



ENTECH
ENGINEERING, INC.

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

September 15, 2020

FLRD #5
2138 Flying Horse Club Drive
Colorado Springs, Colorado 80921

Attn: Mark Sherwood

Re: Pavement Recommendations
Forest Lakes Filing No. 5
El Paso County, Colorado

Dear Mr. Sherwood:

As requested, Entech Engineering, Inc. has obtained samples of the pavement subgrade soils from the roadways in the Forest Lakes, Filing No. 5 subdivision in El Paso County, Colorado. This letter presents the results of the laboratory testing and pavement recommendations for the roadways.

Project Description

The roadways for this project consist of sections of, Mesa Top Road and Forest Lakes Drive. A Subsurface Soil Investigation and laboratory testing was performed in order to determine the pavement support characteristics of the soils. The general layout of the site is presented in the Test Boring Location Map in Figure 1.

Subgrade Conditions

Sixteen test borings were drilled along the roadways to depths of approximately 5 and 10 feet below the existing subgrade surface. The soils at the roadway subgrade depth consisted of silty to clayey sand fill (Soil Type 1), native silty sand (Soil Type 1A), very silty sand fill (Soil Type 2), and native very silty to very clayey sand (Soil Type 2A). The Type 1 soils were encountered in all of the borings with the exception of Test Boring Nos. 11-14, and 16, in which Soil Types 1, 1A, and 2A were encountered at subgrade depth. The Type 3 soils were not encountered in the subgrade influence zone. Groundwater was not encountered in the test borings. The Test Boring Logs are presented in Appendix A. Sieve Analyses and Atterberg Limit testing were performed on soil samples obtained from the test borings for the purpose of classification. The Type 1 soils percent passing the No. 200 sieve ranged from approximately 23 to 34 percent and classified as A-2-4 and A-1-b soils, using the AASHTO classification system. The Type 1A, 2, and 2A soils percent passing the No. 200 sieve ranged from approximately 35 to 40 percent and classified as A-2-4 and A-4 soils, using the AASHTO classification system. One general subgrade soil type was determined for pavement evaluation based on the laboratory testing (Type 1). The Type 1A, 2, and 2A soils will be grouped with the Type 1 soils due the limited areas in which they were encountered and their similar characteristics. Water-soluble sulfate tests results indicated that the soils exhibit a negligible potential for sulfate attack.

Swell/Consolidation Testing was not required on the site soils due to their plastic indexes. Mitigation of expansive soils on this site 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 representative sample to determine the support characteristics of the subgrade soils for the roadway section. The results of the CBR testing, are presented in Appendix B and summarized as follows:

Soil Type 1 – Silty Sand Fill

CBR 1

R @ 90% = 12.0

R @ 95% = 71.0

Use R = 50.0 for design

Classification Testing

| | |
|------------------------------|-------|
| Liquid Limit | NV |
| Plasticity Index | NP |
| Percent Passing 200 | 27.3 |
| AASHTO Classification | A-2-4 |
| Group Index | 0 |
| Unified Soils Classification | SM |

Pavement Design

CBR testing was used to determine pavement sections for the roadways. Pavement sections were determined utilizing El Paso County Engineering Criteria Manual. The roadways classify as urban residential collectors, which used an 18k ESAL value of 821,000 for design purposes. Alternative pavement sections were determined for asphalt supported on aggregate basecourse, and asphalt on cement stabilized subgrade.

Design parameters used in the pavement analysis for the roadways are as follows:

| | |
|-----------------------------|------------|
| Reliability | |
| Urban Residential Collector | 85% |
| Standard Deviation | 0.45 |
| Δ psi | 2.2 |
| “R” Value Subgrade | 50 |
| Resilient Modulus | 13,168 psi |
| Hot Bituminous Pavement | 0.44 |
| Aggregate Basecourse | 0.11 |
| Cement Stabilized Subgrade | 0.12 |

The pavement design calculations are presented in Appendix C. Pavement section alternatives for the roadway sections are presented as follows. 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 – Soil Type 1

| <u>Urban Residential Collectors – ESAL = 821,000</u> | | | |
|--|--------------------------|---------------------------|---|
| <u>Alternative</u> | <u>Asphalt**</u> (in) | <u>Basecourse</u> (in) | <u>Cement Stabilized</u> <u>Subgrade (in.)</u> |
| 1. Asphalt Over Basecourse | 4.0* | 8.0* | -- |
| 2. Cement Stabilized Subgrade | 4.0* | -- | 10.0 |

*Minimum sections required per the El Paso County Engineering Criteria Manual.

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

Prior to placement of the asphalt, the subgrade should be proofrolled and compacted to a minimum of 95 percent of the soils 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. Basecourse 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 at least 10 inches. 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 a 10 inches depth 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 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.

Classic Communities
Pavement Recommendations
Forest Lakes Filing No. 5
El Paso County, Colorado

- 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.

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,

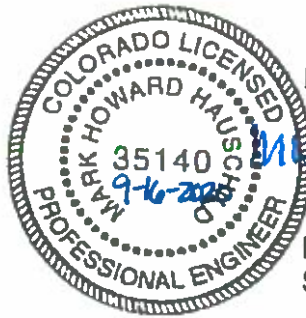
ENTECH ENGINEERING, INC.



Daniel P. Stegman

DPS/bs

Entech Job No. 201782
AAprojects/2020/201782 - pr



Reviewed by:



Mark H. Hauschild, P.E.
Senior Engineer

TABLE

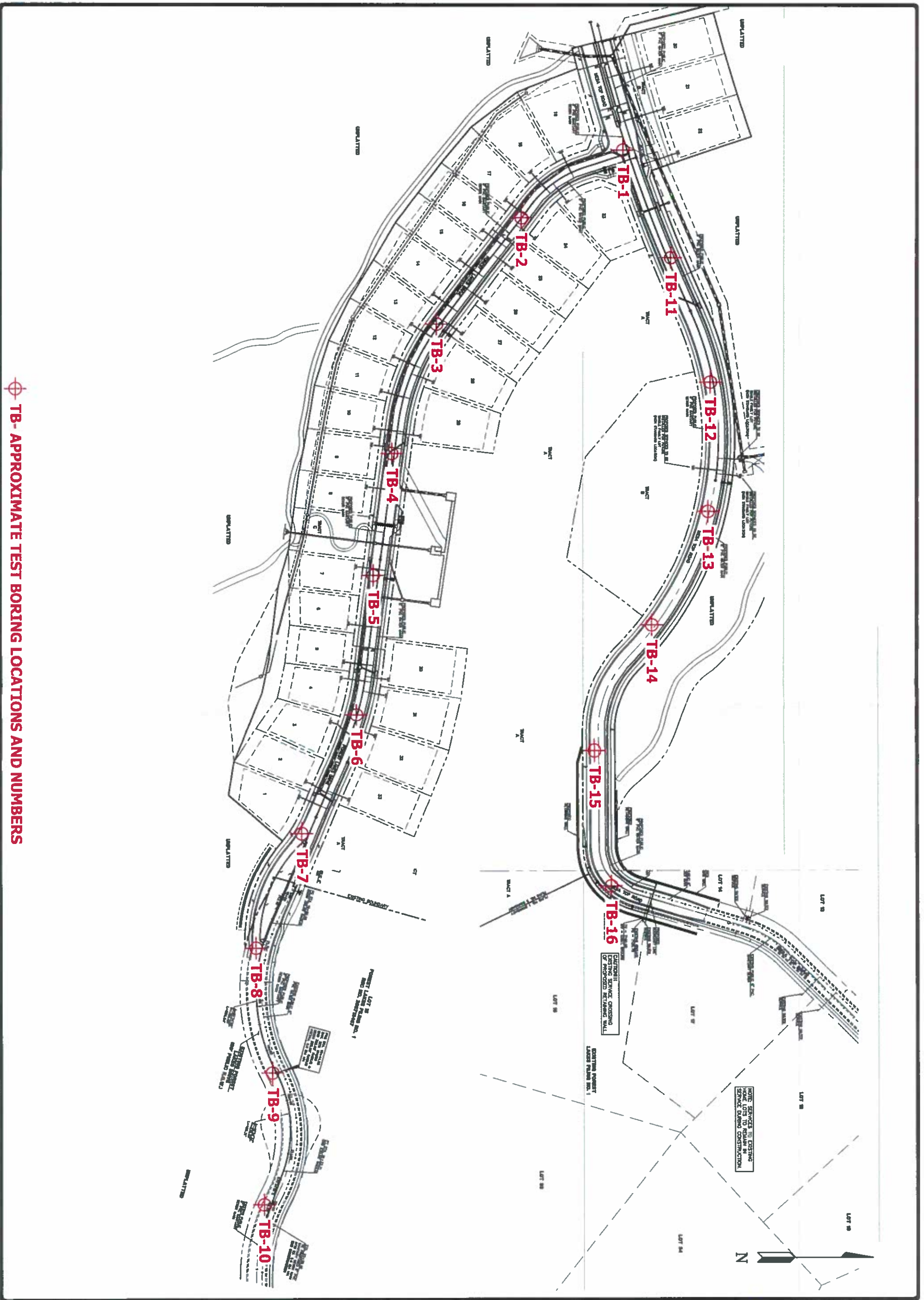
TABLE 1

SUMMARY OF LABORATORY TEST RESULTS

CLIENT FLRD #2
 PROJECT FOREST LAKES, FILING 5
 JOB NO. 201782

| 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 | 7 | 0-3 | | | 27.3 | NV | NP | | A-2-4 | | SM | FILL, SAND, SILTY |
| 1 | 1 | 1-2 | | | 26.0 | 28 | 10 | | A-2-4 | | SC | FILL, SAND, CLAYEY |
| 1 | 2 | 1-2 | | | 25.1 | NV | NP | <0.01 | A-1-b | | SM | FILL, SAND, SILTY |
| 1 | 3 | 1-2 | | | 29.4 | NV | NP | | A-2-4 | | SM | FILL, SAND, SILTY |
| 1 | 4 | 1-2 | | | 33.7 | NV | NP | | A-2-4 | | SM | FILL, SAND, SILTY |
| 1 | 5 | 1-2 | | | 31.5 | NV | NP | <0.01 | A-2-4 | | SM | FILL, SAND, SILTY |
| 1 | 6 | 1-2 | | | 29.5 | NV | NP | | A-2-4 | | SM | FILL, SAND, SILTY |
| 1 | 7 | 1-2 | | | 24.0 | NV | NP | | A-1-b | | SM | FILL, SAND, SILTY |
| 1 | 8 | 1-2 | | | 29.2 | 26 | 8 | <0.01 | A-2-4 | | SC | FILL, SAND, CLAYEY |
| 1 | 9 | 1-2 | | | 32.3 | NV | NP | | A-2-4 | | SM | FILL, SAND, SILTY |
| 1 | 10 | 1-2 | | | 30.6 | NV | NP | | A-2-4 | | SM | FILL, SAND, SILTY |
| 1 | 15 | 1-2 | | | 22.9 | NV | NP | | A-1-b | | SM | FILL, SAND, SILTY |
| 1A | 11 | 1-2 | | | 34.8 | NV | NP | <0.01 | A-2-4 | | SM | SAND, SILTY |
| 2 | 13 | 1-2 | | | 40.4 | NV | NP | | A-4 | | SM | FILL, SAND, VERY SILTY |
| 2 | 14 | 1-2 | | | 39.4 | NV | NP | 0.03 | A-4 | | SM | FILL, SAND, VERY SILTY |
| 2A | 12 | 1-2 | | | 38.0 | NV | NP | | A-4 | | SM | SAND, VERY SILTY |
| 2A | 16 | 1-2 | | | 39.9 | 24 | 9 | | A-4 | | SC | SAND, VERY CLAYEY |
| 3 | 10 | 10 | | | 27.5 | NV | NP | | A-2-4 | | SM | SANDSTONE, SILTY |

FIGURE



⊕ TB- APPROXIMATE TEST BORING LOCATIONS AND NUMBERS

| | |
|-------------|----------|
| DATE | 1/11/20 |
| DRAWN BY | AS |
| CHECKED BY | AS |
| DATE | 08/11/20 |
| PROJECT NO. | 201772 |
| PHASE NO. | 1 |

TEST BORING LOCATION MAP
 FOREST LAKES FILING #5
 EL PASO COUNTY, CO
 FOR: FLRD #5

ENTECH
 ENGINEERING, INC.
 505 ELKTON DRIVE
 COLORADO SPRINGS, CO. 80907 (719) 531-5599

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

APPENDIX A: Test Boring Logs

TEST BORING NO. 1
 DATE DRILLED 8/26/2020
 Job # 201782

TEST BORING NO. 2
 DATE DRILLED 8/26/2020
 CLIENT FLRD #2
 LOCATION FOREST LAKES, FILING 5

| REMARKS | | | | | | REMARKS | | | | | |
|---|--------|---------|----------------|----------------|-----------|---|--------|---------|----------------|----------------|-----------|
| Depth (ft) | Symbol | Samples | Blows per foot | Watercontent % | Soil Type | Depth (ft) | Symbol | Samples | Blows per foot | Watercontent % | Soil Type |
| DRY TO 10', 8/26/20 | | | | | | DRY TO 5', 8/26/20 | | | | | |
| FILL 0-10', SAND, CLAYEY TO SILTY, FINE TO COARSE GRAINED, RED BROWN, MEDIUM DENSE, MOIST | | | | | | FILL 0-5', SAND, SILTY, FINE TO COARSE GRAINED, RED BROWN, MEDIUM DENSE TO LOOSE, MOIST | | | | | |
| 5 | | | 24 | 7.7 | 1 | 5 | | | 17 | 6.4 | 1 |
| 5 | | | 15 | 4.5 | 1 | 5 | | | 9 | 6.4 | 1 |
| 10 | | | 32 | 4.9 | 1 | 10 | | | | | |
| 15 | | | | | | 15 | | | | | |
| 20 | | | | | | 20 | | | | | |



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TEST BORING LOG

| | | | |
|--------|-------|----------|---------|
| DRAWN: | DATE: | CHECKED: | DATE: |
| | | DS | 8/26/20 |

JOB NO:
 201782

FIG NO:
 A- 1

TEST BORING NO. 3
 DATE DRILLED 8/26/2020
 Job # 201782

TEST BORING NO. 4
 DATE DRILLED 8/26/2020
 CLIENT FLRD #2
 LOCATION FOREST LAKES, FILING 5

REMARKS

DRY TO 5', 8/26/20
 FILL 0-5', SAND, SILTY, FINE TO
 COARSE GRAINED, RED BROWN,
 MEDIUM DENSE, MOIST

| Depth (ft) | Symbol | Samples | Blows per foot | Watercontent % | Soil Type |
|------------|--------|---------|----------------|----------------|-----------|
| 5 | | | 15 | 4.6 | 1 |
| 5 | | | 20 | 6.0 | 1 |
| 10 | | | | | |
| 15 | | | | | |
| 20 | | | | | |

REMARKS

DRY TO 10', 8/26/20
 FILL 0-10', SAND, SILTY, FINE TO
 COARSE GRAINED, RED BROWN,
 MEDIUM DENSE TO LOOSE,
 MOIST

| Depth (ft) | Symbol | Samples | Blows per foot | Watercontent % | Soil Type |
|------------|--------|---------|----------------|----------------|-----------|
| 5 | | | 13 | 9.7 | 1 |
| 5 | | | 14 | 7.6 | 1 |
| 10 | | | 9 | 7.7 | 1 |
| 15 | | | | | |
| 20 | | | | | |



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TEST BORING LOG

DRAWN:

DATE:

CHECKED: *[Signature]*

DATE: 9/11/20

JOB NO.:
 201782

FIG NO.:
 A- 2

TEST BORING NO. 5
 DATE DRILLED 8/26/2020
 Job # 201782

TEST BORING NO. 6
 DATE DRILLED 8/26/2020
 CLIENT FLRD #2
 LOCATION FOREST LAKES, FILING 5

| REMARKS | | | | | | REMARKS | | | | | |
|--|--------|---------|----------------|----------------|-----------|---|--------|---------|----------------|----------------|-----------|
| Depth (ft) | Symbol | Samples | Blows per foot | Watercontent % | Soil Type | Depth (ft) | Symbol | Samples | Blows per foot | Watercontent % | Soil Type |
| DRY TO 5', 8/26/20 | | | | | | DRY TO 5', 8/26/20 | | | | | |
| FILL 0-5', SAND, SILTY, FINE TO COARSE GRAINED, RED BROWN, MEDIUM DENSE, MOIST | | | | | | FILL 0-5', SAND, SILTY, FINE TO COARSE GRAINED, RED BROWN, LOOSE, MOIST | | | | | |
| 5 | | | 10 | 5.6 | 1 | 5 | | | 9 | 5.6 | 1 |
| 5 | | | 10 | 4.8 | 1 | 5 | | | 5 | 4.8 | 1 |
| 10 | | | | | | 10 | | | | | |
| 15 | | | | | | 15 | | | | | |
| 20 | | | | | | 20 | | | | | |



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TEST BORING LOG

DRAWN:

DATE:

CHECKED *[Signature]*

DATE: 9/11/20

JOB NO:
 201782

FIG NO:
 A- 3

TEST BORING NO. 7
 DATE DRILLED 8/26/2020
 Job # 201782

TEST BORING NO. 8
 DATE DRILLED 8/27/2020
 CLIENT FLRD #2
 LOCATION FOREST LAKES, FILING 5

| REMARKS | Depth (ft) | Symbol | Samples | Blows per foot | Watercontent % | Soil Type | REMARKS | Depth (ft) | Symbol | Samples | Blows per foot | Watercontent % | Soil Type |
|---|------------|----------|---------|----------------|----------------|-----------|---|------------|----------|---------|----------------|----------------|-----------|
| DRY TO 10', 8/26/20 | | | | | | | DRY TO 5', 8/27/20 | | | | | | |
| FILL 0-6', SAND, SILTY, FINE TO COARSE GRAINED, RED BROWN, DENSE TO MEDIUM DENSE, MOIST | 0-6' | [Symbol] | | 33 | 4.2 | 1 | FILL 0-5', SAND, CLAYEY, FINE TO COARSE GRAINED, BROWN, MEDIUM DENSE, MOIST | 0-5' | [Symbol] | | 25 | 7.8 | 1 |
| | 5 | [Symbol] | | 28 | 4.8 | 1 | | 5 | [Symbol] | | 21 | 8.0 | 1 |
| SAND, SILTY, FINE TO COARSE GRAINED, BROWN, MEDIUM DENSE, MOIST | 10 | [Symbol] | | 28 | 3.5 | 1A | | 10 | [Symbol] | | | | |
| | 15 | [Symbol] | | | | | | 15 | [Symbol] | | | | |
| | 20 | [Symbol] | | | | | | 20 | [Symbol] | | | | |



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TEST BORING LOG

DRAWN:

DATE

CHECKED: *[Signature]*

DATE: 9/10/20

JOB NO.:
 201782

FIG NO.:
 A- 4

TEST BORING NO. 9
 DATE DRILLED 8/27/2020
 Job # 201782

TEST BORING NO. 10
 DATE DRILLED 8/27/2020
 CLIENT FLRD #2
 LOCATION FOREST LAKES, FILING 5

REMARKS

DRY TO 5', 8/27/20
 POSS. FILL 0-5', SAND, SILTY,
 FINE TO COARSE GRAINED,
 BROWN, MEDIUM DENSE, MOIST

| Depth (ft) | Symbol | Samples | Blows per foot | Watercontent % | Soil Type |
|------------|--------|---------|----------------|----------------|-----------|
| 5 | | | 23 | 7.9 | 1 |
| 5 | | | 21 | 8.6 | 1 |
| 10 | | | | | |
| 15 | | | | | |
| 20 | | | | | |

REMARKS

DRY TO 10', 8/27/20
 POSS. FILL 0-4', SAND, SILTY,
 FINE TO COARSE GRAINED,
 TAN, MEDIUM DENSE, MOIST
 SAND, SILTY, FINE TO COARSE
 GRAINED, RED BROWN, MEDIUM
 DENSE, MOIST
 SANDSTONE, SILTY, FINE TO
 COARSE GRAINED, RED BROWN,
 VERY DENSE, MOIST

| Depth (ft) | Symbol | Samples | Blows per foot | Watercontent % | Soil Type |
|------------|--------|---------|----------------|----------------|-----------|
| 5 | | | 19 | 8.4 | 1 |
| 5 | | | 17 | 7.2 | 1A |
| 10 | | | 50 4" | 4.5 | 3 |
| 15 | | | | | |
| 20 | | | | | |



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TEST BORING LOG

DRAWN:

DATE:

CHECKED: *h*

DATE: 9/11/20

JOB NO:
 201782

FIG NO:
 A- 5

TEST BORING NO. 11
 DATE DRILLED 8/27/2020
 Job # 201782

TEST BORING NO. 12
 DATE DRILLED 8/27/2020
 CLIENT FLRD #2
 LOCATION FOREST LAKES, FILING 5

| REMARKS | | | | | | REMARKS | | | | | |
|---|----------|---------|----------------|----------------|-----------|--|----------|---------|----------------|----------------|-----------|
| Depth (ft) | Symbol | Samples | Blows per foot | Watercontent % | Soil Type | Depth (ft) | Symbol | Samples | Blows per foot | Watercontent % | Soil Type |
| DRY TO 5', 8/27/20 | | | | | | DRY TO 5', 8/27/20 | | | | | |
| SAND, SILTY, FINE TO COARSE GRAINED, BROWN, MEDIUM DENSE TO DENSE, MOIST | | | | | | SAND, VERY SILTY, FINE TO COARSE GRAINED, BROWN, MEDIUM DENSE, MOIST | | | | | |
| 5 | [Symbol] | | 16 | 8.5 | 1A | 5 | [Symbol] | | 21 | 7.6 | 2A |
| 5 | [Symbol] | | 40 | 6.4 | 3 | 5 | [Symbol] | | 20 | 7.4 | 2A |
| WEATHERED SANDSTONE, SILTY, FINE TO COARSE GRAINED, RED BROWN, DENSE, MOIST | | | | | | | | | | | |



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TEST BORING LOG

DRAWN:

DATE:

CHECKED: *[Signature]*

DATE: 9/11/20

JOB NO.:
 201782

FIG NO.:
 A- 6

TEST BORING NO. 13
 DATE DRILLED 8/27/2020
 Job # 201782

TEST BORING NO. 14
 DATE DRILLED 8/27/2020
 CLIENT FLRD #2
 LOCATION FOREST LAKES, FILING 5

REMARKS

DRY TO 10', 8/27/20
 FILL 0-10', SAND, VERY SILTY,
 FINE TO COARSE GRAINED,
 BROWN TO RED BROWN, MEDIUM
 DENSE TO DENSE, MOIST

| Depth (ft) | Symbol | Samples | Blows per foot | Watercontent % | Soil Type |
|------------|--------|---------|----------------|----------------|-----------|
| 0-5 | | | 28 | 7.4 | 2 |
| 5-10 | | | 34 | 5.8 | 2 |
| 10-15 | | | 24 | 4.8 | 2 |

REMARKS

DRY TO 5', 8/27/20
 FILL 0-5', SAND, VERY SILTY,
 FINE TO COARSE GRAINED, RED
 BROWN, MEDIUM DENSE TO
 DENSE, MOIST

| Depth (ft) | Symbol | Samples | Blows per foot | Watercontent % | Soil Type |
|------------|--------|---------|----------------|----------------|-----------|
| 0-5 | | | 37 | 5.9 | 2 |
| 5-10 | | | 26 | 4.5 | 2 |



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TEST BORING LOG

DRAWN: _____ DATE _____ CHECKED: *h* DATE 9/11/20

JOB NO.:
 201782

FIG NO.:
 A- 7

TEST BORING NO. 15
 DATE DRILLED 8/27/2020
 Job # 201782

TEST BORING NO. 16
 DATE DRILLED 8/27/2020
 CLIENT FLRD #2
 LOCATION FOREST LAKES, FILING 5

REMARKS

DRY TO 5', 8/27/20

FILL 0-5, SAND, SILTY WITH ORGANICS, FINE TO COARSE GRAINED, DARK BROWN, DENSE TO MEDIUM DENSE, MOIST

| Depth (ft) | Symbol | Samples | Blows per foot | Watercontent % | Soil Type |
|------------|--------|---------|----------------|----------------|-----------|
| 5 | | | 36 | 5.5 | 1 |
| 5 | | | 27 | 7.3 | 1 |
| 10 | | | | | |
| 15 | | | | | |
| 20 | | | | | |

REMARKS

DRY TO 10', 8/27/20

SAND, VERY CLAYEY, FINE GRAINED, RED BROWN, DENSE, MOIST

| Depth (ft) | Symbol | Samples | Blows per foot | Watercontent % | Soil Type |
|------------|--------|---------|----------------|----------------|-----------|
| 5 | | | 39 | 5.7 | 2A |
| 5 | | | 39 | 4.3 | 2A |
| 10 | | | 31 | 5.8 | 2A |
| 15 | | | | | |
| 20 | | | | | |



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505 ELKTON DRIVE
 COLORADO SPRINGS, COLORADO 80907

TEST BORING LOG

DRAWN:

DATE:

CHECKED: *[Signature]*

DATE: 8/31/20

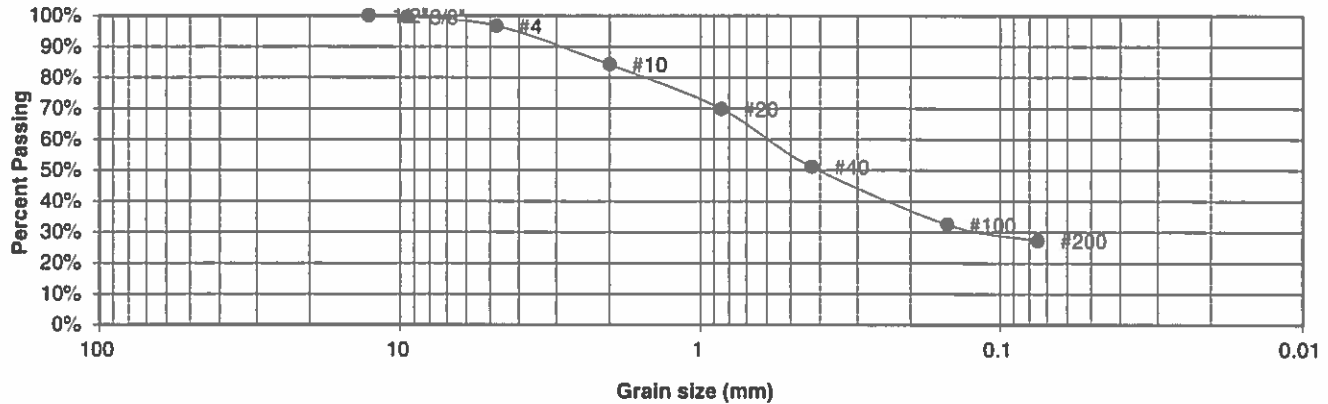
JOB NO.:
 201782

FIG NO.:
 A- 8

APPENDIX B: Laboratory Test Results

| | | | |
|-------------------------------|--------|--------------------|------------------------|
| <u>UNIFIED CLASSIFICATION</u> | SM | <u>CLIENT</u> | FLRD #2 |
| <u>SOIL TYPE #</u> | 1, CBR | <u>PROJECT</u> | FOREST LAKES, FILING 5 |
| <u>TEST BORING #</u> | 7 | <u>JOB NO.</u> | 201782 |
| <u>DEPTH (FT)</u> | 0-3 | <u>TEST BY</u> | BL |
| <u>AASHTO CLASSIFICATION</u> | A-2-4 | <u>GROUP INDEX</u> | 0 |

**Sieve Analysis
Grain Size Distribution**



| U.S. Sieve # | Percent Finer |
|--------------|---------------|
| 3" | |
| 1 1/2" | |
| 3/4" | |
| 1/2" | 100.0% |
| 3/8" | 99.6% |
| 4 | 96.7% |
| 10 | 84.2% |
| 20 | 69.8% |
| 40 | 51.1% |
| 100 | 32.4% |
| 200 | 27.3% |

| 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:

[Signature] 9/11/20

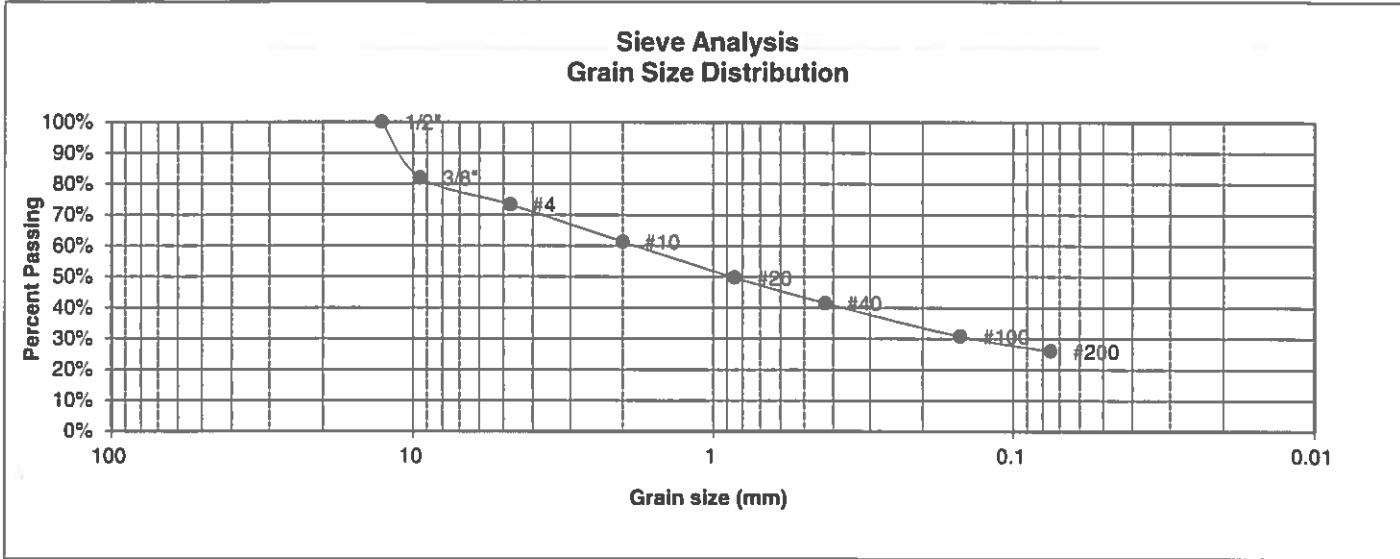
JOB NO.:

201782

FIG NO.:

P-1

| | | | |
|-------------------------------|-------|--------------------|------------------------|
| <u>UNIFIED CLASSIFICATION</u> | SC | <u>CLIENT</u> | FLRD #2 |
| <u>SOIL TYPE #</u> | 1 | <u>PROJECT</u> | FOREST LAKES, FILING 5 |
| <u>TEST BORING #</u> | 1 | <u>JOB NO.</u> | 201782 |
| <u>DEPTH (FT)</u> | 1-2 | <u>TEST BY</u> | BL |
| <u>AASHTO CLASSIFICATION</u> | A-2-4 | <u>GROUP INDEX</u> | 0 |



| U.S. Sieve # | Percent Finer |
|--------------|---------------|
| 3" | |
| 1 1/2" | |
| 3/4" | |
| 1/2" | 100.0% |
| 3/8" | 82.0% |
| 4 | 73.3% |
| 10 | 61.3% |
| 20 | 49.8% |
| 40 | 41.5% |
| 100 | 30.8% |
| 200 | 26.0% |

| Atterberg Limits | |
|------------------|----|
| Plastic Limit | 17 |
| Liquid Limit | 28 |
| Plastic Index | 10 |

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



**ENTECH
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505 ELKTON DRIVE
COLORADO SPRINGS, COLORADO 80907

**LABORATORY TEST
RESULTS**

| | | | |
|--------|-------|--------------------|---------|
| DRAWN: | DATE: | CHECKED: | DATE: |
| | | <i>[Signature]</i> | 9/11/20 |

JOB NO.:

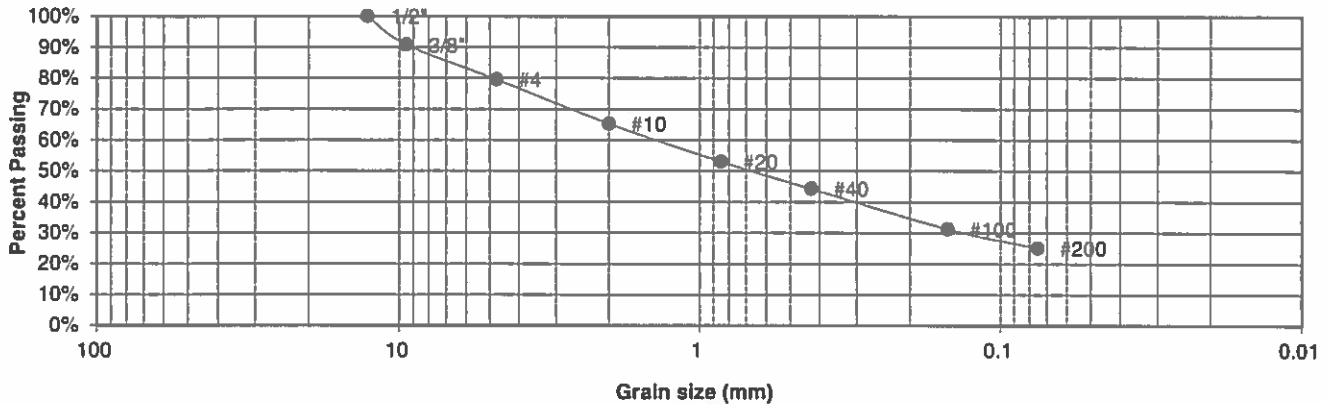
201782

FIG NO.:

B-2

| | | | |
|-------------------------------|-------|--------------------|------------------------|
| <u>UNIFIED CLASSIFICATION</u> | SM | <u>CLIENT</u> | FLRD #2 |
| <u>SOIL TYPE #</u> | 1 | <u>PROJECT</u> | FOREST LAKES, FILING 5 |
| <u>TEST BORING #</u> | 2 | <u>JOB NO.</u> | 201782 |
| <u>DEPTH (FT)</u> | 1-2 | <u>TEST BY</u> | BL |
| <u>AASHTO CLASSIFICATION</u> | A-1-b | <u>GROUP INDEX</u> | 0 |

**Sieve Analysis
Grain Size Distribution**



| U.S. Sieve # | Percent Finer |
|--------------|---------------|
| 3" | |
| 1 1/2" | |
| 3/4" | |
| 1/2" | 100.0% |
| 3/8" | 90.7% |
| 4 | 79.6% |
| 10 | 65.3% |
| 20 | 53.1% |
| 40 | 44.3% |
| 100 | 31.2% |
| 200 | 25.1% |

| 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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**LABORATORY TEST
RESULTS**

DRAWN:

DATE:

CHECKED:

DATE:

[Signature] 9/11/20

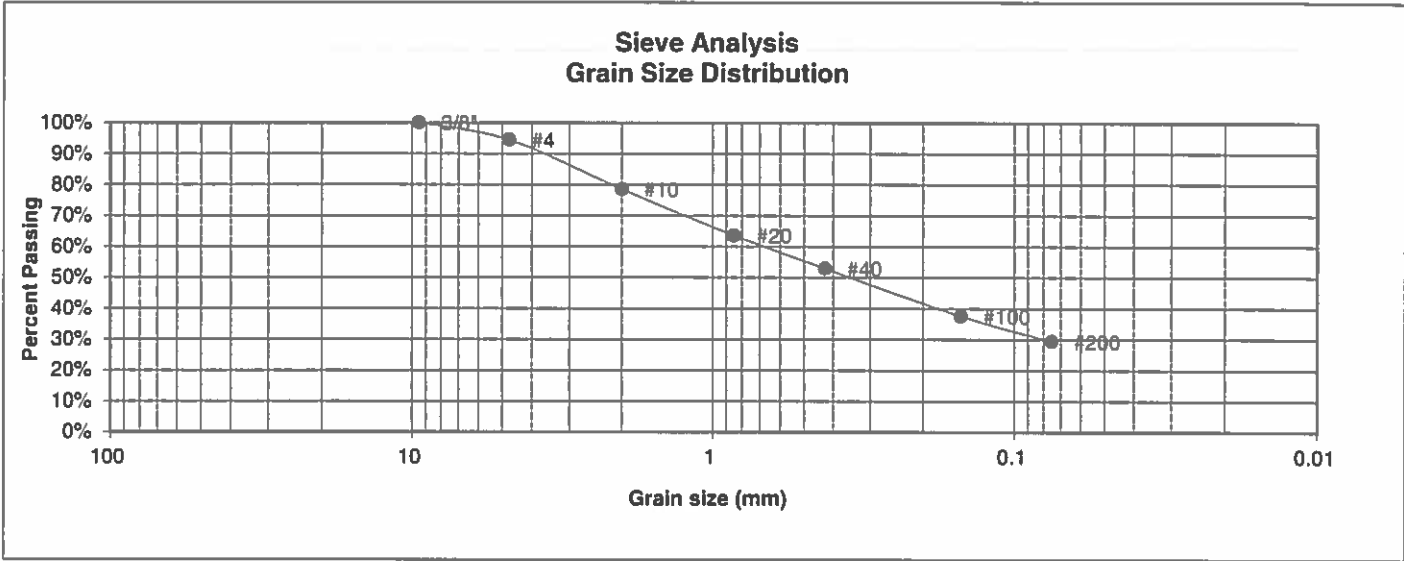
JOB NO.:

201782

FIG NO.:

B-3

| | | | |
|-------------------------------|-------|--------------------|------------------------|
| <u>UNIFIED CLASSIFICATION</u> | SM | <u>CLIENT</u> | FLRD #2 |
| <u>SOIL TYPE #</u> | 1 | <u>PROJECT</u> | FOREST LAKES, FILING 5 |
| <u>TEST BORING #</u> | 3 | <u>JOB NO.</u> | 201782 |
| <u>DEPTH (FT)</u> | 1-2 | <u>TEST BY</u> | BL |
| <u>AASHTO CLASSIFICATION</u> | A-2-4 | <u>GROUP INDEX</u> | 0 |



| U.S. Sieve # | Percent Finer |
|--------------|---------------|
| 3" | |
| 1 1/2" | |
| 3/4" | |
| 1/2" | |
| 3/8" | 100.0% |
| 4 | 94.5% |
| 10 | 78.6% |
| 20 | 63.6% |
| 40 | 52.9% |
| 100 | 37.6% |
| 200 | 29.4% |

| 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) | |



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**LABORATORY TEST
RESULTS**

DRAWN:

DATE:

CHECKED:

DATE:

9/11/20

JOB NO.:

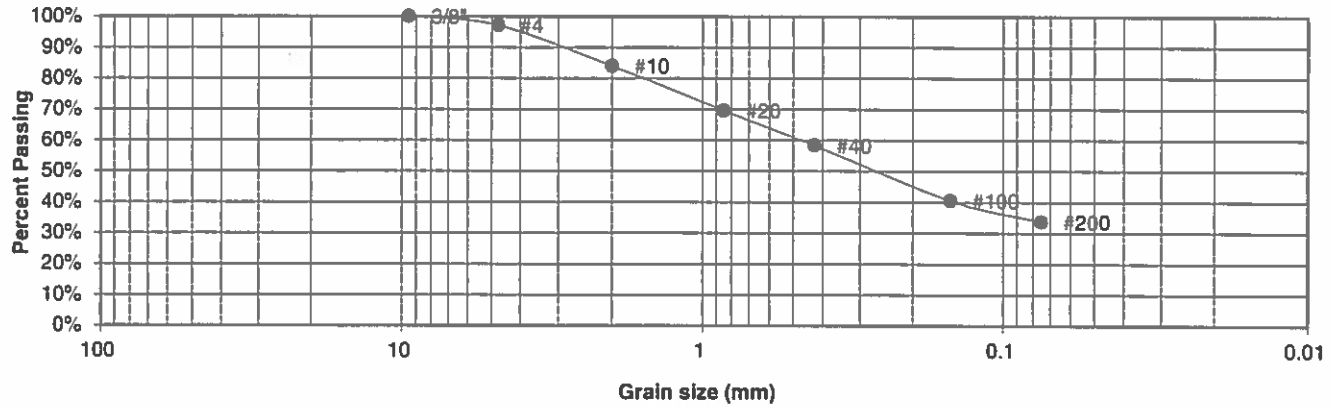
201782

FIG NO.:

B-4

| | | | |
|-------------------------------|-------|--------------------|------------------------|
| <u>UNIFIED CLASSIFICATION</u> | SM | <u>CLIENT</u> | FLRD #2 |
| <u>SOIL TYPE #</u> | 1 | <u>PROJECT</u> | FOREST LAKES, FILING 5 |
| <u>TEST BORING #</u> | 4 | <u>JOB NO.</u> | 201782 |
| <u>DEPTH (FT)</u> | 1-2 | <u>TEST BY</u> | BL |
| <u>AASHTO CLASSIFICATION</u> | A-2-4 | <u>GROUP INDEX</u> | 0 |

**Sieve Analysis
Grain Size Distribution**



| U.S. Sieve # | Percent Finer |
|--------------|---------------|
| 3" | |
| 1 1/2" | |
| 3/4" | |
| 1/2" | |
| 3/8" | 100.0% |
| 4 | 97.2% |
| 10 | 84.0% |
| 20 | 69.6% |
| 40 | 58.3% |
| 100 | 40.5% |
| 200 | 33.7% |

| <u>Atterberg Limits</u> | |
|-------------------------|----|
| Plastic Limit | NP |
| Liquid Limit | NV |
| Plastic Index | NP |

| <u>Swell</u> | |
|---------------------------|--|
| 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:

[Signature] 9/11/20

JOB NO.:

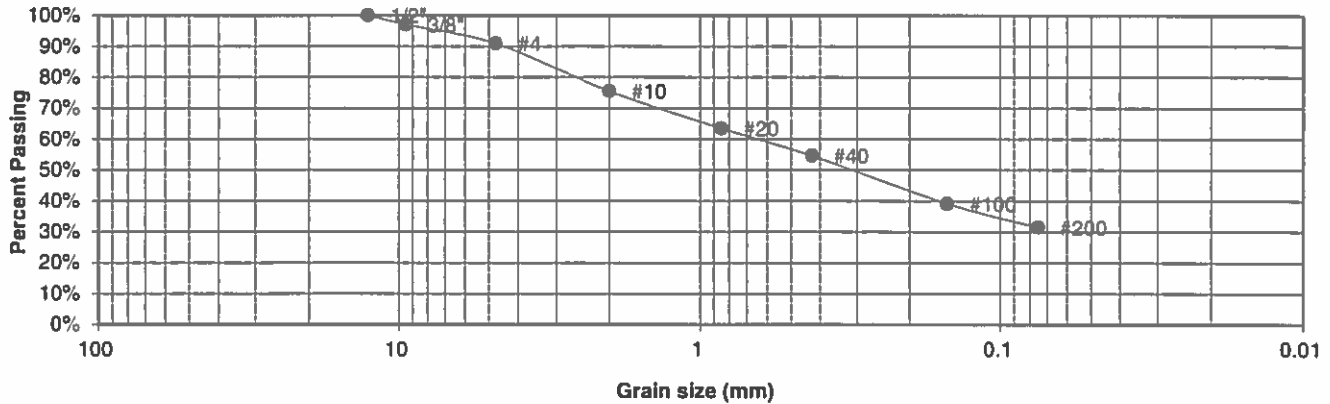
201782

FIG NO.:

B-5

| | | | |
|-------------------------------|-------|--------------------|------------------------|
| <u>UNIFIED CLASSIFICATION</u> | SM | <u>CLIENT</u> | FLRD #2 |
| <u>SOIL TYPE #</u> | 1 | <u>PROJECT</u> | FOREST LAKES, FILING 5 |
| <u>TEST BORING #</u> | 5 | <u>JOB NO.</u> | 201782 |
| <u>DEPTH (FT)</u> | 1-2 | <u>TEST BY</u> | BL |
| <u>AASHTO CLASSIFICATION</u> | A-2-4 | <u>GROUP INDEX</u> | 0 |

**Sieve Analysis
Grain Size Distribution**



| U.S. Sieve # | Percent Finer |
|--------------|---------------|
| 3" | |
| 1 1/2" | |
| 3/4" | |
| 1/2" | 100.0% |
| 3/8" | 97.0% |
| 4 | 91.0% |
| 10 | 75.5% |
| 20 | 63.5% |
| 40 | 54.6% |
| 100 | 39.1% |
| 200 | 31.5% |

| 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) | |



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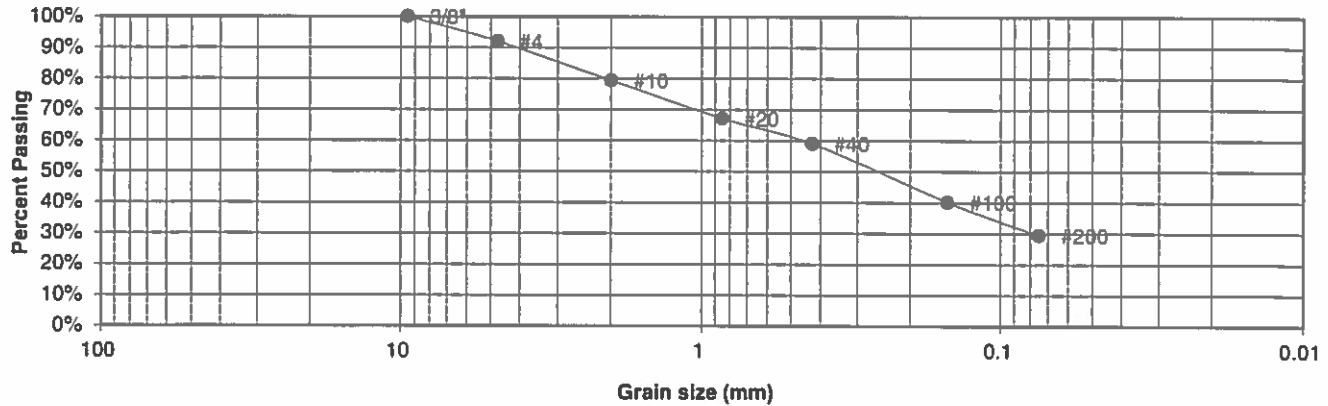
**LABORATORY TEST
RESULTS**

| | | | |
|--------|-------|----------|---------|
| DRAWN: | DATE: | CHECKED: | DATE: |
| | | <i>W</i> | 9/11/21 |

JOB NO.:
201782
FIG NO.:
B-6

| | | | |
|-------------------------------|-------|--------------------|------------------------|
| <u>UNIFIED CLASSIFICATION</u> | SM | <u>CLIENT</u> | FLRD #2 |
| <u>SOIL TYPE #</u> | 1 | <u>PROJECT</u> | FOREST LAKES, FILING 5 |
| <u>TEST BORING #</u> | 6 | <u>JOB NO.</u> | 201782 |
| <u>DEPTH (FT)</u> | 1-2 | <u>TEST BY</u> | BL |
| <u>AASHTO CLASSIFICATION</u> | A-2-4 | <u>GROUP INDEX</u> | 0 |

**Sieve Analysis
Grain Size Distribution**



| U.S. Sieve # | Percent Finer |
|--------------|---------------|
| 3" | |
| 1 1/2" | |
| 3/4" | |
| 1/2" | |
| 3/8" | 100.0% |
| 4 | 92.0% |
| 10 | 79.4% |
| 20 | 67.1% |
| 40 | 59.1% |
| 100 | 40.2% |
| 200 | 29.5% |

| <u>Atterberg Limits</u> | |
|-------------------------|----|
| Plastic Limit | NP |
| Liquid Limit | NV |
| Plastic Index | NP |

| <u>Swell</u> | |
|---------------------------|--|
| Moisture at start | |
| Moisture at finish | |
| Moisture increase | |
| Initial dry density (pcf) | |
| Swell (psf) | |



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505 ELKTON DRIVE
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**LABORATORY TEST
RESULTS**

DRAWN:

DATE:

CHECKED:

DATE:

9/11/20

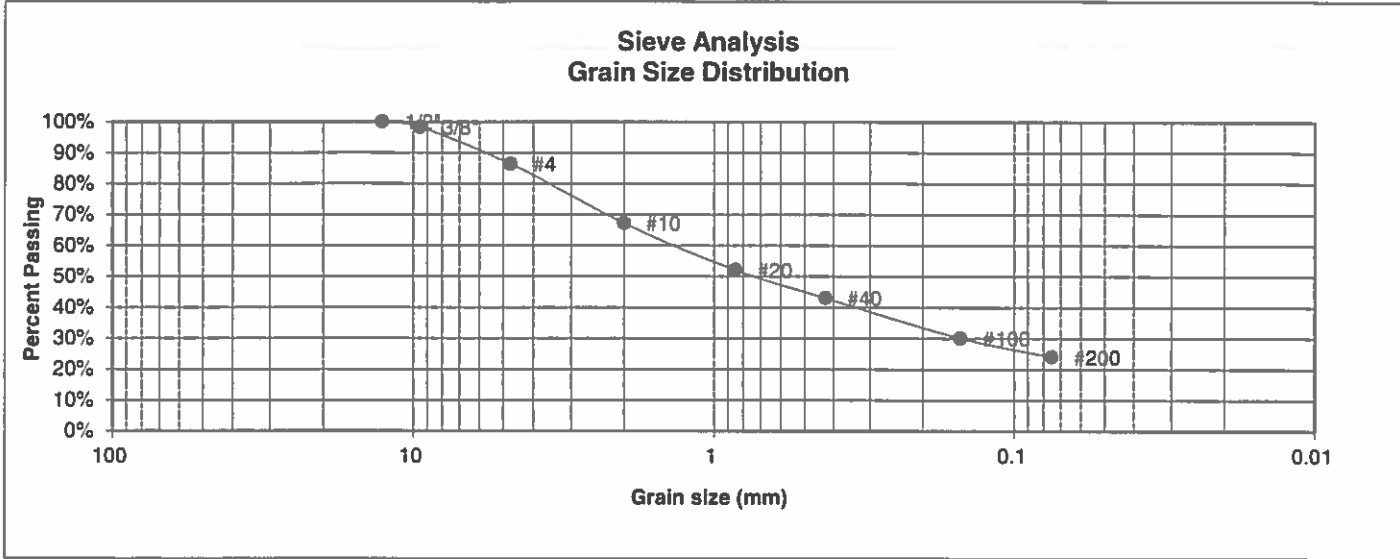
JOB NO.:

201782

FIG NO.:

B-7

| | | | |
|-------------------------------|-------|--------------------|------------------------|
| <u>UNIFIED CLASSIFICATION</u> | SM | <u>CLIENT</u> | FLRD #2 |
| <u>SOIL TYPE #</u> | 1 | <u>PROJECT</u> | FOREST LAKES, FILING 5 |
| <u>TEST BORING #</u> | 7 | <u>JOB NO.</u> | 201782 |
| <u>DEPTH (FT)</u> | 1-2 | <u>TEST BY</u> | BL |
| <u>AASHTO CLASSIFICATION</u> | A-1-b | <u>GROUP INDEX</u> | 0 |



| U.S. Sieve # | Percent Finer |
|--------------|---------------|
| 3" | |
| 1 1/2" | |
| 3/4" | |
| 1/2" | 100.0% |
| 3/8" | 98.3% |
| 4 | 86.5% |
| 10 | 67.2% |
| 20 | 52.1% |
| 40 | 43.0% |
| 100 | 30.1% |
| 200 | 24.0% |

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) | |



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**LABORATORY TEST
RESULTS**

| | | | |
|--------|-------|--------------------|---------|
| DRAWN: | DATE: | CHECKED: | DATE: |
| | | <i>[Signature]</i> | 9/11/20 |

JOB NO.:

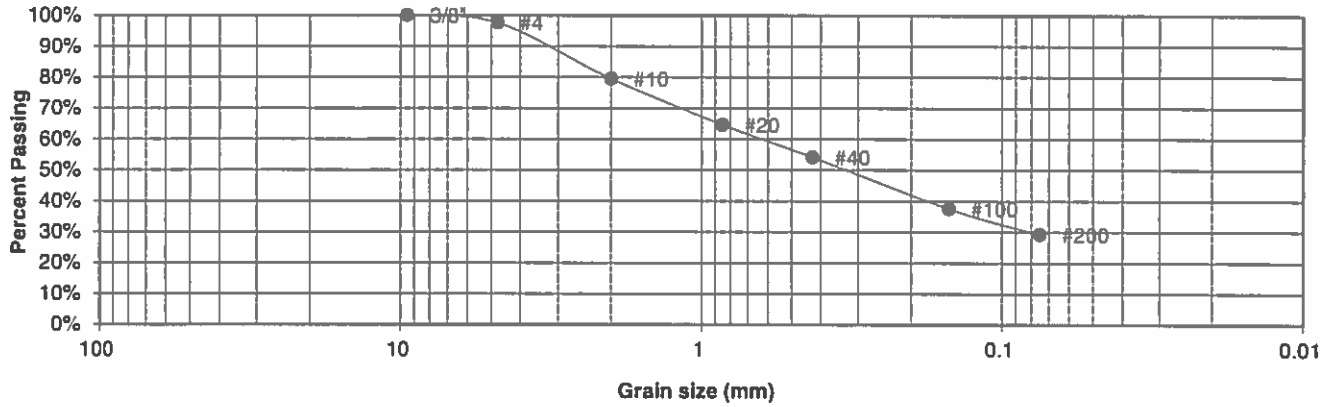
201782

FIG NO.:

B-8

| | | | |
|-------------------------------|-------|--------------------|------------------------|
| <u>UNIFIED CLASSIFICATION</u> | SC | <u>CLIENT</u> | FLRD #2 |
| <u>SOIL TYPE #</u> | 1 | <u>PROJECT</u> | FOREST LAKES, FILING 5 |
| <u>TEST BORING #</u> | 8 | <u>JOB NO.</u> | 201782 |
| <u>DEPTH (FT)</u> | 1-2 | <u>TEST BY</u> | BL |
| <u>AASHTO CLASSIFICATION</u> | A-2-4 | <u>GROUP INDEX</u> | 0 |

**Sieve Analysis
Grain Size Distribution**



| <u>U.S. Sieve #</u> | <u>Percent Finer</u> |
|---------------------|----------------------|
| 3" | |
| 1 1/2" | |
| 3/4" | |
| 1/2" | |
| 3/8" | 100.0% |
| 4 | 97.6% |
| 10 | 79.5% |
| 20 | 64.6% |
| 40 | 54.2% |
| 100 | 37.5% |
| 200 | 29.2% |

| <u>Atterberg Limits</u> | |
|-------------------------|----|
| Plastic Limit | 18 |
| Liquid Limit | 26 |
| Plastic Index | 8 |

| <u>Swell</u> | |
|---------------------------|--|
| 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: |
| | | | 9/11/20 |

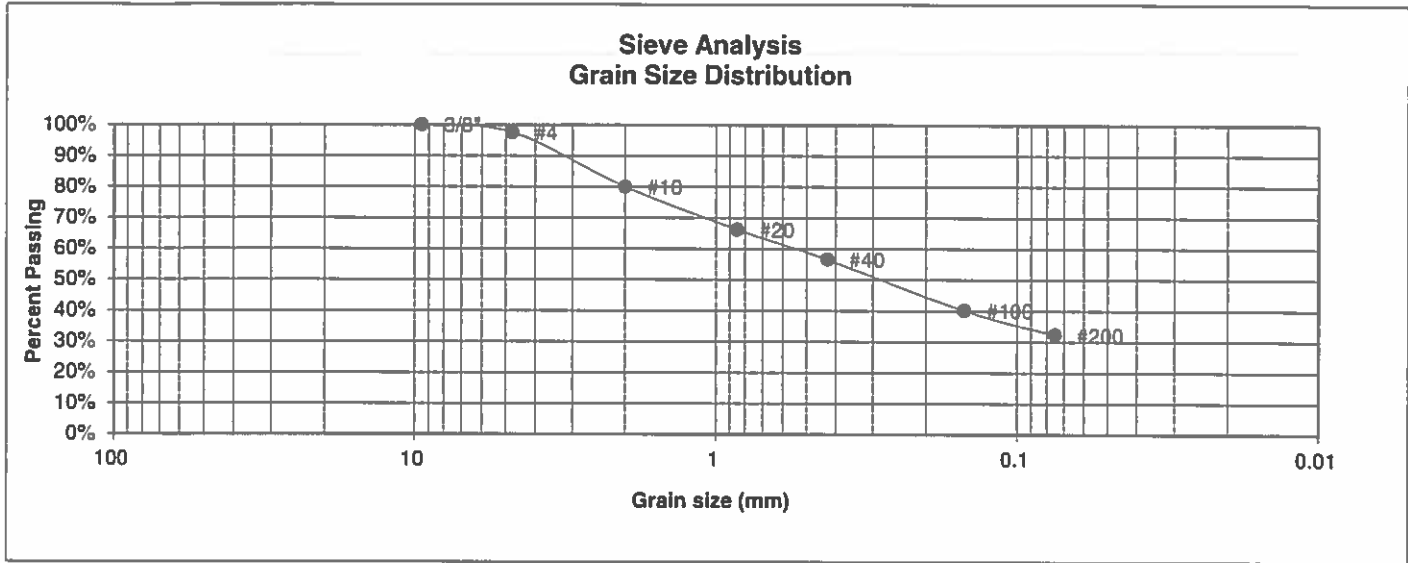
JOB NO.:

201782

FIG NO.:

B-9

| | | | |
|-------------------------------|-------|--------------------|------------------------|
| <u>UNIFIED CLASSIFICATION</u> | SM | <u>CLIENT</u> | FLRD #2 |
| <u>SOIL TYPE #</u> | 1 | <u>PROJECT</u> | FOREST LAKES, FILING 5 |
| <u>TEST BORING #</u> | 9 | <u>JOB NO.</u> | 201782 |
| <u>DEPTH (FT)</u> | 1-2 | <u>TEST BY</u> | BL |
| <u>AASHTO CLASSIFICATION</u> | A-2-4 | <u>GROUP INDEX</u> | 0 |



| U.S. Sieve # | Percent Finer |
|--------------|---------------|
| 3" | |
| 1 1/2" | |
| 3/4" | |
| 1/2" | |
| 3/8" | 100.0% |
| 4 | 97.5% |
| 10 | 80.0% |
| 20 | 66.2% |
| 40 | 56.6% |
| 100 | 40.1% |
| 200 | 32.3% |

| 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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**LABORATORY TEST
RESULTS**

| | | | |
|--------|-------|----------|---------|
| DRAWN: | DATE: | CHECKED: | DATE: |
| | | <i>h</i> | 9/11/20 |

JOB NO.:

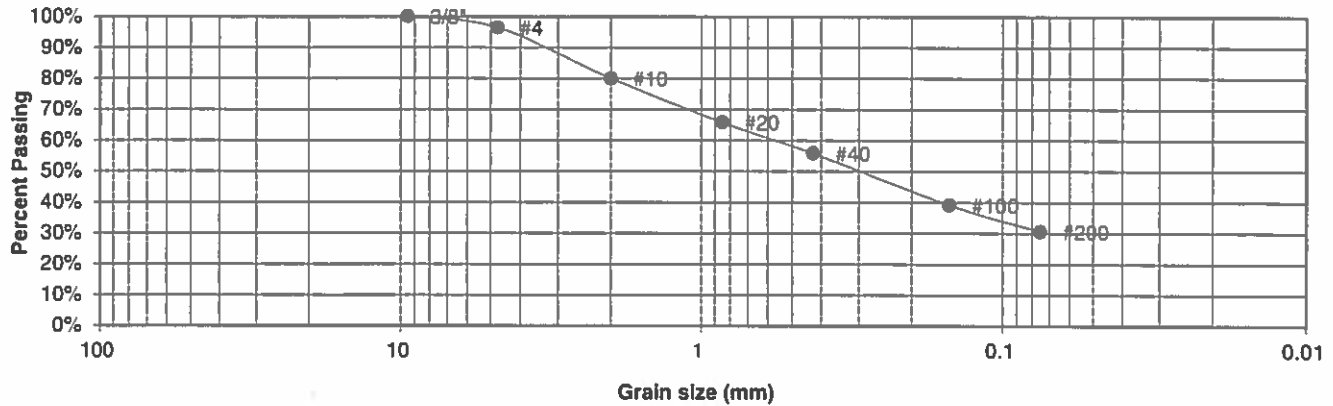
201782

FIG NO.:

B-10

| | | | |
|-------------------------------|-------|--------------------|------------------------|
| <u>UNIFIED CLASSIFICATION</u> | SM | <u>CLIENT</u> | FLRD #2 |
| <u>SOIL TYPE #</u> | 1 | <u>PROJECT</u> | FOREST LAKES, FILING 5 |
| <u>TEST BORING #</u> | 10 | <u>JOB NO.</u> | 201782 |
| <u>DEPTH (FT)</u> | 1-2 | <u>TEST BY</u> | BL |
| <u>AASHTO CLASSIFICATION</u> | A-2-4 | <u>GROUP INDEX</u> | 0 |

**Sieve Analysis
Grain Size Distribution**



| <u>U.S. Sieve #</u> | <u>Percent Finer</u> |
|---------------------|----------------------|
| 3" | |
| 1 1/2" | |
| 3/4" | |
| 1/2" | |
| 3/8" | 100.0% |
| 4 | 96.5% |
| 10 | 80.0% |
| 20 | 65.8% |
| 40 | 55.9% |
| 100 | 39.1% |
| 200 | 30.6% |

| <u>Atterberg Limits</u> | |
|-------------------------|----|
| Plastic Limit | NP |
| Liquid Limit | NV |
| Plastic Index | NP |

| <u>Swell</u> | |
|---------------------------|--|
| 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: 9/16/20 |
|--------|-------|----------|---------------|

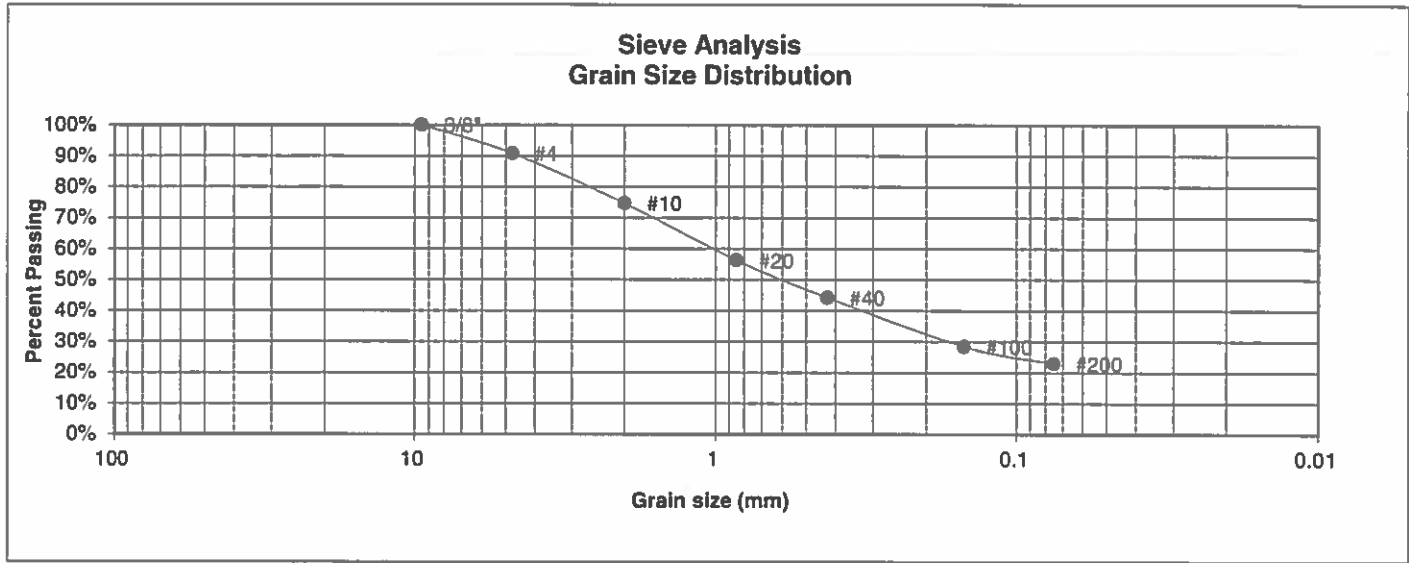
JOB NO.:

201782

FIG NO.:

B-11

| | | | |
|-------------------------------|-------|--------------------|------------------------|
| <u>UNIFIED CLASSIFICATION</u> | SM | <u>CLIENT</u> | FLRD #2 |
| <u>SOIL TYPE #</u> | 1 | <u>PROJECT</u> | FOREST LAKES, FILING 5 |
| <u>TEST BORING #</u> | 15 | <u>JOB NO.</u> | 201782 |
| <u>DEPTH (FT)</u> | 1-2 | <u>TEST BY</u> | BL |
| <u>AASHTO CLASSIFICATION</u> | A-1-b | <u>GROUP INDEX</u> | 0 |



| U.S. Sieve # | Percent Finer |
|--------------|---------------|
| 3" | |
| 1 1/2" | |
| 3/4" | |
| 1/2" | |
| 3/8" | 100.0% |
| 4 | 90.8% |
| 10 | 74.7% |
| 20 | 56.3% |
| 40 | 44.2% |
| 100 | 28.4% |
| 200 | 22.9% |

| 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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**LABORATORY TEST
RESULTS**

| | | | |
|--------|-------|--------------------|---------|
| DRAWN: | DATE: | CHECKED: | DATE: |
| | | <i>[Signature]</i> | 9/11/20 |

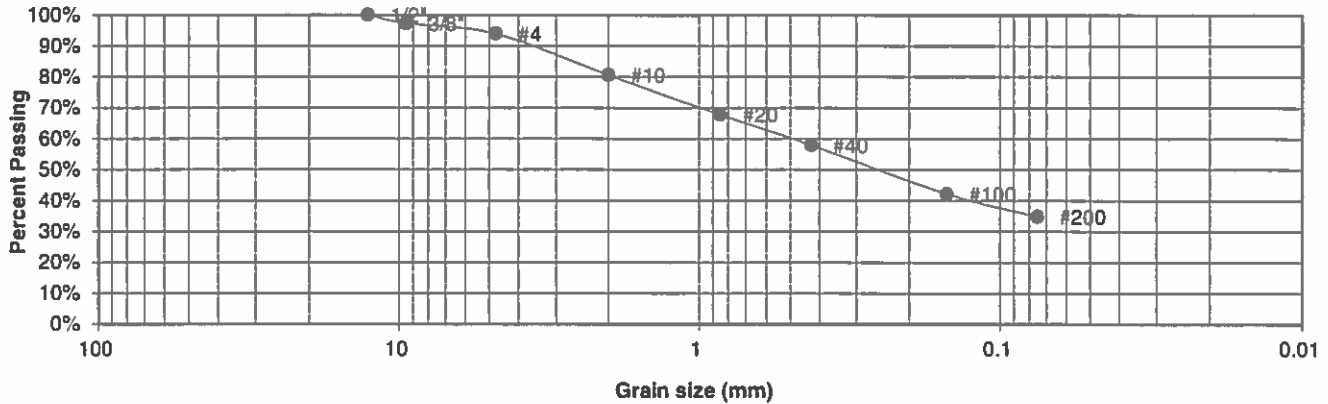
JOB NO.:

201782
FIG NO.

2-12

| | | | |
|-------------------------------|-------|--------------------|------------------------|
| UNIFIED CLASSIFICATION | SM | CLIENT | FLRD #2 |
| SOIL TYPE # | 1A | PROJECT | FOREST LAKES, FILING 5 |
| TEST BORING # | 11 | JOB NO. | 201782 |
| 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" | 100.0% |
| 3/8" | 97.3% |
| 4 | 93.9% |
| 10 | 80.6% |
| 20 | 67.8% |
| 40 | 57.9% |
| 100 | 42.1% |
| 200 | 34.8% |

| 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
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**LABORATORY TEST
RESULTS**

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DATE:

CHECKED:

DATE:

[Signature] 9/11/20

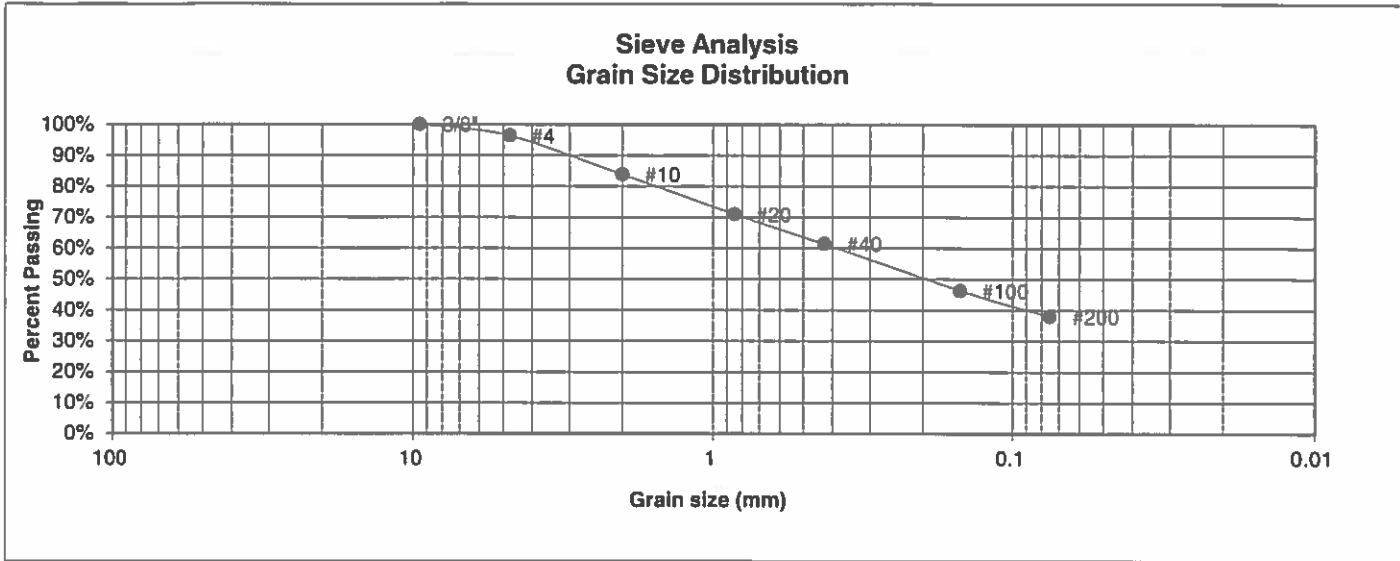
JOB NO.:

201782

FIG NO.:

3-13

| | | | |
|-------------------------------|-----|--------------------|------------------------|
| <u>UNIFIED CLASSIFICATION</u> | SM | <u>CLIENT</u> | FLRD #2 |
| <u>SOIL TYPE #</u> | 2A | <u>PROJECT</u> | FOREST LAKES, FILING 5 |
| <u>TEST BORING #</u> | 12 | <u>JOB NO.</u> | 201782 |
| <u>DEPTH (FT)</u> | 1-2 | <u>TEST BY</u> | BL |
| <u>AASHTO CLASSIFICATION</u> | A-4 | <u>GROUP INDEX</u> | 0 |



| U.S. Sieve # | Percent Finer |
|--------------|---------------|
| 3" | |
| 1 1/2" | |
| 3/4" | |
| 1/2" | |
| 3/8" | 100.0% |
| 4 | 96.4% |
| 10 | 83.8% |
| 20 | 71.0% |
| 40 | 61.4% |
| 100 | 46.3% |
| 200 | 38.0% |

| 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)



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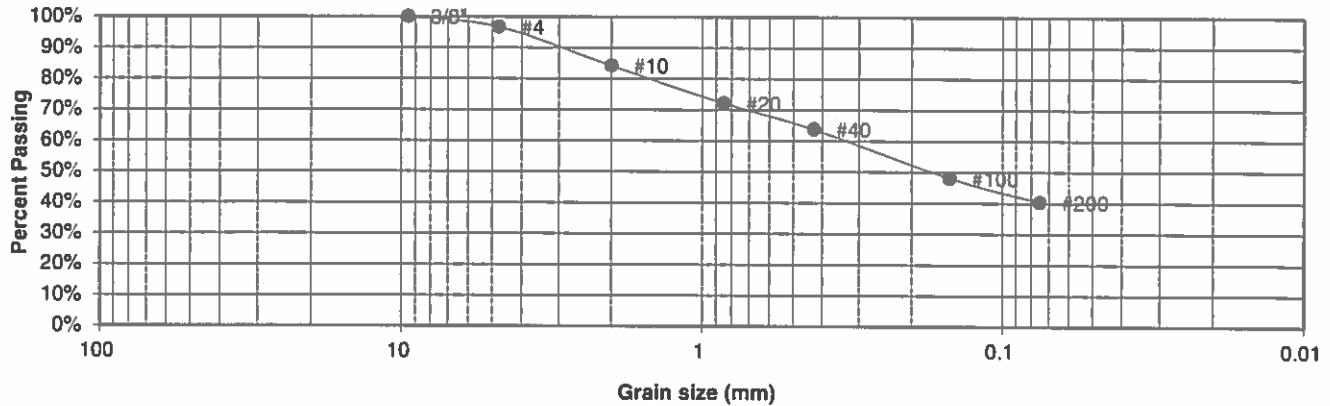
**LABORATORY TEST
RESULTS**

| | | | |
|--------|-------|--------------------|---------|
| DRAWN: | DATE: | CHECKED: | DATE: |
| | | <i>[Signature]</i> | 9/11/20 |

JOB NO.:
201782
FIG NO.:
B-14

| | | | |
|-------------------------------|-----|--------------------|------------------------|
| <u>UNIFIED CLASSIFICATION</u> | SM | <u>CLIENT</u> | FLRD #2 |
| <u>SOIL TYPE #</u> | 2 | <u>PROJECT</u> | FOREST LAKES, FILING 5 |
| <u>TEST BORING #</u> | 13 | <u>JOB NO.</u> | 201782 |
| <u>DEPTH (FT)</u> | 1-2 | <u>TEST BY</u> | BL |
| <u>AASHTO CLASSIFICATION</u> | A-4 | <u>GROUP INDEX</u> | 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 | 84.2% |
| 20 | 72.1% |
| 40 | 63.8% |
| 100 | 48.1% |
| 200 | 40.4% |

| 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) | |



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COLORADO SPRINGS, COLORADO 80907

**LABORATORY TEST
RESULTS**

DRAWN:

DATE:

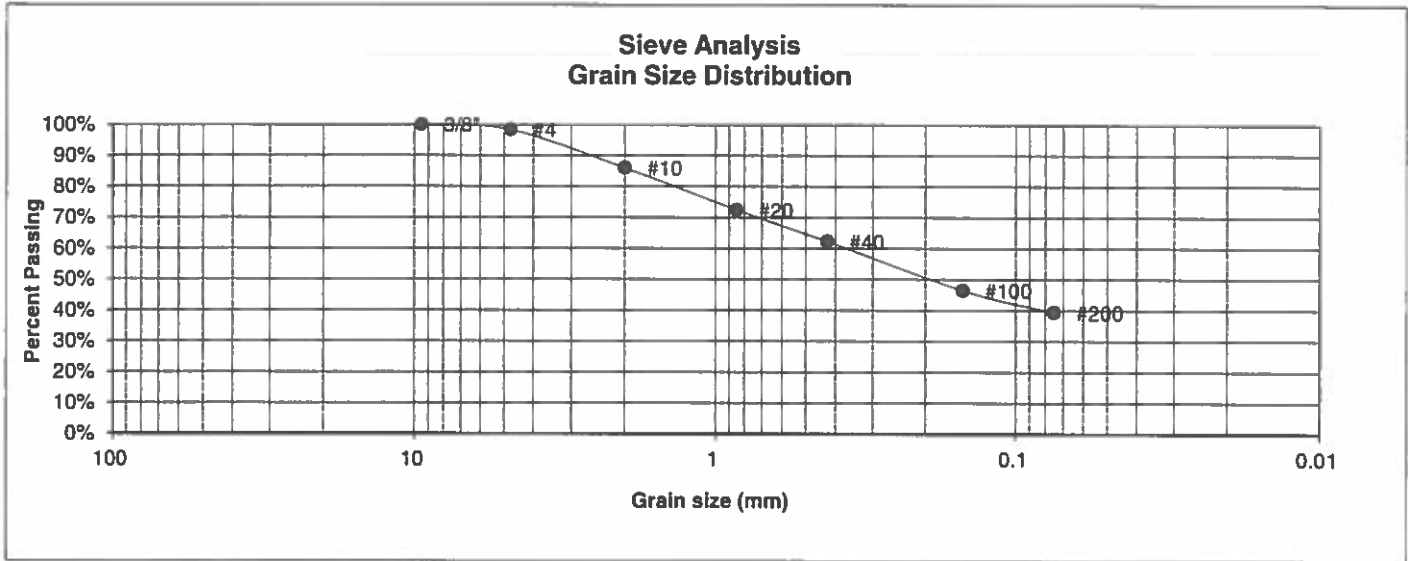
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DATE:
9/11/20

JOB NO.:

201782
FIG NO.:
B-15

| | | | |
|-------------------------------|-----|--------------------|------------------------|
| <u>UNIFIED CLASSIFICATION</u> | SM | <u>CLIENT</u> | FLRD #2 |
| <u>SOIL TYPE #</u> | 2 | <u>PROJECT</u> | FOREST LAKES, FILING 5 |
| <u>TEST BORING #</u> | 14 | <u>JOB NO.</u> | 201782 |
| <u>DEPTH (FT)</u> | 1-2 | <u>TEST BY</u> | BL |
| <u>AASHTO CLASSIFICATION</u> | A-4 | <u>GROUP INDEX</u> | 0 |



| U.S. Sieve # | Percent Finer |
|--------------|---------------|
| 3" | |
| 1 1/2" | |
| 3/4" | |
| 1/2" | |
| 3/8" | 100.0% |
| 4 | 98.3% |
| 10 | 86.0% |
| 20 | 72.4% |
| 40 | 62.3% |
| 100 | 46.4% |
| 200 | 39.4% |

| 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) | |



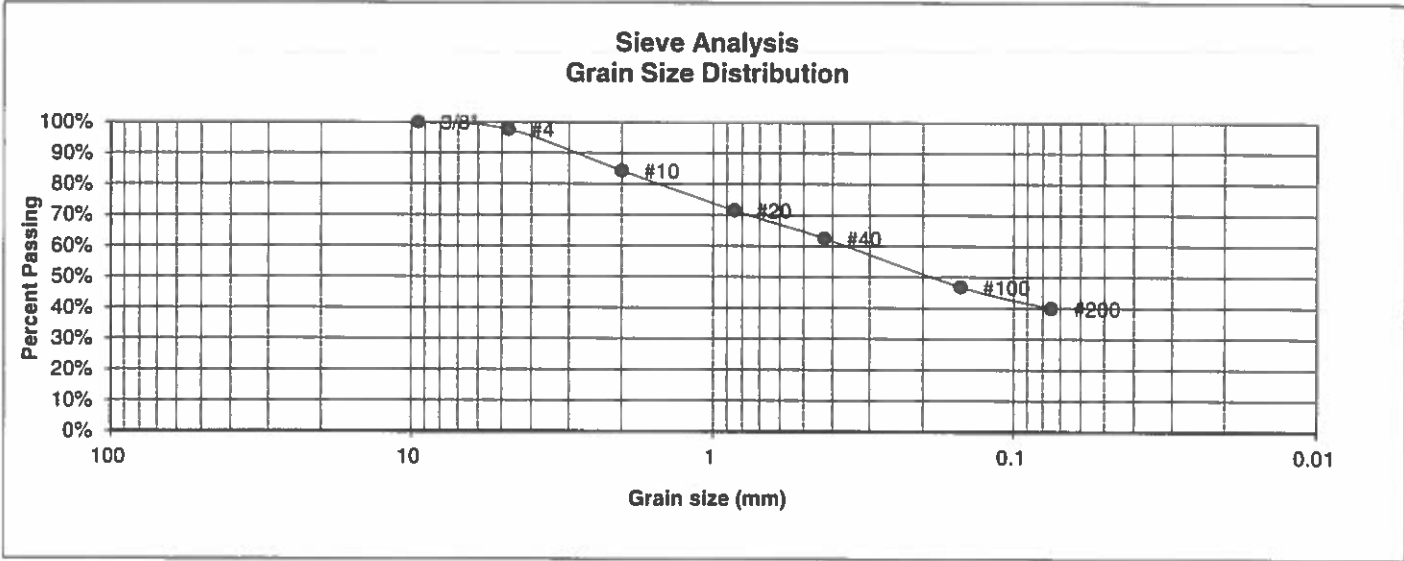
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**LABORATORY TEST
RESULTS**

| | | | |
|--------|------|--------------------|---------|
| DRAWN: | DATE | CHECKED: | DATE |
| | | <i>[Signature]</i> | 9/11/20 |

JOB NO.:
201782
FIG NO.:
B1C

| | | | |
|-------------------------------|-----|--------------------|------------------------|
| <u>UNIFIED CLASSIFICATION</u> | SC | <u>CLIENT</u> | FLRD #2 |
| <u>SOIL TYPE #</u> | 2A | <u>PROJECT</u> | FOREST LAKES, FILING 5 |
| <u>TEST BORING #</u> | 16 | <u>JOB NO.</u> | 201782 |
| <u>DEPTH (FT)</u> | 1-2 | <u>TEST BY</u> | BL |
| <u>AASHTO CLASSIFICATION</u> | A-4 | <u>GROUP INDEX</u> | 0 |



| U.S. Sieve # | Percent Finer |
|--------------|---------------|
| 3" | |
| 1 1/2" | |
| 3/4" | |
| 1/2" | |
| 3/8" | 100.0% |
| 4 | 97.6% |
| 10 | 84.3% |
| 20 | 71.5% |
| 40 | 62.4% |
| 100 | 46.8% |
| 200 | 39.9% |

| <u>Atterberg Limits</u> | |
|-------------------------|----|
| Plastic Limit | 15 |
| Liquid Limit | 24 |
| Plastic Index | 9 |

| <u>Swell</u> | |
|---------------------------|--|
| 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: 9/11/20 |
|--------|-------|----------|---------------|

JOB NO.:

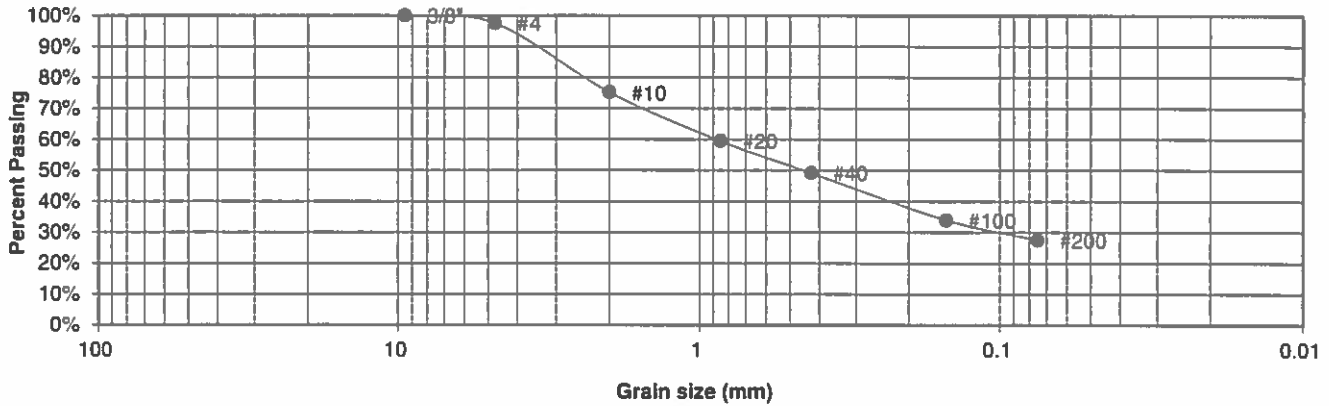
201782

FIG NO.:

617

| | | | |
|-------------------------------|-------|--------------------|------------------------|
| UNIFIED CLASSIFICATION | SM | CLIENT | FLRD #2 |
| SOIL TYPE # | 3 | PROJECT | FOREST LAKES, FILING 5 |
| TEST BORING # | 10 | JOB NO. | 201782 |
| DEPTH (FT) | 10 | 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 | 97.6% |
| 10 | 75.2% |
| 20 | 59.5% |
| 40 | 49.2% |
| 100 | 33.9% |
| 200 | 27.5% |

| 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) | |



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**LABORATORY TEST
RESULTS**

| | | | |
|--------|-------|--------------------|---------|
| DRAWN: | DATE: | CHECKED: | DATE: |
| | | <i>[Signature]</i> | 9/11/20 |

JOB NO.:

201782

FIG NO.:

B-18

| | | | |
|----------|------------------------|---------|----------|
| CLIENT | FLRD #2 | JOB NO. | 201782 |
| PROJECT | FOREST LAKES, FILING 5 | DATE | 9/3/2020 |
| LOCATION | FOREST LAKES, FILING 5 | TEST BY | BL |

| BORING NUMBER | DEPTH, (ft) | SOIL TYPE NUMBER | UNIFIED CLASSIFICATION | WATER SOLUBLE SULFATE, (wt%) |
|---------------|-------------|------------------|------------------------|------------------------------|
| TB-2 | 1-2 | 1 | SM | <0.01 |
| TB-5 | 1-2 | 1 | SM | <0.01 |
| TB-8 | 1-2 | 1 | SC | <0.01 |
| TB-11 | 1-2 | 1A | SM | <0.01 |
| TB-14 | 1-2 | 2 | SM | 0.03 |
| | | | | |
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LABORATORY TEST SULFATE RESULTS

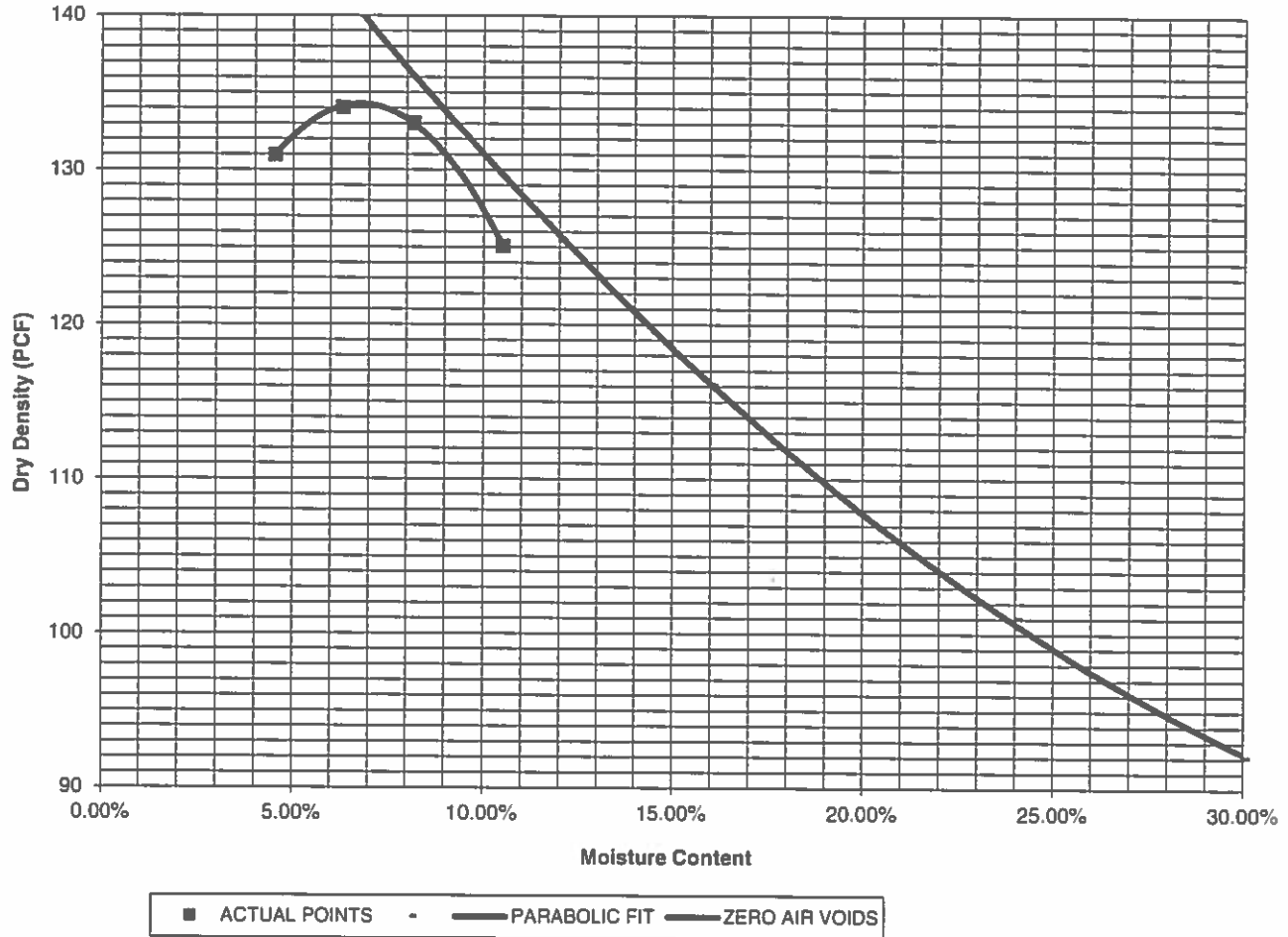
| | | | |
|--------|-------|------------------|---------------------|
| DRAWN: | DATE: | CHECKED <i>L</i> | DATE <i>9/11/20</i> |
|--------|-------|------------------|---------------------|

JOB NO.:
 201782
 FIG NO.:
 B-19

| | | | |
|-------------------------|------------------------|----------------|----------|
| PROJECT | FOREST LAKES, FILING 5 | CLIENT | FLRD #2 |
| SAMPLE LOCATION | TB-7 @ 0-3' | JOB NO. | 201782 |
| SOIL DESCRIPTION | SAND, SILTY, RED BROWN | DATE | 08/27/20 |

| | | | |
|----------------------------------|---------------|--------------------------|------|
| IDENTIFICATION | SM | COMPACTION TEST # | 1 |
| TEST DESIGNATION / METHOD | ASTM D-1557-A | TEST BY | BL |
| MAXIMUM DRY DENSITY (PCF) | 134.2 | OPTIMUM MOISTURE | 6.8% |

Compaction Curve



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MOISTURE DENSITY RELATION

DRAWN:

DATE:

CHECKED:

DATE:

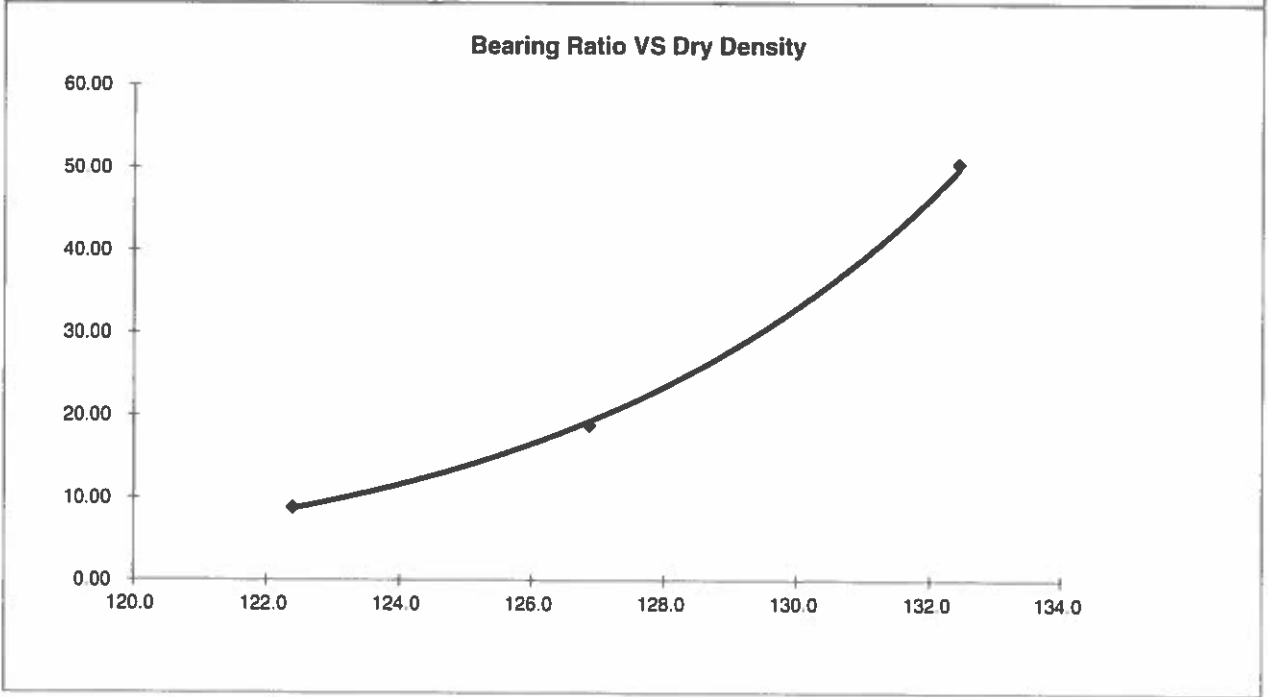
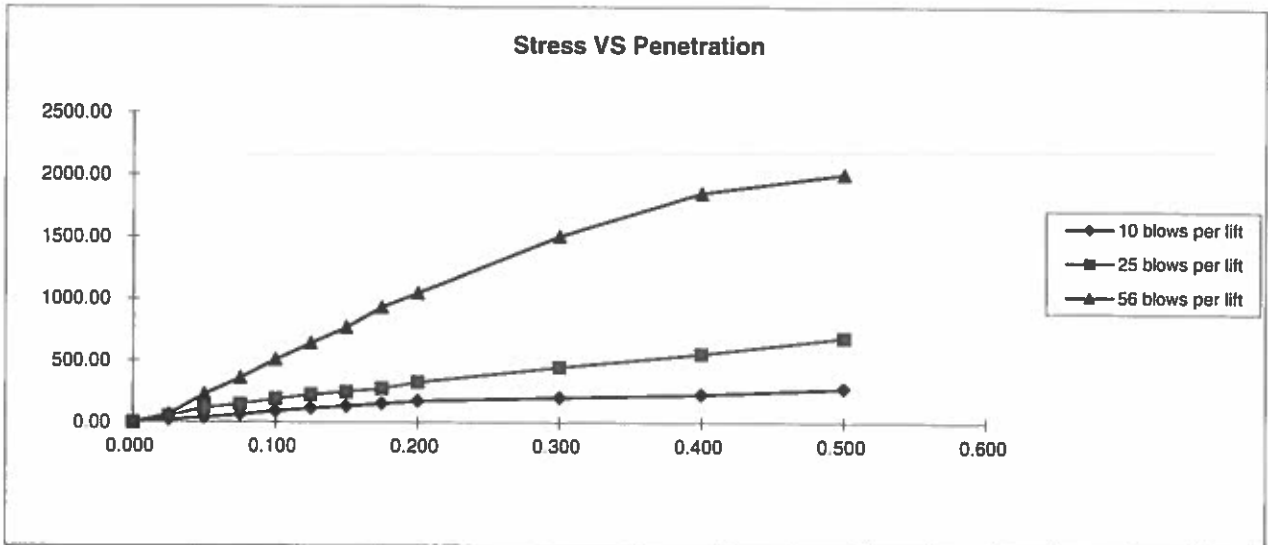
[Signature] 9/11/20

JOB NO.:

201782

FIG NO.:

B-20



| | | |
|-----------------------------|-----------------|-------|
| BEARING RATIO AT 90% OF MAX | 5.27 ~ R VALUE | 12.00 |
| BEARING RATIO AT 95% OF MAX | 22.30 ~ R VALUE | 71.00 |

JOB NO: 201782
SOIL TYPE: I



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CALIFORNIA BEARING RATIO

DRAWN:

DATE:

CHECKED:

9/11/20

JOB NO:
201782

FIG NO:
B22

APPENDIX C: Pavement Design Calculations

FLEXIBLE PAVEMENT DESIGN

DESIGN DATA

FLRD#5 - FOREST LAKES FILING NO.5
URBAN RESIDENTIAL COLLECTOR ROADS - SOIL TYPE 1

| | | |
|---|---------------------|---------|
| Equivalent (18 kip) Single Axle Load Applications (ESAL): | ESAL (W_{18}) = | 821,000 |
| Hveem Stabilometer (R Value) Results: | R = | 50 |
| Standard Deviation | S_o = | 0.45 |
| Loss in Serviceability | Δpsi = | 2.2 |
| Reliability | Reliability = | 85 |
| Reliability (z-statistic) | Z_R = | -1.036 |
| Soil Resilient Modulus | M_R = | 13168 |

Weighted Structural Number (WSN): ➔ WSN = 2.54

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)

| | |
|-------|--------|
| 60 | -0.253 |
| 70 | -0.524 |
| 75 | -0.674 |
| 80 | -0.841 |
| 85 | -1.036 |
| 90 | -1.282 |
| 95 | -1.65 |
| 97 | -1.88 |
| 98 | -2.05 |
| 99 | -2.33 |
| 99.9 | -3.09 |
| 99.99 | -3.75 |

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

| | | |
|------|-------|------------|
| Left | Right | Difference |
| 5.91 | 5.91 | 0.0 |

Job No. 201782
Fig. No. C-1

DESIGN CALCULATIONS

DESIGN DATA CLASSIC COMMUNITIES - MIDTOWN AT HANNAH RIDGE, F1
URBAN RESIDENTIAL COLLECTOR ROADS - SOIL TYPE 1

| | |
|---|----------------|
| Equivalent (18 kip) Single Axle Load Applications (ESAL): | ESAL = 821,000 |
| Hveem Stabilometer (R Value) Results: | R = 50 |
| Weighted Structural Number (WSN): | WSN = 2.54 |

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

$$D_1 = (WSN)/C_1 = 5.8 \text{ inches of Full Depth Asphalt}$$

Use 6.0 inches Full Depth

FOR ASPHALT + AGGREGATE BASE COURSE SECTION

$$\text{Asphalt Thickness (t)} = \boxed{4} \text{ inches}$$

$$D_2 = ((WSN) - (t)(C_1))/C_2 = 7.1 \text{ inches of Aggregate}$$

Base Course, use 8.0 inches

RECOMMENDED ALTERNATIVES

1. 4.0 inches of Asphalt + 8.0 inches of Aggregate Base Course, or
2. 6.0 inches of Asphalt

Job No. 201782

Fig. No. C- 2

DESIGN CALCULATIONS

CEMENT TREATED SECTIONS

DESIGN DATA: FLRD#5 - FOREST LAKES FILING NO, 5
URBAN RESIDENTIAL COLLECTOR ROADS - SOIL TYPE 1
ALL ROADWAYS

| | |
|---|----------------|
| Equivalent (18 kip) Single Axle Load Applications (ESAL): | ESAL = 821,000 |
| Hveem Stabilometer (R Value) Results: | R = 50 |
| Weighted Structural Number (WSN): | WSN = 2.54 |

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)

$D_1 = (WSN)/C_1 = 5.8$ inches of Full Depth Asphalt
Use 6.0 inches Full Depth

FOR ASPHALT + CEMENT TREATED SUBGRADE SECTION

Asphalt Thickness (t) = 4 inches
 $D_2 = ((WSN) - (t)(C_1))/C_2 = 6.5$ inches
Use 10.0 inches of Cement Treated Subgrade.

RECOMMENDED ALTERNATIVES

1. 4.0 inches of Asphalt + 10 inches of Cement Treated Subgrade.
2. 6.0 inches of Full Depth Asphalt

Job No. 201782
Fig. No. C-3