Stantec Consulting Services Inc.
10200 Alliance Road, Suite 300, Cincinnati OH 45242

February 24, 2023
File: 175538119

Attention: Jeff Hipp, PE
Ohio Department of Transportation, District 6
400 East William Street
Delaware, Ohio 43015

Reference: Geotechnical Data Report
PIC-56-20.41 (PID No. 144152)
Pickaway County, Ohio

Dear Mr. Hipp,

Stantec Consulting Services Inc. (Stantec) has completed the geotechnical boring and lab testing for the referenced project on State Route 56 near Circleville, Ohio. The enclosed report contains a brief description of the site, the scope of work performed, and the resulting geotechnical data.

Slope instability is occurring along portions of State Route (SR) 56 near Circleville, Ohio. The Ohio Department of Transportation (ODOT) is planning measures to stabilize the slope in these areas. To accompany a cone penetration test (CPT) sounding performed by ODOT, Stantec was contracted to perform a geotechnical boring and soil laboratory testing for the project. Stantec performed one soil boring (B-001-0-22) with the approximate location shown on the boring location map in Appendix A. The coordinates for the boring were recorded using smartphone GPS functions. The surface elevation for the boring was estimated using topographic data supplied by Google Earth. The boring was performed with a truck-mounted CME 45 drill rig using 3¼ inch inside diameter hollow stem augers. Standard Penetration Test (SPT) sampling was performed continuously to a depth of 40 feet. The energy ratio (ER) of the automatic hammer and drill rod was measured at 88.4 percent on April 24, 2018.

The soil samples obtained from the boring were returned to a geotechnical laboratory for visual classification and water content testing. Engineering classification testing was performed on samples reflecting each of the main soil horizons. The engineering classification tests conducted on the samples were sieve and hydrometer analysis (ASTM D 422) and Atterberg limits (ASTM D 4318). The samples were classified according to the ODOT classification method.

The surface material at the boring consisted of 12 inches of asphalt pavement. Below the pavement, non-cohesive soils classifying as sandy silt (A-4a), gravel and stone fragments with sand (A-1-b) and coarse and fine sand (A-3a) were typically encountered in the boring. These soils were mostly described as loose to very dense with SPT N_{60} values ranging from 9 to over 50 blows per foot. One sample was described as very loose due to an SPT N_{60} value of 3 at a depth of 31.0 to 32.5 feet. Moisture contents varied from 5 to 21 percent with an average of 13 percent. A layer of slightly cohesive sandy silt was encountered at a depth of 16 feet to a depth of 20.5 feet. This soil was described as very stiff to hard with SPT N_{60} values ranging from 18 to 40 blows per foot. Moisture contents ranged from 11 to 12 percent in the sandy silt. One sample tested in this material resulted in a liquid limit value of 24 and a plastic limit value of 15. Groundwater was

Reference: **Geotechnical Data Report, PIC-56-20.41**

observed in B-001-0-22 while drilling at a depth of 23.5 feet. Bedrock was not encountered in the boring. The boring log is included in Appendix B.

ODOT performed the CPT sounding along the same alignment at the location shown on the map in Appendix A. The CPT sounding was advanced to a depth of 48.9 feet with soil layers described as mostly as sand, silty sand, and sandy silt, but also as clay and silty clay at isolated depths. The CPT Sounding Report prepared by ODOT is provided in Appendix C.

Regards,

Stantec Consulting Services Inc.

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Appendices: Appendix A – Boring Location Map
Appendix B – Boring Log
Appendix C – CPT Sounding Report

cc: Andrew Holloway – District 6 Transportation Engineer

APPENDIX A
BORING LOCATION MAP


Boring Location Map
Legend
B-001-0-22
C-001-0-23
C-001-0-23
SR 56
B-001-0-22
Hitler Rd 1
Google Earth
N
1000 ft

APPENDIX B
BORING LOG

PROJECT: PIC-56-20.41	DRILLING FIRM / OPERATOR: STANTEC / DC	DRILL RIG: CME 45C#3 (812)	STATION / OFFSET: TBD	EXPLORATION ID B-001-0-22
TYPE: GEOHAZARD EXPLORATION	SAMPLING FIRM / LOGGER: STANTEC / JP	HAMMER: CME AUTOMATIC	ALIGNMENT: SR 56	
PID: 114152 SFN: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 4/24/18	ELEVATION: 721.0 (MSL) EOB: 40.0 ft.	PAGE 1 OF 2
START: 1/6/23 END: 1/6/23	SAMPLING METHOD: SPT	ENERGY RATIO (%): 88.4	LAT / LONG: 39.585770, -82.918239	

MATERIAL DESCRIPTION AND NOTES	ELEV. 721.0	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
BLACK, **ASPHALT**, 12 INCHES	720.0																	
LOOSE TO MEDIUM DENSE, BROWN, **SANDY SILT**, LITTLE GRAVEL, SOME CLAY, DAMP TO MOIST		1	12 8 5	19	78	SS-1	-	13	18	23	26	20	21	16	5	12	A-4a (2)	
		2																
		3	5 7 4	16	11	SS-2	-	-	-	-	-	-	-	-	-	21	A-4a (V)	
		4																
		5	5 3 3	9	67	SS-3	1.50	-	-	-	-	-	-	-	-	14	A-4a (V)	
		6	5 6 6	18	67	SS-4	-	-	-	-	-	-	-	-	-	17	A-4a (V)	
		7																
		8	8 10 11	31	56	SS-5	-	-	-	-	-	-	-	-	-	7	A-4a (V)	
		9	7 10 10	29	78	SS-6	-	-	-	-	-	-	-	-	-	5	A-4a (V)	
	711.0	10																
MEDIUM DENSE TO DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE SILT, LITTLE CLAY, MOIST		11	5 6 6	18	100	SS-7	-	23	35	21	10	11	NP	NP	NP	13	A-1-b (0)	
		12	5 13 13	38	67	SS-8	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	
		13	7 9 11	29	100	SS-9	-	42	26	10	14	8	NP	NP	NP	7	A-1-b (0)	
		14																
		15	5 5 5	15	11	SS-10	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
	705.0	16																
VERY STIFF TO HARD, BROWN, **SANDY SILT**, SOME GRAVEL, LITTLE CLAY, DAMP		17	7 5 7	18	67	SS-11	-	-	-	-	-	-	-	-	-	12	A-4a (V)	
		18	8 11 13	35	94	SS-12	4.50	-	-	-	-	-	-	-	-	11	A-4a (V)	
		19																
		20	5 10 17	40	100	SS-13	3.00	24	13	13	31	19	24	15	9	11	A-4a (3)	
	700.5	21																
DENSE TO VERY DENSE, BROWN, **COARSE AND FINE SAND**, "AND" GRAVEL, LITTLE SILT, TRACE CLAY, MOIST TO WET		22	9 26 30	83	78	SS-14	-	-	-	-	-	-	-	-	-	9	A-3a (V)	
		23	8 12 13	37	67	SS-15	-	-	-	-	-	-	-	-	-	15	A-3a (V)	
W 697.5		24	7 12 12	35	100	SS-16	-	12	25	33	20	10	NP	NP	NP	18	A-3a (0)	

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 2/24/23 11:08 - U:\175538119\TECHNICAL_PRODUCTION\FIELD_DATA\PIC-56\PIC-56 LOG.GPJ

PID: 114152	SFN: N/A	PROJECT: PIC-56-20.41	STATION / OFFSET: TBD	START: 1/6/23	END: 1/6/23	PG 2 OF 2	B-001-0-22

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
	696.0																	
	694.5	26	13 15 17	47	100	SS-17	-	-	-	-	-	-	-	-	-	13	A-3a (V)	
DENSE, BROWNISH GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, WET		27	11 14 15	43	100	SS-18	-	40	29	10	15	6	NP	NP	NP	14	A-1-b (0)	
		28																
		29	5 12 11	34	0	SS-19	-	-	-	-	-	-	-	-	-	-	A-1-b (V)	
		30	6 9 13	32	100	SS-20	-	-	-	-	-	-	-	-	-	18	A-1-b (V)	
		31																
VERY LOOSE FROM 31 FT. TO 32.5 FT.		32	0 0 2	3	100	SS-21	-	-	-	-	-	-	-	-	-	17	A-1-b (V)	
		33	6 11 11	32	100	SS-22	-	39	31	10	11	9	NP	NP	NP	17	A-1-b (0)	
		34																
		35	4 8 11	28	100	SS-23	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	
		36	4 8 10	27	100	SS-24	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	
		37																
		38	4 6 11	25	100	SS-25	-	-	-	-	-	-	-	-	-	17	A-1-b (V)	
		39	3 17 17	50	100	SS-26	-	-	-	-	-	-	-	-	-	11	A-1-b (V)	
	681.0	EOB 40																

NOTES: BORING COORDINATES AND ELEVATION ARE ESTIMATED.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: ASPHALT PATCH; AUGER CUTTINGS MIXED WITH BENTONITE CHIPS

APPENDIX C
CPT SOUNDING REPORT

CONE PENETRATION TEST SOUNDINGS REPORT

Office of Geotechnical Engineering
Division of Engineering

Project: PIC-56-20.41

PID: 118525

Date: January 4, 2023

Number of Soundings: 1

Equipment: A.P. van den Berg, 23 Ton Crawler, Hyson 200kN

Sounding ID	Completion Date	Probe SN	Calibration Date	Elevation	Latitude	Longitude	Surface Material	Depth (ft.)
C-001-0-23	1/4/2023	130510	9/9/2021	700.6	39.589685	-82.922881	Asphalt (13")	48.87

Project Information

Sounding C-001-0-23 was completed within the road through a pre-cored hole. A dummy cone was used to advance through stiff material to a depth of 1.5 feet. The static water level reported on the attached log was determined by pore pressure response from a dissipation test. The latitude, longitude, and elevation values are from a Trimble Geo7X handheld GPS with an external Trimble Tornado antenna.

The raw CPT data is available upon request. The included CPT logs are for informational purposes only. The CPT logs have been filtered for negative values, corrected for inclination at depth, and filtered for data spikes. Additionally, for each sounding, the measured values of q_c and f_s were shifted relative to one another with a cross correlation function.

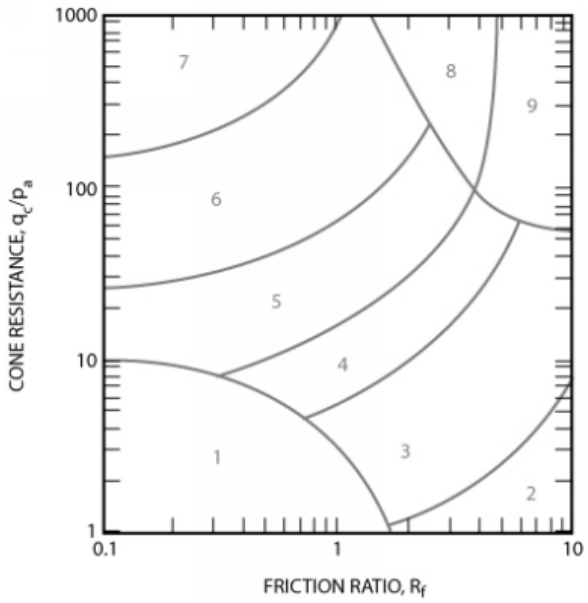
Cone Penetration Test Data and Interpretation

These Cone Penetration Test (CPT) Soundings follow ASTM D 5778 and were made by ordinary and conventional methods and with care deemed adequate for the Department's design purposes. Since subsurface conditions outside each CPT sounding are unknown, and soil, rock, and water conditions cannot be relied upon to be consistent or uniform, no warrant is made that conditions adjacent to this sounding will necessarily be the same as or similar to those shown in this report.

The CPT data collected are presented as graphical plots in the report, generated by CPeT-IT software. The plots include interpreted Soil Behavior Type (SBT) based on the method described by Robertson (2010). The interpretations are presented only as a guide for geotechnical use and should be carefully reviewed.

The department does not warrant the correctness or the applicability of any of the geotechnical parameters interpreted by the software and does not assume any liability for use of the results in any design or review.

The user should be fully aware of the techniques and limitations of any method used in the software. Furthermore, the Department will not be responsible for an interpretations, assumptions, projections, or interpolations made by the contractor, or other users of this report. While the Department believes that the information as to the condition and materials reported is accurate, it does not warrant that the information is necessarily complete. Water pressure measurements and subsequent interpreted water levels shown in this report should be used with discretion since they represent dynamic conditions. Dynamic pore water pressure measurements may deviate substantially from hydrostatic conditions, especially in cohesive soils.



Zone	*Soil Behavior Type*
1	*Sensitive, fine grained*
2	*Organic soils - clay*
3	*Clay – silty clay to clay*
4	*Silt mixtures – clayey silt to silty clay*
5	*Sand mixtures – silty sand to sandy silt*
6	*Sands – clean sand to silty sand*
7	*Gravelly sand to dense sand*
8	*Very stiff sand to clayey sand**
9	*Very stiff fine grained**

** Heavily overconsolidated or cemented*

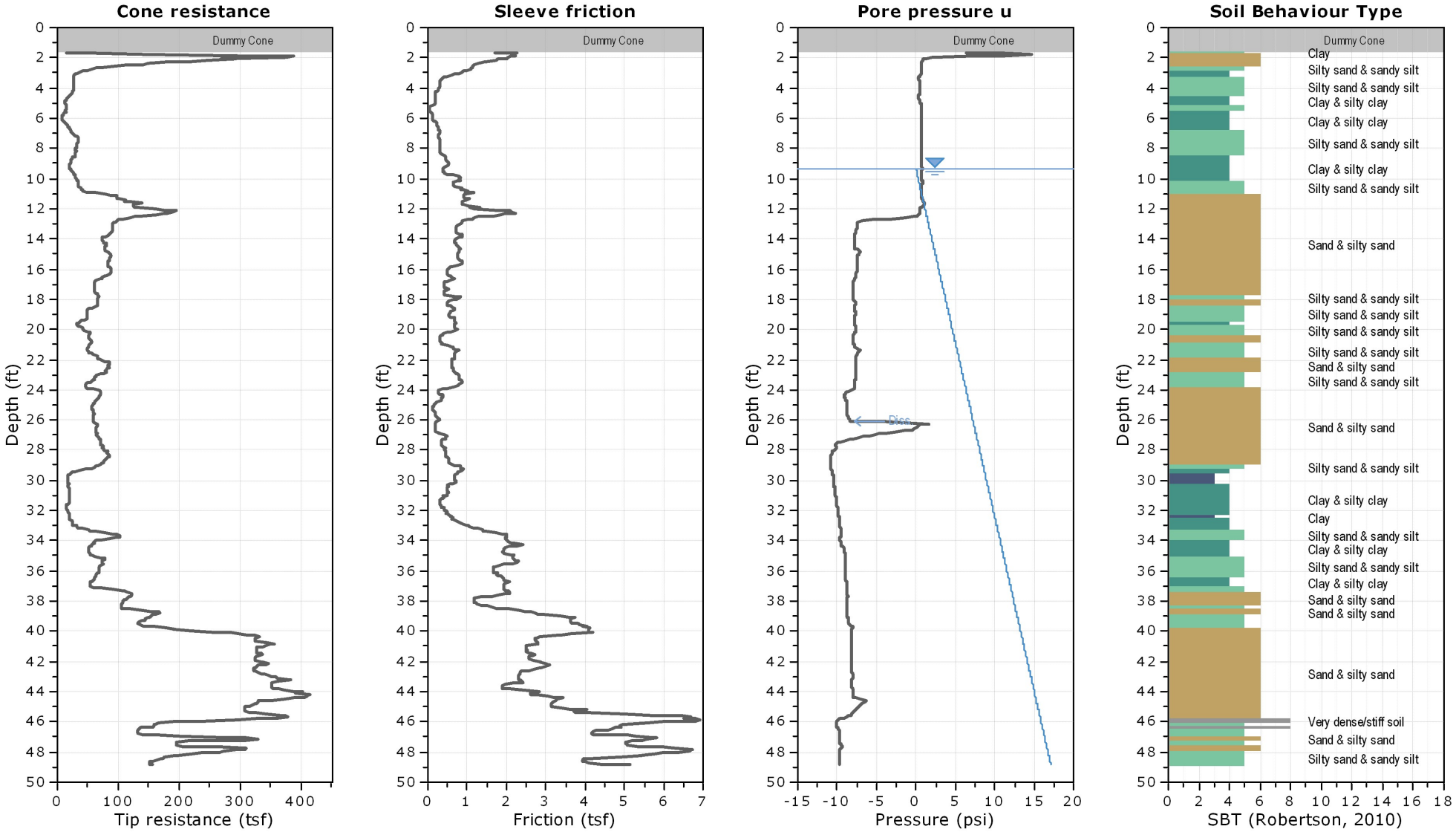
Non-normalized CPT Soil Behavior Type (SBT) chart

Robertson, P.K. and Cabal, K.L, 2016. *Guide to Cone Penetration Testing for Geotechnical Engineering, 6th Edition*. Signal Hill, California: 34.
http://www.greggdrilling.com/wp-content/uploads/2017/07/CPT-Guide-6th-Edition-2016.pdf
Accessed May 21, 2019.

Office of Geotechnical Engineering
Geology, Exploration and, Laboratory Section
http://www.dot.state.oh.us/Divisions/Engineering/Geotechnical

CPT: C-001-0-23
Total depth: 48.87 ft, Date: 1/4/2023
Surface Elevation: 700.6 ft
Coords: lat 39.589685° lon -82.922881°

Project: PIC-56-20.41
Location: Pickaway County



Dissipation Tests Results

Dissipation tests

Dissipation tests consists of stopping the piezocone penetration and observing porepressures (u) with elapsed time (t). The data are automatic recorded by the field computer and should take place until a minimum of 50% dissipation.

The porepressures are plotted as a function of square root of (t). The graphical technique suggested by Robertson and Campanella (1989), yields a value for t_{50}, which corresponds to the time for 50% consolidation.

The value of the coefficient of consolidation in the radial or horizontal direction c_h was then calculated by Houlsby and Teh's (1988) theory using the following equation:

$$c_h = \frac{T \times r^2 \times I_r^{0.5}}{t_{50}}$$

where:

T: time factor given by Houlsby and Teh's (1988) theory corresponding to the porepressure position
r: piezocone radius
I_r: stiffness index, equal to shear modulus G divided by the undrained strength of clay (S_u).
t_{50}: time corresponding to 50% consolidation

Permeability estimates based on dissipation test

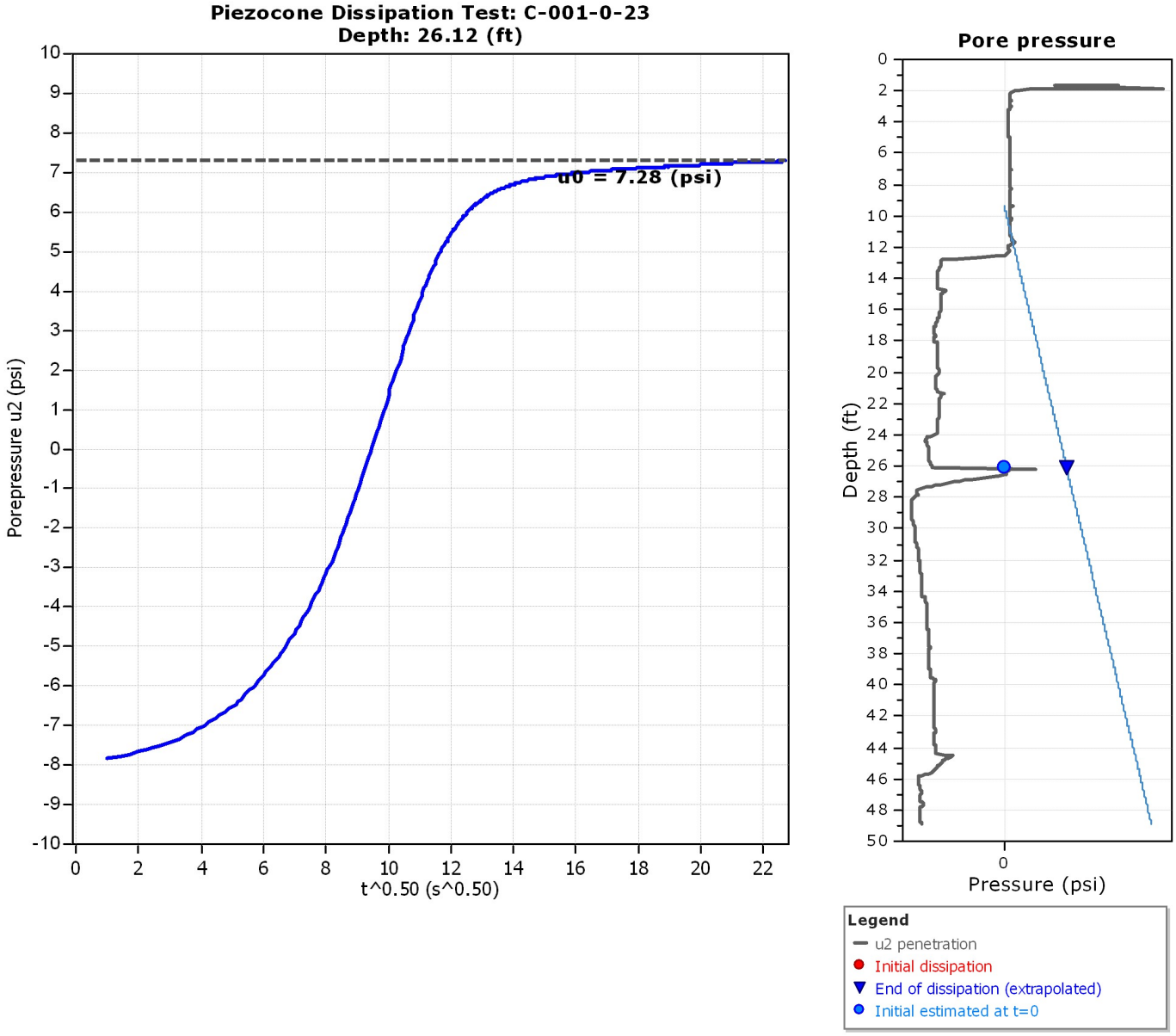
The dissipation of pore pressures during a CPTu dissipation test is controlled by the coefficient of consolidation in the horizontal direction (c_h) which is influenced by a combination of the soil permeability (k_h) and compressibility (M), as defined by the following:

$$k_h = c_h \times \gamma_w / M$$

where: M is the 1-D constrained modulus and γ_w is the unit weight of water, in compatible units.

Tabular results

CPTU Borehole	Depth (ft)	$(t_{50})^{0.50}$	t_{50} (s)	t_{50} (years)	G/S_u	c_h (ft^2/s)	c_h (ft^2/year)	M (tsf)	k_h (ft/s)
C-001-0-23	26.12	0.0	0	0.00E+000	100.00	0.00E+000	0	566.32	-1.00E+004


Piezocone Dissipation Test: C-001-0-23
Depth: 26.12 (ft)
u0 = 7.28 (psi)
Porepressure u2 (psi)
t^0.50 (s^0.50)
Pore pressure
Depth (ft)
Pressure (psi)
Legend
u2 penetration
Initial dissipation
End of dissipation (extrapolated)
Initial estimated at t=0