Huddleston-Berry
Engineering & Testing, LLC

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June 5, 2018
Project#00208-0080

City of Grand Junction Engineering
333 West Avenue, Building C
Grand Junction, Colorado 81501

Attention: Mr. John Eklund

Subject: Geotechnical Investigation
Purdy Mesa Flowline
Whitewater, Colorado

Dear Mr. Eklund,

This letter presents the results of a geotechnical investigation conducted by Huddleston-Berry Engineering & Testing, LLC (HBET) for the Purdy Mesa Flowline project in Whitewater, Colorado. The site location is shown on Figure 1 – Site Location Map. The proposed construction is anticipated to include replacement of approximately 1.25 miles of water pipeline. In addition, a new storage tank is proposed at the east end of the pipeline. The scope of our investigation included collecting subsurface information along the pipeline alignment and tank location for use by consultants on the project.

Subsurface Investigation

The subsurface investigation included eight test pits along the pipeline and at the proposed tank location as shown on Figure 2 – Site Plan. The test pits were excavated to depths of between 5.0 and 10.0 feet below the existing ground surface. Typed test pit logs are included in Appendix A.

As indicated on the logs, the subsurface conditions along the pipeline were variable. However, Test Pits TP-1 through TP-3, and TP-6, encountered 1.0 to 2.5 feet of sand and clay soils above soft to medium hard, completely to highly weathered shale bedrock to the bottoms of the excavations. Groundwater was not encountered in these pits at the time of the investigation.

In Test Pit TP-4, the weathered shale bedrock was deeper. Brown, moist, medium stiff to stiff sandy lean clay soils with gravel and trace cobbles extended to a depth of 9.0 feet where the shale was encountered. Groundwater was not encountered in TP-4 at the time of the investigation.

In Test Pits TP-5 and TP-7, the shallow soils consisted of dense to very dense cobbles and boulders in matrix soils ranging from sandy gravel to sandy lean clay. In TP-5, the cobble and boulder soils extended to a depth of 6.5 feet where soft to medium hard, weathered shale bedrock was encountered. Backhoe bucket refusal was encountered on a boulder in TP-5 at a depth of 5.0 feet. Groundwater was not encountered in TP-5 or TP-7 at the time of the investigation.

Test Pit TP-8, conducted at the proposed tank location, encountered tan, moist, dense sandy gravel and cobbles soils from the ground surface to the bottom of the excavation. Groundwater was not encountered in TP-8 at the time of the investigation.

Laboratory Testing

Laboratory testing was conducted on samples of the native soils encountered in the test pits. The testing included grain size analysis, Atterberg limits determination, natural moisture content determination, 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 native clay soils are moderately plastic. Due to the presence of larger particles, undisturbed samples of the clay were unable to be collected for swell/consolidation testing. However, based upon the plasticity of the material and upon our experience with similar soils in the area, the native clay soils are anticipated to be slightly expansive.

General Notes

The information included above is based upon the results of the subsurface investigation and on our local experience. This information is valid only for the proposed construction.

In addition, as discussed previously, the subsurface conditions across the site were variable. However, the precise nature and extent of subsurface variability may not become evident until construction. HBET should be contacted to evaluate the subgrade conditions where significant subsurface variations beyond those outlined above are encountered during construction.

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

Google Earth

miles 4
km 7

FIGURE 1
Site Location Map

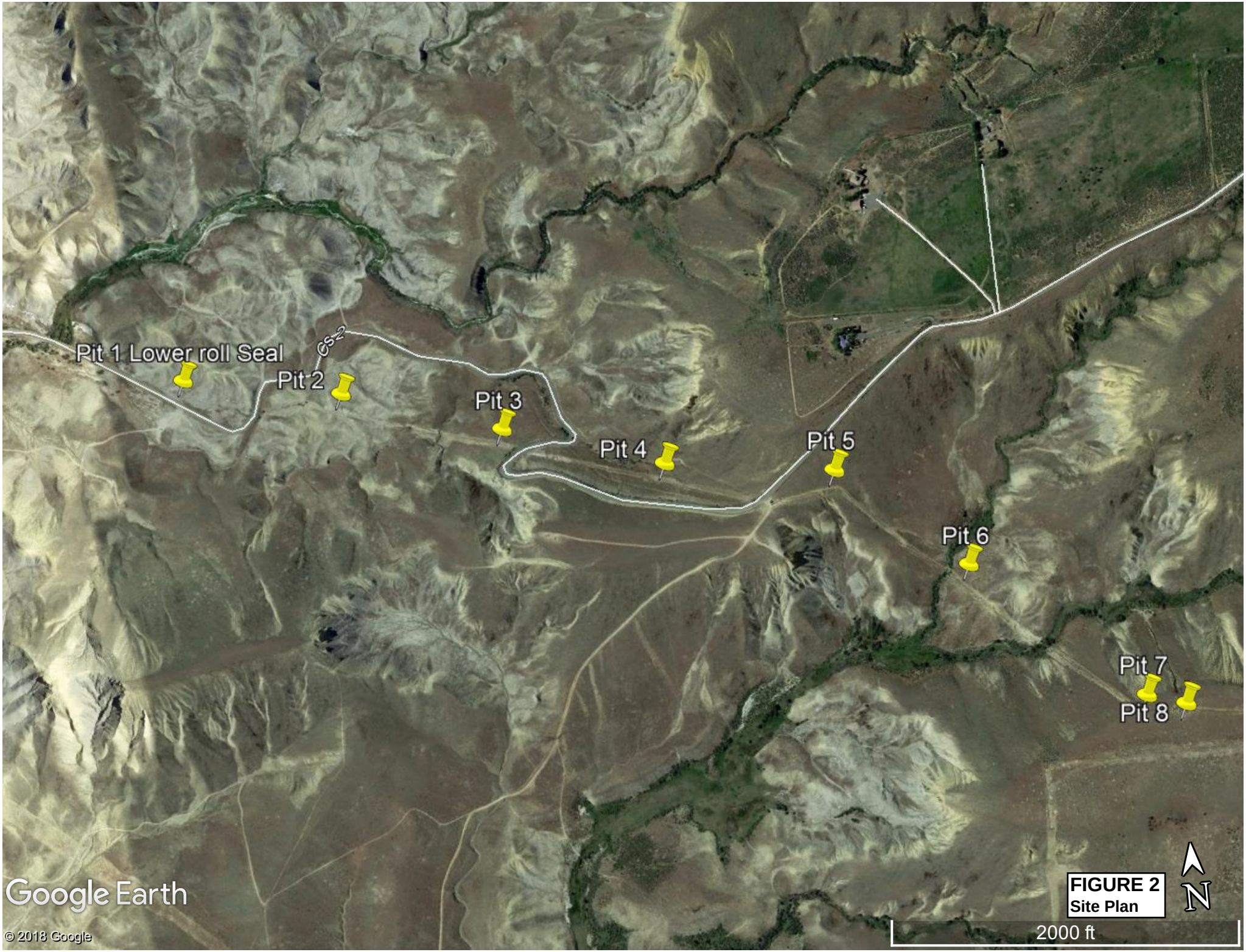

FIGURE 2
Site Plan

APPENDIX A
Typed Test Pit Logs

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
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TEST PIT NUMBER TP-1

CLIENT City of Grand Junction
PROJECT NAME Purdy Mesa Flowline
PROJECT NUMBER 00208-0080
PROJECT LOCATION Whitewater, CO
DATE STARTED 4/24/18 **COMPLETED** 4/24/18
GROUND ELEVATION _____ **TEST PIT SIZE** _____
EXCAVATION CONTRACTOR Client
GROUND WATER LEVELS:
EXCAVATION METHOD Backhoe
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		Silty SAND with Organics (TOPSOIL)										
2.5		Silty SAND (sm), tan, moist, loose										
5.0		SHALE, grey, soft to medium hard, completely weathered to highly weathered										
7.5		Bottom of test pit at 9.0 feet.										

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TEST PIT NUMBER TP-2

CLIENT City of Grand Junction
PROJECT NAME Purdy Mesa Flowline
PROJECT NUMBER 00208-0080
PROJECT LOCATION Whitewater, CO
DATE STARTED 4/24/18 **COMPLETED** 4/24/18
GROUND ELEVATION _____ **TEST PIT SIZE** _____
EXCAVATION CONTRACTOR Client
GROUND WATER LEVELS:
EXCAVATION METHOD Backhoe
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		Sandy Lean CLAY with Organics (TOPSOIL)										
		SHALE, black, soft to medium hard, completely weathered to highly weathered										
2.5												
5.0												
7.5												
		Bottom of test pit at 9.0 feet.										

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TEST PIT NUMBER TP-3

CLIENT City of Grand Junction
PROJECT NAME Purdy Mesa Flowline
PROJECT NUMBER 00208-0080
PROJECT LOCATION Whitewater, CO
DATE STARTED 4/24/18 **COMPLETED** 4/24/18
GROUND ELEVATION _____ **TEST PIT SIZE** _____
EXCAVATION CONTRACTOR Client
GROUND WATER LEVELS:
EXCAVATION METHOD Backhoe
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		Sandy Lean CLAY with Organics (TOPSOIL)										
		Sandy Lean CLAY with trace Gravel and Cobbles (CL), brown, moist, medium stiff *** Lab Classified GB1	GB 1					7	40	25	15	67
2.5		SHALE, grey, soft to medium hard, highly weathered										
5.0												
7.5		Bottom of test pit at 9.5 feet.										

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TEST PIT NUMBER TP-4

CLIENT City of Grand Junction
PROJECT NAME Purdy Mesa Flowline
PROJECT NUMBER 00208-0080
PROJECT LOCATION Whitewater, CO
DATE STARTED 4/24/18 **COMPLETED** 4/24/18
GROUND ELEVATION _____ **TEST PIT SIZE** _____
EXCAVATION CONTRACTOR Client
GROUND WATER LEVELS:
EXCAVATION METHOD Backhoe
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		Sandy Lean CLAY with Organics (TOPSOIL)										
		Sandy Lean CLAY with Gravel and trace Cobbles (CL), brown, moist, medium stiff to stiff										
		*** Lab Classified GB1	GB 1					4	39	18	21	62
2.5												
5.0												
7.5												
		SHALE, black, soft, highly weathered										
10.0		Bottom of test pit at 10.0 feet.										

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TEST PIT NUMBER TP-5

CLIENT City of Grand Junction
PROJECT NAME Purdy Mesa Flowline
PROJECT NUMBER 00208-0080
PROJECT LOCATION Whitewater, CO
DATE STARTED 4/24/18 **COMPLETED** 4/24/18
GROUND ELEVATION _____ **TEST PIT SIZE** _____
EXCAVATION CONTRACTOR Client
GROUND WATER LEVELS:
EXCAVATION METHOD Backhoe
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		Sandy Lean CLAY with Gravel and Organics (TOPSOIL0										
		COBBLES and BOULDERS in a Sandy Lean CLAY Matrix (cl), brown, moist, dense										
2.5												
5.0												
		SHALE, grey, soft to medium hard, highly weathered										
7.5												
10.0		Bottom of test pit at 10.0 feet.										

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TEST PIT NUMBER TP-6

CLIENT City of Grand Junction
PROJECT NAME Purdy Mesa Flowline
PROJECT NUMBER 00208-0080
PROJECT LOCATION Whitewater, CO
DATE STARTED 4/24/18 **COMPLETED** 4/24/18
GROUND ELEVATION _____ **TEST PIT SIZE** _____
EXCAVATION CONTRACTOR Client
GROUND WATER LEVELS:
EXCAVATION METHOD Backhoe
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		Sandy Lean CLAY with Gravel and trace Cobbles (cl), brown, moist, soft to medium stiff										
2.5		SHALE, grey, soft to medium hard, highly weathered										
5.0												
7.5												
		Bottom of test pit at 9.5 feet.										

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TEST PIT NUMBER TP-7

CLIENT City of Grand Junction
PROJECT NAME Purdy Mesa Flowline
PROJECT NUMBER 00208-0080
PROJECT LOCATION Whitewater, CO
DATE STARTED 4/24/18 **COMPLETED** 4/24/18
GROUND ELEVATION _____ **TEST PIT SIZE** _____
EXCAVATION CONTRACTOR Client
GROUND WATER LEVELS:
EXCAVATION METHOD Backhoe
AT TIME OF EXCAVATION dry
LOGGED BY CM **CHECKED BY** MAB
AT END OF EXCAVATION dry
NOTES Bucket Refusal at 5-Ft
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		Sandy GARVEL and COBBLES with Organics (TOPSOIL)										
		COBBLES and BOULDERS in a Sandy GRAVEL Matrix (gw), tan, moist, dense to very dense										
2.5												
5.0		Bottom of test pit at 5.0 feet.										

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TEST PIT NUMBER TP-8

CLIENT City of Grand Junction
PROJECT NAME Purdy Mesa Flowline
PROJECT NUMBER 00208-0080
PROJECT LOCATION Whitewater, CO
DATE STARTED 4/24/18 **COMPLETED** 4/24/18
GROUND ELEVATION _____ **TEST PIT SIZE** _____
EXCAVATION CONTRACTOR Client
GROUND WATER LEVELS:
EXCAVATION METHOD Backhoe
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		Sandy GRAVEL and COBBLES with Organics (TOPSOIL)										
		Sandy GRAVEL and COBBLES with trace Boulders (gw), tan, moist, dense										
2.5												
5.0												
7.5												
10.0		Bottom of test pit at 10.0 feet.										

APPENDIX B
Laboratory Testing Results

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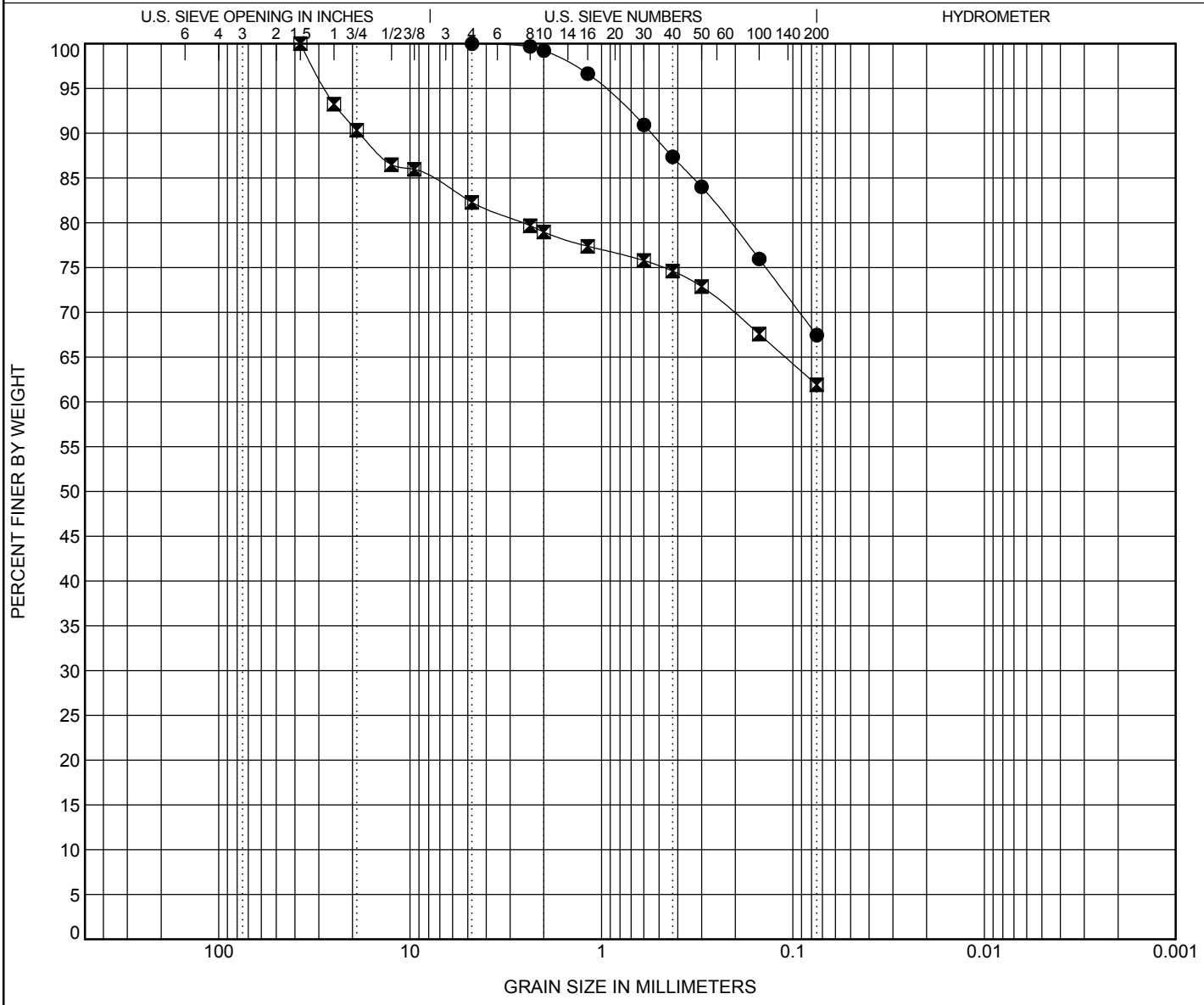
GRAIN SIZE DISTRIBUTION

CLIENT City of Grand Junction **PROJECT NAME** Purdy Mesa Flowline

PROJECT NUMBER 00208-0080 **PROJECT LOCATION** Whitewater, CO



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	LL	PL	PI	Cc	Cu
● TP-3, GB1	4/2018	**SANDY LEAN CLAY(CL)**	**40**	**25**	**15**		
⊠ TP-4, GB1	4/2018	**SANDY LEAN CLAY with GRAVEL(CL)**	**39**	**18**	**21**		

Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-3, GB1	4/2018	**4.75**				**0.0**	**32.5**	**67.5**	
⊠ TP-4, GB1	4/2018	**37.5**				**17.7**	**20.4**	**61.9**	

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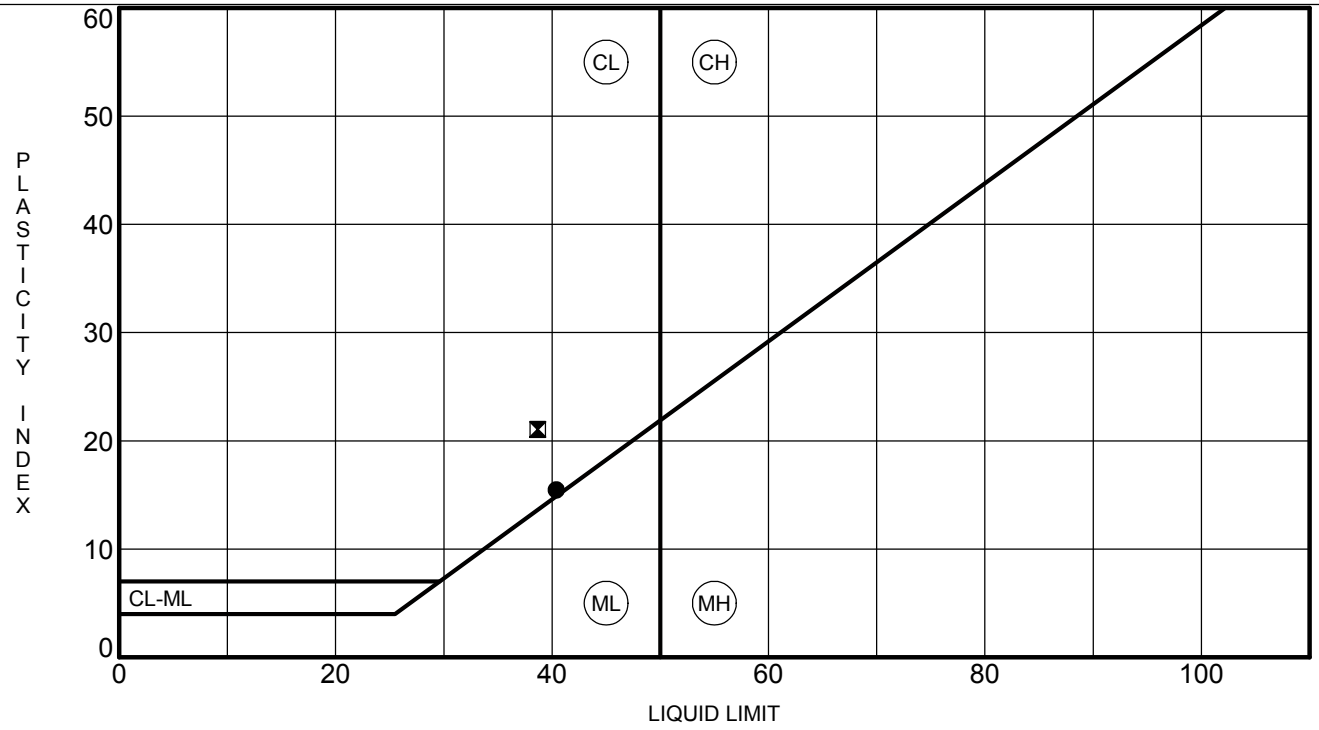
ATTERBERG LIMITS' RESULTS

CLIENT City of Grand Junction **PROJECT NAME** Purdy Mesa Flowline

PROJECT NUMBER 00208-0080 **PROJECT LOCATION** Whitewater, CO



	Specimen Identification		LL	PL	PI	#200	Classification
●	**TP-3, GB1**	**4/2018**	**40**	**25**	**15**	**67**	**SANDY LEAN CLAY(CL)**
⧓	**TP-4, GB1**	**4/2018**	**39**	**18**	**21**	**62**	**SANDY LEAN CLAY with GRAVEL(CL)**

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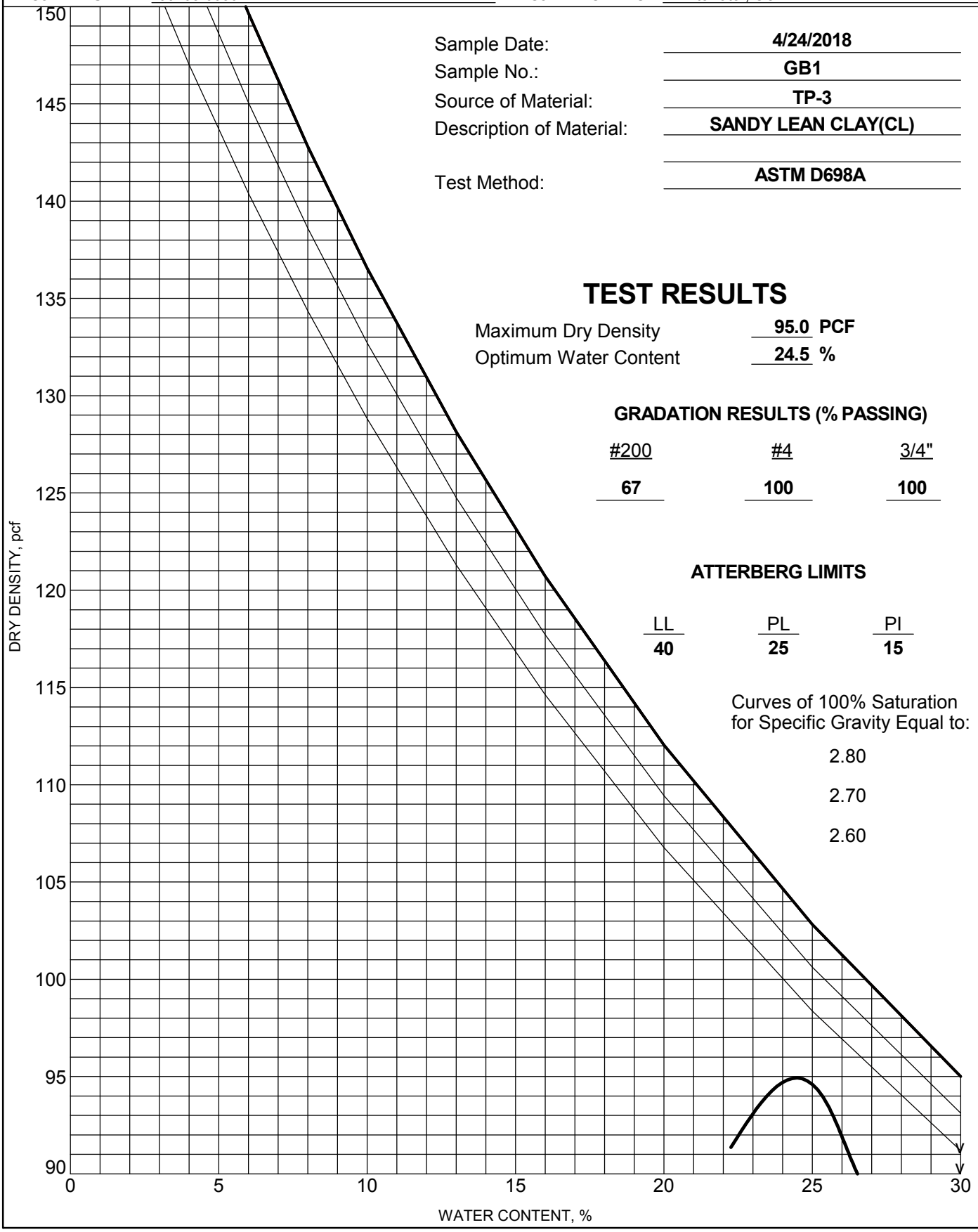
MOISTURE-DENSITY RELATIONSHIP

CLIENT City of Grand Junction **PROJECT NAME** Purdy Mesa Flowline

PROJECT NUMBER 00208-0080 **PROJECT LOCATION** Whitewater, CO



Sample Date: **4/24/2018**

Sample No.: **GB1**

Source of Material: **TP-3**

Description of Material: **SANDY LEAN CLAY(CL)**

Test Method: **ASTM D698A**

TEST RESULTS

Maximum Dry Density **95.0** PCF

Optimum Water Content **24.5** %

GRADATION RESULTS (% PASSING)

#200	#4	3/4"
67	100	100

ATTERBERG LIMITS

LL	PL	PI
40	25	15

Curves of 100% Saturation for Specific Gravity Equal to:

2.80

2.70

2.60

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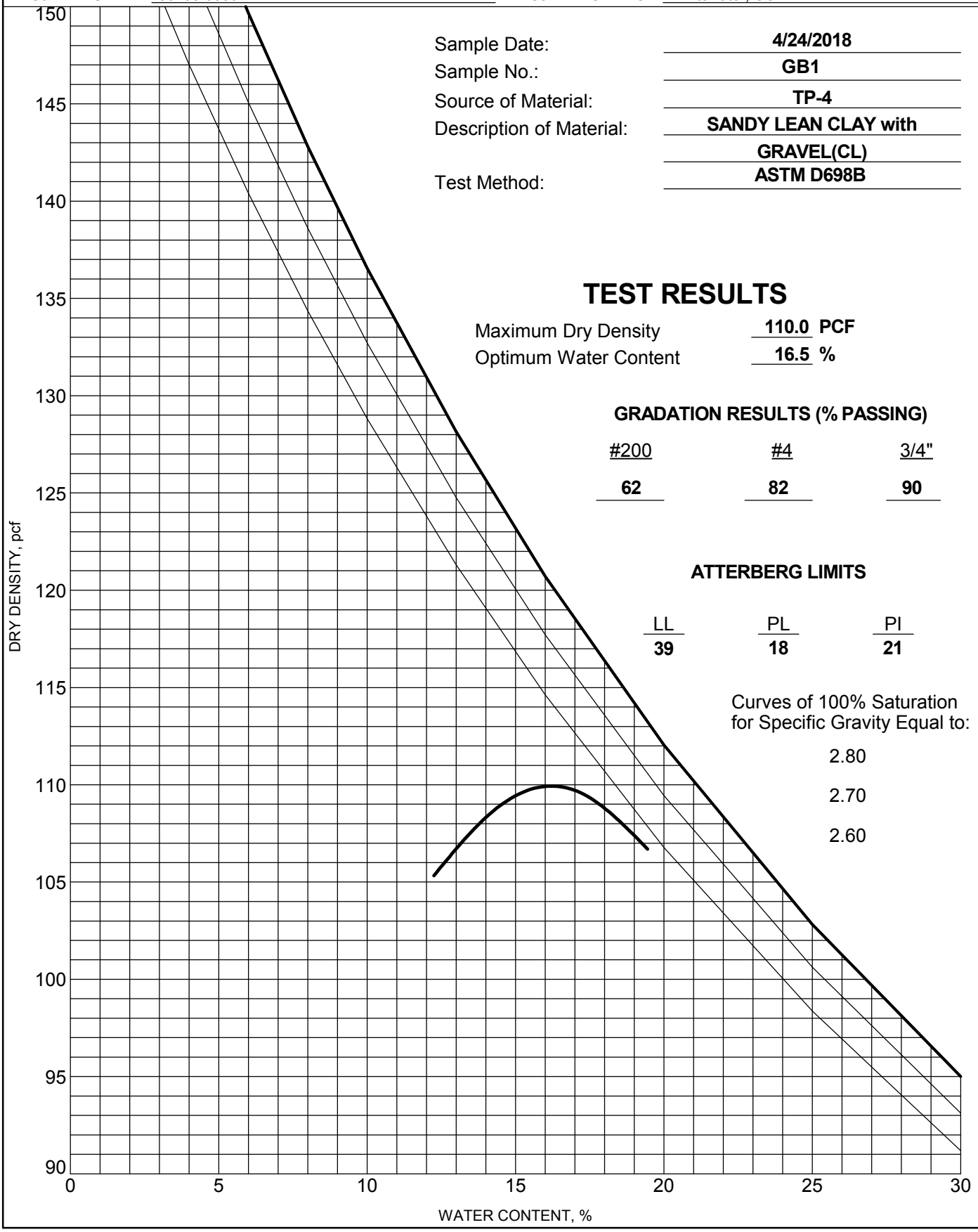
MOISTURE-DENSITY RELATIONSHIP

CLIENT City of Grand Junction **PROJECT NAME** Purdy Mesa Flowline

PROJECT NUMBER 00208-0080 **PROJECT LOCATION** Whitewater, CO



Sample Date: **4/24/2018**

Sample No.: **GB1**

Source of Material: **TP-4**

Description of Material: **SANDY LEAN CLAY with GRAVEL(CL)**

Test Method: **ASTM D698B**

TEST RESULTS

Maximum Dry Density **110.0** PCF

Optimum Water Content **16.5** %

GRADATION RESULTS (% PASSING)

#200	#4	3/4"
62	82	90

ATTERBERG LIMITS

LL	PL	PI
39	18	21

Curves of 100% Saturation for Specific Gravity Equal to:

2.80

2.70

2.60