Huddleston-Berry
Engineering & Testing, LLC

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Grand Junction, Colorado 81501
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Info@huddlestonberry.com

February 16, 2017
Project#01616-0001

Steve Ryan
890 Sabil Drive
Fruita, Colorado 81521

Subject: Geotechnical Investigation
460 N. Mesa
Fruita, Colorado

Dear Mr. Ryan,

This letter presents the results of a geotechnical investigation conducted by Huddleston-Berry Engineering & Testing, LLC (HBET) at 460 N. Mesa in Fruita, Colorado. The site location is shown on Figure 1. The proposed construction is anticipated to consist of a single family residence. The scope of our investigation included evaluating the subsurface conditions at the site to aid in developing foundation recommendations for the proposed construction.

Site Conditions

At the time of the investigation, the site was open. Most of the site was fairly flat; however, Little Salt Wash ran through the northern portion of the site and steep slopes were present along the banks. A small irrigation ditch ran through the north-central portion of the site. Vegetation consisted primarily of weeds and grasses with numerous trees along the wash. The site was bordered to the north by Sierra Drive, to the south and east by existing residences, and to the west by N. Mesa Street.

Subsurface Investigation

The subsurface investigation included four test pits as shown on Figure 2 – Site Plan. The test pits were excavated to depths of between 8.0 and 9.0 feet below the existing ground surface. Typed test pit logs are included in Appendix A.

As indicated on the logs, the subsurface conditions at the site were variable. Test pits TP-1 and TP-2, conducted in the far northern portion of the site, encountered brown, moist, very dense silt with sand fill materials containing asphalt, concrete, ash, and trash. The fill materials extended to the bottom of TP-2. In TP-1, the fill extended to a depth of 7.0 feet and was underlain by brown, moist, medium dense silty gravel with sand to the bottom of the excavation. Groundwater was not encountered in TP-1 or TP-2 at the time of the investigation.

Test pits TP-3 and TP-4, conducted south of the irrigation ditch, encountered 1.0 foot of topsoil above brown, moist, medium stiff lean clay soils to depths of between 4.0 and 4.5 feet. Below the lean clay, brown, moist, medium stiff silty clay with sand extended to the bottom of the excavation. Groundwater was not encountered in TP-3 or TP-4 at the time of the investigation.

Laboratory Testing

Laboratory testing was conducted on samples of the fill materials and native soils encountered in the test pits. The testing included grain size analysis, Atterberg limits determination, natural moisture content and density determination, water soluble sulfates content determination, swell/consolidation testing, and maximum dry density and optimum moisture content (Proctor) determination. The laboratory testing results are included in Appendix B.

The laboratory testing results indicate that the silt fill materials in TP-1 and TP-2 are slightly plastic. Based upon the fact that the fill materials were likely uncontrolled at the time of placement, the fill materials are anticipated to tend to consolidate under loading. The native silty gravel soils were indicated to be non-plastic.

The native clay soils encountered in TP-3 and TP-4 were indicated to be slightly plastic. In addition, the native lean clay with sand soils were indicated to be slightly expansive with up to approximately 0.8% expansion at 1,600 psf measured in the laboratory. Water soluble sulfates were not detected in the site soils.

Foundation Recommendations

Based upon the results of the subsurface investigation, HBET believes that construction in the vicinity of TP-1 and TP-2 would be difficult. Historical aerial photographs on the Mesa County GIS database indicate that this area used to be part of the Little Salt Wash channel. The aerial photos suggest that this area was filled in between 1977 and 1986. Due to the uncontrolled nature of the fill materials, significant effort would be necessary to control the risk of excessive differential settlements in this area.

In general, HBET recommends that the new structure be built in the vicinity of TP-3 and TP-4. Shallow foundations such as spread footings and monolithic (turndown) structural slabs are both appropriate alternatives. However, the laboratory testing results indicate that the native clay soils are slightly expansive. Therefore, in order to provide a uniform bearing stratum and reduce the risk of excessive differential movements, HBET recommends that the foundations be constructed above a minimum of 24-inches of structural fill.

As discussed above, the native clay soils were indicated to be slightly expansive. However, the magnitude of expansion measured in the laboratory was small. Therefore, with careful moisture control and proper compaction, the native clay soils, exclusive of topsoil, may be reused as structural fill. Imported structural fill should consist of a granular, non-expansive, ***non-free draining*** material such as crusher fines or CDOT Class 6 base course. Unless it can be demonstrated that the materials are not free-draining, pit-run materials should not be used as structural fill.

Prior to placement of structural fill, it is recommended that the bottom of the foundation excavation be scarified to a depth of 6 to 9 inches, moisture conditioned, and compacted to a minimum of 95% of the standard Proctor maximum dry density, within ± 2% of the optimum moisture content as determined in accordance with ASTM D698. Structural fill should extend laterally beyond the edges of the foundation a distance equal to the thickness of structural fill. Structural fill should be moisture conditioned, placed in maximum 8-inch loose lifts, and compacted to a minimum of 95% of the standard Proctor maximum dry density for fine grained soils and modified Proctor maximum dry density for coarse grained soils, within ± 2% of the optimum moisture content as determined in accordance with ASTM D698 and D1557C, respectively.

For structural fill consisting of the native soils or imported granular materials and foundation building pad preparation as recommended, a maximum allowable bearing capacity of 1,500 psf may be used. In addition, a modulus of subgrade reaction of 150 pci may be used for structural fill consisting of the native soils and a modulus of 250 pci may be used for structural fill consisting of crusher fines or base course. Foundations subject to frost should be at least 24-inches below the finished grade.

Any stemwalls, basement walls, or retaining walls should be designed to resist lateral earth pressures. For backfill consisting of the native soils or imported granular, non-free draining, non-expansive material, we recommend that the walls be designed for an active equivalent fluid unit weight of 55 pcf in areas where no surcharge loads are present. An at-rest equivalent fluid unit weight of 75 pcf is recommended for basement or other braced walls. Lateral earth pressures should be increased as necessary to reflect any surcharge loading behind the walls.

As discussed previously, water soluble sulfates were not detected in the site soils. Therefore, sulfate resistant cement may not be required for construction at this site.

Non-Structural Floor Slab and Exterior Flatwork Recommendations

In order to reduce the potential for excessive differential movements, it is recommended that non-structural floating floor slabs be constructed above a minimum of 18-inches of structural fill with subgrade preparation, structural fill materials, and fill placement be in accordance with the *Foundation Recommendations* section of this report. It is recommended that exterior flatwork be constructed above subgrade soils, below the topsoil, that have been scarified to a depth of 12-inches, moisture conditioned, and compacted to a minimum of 95% of the standard Proctor maximum dry density, within ±2% of the optimum moisture content as determined in accordance with ASTM D698.

Drainage Recommendations

Grading and drainage are critical for the long-term performance of the structure and grading around the structure should be designed to carry precipitation and runoff away from the structure. It is recommended that the finished ground surface drop at least twelve inches within the first ten feet away from the structure. Positive drainage should be maintained beyond that to the extent practical. It is also recommended that landscaping within five feet of the structure include primarily desert plants with low water requirements. In addition, it is recommended that irrigation within ten feet of foundations be minimized.

HBET recommends that downspout extensions be used which discharge a minimum of 5 feet from the structure or beyond the backfill zone, whichever is greater. However, if subsurface downspout drains are utilized, they should be carefully constructed of solid-wall PVC and should daylight a minimum of 10 feet from the structure. In addition, an impermeable membrane is recommended below subsurface downspout drain lines. Dry wells should not be used.

As discussed previously, groundwater was not encountered at the site. However, if a structural floor and crawlspace or basement are utilized, a perimeter foundation drain is recommended to limit the potential for surface moisture to impact the structure. In general, the perimeter foundation drain should consist of prefabricated drain materials or perforated pipe and gravel systems with the flowline of the drain at the bottom of the foundation (at the highest point). The prefabricated drain materials or gravel should extend along basement walls to within 36-inches of the finished ground surface. The perimeter drain should slope at a minimum of 1% to daylight or to a sump with submersible pump. An impermeable membrane is also recommended at the base of the drain to limit the potential for moisture to infiltrate into the subsurface below the foundations.

General Notes

The recommendations included above are based upon the results of the subsurface investigation and on our local experience. These conclusions and recommendations are valid only for the proposed construction.

As discussed previously, the subsurface conditions at the site were variable. However, the precise nature and extent of subsurface variability may not become evident until construction. The recommendations contained herein are designed to reduce the risk and magnitude of movements and it is extremely critical that ***ALL*** of the recommendations herein be applied to the design and construction. However, HBET cannot predict long-term changes in subsurface moisture conditions and/or the precise magnitude or extent of any volume change in the native soils. ***Where significant increases in subsurface moisture occur due to poor grading, improper stormwater management, utility line failure, excess irrigation, or other cause, during or after construction, significant movements are possible***.

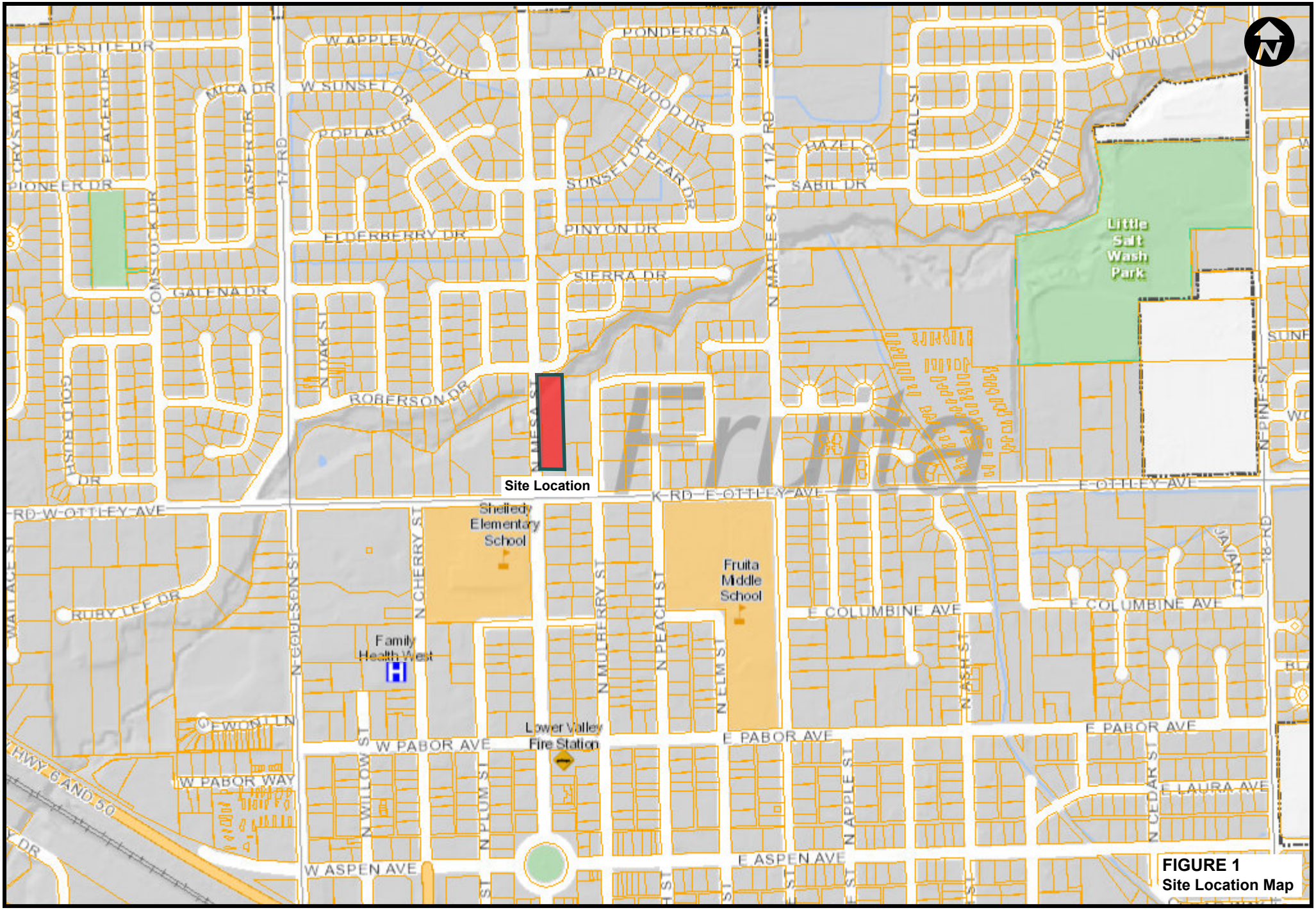
In addition, the success of the structure foundations, slabs, etc. is critically dependent upon proper construction. Therefore, HBET should be retained to provide materials testing, special inspections, and engineering oversight during ***ALL*** phases of the construction to ensure conformance with the recommendations herein. In addition, the property owner/buyer should be provided a copy of this report and made fully aware of the risks associated with living in an area of moisture sensitive soils.

We are pleased to be of service to your project. Please contact us if you have any questions or comments regarding the contents of this report.

Respectfully Submitted:
Huddleston-Berry Engineering and Testing, LLC

Michael A. Berry, P.E.
Vice President of Engineering

FIGURES



Mesa County Map

The Geographic Information System (GIS) and its components are designed as a source of reference for answering inquiries, for planning and for modeling. GIS is not intended or does not replace legal description information in the chain of title and other information contained in official government records such as the County Clerk and Recorders office or the courts. In addition, the representations of location in this GIS cannot be substitute for actual legal surveys.
The information contained herein is believed accurate and suitable for the limited uses, and subject to the limitations, set forth above. Mesa County makes no warranty as to the accuracy or suitability of any information contained herein. Users assume all risk and responsibility for any and all damages, including consequential damages, which may flow from the user's use of this information.

0 0.05 0.1 0.2 mi
0 0.075 0.15 0.3 km

Print Date: February 7, 2017

Mesa County, Colorado
GIS/IT Department
gis.mesacounty.us

City of Grand Junction

FIGURE 2
Site Plan

N

0 0.0375 0.075 Miles

Printed: 2/7/2017

1 inch = 134 feet

CITY OF Grand Junction COLORADO
GEOGRAPHIC INFORMATION SYSTEM

APPENDIX A
Typed Test Pit Logs

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

TEST PIT NUMBER TP-1

CLIENT Steve Ryan
PROJECT NAME 460 N. Mesa Street
PROJECT NUMBER 01616-0001
PROJECT LOCATION Fruita, CO
DATE STARTED 12/22/16 **COMPLETED** 12/22/16
GROUND ELEVATION _____ **TEST PIT SIZE** _____
EXCAVATION CONTRACTOR Hi-River
GROUND WATER LEVELS:
EXCAVATION METHOD Mini-Excavator
AT TIME OF EXCAVATION dry
LOGGED BY CM **CHECKED BY** MAB
AT END OF EXCAVATION dry
NOTES _____
AFTER EXCAVATION ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		SILT with Sand and traces fo Gravel, Asphalt, Concrete, Ash and Trash (FILL), brown, moist, very dense										
2.5												
5.0												
7.5		Silty GRAVEL with Sand (GM), brown, moist, medium dense *** Lab Classified GB1	GB 1					7	NP	NP	NP	21
		Bottom of test pit at 8.0 feet.										

GEOTECH BH COLUMNS 01616-0001 460 N MESA RD.GPJ GINT US LAB.GDT 2/7/17

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TEST PIT NUMBER TP-2

CLIENT Steve Ryan
PROJECT NAME 460 N. Mesa Street
PROJECT NUMBER 01616-0001
PROJECT LOCATION Fruita, CO
DATE STARTED 12/22/16 **COMPLETED** 12/22/16
GROUND ELEVATION _____ **TEST PIT SIZE** _____
EXCAVATION CONTRACTOR Hi-River
GROUND WATER LEVELS:
EXCAVATION METHOD Mini-Excavator
AT TIME OF EXCAVATION dry
LOGGED BY CM **CHECKED BY** MAB
AT END OF EXCAVATION dry
NOTES _____
AFTER EXCAVATION ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		SILT with Sand and traces fo Gravel, Asphalt, Concrete, Ash and Trash (FILL), brown, moist, very dense										
2.5		*** Lab Classified GB1	GB 1					9	24	21	3	70
5.0												
7.5		Bottom of test pit at 8.0 feet.										

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970-255-8005
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TEST PIT NUMBER TP-3

CLIENT Steve Ryan
PROJECT NAME 460 N. Mesa Street
PROJECT NUMBER 01616-0001
PROJECT LOCATION Fruita, CO
DATE STARTED 1/20/17 **COMPLETED** 1/20/17
GROUND ELEVATION _____ **TEST PIT SIZE** _____
EXCAVATION CONTRACTOR Hi-River
GROUND WATER LEVELS:
EXCAVATION METHOD Mini-Excavator
AT TIME OF EXCAVATION dry
LOGGED BY CM **CHECKED BY** MAB
AT END OF EXCAVATION dry
NOTES _____
AFTER EXCAVATION ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		Lean CLAY with Sand and Organics (TOPSOIL)										
		Lean CLAY (CL), brown, moist, medium stiff										
2.5			MC 1				97	13				
		*** Lab Classified GB1	GB 1					9	27	16	11	79
		Silty CLAY with Sand (CL-ML), brown, moist, medium stiff										
5.0		*** Lab Classified GB2	GB 2					8	25	19	6	72
7.5		Bottom of test pit at 9.0 feet.										

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TEST PIT NUMBER TP-4

CLIENT Steve Ryan
PROJECT NAME 460 N. Mesa Street
PROJECT NUMBER 01616-0001
PROJECT LOCATION Fruita, CO
DATE STARTED 1/20/17 **COMPLETED** 1/20/17
GROUND ELEVATION _____ **TEST PIT SIZE** _____
EXCAVATION CONTRACTOR Hi-River
GROUND WATER LEVELS:
EXCAVATION METHOD Mini-Excavator
AT TIME OF EXCAVATION dry
LOGGED BY CM **CHECKED BY** MAB
AT END OF EXCAVATION dry
NOTES _____
AFTER EXCAVATION ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		Lean CLAY with Sand Organics (TOPSOIL)										
		Lean CLAY with Sand (cl), brown, moist, medium stiff										
2.5												
		Silty CLAY with Sand (cl-ml), brown, moist, medium stiff										
5.0												
7.5												
		Bottom of test pit at 9.0 feet.										

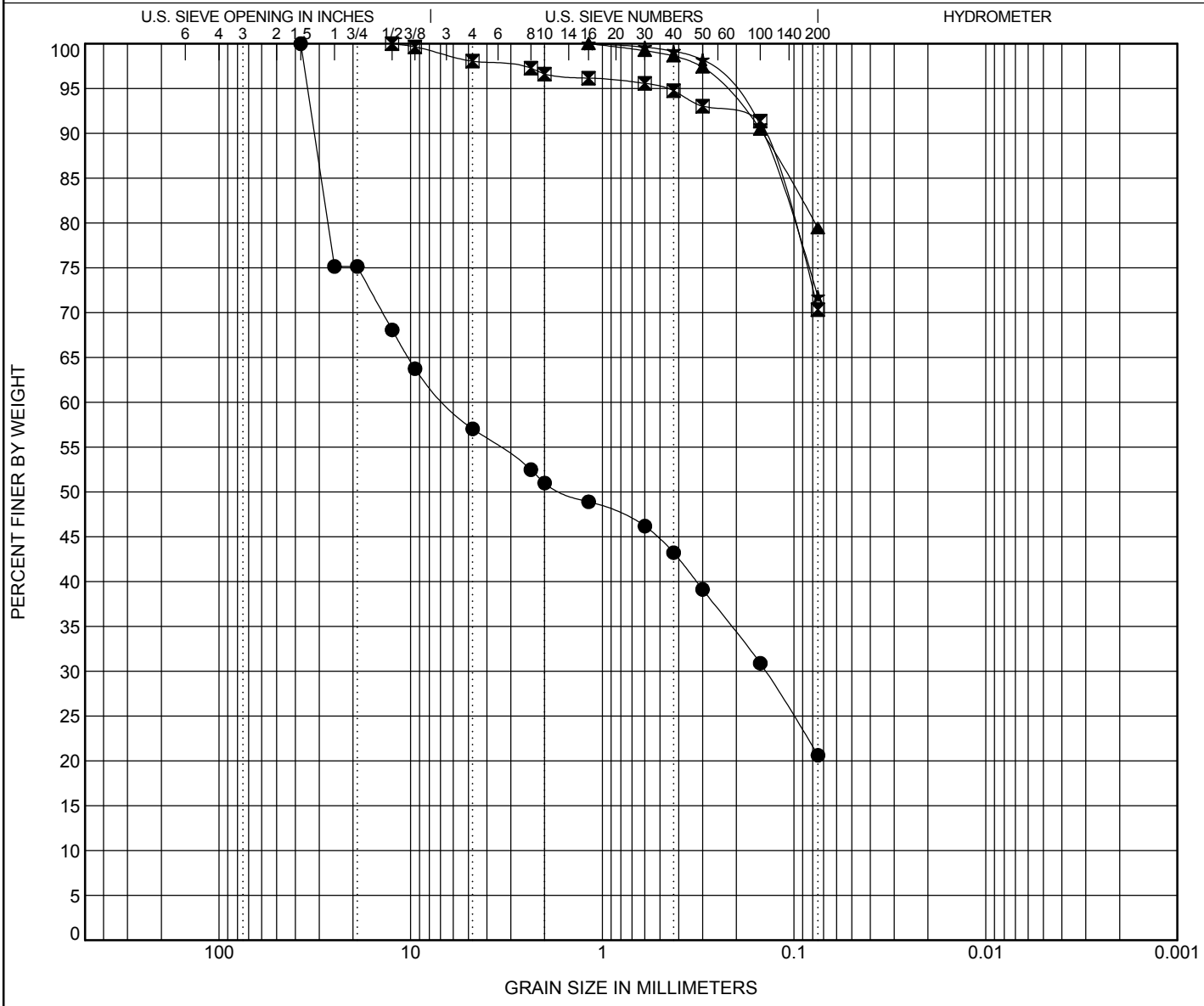
APPENDIX B
Laboratory Testing Results

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

GRAIN SIZE DISTRIBUTION

CLIENT Steve Ryan **PROJECT NAME** 460 N. Mesa Street

PROJECT NUMBER 01616-0001 **PROJECT LOCATION** Fruita, CO



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● TP-1, GB1 12/2016	**SILTY GRAVEL with SAND(GM)**	**NP**	**NP**	**NP**		
⊠ TP-2, GB1 12/2016	**SILT with SAND(ML)**	**24**	**21**	**3**		
▲ TP-3, GB1 1/2017	**LEAN CLAY with SAND(CL)**	**27**	**16**	**11**		
★ TP-3, GB2 1/2017	**SILTY CLAY with SAND(CL-ML)**	**25**	**19**	**6**		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-1, GB1 12/2016	**37.5**	**6.452**	**0.141**		**43.0**	**36.4**	**20.6**	
⊠ TP-2, GB1 12/2016	**12.5**				**2.0**	**27.7**	**70.3**	
▲ TP-3, GB1 1/2017	**1.18**				**0.0**	**20.6**	**79.4**	
★ TP-3, GB2 1/2017	**1.18**				**0.0**	**28.2**	**71.8**	

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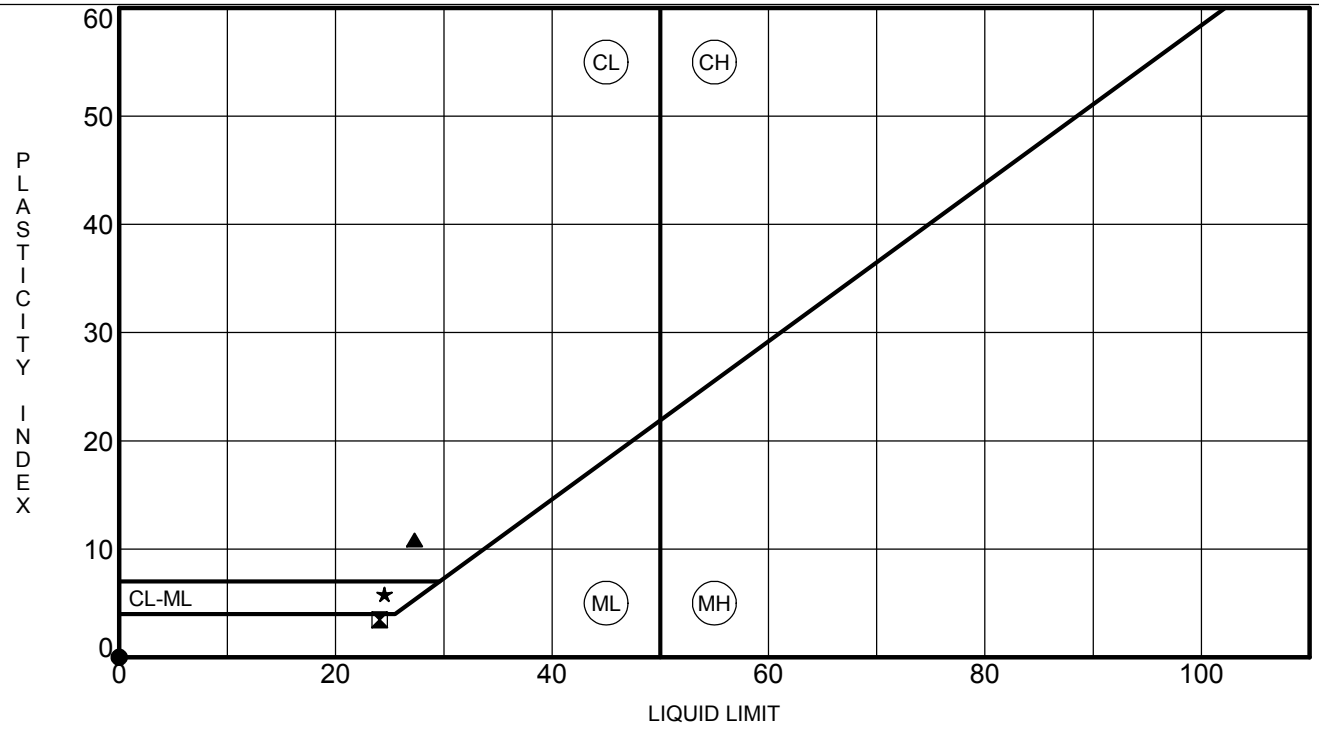
ATTERBERG LIMITS' RESULTS

CLIENT Steve Ryan **PROJECT NAME** 460 N. Mesa Street

PROJECT NUMBER 01616-0001 **PROJECT LOCATION** Fruita, CO



	Specimen Identification		LL	PL	PI	#200	Classification
●	TP-1, GB1	12/2016	NP	NP	NP	21	SILTY GRAVEL with SAND(GM)
⧓	TP-2, GB1	12/2016	24	21	3	70	SILT with SAND(ML)
▲	TP-3, GB1	1/2017	27	16	11	79	LEAN CLAY with SAND(CL)
★	TP-3, GB2	1/2017	25	19	6	72	SILTY CLAY with SAND(CL-ML)

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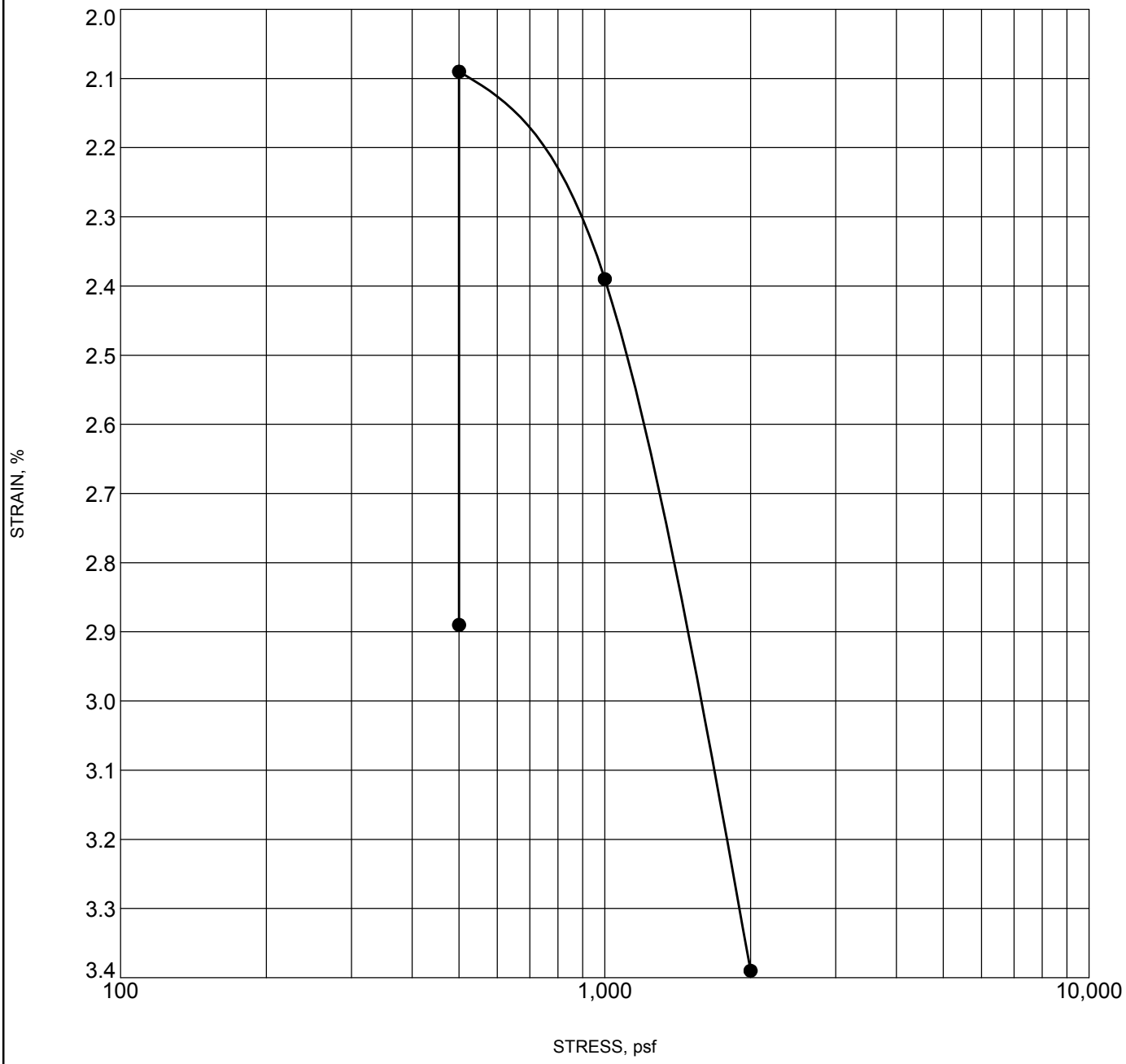
970-255-6818

CONSOLIDATION TEST

CLIENT Steve Ryan **PROJECT NAME** 460 N. Mesa Street

PROJECT NUMBER 01616-0001 **PROJECT LOCATION** Fruita, CO



Specimen Identification		Classification	γ_d	MC%
● TP-3	2.0		90	22

CONSOL STRAIN 01616-0001 460 N MESA RD.GPJ GINT US LAB.GDT 2/7/17

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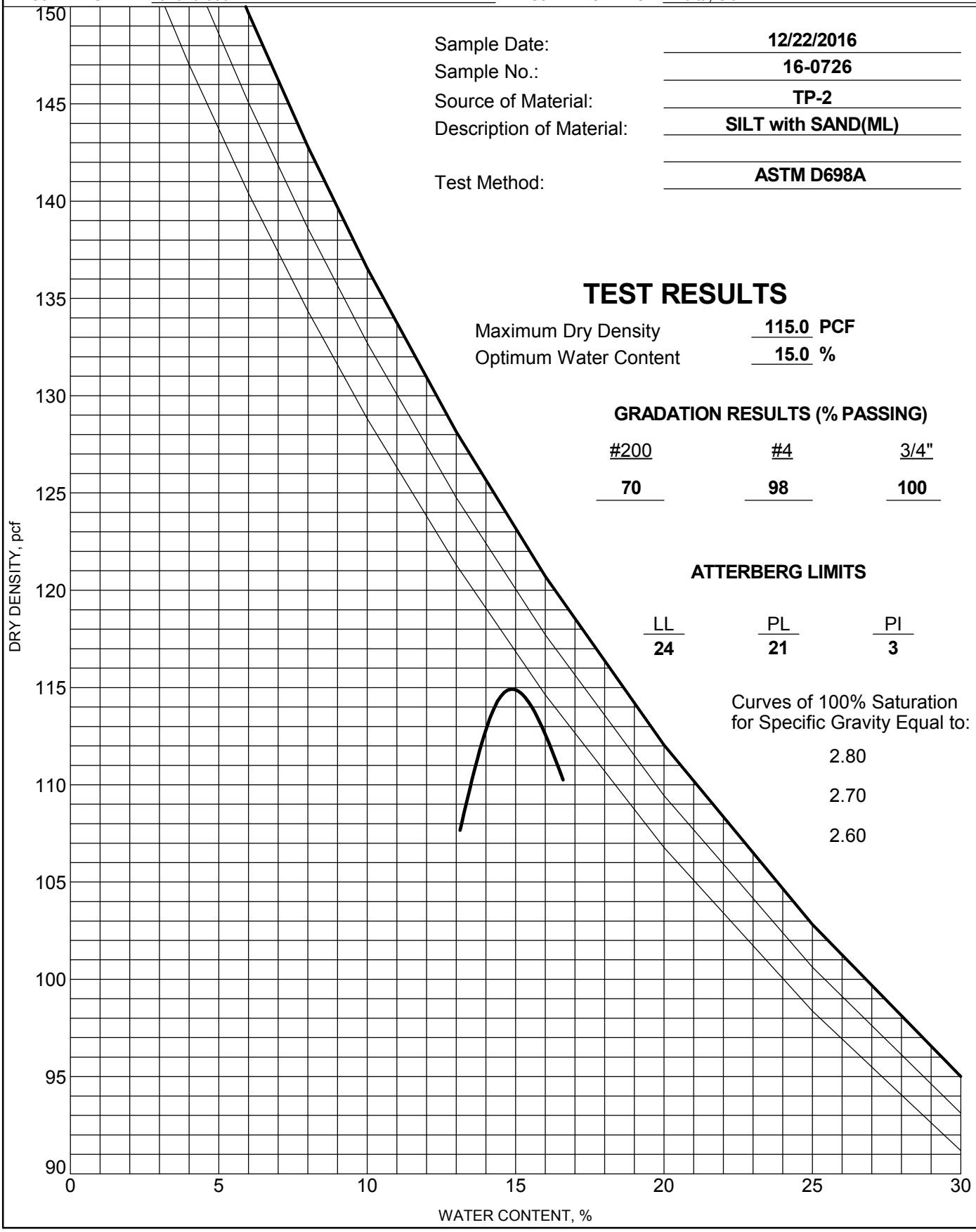
MOISTURE-DENSITY RELATIONSHIP

CLIENT Steve Ryan **PROJECT NAME** 460 N. Mesa Street

PROJECT NUMBER 01616-0001 **PROJECT LOCATION** Fruita, CO



Sample Date:	**12/22/2016**
Sample No.:	**16-0726**
Source of Material:	**TP-2**
Description of Material:	**SILT with SAND(ML)**
Test Method:	**ASTM D698A**

TEST RESULTS

Maximum Dry Density	**115.0** PCF
Optimum Water Content	**15.0** %

GRADATION RESULTS (% PASSING)

#200	#4	3/4"
70	**98**	**100**

ATTERBERG LIMITS

LL	PL	PI
24	**21**	**3**

Curves of 100% Saturation for Specific Gravity Equal to:

2.80

2.70

2.60

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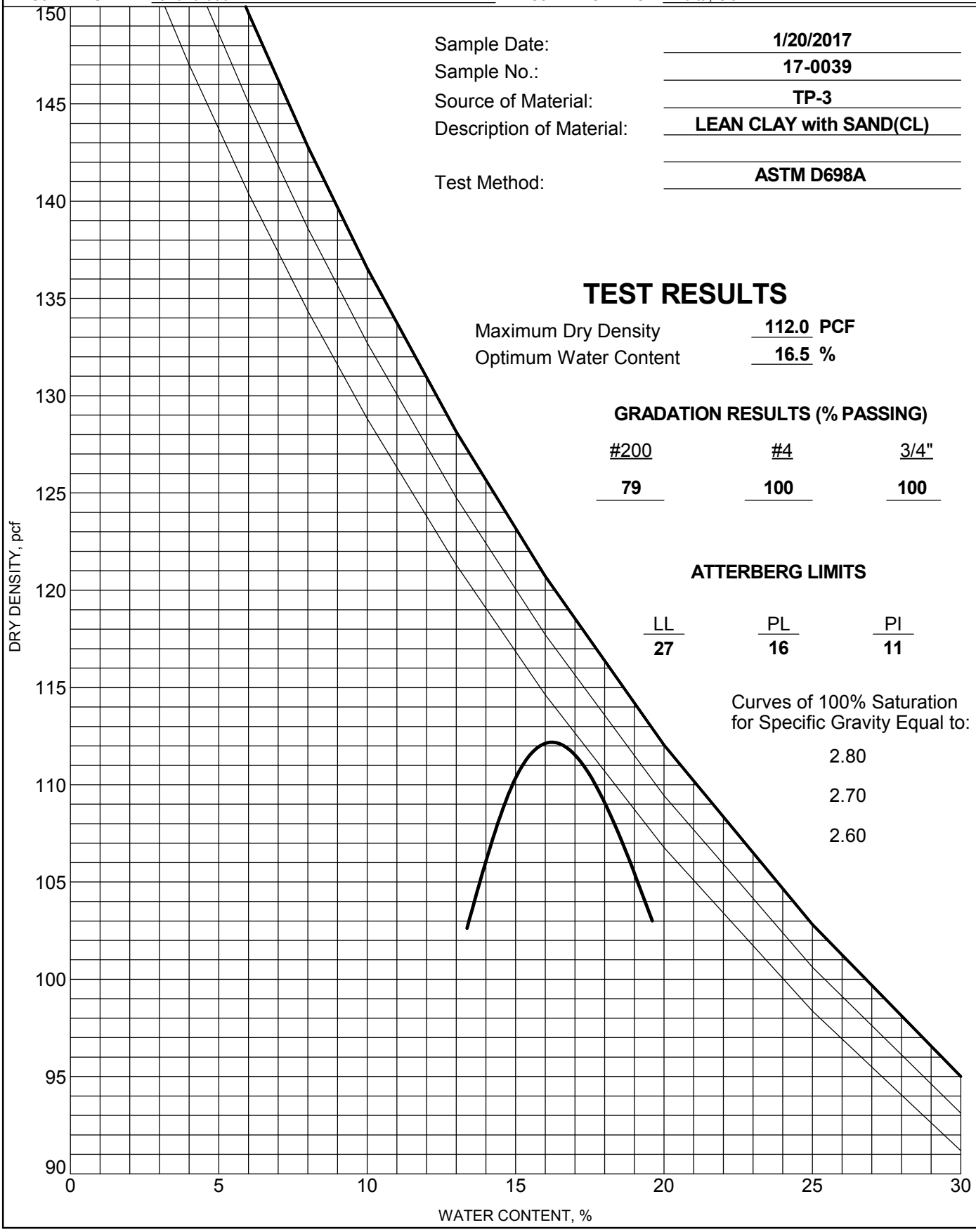
MOISTURE-DENSITY RELATIONSHIP

CLIENT Steve Ryan **PROJECT NAME** 460 N. Mesa Street

PROJECT NUMBER 01616-0001 **PROJECT LOCATION** Fruita, CO



Sample Date: **1/20/2017**

Sample No.: **17-0039**

Source of Material: **TP-3**

Description of Material: **LEAN CLAY with SAND(CL)**

Test Method: **ASTM D698A**

TEST RESULTS

Maximum Dry Density **112.0** **PCF**

Optimum Water Content **16.5** **%**

GRADATION RESULTS (% PASSING)

#200	#4	3/4"
79	**100**	**100**

ATTERBERG LIMITS

LL	PL	PI
27	**16**	**11**

Curves of 100% Saturation for Specific Gravity Equal to:

2.80

2.70

2.60

COMPACTION 01616-0001 460 N MESA RD.GPJ GINT US LAB.GDT 2/7/17