

Date: July 31<sup>st</sup>, 2019

Prepared by: **GCME, Inc.**

TO: RS&H, Inc.  
3125 W Commercial Boulevard, Suite 130  
Fort Lauderdale, FL 33309

Attention: Mr. Paul Heeg, P.E.  
Senior Transportation Engineer

SUBJECT: **Geotechnical Report – Borehole Permeability Tests**  
PD&E Study – SW 10<sup>th</sup> Street / SR-869  
From Powerline Road to West of Military Trail  
Broward County, Florida  
FPID No.: 439891-1-22-02  
GCME Project No.: 2000-01-17003

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Dear Mr. Heeg,

**GCME, Inc.** has completed borehole permeability tests (BHP) along SW 10th Street / SR-869 in reference to the scope of services detailed in Optional Services (OPT) #11 Dated February 8, 2019.

This entire project corridor runs along SW 10th Street / SR-869 from west of Powerline Road to west of Military Trail, a distance of about 2.0 miles. In order to evaluate the soil permeability along the roadway alignment, the scope of work included performing nine (9) borehole permeability tests at three (3) locations. At first, three (3) SPT borings, each 30 feet deep were drilled at these three (3) locations to verify the subsurface soil stratum. The locations of these tests were provided by your office. At each location, three BHP tests were performed with different test intervals (i.e., 0 to 10 feet, 10 to 20 feet, and 20 to 30 feet) and the horizontal distance between each BHP test was about 10 feet.

The numbering schedule and location of the BHP tests and soil borings for the proposed improvements of the roadway corridor are as follows:

- Along South of SR-869: Three (3) Borings, numbered BHP-1, BHP-2 and BHP-3  
Nine (9) BHP tests:  
BHP-1A, BHP-2A and BHP-3A. Test Interval 20' – 30'  
BHP-1B, BHP-2B and BHP-3B. Test Interval 10' – 20'  
BHP-1C, BHP-2C and BHP-3C. Test Interval 0' – 10'

The approximate locations of the BHP tests and the soil borings are presented on Plate 1, titled 'Approximate Boring Location Plan'. For this report, the boring location plans are presented on

Google Earth maps for your review. The station, offset and elevation information at the test / boring locations were not available at the time of writing this report.

The subsurface geologic profiles encountered at the boring location along with the SPT results, are presented in Figure 1. The soil profiles are drawn with reference to depth.

The SPT boring was advanced using mud rotary procedures. The boring was drilled to depth of 30 feet below grade. Samples of the in-place materials were recovered with a standard split barrel advanced with a 140-pound hammer falling 30 inches (the SPT after ASTM D 1586). Soil samples were field classified, placed in sealed containers and transported to our laboratory for further analysis by a soils engineer. Classification of the subsoils found in the borings followed the Unified Soil Classification System (ASTM D 2487). The borehole was filled with cement grout at the completion of the drilling activities.

Index property tests such as moisture content, organic content and grain size distribution are being performed on representative samples from the SPT borings. All the available laboratory test results are provided in Table – 1.


Borehole Permeability Test (BHP) were performed using the usual open-hole, constant head methodology. The boreholes were 10, 20 and 30 feet deep and completed as an open well with gravel pack (6-20 silica sand). The well screen slot width was 0.020 inches. Water from the drill rig tank was then pumped into the open well, and the amount of water required to maintain a constant head in the pipe was recorded. The BHP results are presented in Table – 2.

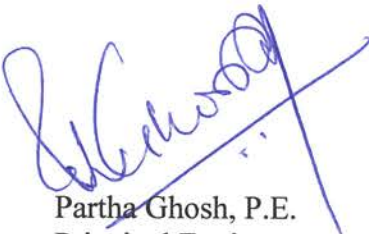
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We are pleased to be of continued service to RS&H and the Florida Department of Transportation (FDOT). If you have any questions or comments regarding the contents of the following report, please call.

Very truly yours,

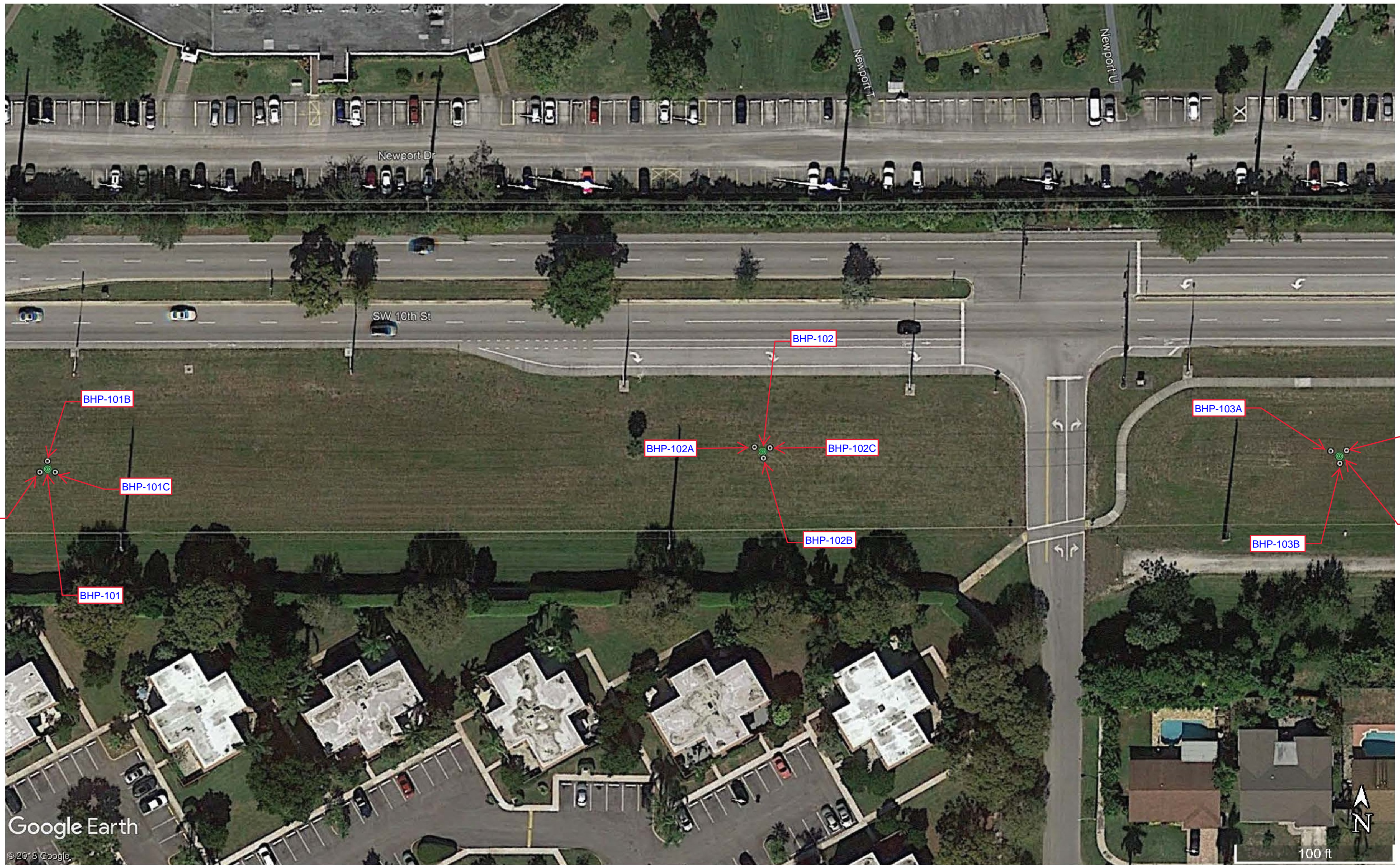
GCME, INC.

  
Zhijun Pan, P.E.  
Project Geotechnical Engineer  
FL. Reg. No. 70634

  
Partha Ghosh, P.E.  
Principal Engineer  
FL Registration No. 51377

Appendices:

Plate – 1	Approximate Boring Location Plan
Figure – 1	Report of Core Borings
Table – 1	Summary of Laboratory Testing Results
Table – 2	Borehole Permeability Test Results



REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

ENGINEER OF RECORD:  
 PARTHA GHOSH, P.E. LICENSE NO. 51377  
 GCME, INC.  
 1730 W. 10TH STREET  
 RIVIERA BEACH, FLORIDA 33404  
 CERTIFICATE OF AUTHORIZATION NO. 9076

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION		
ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR-869	BROWARD	439891-1-22-02

**APPROXIMATE BORING LOCATION PLAN  
 PLATE-1**

SHEET NO.  
 \_\_\_\_\_

# LEGEND

- (SP) UNIFIED SOIL CLASSIFICATION SYSTEM SYMBOL
  - N STANDARD PENETRATION RESISTANCE IN BLOWS PER 12 inches UNLESS OTHERWISE NOTED. 50/5 INDICATES (50) BLOWS REQUIRED TO DRIVE A SAMPLING SPOON 5 INCHES.
  - LOSS OF CIRCULATION
  - 2/18/19 WATER LEVEL WITH DATE OF READING
  - WR SAMPLER DROPPED DUE TO WEIGHT OF ROD
  - WH SAMPLER DROPPED DUE TO WEIGHT OF HAMMER
  - NR NO RECOVERY
  - HA DRILLED WITH A HAND AUGER IN ORDER TO CLEAR LOCATION FROM UNDERGROUND UTILITIES
- STATION / OFFSET / ELEVATION / COORDINATE INFORMATION ARE PROVIDED BY SURVEYORS.
- MC= NATURAL MOISTURE CONTENT (%)
  - 200= FINES PASSING #200 SIEVE (%)
  - OC= ORGANIC CONTENT (%)
  - LL= LIQUID LIMIT (%)
  - PI= PLASTICITY INDEX (%)
  - NP= INDICATES NON-PLASTIC

NOTES: STRATA BOUNDARIES ARE APPROXIMATE AND MAY VARY BETWEEN OR AWAY FROM BORING LOCATIONS.

DRILLER: JAIME

STANDARD PENETRATION TEST DATA  
 SPOON INSIDE DIA. 1.375 inches  
 SPOON OUTSIDE DIA. 2.0 inches  
 AVG. HAMMER DROP 30.0 inches  
 HAMMER WEIGHT 140.0 pounds

### SPT CONSISTENCY CHART

SILTS AND CLAYS-	AUTOMATIC HAMMER
CONSISTENCY	SPT (BLOWS/1.0 ft)
VERY SOFT	LESS THAN 1
SOFT	1 - 3
FIRM	3 - 6
STIFF	6 - 12
VERY STIFF	12 - 24
HARD	GREATER THAN 24

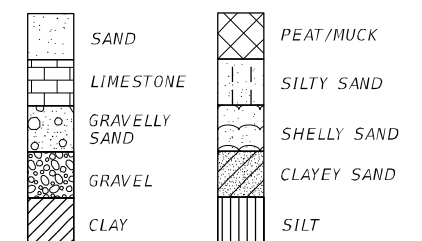
### SPT DENSITY CHART

GRANULAR MATERIALS-	AUTOMATIC HAMMER
RELATIVE DENSITY	SPT (BLOWS/1.0 ft)
VERY LOOSE	LESS THAN 3
LOOSE	3 - 8
MEDIUM DENSE	8 - 24
DENSE	24 - 40
VERY DENSE	GREATER THAN 40

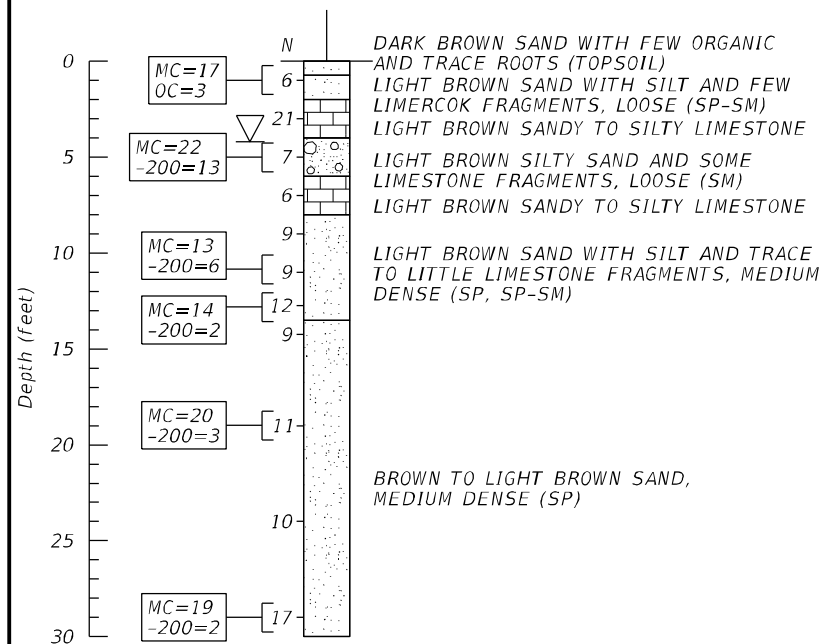
### ENVIRONMENTAL CLASSIFICATION:

SUBSTRUCTURE: MODERATELY AGGRESSIVE (STEEL)  
 MODERATELY AGGRESSIVE (CONCRETE)

SUPERSTRUCTURE: SLIGHTLY AGGRESSIVE  
 SOIL TYPE SYMBOLS:

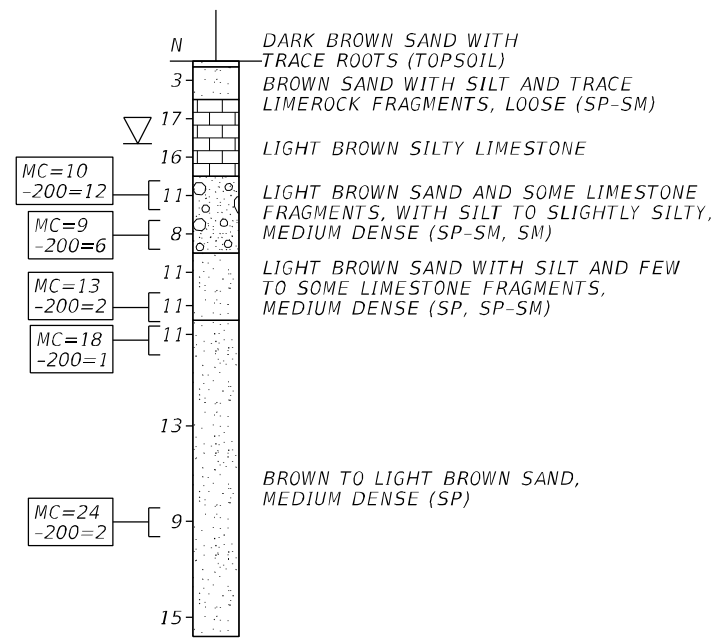


BOR # BHP-101  
 DATE 2/18/2019  
 HAMMER Auto  
 RIG CME-55  
 COORDINATES 26.3039°  
 -80.1432°



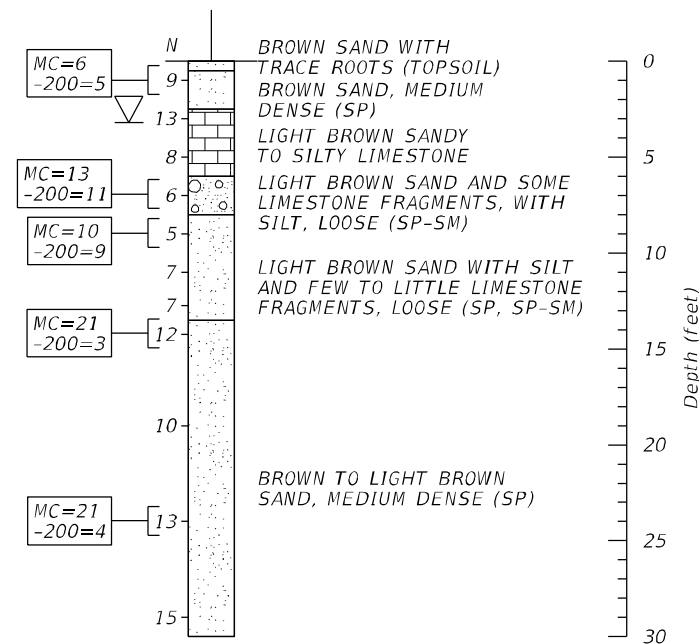
Boring Terminated at Depth of 30ft  
 Casing is 28 feet below grade

BOR # BHP-102  
 DATE 2/18/2019  
 HAMMER Auto  
 RIG CME-55  
 COORDINATES 26.3040°  
 -80.1419°



Boring Terminated at Depth of 30ft  
 Casing is 28 feet below grade

BOR # BHP-103  
 DATE 2/18/2019  
 HAMMER Auto  
 RIG CME-55  
 COORDINATES 26.3040°  
 -80.1408°



Boring Terminated at Depth of 30ft  
 Casing is 28 feet below grade

SCALE: 1"=10'V

GCME PROJECT NO. 2000-01-17003

NOTICE: THE OFFICIAL RECORD OF THIS SHEET IS THE ELECTRONIC FILE DIGITALLY SIGNED AND SEALED UNDER RULE 61G15-23.004, F.A.C. FIGURE: 1

REVISIONS						ENGINEER OF RECORD:			STATE OF FLORIDA			SHEET TITLE:		REF. DWG. NO.
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION	PARTHA GHOSH, P.E. LICENSE NO. 51377			DEPARTMENT OF TRANSPORTATION			REPORT OF CORE BORINGS		
						1730 W. 10TH STREET			ROAD NO.	COUNTY	FINANCIAL PROJECT ID	PROJECT NAME:		SHEET NO.
						RIVIERA BEACH, FLORIDA 33404			869	BROWARD	439891-1-22-02	SW 10TH STREET PD&E STUDY		
						CERTIFICATE OF AUTHORIZATION NO. 9076								

**TABLE - 1**

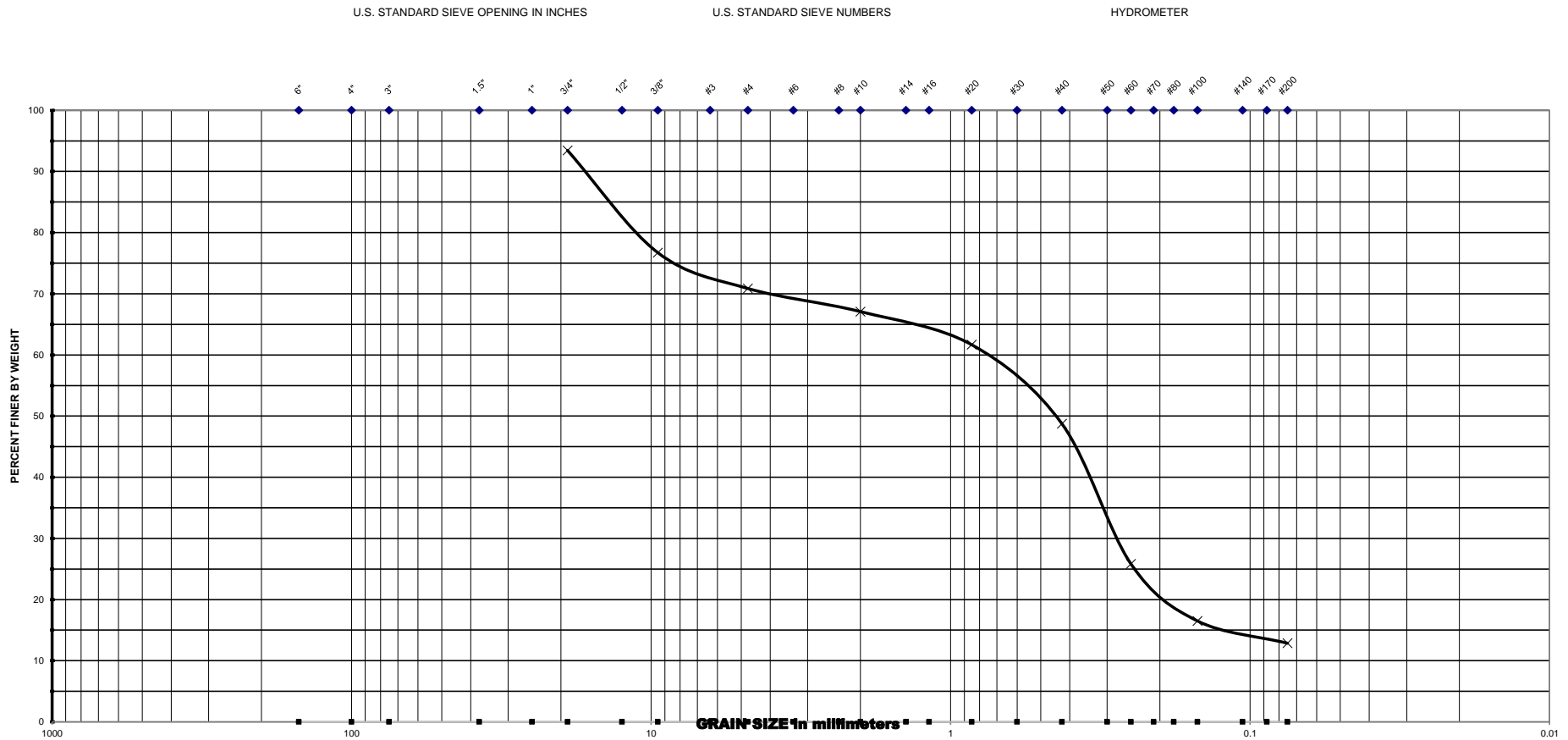
**SUMMARY OF LABORATORY TESTING RESULTS [DRAINAGE]**

**Project Name: PD&E Study - SW 10th Street From Powerline Road to Military Trail**

Boring No.	Sample Depth (ft)		USCS Symbol	Natural Moisture Content (%)	Organic Content (%)	Atterberg Limits			Sieve Analysis								
						LL (%)	PL (%)	PI (%)	3/4"	3/8"	#4	#10	#20	#40	#60	#100	#200
BHP-101	0.0	- 2.0	SP-SM	16.9	3.0												
BHP-101	4.0	- 6.0	SM	21.9					93.4	76.7	70.9	67.1	61.7	48.7	25.8	16.5	12.9
BHP-101	10.0	- 12.0	SP-SM	13.1					100.0	99.2	95.2	93.0	90.2	68.3	26.0	9.8	6.0
BHP-101	12.0	- 13.5	SP	14.2					85.2	78.6	74.9	72.6	71.0	61.6	25.3	4.9	2.4
BHP-101	18.0	- 20.0	SP	19.6					100.0	100.0	100.0	99.9	98.2	83.0	40.1	10.2	3.2
BHP-101	28.0	- 30.0	SP	19.0					100.0	100.0	100.0	100.0	99.6	88.6	34.6	4.4	1.6
BHP-102	6.0	- 8.0	SP-SM	10.0					88.8	74.3	68.5	64.7	60.2	42.9	21.8	14.2	11.7
BHP-102	8.0	- 10.0	SP-SM	9.4					85.4	74.4	61.4	53.5	49.0	34.1	13.7	8.1	6.3
BHP-102	12.0	- 13.5	SP	13.2					86.1	74.0	68.8	67.7	66.9	64.0	20.5	3.4	1.9
BHP-102	13.5	- 15.0	SP	17.9					100.0	100.0	100.0	100.0	98.7	84.0	26.6	3.5	1.4
BHP-102	23.0	- 25.0	SP	24.2					100.0	100.0	100.0	100.0	99.6	95.3	59.4	6.4	1.7
BHP-103	0.0	- 2.0	SP	5.8					100.0	97.7	95.7	94.8	92.9	74.3	32.8	12.8	4.6
BHP-103	6.0	- 8.0	SP-SM	12.8					81.8	73.5	70.1	66.9	59.3	44.5	24.5	14.1	11.1
BHP-103	8.0	- 10.0	SP-SM	10.4					96.3	89.0	84.8	80.3	74.6	56.1	29.3	13.8	9.3
BHP-103	13.5	- 15.0	SP	20.8					100.0	100.0	100.0	99.9	99.3	89.5	67.3	20.7	3.3
BHP-103	23.0	- 25.0	SP	20.5					100.0	100.0	100.0	100.0	99.5	94.1	37.7	7.9	3.9

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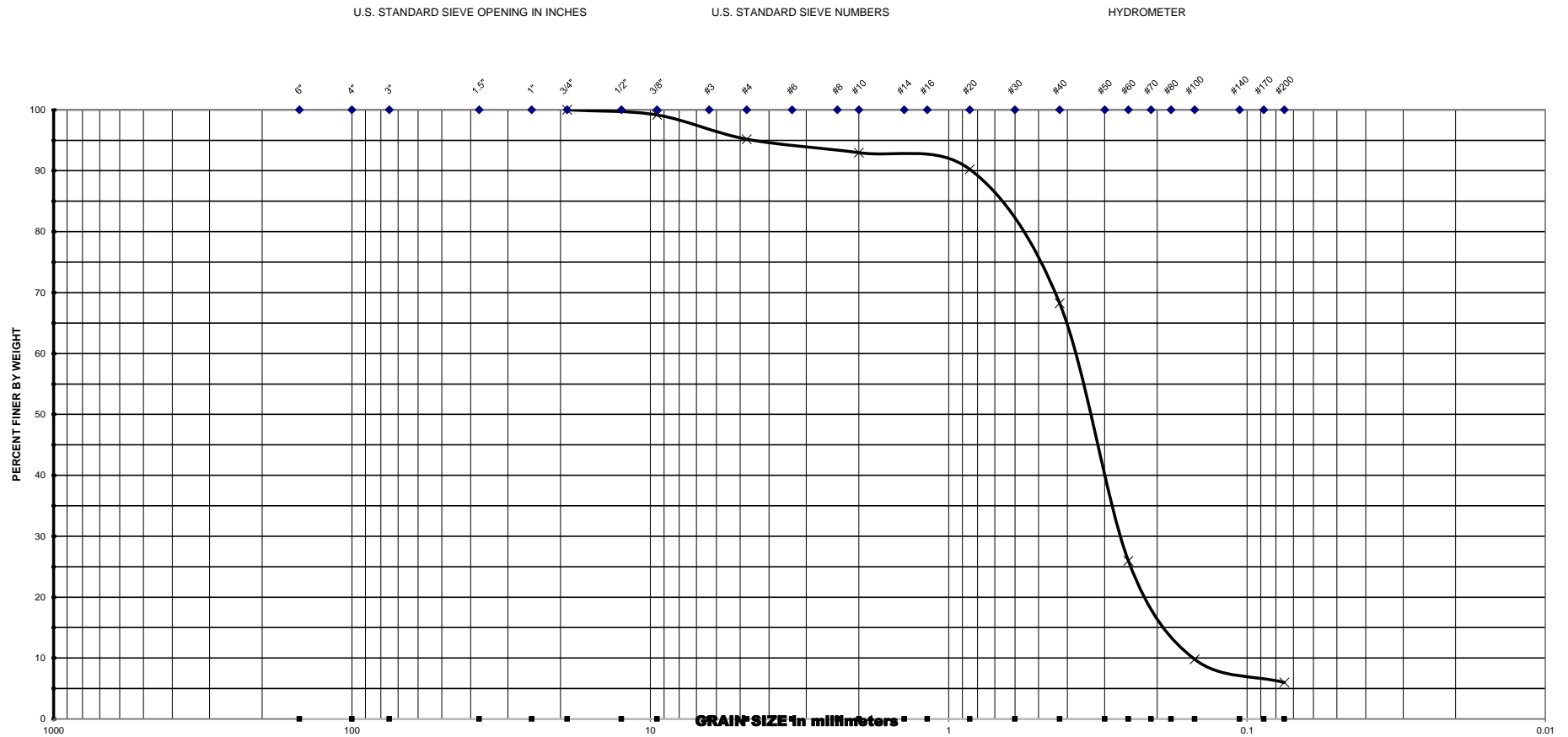
Geotechnical - Consulting - Engineering - Testing



Project Name : <u>PD&amp;E Study - SW 10th Street From Powerline Road to Military Trail</u>					<b>U.S SIEVE NO.</b>	<b>CUMM. % PASSING</b>
Project No. : <u>2000-01-17003</u> Date : <u>7/8/2019</u>					<u>3/4"</u>	93.4
					<u>3/8"</u>	76.7
					<u>#4</u>	70.9
<b>BORING NO.</b>	<b>DEPTH INTERVAL [FT]</b>	<b>SOIL DESCRIPTION</b>	<b>MC</b>	<b>OC</b>	<u>#10</u>	67.1
BHP-101	4.0 - 6.0	SM	21.9		<u>#20</u>	61.7
					<u>#40</u>	48.7
					<u>#60</u>	25.8
Note : MC - Moisture Content (%) OC - Organic Content (%)					<u>#100</u>	16.5
					<u>#200</u>	12.9

# GCME

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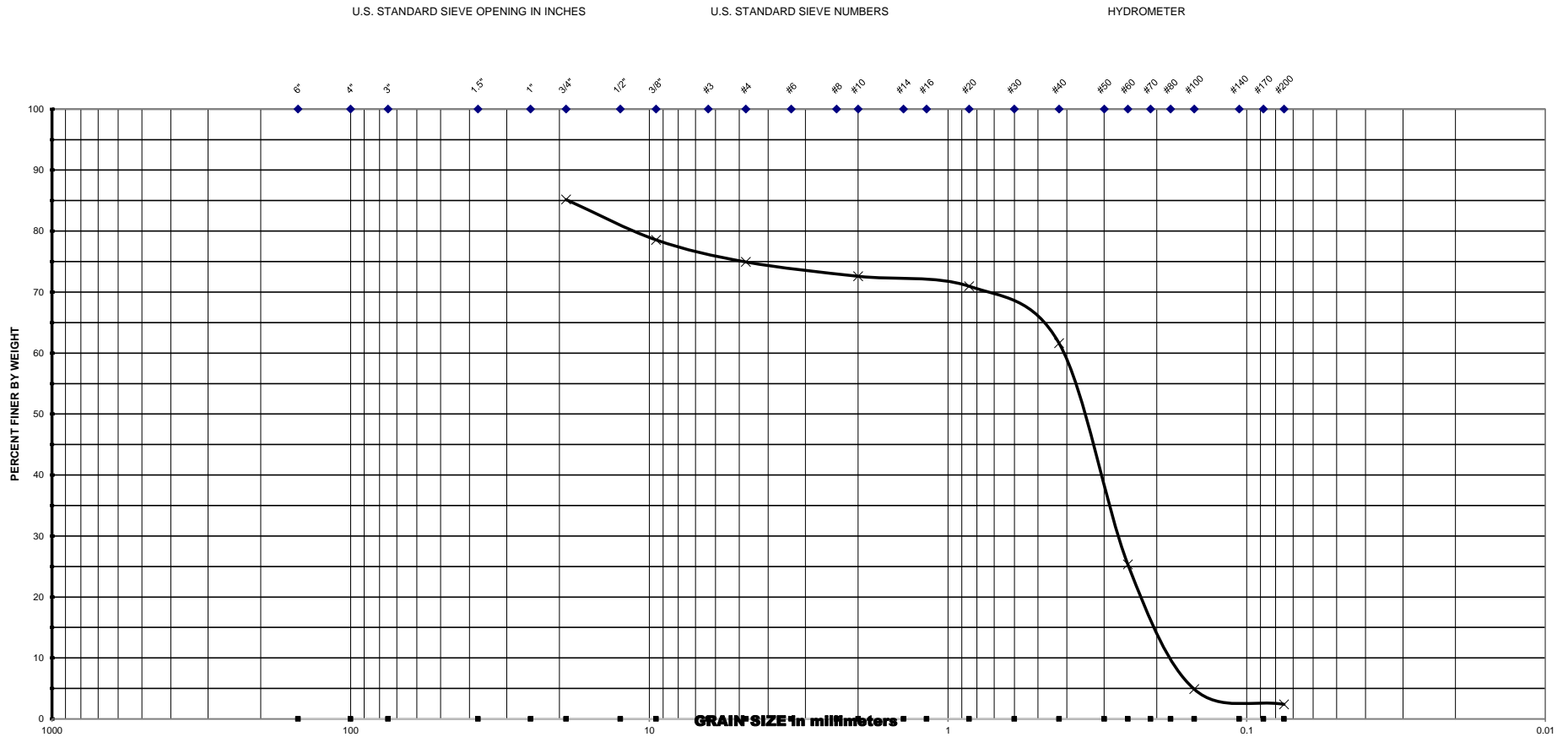


Project Name : <u>PD&amp;E Study - SW 10th Street From Powerline Road to Military Trail</u>					U.S. SIEVE NO.	CUMM. % PASSING
Project No. : <u>2000-01-17003</u>					3/4"	100.0
Date : <u>7/8/2019</u>					3/8"	99.2
BORING NO.	DEPTH INTERVAL [FT]	SOIL DESCRIPTION	MC	OC	#4	95.2
BHP-101	10.0 - 12.0	SP-SM	13.1		#10	93.0
					#20	90.2
					#40	68.3
					#60	26.0
					#100	9.8
					#200	6.0

Note : MC - Moisture Content (%)  
OC - Organic Content (%)

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Project Name : PD&E Study - SW 10th Street From Powerline Road to Military Trail

Project No. : 2000-01-17003

Date : 7/8/2019

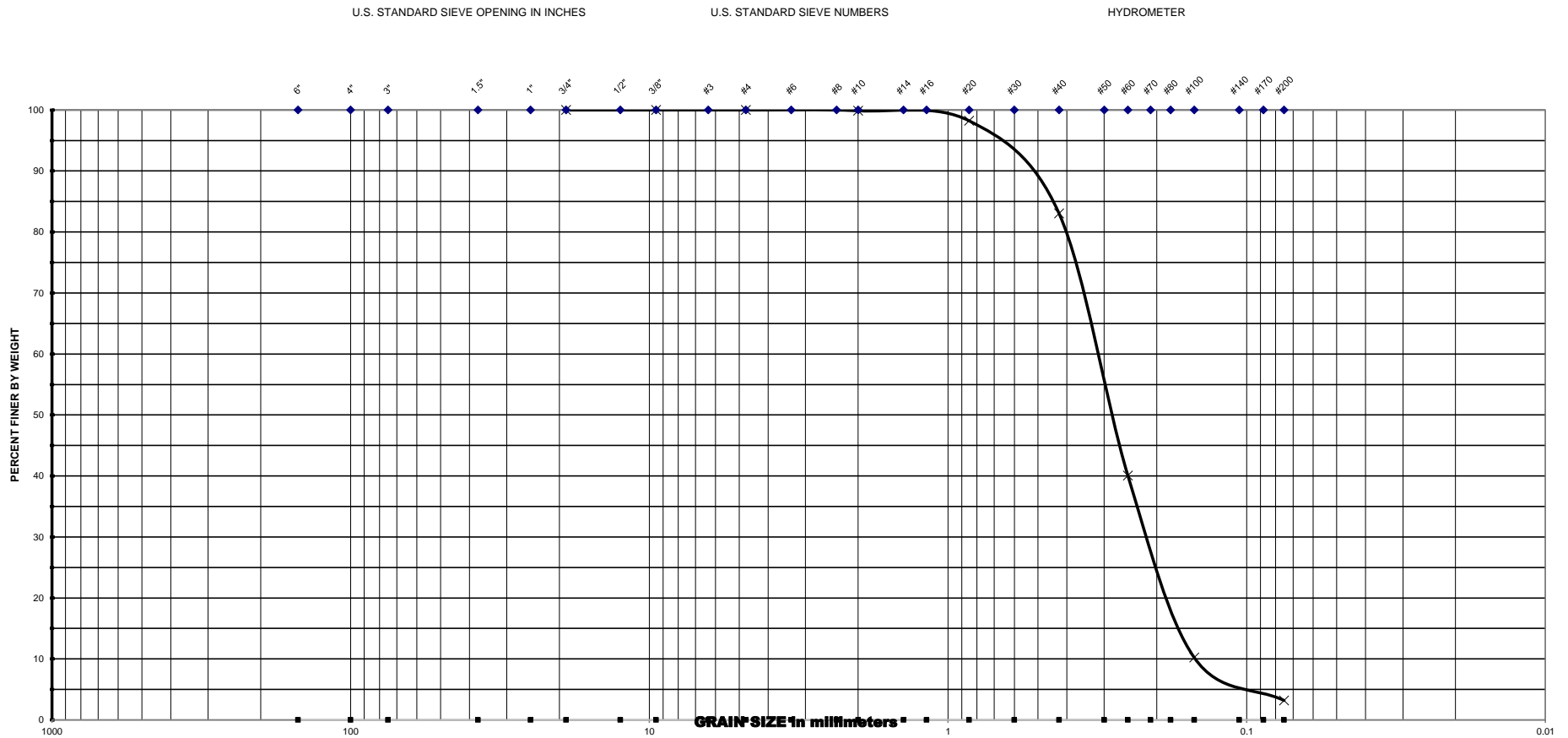
U.S SIEVE NO.	CUMM. % PASSING
3/4"	85.2
3/8"	78.6
#4	74.9
#10	72.6
#20	71.0
#40	61.6
#60	25.3
#100	4.9
#200	2.4

BORING NO.	DEPTH INTERVAL [FT]	SOIL DESCRIPTION	MC	OC
BHP-101	12.0 - 13.5	SP	14.2	

Note : MC - Moisture Content (%)  
OC - Organic Content (%)

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Project Name : PD&E Study - SW 10th Street From Powerline Road to Military Trail

Project No. : 2000-01-17003

Date : 7/8/2019

U.S. SIEVE NO.	CUMM. % PASSING
----------------	-----------------

3/4"	100.0
------	-------

3/8"	100.0
------	-------

#4	100.0
----	-------

#10	99.9
-----	------

#20	98.2
-----	------

#40	83.0
-----	------

#60	40.1
-----	------

#100	10.2
------	------

#200	3.2
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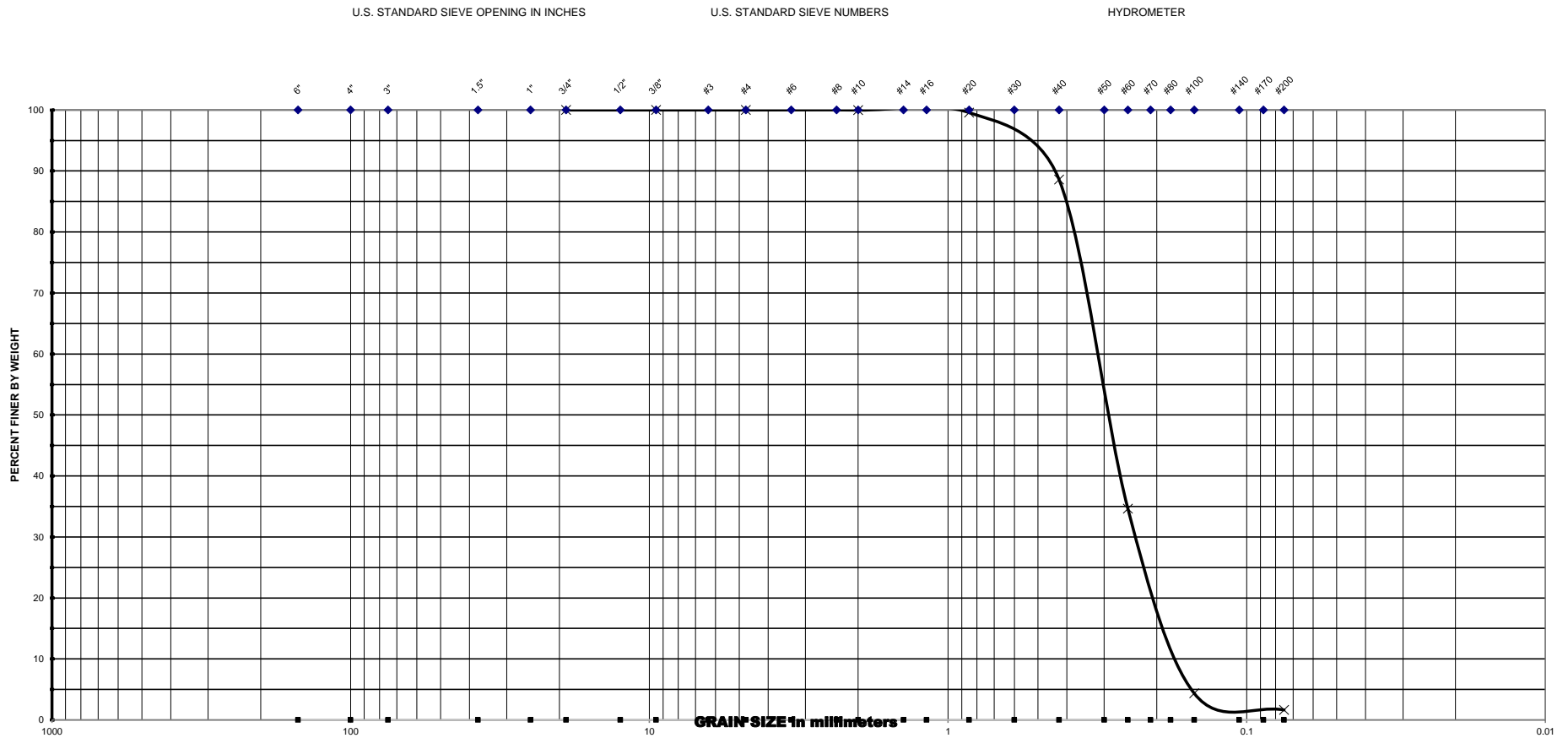
Note : MC - Moisture Content (%)

OC - Organic Content (%)

BORING NO.	DEPTH INTERVAL [FT]	SOIL DESCRIPTION	MC	OC
BHP-101	18.0 - 20.0	SP	19.6	

# GCME

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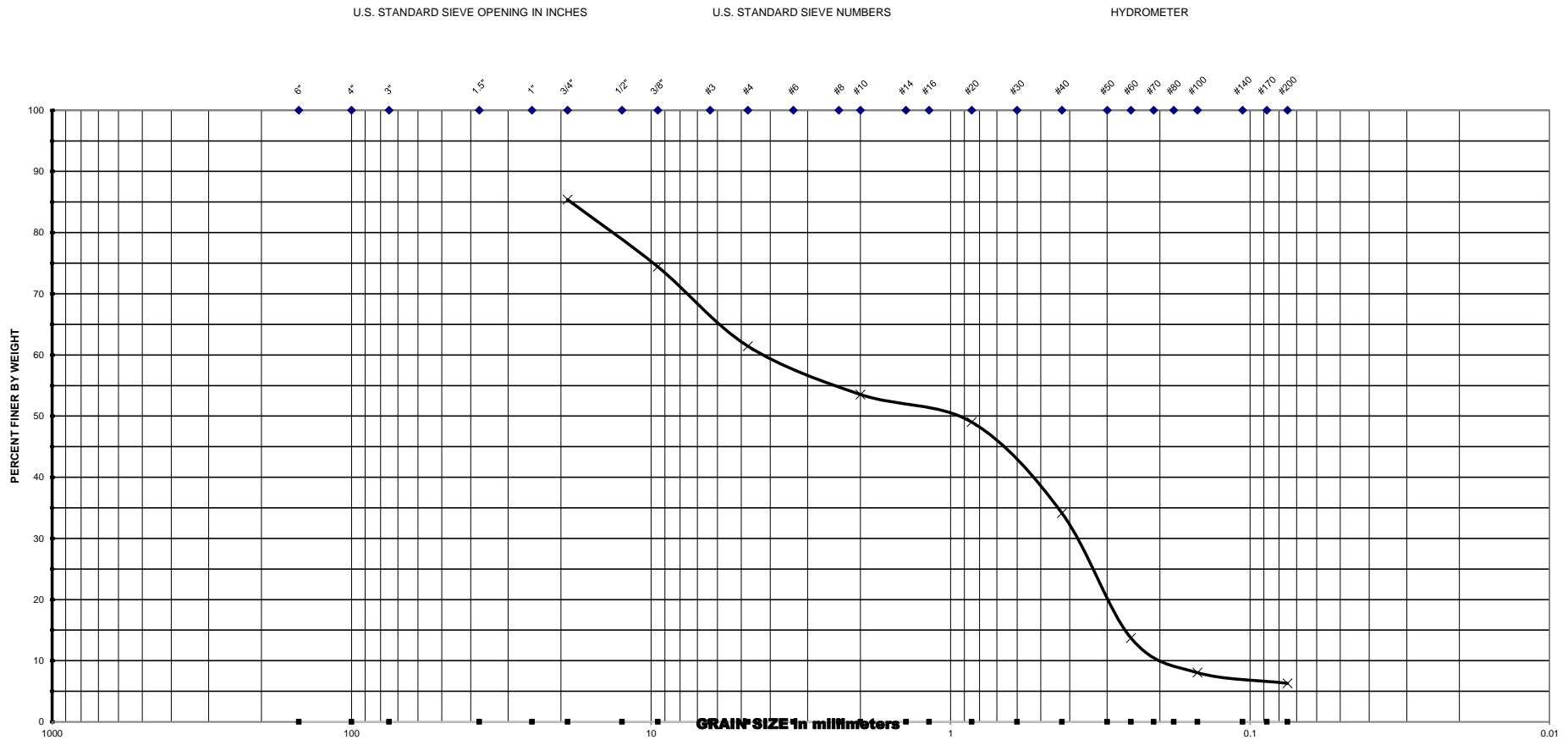


Project Name : <u>PD&amp;E Study - SW 10th Street From Powerline Road to Military Trail</u>					<b>U.S. SIEVE NO.</b>	<b>CUMM. % PASSING</b>
Project No. : <u>2000-01-17003</u> Date : <u>7/8/2019</u>					3/4"	100.0
					3/8"	100.0
					#4	100.0
<b>BORING NO.</b>	<b>DEPTH INTERVAL [FT]</b>	<b>SOIL DESCRIPTION</b>	<b>MC</b>	<b>OC</b>	#10	100.0
BHP-101	28.0 - 30.0	SP	19.0		#20	99.6
					#40	88.6
					#60	34.6
<p style="text-align: right;">Note : MC - Moisture Content (%) OC - Organic Content (%)</p>					#100	4.4
					#200	1.6



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Geotechnical - Consulting - Engineering - Testing



Project Name : PD&E Study - SW 10th Street From Powerline Road to Military Trail

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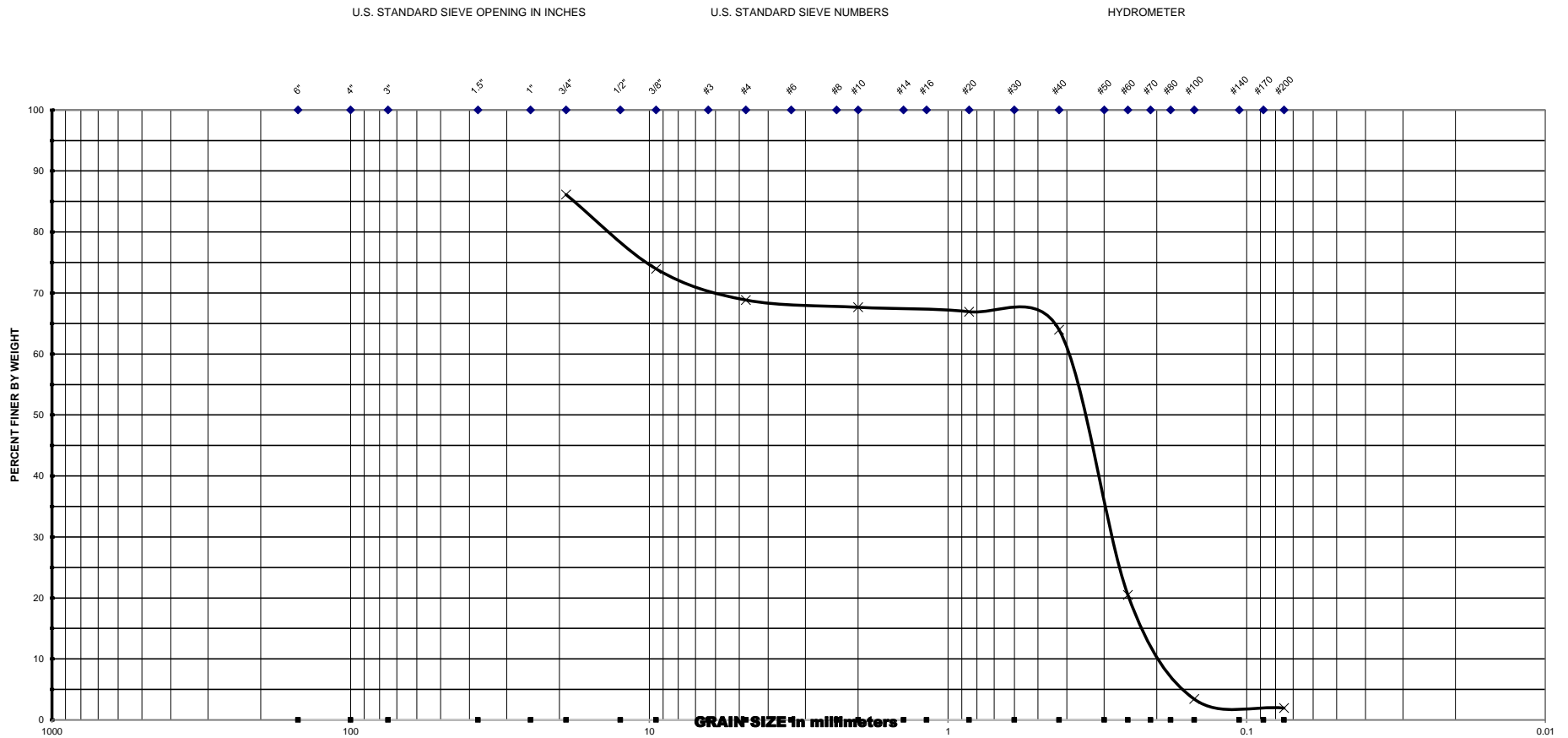
U.S. SIEVE NO.	CUMM. % PASSING
3/4"	85.4
3/8"	74.4
#4	61.4
#10	53.5
#20	49.0
#40	34.1
#60	13.7
#100	8.1
#200	6.3

BORING NO.	DEPTH INTERVAL [FT]	SOIL DESCRIPTION	MC	OC
BHP-102	8.0 - 10.0	SP-SM	9.4	

Note : MC - Moisture Content (%)  
OC - Organic Content (%)

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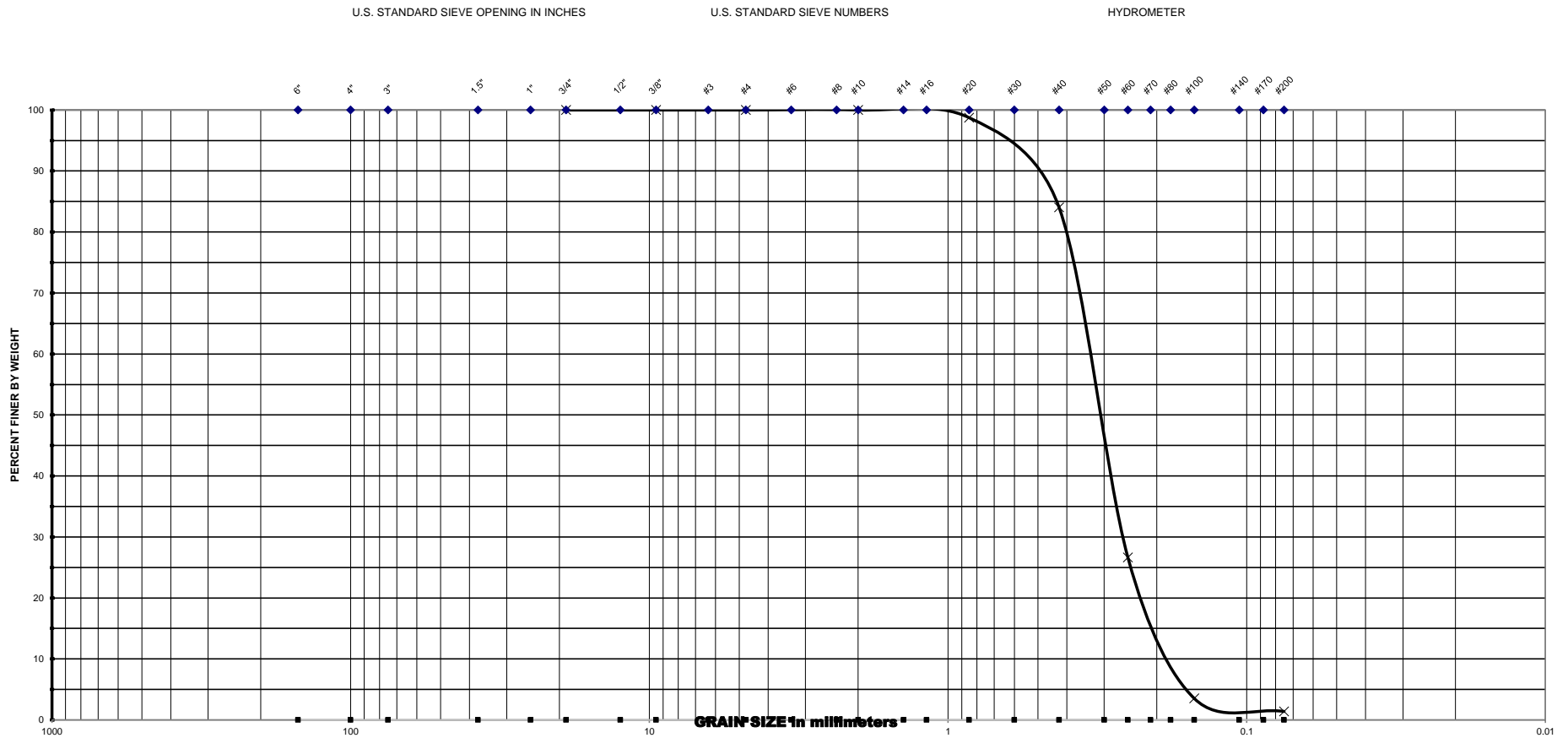


Project Name : <u>PD&amp;E Study - SW 10th Street From Powerline Road to Military Trail</u>					<b>U.S SIEVE NO.</b>	<b>CUMM. % PASSING</b>
Project No. : <u>2000-01-17003</u> Date : <u>7/8/2019</u>					3/4"	86.1
					3/8"	74.0
					#4	68.8
<b>BORING NO.</b>	<b>DEPTH INTERVAL [FT]</b>	<b>SOIL DESCRIPTION</b>	<b>MC</b>	<b>OC</b>	#10	67.7
BHP-102	12.0 - 13.5	SP	13.2		#20	66.9
					#40	64.0
					#60	20.5
					#100	3.4
					#200	1.9

Note : MC - Moisture Content (%)  
OC - Organic Content (%)

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Project Name : PD&E Study - SW 10th Street From Powerline Road to Military Trail

Project No. : 2000-01-17003

Date : 7/8/2019

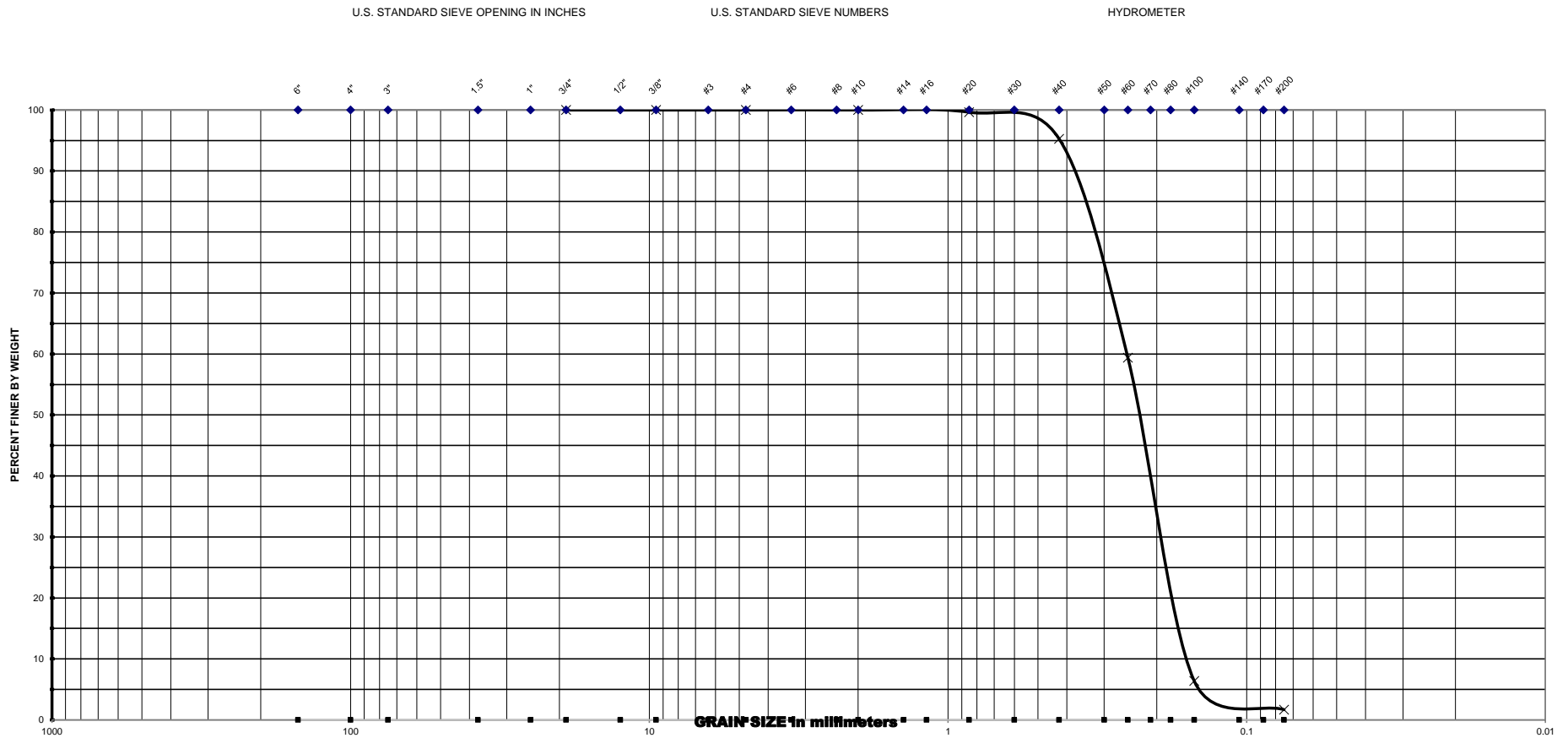
U.S SIEVE NO.	CUMM. % PASSING
3/4"	100.0
3/8"	100.0
#4	100.0
#10	100.0
#20	98.7
#40	84.0
#60	26.6
#100	3.5
#200	1.4

BORING NO.	DEPTH INTERVAL [FT]	SOIL DESCRIPTION	MC	OC
BHP-102	13.5 - 15.0	SP	17.9	

Note : MC - Moisture Content (%)  
OC - Organic Content (%)

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Project No. : 2000-01-17003

Date : 7/8/2019

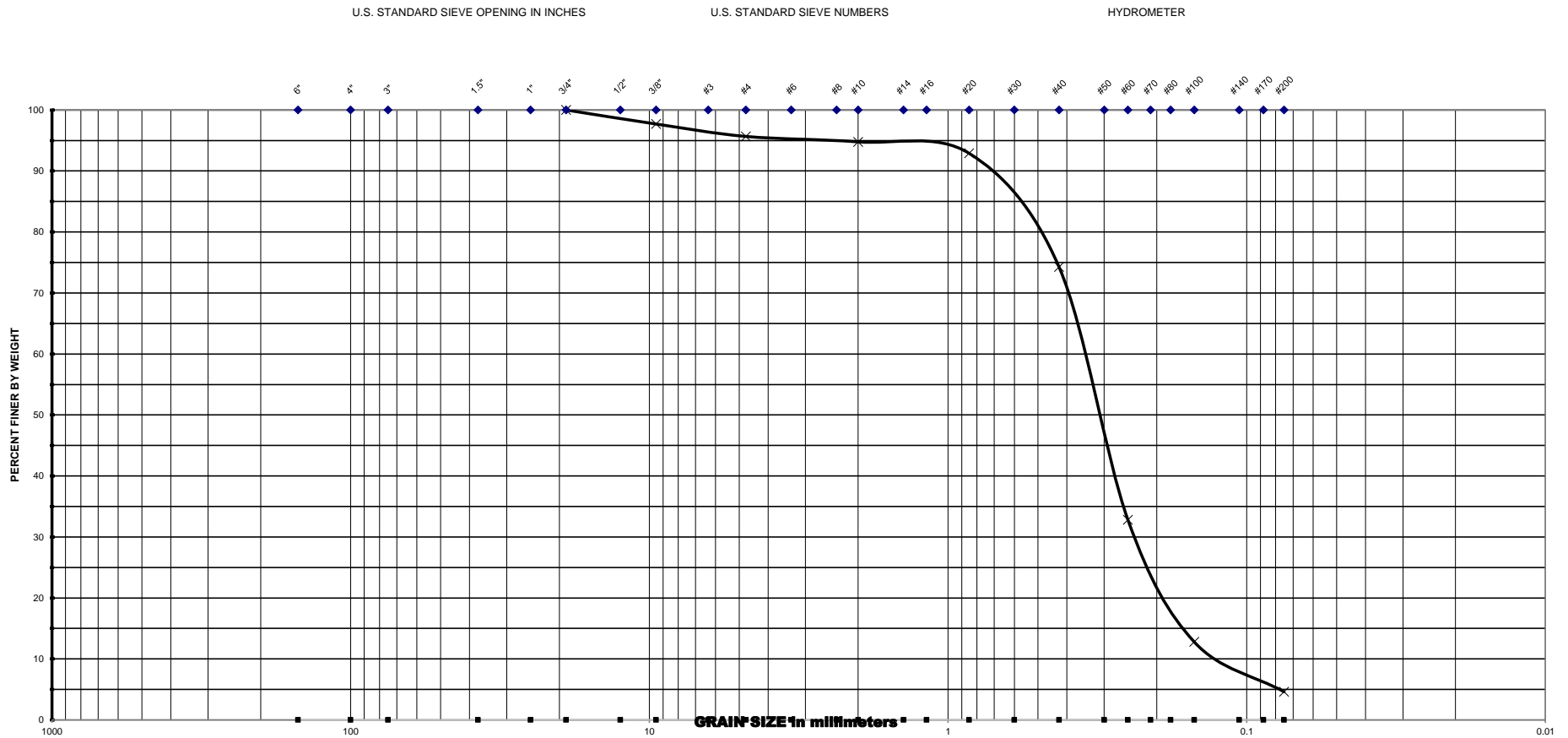
U.S SIEVE NO.	CUMM. % PASSING
3/4"	100.0
3/8"	100.0
#4	100.0
#10	100.0
#20	99.6
#40	95.3
#60	59.4
#100	6.4
#200	1.7

BORING NO.	DEPTH INTERVAL [FT]	SOIL DESCRIPTION	MC	OC
BHP-102	23.0 - 25.0	SP	24.2	

Note : MC - Moisture Content (%)  
OC - Organic Content (%)

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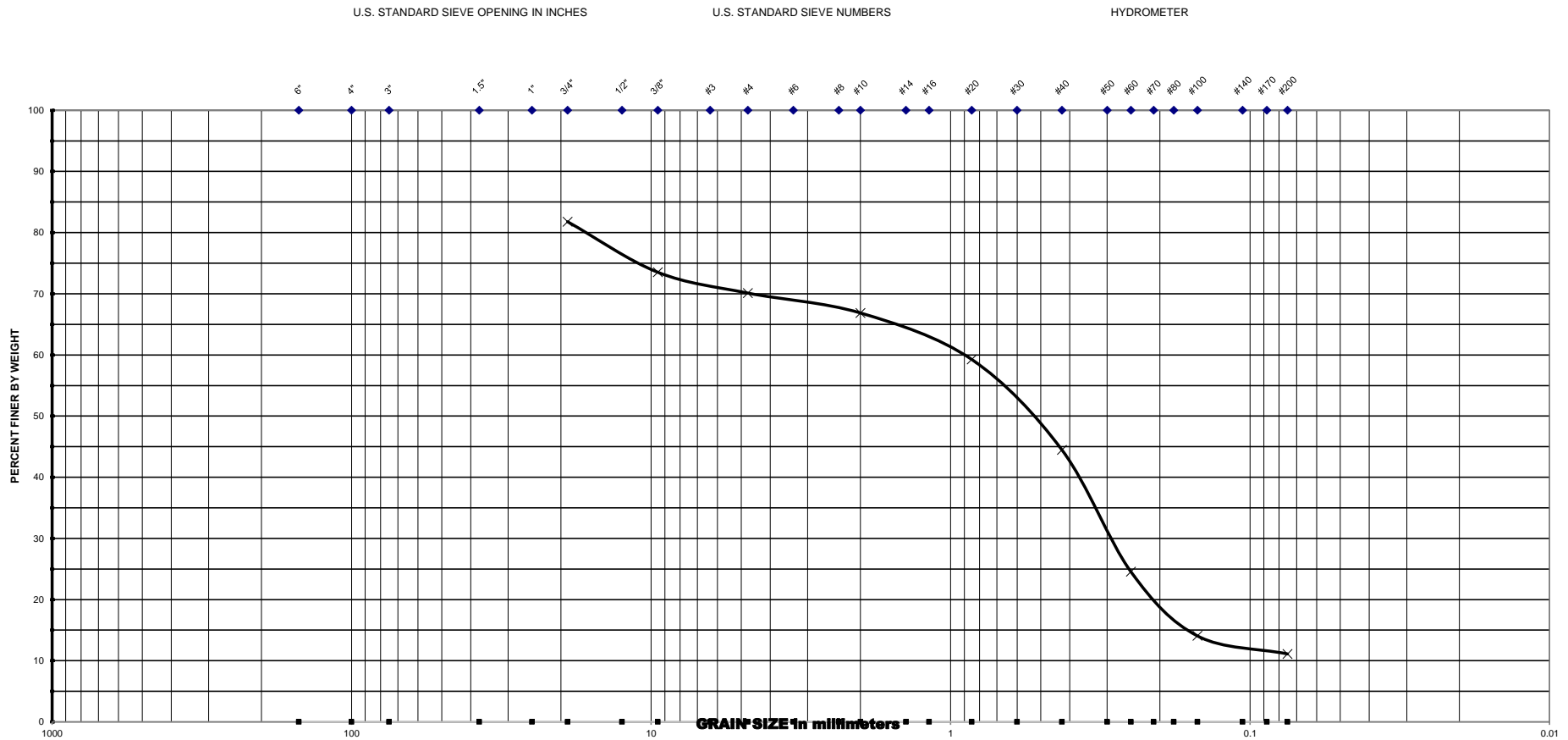
U.S SIEVE NO.	CUMM. % PASSING
3/4"	100.0
3/8"	97.7
#4	95.7
#10	94.8
#20	92.9
#40	74.3
#60	32.8
#100	12.8
#200	4.6

BORING NO.	DEPTH INTERVAL [FT]	SOIL DESCRIPTION	MC	OC
BHP-103	0.0 - 2.0	SP	5.8	

Note : MC - Moisture Content (%)  
OC - Organic Content (%)

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Project Name : <u>PD&amp;E Study - SW 10th Street From Powerline Road to Military Trail</u>					<b>U.S SIEVE NO.</b>	<b>CUMM. % PASSING</b>
Project No. : <u>2000-01-17003</u> Date : <u>7/8/2019</u>					3/4"	81.8
					3/8"	73.5
					#4	70.1
<b>BORING NO.</b>	<b>DEPTH INTERVAL [FT]</b>	<b>SOIL DESCRIPTION</b>	<b>MC</b>	<b>OC</b>	#10	66.9
BHP-103	6.0 - 8.0	SP-SM	12.8		#20	59.3
					#40	44.5
					#60	24.5
Note : MC - Moisture Content (%) OC - Organic Content (%)					#100	14.1
					#200	11.1

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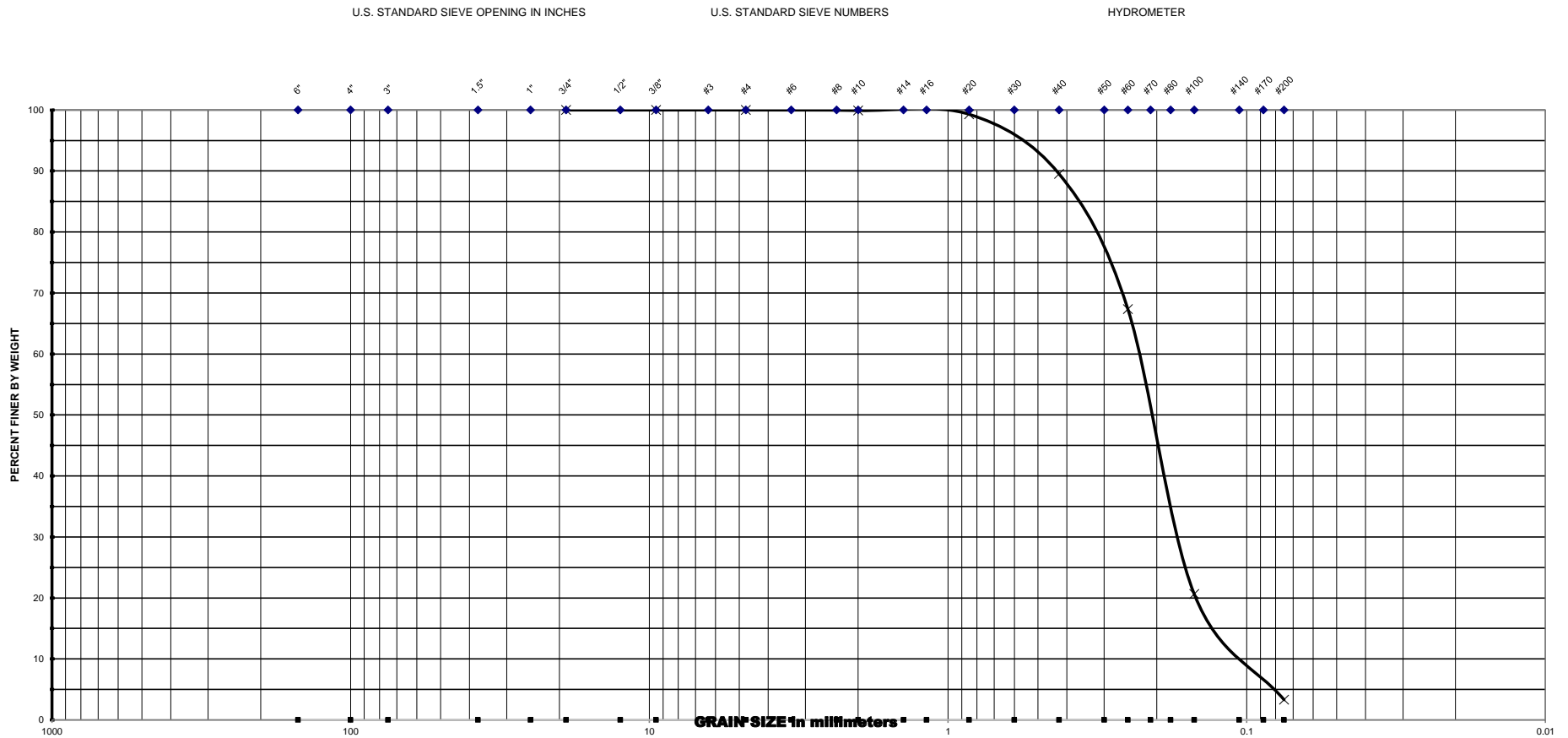


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Project No. : <u>2000-01-17003</u>						
Date : <u>7/8/2019</u>						
BORING NO.	DEPTH INTERVAL [FT]	SOIL DESCRIPTION	MC	OC	U.S. SIEVE NO.	CUMM. % PASSING
BHP-103	8.0 - 10.0	SP-SM	10.4		#10	80.3
					#20	74.6
					#40	56.1
					#60	29.3
					#100	13.8
					#200	9.3

Note : MC - Moisture Content (%)  
OC - Organic Content (%)

# GCME

Geotechnical - Consulting - Engineering - Testing



Project Name : PD&E Study - SW 10th Street From Powerline Road to Military Trail

Project No. : 2000-01-17003

Date : 7/8/2019

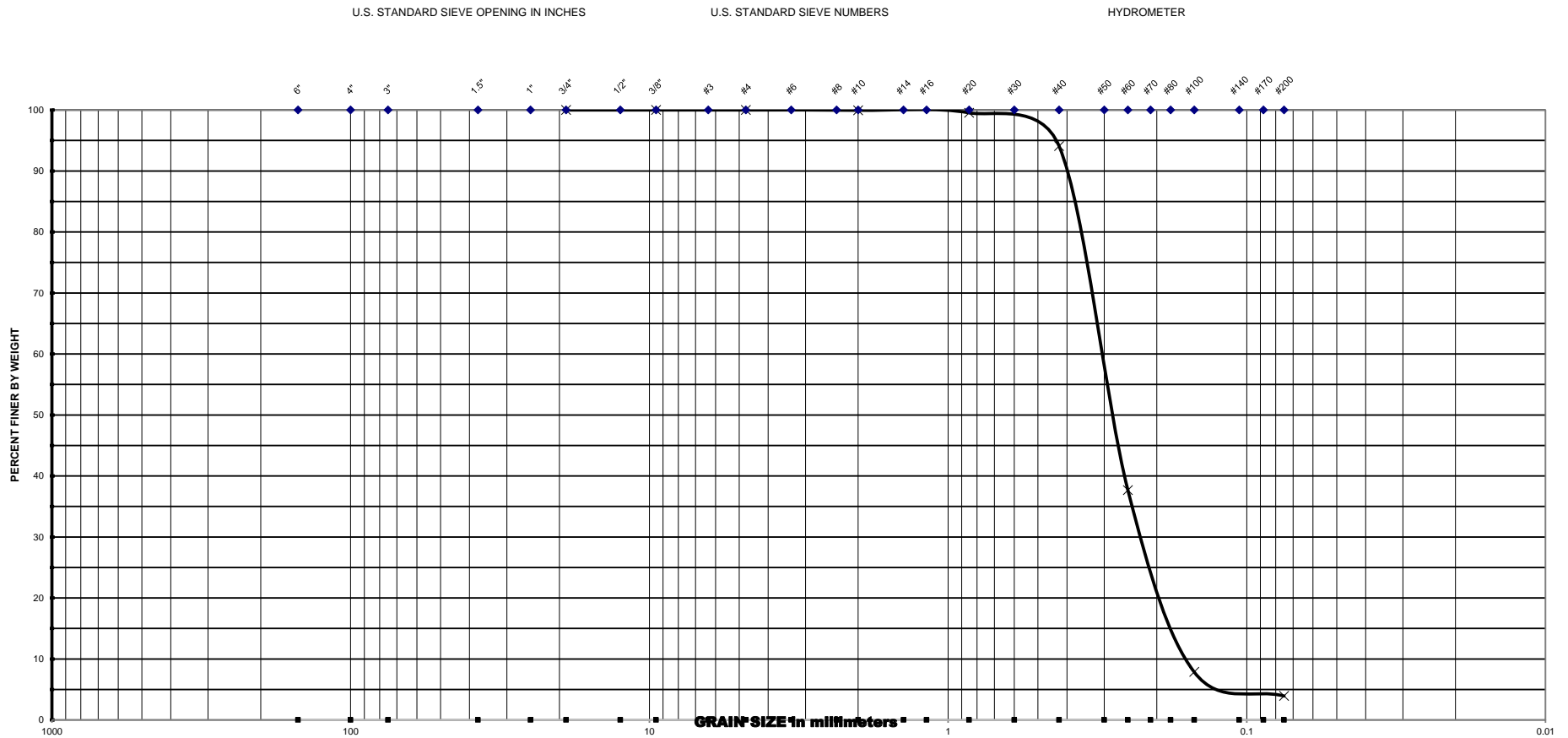
U.S. SIEVE NO.	CUMM. % PASSING
3/4"	100.0
3/8"	100.0
#4	100.0
#10	99.9
#20	99.3
#40	89.5
#60	67.3
#100	20.7
#200	3.3

BORING NO.	DEPTH INTERVAL [FT]	SOIL DESCRIPTION	MC	OC
BHP-103	13.5 - 15.0	SP	20.8	

Note : MC - Moisture Content (%)  
OC - Organic Content (%)

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Project No. : <u>2000-01-17003</u> Date : <u>7/8/2019</u>					3/4"	100.0
					3/8"	100.0
					#4	100.0
<b>BORING NO.</b>	<b>DEPTH INTERVAL [FT]</b>	<b>SOIL DESCRIPTION</b>	<b>MC</b>	<b>OC</b>	#10	100.0
BHP-103	23.0 - 25.0	SP	20.5		#20	99.5
					#40	94.1
					#60	37.7
Note : MC - Moisture Content (%) OC - Organic Content (%)					#100	7.9
					#200	3.9

**TABLE - 2**

**BOREHOLE PERMEABILITY TEST RESULTS**

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**EARTH MANUAL METHOD**

<b>BHP No.</b>	<b>Approx. Station</b>	<b>Approx. Offset</b>	<b>Bore Hole Dia. (in)</b>	<b>Test Interval (ft)</b>	<b>GWT Depth (ft)</b>	<b>Flow Rate Q [gal/min]</b>	<b>K [cfs/ft<sup>2</sup>]</b>	<b>K [ft/day]</b>
BHP-101C	Refer Plate-1 for location		8.00	0-10	4.17	3.2000	9.26E-05	<b>8.0</b>
BHP-101B	Refer Plate-1 for location		8.00	10-20	4.17	14.0000	4.05E-04	<b>35.0</b>
BHP-101A	Refer Plate-1 for location		8.00	20-30	4.17	17.0000	4.92E-04	<b>42.5</b>
BHP-102C	Refer Plate-1 for location		8.00	0-10	4.33	2.5000	6.96E-05	<b>6.0</b>
BHP-102B	Refer Plate-1 for location		8.00	10-20	4.33	14.0000	3.90E-04	<b>33.7</b>
BHP-102A	Refer Plate-1 for location		8.00	20-30	4.33	19.5000	5.43E-04	<b>46.9</b>
BHP-103C	Refer Plate-1 for location		8.00	0-10	3.17	2.0000	7.62E-05	<b>6.6</b>
BHP-103B	Refer Plate-1 for location		8.00	10-20	3.17	12.3000	4.68E-04	<b>40.5</b>
BHP-103A	Refer Plate-1 for location		8.00	20-30	3.17	16.4000	6.25E-04	<b>54.0</b>