



ENTECH
ENGINEERING, INC.

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

May 14, 2018

Hammers Construction
1411 Woolsey Heights
Colorado Springs, CO 80915

Attn: Zach Crabtree

Re: Detention Basin
Big-O Tires
6985 Meridian Road
El Paso County, Colorado
PCD File No. SF-18-003

Dear Mr. Crabtree:

A small and narrow detention basin will be constructed along the south property line as shown on the Big "O" Tires Site Grading & Erosion Control Plan prepared by JPS Engineering, last modified April 18, 2018. Figure 1 shows the location of the proposed detention basin. The stormwater will be conveyed offsite to the east ditch of North Meridian Road with flows trending south within the ditch system. Entech Engineering, Inc. prepared a Soil, Geology, and Geologic Hazard Evaluation for this property, dated March 28, 2018, Job No. 171206 with reported findings and development recommendations. This letter provides recommendations for constructing the detention basin based on our previous investigations, laboratory testing, and requirements specified in the El Paso County Engineering Criteria Manual and the El Paso County Drainage Criteria Manual. This letter should be used in conjunction with future County submittals for this development.

Two test borings were drilled in the proposed commercial development on the small 1.22 acre lot. The location of the test borings and basin are depicted on the Test Boring Location Map, Figure 1. The Test Boring Logs are presented in Appendix A. A description of proposed pond geometry and the soils encountered along with the laboratory test results for the detention facility is discussed in the following section. The laboratory test results are summarized on Table 1 and presented in Appendix B.

Detention Basin

Soils recovered on this small commercial property in the vicinity of Detention Basin consisted of silty sand fill and native silt sand overlying sandstone which was encountered at a depth of 17 feet in Test Boring No. 1. Groundwater was encountered in the test borings at depths ranging between 10 to 10.5 feet bgs (below the existing ground surface). The maximum height of the pond embankment walls will be approximately 4 to 5 feet. The detention facility is created by segmented retaining walls and cuts into the native soils approximately 2.5 to 5 feet on the south side of the property based on the grading plans.

Laboratory testing was conducted on samples of the slightly silty to silty sand obtained from the test borings. SPT Testing conducted on the sand resulted in N-values of 3 to 8 bpf indicating very loose to loose states. Moisture content and grain size analysis indicated a moisture contents ranging between 2 to 15 percent and 6 to 19 percent of the soil particles passing the No. 200 Sieve. Atterberg Limits Testing resulted in Liquid Limits of 24 and no value and Plastic Indexes of non-plastic and 2. Sulfate Testing indicated the sand to exhibit a negligible potential for sulfate attack.

Detention Basin

The design parameters and geometry of the detention basin shall conform to the requirements specified in the El Paso County Engineering Criteria Manual and the El Paso County Drainage Criteria Manual. The native sand and sand fill were relatively similar in structure and will likely be exposed based on our soil investigation on this site. The soils were encountered at very loose to loose states. Removal and replacement of the loose soils where encountered in the basin foundation may be required. A soil bearing capacity of 2,000 psf is anticipated for the well compacted sands or the underlying medium dense sand. All soils should be approved by Entech prior to backfilling and use of site soils as backfill.

The wall foundations/subgrade shall be fully exposed and observed by personnel of Entech prior to placing any soil/embankment fill. Soil mitigation requirements, if any, shall be completed prior to constructing the detention facility. The subgrade of the embankment area shall be scarified, moisture conditioned, and compacted prior to fill placement. Groundwater is not expected at the proposed excavated depths. All fill placed in the detention area should be approved prior to placement.

Pond embankment soils or wall backfill soils consisting of site soils should be placed in lifts to exceed 6 inches following compaction and compacted to at least 95 percent of the maximum Dry Density determined by Modified Proctor (ASTM D-1557). The site sand materials should be placed in compacted lifts less than 6 inches thick compacted to at least 95 percent of maximum Modified Proctor (ASTM D-1557) Dry Density. The soil materials should be placed at a moisture content conducive to adequate compaction, usually within ± 2 percent of optimum moisture content for cohesionless soil and 0 to 3 percent of optimum moisture content for cohesive soil. Fill placement and compaction should be observed and tested by Entech during construction to verify that adequate moisture and density has been achieved.

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Page 3

Based on the suggested compaction efforts for the fill soils and the expected foundation soils exposed, it is likely that fill settlement will be less than 2 to 3 percent of the fill height. The soils used to construct the detention facility should perform adequately for the proposed retaining walls. Routine basin maintenance and maintaining shallow rooting vegetation on the embankment faces will be very important to prevent damage to the embankment due to wind and surficial runoff erosion. Seepage through the embankment should be minimal due to the limited detention time.

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

Respectfully Submitted,

ENTECH ENGINEERING, INC.



Stan C. Culp, P.E.
Senior Engineer

SCC/kp

Entech Job No. 171206
F:\AA projects\2017\171206\171206 dp



Reviewed By:



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

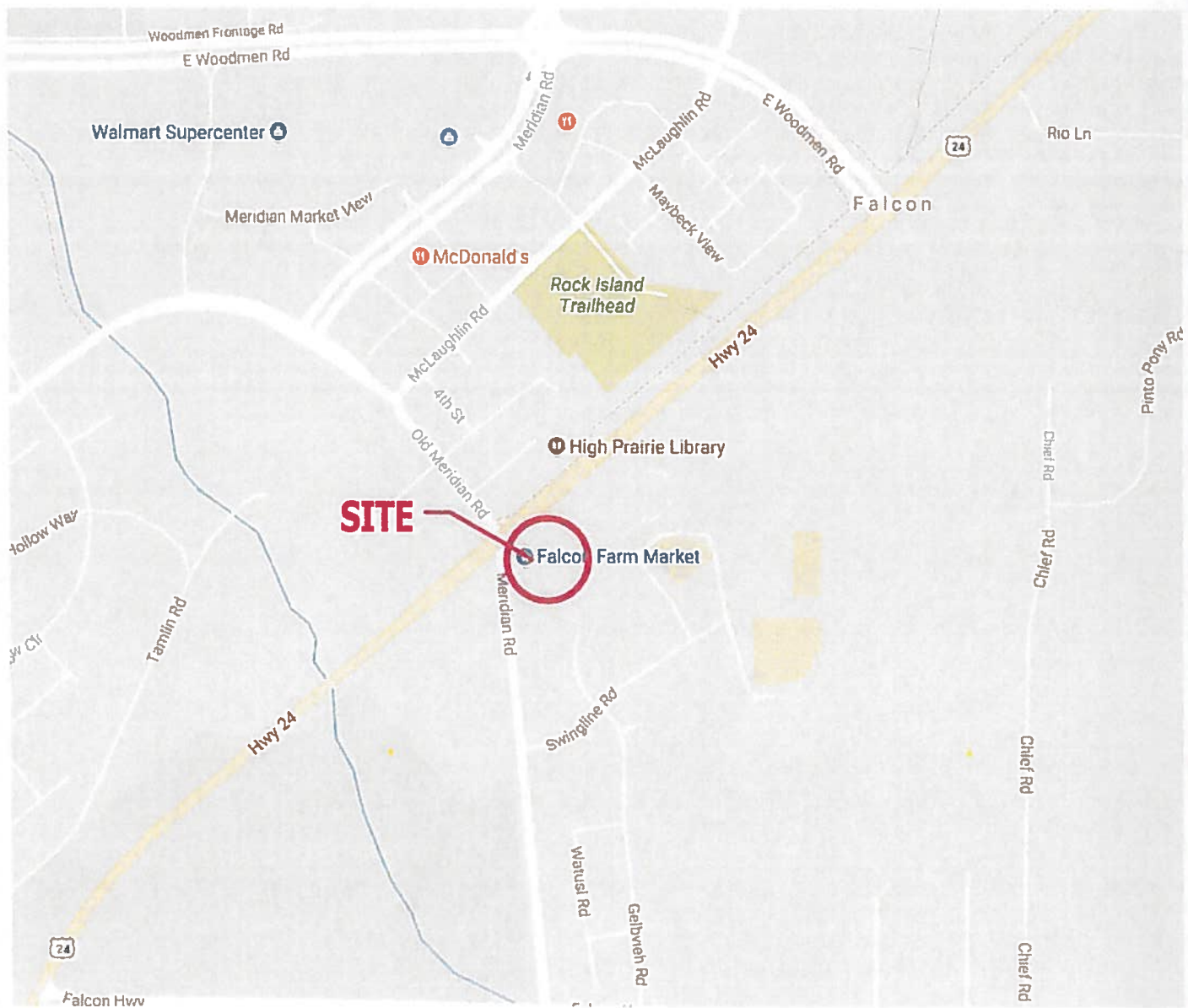
TABLE

TABLE 1
SUMMARY OF LABORATORY TEST RESULTS

CLIENT HAMMERS CONSTRUCTION
 PROJECT 6985 MERIDIAN ROAD
 JOB NO. 171206

SOIL TYPE	TEST BORING NO.	DEPTH (FT)	WATER (%)	DRY DENSITY (PCF)	PASSING NO. 200 SIEVE (%)	LIQUID LIMIT (%)	PLASTIC INDEX (%)	SULFATE (WT %)	FHA SWELL (PSF)	SWELL/CONSOL (%)	UNIFIED CLASSIFICATION	SOIL DESCRIPTION
1	1	5			12.3	NV	NP	<0.01			SM	SAND, SILTY
1	2	5			6.2						SM-SW	SAND, SLIGHTLY SILTY
1	2	15			12.8						SM	SAND, SILTY
2	1	20			18.7						SM	SANDSTONE, SILTY
1	2	20			18.2	24	2	<0.01			SM	SAND, SILTY

FIGURES

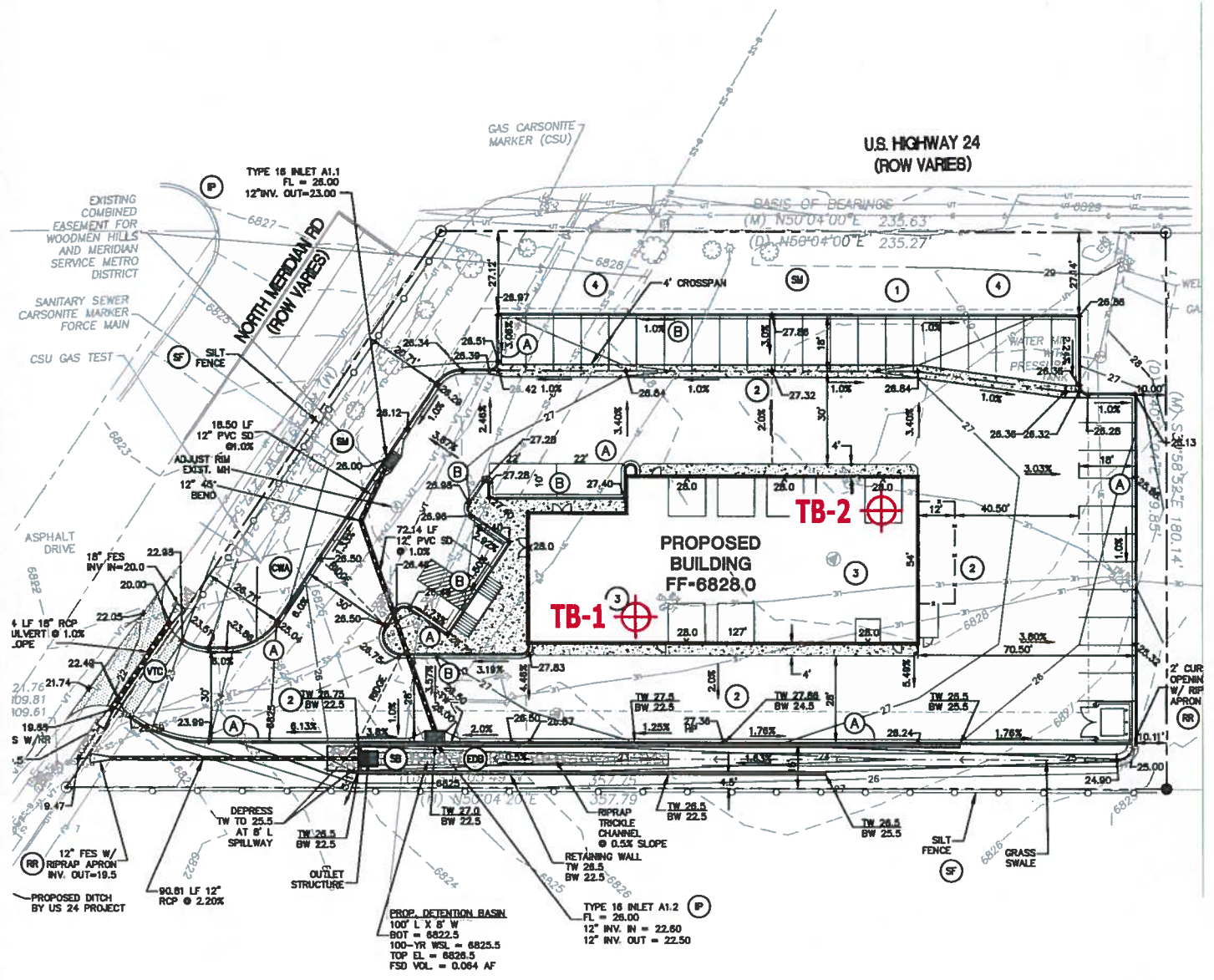
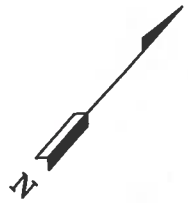


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VICINITY LOCATION MAP
 6985 MERIDIAN ROAD
 FALCON, CO
 FOR: *HAMMERS CONSTRUCTION*

DRAWN BY: BWV	DATE DRAWN: 09/29/17	DESIGNED BY: DS	CHECKED: <i>[Signature]</i>
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JOB NO.:
171206
FIG. NO.:
1



 TB-2- APPROXIMATE TEST BORING LOCATION AND NUMBER



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TEST BORING LOCATION MAP
 6985 MERIDIAN ROAD
 EL PASO COUNTY, CO
 FOR: HAMMERS CONSTRUCTION

DRAWN BY: SC	DATE DRAWN: 05/15/18	DESIGNED BY: SC	CHECKED:
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JOB NO.:
171206
 FIG. NO.:
2

APPENDIX A: Test Boring Logs

TEST BORING NO. 1
 DATE DRILLED 9/14/2017
 Job # 171206

TEST BORING NO. 2
 DATE DRILLED 9/14/2017
 CLIENT HAMMERS CONSTRUCTION
 LOCATION 6985 MERIDIAN ROAD

REMARKS

WATER @ 10',
 9/14/17
 CAVED TO 6',
 9/26/17, DRY

FILL 0-3', SAND, SILTY, FINE
 TO COARSE GRAINED, BROWN,
 LOOSE, MOIST
 SAND, SILTY, FINE TO
 COARSE GRAINED, BROWN,
 VERY LOOSE, MOIST

SAND, SILTY, FINE TO COARSE
 GRAINED, TAN, MEDIUM DENSE,
 VERY MOIST TO WET

SANDSTONE, SILTY, FINE TO
 COARSE GRAINED, GRAY
 BROWN, VERY DENSE, MOIST

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
0-3			6	8.1	1A
3-5			3	8.0	1
5-10			21	7.6	1
10-15			18	9.6	1
15-20			50	9.8	2
20			9"		

REMARKS

WATER @ 10.5', 9/26/17
 SAND, SLIGHTLY SILTY, FINE
 GRAINED, TAN, LOOSE
 MOIST

SAND, SILTY, FINE TO COARSE
 GRAINED, TAN TO GRAY,
 MEDIUM DENSE TO DENSE,
 VERY MOIST TO WET

Depth (ft)	Symbol	Samples	Blows per foot	Watercontent %	Soil Type
0-8			8	2.2	1
8-6			6	2.4	1
6-10			12	5.0	1
10-15			30	9.9	1
15-20			25	14.8	1



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TEST BORING LOG

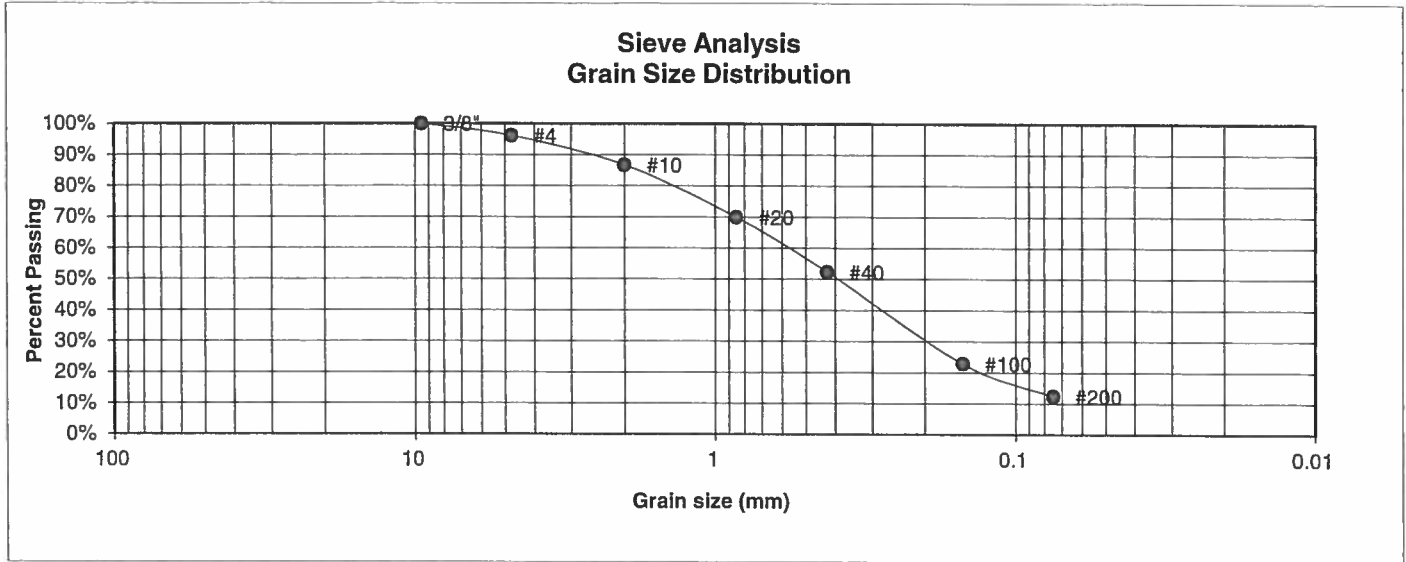
DRAWN:	DATE:	CHECKED: <i>W</i>	DATE: 10/17/17
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JOB NO.:
 171206

FIG NO.:
 A-1

APPENDIX B: Laboratory Test Results

<u>UNIFIED CLASSIFICATION</u>	SM	<u>CLIENT</u>	HAMMERS CONSTRUCTION
<u>SOIL TYPE #</u>	1	<u>PROJECT</u>	6985 MERIDIAN ROAD
<u>TEST BORING #</u>	1	<u>JOB NO.</u>	171206
<u>DEPTH (FT)</u>	5	<u>TEST BY</u>	BL



<u>U.S. Sieve #</u>	<u>Percent Finer</u>
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	96.2%
10	86.7%
20	69.9%
40	52.3%
100	22.8%
200	12.3%

<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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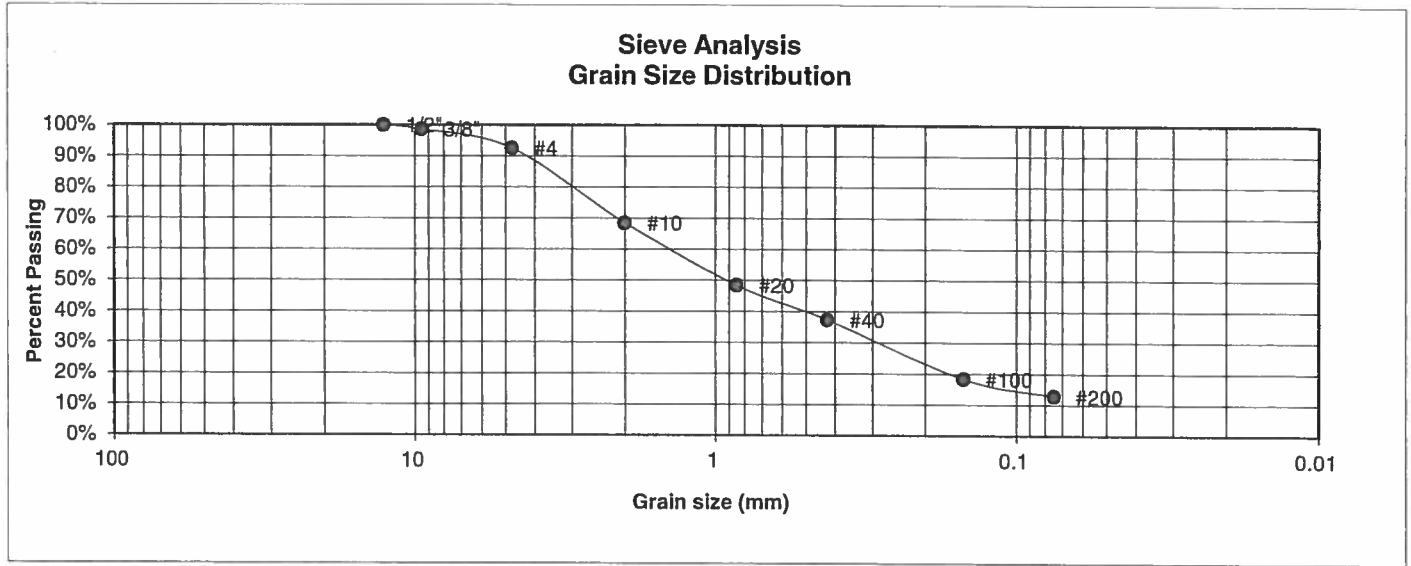
**LABORATORY TEST
RESULTS**

<u>DRAWN:</u>	<u>DATE:</u>	<u>CHECKED:</u> BV	<u>DATE:</u> 9/24/17
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JOB NO.:
171206

FIG NO.:
B-1

<u>UNIFIED CLASSIFICATION</u>	SM	<u>CLIENT</u>	HAMMERS CONSTRUCTION
<u>SOIL TYPE #</u>	1	<u>PROJECT</u>	6985 MERIDIAN ROAD
<u>TEST BORING #</u>	2	<u>JOB NO.</u>	171206
<u>DEPTH (FT)</u>	15	<u>TEST BY</u>	BL



<u>U.S. Sieve #</u>	<u>Percent Finer</u>
3"	
1 1/2"	
3/4"	
1/2"	100.0%
3/8"	98.7%
4	92.5%
10	68.5%
20	48.4%
40	37.3%
100	18.4%
200	12.8%

Atterberg Limits
 Plastic Limit
 Liquid Limit
 Plastic Index

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



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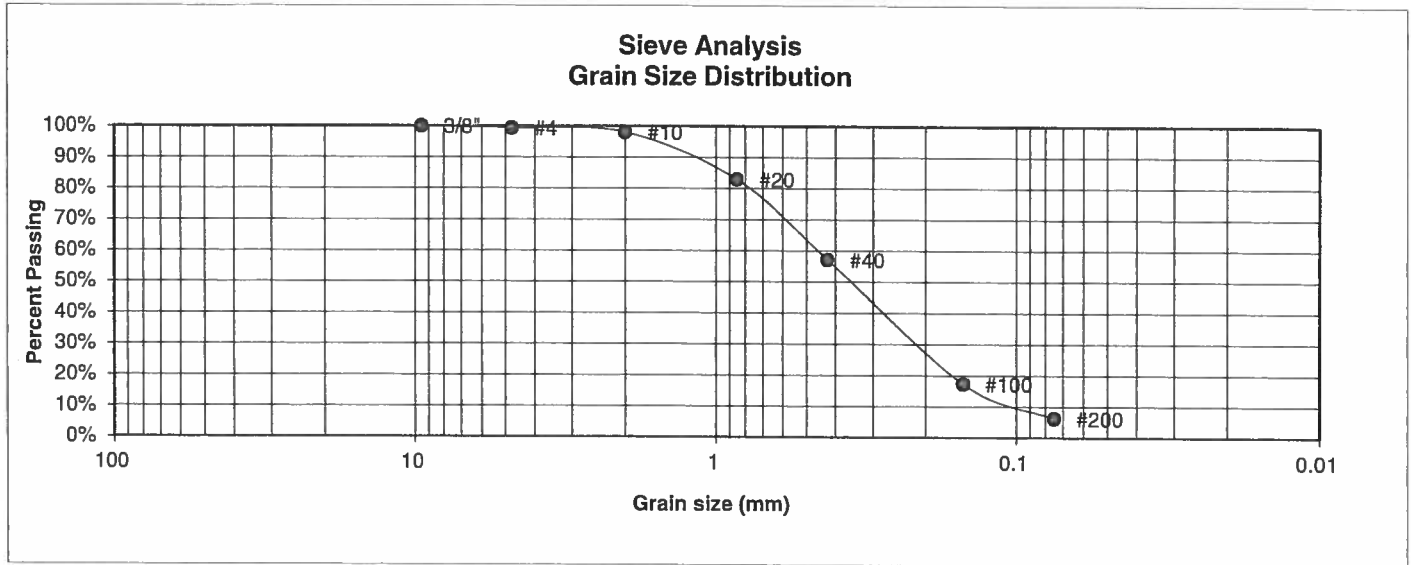
**LABORATORY TEST
 RESULTS**

<u>DRAWN:</u>	<u>DATE:</u>	<u>CHECKED:</u> Bv	<u>DATE:</u> 9/29/17
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JOB NO.:
171206

FIG NO.:
B-2

<u>UNIFIED CLASSIFICATION</u>	SM-SW	<u>CLIENT</u>	HAMMERS CONSTRUCTION
<u>SOIL TYPE #</u>	1	<u>PROJECT</u>	6985 MERIDIAN ROAD
<u>TEST BORING #</u>	2	<u>JOB NO.</u>	171206
<u>DEPTH (FT)</u>	5	<u>TEST BY</u>	BL



<u>U.S. Sieve #</u>	<u>Percent Finer</u>
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	99.4%
10	98.1%
20	82.9%
40	57.1%
100	17.3%
200	6.2%

Atterberg
Limits
Plastic Limit
Liquid Limit
Plastic Index

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



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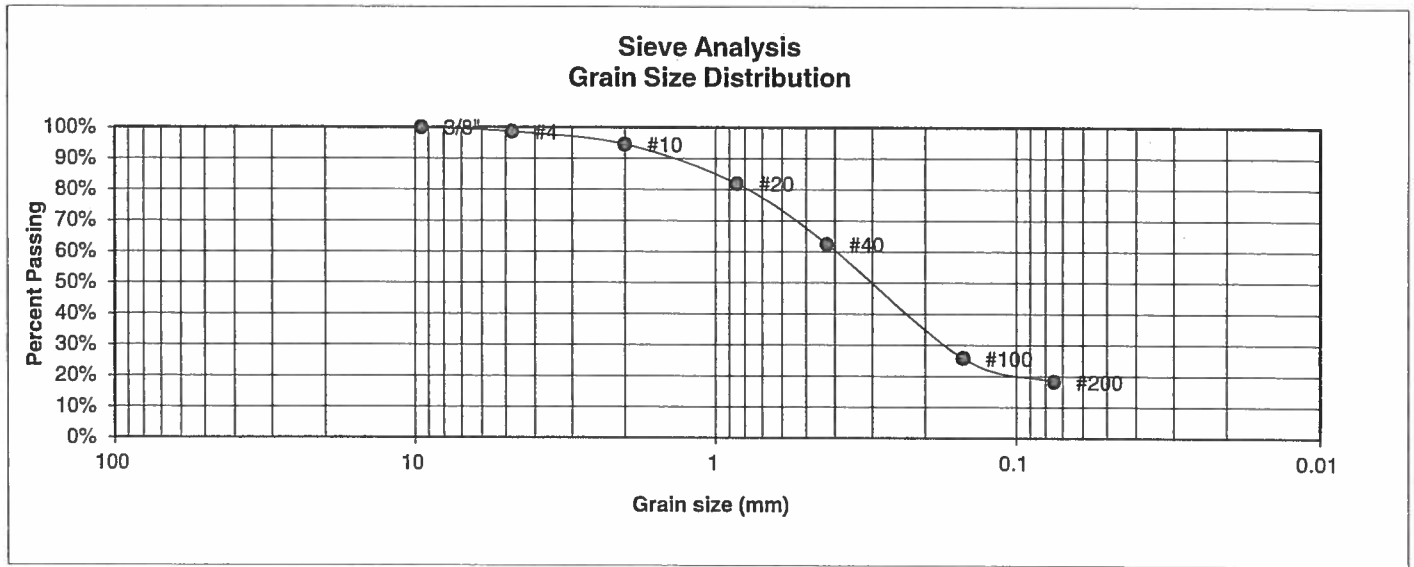
**LABORATORY TEST
RESULTS**

<u>DRAWN:</u>	<u>DATE:</u>	<u>CHECKED:</u> BV	<u>DATE:</u> 9/29/17
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JOB NO.:
171206

FIG NO.:
B-3

<u>UNIFIED CLASSIFICATION</u>	SM	<u>CLIENT</u>	HAMMERS CONSTRUCTION
<u>SOIL TYPE #</u>	1	<u>PROJECT</u>	6985 MERIDIAN ROAD
<u>TEST BORING #</u>	2	<u>JOB NO.</u>	171206
<u>DEPTH (FT)</u>	20	<u>TEST BY</u>	BL



U.S. Sieve #	Percent Finer
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	98.6%
10	94.6%
20	81.9%
40	62.5%
100	25.8%
200	18.2%

Atterberg Limits	
Plastic Limit	22
Liquid Limit	24
Plastic Index	2

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: *BL*

DATE:

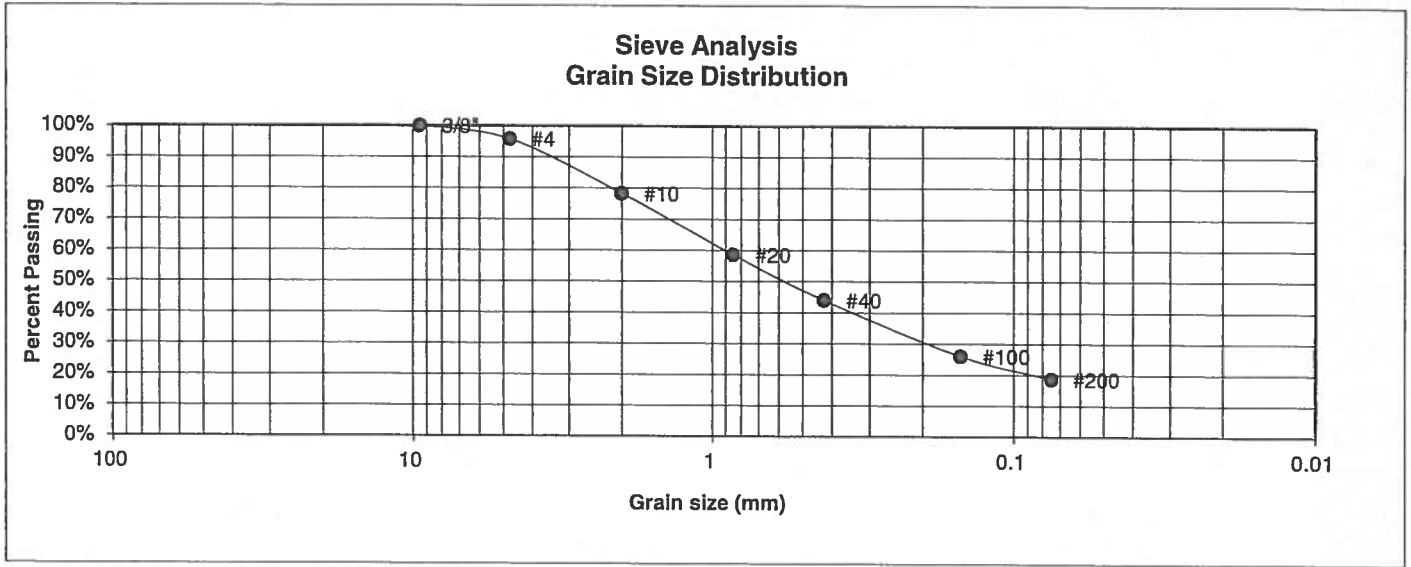
10/17/17

JOB NO.:
171206

FIG NO.:

B-4

<u>UNIFIED CLASSIFICATION</u>	SM	<u>CLIENT</u>	HAMMERS CONSTRUCTION
<u>SOIL TYPE #</u>	2	<u>PROJECT</u>	6985 MERIDIAN ROAD
<u>TEST BORING #</u>	1	<u>JOB NO.</u>	171206
<u>DEPTH (FT)</u>	20	<u>TEST BY</u>	BL



<u>U.S. Sieve #</u>	<u>Percent Finer</u>
3"	
1 1/2"	
3/4"	
1/2"	
3/8"	100.0%
4	95.8%
10	78.3%
20	58.6%
40	44.0%
100	26.1%
200	18.7%

Atterberg
Limits
Plastic Limit
Liquid Limit
Plastic Index

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



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**LABORATORY TEST
RESULTS**

<u>DRAWN:</u>	<u>DATE:</u>	<u>CHECKED:</u>	<u>DATE:</u>
		<i>[Signature]</i>	10/17/17

JOB NO.:
171206

FIG NO.:

13-5

