REPORT OF THE
GEOTECHNICAL INVESTIGATION

BRADEN WOODS LIFT STATION REHABILITATION
NEW WET WELL AND FORCE MAIN
BRADENTON, FLORIDA

DRIGGERS ENGINEERING SERVICES INCORPORATED
Geotechnical Engineering & Construction Materials Testing

September 4, 2020

Jacobs Engineering Group, Inc
4350 W. Cypress Street, Suite 600
Tampa, FL 33607

Attn: Ms. Michelle Collins, P.E.

RE: Report of the Geotechnical Investigation
Braden Woods Lift Station Rehabilitation
New Wet Well and Force Main
Bradenton, Florida
Our File: DES 208523

Dear Ms. Collins:

DRIGGERS ENGINEERING SERVICES, INC. has completed the requested subsurface investigation program for the subject project. Presented herein are the results of our field and laboratory tests, together with a discussion of our findings and recommendations.

SUBSURFACE INVESTIGATION PROGRAM

Plate I of the report illustrations identifies the respective positioning of a series of test borings that have been completed to investigate subsurface conditions. The program consisted of three (3) classification or hand auger borings and a single Standard Penetration Test (SPT) boring. The hand auger borings were advanced to depths of 10 feet below existing grade within the planned force main alignment while the SPT boring penetrated to a depth of 30 feet below existing grade within the planned lift station location. The locations depicted on Plate I are approximate. Logs of the test borings are presented in the report attachments reflecting visual together with estimated Unified Soil classification. Soils were logged in the field by our geotechnician, with representative soil samples sealed in glass jars and returned to the laboratory for further examination by the project engineer and development of boring logs. A log of each hand auger boring is attached.

LABORATORY INVESTIGATION

A limited laboratory testing program was undertaken to aid in characterizing the engineering properties of the subsurface soils. Our laboratory tests included grainsize analyses and Atterberg Limits determinations. The results of our laboratory tests are included in the report attachments.

GENERALIZED SUBSURFACE CONDITIONS

SOIL AND GROUNDWATER CONDITIONS - The borings have identified predominantly fine sands with variable silt and clay fines to a depth of 16 feet below existing grade. The soils within these depths varied from loose to medium dense in relative density and generally have a Unified Classification of SP, SP-SM, SM and SC. Below 16 feet, the borings encountered clay soils with intermittent lenses of clayey to silty fine sand to the termination depth of the boring at 30 feet below grade. These clay soils having a Unified Classification of CH would be considered stiff to very stiff in relative consistency while intermittent seams of silty to clayey fine sands typical of the SM and SC Unified Classification were found to be loose to medium dense.

GROUNDWATER CONDITIONS - Groundwater was recorded on June 30, 2020 at 2.8 to 6.1 feet below grade at the test locations. These variations in the groundwater depths are most likely attributed to surface elevation changes along the proposed alignment. Considering the water levels were recorded prior to the start of the wet season, we would expect the groundwater levels to rise about 2 feet from their current levels at the peak of a typical wet season.

EVALUATION AND GEOTECHNICAL RECOMMENDATIONS

PROJECT DESCRIPTION – It is our understanding that the project consists of the installation of a nominal 12-inch diameter PVC water line using open-cut direct burial. It is also our understanding that open-cut installation sections of the water main will be embedded at about 4.0 feet below existing grade.

DIRECT EMBEDMENT – In accordance with our discussions, the pipeline will be embedded with a minimum of 3 feet of cover. Thus, one would anticipate that the pipe embedment would typically be in the range of perhaps 4 feet below existing grade.

The soils typically encountered within and just below this anticipated depth of embedment would predominately consist of fine sands with variable silt content, which should be suitable for pipe support as well as provide suitable material for backfill placement. Careful geotechnical inspection is recommended during construction to help identify any unsuitable soils or materials that may warrant removal and replacement. Where evidenced, these materials should be removed and replaced with suitable bedding material as directed by the project engineer. Furthermore, such zones with excessive silt, clay and organic content may not meet project specification requirements with respect to their usage as suitable backfill. Where directed, these soils should be removed and disposed as directed by project specification requirements.

In accordance with project specifications, it is our understanding that compaction should achieve a minimum density of no less than 98% of the Modified Proctor, maximum dry density established in ASTM D-1557 under roadways while a minimum density of no less than 95% of the Modified Proctor, maximum dry density will be required for all other compaction applications including the pipe placement and pipe backfill. Identified suitable soil conditions would be considered suitable to achieve the recommended compaction requirements.

EXCAVATION STABILITY AND MANAGEMENT OF GROUNDWATER – It is anticipated that the direct embedded pipeline section of the project will be constructed in an open excavation or perhaps utilizing trench box construction. With all the excavation activities and considering the existing shallow groundwater level at various locations along the alignment, it is anticipated that control and management of groundwater will be important to maintain excavation stability, allow appropriate placement of piping to line and grade and to permit proper backfill placement and compaction. It is recommended that groundwater levels be maintained no less than one (1) foot below the maximum depth of excavation or deeper as needed, dependent upon the ways and means of construction. It is envisioned that the de-watering where needed, will be accomplished utilizing an appropriately designed well-point system. Open excavation areas should be appropriately sloped in accordance with applicable OSHA Trench Safety requirements. The excavation contractor should certainly exercise due care with respect to identification and protection of any existing structures or utilities that are within the area of influence of his work activities.

PROPOSED LIFT STATION - It is our understanding, based on preliminary information provided by your office that the proposed pump station will include a single pump can or wet well with the bottom of the pump can foundation at about 20 feet below grade.

A clayey fine sand was encountered at a depth of about 18 feet below grade and continued to a depth of about 23 feet. The bottom of the excavation should be carefully inspected and probed by a representative of the project geotechnical engineer and undercut at least 6 inches, replaced with a lean concrete working slab to avoid disturbance and remolding of clayey soils due to rain, foot traffic, etc. Following proper subgrade preparation as recommended herein, we would anticipate settlements of the wet well of less than 1 inch. We would expect these settlements would occur virtually coincident with the replacement of backfill soils and pump can filling. Further, we would anticipate relatively uniform settlement provided that appropriate plumbness is maintained during backfilling operations and extraction of any sheeting utilized.

SOIL STRENGTH PARAMETERS - It is our understanding that there will be the need for various earth retention systems to facilitate construction as well as other below grade structures. Accordingly, the following geotechnical parameters are considered preliminary for use in the analyses of the various structures.

Soil Consistency	Total Unit Weight (pcf)	Buoyant Unit Weight (pcf)	Angle of Internal Friction, φ	Active Earth Pressure Coefficient (Ka)	At-Rest Earth Pressure Coefficient (Ko)	Passive Earth Pressure Coefficient (Kp)
Very loose fine sands and silty sands	115	55	28	0.36	0.53	2.7
Loose fine sands and silty sands	120	60	30	0.33	0.5	3.0
Medium dense fine sands and silty sands	120	60	32	0.30	0.47	3.33

Note: Properly compacted sands and non-plastic slightly silty and silty sands would likely possess a medium dense relative density for use in analyses.

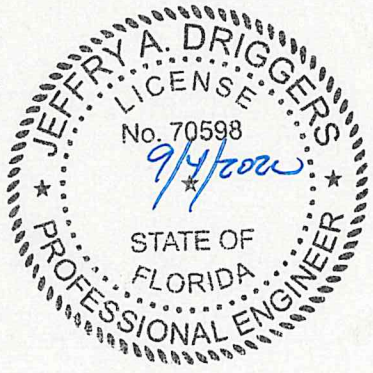
LIMITATIONS

The geotechnical investigation herein was performed to obtain subsurface information to help facilitate the design of the planned utilities. Our geotechnical investigation may not have included gathering of all information that may be desired by the respective contractor in the preparation of his bid proposal, or in the development of his ways and means of construction. Each contractor is encouraged to conduct such additional investigative effort or testing that he may deem appropriate to prepare his bid proposal and construction plan.

DRIGGERS ENGINEERING SERVICES, INC. appreciates the opportunity to serve you and we trust that if you have any questions concerning our report, you will not hesitate to contact this office at your convenience.

Respectfully Submitted,
DRIGGERS ENGINEERING SERVICES, INC.

Jeffry A. Driggers, P.E.
Vice President
FL Registration No. 70598



JAD
JAD-REP\208523
Copies submitted: (1) Email

APPENDIX

PLATE I - BORING LOCATION PLAN

STANDARD PENETRATION TEST BORING LOG

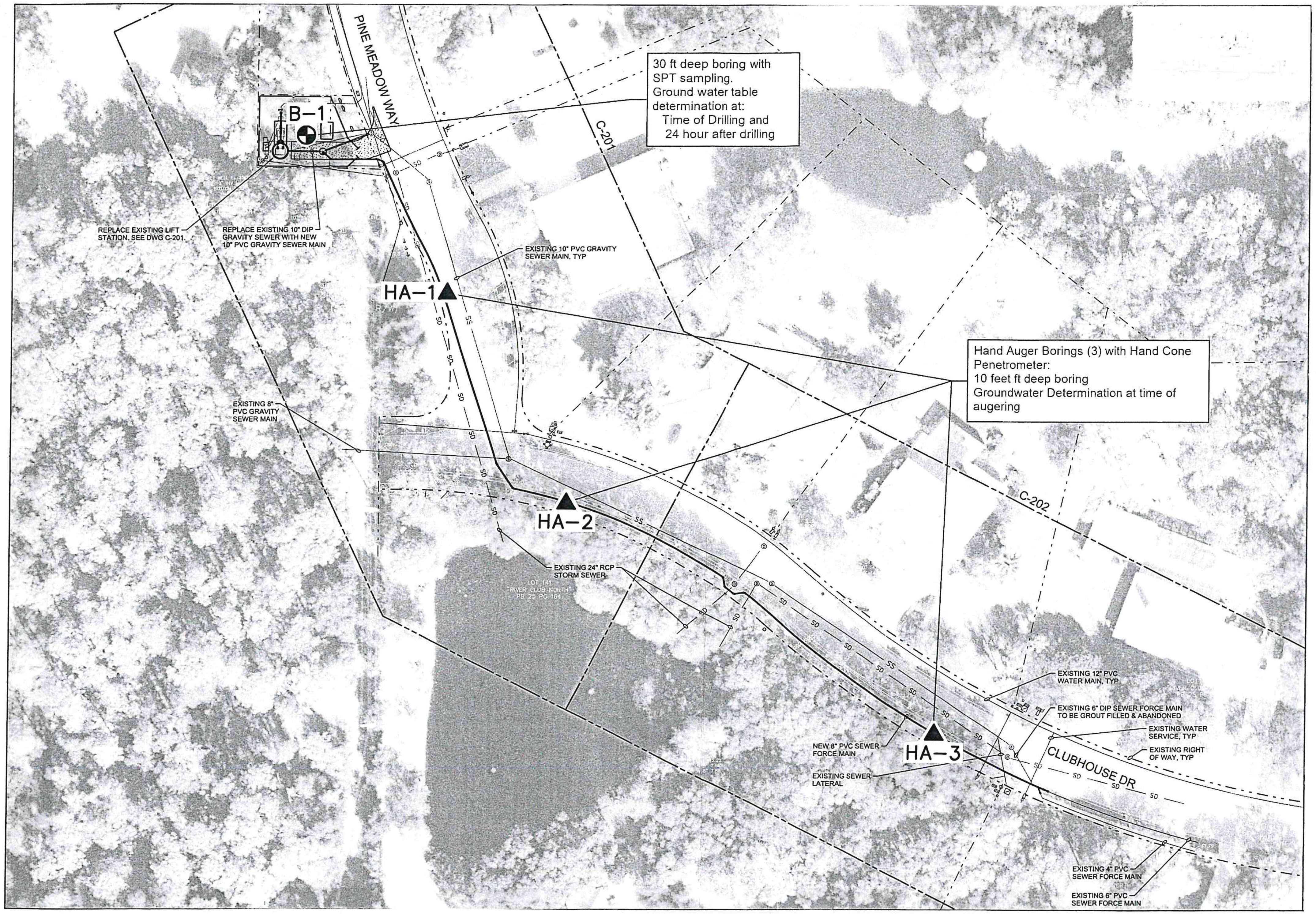
HAND AUGER BORING / HAND CONE SOUNDING LOGS

SUMMARY OF LABORATORY TEST RESULTS

GRAINSIZE ANALYSES

METHOD OF TESTING

PLATE I - BORING LOCATION PLAN



LEGEND:

▲ HAND AUGER BORING/ HAND CONE SOUNDING LOCATION

⊕ STANDARD PENETRATION TEST BORING/ HAND CONE SOUNDING LOCATION

N

0 40 80 160

SCALE IN FEET

DATE: 7/16/20

PROJECT NO.

DES 208523

SHEET NO.

PLATE 1

SHEET TITLE

BORING LOCATION PLAN

PROJECT NAME

BRADEN WOODS LIFT STATION REHABILITATION/FORCE MAIN BRADENTON, FLORIDA

CAD / ENGINEER

R.D.B. / J.A.D.

PREPARED BY

DRIGGERS ENGINEERING SERVICES, INCORPORATED

STANDARD PENETRATION TEST BORING LOG

DRIGGERS ENGINEERING SERVICES INCORPORATED

Project No. DES 208523 **BORING NO.** B-1

Project Braden Woods Lift Station Rehabilitation/Force Main, Bradenton, Florida

Location See Plate I **Foreman** N.N.

Completion Depth 31.5' **Date** 7/6/20 **Depth To Water** 5.9' **Time** _____ **Date** 7/6/20

DEPTH, FT	SYMBOL	SAMPLES	SOIL DESCRIPTION	BLOWS ON SAMPLER PER 6" OR PEN. STR.
			SURF. EL:	
0			Brown slightly silty Fine SAND with pockets of clayey Fine SAND and trace of roots (SP-SM/SC) (A-3/A-2-6)	
			Brown slightly silty Fine SAND with pockets of clayey Fine SAND (SP-SM/SC) (A-3/A-2-6)	
5			Brown slightly silty Fine SAND (SP-SM) (A-3)	
			Brownish-gray slightly silty Fine SAND (SP-SM) (A-3)	
			Medium dense brown slightly silty Fine SAND (SP-SM) (A-3)	8/5/8
				6/6/14
10				6/6/5
			Loose light grayish-brown clayey Fine SAND (SC) (A-2-6)	4/3/3
15			Stiff green sandy CLAY with seams of light grayish-brown Fine SAND (CH/SP) (A-7-6/A-3)	4/5/8
			Loose green clayey Fine SAND (SC) (A-2-6)	
20				2/3/4
			Medium dense grayish-green phosphatic, silty, slightly clayey Fine SAND (SM) (A-2-4)	
25				8/12/14
			Very stiff dark green sandy CLAY (CH) (A-7-6)	
30				6/8/9

STANDARD PENETRATION TEST BLOWS/FT. ON 2" O.D. SAMPLER-140 LB. HAMMER, 30" DROP

10 20 40 60 80

Remarks Borehole Grouted

Casing Length _____

HAND AUGER BORING / HAND CONE SOUNDING LOGS

DRIGGERS ENGINEERING SERVICES INCORPORATED

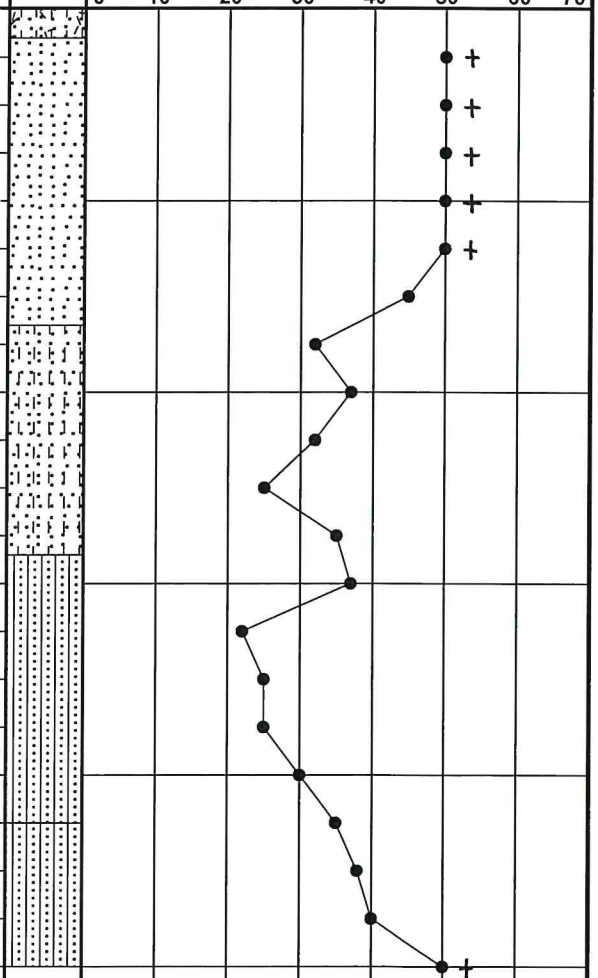
HAND AUGER BORING/HAND CONE SOUNDING LOG

PROJECT:	Braden Woods Lift Station Rehabilitation/Force Main Bradenton, Florida Project No.: DES 208523	**CLIENT:**	Jacobs Engineering Group, Inc.
		WATER TABLE:	4.5'
		DATE:	6/30/20
TECHNICIAN:	N.N.	**DATE:**	6/30/20
		COMPLETION DEPTH:	10.0'
LOCATION:	See Plate I	**TEST NUMBER:**	HA-1

ELEV. (FT)	DESCRIPTION	DEPTH (FT)	SYMBOL
	Brown slightly silty Fine SAND with roots (SP-SM) (A-3)	0	
	Light grayish-brown Fine SAND (SP) (A-3)	2	
	Dark brown slightly silty Fine SAND (SP-SM) (A-3)	4	
	Brown silty Fine SAND (SM) (A-2-4)	6	
		8	
	Grayish-brown and orange silty Fine SAND (SM) (A-2-4)	10	
		12	
		14	

HAND CONE TIP RESISTANCE (TSF)

0 10 20 30 40 50 60 70



LEGEND:

● + Denotes Penetration Resistance in excess of 50 TSF

DRIGGERS ENGINEERING SERVICES INCORPORATED

HAND AUGER BORING/HAND CONE SOUNDING LOG

PROJECT:	Braden Woods Lift Station Rehabilitation/Force Main Bradenton, Florida Project No.: DES 208523	**CLIENT:**	Jacobs Engineering Group, Inc.
		WATER TABLE:	2.8'
		DATE:	6/30/20
TECHNICIAN:	N.N.	**DATE:**	6/30/20
		COMPLETION DEPTH:	10.0'
LOCATION:	See Plate I	**TEST NUMBER:**	HA-2

ELEV. (FT)	DESCRIPTION	DEPTH (FT)	SYMBOL
	Brownish-gray Fine SAND with trace of roots (SP) (A-3)	0	
	Gray Fine SAND (SP) (A-3)	2	
	Dark brown Fine SAND (SP) (A-3)	4	
		6	
	Tan Fine SAND (SP) (A-3)	8	
		10	
		12	
		14	

HAND CONE TIP RESISTANCE (TSF)

0 10 20 30 40 50 60 70

LEGEND:

● + Denotes Penetration Resistance in excess of 50 TSF

DRIGGERS ENGINEERING SERVICES INCORPORATED

HAND AUGER BORING/HAND CONE SOUNDING LOG

PROJECT:	Braden Woods Lift Station Rehabilitation/Force Main Bradenton, Florida Project No.: DES 208523	**CLIENT:**	Jacobs Engineering Group, Inc.
		WATER TABLE:	6.1'
		DATE:	6/30/20
TECHNICIAN:	N.N.	**DATE:**	6/30/20
		COMPLETION DEPTH:	10.0'
LOCATION:	See Plate I	**TEST NUMBER:**	HA-3

ELEV. (FT)	DESCRIPTION	DEPTH (FT)	SYMBOL	HAND CONE TIP RESISTANCE (TSF) 0 10 20 30 40 50 60 70
	2" Grass and Roots	0		
	Gray Fine SAND with trace of roots (SP) (A-3)			
	Orangish-brown slightly silty Fine SAND (SP-SM) (A-3)			
	Brown Fine SAND (SP) (A-3)	2		
	Light grayish-brown Fine SAND (SP) (A-3)	4		
	Brown Fine SAND (SP) (A-3)			
	Light brown and brown Fine SAND (SP) (A-3)			
	Grayish-brown and orange silty, slightly clayey Fine SAND (SM) (A-2-4)	6		
	Grayish-brown silty Fine SAND (SM) (A-2-4)	8		
		10		
		12		
		14		

LEGEND:

• + Denotes Penetration Resistance in excess of 50 TSF

SUMMARY OF LABORATORY TEST RESULTS

SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	DEPTH (ft)	DESCRIPTION	W %	Y d (pcf)	G s	ATTERBERG LIMITS			P.P. (tsf)	U.C.	CON.	G.S.	ORG. (%)	pH	Cl. (ppm)	SO 4 (ppm)	RES. (ohm-cm)
						LL	PL	PI									
B-1	3.7-4.6	Brown slightly silty Fine SAND										*					
B-1	6.0-7.5	Brown slightly silty Fine SAND										*					
B-1	20.0-21.5	Green clayey Fine SAND	41.6			44	25	19				** 26.3					
B-1	25.0-26.5	Grayish-green silty, clayey Fine SAND	35.3			35	22	13				** 33.9					
HA-1	5.7-7.4	Brown silty Fine SAND										*					
HA-1	8.5-10.0	Grayish-brown and orange silty Fine SAND										*					
HA-3	0.9-1.8	Orangish-brown slightly silty Fine SAND										*					
HA-3	5.9-7.4	Grayish-brown and orange silty, slightly clayey Fine SAND	14.2			25	19	6				** 17.8					

W % = Water Content
Y d (pcf) = Dry Density
G_S = Specific Gravity
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
P.P. (tsf) = Pocket Penetrometer
U.C. = Unconfined Compression

Con. = Consolidation Test
G.S. (+1) = Grainsize Analysis (Hydrometer)
ORG. (%) = Organic Content
Cl. (ppm) = Total Chloride
SO_4 (ppm) = Total Sulfate
RES. (ohm-cm) = Lab Resistivity
* = See Test Curves
** = Percent Passing No. 200 Sieve

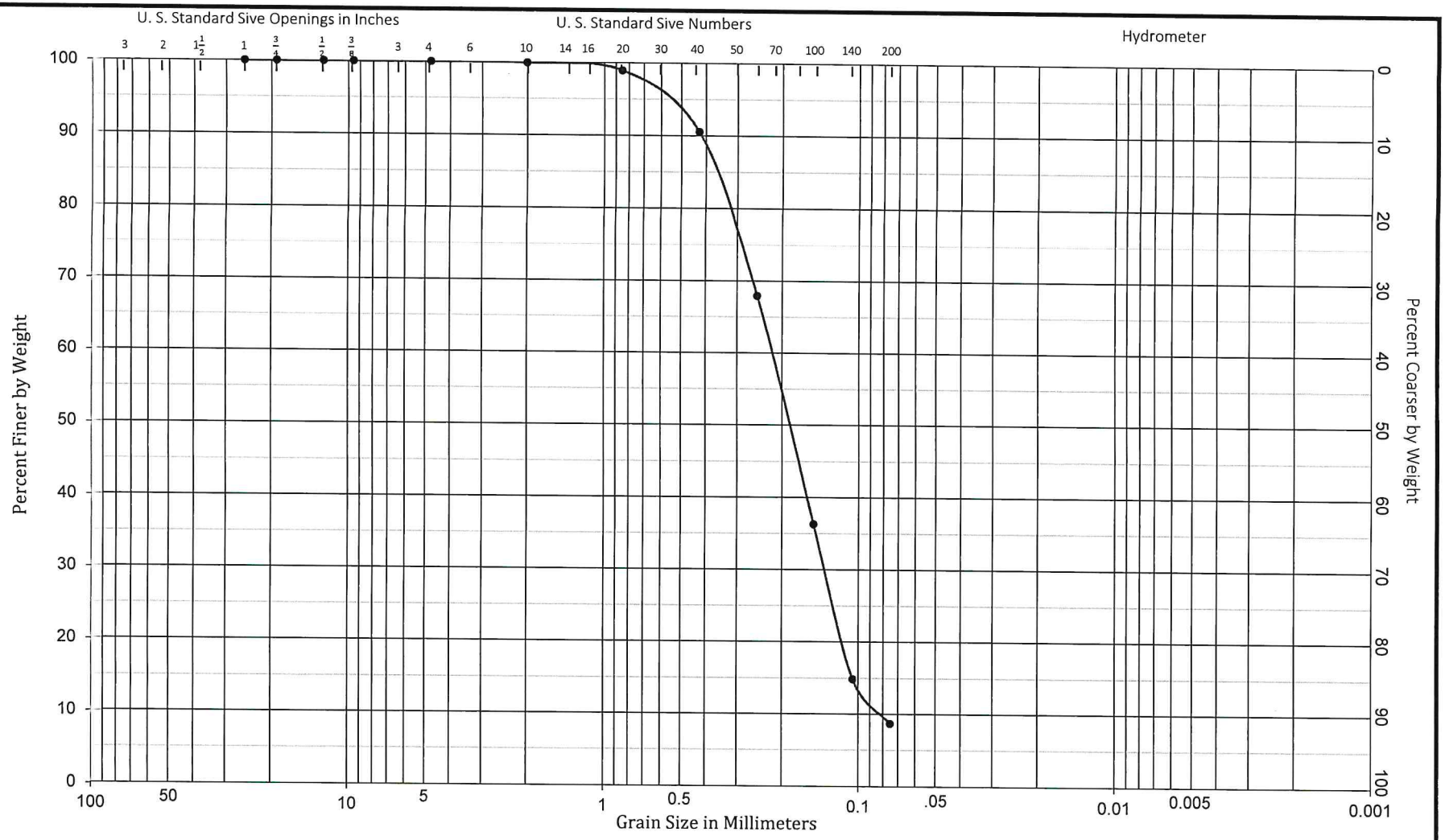
CLIENT: Jacobs Engineering Group, Inc.

PROJECT: Braden Woods Lift Station Rehabilitation/Force Main, Bradenton, Florida

FILE: DES 208523

GRAINSIZE ANALYSES

DRIGGERS ENGINEERING SERVICES, INC.



	GRAVEL	SAND			SILT or CLAY
		Coarse	Medium	Fine	

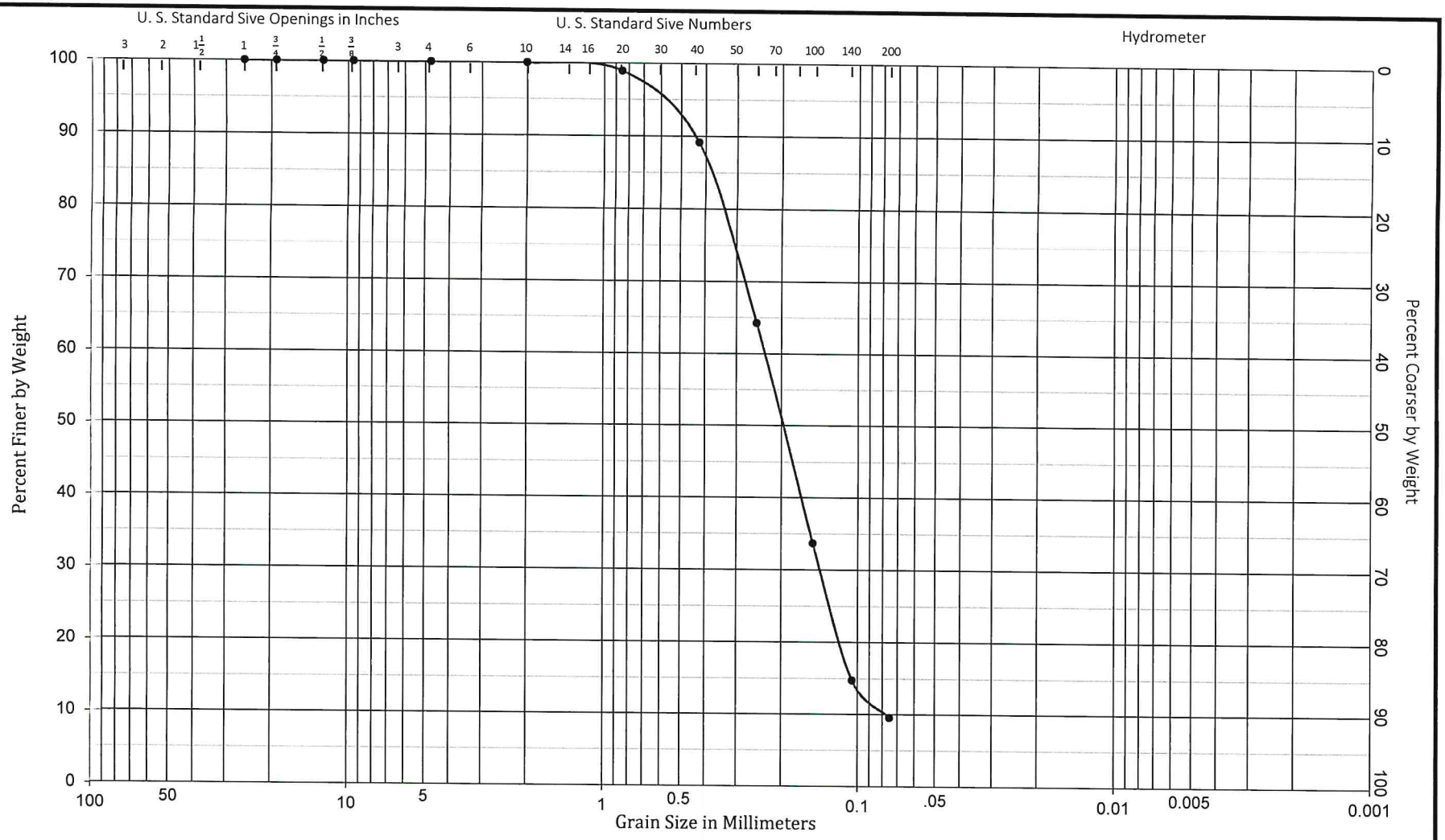
Number	Depth	Moisture	L.L.	P.L.	P.I.	Classification
B-1	3.7'-4.6'					Brown slightly silty Fine SAND

CLIENT: Jacobs Engineering Group, Inc.

PROJECT: Braden Woods Lift Sta. Rehab/Force Main

FILE: DES 208523

DRIGGERS ENGINEERING SERVICES, INC.



GRAVEL	SAND			SILT or CLAY
	Coarse	Medium	Fine	

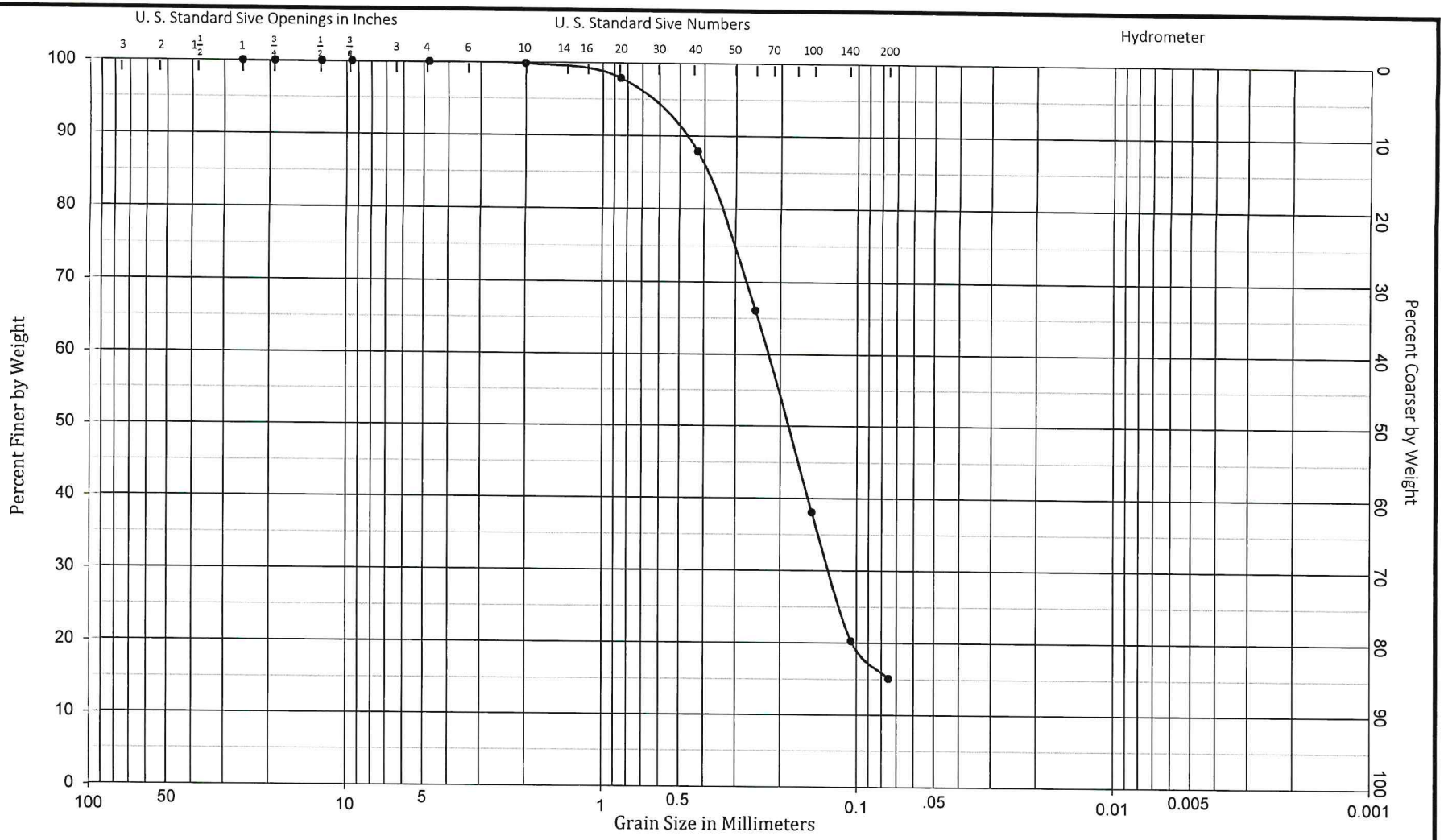
Number	Depth	Moisture	L.L.	P.L.	P.I.	Classification
B-1	6.0'-7.5'					Brown slightly silty Fine SAND

CLIENT: Jacobs Engineering Group, Inc.

PROJECT: Braden Woods Lift Sta. Rehab/Force Main

FILE: DES 208523

DRIGGERS ENGINEERING SERVICES, INC.



	GRAVEL	SAND			SILT or CLAY
		Coarse	Medium	Fine	

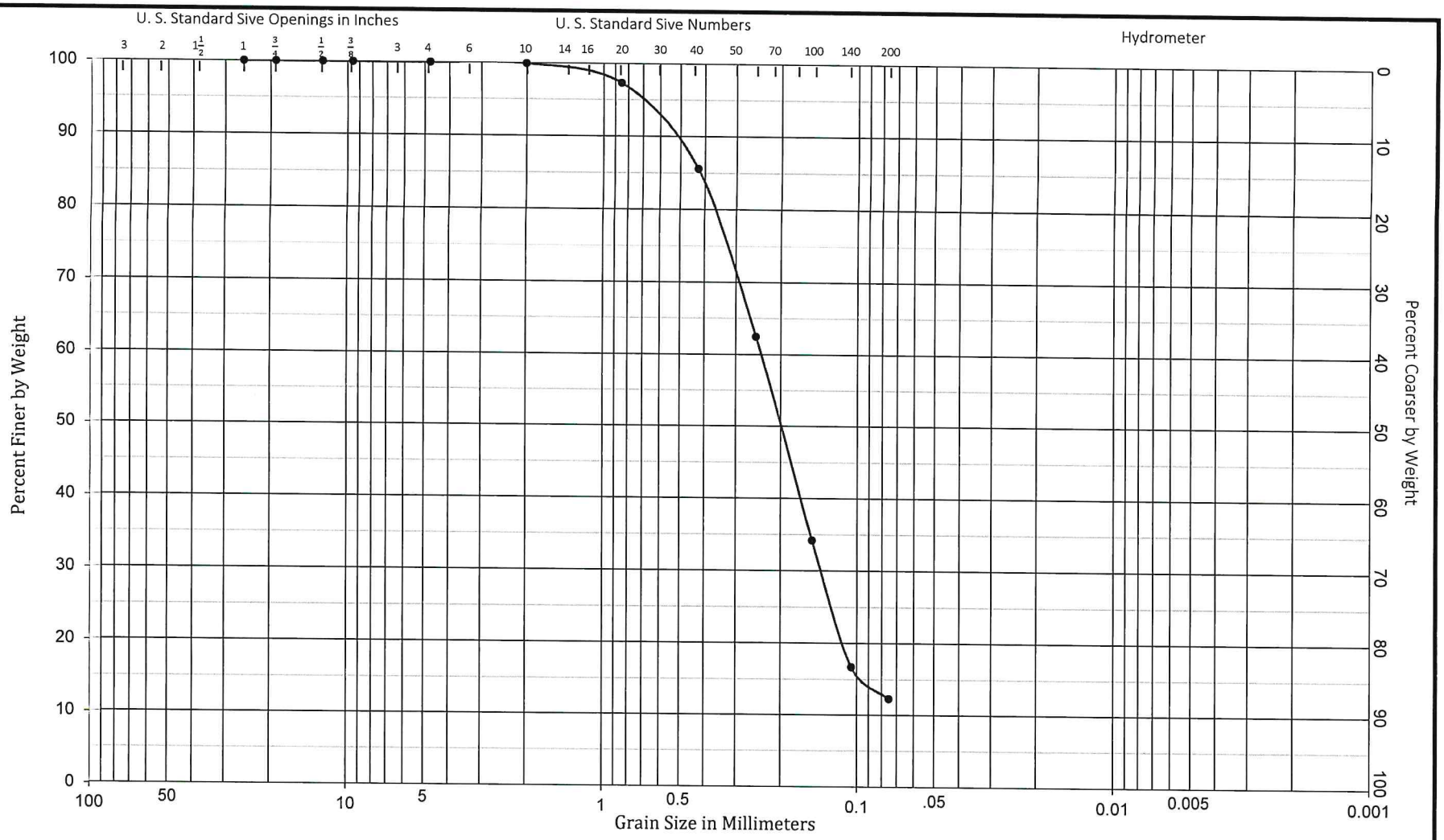
Number	Depth	Moisture	L.L.	P.L.	P.I.	Classification
HA-1	5.7'-7.4'					Brown silty Fine SAND

CLIENT: Jacobs Engineering Group, Inc.

PROJECT: Braden Woods Lift Sta. Rehab/Force Main

FILE: DES 208523

DRIGGERS ENGINEERING SERVICES, INC.



	GRAVEL	SAND			SILT or CLAY
		Coarse	Medium	Fine	

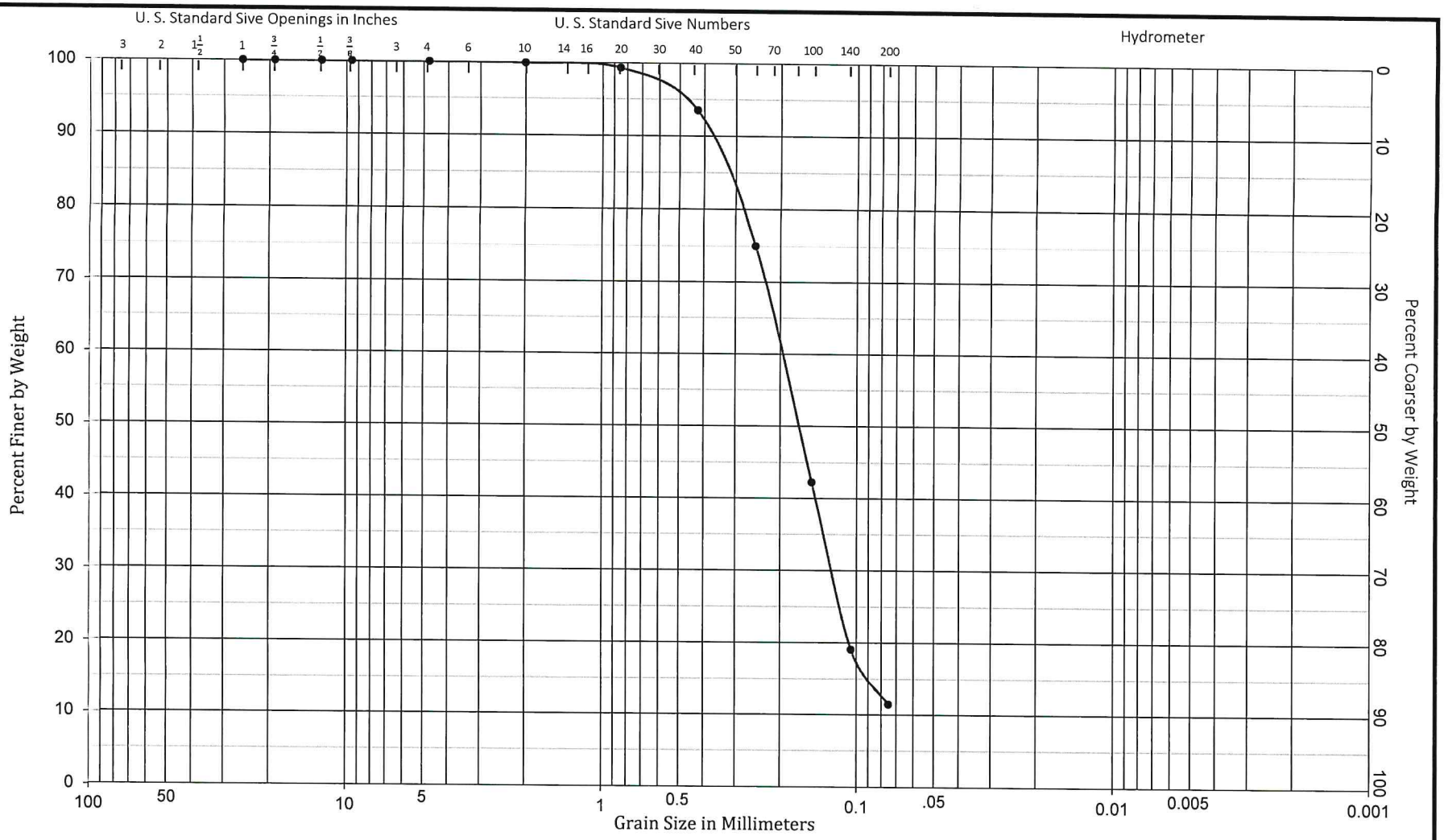
Number	Depth	Moisture	L.L.	P.L.	P.I.	Classification
HA-1	8.5'-10.0'					Grayish-brown and orange silty Fine SAND

CLIENT: Jacobs Engineering Group, Inc.

PROJECT: Braden Woods Lift Sta. Rehab/Force Main

FILE: DES 208523

DRIGGERS ENGINEERING SERVICES, INC.



	GRAVEL	SAND			SILT or CLAY
		Coarse	Medium	Fine	

Number	Depth	Moisture	L.L.	P.L.	P.I.	Classification
HA-3	0.9'-1.8'					Orangish-brown slightly silty Fine SAND

CLIENT: Jacobs Engineering Group, Inc.

PROJECT: Braden Woods Lift Sta. Rehab/Force Main

FILE: DES 208523

METHOD OF TESTING

STANDARD PENETRATION TEST
AND
SOIL CLASSIFICATION

STANDARD PENETRATION TEST (ASTM D-1586)

In the Standard Penetration Test borings, a rotary drilling rig is used to advance the borehole to the desired test depth. A viscous drilling fluid is circulated through the drill rods and bit to stabilize the borehole and to assist in removal of soil and rock cuttings up and out of the borehole.

Upon reaching the desired test depth, the 2 inch O.D. split-barrel sampler or "split-spoon", as it is sometimes called, is attached to an N-size drill rod and lowered to the bottom of the borehole. A 140 pound hammer, attached to the drill string at the ground surface, is then used to drive the sampler into the formation. The hammer is successively raised and dropped for a distance of 30 inches using a rope and "cathead" assembly. The number of blows is recorded for each 6 inch interval of penetration or until virtual refusal is achieved. In the above manner, the samples are ideally advanced a total of 18 inches. The sum of the blows required to effect the final 12 inches of penetration is called the blowcount, penetration resistance or "N" value of the particular material at the sample depth.

After penetration, the rods and sampler are retracted to the ground surface where the core sample is removed, sealed in a glass jar and transported to the laboratory for verification of field classification and storage.

SOIL SYMBOLS AND CLASSIFICATION

Soil and rock samples secured in the field sampling operation were visually classified as to texture, color and consistency. The Unified Soil Classification was assigned to each soil stratum per ASTM D-2487. Soil classifications are presented descriptively and symbolically for ease of interpretation. The stratum identification lines represent the approximate boundary between soil types. In many cases, this transition may be gradual.

Consistency of the soil as to relative density or undrained shear strength, unless otherwise noted, is based upon Standard Penetration resistance values of "N" values and industry-accepted standards. "N" values, or blowcounts, are presented in both tabular and graphical form on each respective boring log at each sample interval. The graphical plot of blowcount versus depth is for illustration purposes only and does not warrant continuity in soil consistency or linear variation between sample intervals.

The borings represent subsurface conditions at respective boring locations and sample intervals only. Variations in subsurface conditions may occur between boring locations. Groundwater depths shown represent water depths at the dates and time shown only. The absence of water table information does not necessarily imply that groundwater was not encountered.

HAND CONE PENETRATION TEST

The cone penetration test was performed using a DGSI Model S-215 double rod Static Cone Penetrometer.

Dual rods enable the cone stress to be measured directly. Soil friction on the outer rod does not influence the reading. Depending upon the application, either the maximum bearing for an increment of push or the least bearing for an increment can be reported. If you were investigating for soft spots, you would take the least reading. In typical use, you would force the cone into the soil 6 inches, retract the cone slightly until the gauge reads zero, then advance an additional 6 inch increment. If you meet with refusal, the cone can be removed and the hole opened with a hand auger to permit a continuation of measurements against depth.

The tool has been designed to allow a maximum force of 250 lbs. to be applied, somewhat more than the average weight of an operator. The unit can be operated in a vertical or horizontal position. The cone tip has an included angle of 60E. The cone has a section area of 1.5 cm^2. The maximum total bearing (Q_c) is 70 kg/cm^2.

The reading (Q_c) is in kg/cm^2 which is essentially equal to ton/ft^2.

The cone index (Q_c) is read directly. The correlation between the cone index and soil constants is not absolute. Generally, the following results have been determined through extensive field use of the unit. Further verification of correlation in your local soil types is essential.

Standard Penetration (Sands) Test AN@ Value $Q_c = 4$ AN@	**Strength and Cohesion** Q_u - Unconfined compression (kg/cm^2) c - Cohesion (kg/cm2) Uniform clay and silty clays: $Q_c = 5\ Q_u$ $Q_c = 10\ c$ Clayey Silts: $Q_c = (10 \text{ to } 20)\ Q_u$ $Q_c = (20 \text{ to } 40)\ c$