GEOTECHNICAL DESIGN MEMORANDUM

To: Jonathan M. Koester, P.E., District 7 Planning and Engineering

COPY: Daniel H. Grilliot, District 7 Geotechnical Engineer

FROM: Amal Goza, P.E., Office of Geotechnical Engineering

DATE: August 28, 2023

SUBJECT: LOG-273-0002, PID 114937 Geotechnical Design Memo

ANALYSIS AND RECOMMENDATIONS

This memo includes the foundation recommendations for the new bridge construction proposed to replace the existing single span LOG-273-0002 over Indian Lake boat passage conforming with the dimensions, and grades shown on the project plans. The recommendations were developed in accordance with the AASHTO LRFD Bridge Design Specifications 9th Edition (2020), with all Interim Revisions (AASHTO LRFD). Project Borings B-001-0-22, B-002-0-22 and project soundings C-001-1-22 and B-002-1-22 were drilled/pushed for the bridge foundation design. Top of rock was not encountered in any of the project borings, the lowest drilled elevation is 890.5' in B-001-0-22. According to the "Bedrock topography of the Roundhead, Ohio, quadrangle" map published by the Department of Natural Resources, top of rock (TR) at the project site is expected at or below elevation 820 ft. No historical records were found for this project. Our recommended foundation type is driven cast-in-place reinforced concrete pipe piles at both abutments. Phased construction is required to maintain traffic cross the bridge. Given this is a small, single-span integral abutment bridge, lateral loads on the abutment piles are anticipated to be insignificant. Details are provided below in relevant sections for foundation and temporary shoring recommendations.

Summary of the boring information is as follows:

Substructure Unit	Boring/Sounding ID	Ground Surface Elevation (ft)	Termination Elevation (ft)	Depth (ft)
Rear Abutment	B-001-0-22	1003.0	890.5	112.5
	C-001-1-22	1003.1	905.41	97.69 (Pre-drilled to 25 ft)
Forward Abutment	B-002-0-22	1003.3	890.8	112.5
	C-002-1-22	1003.3	910.97	92.33 (Pre-drilled to 25 ft)

Temporary Shoring:

In accordance with BDM Section 310.1.1.2, a complete design for excavation bracing is required whenever the depth of any side of the excavation exceeds 8 feet or if the excavation will expose the deep foundation members, which both occur at the rear and forward abutments of bridge LOG-273-0002.

The excavation soils behind the wall classify as a Type B soil by the OSHA Regulations (cohesive soils with an unconfined compressive strength greater than 0.5 tsf but less than 1.5 tsf). Temporary excavations may be made at a 1H:1V slope angle of 45 degrees to a maximum depth of 20 feet as per OSHA requirements for Type B soils.

Using the provided temporary shoring plans, temporary sheet pile walls are proposed to run transverse to Indian Lake boat passage and parallel to SR273 (Long Island Dr). The cantilever height for the shoring is shown to be a maximum of 8.85 feet. Using this height, a minimum section modulus of 10.7 in^3/ft and a minimum moment of inertia of 39.8 $in.^4$/ft at the rear and forward approaches is required to resist the shear forces and bending moment. The minimum yield stress is 50 ksi, and the minimum embedment depth is 9 ft, making the required sheet pile length 18 feet (includes rounding up) at both approaches.

Table 1 provides a summary of the assumptions used for design and the results of the analyses. Note that the estimated top of wall elevations and minimum section lengths reflect only the height of soil retained. If additional wall length is desired at the top of the wall for freeboard, this must be added to the values. For example, if one foot of freeboard is desired, the minimum section lengths become 19.0 feet.

Table 1. Temporary Shoring Recommendations

Parameter	Rear Approach	Forward Approach
Estimated Top of Wall Elev., excluding freeboard (ft)	1,003.20	1,003.20
Bottom of Excavation Elev. (ft)	994.37	994.35
Retained Height (ft)	8.83	8.85
Sheeting Tip Elev. (ft)	985.20	985.20
Minimum Section Length, excluding freeboard (ft)	18.0	18.0
Minimum Yield Stress (ksi)	50	50
Minimum Section Modulus ($in.^3$/ft)	10.7	10.7
Minimum Moment of Inertia ($in.^4$/ft)	39.8	39.8

Driven Piles – Rear and Forward Abutments:

The recommended foundation type is 12" Cast-In-Place Reinforced Concrete friction driven piles at the Rear and Forward Abutments. Based on the provided bridge loads and, the estimated and order pile lengths are as follows (all piles are Steel CIP Piles conforming to ASTM A252 Grade 2 - Yield Strength 35-ksi).

Substructure Unit (Boring/Sounding ID)	Bottom of Pile Cap Elev.	Ultimate Bearing Value	Pile Tip Elev.	Geotechnical Pile Length[1]	Est. Length	Order Length
Rear Abut. B-001-0-22 C-001-1-22	994.37'	145 kips	944.37'	50.00'	55'	60'
Forward Abut. B-002-0-22 C-002-1-22	994.37'	145 kips	955.37'	39.00'	45'	50'

[1] the Geotechnical Pile Length includes the Pile Cap Embedment depth of 2.00 ft.

The estimated driving resistance as indicated by the driving losses would increase the length of the pile during driving by more than 10-ft at End of Initial Drive (EOID) to achieve the required pile resistance as compared to the UBV, thus we have accounted for pile setup in the design. See BDM 2020, Section 305.3.2.4. The EOID resistance and the anticipated waiting period related to the expected setup are summarized below:

Substructure Unit	UBV (kips)	EOID (kips)	Geotechnical Pile Length Ultimate (ft)	Geotechnical Pile Length Driving (ft)	Difference (ft)	UBV/EOID	Waiting Time (Days)
Rear Abut.	145	105.75	48.00	63.00	15.00	1.37	7
Forward Abut.	145	99.03	37.00	60.00	23.00	1.46	7

We have performed GRLWEAP drivability analyses at both abutments using the minimum wall thickness of 0.250-in. and steel closed-end CIP reinforced concrete pipe piles conforming to ASTM A252 Grade 2 - Yield Strength 35-ksi. We find that the driving stresses in the piles will not exceed the permissible driving stresses. The driving stresses must be kept below 90% of the steel yield strength per AASHTO LRFD Bridge Design Specifications Article 10.7.8. For Grade 2 Steel with yield strength of 35 ksi, the compressive driving stresses must be kept below 31.5 ksi.

In accordance with the BDM Section 305.3.5.6, there is no need to protect the tips of the CIP piles, and conical points are not required for piling at the project site.

CLOSING REMARKS

Add the geotechnical plan notes provided through this design memo to the Structures General Notes. Add the following estimated quantities to the project plans:

Item	Item Description	Units	Estimated Quantities		
			Rear Abut	Forward Abut	Total
503E11101	Cofferdams And Excavation Bracing, As Per Plan	LS			LS
505E11100	PILE DRIVING EQUIPMENT MOBILIZATION	LS			LS
507E00500	12" CAST-IN-PLACE REINFORCED CONCRETE PILES, DRIVEN	FT	495	405	900
507E00550	12" CAST-IN-PLACE REINFORCED CONCRETE PILES, FURNISHED	FT	540	450	990
523E20001	DYNAMIC LOAD TESTING, AS PER PLAN	EACH	1	1	2
523E20501	RESTRIKE, AS PER PLAN	EACH	1	1	2

If you have any questions, please feel free to contact either myself at 614-387-2379, or Alex Dettloff, at 614-275-1308.

Thank you,
AAG

PC: Reading File, File

ATTACHMENTS:

- Project Geotechnical Plan Notes.
- A snapshot of ODNR Bedrock topography of the Roundhead, Ohio, quadrangle map at the project site.
- Cone Penetration Test Soundings Report.
- Project SPT Boring Logs.
- SPT/CPT N_{60} Blow Counts – Depth/Elevation Graphs.
- Temporary Shoring Selected Plan Sheets.
- Site Plan: Bridge No.: LOG-273-0002 Over Indian Lake.
- Temporary Shoring Stability Calculation.
- Temporary Shoring - LPILE Graphical Output Results.
- Pile Nominal Resistance versus Embedment Depth Graphs – SPT.
- GRLWEAP Drivability Analyses.

PROJECT GEOTECHNICAL PLAN NOTES:

In the Design Data, provide the steel grade for the bearing piles and sheet pile as:

STEEL SHEET PILES – ASTM A572 GRADE 50 - YIELD STRENGTH 50 KSI

STEEL CIP PILES – ASTM A252 GRADE 2 - YIELD STRENGTH 35-KSI

PILE DESIGN LOADS (ULTIMATE BEARING VALUE):

THE ULTIMATE BEARING VALUE IS 145 KIPS PER PILE FOR THE ABUTMENT PILES.

REAR ABUTMENT PILES:

12" CAST-IN-PLACE REINFORCED CONCRETE PILES, 60 FEET LONG, ORDER LENGTH

1 DYNAMIC LOAD TESTING, AS PER PLAN

1 RESTRIKE, AS PER PLAN

FORWARD ABUTMENT PILES:

12" CAST-IN-PLACE REINFORCED CONCRETE PILES, 50 FEET LONG, ORDER LENGTH

1 DYNAMIC LOAD TESTING, AS PER PLAN

1 RESTRIKE, AS PER PLAN

PROVIDE PLAIN CYLINDRICAL CASINGS WITH A MINIMUM PILE WALL THICKNESS OF 0.250 INCH FOR THE CAST-IN-PLACE REINFORCED CONCRETE PILES.

PILES DRIVEN TO FULL ESTIMATED LENGTH WITH PILE/SOIL SETUP:

THE ULTIMATE BEARING VALUE (UBV) IS 145 KIPS PER PILE FOR THE 12-INCH DIAMETER CAST-IN-PLACE REINFORCED CONCRETE ABUTMENT PILES. PART OF THE UBV WILL BE ACHIEVED THROUGH PILE/SOIL SETUP, WHICH IS A TIME DEPENDENT INCREASE IN RESISTANCE THAT OCCURS IN SOME SOILS.

NOTIFY THE ENGINEER AT LEAST 5 DAYS BEFORE DRIVING PILES SO THAT THE ENGINEER CAN NOTIFY THE DISTRICT GEOTECHNICAL ENGINEER, THE OFFICE OF CONSTRUCTION ADMINISTRATION, AND THE OFFICE OF GEOTECHNICAL ENGINEERING.

DRIVE THE FIRST TWO PILES AT THE REAR ABUTMENT (R6 AND R9) TO THE FULL ESTIMATED LENGTH OF 55 FEET AND THE FIRST TWO PILES AT THE FORWARD ABUTMENT (F1 AND F4) TO THE FULL ESTIMATED LENGTH OF 45 FEET. PERFORM DYNAMIC LOAD TESTING ON BOTH PILES AT EACH ABUTMENT WHILE DRIVING. AFTER DRIVING AND TESTING THE FIRST TWO PILES, DRIVE THE REMAINING PHASE 1 PILES IN THE SUBSTRUCTURE TO THE SAME DEPTH AS THE FIRST TWO PILES. AFTER DRIVING ALL PILES TO THE ESTIMATED LENGTH, CEASE ALL DRIVING OPERATIONS AT THE SUBSTRUCTURE FOR A PERIOD OF 7 DAYS. INCLUDE THE WAITING PERIOD AS A SEPARATE ACTIVITY IN THE PROGRESS SCHEDULE. AFTER THE WAITING PERIOD, PERFORM PILE RESTRIKES ON BOTH OF THE FIRST TWO PILES AT EACH ABUTMENT (ONE RESTRIKE ITEM).

SUBMIT ALL TEST RESULTS TO THE ENGINEER. IF THE RESTRIKE TEST RESULTS INDICATE THAT BOTH PILES ACHIEVED THE REQUIRED UBV, ALL PILES IN THE SUBSTRUCTURE MAY BE ACCEPTED BY THE ENGINEER.

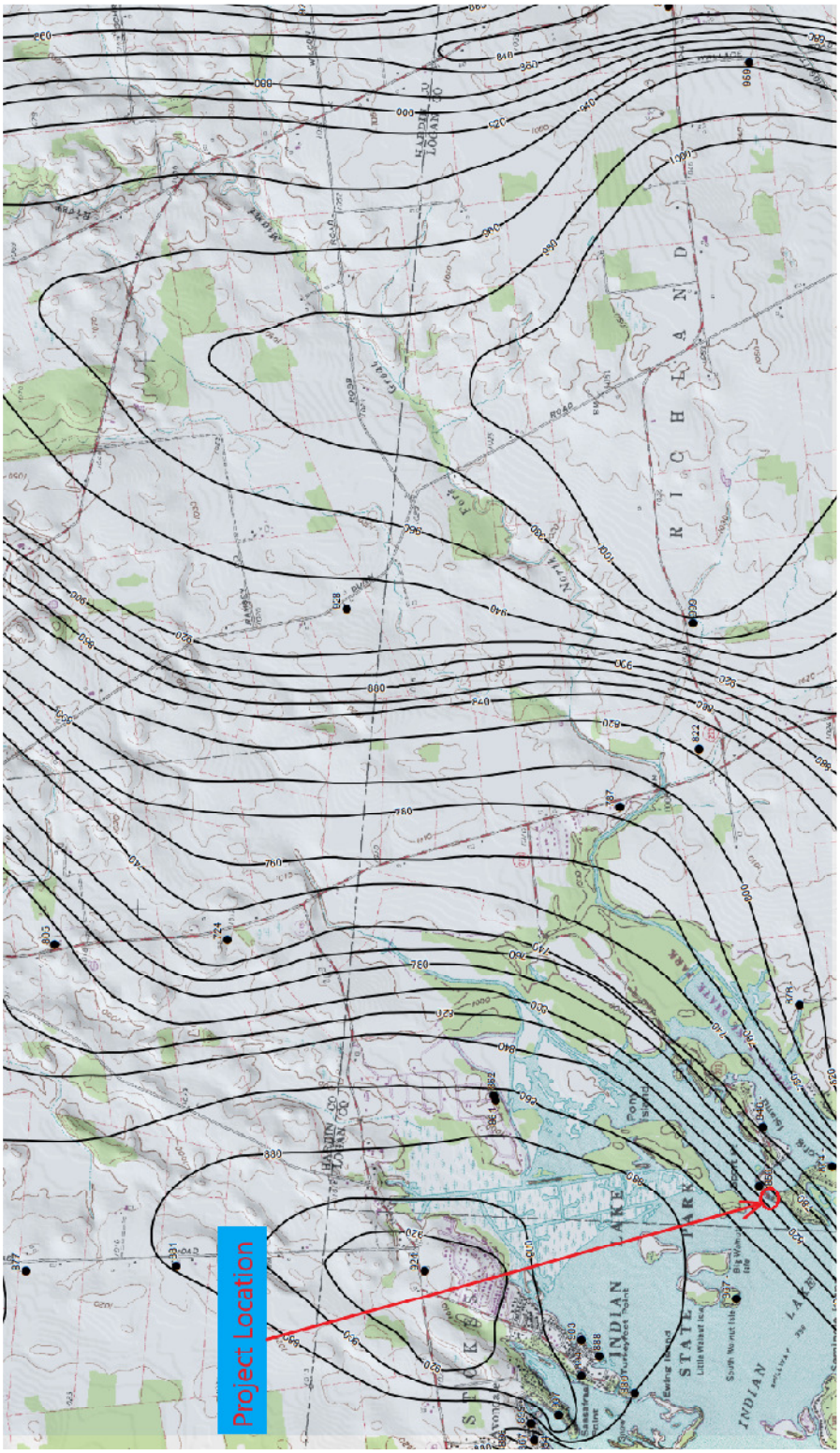
IF THE RESTRIKE TEST RESULTS INDICATE THAT EITHER OF THE TWO PILES DID NOT ACHIEVE THE REQUIRED UBV, IMMEDIATELY NOTIFY THE ENGINEER SO THAT THE ENGINEER CAN NOTIFY THE DISTRICT GEOTECHNICAL ENGINEER, THE OFFICE OF CONSTRUCTION ADMINISTRATION, AND THE OFFICE OF GEOTECHNICAL ENGINEERING.

THE ENGINEER WILL REVIEW THE TEST RESULTS AND ESTABLISH ADDITIONAL RESTRIKE TESTING OR DRIVING CRITERIA FOR THE PILING IN THE SUBSTRUCTURE WITH THE ASSISTANCE OF THE DISTRICT GEOTECHNICAL ENGINEER, THE OFFICE OF CONSTRUCTION ADMINISTRATION, AND THE OFFICE OF GEOTECHNICAL ENGINEERING.

IF DIRECTED BY THE ENGINEER, PERFORM ADDITIONAL RESTRIKE TESTING OR DRIVE ALL PILES IN THE SUBSTRUCTURE TO THE ESTABLISHED DRIVING CRITERIA. THE DEPARTMENT WILL PAY FOR SPLICING OF THE PILES BEYOND THE ESTIMATED LENGTH PROVIDED IN THE PLANS UNDER C&MS 109.05 WITH A NEGOTIATED PRICE PER SPLICE.

THIS PLAN NOTE INCLUDES A QUANTITY OF ONE EACH ITEM 523 DYNAMIC LOAD TESTING, AS PER PLAN AND A QUANTITY OF ONE EACH ITEM 523 RESTRIKE, AS PER PLAN PER EACH SUBSTRUCTURE UNIT.

A SNAPSHOT OF ODNR BEDROCK TOPOGRAPHY OF THE ROUNDHEAD, OHIO, QUADRANGLE MAP AT THE PROJECT SITE



CONE PENETRATION TEST SOUNDINGS REPORT

Office of Geotechnical Engineering
Division of Engineering

Project: LOG-273-00.02
PID: 114937
Date: December 19, 2022
Number of Soundings: 2
Equipment: A.P. van den Berg, 23 Ton Crawler, Hyson 200kN

Sounding ID	Completion Date	Probe SN	Calibration Date	Elevation (ft.)	Latitude	Longitude	Station Offset	Pre-drilled	Depth (ft.)
C-001-1-22	11/16/2022	090304	8/19/2020	1003.1	40.504780	-83.854692	22+55 7' Rt.	25 ft.	97.69
C-002-1-22	11/16/2022	160701	1/29/2019	1003.32	40.504958	-83.854654	23+19 8' Lt.	25 ft.	92.33

Project Information

All soundings were completed within the road through pre-drilled holes that were back filled with bentonite grout. The static water levels reported on the attached logs were determined by pore pressure response from dissipation tests. The latitude, longitude, and elevation values are from survey grade instruments.

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.

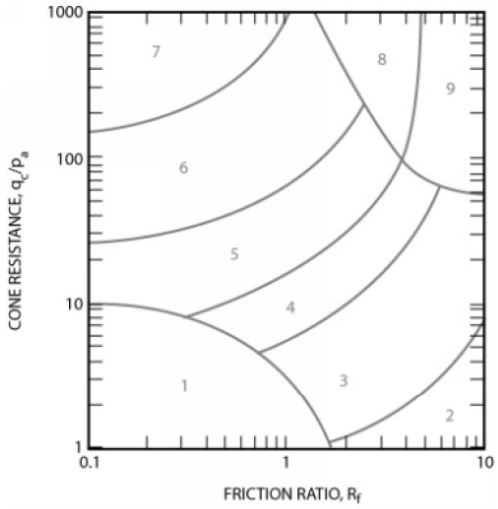
Cone Penetration Test Data and Interpretation

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.

Date: December 19, 2022
Subject: LOG-273-00.02, PID 114937

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.

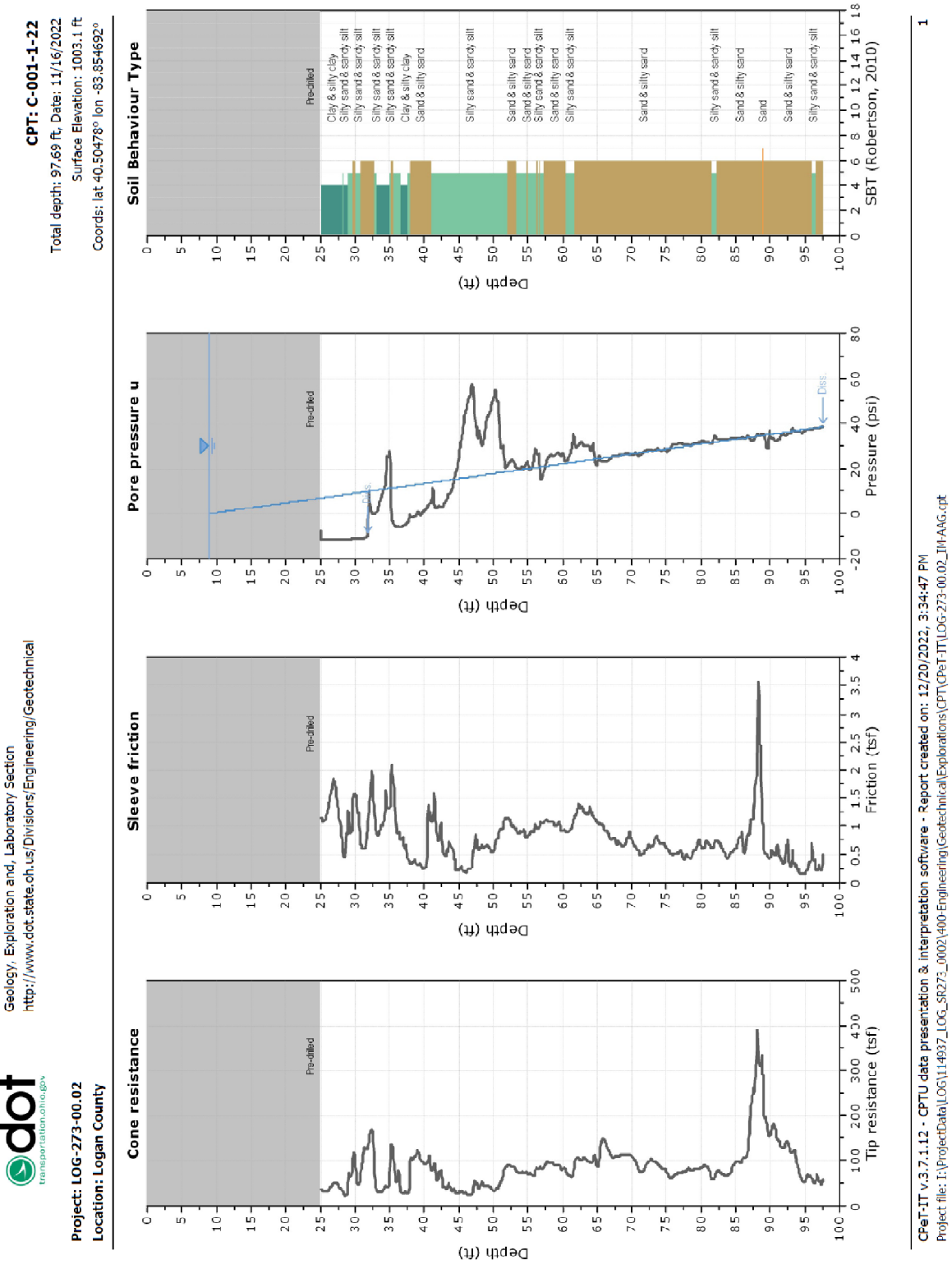


Zone	*Soil Behavior Type*
1	*Sensitive, fine grained*
2	*Organic soils - clay*
3	*Clay – silty clay to clay*
4	*Silt mixtures – clayey silt to silty clay*
5	*Sand mixtures – silty sand to sandy silt*
6	*Sands – clean sand to silty sand*
7	*Gravelly sand to dense sand*
8	*Very stiff sand to clayey sand**
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-001-1-22
Total depth: 97.69 ft, Date: 11/16/2022
Surface Elevation: 1003.1 ft
Coords: lat 40.50478° lon -83.854692°
Project: LOG-273-00.02
Location: Logan County
Cone resistance
Tip resistance (tsf)
Sleeve friction
Friction (tsf)
Pore pressure u
Pressure (psi)
Soil Behaviour Type
SBT (Robertson, 2010)
Depth (ft)
Pre-drilled
Clay & silty clay
Silty sand & sandy silt
Sand & silty sand
Sand
CPeT-IT v.3.7.1.12 - CPTU data presentation & interpretation software - Report created on: 12/20/2022, 3:34:47 PM
Project file: I:\ProjectData\LOG\114937_LOG_SR273_0002\400-Engineering\Geotechnical\Explorations\CPT\CPeT-IT\LOG-273-00.02_IM-AAG.cpt
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Office of Geotechnical Engineering
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Project: **LOG-273-00.02**
Location: **Logan 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

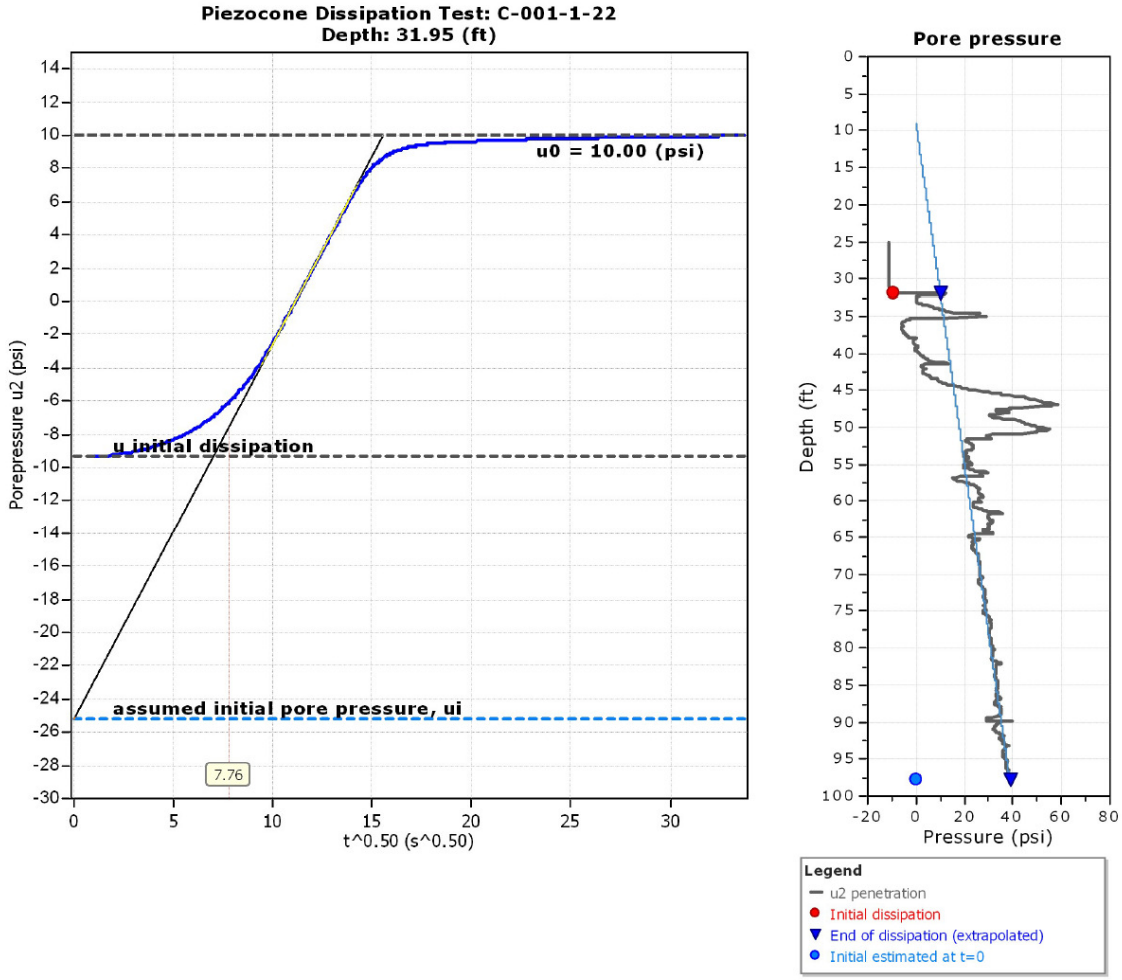
The dissipation of pore pressures during a CPTu dissipation test is controlled by the coefficient of consolidation in the horizontal direction (c_h) which is influenced by a combination of the soil permeability (k_h) and compressibility (M), as defined by the following:

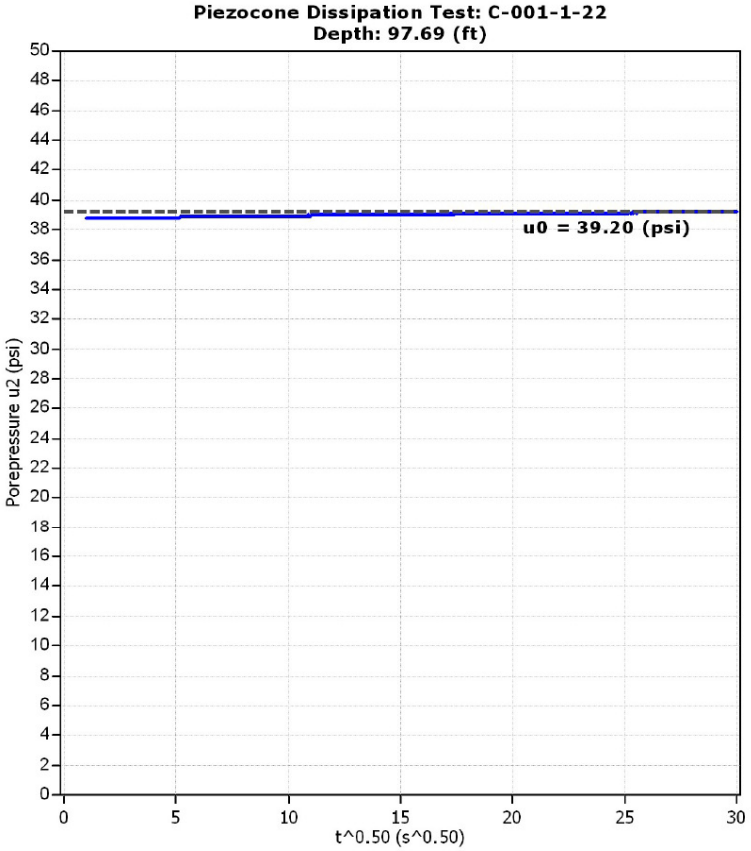
$$k_h = c_h \times \gamma_w / M$$

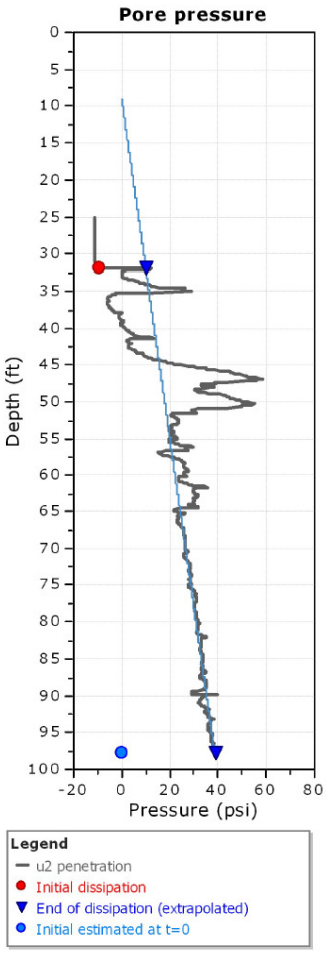
where: M is the 1-D constrained modulus and γ_w is the unit weight of water, in compatible units.

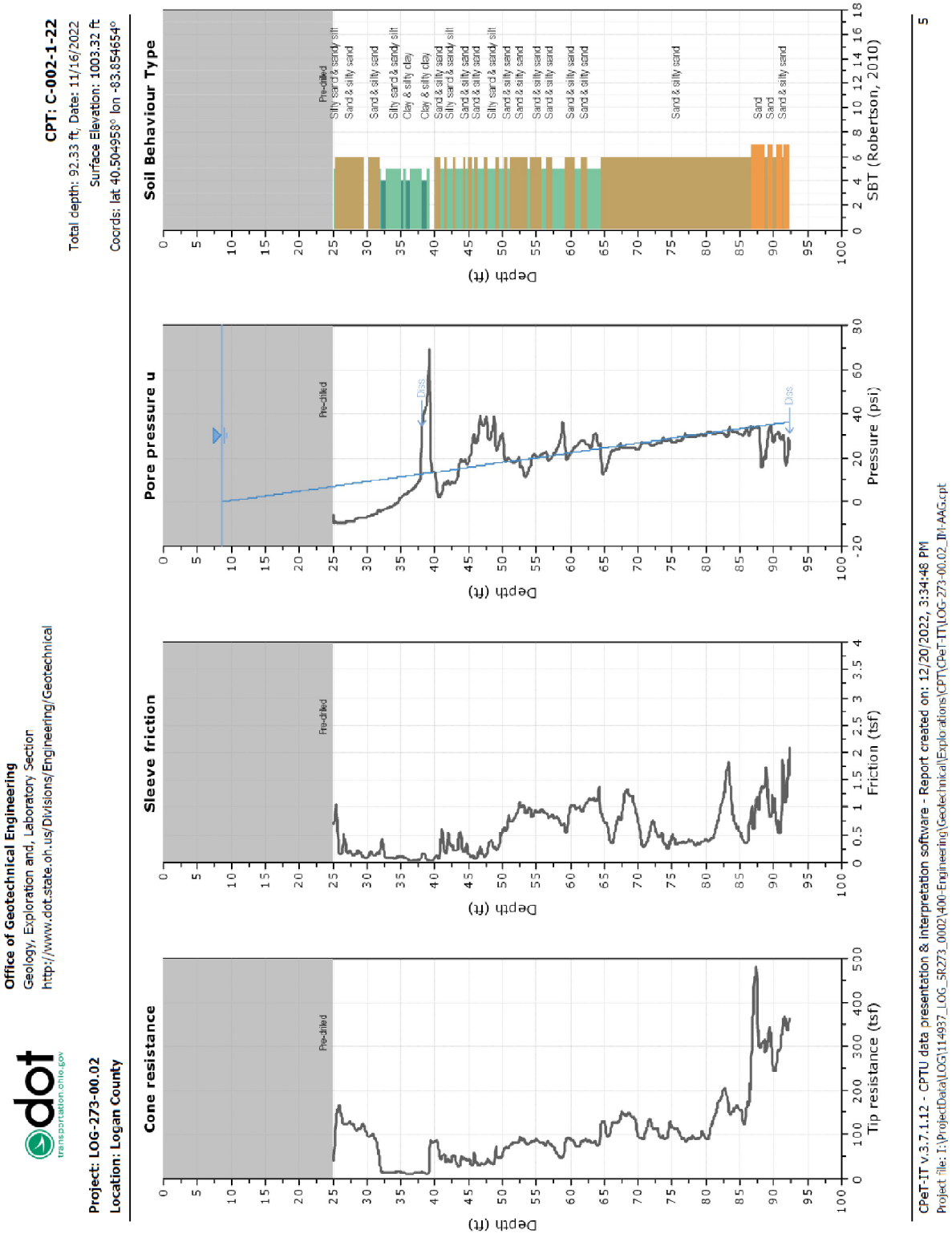
Tabular results

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-001-1-22	31.95	7.8	60	1.91E-006	100.00	2.09E-004	6596	1106.81	5.90E-009
C-001-1-22	97.69	0.0	0	0.00E+000	100.00	0.00E+000	0	719.22	-1.00E+004


Piezocone Dissipation Test: C-001-1-22
Depth: 31.95 (ft)
u0 = 10.00 (psi)
u initial dissipation
assumed initial pore pressure, ui
7.76
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


Piezocone Dissipation Test: C-001-1-22
Depth: 97.69 (ft)
u0 = 39.20 (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


CPT: C-002-1-22
Total depth: 92.33 ft, Date: 11/16/2022
Surface Elevation: 1003.32 ft
Coords: lat 40.504958° lon -83.854654°
Office of Geotechnical Engineering
Geology, Exploration and, Laboratory Section
http://www.dot.state.oh.us/Divisions/Engineering/Geotechnical
Project: LOG-273-00.02
Location: Logan County
Cone resistance
Sleeve friction
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Soil Behaviour Type
Pre-drilled
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Tip resistance (tsf)
Friction (tsf)
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Silty sand & sandy silt
Sand & silty sand
Clay & silty clay
Sand
CPeT-IT v.3.7.1.12 - CPTU data presentation & interpretation software - Report created on: 12/20/2022, 3:34:48 PM
Project file: I:\ProjectData\LOG\114937_LOG_SR273_0002\400-Engineering\Geotechnical\Explorations\CPT\CPeT-IT\LOG-273-00.02_IM-AAG.cpt
5

Office of Geotechnical Engineering
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http://www.dot.state.oh.us/Divisions/Engineering/Geotechnical

CPT: C-002-1-22
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Project: LOG-273-00.02
Location: Logan County

Dissipation Tests Results

Dissipation tests

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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:

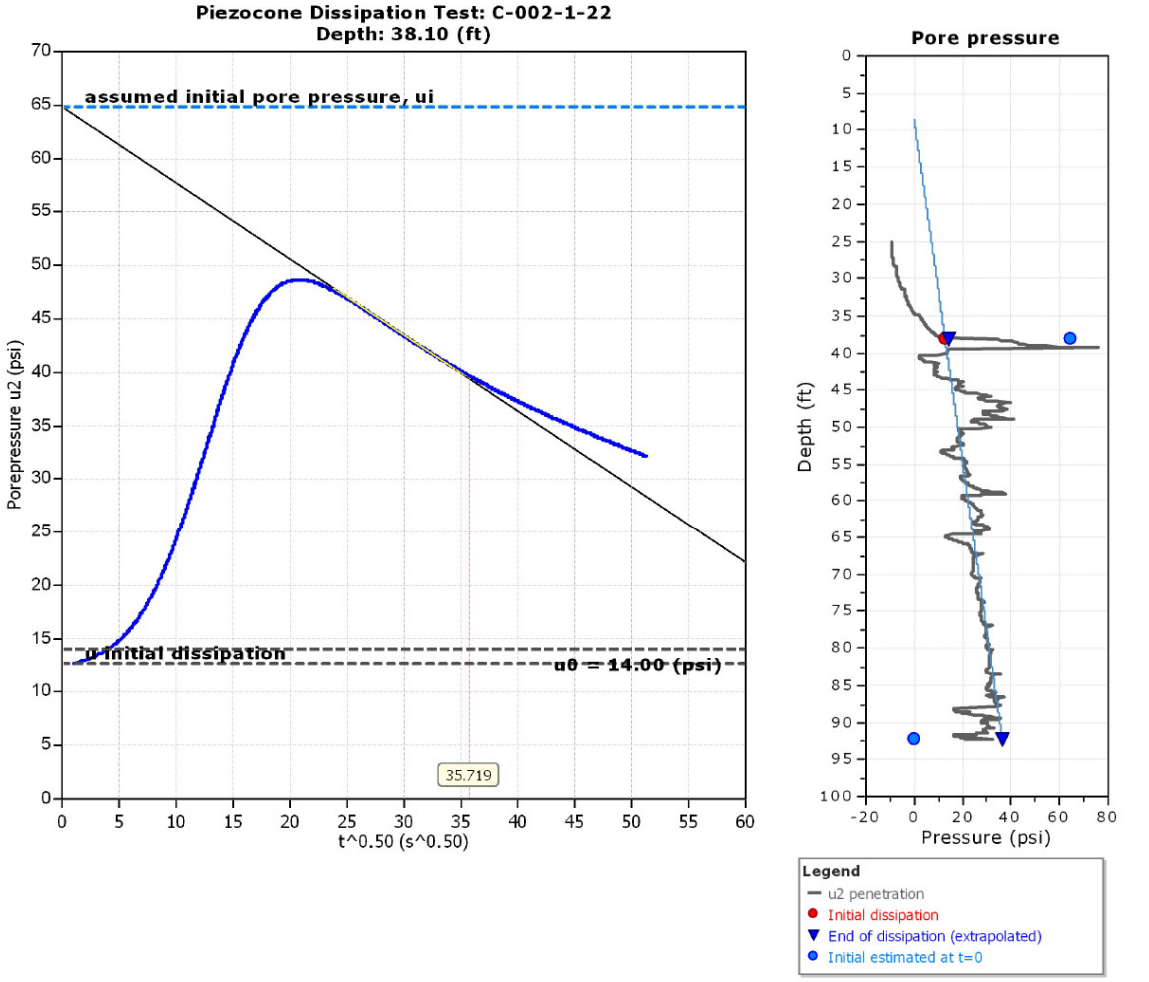
$$k_h = c_h \times \gamma_w / M$$

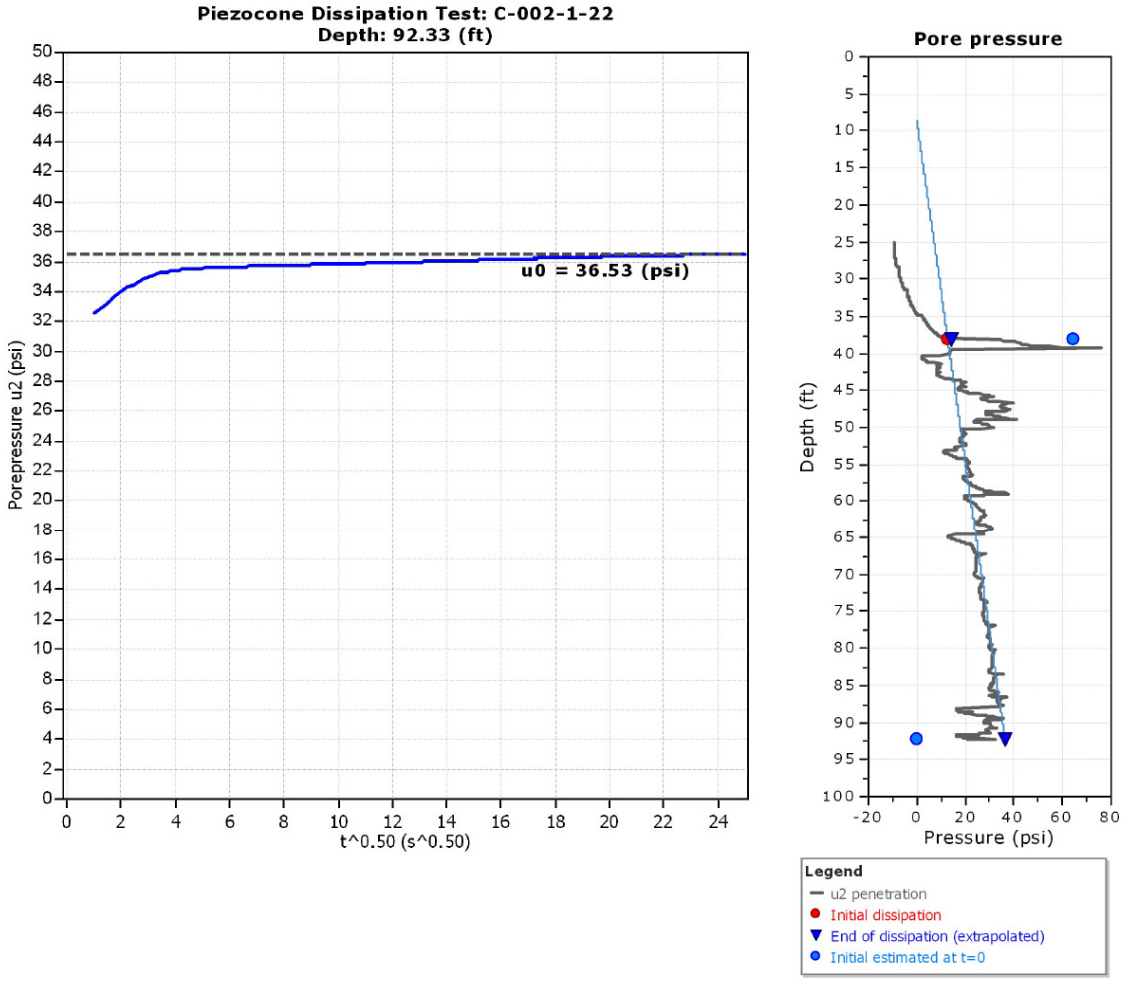
where: M is the 1-D constrained modulus and γ_w is the unit weight of water, in compatible units.

Tabular results

CPTU Borehole	Depth (ft)	$(t_{50})^{0.50}$	t_{50} (s)	t_{50} (years)	G/S_u	c_h (ft²/s)	c_h (ft²/year)	M (tsf)	k_h (ft/s)
C-002-1-22	38.10	35.7	1276	4.05E-005	100.00	9.87E-006	311	198.93	1.55E-009
C-002-1-22	92.33	0.0	0	0.00E+000	100.00	0.00E+000	0	2135.44	-1.00E+004

 CPT name: C-002-1-22




Piezocone Dissipation Test: C-002-1-22
Depth: 92.33 (ft)
u0 = 36.53 (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

PROJECT: LOG-273-0.02 | DRILLING FIRM / OPERATOR: ODOT / MCINTOSH | DRILL RIG: CME 75 TRUCK | STATION / OFFSET: 22+63, 7' RT. | EXPLORATION ID B-001-0-22
TYPE: BRIDGE | SAMPLING FIRM / LOGGER: ODOT / LEWIS | HAMMER: CME AUTOMATIC | ALIGNMENT: CL SR 273
PID: 114937 SFN: 4602315 | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 4/18/22 | ELEVATION: 1003.0 (ft) EOB: 112.5 ft. | PAGE 1 OF 2
START: 11/1/22 END: 11/3/22 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 90* | LAT / LONG: 40.504795, -83.854682

MATERIAL DESCRIPTION AND NOTES	ELEV. 1003.0	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
ASPHALT (8")	1002.4																	
VERY STIFF, BROWN AND GRAY, **SANDY SILT**, SOME CLAY, SOME GRAVEL AND STONE FRAGMENTS, INCLUDING COBBLES, MOIST			6 4 7	17	50	SS-1	2.00	23	8	12	31	26	26	17	9	17	A-4a (4)	
@3.0'; MEDIUM STIFF, POOR RECOVERY, NOT ENOUGH MATERIAL TO TEST, DAMP	998.5		4 2 3	8	17	SS-2	-	-	-	-	-	-	-	-	-	8	A-4a (V)	
STIFF, BROWN AND GRAY, **SILTY CLAY**, SOME SAND, LITTLE GRAVEL AND STONE FRAGMENTS, INCLUDING COBBLES, DAMP			3 2 3	8	22	SS-3	1.50	-	-	-	-	-	-	-	-	12	A-6b (V)	
@4.5' - 6.0'; POOR RECOVERY, NOT ENOUGH MATERIAL TO TEST			3 3 5	12	28	SS-4	1.50	20	11	13	20	36	37	16	21	14	A-6b (9)	
	994.5																	
MEDIUM STIFF, DARK GRAY AND BLACK, **SILTY CLAY**, SOME SAND, TRACE GRAVEL AND STONE FRAGMENTS, MODERATELY ORGANIC (LOI = 7.9%) WITH ROOTS, WET			3 2 3	8	78	SS-5	1.00	4	6	19	29	42	40	24	16	44	A-6b (10)	
	992.0																	
VERY STIFF, MOTTLED BROWN AND GRAY, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL AND STONE FRAGMENTS, MOIST			4 5 9	21	78	SS-6	3.50	9	5	9	24	53	37	17	20	18	A-6b (12)	
@13.5'; HARD			8 18 15	50	89	SS-7	4.5+	-	-	-	-	-	-	-	-	16	A-6b (V)	
	987.0																	
DENSE, BROWN, **SANDY SILT**, TRACE CLAY, MOIST			10 10 12	33	72	SS-8	-	0	0	44	49	7	NP	NP	NP	22	A-4a (4)	
@18.5'; GRAY			9 14 15	44	67	SS-9	-	-	-	-	-	-	-	-	-	20	A-4a (V)	
	979.5	W 980.4																
HARD, GRAY, **SILT AND CLAY**, TRACE SAND, MOIST			10 11 14	38	89	SS-10	4.5+	0	1	1	51	47	29	17	12	17	A-6a (9)	
@28.5'; VERY STIFF	973.5		6 7 9	24	89	SS-11A	2.00	-	-	-	-	-	-	-	-	21	A-6a (V)	
						SS-11B	2.00	0	11	52	13	24	15	11	4	17	A-4a (0)	
VERY STIFF, GRAY, **SANDY SILT**, SOME CLAY, WET	969.5																	
VERY STIFF, GRAY, **SILT**, SOME CLAY, TRACE SAND, MOIST			6 5 9	21	56	SS-12	3.50	0	0	4	64	32	21	15	6	18	A-4b (8)	
@33.5'; 3.0' OF HEAVING SAND ENCOUNTERED	964.5																	
LOOSE, GRAY, **COARSE AND FINE SAND**, LITTLE SILT, TRACE GRAVEL, TRACE CLAY, WET			2 2 4	9	11	SS-13	-	8	27	51	10	4	NP	NP	NP	21	A-3a (0)	
@38.5'; 7.0' OF HEAVING SAND ENCOUNTERED	959.5																	
MEDIUM DENSE, GRAY, **SILT**, LITTLE CLAY, TRACE SAND, TRACE GRAVEL, WET			3 4 4	12	67	SS-14	-	2	1	2	77	18	NP	NP	NP	27	A-4b (8)	
@48.5'; LOOSE			1 2 3	8	72	SS-15	-	-	-	-	-	-	-	-	-	24	A-4b (V)	
			0 2 3	8	78	SS-16	-	-	-	-	-	-	-	-	-	25	A-4b (V)	
@58.5'; LITTLE SAND, TRACE CLAY			0 1 3	6	67	SS-17	-	0	1	13	78	8	NP	NP	NP	24	A-4b (8)	

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT.GDT - 1/3/23 14:13 - X:\GINT\PROJECTS\601014.GPJ

PID: 114937 | SFN: 4602315 | PROJECT: LOG-273-0.02 | STATION / OFFSET: 22+63, 7' RT. | START: 11/1/22 | END: 11/3/22 | PG 2 OF 2 | B-001-0-22

MATERIAL DESCRIPTION AND NOTES	ELEV. 943.0	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
MEDIUM DENSE, GRAY, **SILT**, LITTLE CLAY, TRACE SAND, TRACE GRAVEL, WET *(continued)*		61																
		62																
		63																
@63.5'; MEDIUM DENSE		64	4 6 5	17	78	SS-18	-	-	-	-	-	-	-	-	-	24	A-4b (V)	
		65																
		66																
		67																
		68																
	934.5																	
MEDIUM DENSE, GRAY, **COARSE AND FINE SAND**, LITTLE SILT, TRACE CLAY, WET		69	4 5 7	18	67	SS-19	-	0	1	77	20	2	NP	NP	NP	22	A-3a (0)	
		70																
		71																
		72																
		73																
		74	2 4 6	15	67	SS-20	-	-	-	-	-	-	-	-	-	22	A-3a (V)	
		75																
		76																
		77																
		78																
@83.5'; 4.0' OF HEAVING SAND ENCOUNTERED		79	3 5 6	17	78	SS-21	-	-	-	-	-	-	-	-	-	21	A-3a (V)	
		80																
		81																
		82																
		83																
		84	3 4 7	17	33	SS-22	-	-	-	-	-	-	-	-	-	23	A-3a (V)	
		85																
		86																
		87																
		88																
@88.5'; DENSE, TRACE GRAVEL, 2.8' OF HEAVING SAND ENCOUNTERED		89	5 12 17	44	67	SS-23	-	8	18	62	11	1	NP	NP	NP	18	A-3a (0)	
		90																
		91																
		92																
		93																
	909.5																	
DENSE, GRAY, **GRAVEL**, "AND" SAND, TRACE SILT, TRACE CLAY, WET		94	8 9 14	35	33	SS-24	-	53	24	17	5	1	NP	NP	NP	11	A-1-a (0)	
@93.5'; 3.8' OF HEAVING SAND ENCOUNTERED		95																
		96																
		97																
		98																
	904.5																	
MEDIUM DENSE, GRAY, **GRAVEL WITH SAND**, TRACE SILT, WET		99	13 9 10	29	72	SS-25	-	24	53	19	4	0	NP	NP	NP	16	A-1-b (0)	
@98.5'; 6.8' OF HEAVING SAND ENCOUNTERED		100																
		101																
		102																
		103																
@103.5'; VERY DENSE, 5.4' OF HEAVING SAND ENCOUNTERED		104	14 18 25	65	44	SS-26	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	
		105																
		106																
		107																
		108																
@108.5'; TRACE CLAY, 5.8' OF HEAVING SAND ENCOUNTERED		109	14 18 22	60	72	SS-27	-	13	48	34	2	3	NP	NP	NP	14	A-1-b (0)	
		110																
		111																
@111.0'; DENSE, 3.2' OF HEAVING SAND ENCOUNTERED		112	11 13 17	45	67	SS-28	-	-	-	-	-	-	-	-	-	16	A-1-b (V)	
	890.5	EOB																

NOTES: LAT/LONG/ELEV FROM DISTRICT SURVEY GRADE INSTRUMENTS.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: TREMIED 50 LB. BENTONITE GROUT; 188 LB. CEMENT; 60 GAL. WATER

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT.GDT - 1/3/23 14:13 - X:\GINT\PROJECTS\601014.GPJ

PROJECT: LOG-273-0.02	DRILLING FIRM / OPERATOR: ODOT / MCINTOSH	DRILL RIG: CME 75 TRUCK	STATION / OFFSET: 23+12, 6' LT.
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: ODOT / LEWIS	HAMMER: CME AUTOMATIC	ALIGNMENT: CL SR 273
PID: 114937 SFN: 4602315	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 4/18/22	ELEVATION: 1003.3 (ft) EOB: 112.5 ft.
START: 11/7/22 END: 11/9/22	SAMPLING METHOD: SPT	ENERGY RATIO (%): 90*	LAT / LONG: 40.504930, -83.854660

EXPLORATION ID B-002-0-22 | PAGE 1 OF 2

MATERIAL DESCRIPTION AND NOTES	ELEV. 1003.3	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
ASPHALT (6")	1002.8																	
HARD, BROWN AND GRAY, **SILT AND CLAY**, SOME STONE FRAGMENTS, LITTLE SAND, CONTAINS ASPHALT GRINDINGS AND COBBLES, DAMP	1000.3		14 9 5	21	33	SS-1	4.50	-	-	-	-	-	-	-	-	9	A-6a (V)	
VERY STIFF, BROWN AND GRAY, **SILT AND CLAY**, SOME SAND, LITTLE STONE FRAGMENTS, INCLUDING COBBLES, DAMP			3 4 3	11	28	SS-2	2.50	17	15	19	22	27	28	17	11	13	A-6a (3)	
			4 4 3	11	44	SS-3	3.00	20	12	16	21	31	29	17	12	15	A-6a (4)	
@6.0'; STIFF	994.8		6 3 5	12	39	SS-4	1.50	-	-	-	-	-	-	-	-	14	A-6a (V)	
STIFF, GRAYISH BROWN, **CLAY**, SOME SAND, SOME SILT, TRACE STONE FRAGMENTS, MOIST	992.3		2 3 4	11	50	SS-5	2.00	6	7	14	20	53	42	19	23	22	A-7-6 (13)	
HARD, BROWN MOTTLED WITH LIGHT GRAY, **SILTY CLAY**, LITTLE SAND, LITTLE STONE FRAGMENTS, DAMP	987.3		6 8 12	30	100	SS-6	4.5+	10	5	8	25	52	38	19	19	19	A-6b (12)	
			6 13 18	47	100	SS-7	4.5+	-	-	-	-	-	-	-	-	17	A-6b (V)	
VERY STIFF, MOTTLED BROWN AND GRAY, **SILT**, SOME CLAY, LITTLE SAND, TRACE STONE FRAGMENTS, MOIST	984.8		12 19 22	62	100	SS-8	3.50	6	2	16	55	21	20	15	5	18	A-4b (8)	
STIFF, GRAY, **SILT**, TRACE CLAY, TRACE SAND, DAMP			7 13 15	42	72	SS-9	1.50	0	0	2	88	10	21	18	3	18	A-4b (8)	
@23.5'; VERY STIFF	974.8	W 980.5	6 12 11	35	94	SS-10	3.00	-	-	-	-	-	-	-	-	17	A-4b (V)	
VERY LOOSE, GRAY, **STONE FRAGMENTS WITH SAND**, TRACE SILT, TRACE CLAY, WET	969.8		1 1 1	3	56	SS-11	-	2	50	41	5	2	NP	NP	NP	25	A-1-b (0)	
STIFF, GRAY, **SILT**, SOME CLAY, LITTLE SAND, WET @33.5'; 2.7' OF HEAVING SAND ENCOUNTERED	964.8		4 3 4	11	61	SS-12	2.00	0	1	17	60	22	17	14	3	23	A-4b (8)	
STIFF, GRAY, **SILT AND CLAY**, TRACE SAND, MOIST	959.8		1 3 7	15	56	SS-13	1.50	0	2	5	35	58	31	17	14	27	A-6a (10)	
STIFF, GRAY, **SILT**, SOME CLAY, TRACE SAND, WET @43.5'; 3.2' OF HEAVING SAND ENCOUNTERED	954.8		4 3 4	11	67	SS-14	1.00	0	1	0	77	22	23	18	5	26	A-4b (8)	
VERY LOOSE, GRAY, **SILT**, LITTLE SAND, TRACE CLAY, WET @48.5'; 1.8' OF HEAVING SAND ENCOUNTERED			0 0 0	0	100	SS-15	-	-	-	-	-	-	-	-	-	25	A-4b (V)	
@53.5'; LOOSE			0 1 2	5	89	SS-16	-	0	2	12	81	5	NP	NP	NP	27	A-4b (8)	
			0 1 3	6	100	SS-17	-	-	-	-	-	-	-	-	-	25	A-4b (V)	

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT GDT - 1/3/23 14:13 - X:\GINT\PROJECTS\601014.GPJ

PID: 114937 | SFN: 4602315 | PROJECT: LOG-273-0.02 | STATION / OFFSET: 23+12, 6' LT. | START: 11/7/22 | END: 11/9/22 | PG 2 OF 2 | B-002-0-22

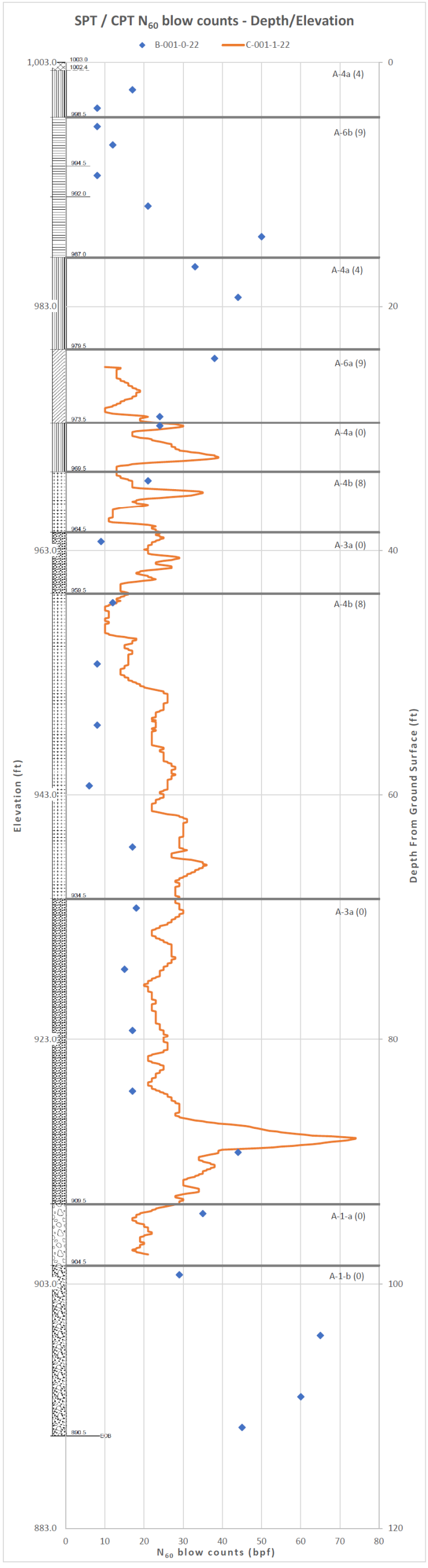
MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
VERY LOOSE, GRAY, **SILT**, LITTLE SAND, TRACE CLAY, WET *(continued)*	943.3	61–68																
		64	0 2 2	6	83	SS-18	-	-	-	-	-	-	-	-	-	25	A-4b (V)	
	934.8	68																
MEDIUM DENSE, GRAY, **COARSE AND FINE SAND**, LITTLE SILT, TRACE GRAVEL, TRACE CLAY, WET @68.5'; 2.8' OF HEAVING SAND ENCOUNTERED		69	2 4 5	14	61	SS-19	-	1	1	82	15	1	NP	NP	NP	24	A-3a (0)	
@73.5'; 2.3' OF HEAVING SAND ENCOUNTERED		74	3 4 6	15	44	SS-20	-	-	-	-	-	-	-	-	-	24	A-3a (V)	
	924.8	78																
LOOSE, GRAY, **FINE SAND**, TRACE SILT, TRACE CLAY, TRACE COARSE SAND, WET @78.5'; 3.8' OF HEAVING SAND ENCOUNTERED		79	2 2 3	8	67	SS-21	-	0	1	89	8	2	NP	NP	NP	24	A-3 (0)	
@83.5'; 6.7' OF HEAVING SAND ENCOUNTERED	R.S.	84	1 3 3	9	100	SS-22	-	-	-	-	-	-	-	-	-	23	A-3 (V)	
	914.8	89																
DENSE, GRAY, **STONE FRAGMENTS WITH SAND**, TRACE SILT, WET @88.5'; 7.0' OF HEAVING SAND ENCOUNTERED		89	5 9 13	33	83	SS-23	-	29	25	42	4	0	NP	NP	NP	16	A-1-b (0)	
	909.8	94																
VERY DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS**, SOME SAND, TRACE SILT, TRACE CLAY, WET		94	10 17 19	54	39	SS-24	-	63	22	9	5	1	NP	NP	NP	9	A-1-a (0)	
	904.8	99																
MEDIUM DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT, TRACE CLAY, WET @98.5'; 3.5' OF HEAVING SAND ENCOUNTERED		99	7 8 6	21	39	SS-25	-	35	51	8	5	1	NP	NP	NP	14	A-1-b (0)	
	899.8	104																
DENSE, GRAY, **FINE SAND**, "AND" COARSE SAND, LITTLE GRAVEL AND STONE FRAGMENTS, TRACE SILT, TRACE CLAY, WET @103.5'; 2.2' OF HEAVING SAND ENCOUNTERED		104	8 15 18	50	83	SS-26	-	10	38	47	4	1	NP	NP	NP	20	A-3 (0)	
@108.5'; VERY DENSE, LITTLE COARSE SAND, TRACE GRAVEL, 3.8' OF HEAVING SAND ENCOUNTERED	F.S.	109	13 14 23	56	78	SS-27	-	6	17	68	8	1	NP	NP	NP	23	A-3 (0)	
@111.0'; 2.3' OF HEAVING SAND ENCOUNTERED	890.8	112	18 22 20	63	61	SS-28	-	-	-	-	-	-	-	-	-	23	A-3 (V)	
		EOB																

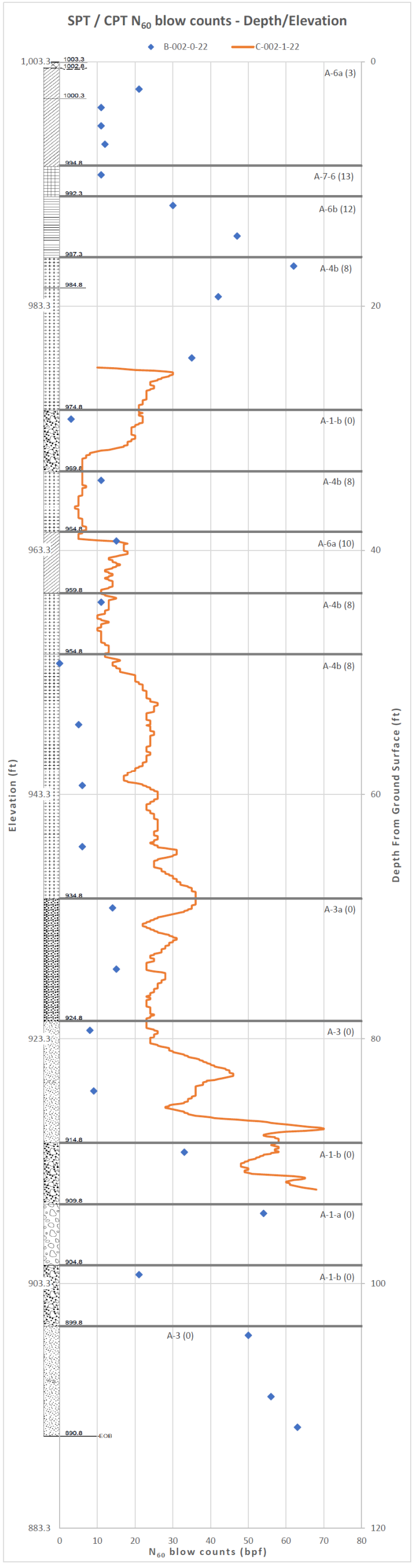
NOTES: LAT/LONG/ELEV FROM DISTRICT SURVEY GRADE INSTRUMENTS.

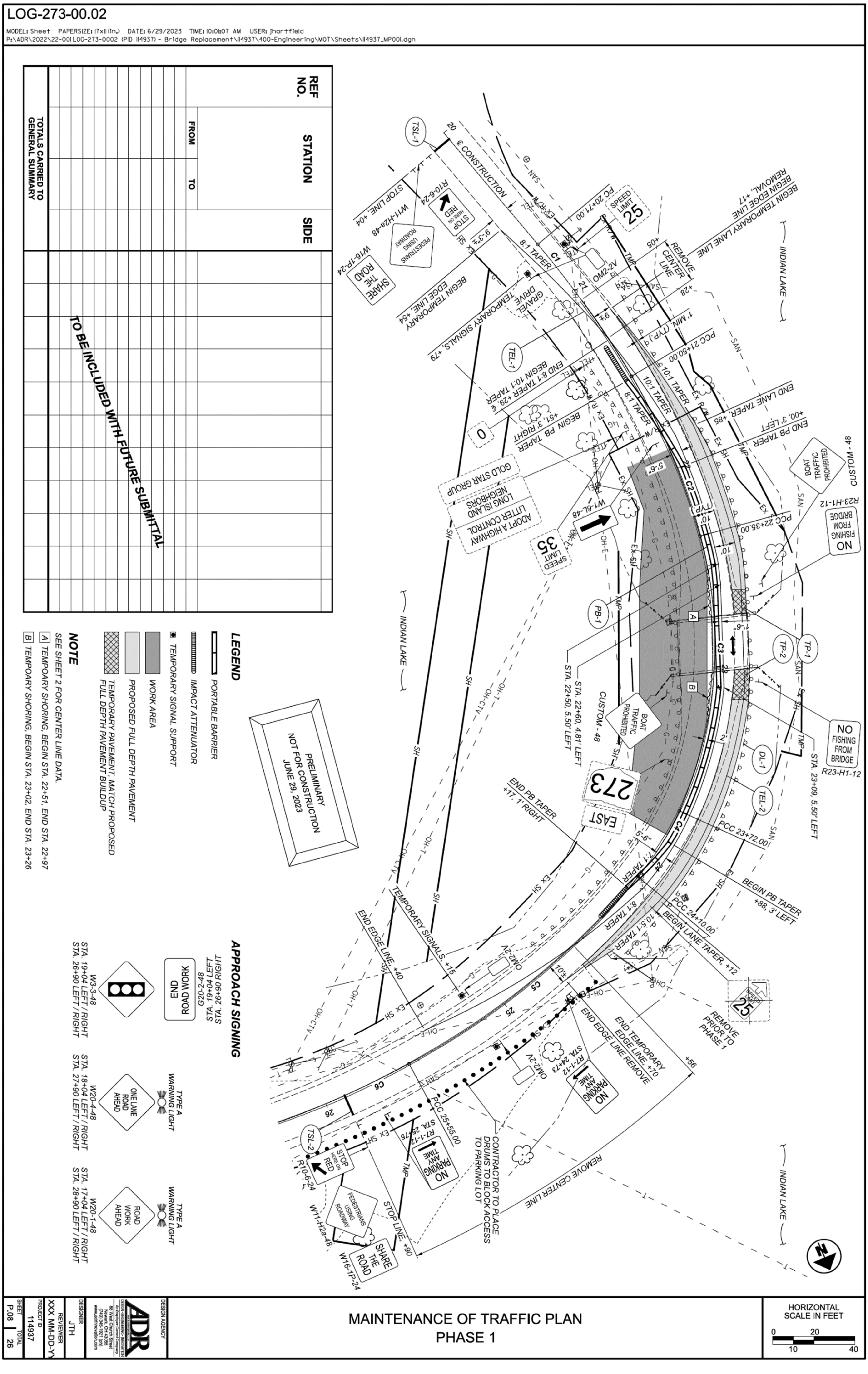
ABANDONMENT METHODS, MATERIALS, QUANTITIES: TREMIED 50 LB. BENTONITE GROUT; 188 LB. CEMENT; 60 GAL. WATER

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT.GDT - 1/3/23 14:13 - X:\GINT\PROJECTS\601014.GPJ

LOG-273-0.02 PID 114937 Foundation Design



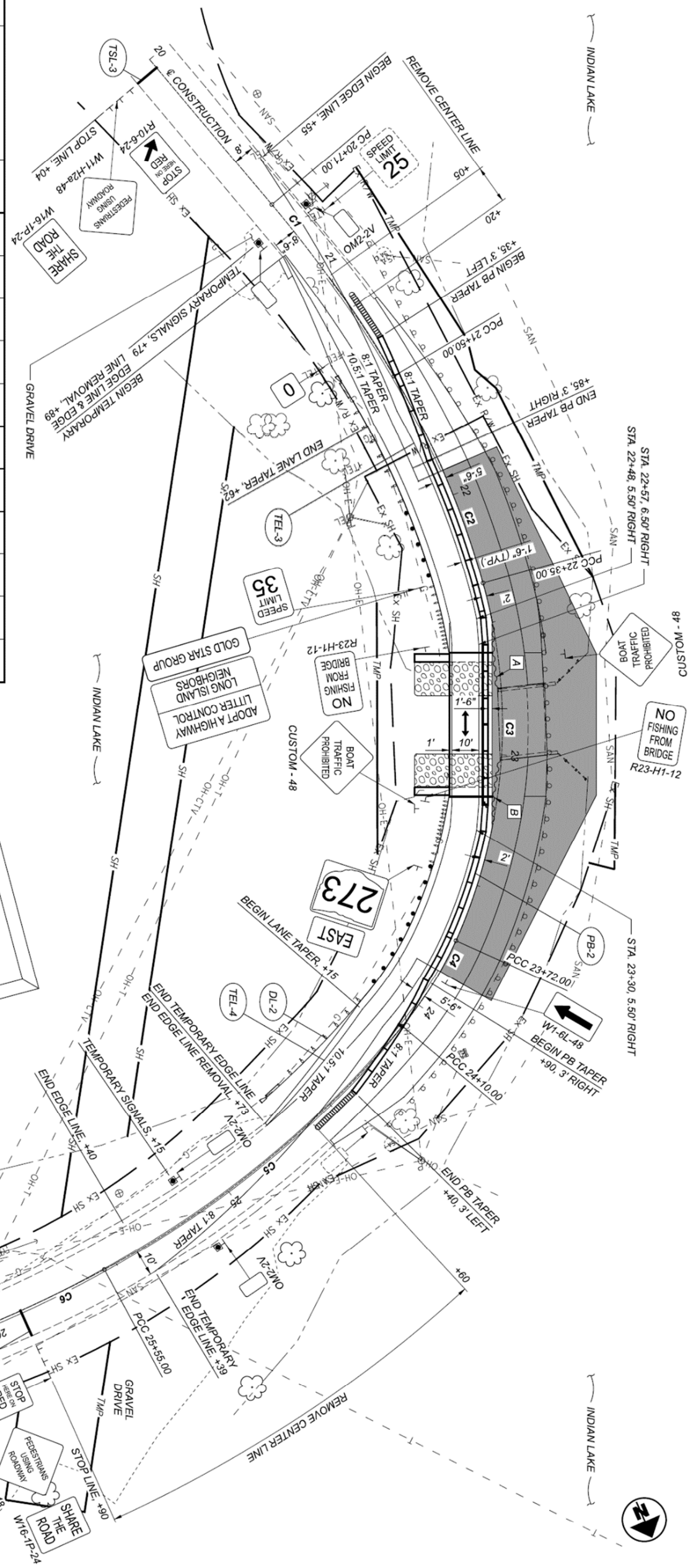



LOG-273-00.02
MAINTENANCE OF TRAFFIC PLAN
PHASE 1
LEGEND
PORTABLE BARRIER
IMPACT ATTENUATOR
TEMPORARY SIGNAL SUPPORT
WORK AREA
PROPOSED FULL DEPTH PAVEMENT
NOTE
APPROACH SIGNING
PRELIMINARY
NOT FOR CONSTRUCTION
JUNE 29, 2023
TO BE INCLUDED WITH FUTURE SUBMITTAL
INDIAN LAKE
HORIZONTAL SCALE IN FEET

LOG-273-00.02

MODEL: Sheet PAPERSIZE: 17x11 (in.) DATE: 6/29/2023 TIME: 10:01:32 AM USER: jhartfield
P:\ADR\2022\22-001 LOG-273-0002 (PID 114937) - Bridge Replacement\114937\400-Engineering\MOT\Sheets\114937_MP002.dgn

REF NO.	STATION FROM	STATION TO	SIDE
TOTALS CARRIED TO GENERAL SUMMARY			



PRELIMINARY
NOT FOR CONSTRUCTION
JUNE 29, 2023

LEGEND

- PORTABLE CONCRETE BARRIER
- IMPACT ATTENUATOR
- TEMPORARY SIGNAL SUPPORT
- WORK AREA

APPROACH SIGNING

END ROAD WORK G20-2-48	STA. 19+04 LEFT STA. 26+90 RIGHT		
W3-3-48	STA. 19+04 LEFT / RIGHT STA. 26+90 LEFT / RIGHT	TYPE A WARNING LIGHT	
W20-4-48 ONE LANE ROAD AHEAD	STA. 18+04 LEFT / RIGHT STA. 27+90 LEFT / RIGHT	TYPE A WARNING LIGHT	
W20-1-48 ROAD WORK AHEAD	STA. 17+04 LEFT / RIGHT STA. 28+90 LEFT / RIGHT	TYPE A WARNING LIGHT	

NOTE

SEE SHEET 2 FOR CENTER LINE DATA

A TEMPOARY SHORING, BEGIN STA. 22+51, END STA. 22+97

B TEMPOARY SHORING, BEGIN STA. 23+02, END STA. 23+26

MAINTENANCE OF TRAFFIC PLAN
PHASE 2

HORIZONTAL SCALE IN FEET
0 20
10 40

DESIGN AGENCY
ADR Architect, Engineer, Consultant
88 West Church Street
Newark, OH 43055
(740) 345-1927 (ph)
www.adrinnovation.com

DESIGNER JTH
REVIEWER XXX MM-DD-YY
PROJECT ID 114937
SHEET P.09 TOTAL 26

LOG-273-00.02

MODEL: Sheet PAPERSIZE: 17x11 (in.) DATE: 6/29/2023 TIME: 10:02:44 AM USER: jhartfield
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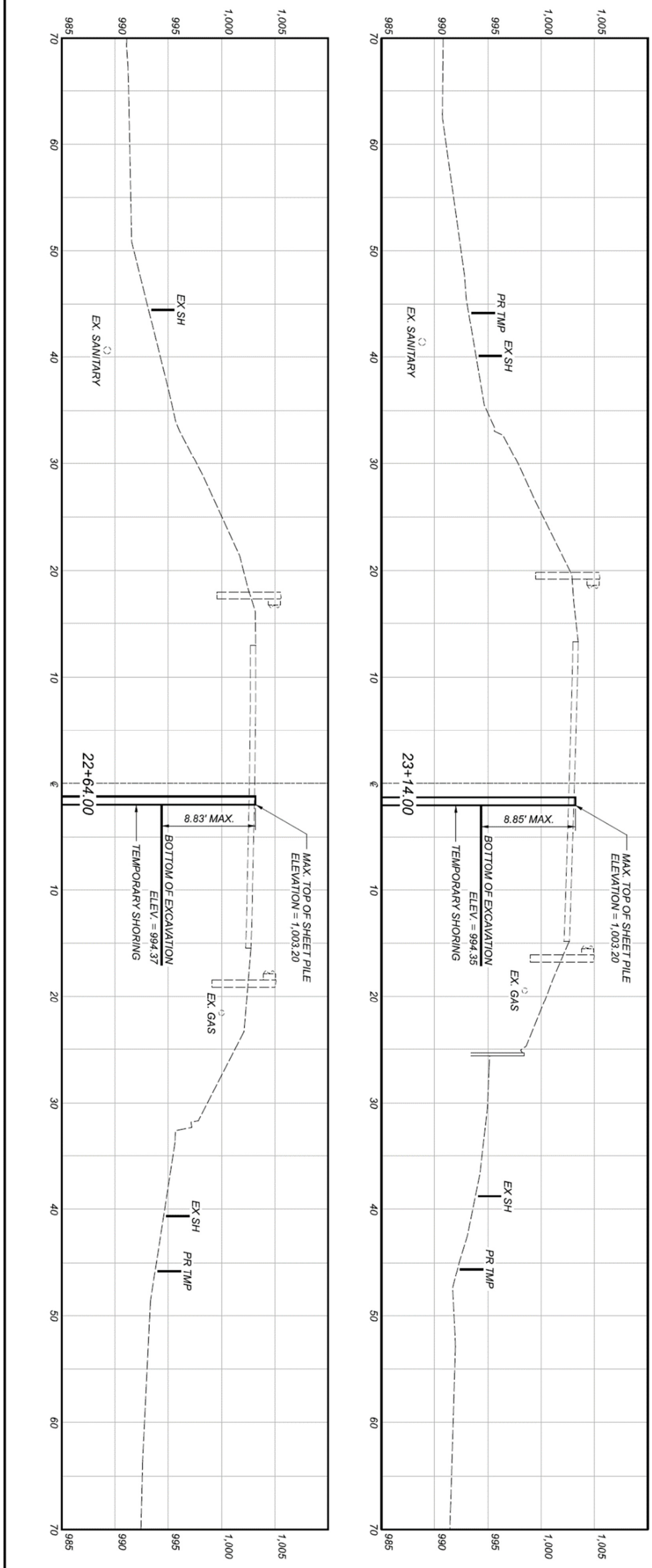
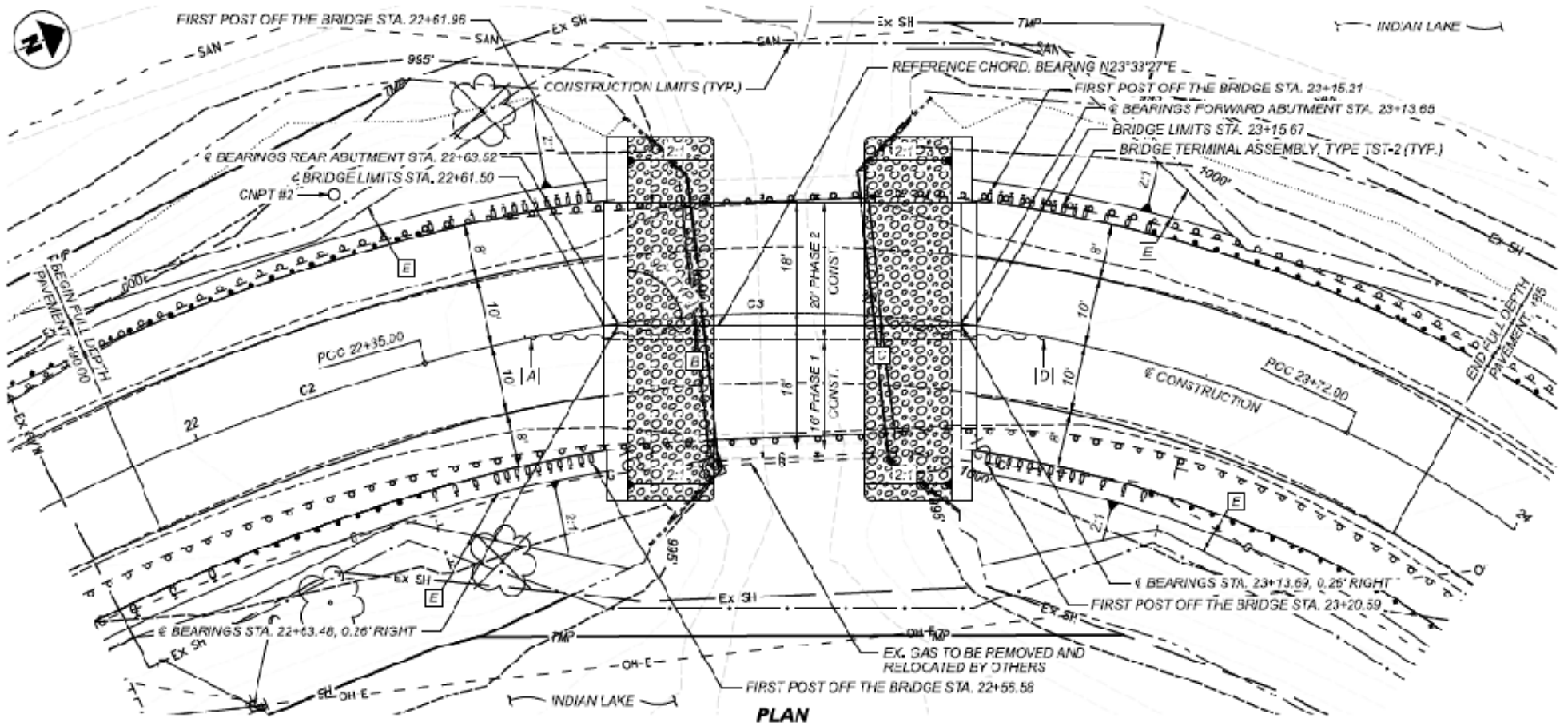


TEMPORARY SHORING
SECTIONS

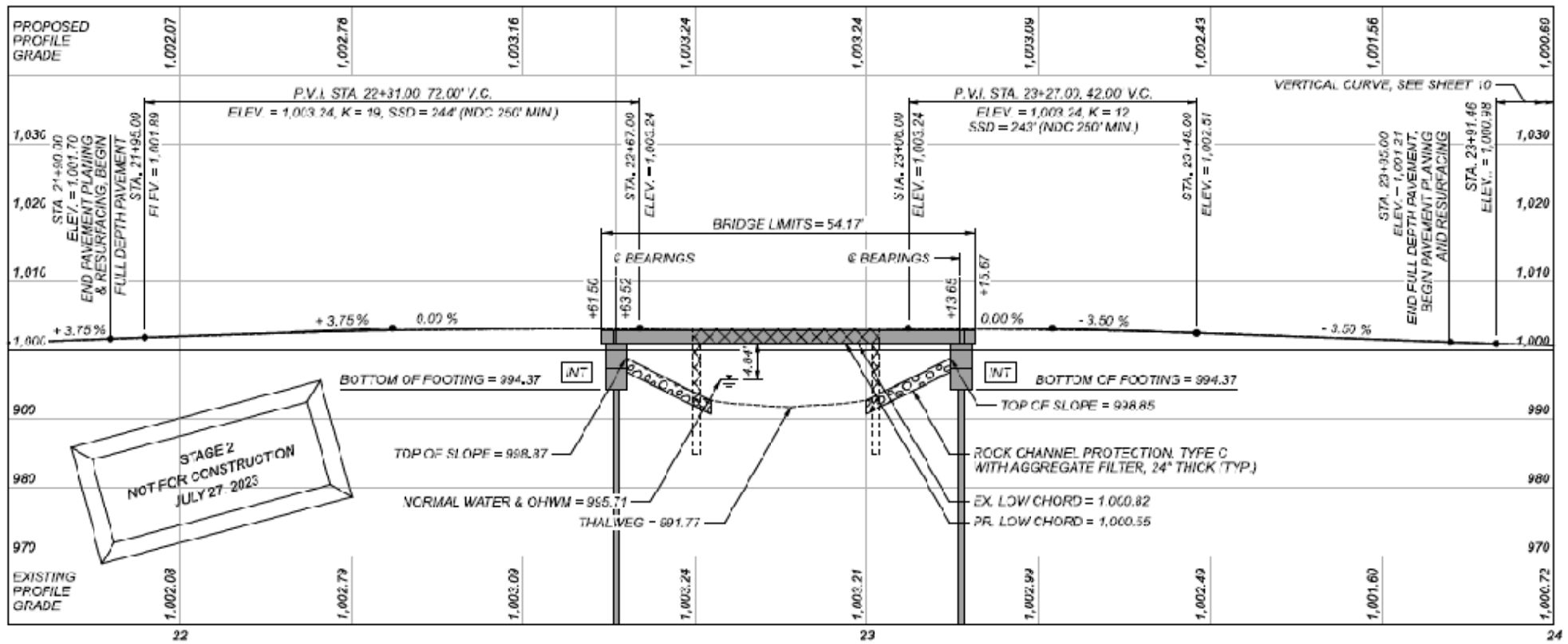
HORIZONTAL
SCALE IN FEET
0 5
2.5 10

DESIGN AGENCY
ADR
ADR ENGINEERING INNOVATION
89 West Church Street
Newark, OH 43055
(740) 345-1921 (ph)
www.adrinnovation.com

DESIGNER JTH
REVIEWER XXX MM-DD-YY
PROJECT ID 114937
SHEET 1 TOTAL 1



PLAN



PROFILE ALONG ℄ CONSTRUCTION

BENCHMARK DATA

CNPT #1	STA. 26+28.61,	ELEV. 997.35,	OFFSET 23.07' LEFT
CNPT #2	STA. 22+20.26,	ELEV. 1,001.45,	OFFSET 27.16' LEFT
CNPT #3	STA. 20+35.73,	ELEV. 977.37,	OFFSET 22.56' LEFT
CNPT #4	STA. 25+35.35,	ELEV. 997.15,	OFFSET 22.01' RIGHT

FOR ADDITIONAL BENCHMARK INFORMATION SEE ROADWAY PLAN SHEET P.02.

NOTES

EARTHWORK LIMITS SHOWN ARE APPROXIMATE. ACTUAL SLOPES SHALL CONFORM TO PLAN CROSS SECTIONS.

DESIGN TRAFFIC:
2020 ADT = 379 *2020 ADTT = 7*
2040 ADT = 379 *2043 ADTT = 7*

LEGEND

- ROCK CHANNEL PROTECTION PROTECTION. TYPE C WITH AGGREGATE FILTER, 24" THICK
- STRUCTURE REMOVAL
- A BEGIN TEMPORARY SHORING STA. 22+51, ℄
- B END TEMPORARY SHORING STA. 22+75, 1.35' RIGHT
- C BEGIN TEMPORARY SHORING STA. 23+02, 0.46' RIGHT
- D END TEMPORARY SHORING STA. 23+26, ℄
- E PROPOSED BREAK LINE

EXISTING STRUCTURE

TYPE: SIMPLE STEEL BEAM WITH ASPHALT FILLED CORRUGATED METAL DECK ON PILE SUBSTRUCTURE
SPANS: 24'-9"± F/F ABUTMENT
ROADWAY: 34-6"± F/F GUARDRAIL
LOADING: HS20-44
SKEW: 4°30'± RIGHT FORWARD
WEARING SURFACE: ASPHALT CONCRETE
APPROACH SLABS: NONE
ALIGNMENT: 40° CURVE RIGHT
CROWN: SUPERELEVATED
STRUCTURE FILE NUMBER: 4602315
DATE BUILT: 1978
DISPOSITION: TO BE REPLACED

PROPOSED STRUCTURE

TYPE: SINGLE SPAN PRESTRESSED NON-COMPOSITE BOX BEAM SUPERSTRUCTURE ON INTEGRAL CAPPED PILE ABUTMENTS.
SPANS: 50.00' C/C BEARINGS ALONG REFERENCE CHORD
ROADWAY: 36'-0" F/F RAIL
LOADING: HL93 AND 60 PSF FUTURE WEARING SURFACE
SKEW: NONE
WEARING SURFACE: 3" MINIMUM ASPHALT CONCRETE
APPROACH SLABS: NONE
ALIGNMENT: 39°50'43" CURVE RIGHT
CROWN: SUPERELEVATED 0.03 FT/FT
DECK AREA: 1,944 SQUARE FEET
STRUCTURE FILE NUMBER: YET TO BE ASSIGNED
COORDINATES: LATITUDE 40°30'17.20" NORTH
LONGITUDE 83°51'17.00" WEST

HORIZONTAL SCALE IN FEET 0 5 10 20

SITE PLAN
BRIDGE NO.: LOG-273-0002
OVER INDIAN LAKE

SFN 0
DESIGN AGENCY
ADR
DESIGNER JT-I CHECKER RSB
REVIEWER BCK 06-27-23
PROJECT ID 114937
SUBSET 1 TOTAL 11
SHEET P.19 TOTAL 29

LOG-273-00.02

MODEL: Sheet PAPERSIZE: 17x11 (B-) DATE: 7/27/2023 TIME: 1:35:27 PM USER: jtwirtel
P:\ADR\2023\03 LOG 273 0002 PID 114937\ 24\dgn Replace\sheet\114937x100 Engineering\Structures\SFN_0000000\sheet\114937_SFN_0000000_SP001.dgn

TEMPORARY SHORING STABILITY CALCULATION

Distributed Lateral Loads Calculation:

	Rear Approach (B-001-0-22)			
	At Ground Surface (0.0 ft)		At Design Grade (8.83 ft)	
	Unfactored	Factored	Unfactored	Factored
Horizontal Earth Pressure	0.0	0.0	353.16 lb/ft (29.43 lb/in)	529.75 lb/ft (44.15 lb/in)
Live Load Pressure	83.33 lb/ft (6.94 lb/in)	145.83 lb/ft (12.15 lb/in)	83.33 lb/ft (6.94 lb/in)	145.83 lb/ft (12.15 lb/in)
Total Pressure	83.33 lb/ft (6.94 lb/in)	145.83 lb/ft (12.15 lb/in)	436.49 lb/ft (36.37 lb/in)	675.58 lb/ft (56.3 lb/in)
	Forward Approach (B-002-0-22)			
	At Ground Surface (0.0 ft)		At Design Grade (8.85 ft)	
	Unfactored	Factored	Unfactored	Factored
Horizontal Earth Pressure	0.0	0.0	353.96 lb/ft (29.50 lb/in)	530.94 lb/ft (44.25 lb/in)
Live Load Pressure	83.33 lb/ft (6.94 lb/in)	145.83 lb/ft (12.15 lb/in)	83.33 lb/ft (6.94 lb/in)	145.83 lb/ft (12.15 lb/in)
Total Pressure	83.33 lb/ft (6.94 lb/in)	145.83 lb/ft (12.15 lb/in)	437.29 lb/ft (36.44 lb/in)	676.77 lb/ft (56.40 lb/in)

Where:

Rear Approach:

p_{EH} = lateral earth pressure (psf) = $k\ \gamma_s\ z$, 353.16 psf ..... (3.11.5.1-1)

$p_{EH,Factored}$ = $\Delta_p\ x\ \gamma_{EH}$ = 529.75 psf

h = maximum effective or "notional" retained height behind the wall (8.83 ft)

H = maximum face height of the wall (8.83 ft)

Forward Approach:

S = Pile Spacing (ft), 1.0 ft.

p_{EH} = lateral earth pressure (psf) = $k\ \gamma_s\ z$, 353.96 psf ..... (3.11.5.1-1)

$p_{EH,Factored}$ = $\Delta_p\ x\ \gamma_{EH}$ = 530.94 psf

h = maximum effective or "notional" retained height behind the wall (8.85 ft)

H = maximum face height of the wall (8.85 ft)

Rear and Forward Approaches:

S = Pile Spacing (ft), 1.0 ft.

γ_s = total unit weight of soil (pcf), 120 pcf

k = coefficient of lateral earth pressure, 0.3333

γ_{EH} = Active Horizontal Earth Pressure Load Factor, Strength I, 1.50..... (Table 3.4.1-2)

δ = friction angle between fill and wall (degrees) = 0 degrees for non-gravity cantilever walls.....BDM Section 307.1.1

β = angle of fill to the horizontal as shown in Figure 3.11.5.3-1 (degrees), 0.00 degrees (0H:1V slope of fill)

θ = angle of back face of wall to the horizontal as shown in Figure 3.11.5.3-1 (degrees), 90 degrees.

ϕ'_f = effective angle of internal friction (degrees), 30 degrees.

p_{LL} = Live load surcharge (psf), 83.33 psf

$p_{LL,Factored} = \Delta_p \; x \; \gamma_{LL}$ = 145.83 psf

p_{LL} = ($\Delta p = k*\gamma_s*h_{eq}$) h_{eq} = 2.0 ft ..... AASHTO Table 3.11.6.4-2 and BDM 307.1.1

γ_{LL} = Live Load Factor, Strength I, 1.75 ..... (Table 3.4.1-1)

Sheet Pile Section Analyzed:

Section	Section Nominal Width	Section Depth	Web Thickness	Flange Thickness	Per foot of Wall					
					Area (in^2)	Weight (lb)	Moment of Inertia (in^4)	Section Modulus(in^3)	D_w (in)	$D_w t_w$ (in^2)
PDA27	16	5	0.375	0.375	7.94	27.0	39.8	10.7	4.25	1.195

Section Modulus, S_x = 10.7 in^3

F_y = 50 ksi, φ_f = 0.90, For flexure resistance (AASHTO LRFD Table 11.5.7-1), φ_v = 1.00, For shear (AASHTO LRFD 6.5.4.2)

LPILE output Summary, Service I	**Rear Approach**	**Forward Approach**
Pile-head deflection	0.79265460 inches	0.69499705 inches
Computed slope at pile head	-0.0070137 radians	-0.0063536 radians
LPILE output Summary, Strength I	**Rear Approach**	**Forward Approach**
Maximum bending moment	202987. inch-lbs	194987. inch-lbs
Maximum shear force	7104. lbs	7337. lbs
Depth of maximum bending moment	10.80 feet below pile head	10.44 feet below pile head
Depth of maximum shear force	12.78 feet below pile head	12.06 feet below pile head

Strength I Checks - Rear Approach:

Maximum bending moment = 202987 inch-lbs = 202.987 inch-kip

Maximum shear force = 7104 lbs = 7.104 kip

S_x required = $\frac{M_{max}}{\varphi_f F_y} = \frac{202.987}{0.90 \; x \; 50}$ = 4.51 $in^3 < 10.7 \; in^3$ (Good)

$D_w t_w$ required = $\frac{V_{max}}{0.58 \; \varphi_v F_y} = \frac{7.104}{0.58 x 1.00 \; x \; 50}$ = 0.245 $in^2 \; < 1.195 \; in^2$ (Good)

Strength I Checks - Forward Abutment:

Maximum bending moment = 194987 inch-lbs = 194.987 inch-kip

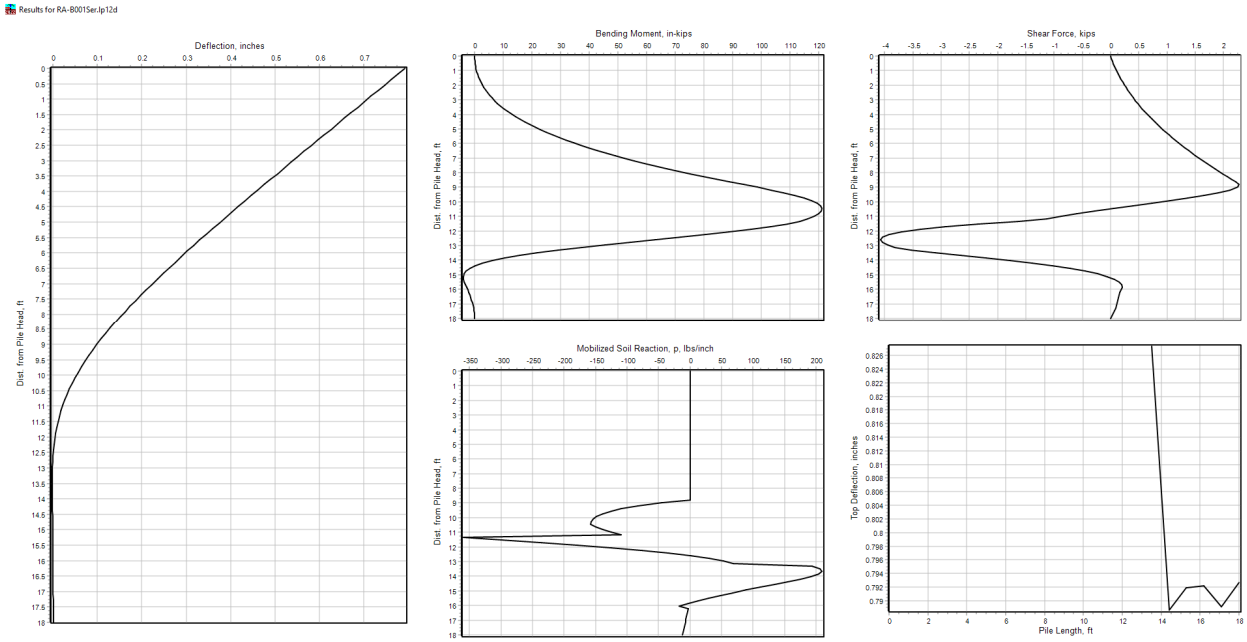
Maximum shear force = 7337 lbs = 7.337 kip

S_x required = $\frac{M_{max}}{\varphi_f F_y} = \frac{194.987}{0.90 \; x \; 50}$ = 4.33 $in^3 < 10.7 \; in^3$ (Good)

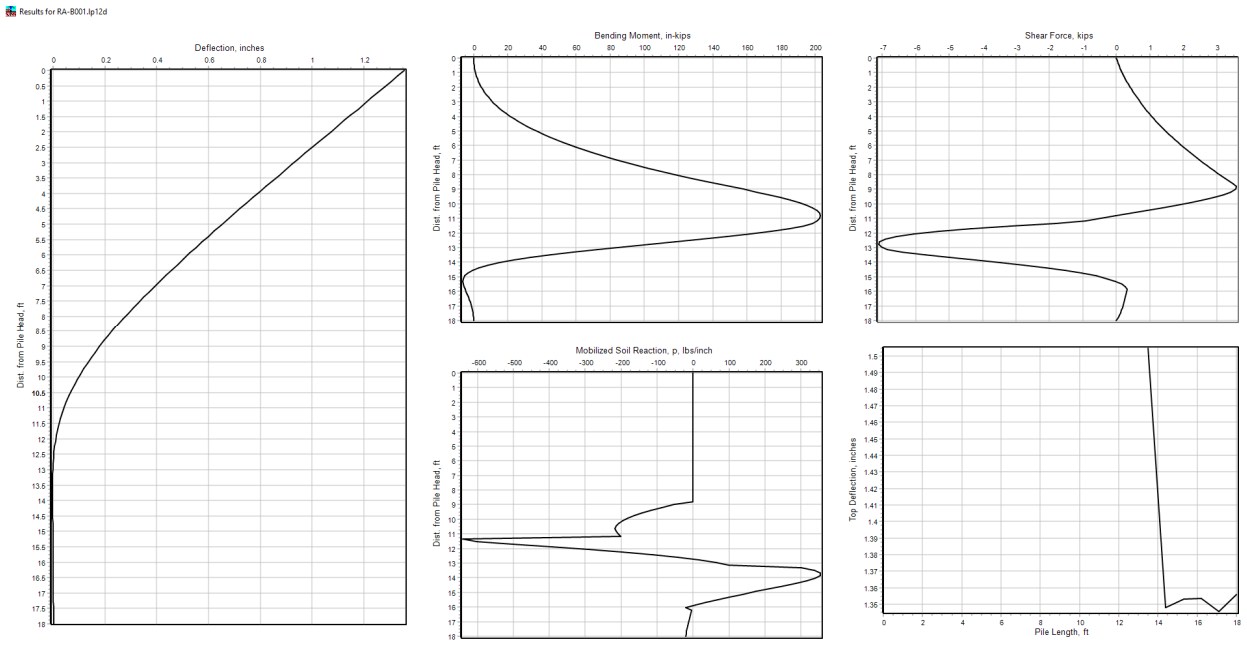
$D_w t_w$ required = $\frac{V_{max}}{0.58 \; \varphi_v F_y} = \frac{7.337}{0.58 x 1.00 \; x \; 50}$ = 0.253 $in^2 \; < 1.195 \; in^2$ (Good)

TEMPORARY SHORING - LPILE GRAPHICAL OUTPUT RESULTS

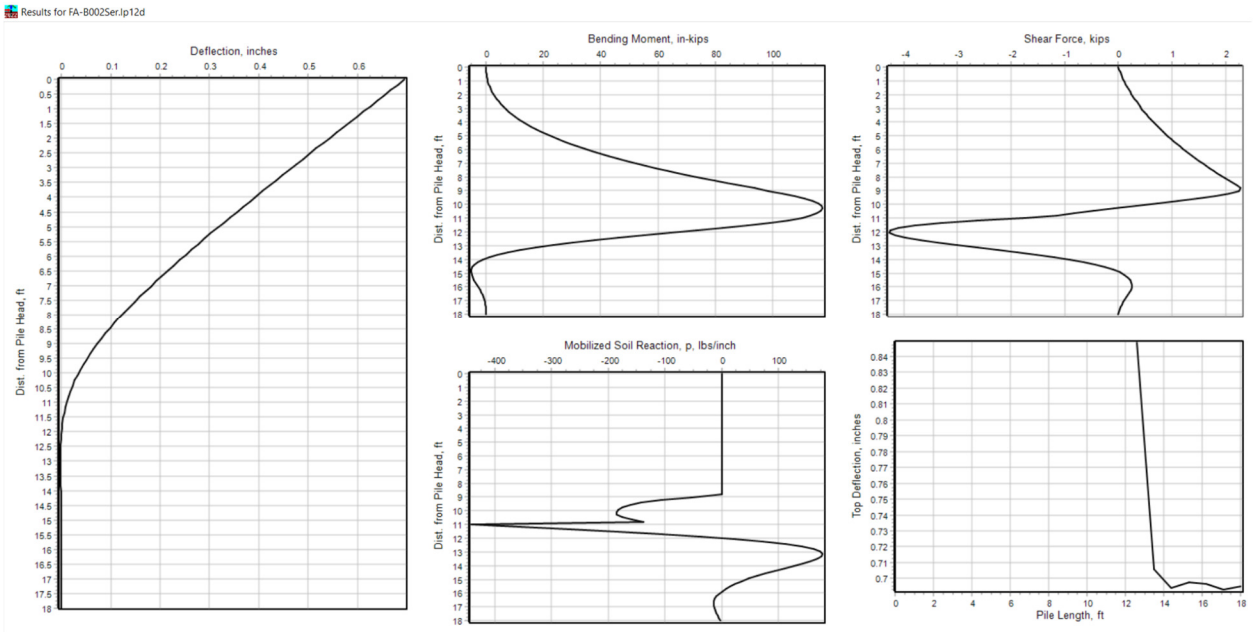
Rear Approach (B-001-0-22) Service Limit Check:



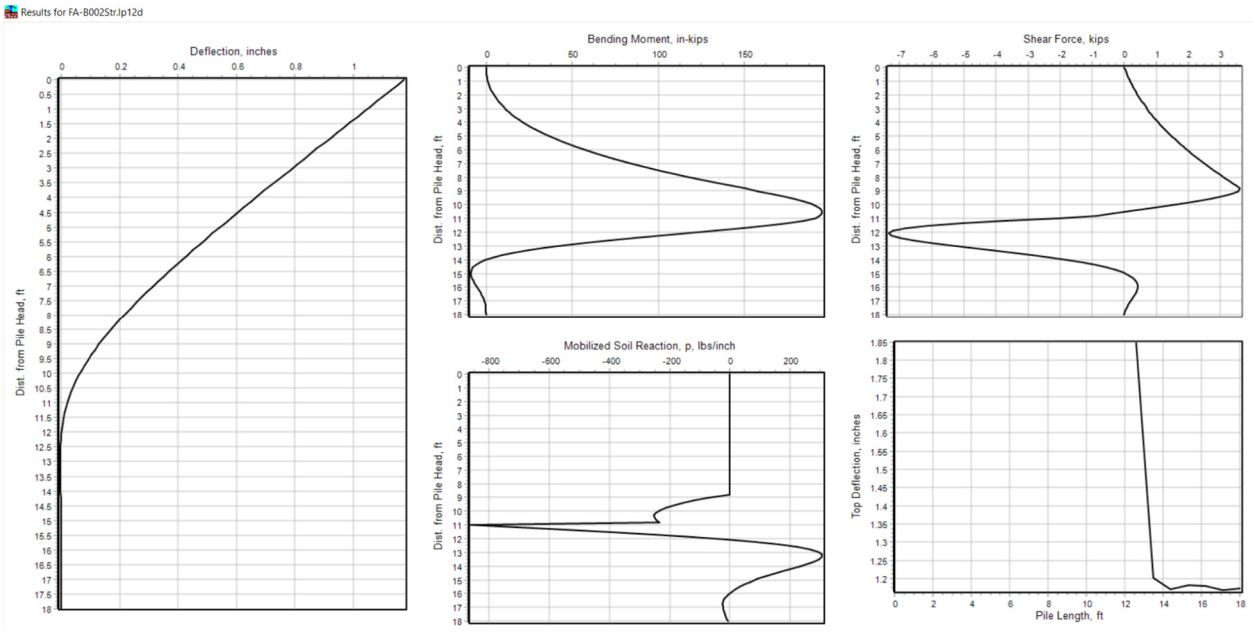
Rear Approach (B-001-0-22) Strength Limit Check:



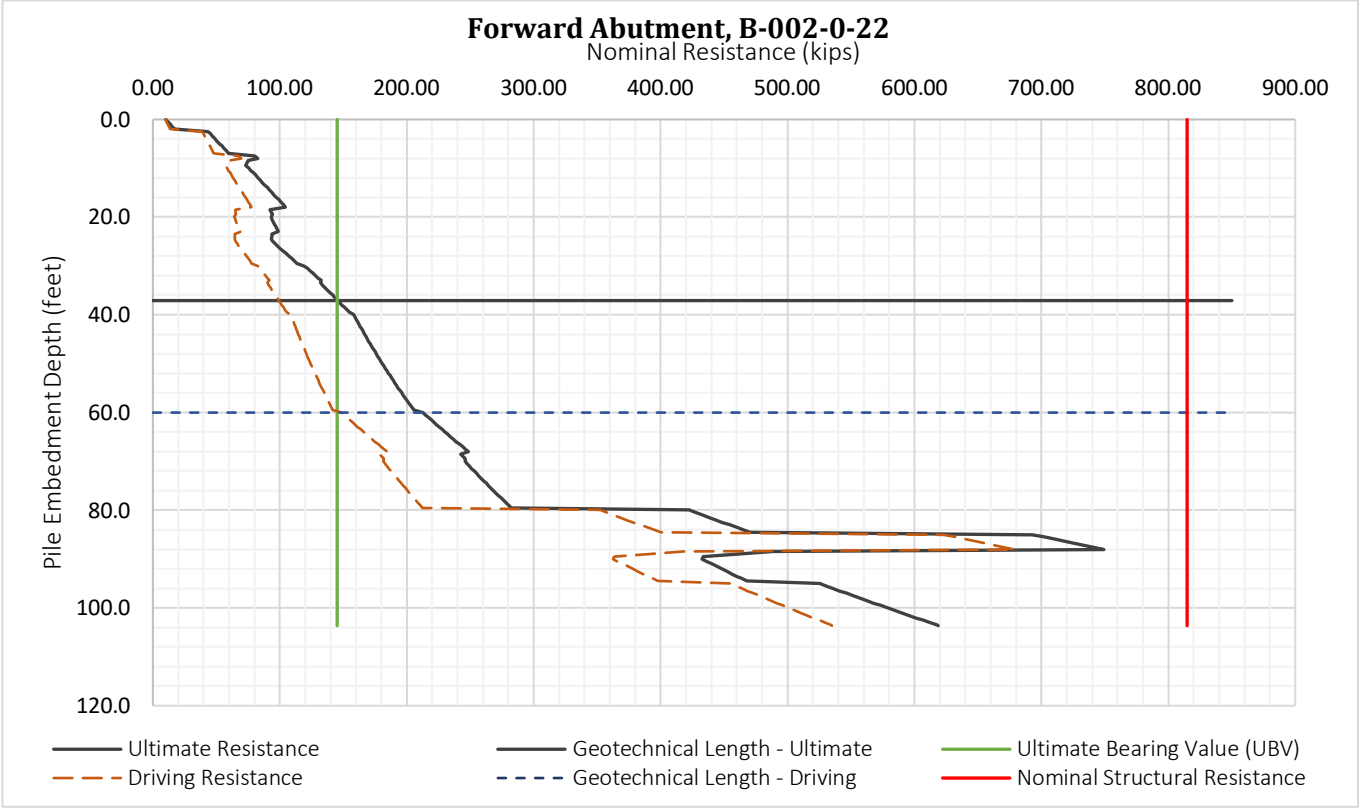
Forward Approach (B-002-0-22) Service Limit Check:

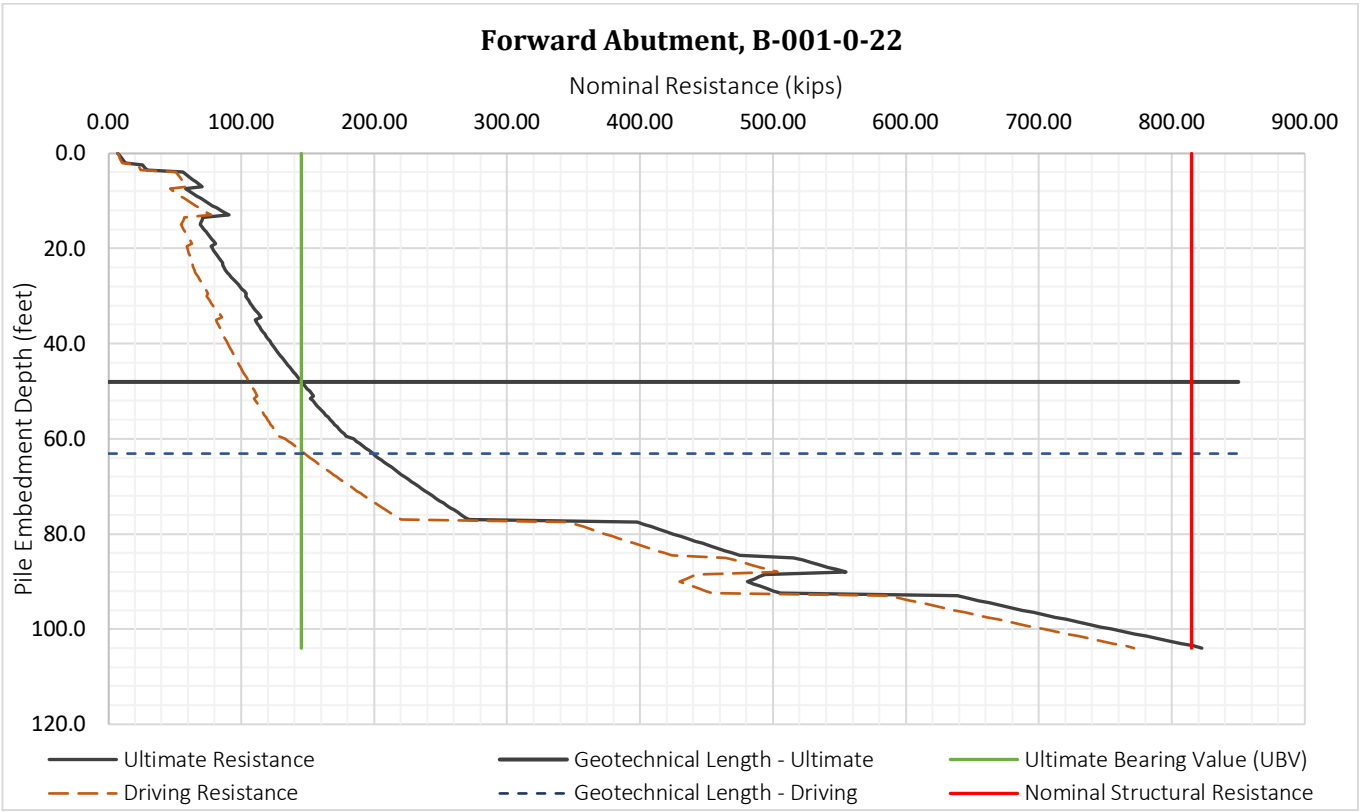


Forward Approach (B-002-0-22) Strength Limit Check:

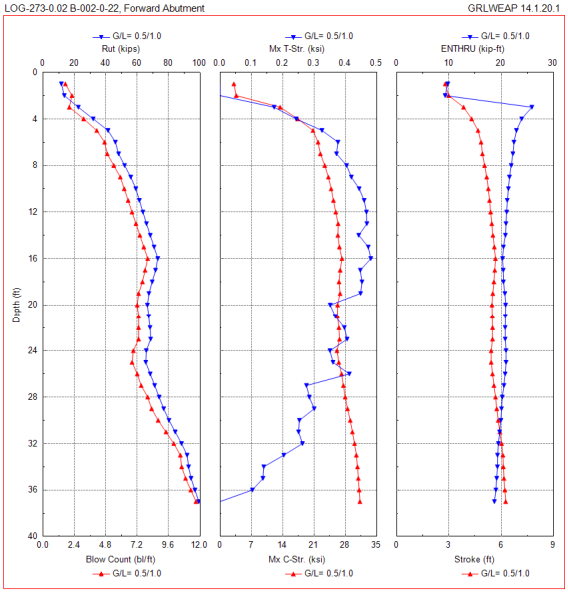


Pile Nominal Resistance versus Embedment Depth Graphs – SPT





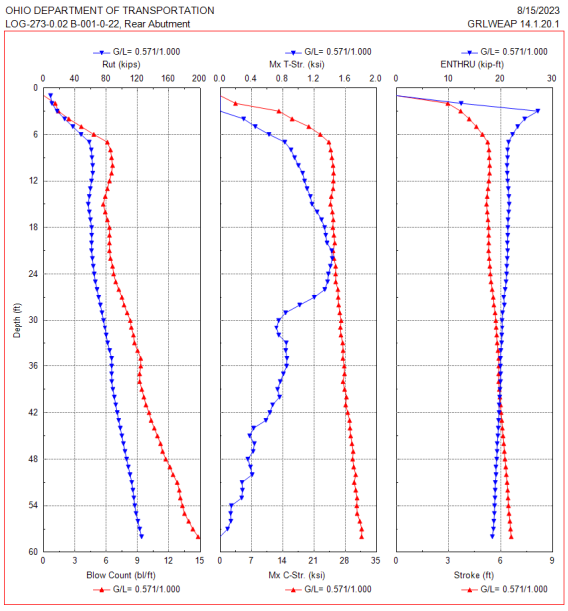
GRLWEAP Drivability Analyses



OHIO DEPARTMENT OF TRANSPORTATION — 8/15/2023
LOG-273-0.02 B-002-0-22, Forward Abutment — GRLWEAP 14.1.20.1
Gain/Loss 1 at Shaft and Toe 0.500/1.000

Depth ft	Rut kips	Rshaft kips	Rtoe kips	Blow Ct bl/ft	Mx C-Str. ksi	Mx T-Str. ksi	Stroke ft	ENTHRU kip-ft	Hammer -
1.0	11.6	1.9	9.7	1.7	3.12	0.00	2.79	9.8	D 19-42
2.0	13.5	3.7	9.7	2.2	3.64	0.00	2.99	9.3	D 19-42
3.0	22.4	5.8	16.6	2.0	13.45	0.17	3.84	25.9	D 19-42
4.0	31.9	7.9	24.0	3.1	17.37	0.24	4.31	23.9	D 19-42
5.0	41.4	10.0	31.4	4.1	20.77	0.33	4.67	22.9	D 19-42
6.0	46.0	12.0	34.0	4.7	21.91	0.38	4.85	22.5	D 19-42
7.0	48.1	14.1	34.0	4.9	22.43	0.37	4.92	22.3	D 19-42
8.0	51.9	17.7	34.2	5.4	23.41	0.40	5.05	21.9	D 19-42
9.0	55.9	21.5	34.4	5.9	24.22	0.42	5.17	21.6	D 19-42
10.0	59.1	24.6	34.5	6.2	24.83	0.44	5.26	21.4	D 19-42
11.0	61.3	27.0	34.3	6.5	25.34	0.46	5.33	21.2	D 19-42
12.0	63.6	29.5	34.2	6.8	25.87	0.47	5.40	21.1	D 19-42
13.0	65.9	31.9	34.0	7.1	26.39	0.47	5.46	20.9	D 19-42
14.0	68.3	34.3	34.0	7.4	26.33	0.44	5.53	20.8	D 19-42
15.0	70.7	36.7	34.0	7.7	26.68	0.47	5.61	20.4	D 19-42
16.0	73.2	39.1	34.0	8.0	27.25	0.48	5.67	20.3	D 19-42
17.0	71.6	41.6	30.1	7.8	26.84	0.45	5.63	20.4	D 19-42
18.0	69.5	44.0	25.6	7.6	26.60	0.45	5.59	20.4	D 19-42
19.0	67.4	46.4	21.0	7.3	26.83	0.45	5.52	20.7	D 19-42
20.0	66.5	48.3	18.2	7.2	26.28	0.35	5.47	20.9	D 19-42
21.0	67.3	49.5	17.8	7.3	26.22	0.37	5.49	20.8	D 19-42
22.0	68.2	50.8	17.4	7.3	26.58	0.40	5.51	20.8	D 19-42
23.0	68.5	52.2	16.4	7.3	26.70	0.41	5.50	20.8	D 19-42
24.0	65.8	53.6	12.2	6.9	26.14	0.35	5.43	20.9	D 19-42
25.0	65.4	55.6	9.8	6.8	26.54	0.36	5.43	20.9	D 19-42
26.0	68.3	58.5	9.8	7.2	27.16	0.41	5.51	20.8	D 19-42
27.0	71.1	61.4	9.8	7.5	27.57	0.28	5.59	20.5	D 19-42
28.0	74.0	64.3	9.7	8.0	27.97	0.29	5.68	20.2	D 19-42
29.0	76.9	67.1	9.7	8.3	28.50	0.30	5.75	20.1	D 19-42
30.0	80.2	70.0	10.2	8.8	29.10	0.25	5.83	20.0	D 19-42
31.0	84.2	73.0	11.3	9.4	29.58	0.25	5.93	19.7	D 19-42
32.0	88.3	75.9	12.3	10.0	30.06	0.26	6.02	19.5	D 19-42
33.0	91.8	78.9	13.0	10.5	30.47	0.20	6.10	19.3	D 19-42
34.0	92.7	81.8	10.9	10.6	30.72	0.14	6.12	19.3	D 19-42
35.0	94.3	84.6	9.8	10.9	30.90	0.14	6.16	19.2	D 19-42
36.0	96.8	87.1	9.7	11.3	31.10	0.10	6.21	19.0	D 19-42
37.0	99.3	89.6	9.7	11.7	31.27	0.00	6.26	18.7	D 19-42

Total driving time: 5 minutes; Total Number of Blows: 256 (starting at penetration 3.3 ft)



OHIO DEPARTMENT OF TRANSPORTATION — 8/15/2023
LOG-273-0.02 B-001-0-22, Rear Abutment — GRLWEAP 14.1.20.1
Gain/Loss 1 at Shaft and Toe 0.571/1.000

Depth ft	Rut kips	Rshaft kips	Rtoe kips	Blow Ct bl/ft	Mx C-Str. ksi	Mx T-Str. ksi	Stroke ft	ENTHRU kip-ft	Hammer -
1.0	8.7	1.7	7.1	0.0	0.00	0.00	0.00	0.0	D 19-42
2.0	10.4	3.3	7.1	1.1	3.46	0.00	2.96	12.4	D 19-42
3.0	17.0	5.1	11.9	1.4	13.16	0.00	3.70	27.1	D 19-42
4.0	26.7	7.1	19.6	2.4	16.12	0.30	4.19	24.6	D 19-42
5.0	37.2	9.8	27.4	3.6	19.86	0.45	4.60	23.3	D 19-42
6.0	47.7	12.5	35.2	4.8	22.42	0.63	4.95	22.3	D 19-42
7.0	58.2	15.2	43.0	6.1	24.35	0.83	5.26	21.5	D 19-42
8.0	60.8	16.8	44.0	6.4	24.77	0.91	5.33	21.3	D 19-42
9.0	61.6	18.0	43.6	6.5	25.02	0.95	5.35	21.3	D 19-42
10.0	62.5	19.3	43.2	6.6	25.29	1.00	5.37	21.2	D 19-42
11.0	62.6	20.7	41.9	6.5	25.40	1.06	5.36	21.3	D 19-42
12.0	61.0	22.3	38.7	6.3	25.34	1.08	5.32	21.4	D 19-42
13.0	59.6	24.0	35.5	6.1	25.30	1.11	5.27	21.5	D 19-42
14.0	58.2	25.9	32.3	5.9	24.88	1.16	5.23	21.6	D 19-42
15.0	56.8	27.9	28.9	5.7	24.71	1.18	5.19	21.6	D 19-42
16.0	58.3	29.9	28.4	5.9	25.13	1.24	5.23	21.5	D 19-42
17.0	59.8	31.8	28.0	6.1	25.33	1.30	5.27	21.4	D 19-42
18.0	61.2	33.7	27.5	6.3	25.24	1.34	5.31	21.4	D 19-42
19.0	61.3	35.7	25.6	6.3	25.47	1.35	5.31	21.4	D 19-42
20.0	61.1	37.6	23.4	6.3	25.67	1.37	5.32	21.3	D 19-42
21.0	61.1	39.6	21.5	6.3	25.29	1.43	5.31	21.3	D 19-42
22.0	62.2	41.5	20.7	6.4	25.51	1.44	5.34	21.3	D 19-42
23.0	63.4	43.4	20.0	6.6	25.87	1.41	5.38	21.2	D 19-42
24.0	64.5	45.3	19.2	6.7	25.86	1.39	5.41	21.1	D 19-42
25.0	66.0	47.2	18.8	6.9	25.88	1.37	5.45	21.0	D 19-42
26.0	68.1	49.4	18.7	7.2	26.37	1.34	5.51	20.9	D 19-42
27.0	70.2	51.6	18.6	7.5	26.43	1.20	5.58	20.6	D 19-42
28.0	72.4	53.8	18.6	7.7	26.54	1.02	5.61	20.7	D 19-42
29.0	74.4	56.0	18.5	8.0	26.80	0.84	5.68	20.4	D 19-42
30.0	76.5	58.2	18.3	8.3	27.10	0.75	5.72	20.3	D 19-42
31.0	78.1	60.1	18.1	8.4	26.93	0.72	5.74	20.3	D 19-42
32.0	79.9	62.0	17.9	8.6	27.05	0.75	5.77	20.2	D 19-42
33.0	81.7	64.1	17.6	8.7	27.44	0.85	5.80	20.2	D 19-42
34.0	84.3	66.1	18.2	9.0	27.54	0.84	5.85	20.1	D 19-42
35.0	86.8	68.2	18.7	9.3	27.49	0.85	5.89	20.0	D 19-42
36.0	86.8	69.5	17.3	9.3	27.80	0.85	5.89	20.0	D 19-42
37.0	86.8	70.9	16.0	9.2	27.86	0.81	5.89	20.0	D 19-42
38.0	86.9	72.3	14.6	9.2	27.51	0.77	5.89	20.0	D 19-42
39.0	88.4	73.7	14.7	9.4	27.88	0.74	5.92	19.9	D 19-42
40.0	90.2	75.2	15.0	9.6	28.29	0.76	5.96	19.8	D 19-42
41.0	92.0	76.7	15.3	9.8	28.11	0.67	5.99	19.7	D 19-42
42.0	93.9	78.3	15.6	10.1	28.57	0.64	6.03	19.7	D 19-42
43.0	95.9	79.9	16.0	10.3	28.98	0.59	6.06	19.6	D 19-42
44.0	97.9	81.5	16.4	10.6	29.08	0.43	6.10	19.5	D 19-42
45.0	99.9	83.1	16.7	10.9	29.23	0.38	6.14	19.5	D 19-42
46.0	101.9	84.8	17.0	11.2	29.52	0.44	6.18	19.3	D 19-42
47.0	103.9	86.5	17.4	11.4	29.78	0.42	6.21	19.3	D 19-42
48.0	106.0	88.3	17.7	11.7	29.67	0.35	6.25	19.3	D 19-42
49.0	108.1	90.1	18.0	12.1	29.91	0.39	6.30	19.1	D 19-42
50.0	110.3	91.9	18.4	12.4	30.36	0.41	6.33	19.1	D 19-42
51.0	112.5	93.8	18.8	12.8	30.02	0.28	6.37	19.0	D 19-42
52.0	114.0	95.6	18.4	13.0	30.36	0.29	6.40	19.0	D 19-42
53.0	115.2	97.6	17.6	13.1	30.66	0.28	6.43	18.9	D 19-42
54.0	116.4	99.5	16.9	13.3	30.59	0.14	6.45	18.8	D 19-42
55.0	118.0	101.6	16.5	13.5	30.68	0.13	6.48	18.8	D 19-42
56.0	120.4	103.6	16.8	13.9	31.28	0.14	6.53	18.7	D 19-42
57.0	122.7	105.7	17.0	14.3	31.70	0.10	6.57	18.6	D 19-42
58.0	125.1	107.8	17.3	14.8	31.68	0.00	6.61	18.4	D 19-42

Total driving time: 10 minutes; Total Number of Blows: 474 (starting at penetration 3.3 ft)