 = ((WSN) - (t)(C_1))/C_2$ = 2.8 inches
Use 8.0 inches of Cement Treated Subgrade.

RECOMMENDED ALTERNATIVES

1. 4.0 inches of Asphalt + 8 inches of Cement Treated Subgrade.
2. 5.0 inches of Full Depth Asphalt

Job No. 210527
Fig. No. C-6

ENTECH
ENGINEERING, INC.

505 ELKTON DRIVE
COLORADO SPRINGS, CO 80907
PHONE (719) 531-5599
FAX (719) 531-5238

July 15, 2021

Tech Contractors
3575 Kenyon Street, Suite 200
San Diego, California 92110

Attn: Raul Guzman

Re: Cement Stabilized Subgrade Results - Laboratory Testing
Rolling Hills at Meridian Ranch Filing No.1, Phase 2
El Paso County, Colorado

Ref: Pavement Recommendations Report by Entech Engineering, Inc., Entech Job No. 210527

Dear Mr. Guzman:

As requested, personnel of Entech Engineering, Inc. have performed strength testing on two sets of three soil/cement composite samples for the above reference project. Testing was performed on soil samples prepared with 2% and 4% Portland Cement Type 1/2, from Martin Marietta, near Pueblo, Colorado.

A minimum compression strength of 160 psi is recommended for cement stabilized subgrade. The 5-day average strength value of the 2% mix was 183 psi. The 5-day average strength value of the 4% mix was 193 psi. A 2% mix is recommended based on the laboratory test results. A summary of the testing results is attached.

Pending the results of the field density testing, microfracturing of the stabilized subgrade will likely be required. Soil strengths in excess 200 psi require microfracturing.

We trust this has provided you with the information you required. if you have any questions or need additional information, please do not hesitate to contact us.

Respectfully Submitted,

ENTECH ENGINEERING, INC.

Daniel P. Stegman

Reviewed by:

Joseph C. Goode, Jr., P.E.
President

7/19/21

COLORADO LICENSED
JOSEPH COLLIN GOODE JR.
23725
PROFESSIONAL ENGINEER

DPS/am

Encl.

Entech Job No. 210527
AAprojects/2021/210527 - cssr — lab 2

# SUMMARY OF CTS TEST RESULTS

## LAB TESTING

CLIENT TECH CONSTACTORS
PROJECT ROLLING HILLS
FIELD SAMPLE ID TB-6 @ 0-3'
SOIL ADDITIVE TYPE I/II CEMENT

JOB NO 210527
DATE 7/7/21
BY BL

| *ADDITIVE %* | *WATER %* | *DENSITY (dry)* | *AGE (days)* | *STRENGTH (psi)* |
|---|---|---|---|---|
| 2 | 8.2 | 120.3 | 5 | 176 |
| 2 | 8.2 | 120.2 | 5 | 182 |
| 2 | 8.2 | 120.1 | 5 | 191 |
| | | | AVERAGE: | **183** |
| 4 | 8.2 | 120.4 | 5 | 195 |
| 4 | 8.2 | 120.2 | 5 | 193 |
| 4 | 8.2 | 120.3 | 5 | 192 |
| | | | AVERAGE: | **193** |

CURING METHOD

100° HUMIDIFIED OVEN