Technical Design Memo

Client:	Ohio Department of Transportation, District 10
Project:	**MOE-7-7.55 (Task Order 10-K)** **PID 108676**
HDR Project No:	10238281
Rev:	0
Calculation No:	1
Page:	1 of 183
Title:	Landslide Remediation Analyses and Design
Purpose:	Prepare slope stability analyses and wall calculations for the design of a landslide repair along the northbound travel lane of State Route 7 (SR 7) in Monroe County, Ohio.
Originator:	AKB
Date:	12/3/2020
Checked by:	DCM
Date:	12/15/2020
QC Review by:	DMV
Date:	12/18/2020

Summary

1. A landslide has occurred on the slope below SR 7 near mile marker 7.55 in Monroe County, Ohio. The project location is shown on the attached Site Vicinity and Topographic Map, along the north bank of the Ohio River, just west of the hamlet of Sardis. The field exploration program was conducted in two phases, with the initial phase performed in 2018 and the second phase performed in 2020. During Phase 1, a site reconnaissance was performed on July 10, 2018, and the field explorations performed between July 27 and August 6, 2018. During Phase 2, site reconnaissances were performed on June 9 and July 23, 2020 and the field explorations were performed between August 10 and 12, 2020. Two inclinometers were installed as part of the Phase 2 exploration program. Based on observations gathered during the site reconnaissances, the findings from the geotechnical explorations, the inclinometer data, and the close proximity of the Ohio River to SR 7 at the project site, a soldier pile and lagging retaining wall is recommended to stabilize the landslide and reestablish SR 7. Presented herein are the discussion and evaluation of a soldier pile and lagging wall for landslide mitigation. This design assumes that the topography and slope geometry as presented in the surveyed cross sections are representative of the current field conditions.

2. The Phase 1 geotechnical exploration program performed in 2018 consisted of a series of 4 test borings (designated as Borings B-001-0-18, B-002-0-18, B-003-0-18, and B-004-0-18) drilled within the northbound lane of SR 7. The Phase 2 geotechnical exploration program performed in 2020 consisted of a series of 4 test borings (designated as Borings B-002-1-20, B-002-2-20, B-004-1-20, and B-004-2-20) drilled along the slope between SR 7 and the Ohio River. The borings were used to characterize the subsurface profile in the vicinity of the existing landslide and develop a repair. Locations are shown on the attached Boring Location Plan. Typed boring logs are also included in the appendix. The soil profile, as encountered in the borings, generally consisted of a layer of stiff embankment fill, underlain by stiff to very stiff colluvium, soft to medium stiff alluvium, and hard residuum. The overburden soils were underlain by siltstone, shale, claystone, sandstone, and limestone bedrock.

The generalized soil profile developed for the design section is primarily based on the findings from Borings B-003-0-18, B-002-1-20, B-002-2-20, and B-004-2-20, located near the design section at Sta. 401+25. The soil profile is assumed to be depicted as shown graphically on the attached SLOPE/W output plots based on the generalized soil conditions as encountered in the explorations, as well as our field observations gathered during the course of our site reconnaissances and the inclinometer readings as provided by ODOT. Bedrock depths along the slope below SR 7 were estimated based on limited data available on published bedrock topography maps and overburden soil thicknesses as encountered in the borings.

3. Monroe County lies within the unglaciated Allegheny (Kanawha) Plateaus section of the Appalachian Plateaus physiographic province of southeast Ohio. The physiographic features within this region have been predominantly influenced by processes of erosion and uplift. Drainage-ways have cut steep, V-shaped valleys and narrow ridgetops throughout most of Monroe County, with the central and southeastern parts of the county drained by the Ohio River and its tributaries. The project site itself is directedly drained by the Ohio River running along the toe of the slope below SR 7.

The surficial materials within Monroe County predominantly consist of colluvium, residuum, and weathered material derived from the underlying sedimentary bedrock. Alluvial material is also found in localized areas and narrow bands along streams and the Ohio River. The bedrock at the project site is mapped as the Pennsylvanian-age Monongahela group. The Monongahela Group consists of shale, siltstone, and mudstone, with minor amounts of limestone and coal.

4. Coal seams of note within the Monongahela Group include the Pittsburgh No. 8, Pomeroy (Redstone) No. 8a, Meigs Creek (Sewickley) No. 9, Uniontown No. 10, and Waynesburg No. 11 coals. No significant mining activity is mapped at the project site according to information from the Ohio Department of Natural Resources. However, 5 coal mine points with unknown extents are recorded within about 0.15 to 2.1 miles west and southwest of the site. The mine point 0.15 miles west of the project site is documented as the “Waynesburg No. 12” with a coal elevation of 681. A mine point 0.6 miles west of the project site is documented as the “Waynesburg No. 12 A Horizon” with a coal elevation of 626.

5. A search of the available records on ODOT's Transportation Information Mapping System (TIMS) revealed two previous geotechnical explorations performed as part of the MOE-7-(2.06)(2.21) project in 1938 within the current project limits. Historic Boring B-001-1-38 was located at Sta. 400+00, and historic Boring B-004-3-38 was located at Sta. 403+00. Both borings encountered a 6-inch surficial layer of topsoil underlain by Clay (classified as A-7) to their termination depth of 4 feet below the previously existing ground surface (El 643.3 and El. 641.2, respectively). A note provided on the soil profile sheets for the MOE-7-2.06 project indicate a compaction test was performed on the soils encountered in Boring B-001-1-38, with a compaction of 97.9% achieved at a maximum dry unit weight of 99.6 pounds per cubic foot (pcf) and an optimum moisture content of 20.6%.

6. To determine the design section, a preliminary wall location was plotted with the centerline of the proposed drilled shafts a distance of 27 feet from the centerline of the roadway. A 4-foot bench was included in front of the wall, and the existing grade elevation was used as the proposed bench elevation. Elevations along this preliminary wall profile were reviewed to establish the tallest exposed wall height (considering the elevation at the centerline of SR 7 to the proposed bench elevation), which was about 6.5 feet at Station 402+15 (see attached). The section at Station 401+25 was selected for design, and the elevation of the bench was lowered to match the maximum exposed wall height (see attached).

7. In accordance with ODOT GB-7 recommendations, an initial set of soil strength parameters were selected based on laboratory tests and published correlations of soil strength with SPT N_{60} values. A statistical basis for selecting the initial soil parameters was performed and is in the attached printed spreadsheets entitled "SOIL STRENGTH PARAMETER DETERMINATION". These values were then entered into the SLOPE/W slope stability modeling software to re-create the landslide observed in the field by simulating a series of optimized trial searches to determine the critical mode of failure based on a Morgenstern-Price stability model. In addition, the SLOPE/W optimization feature was utilized, which generates a hybrid circular and translational failure shape. Recognizing that a landslide had already occurred, strength parameters within the existing soil layers were adjusted in order to generate a reasonable slip surface (FS < 1.0) that is consistent with the field observations and engineering judgment.

Inclinometer readings performed in Borings B-002-1-20 and B-004-2-20 indicated observable movement to depths of about 8 to 12 feet below existing grade. Initially, a critical slip surface with a FS value of 0.99 was determined using the Slope/W software. However, this slip surface extended approximately 14 feet below the recorded inclinometer movement depth at B-002-1-20 and into the soft to medium stiff alluvial layer. Subsequently, the slip surface limits were adjusted to develop a slip surface that more closely corresponded to that indicated by the inclinometer readings, which was contained within the stiff colluvium layer (Layer 1). This increased the FS value to 1.26, and would have required an unrealistic decrease in the strength parameters that were already at or slightly below the lower range of the statistical analysis to recreate a failure surface with a FS value of 1.0. Therefore, the results of the deeper slip surface were used for design of the wall.

Once the soil parameters and failure surface were established, they were entered into the UA SLOPE Version 2.3 software program and a model was developed based on the current slope configuration (See attached UA SLOPE screen shot).

Groundwater was encountered during drilling in all of the test borings except Boring B-001-0-18 at elevations ranging from El. 590.7 to 599.7 (depths ranged from 8.5 to 52.5 feet depending on the location of the boring along the slope). As the borings were backfilled upon completion, delayed water level readings were not obtained. Elevated moisture contents were also noted within the alluvial and lower colluvial layers. Normal pool elevations documented on topographic maps indicate a normal pool elevation of 602. The site survey indicated the water's edge at about El. 606 at the time of the survey. Boring B-004-2-20, performed directly adjacent to the bank of the Ohio River, had a ground surface elevation of 603. Review of FEMA Flood maps for the area indicate a high water elevation of 634 at the project site, or within about 10 vertical feet of the roadway elevation. As the conditions were encountered with some consistency across each boring, groundwater was modeled along the top of the Stiff to Very Stiff Colluvium and Soft to Medium Stiff Alluvium layers within the slope and extended to El. 602 at the toe of the slope and within the Ohio River.

8. After the soil profile and parameters between SLOPE/W and UA SLOPE were confirmed and finalized, a drilled shaft lagging wall was selected and analyzed at approximately 27 feet right of the SR 7 centerline. This allows for, at a minimum, a 5-foot clearance between the surveyed guardrail (located approximately 20.5 feet right of the SR 7 centerline) and the back of the proposed 3-foot diameter drilled shaft. This recommended offset also allows for continuity with the existing features (roadway section, shoulder width, guardrail offset, etc.) located to the east and west of the project site. Once the wall location was established, the "Manually Determined Load Transfer Factor" was selected in the UA Slope program and the load transfer factor (η) was set to zero in order to determine the horizontal forces acting on the wall. The computed unfactored force per shaft is **Ps = 59,554** pounds based on 36-inch diameter drilled shafts spaced at approximate 6-foot centers. (See attached UA SLOPE computer screen shots of the post-construction condition of these calculations.) The numbering of soil layers for the UA Slope profile is listed as follows:

a. Layer 1 = Surcharge Load
b. Layer 2 = Item 203 Embankment Fill
c. Layer 3 = Stiff Colluvium
d. Layer 4 = V. Stiff Colluvium
e. Layer 5 = Stiff to V. Stiff Colluvium
f. Layer 6 = Soft to M. Stiff Alluvium

The "Hard Residuum" and "Bedrock" materials were not modeled, as the slip surface did not extend deeper than the alluvium.

9. In accordance with ODOT design requirements, LPILE software was used to determine the pile response to the applied lateral loading from the failure wedge determined by the Slope/W and

UA Slope analyses performed at the design section at Sta. 401+25. Relative to LPILE analyses, the following were considered:

(a) Factored Distributed Load (per GB-7, pg. 30)

- Convert concentrated load from UA SLOPE to distributed load
  - ½(D_L)(H_T) = 59,554 lbs.
    D_L = distributed load
    H_T = 18.1 feet (top/wall to slip surface, see attached)
  - D_L = [(59,554 lbs)(2)]/[(18.1')(12"/ft)] = Resolution of Triangular Area
    D_L = **548 lbs/in** (Service Load)
  - (548 lbs/in)(γ_{EH}) = (548 lbs/in)(1.5) = **823 lbs/in** (Strength Load for Moment/Shear Analysis).

Loading due to conventional earth pressures were performed for comparison purposes.

- Calculate conventional earth pressure wall loading.
  - Equivalent Fluid Weight (G_H) = (γ_m) * (K) = **51 pcf**
    Ym = soil moist unit weight (see attached calculations)
    Ka = active earth pressure (see attached calculations)
  - Lateral Thrust (P) = 1/2 * G_H * H^2 = P = **2,996 lbs/ft**
    H = Wall Height
  - Horizontal Force Per Shaft (P_{SH}) = P*(S_{cc}) = **17,975 lbs/shaft**
    S_{cc} = Center-to-Center Shaft Spacing = 6 ft
  - Resolve Horizontal Earth Pressure to Distributed Triangular Load
    (2* P_{SH}/H) / (12 in/ft)
    = **277 lbs/in per shaft (Service Load)**
    (277 lbs/in) (γ_{EH}) = (277 lbs/in) (1.5)
    = **415 lbs/in per shaft (Strength Load)**

Based on a comparison of the two loading methods, landslide loading from UA SLOPE was applied to the proposed wall.

(b) Traffic Surcharge (per GB-7, pg. 30)

As loading traffic may be present within up to the front edge of the guardrail, located within 5 feet of the back of the drilled shafts, traffic surcharge loading was included in the distributed load acting on the shaft (see attached calculations).

(c) Modification of p-y curves

Since the center-to-center spacing is < 3.5 shaft diameters, a reduction in soil resistance (p) should be applied from the ground surface to the bottom of shaft or bedrock (whichever is shallower).

- $\beta_a = 0.64(S/D)^{0.34} = \beta_a = 0.64(6/3)^{0.34}$
- $\beta_a =$ **0.81**

The downslope stability was determined to be unstable under both normal steady-state and rapid drawdown conditions. (See the SLOPE/W output plot included in the attached calculations exhibiting a Factor of Safety less than 1.3 for steady-state conditions, and less than 1.1 for rapid drawdown conditions.) As such, the GB-7 recommendation of artificially lowering the ground surface in the LPILE analysis was included.

- Top of Wall El. 642.8 ft
  - Assumes approximately 2.6 feet of fill placement to re-establish grade.
- Maintenance Bench GS El. = 636.3 ft
- Wall Height = 642.8 ft – 636.3 ft = 6.5 ft. (Based on Max. Wall Height at Sta. 402+15)
- Artificially lowered surface = 4.3 feet (See attached)
- GS for LPILE analysis = 642.8 ft – 6.5 ft – 4.3 ft = 632.0 ft
  - Wall Height for LPILE Analysis = 6.5 ft + 4.3 ft = **10.8 ft**

(d) Pile Length (per GB-7, pg. 28)

*Minimum 10 feet below slip plane
*Slip Plane = 18.1 ft below top of wall
+10.0 ft
28.1 ft minimum pile length

- **Bottom of Drilled Shaft = 48.5 ft > 28.1 ft** **OK**

ODOT GB-7 requires a minimum drilled shaft depth of 10 feet below the failure surface and review of the "Top Deflection Versus Length" plot produced by the LPILE software to determine a total drilled shaft length such that the shaft is considered to be geotechnically stable. Based on the encountered subsurface profile and review of plots, **a minimum drilled shaft length of 48.5 feet** is recommended.

(e) Pile Head Deflection

As noted in ODOT GB-7 (pages 30 and 31), for the unfactored Service Limit State analysis, pile head deflection shall be limited 1% or less of the drilled shaft length above bedrock (or the total shaft length when bedrock is not encountered). If the drilled shafts are within 10 feet of the edge of pavement, the deflection must be limited to 2 inches. The centerline of the drilled shafts is not anticipated to be located less than 10 feet from the edge of pavement. However, a limited pile head deflection of 2 inches or less was adopted given the potential for traffic loading over the design life of the soldier pile and lagging wall.

Computed Pile Head Deflection (W 24 x 162) = **1.93 inches** < 2.00 inches OK
(See attached calculations)

(f) Steel Reinforcement and Pile Cross Section Character

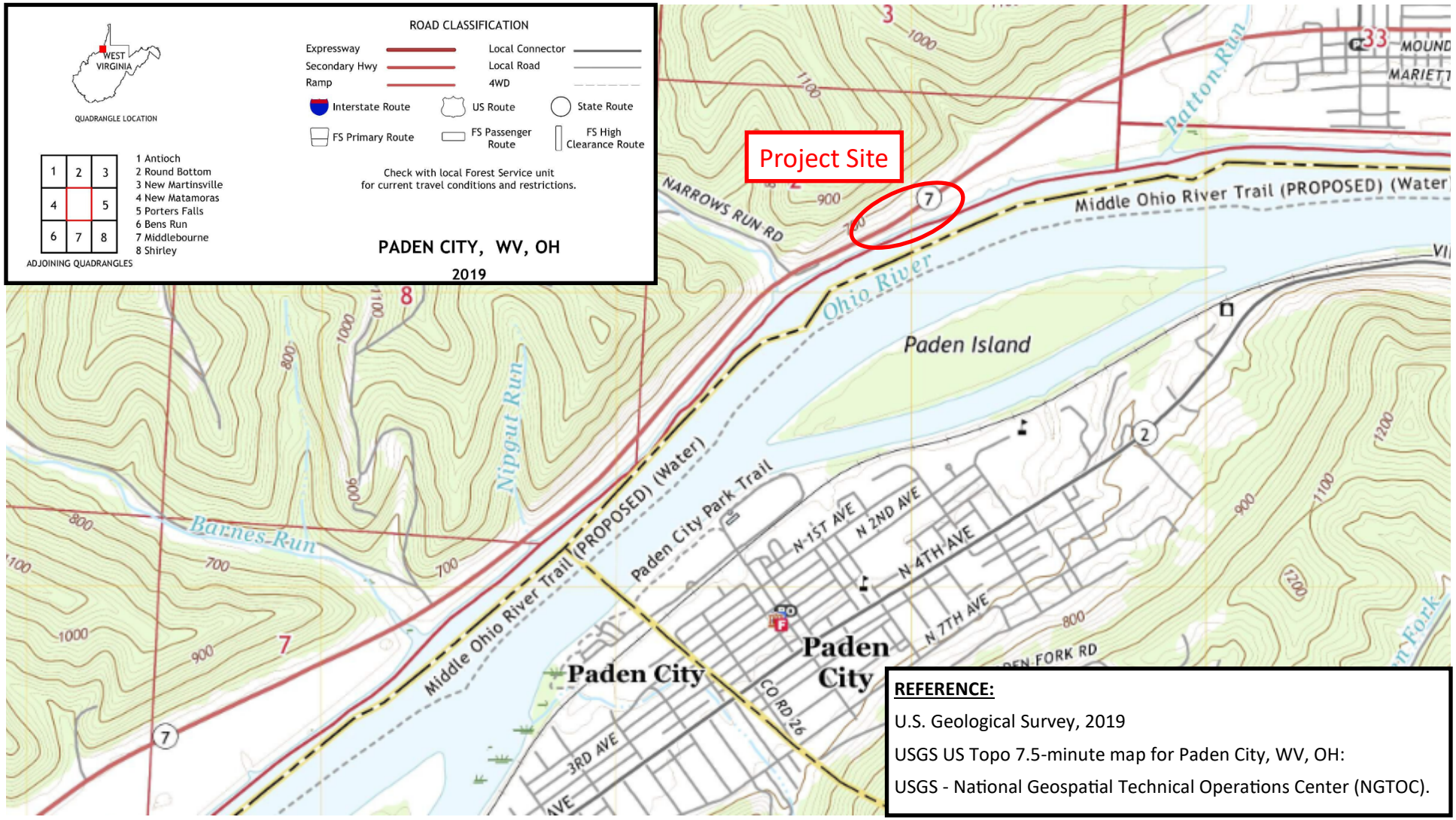
Use W 24 x 162 shaft reinforcement

A_s = Area of Steel = 47.7 in^2
I_x = Moment of Inertia around strong axis = 5,170 in^4
T_w = web thickness = 0.705 in
E = Modulus of Elasticity of Steel = 29,000,000 psi
F_y = yield strength of steel = 50,000 psi
B_f = Flange Width = 13.0 in

8. It is recommended that plug piles be utilized to prevent loss of material and undermining of the concrete lagging given the slope below the retaining wall was determined to be unstable. Please refer to the "Soldier Pile and Lagging Wall Details" sheet located at the end of the design memo for details on the plug piles as well as further details on the wall itself.

Site Vicinity and Topographic Map

Site Vicinity and Topographic Map



REFERENCE:

U.S. Geological Survey, 2019

USGS US Topo 7.5-minute map for Paden City, WV, OH:

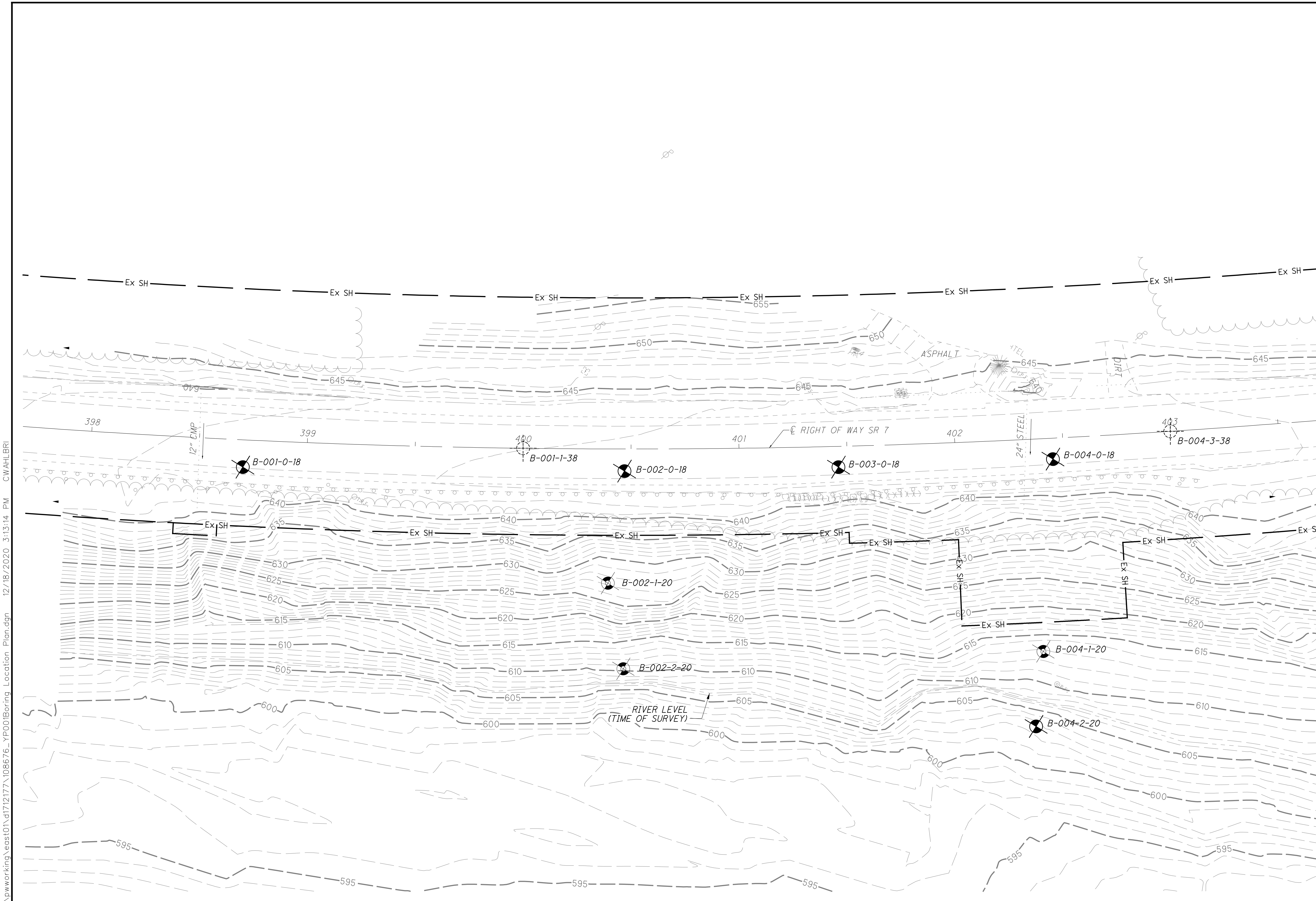
USGS - National Geospatial Technical Operations Center (NGTOC).

1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000

FEET

CONTOUR INTERVAL 20 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

Boring Location Plan



HORIZONTAL SCALE IN FEET
0 10 20 40

DRAWN CLW
CHECKED DMV

BORING LOCATION PLAN

MOE-7-7.55

1/1

c:\pwworking\east01\d171217\108676_YP001Boring Location Plan.dgn 12/18/2020 3:13:14 PM CWAHLBRI

Boring Logs
and
Rock Core Photos

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 12/16/20 08:16 - C:\PW\WORKING\EAST01\D1679058\20180730_MOE-7-7.55_2017 10-AA_TYPED LOGS (UPDATED DESCRIPTIONS).G

PROJECT: MOE-7-07.55	DRILLING FIRM / OPERATOR: DHDC / A.U.	DRILL RIG: MOBILE B-57 TRACK RIG	STATION / OFFSET: 398+71, 13' RT.	EXPLORATION ID B-001-0-18
TYPE: LANDSLIDE	SAMPLING FIRM / LOGGER: HDR / S. REED	HAMMER: AUTOMATIC HAMMER	ALIGNMENT: SR-7	
PID: 108676 SFN:	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 2/27/18	ELEVATION: 642.3 (MSL) EOB: 84.0 ft.	PAGE 1 OF 3
START: 8/3/18 END: 8/6/18	SAMPLING METHOD: SPT/ST/NQ	ENERGY RATIO (%): 82.7	LAT / LONG: 39.616541, -80.931318	

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
ASPHALT PAVEMENT (7.5 INCHES)	642.3 / 641.7																	
VERY STIFF, REDDISH-BROWN, TRACE TAN, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, DAMP		1																
		2	4 4 8	17	50	SS-1	3.50	-	-	-	-	-	-	-	-	19	A-6a (V)	
		3																
@ 4.0' - 5.5' : grab sample obtained from auger spoils		4	4 5 6	15	0	SS-2	-	-	-	-	-	-	-	-	-	18	A-6a (V)	
		5																
		6																
@ 6.5' : orange-brown and tan		7	3 4 7	15	67	SS-3	4.00	-	-	-	-	-	-	-	-	16	A-6a (V)	
		8																
		9																
		10	3 5 6	15	72	SS-4	2.00	6	24	6	27	37	34	22	12	18	A-6a (7)	
		11																
@ 11.5' : brown, trace tan, and gray Below 11.5' : some gravel and stone fragments		12	3 5 7	17	50	SS-5	2.25	-	-	-	-	-	-	-	-	19	A-6a (V)	
		13																
		14	3 5 7	17	67	SS-6	2.00	-	-	-	-	-	-	-	-	17	A-6a (V)	
		15																
		16																
		17	3 6 15	29	61	SS-7	2.00	-	-	-	-	-	-	-	-	17	A-6a (V)	
		18																
		19																
		20	9 6 10	22	83	SS-8	2.50	-	-	-	-	-	-	-	-	16	A-6a (V)	
		21																
		22	3 6 10	22	67	SS-9	2.00	-	-	-	-	-	-	-	-	19	A-6a (V)	
		23																
		24	3 7 11	25	89	SS-10	3.25	-	-	-	-	-	-	-	-	16	A-6a (V)	
		25																
		26																
@ 26.5': brown and gray		27	3 5 7	17	100	SS-11	2.75	-	-	-	-	-	-	-	-	24	A-6a (V)	
		28																
		29	3 6	19	94	SS-12	4.00	-	-	-	-	-	-	-	-	19	A-6a (V)	

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
	612.3		8															
	611.3	31																
MEDIUM STIFF TO STIFF, OLIVE-BROWN TO GRAY, **SANDY SILT**, SOME CLAY, WET @ 33.' - 35.0' : Shelby tube was attempted from 33.0' to 35.0', but no sample was recovered. SPT sample was then driven between 33.0' and 34.5'. @ 35.5' : Qu = 2643 psf		32	2 4 3	10	100	SS-13	0.75	-	-	-	-	-	-	-	-	25	A-4a (V)	
		33	3 4 5	12	100	SS-14	1.00	-	-	-	-	-	-	-	-	23	A-4a (V)	
		34																
		35																
		36			96	ST-15	0.50	0	0	26	43	31	24	18	6	22	A-4a (8)	
		37																
		38	0 4 3	10	83	SS-16	0.75	-	-	-	-	-	-	-	-	23	A-4a (V)	
		39																
	602.3	40																
MEDIUM STIFF TO STIFF, OLIVE-BROWN TO GRAY, **SILT AND CLAY**, LITTLE SAND, MOIST @ 42.5' : Qu = 2320 psf		41	0 2 3	7	100	SS-17	0.50	-	-	-	-	-	-	-	-	24	A-6a (V)	
		42																
		43			92	ST-18	0.75	0	1	16	47	36	31	19	12	26	A-6a (9)	
	597.8	44																
MEDIUM STIFF, BROWN AND GRAY, **SANDY SILT**, SOME CLAY, WET		45	0 2 4	8	100	SS-19	1.00	-	-	-	-	-	-	-	-	25	A-4a (V)	
		46																
		47																
		48	0 0 3	4	100	SS-20	0.75	0	1	33	39	27	24	17	7	24	A-4a (6)	
		49																
		50	3 4 3	10	100	SS-21	1.75	-	-	-	-	-	-	-	-	24	A-4a (V)	
		51																
		52																
		53	0 0 3	4	100	SS-22	0.75	-	-	-	-	-	-	-	-	29	A-4a (V)	
		54																
		55	3 6 7	18	100	SS-23	0.75	-	-	-	-	-	-	-	-	32	A-4a (V)	
	585.8	56																
HARD, REDDISH-BROWN, **SANDY SILT**, SOME CLAY, DAMP		57	33 50/2"	-	100	SS-24	4.50	0	6	34	39	21	24	18	6	15	A-4a (5)	
	583.3	58																
		59	TR															
SHALE, REDDISH-BROWN AND GRAY, HIGHLY WEATHERED, VERY WEAK, FISSILE.		60	50/5"	-	100	SS-25	-	-	-	-	-	-	-	-	-	13	Rock (V)	
		61																

PID: 108676	SFN:	PROJECT: MOE-7-07.55	STATION / OFFSET: 398+71, 13' RT.	START: 8/3/18	END: 8/6/18	PG 3 OF 3	B-001-0-18

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
SHALE, REDDISH-BROWN AND GRAY, HIGHLY WEATHERED, VERY WEAK, FISSILE. *(continued)*	580.2	63	42 \ 50/1"	-	100	SS-26	-	-	-	-	-	-	-	-	-	5	Rock (V)	
	578.3	64																
INTERBEDDED SHALE (54%) AND SILTSTONE (46%), MODERATELY FRACTURED, RQD 26%, REC. 98%; **SHALE**, GRAY, HIGHLY WEATHERED, VERY WEAK, VERY FINE GRAINED, LAMINATED TO THIN BEDDED; **SILTSTONE**, GRAY, MODERATELY WEATHERED, VERY WEAK TO WEAK, FINE GRAINED, THIN TO MEDIUM BEDDED, SLIGHTLY ROUGH SURFACES ALONG BEDDING JOINTS.		65	0		90	NQ-1											CORE	
		66																
		67	25		96	NQ-2											CORE	
		68																
		69																
		70																
@ 71.3' : Qu = 156 psi (shale seam) @ 71.5' : Qu = 666 psi (siltstone seam)		71	25		100	NQ-3											CORE	
		72																
		73																
		74																
		75																
		76	35		96	NQ-4											CORE	
		77																
		78																
	563.3	79																
SILTSTONE, GRAY, UNWEATHERED, SLIGHTLY STRONG, FINE GRAINED, LAMINATED TO THIN BEDDED, MODERATELY FRACTURED, ROUGH SURFACES ALONG BEDDING JOINTS; RQD 36%, REC 100%.		80																
		81	36		100	NQ-5											CORE	
		82																
		83																
	558.3	EOB 84																

NOTES: INTRODUCED WATER INTO THE BOREHOLE AT 35.5 FEET TO FACILITATE PISTON TUBE SAMPLING

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH 4 BAGS BENTONITE GROUT; MIXED 80 GAL. WATER

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 12/16/20 08:16 - C:\PW\WORKING\EAST01\D1679058\20180730_MOE-7-7.55_2017 10-AA_TYPED LOGS (UPDATED DESCRIPTIONS).G

PROJECT: MOE-7-07.55	DRILLING FIRM / OPERATOR: DHDC / A.U.	DRILL RIG: MOBILE B-57 TRACK RIG	STATION / OFFSET: 400+47, 10' RT.	EXPLORATION ID B-002-0-18
TYPE: LANDSLIDE	SAMPLING FIRM / LOGGER: HDR / S. REED	HAMMER: AUTOMATIC HAMMER	ALIGNMENT: SR-7	
PID: 108676 SFN:	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 2/27/18	ELEVATION: 643.2 (MSL) EOB: 83.0 ft.	PAGE 1 OF 3
START: 8/1/18 END: 8/2/18	SAMPLING METHOD: SPT/ST/NQ	ENERGY RATIO (%): 82.7	LAT / LONG: 39.616785, -80.930775	

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
	643.2																	
ASPHALT PAVEMENT (9 INCHES)	642.5	1																
CONCRETE PAVEMENT (6 INCHES)	642.0																	
STIFF, BROWN, **SILT AND CLAY**, SOME SAND, LITTLE GRAVEL, DAMP (FILL)		2	5 4 5	12	0	SS-1	-	18	18	10	23	31	34	22	12	15	A-6a (5)	
@ 1.5' - 3.0' : grab sample obtained from augers	640.2	3	4 3 5	11	56	SS-2	2.50	-	-	-	-	-	-	-	-	22	A-6a (V)	
STIFF, REDDISH-BROWN, **SILT AND CLAY**, SOME TO "AND" SAND, TRACE GRAVEL, DAMP		4	2 3 4	10	44	SS-3	1.50	-	-	-	-	-	-	-	-	25	A-6a (V)	
		5	7 3 5	11	72	SS-4	1.75	-	-	-	-	-	-	-	-	19	A-6a (V)	
		6	2 3 4	10	50	SS-5	1.50	-	-	-	-	-	-	-	-	19	A-6a (V)	
		7																
		8																
Below 9.0' : some stone fragments		9	2 3 4	10	72	SS-6	2.25	-	-	-	-	-	-	-	-	21	A-6a (V)	
		10	2 4 5	12	56	SS-7	1.75	-	-	-	-	-	-	-	-	19	A-6a (V)	
		11	2 5 5	14	83	SS-8	1.50	-	-	-	-	-	-	-	-	19	A-6a (V)	
		12	2 3 5	11	78	SS-9	1.25	-	-	-	-	-	-	-	-	19	A-6a (V)	
		13	2 3 5	11	72	SS-10	1.50	-	-	-	-	-	-	-	-	21	A-6a (V)	
		14																
@ 16.5' : sandstone cobbles		15	50/3"	-	100	SS-11	1.50	-	-	-	-	-	-	-	-	17	A-6a (V)	
		16																
@ 18.0' : sandstone fragments embedded in clayey soil matrix		17	30 12 7	26	78	SS-12	-	-	-	-	-	-	-	-	-	4	A-6a (V)	
		18																
@ 19.5' : sandstone fragments embedded in clayey soil matrix		19	4 4 6	14	61	SS-13	2.50	-	-	-	-	-	-	-	-	14	A-6a (V)	
		20																
		21	3 5 6	15	67	SS-14	2.25	-	-	-	-	-	-	-	-	15	A-6a (V)	
		22																
		23	2 15 14	40	94	SS-15	1.25	4	30	6	27	33	32	20	12	17	A-6a (6)	
		24																
		25	2 6 6	17	78	SS-16	1.50	-	-	-	-	-	-	-	-	18	A-6a (V)	
		26	3 28 10	52	56	SS-17	1.50	1	19	7	33	40	32	20	12	17	A-6a (8)	
		27																
		28	5 6 9	21	50	SS-18	1.50	-	-	-	-	-	-	-	-	18	A-6a (V)	
		29	4 4 6	14	56	SS-19	1.50	-	-	-	-	-	-	-	-	19	A-6a (V)	

PID: 108676	SFN:	PROJECT: MOE-7-07.55	STATION / OFFSET: 400+47, 10' RT.	START: 8/1/18	END: 8/2/18	PG 2 OF 3	B-002-0-18

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
	613.2																	
	612.3	31	5 8 9	23	72	SS-20A	1.75	-	-	-	-	-	-	-	-	-	A-6a (V)	
						SS-20B	3.00	-	-	-	-	-	-	-	-	25	A-6a (V)	
STIFF TO VERY STIFF, MOTTLED BROWN AND GRAY, **SILT AND CLAY**, TRACE SAND, TRACE GRAVEL, MOIST		32	3 6 7	18	100	SS-21	1.75	0	1	6	50	43	35	20	15	22	A-6a (10)	
@ 33.0' - 35.0' : Qu = 4036 psf		33																
		34			96	ST-22	1.00	1	1	7	52	39	31	19	12	18	A-6a (9)	
	608.2	35																
SOFT TO MEDIUM STIFF, GRAY, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, MOIST		36	3 4 5	12	100	SS-23	1.00	-	-	-	-	-	-	-	-	25	A-6a (V)	
		37	3 4 5	12	100	SS-24	0.75	-	-	-	-	-	-	-	-	22	A-6a (V)	
@ 38.0' - 40.0' : Attempted undisturbed shelby tube, but did not recover sample. An SPT sample was then driven from 38.0' to 39.5'		38																
		39			94	ST-25	1.00	-	-	-	-	-	-	-	-	23	A-6a (V)	
		40	0 2 3	7	94	SS-26	1.00	-	-	-	-	-	-	-	-	23	A-6a (V)	
@ 41.5' - 43.5' : Attempted undisturbed shelby tube, but did not recover sample. An SPT sample was then driven from 41.5' to 43.0'.		41																
		42			100	ST-27	0.50	0	0	20	48	32	28	17	11	25	A-6a (8)	
		43	0 0 3	4	100	SS-28	1.00	-	-	-	-	-	-	-	-	23	A-6a (V)	
		44	2 5 5	14	100	SS-29	1.00	-	-	-	-	-	-	-	-	24	A-6a (V)	
		45	0 2 4	8	100	SS-30	0.75	-	-	-	-	-	-	-	-	23	A-6a (V)	
		46	0 3 2	7	100	SS-31	0.75	-	-	-	-	-	-	-	-	24	A-6a (V)	
@ 49.0' : occasional sandy silt seams		47	0 2 3	7	100	SS-32	0.75	-	-	-	-	-	-	-	-	26	A-6a (V)	
		48	2 3 3	8	100	SS-33	1.25	-	-	-	-	-	-	-	-	28	A-6a (V)	
W 590.7		49	0 0 3	4	100	SS-34	0.50	1	0	21	45	33	29	18	11	29	A-6a (8)	
	589.7	50																
LOOSE TO MEDIUM DENSE, GRAY, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL, SLIGHTLY VARVED WITH OCCASIONAL CLAY LAMINATIONS AND THIN BEDS, WET		51	0 2 2	6	100	SS-35	-	-	-	-	-	-	-	-	-	32	A-4a (V)	
		52	0 4 8	17	100	SS-36	-	7	8	38	29	18	NP	NP	NP	22	A-4a (2)	
	586.7	53																
HARD, GRAY, **SILT**, "AND" CLAY, LITTLE SAND, TRACE GRAVEL, DAMP		54	9 38 50/2"	-	93	SS-37	4.50	1	4	9	50	36	29	21	8	14	A-4b (8)	
	585.2	55																
TR		56	50/5"	-	100	SS-38	-	-	-	-	-	-	-	-	-	11	Rock (V)	
CLAYSTONE, BROWNISH-GRAY TO REDDISH-BROWN, HIGHLY WEATHERED, VERY WEAK.		57																
		58	50/5"	-	100	SS-39	-	-	-	-	-	-	-	-	-	8	Rock (V)	
		59																
		60	50/5"	-	100	SS-40	-	-	-	-	-	-	-	-	-	8	Rock (V)	
		61																

PID: 108676	SFN:	PROJECT: MOE-7-07.55	STATION / OFFSET: 400+47, 10' RT.	START: 8/1/18	END: 8/2/18	PG 3 OF 3	B-002-0-18

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
	581.1																	
	580.2	63	50/3"	-	100	SS-41	-	-	-	-	-	-	-	-	-	11	Rock (V)	
CLAYSTONE, REDDISH-BROWN, SEVERELY TO HIGHLY WEATHERED, VERY WEAK, VERY FINE GRAINED, MEDIUM TO THICK BEDDED, OCCASIONAL CLAY SEAMS, FRACTURED WITH SLICKENSIDED SURFACES ALONG BEDDING JOINTS; RQD 32%, REC 100%.	577.1	64 65	40		100	NQ											CORE	
SHALE, GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, WEAK TO SLIGHTLY STRONG, VERY FINE TO FINE GRAINED, THIN TO MEDIUM BEDDED, CALCAREOUS, SEAMS OF ARGILLACEOUS SHALE, OCCASIONAL SILTSTONE SEAMS, SLIGHTLY FRACTURED WITH ROUGH SURFACES ALONG BEDDING JOINTS; RQD 38%, REC 96%. @ 68.5' : Qu = 860 psi		66 67 68 69	55		87	NQ											CORE	
		70 71 72 73	31		100	NQ											CORE	
	564.4	74 75 76 77 78	26		98	NQ											CORE	
SILTSTONE, GRAY, SLIGHTLY TO MODERATELY WEATHERED, WEAK TO SLIGHTLY STRONG, FINE GRAINED, LAMINATED, OCCASIONAL THIN SHALE PARTINGS AND SEAMS, FRACTURED WITH SLIGHTLY ROUGH SURFACES ALONG BEDDING JOINTS; RQD 0%, REC 100%.		79 80 81	0		100	NQ											CORE	
	560.2	EOB 83																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH 4 BAGS BENTONITE GROUT; MIXED 80 GAL. WATER

PROJECT: MOE-7-07.55	DRILLING FIRM / OPERATOR: CENTRAL STAR / TS	DRILL RIG: DIEDRICH D-50	STATION / OFFSET: 400+39, 62' RT.	EXPLORATION ID B-002-1-20
TYPE: LANDSLIDE	SAMPLING FIRM / LOGGER: HDR / AKB	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 7	
PID: 108676 SFN:	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 11/26/19	ELEVATION: 627.7 (MSL) EOB: 64.5 ft.	PAGE 1 OF 3
START: 8/12/20 END: 8/12/20	SAMPLING METHOD: SPT / ST / NQ2	ENERGY RATIO (%): 86.8	LAT / LONG: 39.616651, -80.930705	

MATERIAL DESCRIPTION AND NOTES	ELEV. 627.7	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	INCL.
STIFF TO VERY STIFF, BROWN, **CLAY**, SOME SILT, LITTLE GRAVEL, TRACE SAND, DAMP		1	3 3 4	10	83	SS-1	3.75	-	-	-	-	-	-	-	-	24	A-7-6 (V)	
	624.7	2	6 4 3	10	100	SS-2	2.75	12	5	2	34	47	51	25	26	20	A-7-6 (17)	
MEDIUM STIFF TO STIFF, BROWN, **ELASTIC CLAY**, "AND" SILT, TRACE GRAVEL, TRACE SAND, DAMP	623.2	3 4	2 2 2	6	17	SS-3	2.25	1	3	3	35	58	61	30	31	19	A-7-5 (20)	
MEDIUM STIFF TO STIFF, RED-BROWN, **CLAY**, "AND" SILT, LITTLE GRAVEL, TRACE SAND, DAMP		5 6	2 3 2	7	61	SS-4	1.75	-	-	-	-	-	-	-	-	22	A-7-6 (V)	
		7 8	2 3 4	10	44	SS-5	1.25	-	-	-	-	-	-	-	-	23	A-7-6 (V)	
		9 10	2 3 4	10	72	SS-6	2.00	14	4	3	36	43	44	23	21	21	A-7-6 (13)	
	617.2		2 3 6	13	50	SS-7	2.00	-	-	-	-	-	-	-	-	19	A-7-6 (V)	
STIFF TO VERY STIFF, BROWN TO RED-BROWN, **CLAY**, "AND" SILT, TRACE GRAVEL, TRACE SAND, DAMP		11 12	5 5 6	16	100	SS-8	3.00	-	-	-	-	-	-	-	-	25	A-7-6 (V)	
		13	5 5 6	16	100	SS-9	2.25	-	-	-	-	-	-	-	-	23	A-7-6 (V)	
		14 15			79	ST-10	-	1	0	1	52	46	50	26	24	22	A-7-6 (16)	
		16	6 7 9	23	100	SS-11	3.25	-	-	-	-	-	-	-	-	23	A-7-6 (V)	
		17 18	5 6 7	19	100	SS-12	3.00	-	-	-	-	-	-	-	-	23	A-7-6 (V)	
	607.7	19	4 4 6	14	100	SS-13	1.75	-	-	-	-	-	-	-	-	23	A-7-6 (V)	
STIFF, BROWN, **SILTY CLAY**, TRACE SAND, MOIST	606.2	20	3 3 4	10	100	SS-14	1.50	0	0	3	58	39	40	24	16	27	A-6b (10)	
VERY SOFT TO SOFT, BROWN, **SILT AND CLAY**, SOME SAND, MOIST		21 22	3 3 4	10	100	SS-15	0.50	-	-	-	-	-	-	-	-	25	A-6a (V)	
	603.2	23	0 0 0	0	100	SS-16	0.50	0	0	21	47	32	32	19	13	23	A-6a (9)	
MEDIUM STIFF TO STIFF, BROWNISH-GRAY, **SANDY SILT**, SOME CLAY, MOIST		24 25	2 3 4	10	100	SS-17	0.50	-	-	-	-	-	-	-	-	24	A-4a (V)	
		26			100	ST-18	-	0	0	25	47	28	29	19	10	24	A-4a (8)	
	599.7	W 599.7 27																
MEDIUM STIFF, BROWNISH-GRAY, **SILT**, SOME CLAY, LITTLE SAND, WET		28 29	2 2 2	6	100	SS-19	-	-	-	-	-	-	-	-	-	23	A-4b (V)	
			2															

PID: 108676	SFN:	PROJECT: MOE-7-07.55	STATION / OFFSET: 400+39, 62' RT.	START: 8/12/20	END: 8/12/20	PG 2 OF 3	B-002-1-20

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)	INCL.
	597.7																	
	596.7		2 2	6	100	SS-20	-	0	0	18	53	29	29	19	10	27	A-4b (8)	
SOFT TO MEDIUM STIFF, BROWNISH-GRAY, **SANDY SILT**, SOME CLAY, WET		31	0 0 3	4	100	SS-21	1.00	-	-	-	-	-	-	-	-	28	A-4a (V)	
	593.7	32																
STIFF, GRAY, **SANDY SILT**, SOME CLAY, WET		33	2 2 3	7	100	SS-22	0.75	0	0	24	46	30	29	19	10	27	A-4a (8)	
@ 34.0' - 40.5': contains sand seams		34	2 2 4	9	100	SS-23	-	-	-	-	-	-	-	-	-	27	A-4a (V)	
		35																
		36	2 3 3	9	100	SS-24	-	-	-	-	-	-	-	-	-	25	A-4a (V)	
		37																
		38	2 3 4	10	100	SS-25	-	0	0	38	38	24	27	19	8	34	A-4a (5)	
		39	2 3 3	9	100	SS-26	-	-	-	-	-	-	-	-	-	26	A-4a (V)	
	587.2	40																
HARD, GRAY AND BROWN, **SANDY SILT**, SOME GRAVEL, LITTLE CLAY, DAMP		41	6 6 36	61	78	SS-27	-	-	-	-	-	-	-	-	-	8	A-4a (V)	
		42	30 23 40	91	100	SS-28	-	23	7	26	29	15	21	16	5	10	A-4a (2)	
	584.7	43																
DENSE TO VERY DENSE, RED BROWN AND GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, DAMP		44	7 18 24	61	44	SS-29	-	-	-	-	-	-	-	-	-	14	A-2-4 (V)	
		45	16 21 30	74	83	SS-30	-	32	12	25	21	10	20	17	3	10	A-2-4 (0)	
	581.7	46																
CLAYSTONE, GRAY AND RED-BROWN, SEVERELY WEATHERED, VERY WEAK, ARENACEOUS.		TR	6 50/5"	-	82	SS-31	-	-	-	-	-	-	-	-	-	17	Rock (V)	
		47																
		48	32 50/6"	-	92	SS-32	-	22	4	3	53	18	28	19	9	14	Rock (V)	
		49																
		50	45 50/5"	-	100	SS-33	-	-	-	-	-	-	-	-	-	11	Rock (V)	
		51	35 50/2"	-	100	SS-34	-	-	-	-	-	-	-	-	-	9	Rock (V)	
		52	50/4"	-	100	SS-35	-	-	-	-	-	-	-	-	-	6	Rock (V)	
	574.2	53																
SILTSTONE, GRAY, HIGHLY WEATHERED, VERY WEAK TO WEAK, THIN BEDDED, ARGILLACEOUS, CALCAREOUS, JOINT DISCONTINUITIES, FRACTURED TO HIGHLY FRACTURED, OPEN, SLIGHTLY ROUGH TO SLICKENSIDED, BLOCKY, FAIR TO POOR SURFACE CONDITIONS; RQD 69%, REC 100%.		54	60/2"	-	100	SS-36	-	-	-	-	-	-	-	-	-	8	Rock (V)	
	572.1	55																
SILTSTONE, GRAY, MODERATELY WEATHERED, SLIGHTLY STRONG, MEDIUM BEDDED, ARENACEOUS, CALCAREOUS, JOINT DISCONTINUITIES, MODERATELY FRACTURED TO FRACTURED, NARROW, SLIGHTLY ROUGH, FAIR SURFACE CONDITIONS; RQD 76%, REC 100%.		56																
@ 56.2' - 56.3': contains shale interbed		57	62		100	NQ2-1											CORE	
@ 57.3' - 57.5': contains shale interbed		58																
@ 58.5' - 58.9' : qu = 1,675 psi		59																
		60																
		61																

PID: 108676	SFN:	PROJECT: MOE-7-07.55	STATION / OFFSET: 400+39, 62' RT.	START: 8/12/20	END: 8/12/20	PG 3 OF 3	B-002-1-20

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)	INCL.
	565.6		88		100	NQ2-2											CORE	
@ 64.1' - 64.5': sandstone	563.2	63 64 EOB																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED BENTONITE CHIPS; PUMPED 25 LB. BENTONITE POWDER; 94 LB. CEMENT; 50 GAL. WATER

PROJECT: MOE-7-07.55	DRILLING FIRM / OPERATOR: CENTRAL STAR / TS	DRILL RIG: DIEDRICH D-50	STATION / OFFSET: 400+47, 102' RT.	EXPLORATION ID B-002-2-20
TYPE: RETAINING WALL	SAMPLING FIRM / LOGGER: HDR / AKB	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 7	
PID: 108676 SFN:	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 11/26/19	ELEVATION: 610.1 (MSL) EOB: 44.4 ft.	PAGE 1 OF 2
START: 8/11/20 END: 8/11/20	SAMPLING METHOD: SPT / ST / NQ2	ENERGY RATIO (%): 86.8	LAT / LONG: 39.616568, -80.930611	

MATERIAL DESCRIPTION AND NOTES	ELEV. 610.1	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
STIFF TO VERY STIFF, BROWN, **CLAY**, "AND" SILT, TRACE GRAVEL, TRACE SAND, DAMP		1	5 5 5	14	78	SS-1	2.50	3	4	2	40	51	51	27	24	15	A-7-6 (16)	
	606.6	2																
STIFF TO VERY STIFF, RED-BROWN, **ELASTIC CLAY**, "AND" SILT, TRACE GRAVEL, TRACE SAND, DAMP		3																
	604.1	4	2 4 3	10	94	SS-2	4.00	3	5	2	35	55	56	31	25	25	A-7-5 (17)	
MEDIUM STIFF TO STIFF, BROWN, **SANDY SILT**, SOME CLAY, MOIST		5																
		6	3 2 2	6	100	SS-3	-	-	-	-	-	-	-	-	-	29	A-4a (V)	
		7																
		8	2 3 4	10	100	SS-4	0.50	-	-	-	-	-	-	-	-	25	A-4a (V)	
		9			100	ST-5	0.75	0	0	36	43	21	29	21	8	23	A-4a (6)	
		10																
		11	2 2 2	6	100	SS-6	-	-	-	-	-	-	-	-	-	25	A-4a (V)	
	594.1	12																
VERY SOFT, BROWN, **SILT AND CLAY**, SOME SAND, MOIST	W 594.1	13	0 0 0	0	100	SS-7	-	0	0	20	50	30	33	21	12	28	A-6a (9)	
	591.6	14																
LOOSE TO MEDIUM DENSE, BROWN TRACE GRAY, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, WET		15	4 2 3	7	89	SS-8	-	-	-	-	-	-	-	-	-	18	A-2-4 (V)	
		16																
		17	5 7 4	16	100	SS-9	-	26	4	37	21	12	NP	NP	NP	23	A-2-4 (0)	
	586.6	18																
MEDIUM DENSE, BROWN AND GRAY, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, WET		19	6 8 11	27	67	SS-10	-	50	9	24	11	6	NP	NP	NP	14	A-1-b (0)	
	584.1	20																
DENSE, RED-BROWN AND GRAY, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, WET		21	13 14 15	42	83	SS-11	-	34	9	22	22	13	20	17	3	12	A-2-4 (0)	
	581.6	22																
		23	6 7 8	22	100	SS-12	-	38	9	24	19	10	20	16	4	13	A-2-4 (0)	

PID: 108676	SFN:	PROJECT: MOE-7-07.55	STATION / OFFSET: 400+47, 102' RT.	START: 8/11/20	END: 8/11/20	PG 2 OF 2	B-002-2-20

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
MEDIUM DENSE TO DENSE, RED-BROWN AND GRAY, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, WET *(continued)*	580.1	31																
VERY DENSE, GRAY, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, DAMP	578.1	32	15 30 29	85	100	SS-13	-	-	-	-	-	-	-	-	-	9	A-2-4 (V)	
@ 33.5' - 35': brown and gray, damp	575.7	33																
LIMESTONE, GRAY, HIGHLY WEATHERED, MODERATELY STRONG TO STRONG, THIN BEDDED, MODERATELY FRACTURED, OPEN, VERY ROUGH, VERY BLOCKY, GOOD TO FAIR SURFACE CONDITIONS; RQD 55%, REC 100%.	574.9	TR 34	30 50/5"	-	100	SS-14	-	37	16	19	18	10	20	17	3	13	A-2-4 (0)	
SILTSTONE, BROWN, SEVERELY WEATHERED, VERY WEAK, THIN BEDDED, ARENACEOUS, JOINT DISCONTINUITIES, HIGHLY FRACTURED, NARROW, SLIGHTLY ROUGH, LAMINATED/SHEARED, POOR SURFACE CONDITIONS, OBSERVED IRON STAINING; RQD 0%, REC 90%.	572.7	35 36 37 38 39 40 41	37		97	NQ2-1											CORE	
SILTSTONE, GRAY, MODERATELY WEATHERED, MODERATELY STRONG, THICK BEDDED, ARENACEOUS, CALCAREOUS, JOINT DISCONTINUITIES, MODERATELY FRACTURED TO FRACTURED, NARROW, SLIGHTLY ROUGH, FAIR SURFACE CONDITIONS; RQD 53%, REC 100%. @ 42.9' - 43.3' : qu = 6,495 psi @ 43.7' - 44.1': sandstone seam	565.7	42 43 EOB 44	50		100	NQ2-2											CORE	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 12.5 LB. BENTONITE POWDER; 94 LB. CEMENT; 50 GAL. WATER

PROJECT: MOE-7-07.55	DRILLING FIRM / OPERATOR: DHDC / A.U.	DRILL RIG: MOBILE B-57 TRACK RIG	STATION / OFFSET: 401+46, 10' RT.	EXPLORATION ID B-003-0-18
TYPE: LANDSLIDE	SAMPLING FIRM / LOGGER: HDR / S. REED	HAMMER: AUTOMATIC HAMMER	ALIGNMENT: SR-7	
PID: 108676 SFN:	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 2/27/18	ELEVATION: 643.1 (MSL) EOB: 84.5 ft.	PAGE 1 OF 3
START: 7/27/18 END: 8/1/18	SAMPLING METHOD: SPT/ST/NQ	ENERGY RATIO (%): 82.7	LAT / LONG: 39.616928, -80.930476	

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
ASPHALT PAVEMENT (8.5 INCHES)	643.1 / 642.4	1																
CONCRETE PAVEMENT (5 INCHES)	642.0	2																
STIFF, BROWNISH-GRAY, **CLAY**, SOME SILT, LITTLE SAND, LITTLE GRAVEL, MOIST (FILL)		3	2 3 4	10	50	SS-1	2.00	14	11	6	24	45	45	24	21	29	A-7-6 (12)	
		4	3 3 4	10	50	SS-2	1.75	-	-	-	-	-	-	-	-	26	A-7-6 (V)	
	638.1	5																
MEDIUM STIFF TO STIFF, REDDISH-BROWN, TRACE GRAY AND TAN, **SILT AND CLAY**, SOME SAND, LITTLE GRAVEL, SEVERAL SANDSTONE AND SHALE FRAGMENTS THROUGHOUT, DAMP		6	2 2 2	6	56	SS-3	1.00	-	-	-	-	-	-	-	-	24	A-6a (V)	
		7	3 3 5	11	61	SS-4	2.75	-	-	-	-	-	-	-	-	22	A-6a (V)	
		8	2 3 10	18	56	SS-5	1.50	-	-	-	-	-	-	-	-	21	A-6a (V)	
@ 9.5' - 10.3' : pushed tube only 8 inches due to large rock fragment at the bottom. The tube was damaged and rejected.		9			94	ST-6	-	-	-	-	-	-	-	-	-	-	A-6a (V)	
		10																
		11	7 4 6	14	11	SS-7	-	-	-	-	-	-	-	-	-	6	A-6a (V)	
		12	3 6 5	15	56	SS-8	3.25	-	-	-	-	-	-	-	-	16	A-6a (V)	
		13	3 6 4	14	72	SS-9	2.00	-	-	-	-	-	-	-	-	18	A-6a (V)	
		14	3 5 6	15	39	SS-10	1.75	-	-	-	-	-	-	-	-	18	A-6a (V)	
		15	3 5 7	17	67	SS-11	2.00	-	-	-	-	-	-	-	-	20	A-6a (V)	
@ 18.0' - 20.0' : Qu = 1445 psf		16			83	ST-12	2.00	16	22	4	22	36	35	21	14	19	A-6a (6)	
		17	2 5 7	17	78	SS-13	2.00	-	-	-	-	-	-	-	-	20	A-6a (V)	
		18	4 7 21	39	100	SS-14	3.50	-	-	-	-	-	-	-	-	18	A-6a (V)	
		19	10 12 11	32	100	SS-15	2.50	-	-	-	-	-	-	-	-	19	A-6a (V)	
@ 24.5' - 26.0' : obtained sample from auger spoils (no SPT recovery)		20	8 8 9	23	0	SS-16	-	-	-	-	-	-	-	-	-	17	A-6a (V)	
		21	6 6 8	19	11	SS-17	2.00	-	-	-	-	-	-	-	-	17	A-6a (V)	
		22	4 8 12	28	100	SS-18	2.50	-	-	-	-	-	-	-	-	16	A-6a (V)	
		23	10 8	40	100	SS-19	2.50	-	-	-	-	-	-	-	-	18	A-6a (V)	

PID: 108676	SFN:	PROJECT: MOE-7-07.55	STATION / OFFSET: 401+46, 10' RT.	START: 7/27/18	END: 8/1/18	PG 2 OF 3	B-003-0-18

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
MEDIUM STIFF TO STIFF, REDDISH-BROWN, TRACE GRAY AND TAN, **SILT AND CLAY**, SOME SAND, LITTLE GRAVEL, SEVERAL SANDSTONE AND SHALE FRAGMENTS THROUGHOUT, DAMP *(continued)*		31	5 15 9	33	100	SS-20	1.50	-	-	-	-	-	-	-	-	19	A-6a (V)	
		32																
		33	6 11 10	29	89	SS-21A	3.00	-	-	-	-	-	-	-	-	18	A-6a (V)	
	609.9					SS-21B	4.50	-	-	-	-	-	-	-	-	-	A-6a (V)	
STIFF TO VERY STIFF, MOTTLED BROWN AND GRAY, **SILT AND CLAY**, LITTLE SAND, MOIST		34	4 7 9	22	100	SS-22	2.00	-	-	-	-	-	-	-	-	25	A-6a (V)	
		35																
		36	5 7 7	19	100	SS-23	2.50	-	-	-	-	-	-	-	-	24	A-6a (V)	
	606.6																	
MEDIUM STIFF, MOTTLED BROWN AND GRAY, **SILT AND CLAY**, TRACE SAND, MOIST @ 36.5' - 38.5' : Qu = 2660 psf		37			98	ST-24	1.25	0	0	14	49	37	31	18	13	23	A-6a (9)	
		38																
		39	3 4 6	14	89	SS-25	0.75	-	-	-	-	-	-	-	-	24	A-6a (V)	
		40																
		41	1 3 3	8	100	SS-26	0.50	-	-	-	-	-	-	-	-	24	A-6a (V)	
		42	0 2 4	8	100	SS-27	0.50	0	0	8	55	37	31	19	12	25	A-6a (9)	
		43																
		44	0 1 2	4	100	SS-28	0.75	-	-	-	-	-	-	-	-	23	A-6a (V)	
		45	0 0 3	4	100	SS-29	0.50	-	-	-	-	-	-	-	-	26	A-6a (V)	
		46																
		47	0 2 2	6	100	SS-30	0.50	-	-	-	-	-	-	-	-	24	A-6a (V)	
		48																
		49	0 2 2	6	100	SS-31	0.50	-	-	-	-	-	-	-	-	25	A-6a (V)	
		50	0 3 2	7	100	SS-32	0.75	0	0	8	54	38	30	19	11	27	A-6a (8)	
	591.6	51 W 591.6	2 3 3	8	100	SS-33A	1.25	-	-	-	-	-	-	-	-	27	A-6a (V)	
						SS-33B	-	-	-	-	-	-	-	-	-	-	A-4a (V)	
LOOSE TO MEDIUM DENSE, GRAY, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL, WET		52	0 0 1	1	56	SS-34	-	-	-	-	-	-	-	-	-	27	A-4a (V)	
		53																
		54	0 6 7	18	89	SS-35	-	3	5	49	25	18	NP	NP	NP	24	A-4a (2)	
		55																
		56	4 4 6	14	61	SS-36	-	-	-	-	-	-	-	-	-	28	A-4a (V)	
	586.6																	
HARD, GRAY, **SILT AND CLAY**, LITTLE SAND, DAMP		57	6 20 41	84	72	SS-37	4.50	0	2	10	45	43	31	20	11	17	A-6a (8)	
		58																
	583.6	59	7 45 50/3"	-	73	SS-38	4.50	-	-	-	-	-	-	-	-	13	A-6a (V)	
CLAYSTONE, REDDISH-BROWN, TRACE GRAY, HIGHLY WEATHERED, VERY WEAK.		TR 60	17 50/5"	-	45	SS-39	-	-	-	-	-	-	-	-	-	14	Rock (V)	
		61	29 50/3"	-	89	SS-40	-	-	-	-	-	-	-	-	-	10	Rock (V)	

PID: 108676	SFN:	PROJECT: MOE-7-07.55	STATION / OFFSET: 401+46, 10' RT.	START: 7/27/18	END: 8/1/18	PG 3 OF 3	B-003-0-18

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
CLAYSTONE, REDDISH-BROWN, TRACE GRAY, HIGHLY WEATHERED, VERY WEAK. *(continued)*	581.0	63	50/5"	-	100	SS-41	-	-	-	-	-	-	-	-	-	9	Rock (V)	
	578.6	64	50/4"	-	100	SS-42	-	-	-	-	-	-	-	-	-	4	Rock (V)	
SHALE, GRAY, SEVERELY TO HIGHLY WEATHERED, VERY WEAK TO WEAK, VERY FINE GRAINED, THIN BEDDED, FRACTURED WITH SLIGHTLY ROUGH TO ROUGH SURFACES ALONG HORIZONTAL BEDDING JOINTS, NUMEROUS CLAY SEAMS; RQD 14%, REC 100%.	575.6	65 66 67	12		100	NQ-1											CORE	
SILTSTONE, GRAY, HIGHLY TO MODERATELY WEATHERED, SLIGHTLY STRONG, FINE GRAINED, LAMINATED TO THIN BEDDED, OCCASSIONAL VERY WEAK TO WEAK SHALE SEAMS, FRACTURED WITH SLIGHTLY ROUGH TO ROUGH SURFACES ALONG BEDDING JOINTS; RQD 14%, REC 100%. @ 69.3' - 69.5' : vertical fracture @ 71.2' - 71.3' : vertical fracture @ 72.5' - 72.8' : vertical fracture	568.1	68 69 70 71 72 73 74	0		100	NQ-2											CORE	
			22		100	NQ-3											CORE	
SHALE, GRAY, MODERATELY WEATHERED, WEAK TO SLIGHTLY STRONG, VERY FINE GRAINED, LAMINATED TO THIN BEDDED, SLIGHTLY FRACTURED WITH SLIGHTLY ROUGH TO ROUGH SURFACES ALONG HORIZONTAL BEDDING JOINTS, SEVERAL INTERBEDDED SILTSTONE SEAMS; RQD 54%, REC 100%. @ 75.9' : Qu = 2255 psi	563.1	75 76 77 78 79	54		100	NQ-4											CORE	
SILTSTONE, GRAY, SLIGHTLY WEATHERED, SLIGHTLY STRONG, VERY FINE TO FINE GRAINED, LAMINATED TO THIN BEDDED, OCCASIONAL CROSS-BEDDING IN SILTSTONE, OCCASIONAL SHALE PARTINGS, FRACTURED WITH SLIGHTLY ROUGH TO ROUGH SURFACES ALONG HORIZONTAL BEDDING JOINTS; RQD 43%, REC 100%.	558.6	80 81 82 83 84 EOB	0		100	NQ-5											CORE	
			15		100	NQ-6											CORE	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH 4 BAGS BENTONITE GROUT; MIXED 87 GAL. WATER

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 12/16/20 08:16 - C:\PW\WORKING\EAST01\D1679058\20180730_MOE-7-7.55_2017 10-AA_TYPED LOGS (UPDATED DESCRIPTIONS).G

PROJECT: MOE-7-07.55	DRILLING FIRM / OPERATOR: DHDC / A.U.	DRILL RIG: MOBILE B-57 TRACK RIG	STATION / OFFSET: 402+45, 10' RT.	EXPLORATION ID B-004-0-18
TYPE: LANDSLIDE	SAMPLING FIRM / LOGGER: HDR / S. REED	HAMMER: AUTOMATIC HAMMER	ALIGNMENT: SR-7	
PID: 108676 SFN:	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 2/27/18	ELEVATION: 643.2 (MSL) EOB: 90.5 ft.	PAGE 1 OF 3
START: 7/26/18 END: 7/26/18	SAMPLING METHOD: SPT/ST/NQ	ENERGY RATIO (%): 82.7	LAT / LONG: 39.617076, -80.930180	

MATERIAL DESCRIPTION AND NOTES	ELEV. 643.2	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 PAVEMENT (10 INCHES)	642.4	1																
CONCRETE PAVEMENT (6 INCHES)	641.9																	
STIFF, BROWN, **SILT AND CLAY**, "AND" SAND, LITTLE GRAVEL, MOIST (FILL)	639.7	2	4 3 5	11	11	SS-1	-	12	24	12	22	30	36	24	12	16	A-6a (4)	
STIFF TO VERY STIFF, REDDISH-BROWN, TRACE GRAY, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, MOIST		3																
		4	2 2 2	6	22	SS-2	1.25	-	-	-	-	-	-	-	-	21	A-6a (V)	
		5																
		6																
		7	2 3 5	11	44	SS-3	2.50	-	-	-	-	-	-	-	-	25	A-6a (V)	
		8																
		9																
		10	3 5 6	15	56	SS-4	2.50	-	-	-	-	-	-	-	-	22	A-6a (V)	
		11																
@ 11.0' - 13.0' : Qu = 4100 psf @ 11.0' - 13.0' : rock at tip of sample ST-5 (slightly damaged at bottom)		12			75	ST-5	-	8	17	8	24	43	35	22	13	17	A-6a (8)	
		13	5 6 8	19	67	SS-6	3.50	-	-	-	-	-	-	-	-	18	A-6a (V)	
		14																
		15																
		16	4 5 8	18	67	SS-7	3.25	-	-	-	-	-	-	-	-	18	A-6a (V)	
		17																
		18	3 5 9	19	72	SS-8	2.25	-	-	-	-	-	-	-	-	18	A-6a (V)	
	623.7	19																
VERY STIFF, BROWN AND TAN, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, MOIST		20																
		21	4 9 8	23	72	SS-9	2.75	-	-	-	-	-	-	-	-	16	A-6a (V)	
		22																
		23	4 6 10	22	78	SS-10	3.50	2	19	5	32	42	35	22	13	18	A-6a (9)	
		24																
		25																
		26	7 7 8	21	67	SS-11	1.75	-	-	-	-	-	-	-	-	17	A-6a (V)	
	616.2	27																
VERY STIFF, REDDISH-BROWN, TRACE GRAY, **SILT AND CLAY**, LITTLE SAND, MOIST		28	4 8 11	26	100	SS-12	3.25	0	9	7	38	46	37	23	14	20	A-6a (10)	
		29																

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 STIFF, REDDISH-BROWN, TRACE GRAY, **SILT AND CLAY**, LITTLE SAND, MOIST *(continued)*	613.2	31	6 9 9	25	100	SS-13	3.00	-	-	-	-	-	-	-	-	21	A-6a (V)	
		32																
	610.2	33	7 7 8	21	100	SS-14A	2.50	-	-	-	-	-	-	-	-	-	A-6a (V)	
STIFF, REDDISH-BROWN TO GRAY, **SILTY CLAY**, TRACE SAND, MOIST		34			-	SS-14B	1.50	-	-	-	-	-	-	-	-	29	A-6b (V)	
		35																
		36	4 7 8	21	100	SS-15	2.25	0	1	1	52	46	37	21	16	23	A-6b (10)	
	605.7	37																
MEDIUM STIFF, GRAYISH-BROWN WITH TRACE REDDISH-BROWN AND GRAY, **SILT AND CLAY**, LITTLE SAND, MOIST		38	3 4 5	12	100	SS-16	0.75	0	0	11	50	39	32	20	12	23	A-6a (9)	
		39																
@ 40.0' - 42.0' : Attempted undisturbed shelby tube, but sample was not recovered. An SPT sample was then driven from 40.0' to 41.5'.		40																
		41			94	ST-17	0.75	-	-	-	-	-	-	-	-	26	A-6a (V)	
	601.2	42																
MEDIUM STIFF, BROWNISH-GRAY, **SANDY SILT**, SOME CLAY, MOIST		43	0 3 4	10	100	SS-18	0.75	-	-	-	-	-	-	-	-	24	A-4a (V)	
		44																
		45																
@ 45' : occasional thin wet silty sand seam		46	0 2 3	7	100	SS-19	0.75	0	0	29	46	25	24	18	6	23	A-4a (7)	
		47																
		48	0 3 2	7	100	SS-20	0.75	-	-	-	-	-	-	-	-	25	A-4a (V)	
@ 47.5' : slightly varved		49																
		50																
		51	0 2 4	8	100	SS-21	0.75	-	-	-	-	-	-	-	-	24	A-4a (V)	
W 591.2		52																
		53	0 7 5	17	100	SS-22	1.00	-	-	-	-	-	-	-	-	25	A-4a (V)	
@ 52.5' : several thin wet silty sand seams		54																
		55																
	587.2	56	8 17 50/2"	-	100	SS-23	-	-	-	-	-	-	-	-	-	20	A-4a (V)	
DENSE, OLIVE-BROWN AND GRAY, **GRAVEL WITH SAND AND SILT**, TRACE CLAY, MOIST TO WET		57																
		58	30 50/1"	-	100	SS-24	-	-	-	-	-	-	-	-	-	3	A-2-4 (V)	
		59																
		60																
		61	11 23 25	66	78	SS-25	-	23	21	21	25	10	NP	NP	NP	16	A-2-4 (0)	
	581.2																	

PID: 108676	SFN:	PROJECT: MOE-7-07.55	STATION / OFFSET: 402+45, 10' RT.	START: 7/26/18	END: 7/26/18	PG 3 OF 3	B-004-0-18

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
HARD, REDDISH-BROWN, TRACE GRAY, **SANDY SILT**, SOME CLAY, DAMP *(continued)*	581.1	63	15 35 48	114	72	SS-26	4.50	0	13	16	36	35	29	21	8	17	A-4a (7)	
		64																
		65																
		66	15 34 47	112	83	SS-27	4.50	-	-	-	-	-	-	-	-	17	A-4a (V)	
		67																
	575.7	TR																
SHALE, BLUISH-GRAY, HIGHLY WEATHERED, WEAK.		68	50/3"	-	100	SS-28	-	-	-	-	-	-	-	-	-	16	Rock (V)	
		69																
	572.7	70	50/4"	-	100	SS-29	-	-	-	-	-	-	-	-	-	4	Rock (V)	
SHALE, GRAY, MODERATELY TO HIGHLY WEATHERED, VERY WEAK TO WEAK, VERY FINE GRAINED, LAMINATED TO THIN BEDDED, OCCASIONAL CALCAREOUS SEAMS, OCCASIONAL CLAY SEAMS, MODERATELY FRACTURED WITH SLIGHTLY ROUGH SURFACES ALONG HORIZONTAL BEDDING JOINTS; RQD 32%, REC 96%.		71																
		72																
		73	28		100	NQ-1											CORE	
		74																
		75																
		76																
		77																
		78	36		91	NQ-2											CORE	
		79																
	562.7	80																
SILTSTONE, GRAY, MODERATELY WEATHERED, WEAK TO SLIGHTLY STRONG, VERY FINE GRAINED, THIN TO MEDIUM BEDDED, OCCASIONAL THIN SHALE PARTINGS, MODERATELY FRACTURED WITH ROUGH SURFACES; RQD 19%, REC 94%. @ 83.0' - 83.5' : Qu = 343 psi (very weak seam) @ 83.5' - 83.7' : high angle fracture		81																
		82																
		83	20		94	NQ-3											CORE	
		84																
		85																
	557.3	86																
SHALE, GRAY, HIGHLY WEATHERED, VERY WEAK TO WEAK, VERY FINE GRAINED, THIN BEDDED, INTERBEDDED ZONES OF SLIGHTLY STRONG CALCAREOUS SHALE, FRACTURED TO MODERATELY FRACTURED WITH SLIGHTLY ROUGH SURFACES ALONG HORIZONTAL BEDDING JOINTS; RQD 15%, REC 100%.		87	27		100	NQ-4											CORE	
		88																
		89	0		100	NQ-5											CORE	
	552.7	90 EOB																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH 3.5 BAGS BENTONITE GROUT; MIXED 80 GAL. WATER

PROJECT: MOE-7-07.55	DRILLING FIRM / OPERATOR: CENTRAL STAR / TS	DRILL RIG: DIEDRICH D-50	STATION / OFFSET: 402+36, 98' RT.	EXPLORATION ID B-004-1-20
TYPE: LANDSLIDE	SAMPLING FIRM / LOGGER: HDR / AKB	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 7	
PID: 108676 SFN:	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 11/26/19	ELEVATION: 612.5 (MSL) EOB: 51.3 ft.	PAGE 1 OF 2
START: 8/10/20 END: 8/11/20	SAMPLING METHOD: SPT / ST / NQ2	ENERGY RATIO (%): 86.8	LAT / LONG: 39.616860, -80.930032	

MATERIAL DESCRIPTION AND NOTES	ELEV. 612.5	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	INCL.
MEDIUM STIFF TO STIFF, BROWN TRACE RED-BROWN, **CLAY**, "AND" SILT, TRACE SAND, MOIST		1	2 2 2	6	67	SS-1	3.50	-	-	-	-	-	-	-	-	33	A-7-6 (V)	
		2	2 2 3	7	72	SS-2	1.75	-	-	-	-	-	-	-	-	30	A-7-6 (V)	
		3	2 1 3	6	89	SS-3	2.00	0	1	8	54	37	45	28	17	32	A-7-6 (12)	
		4	2 2 3	7	94	SS-4	1.50	-	-	-	-	-	-	-	-	25	A-7-6 (V)	
		5	2 1 3	6	100	SS-5	1.50	-	-	-	-	-	-	-	-	26	A-7-6 (V)	
	605.0	6																
MEDIUM STIFF TO STIFF, BROWN, **SILT AND CLAY**, LTTLE SAND, MOIST		7	2 2 2	6	100	SS-6	0.75	-	-	-	-	-	-	-	-	25	A-6a (V)	
		8	2 2 2	6	100	SS-7	0.50	0	0	14	49	37	37	22	15	29	A-6a (10)	
@ 10.5' - 12.5' : qu = 2,190 psf		9			100	ST-8	1.00	0	0	11	54	35	36	23	13	27	A-6a (9)	
	600.0	10																
SOFT, GRAY, **SANDY SILT**, SOME CLAY, WET		11	2 1 1	3	100	SS-9	-	-	-	-	-	-	-	-	-	25	A-4a (V)	
		12	1 1 1	3	89	SS-10	-	0	0	35	40	25	26	18	8	29	A-4a (6)	
	595.5	13	0 2 1	4	100	SS-11	-	-	-	-	-	-	-	-	-	24	A-4a (V)	
VERY SOFT TO SOFT, GRAY, **SILT AND CLAY**, SOME SAND, MOIST		14	0 0 0	0	94	SS-12	0.50	-	-	-	-	-	-	-	-	26	A-6a (V)	
	592.5	15	1 2 4	9	100	SS-13	1.25	0	0	23	48	29	34	20	14	27	A-6a (10)	
	W 592.5	16																
VERY SOFT TO SOFT, GRAY, **SANDY SILT**, SOME CLAY, WET		17	2 2 2	6	100	SS-14	-	-	-	-	-	-	-	-	-	27	A-4a (V)	
		18	0 0 0	0	100	SS-15	-	0	0	35	39	26	27	18	9	26	A-4a (6)	
	589.5	19																
MEDIUM DENSE TO DENSE, BROWN, **GRAVEL AND/OR STONE FRAGMENTS**, SOME SAND, TRACE SILT, TRACE CLAY, WET		20	6 10 14	35	44	SS-16	-	-	-	-	-	-	-	-	-	10	A-1-a (V)	
		21	10 9 8	25	100	SS-17	-	63	13	12	7	5	22	17	5	19	A-1-a (0)	
		22	10 11 15	38	44	SS-18	-	-	-	-	-	-	-	-	-	10	A-1-a (V)	
	585.0	23																
MEDIUM DENSE, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, WET		24	10 8 9	25	39	SS-19	-	-	-	-	-	-	-	-	-	19	A-2-4 (V)	
@ 29' - 30.5': trace wood		25	5 5	20	83	SS-20	-	36	13	27	15	9	NP	NP	NP	25	A-2-4 (0)	
		26																
		27																
		28																
		29																

PID: 108676	SFN:	PROJECT: MOE-7-07.55	STATION / OFFSET: 402+36, 98' RT.	START: 8/10/20	END: 8/11/20	PG 2 OF 2	B-004-1-20

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)	INCL.
	582.5																	
	581.5	31	9															
			12			SS-21A	-	-	-	-	-	-	-	-	-	13	A-2-4 (V)	
DENSE, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, DAMP	580.5	32	13 19	46	100	SS-21B	-	40	12	20	20	8	20	16	4	10	A-2-4 (0)	
MEDIUM DENSE TO DENSE, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, WET		33	6 13 15	41	100	SS-22	-	-	-	-	-	-	-	-	-	9	A-2-4 (V)	
	577.5	34	3 6 11	25	100	SS-23	-	27	29	16	18	10	21	16	5	15	A-2-4 (0)	
VERY DENSE, BROWN TRACE RED-BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, WET		35	13 18 21	56	100	SS-24	-	34	7	32	19	8	NP	NP	NP	16	A-2-4 (0)	
	575.5	36	12 43 50/3"	-	100	SS-25	-	25	6	41	18	10	NP	NP	NP	11	A-2-4 (0)	
VERY DENSE, RED-BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, DAMP	574.5	37																
		TR 38	50/6"	-	33	SS-26	-	-	-	-	-	-	-	-	-	9	Rock (V)	
SHALE, GRAY, SEVERELY WEATHERED, VERY WEAK.		39																
		40	50/4"	-	100	SS-27	-	-	-	-	-	-	-	-	-	17	Rock (V)	
	571.2	41	50/3"	-	100	SS-28	-	-	-	-	-	-	-	-	-	18	Rock (V)	
SILTSTONE, GRAY, HIGHLY WEATHERED, MODERATELY STRONG, MEDIUM BEDDED, JOINT DISCONTINUITIES, MODERATELY FRACTURED TO FRACTURED, NARROW TO TIGHT, SLIGHTLY ROUGH TO VERY ROUGH, LAMINATED, FAIR SURFACE CONDITIONS; RQD 40%, REC 100%. @ 42.5' - 42.9': sandstone seam @ 44.1' - 44.5' : qu = 3,644 psi		42	41		100	NQ2-1											CORE	
		45																
		46																
		47																
		48	59		100	NQ2-2											CORE	
	563.5	49																
SILTSTONE, GRAY, MODERATELY WEATHERED, MODERATELY STRONG, MEDIUM TO THICK BEDDED, ARENACEOUS, JOINT DISCONTINUITIES, SLIGHTLY FRACTURED TO MODERATELY FRACTURED, NARROW, SLIGHTLY ROUGH, INTACT, GOOD TO FAIR SURFACE CONDITIONS; RQD 89%, REC 100%. @ 50.7': grades to sandstone	561.2	50 EOB 51																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 25 LB. BENTONITE POWDER; 94 LB. CEMENT; 50 GAL. WATER

PROJECT: MOE-7-07.55	DRILLING FIRM / OPERATOR: CENTRAL STAR / TS	DRILL RIG: DIEDRICH D-50	STATION / OFFSET: 402+31, 133' RT.	EXPLORATION ID B-004-2-20
TYPE: RETAINING WALL	SAMPLING FIRM / LOGGER: HDR / AKB	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 7	
PID: 108676 SFN:	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 11/26/19	ELEVATION: 603.0 (MSL) EOB: 43.0 ft.	PAGE 1 OF 2
START: 8/11/20 END: 8/11/20	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 86.8	LAT / LONG: 39.616773, -80.929979	

MATERIAL DESCRIPTION AND NOTES	ELEV. 603.0	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
VERY SOFT TO SOFT, BROWNISH-GRAY, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, MOIST			1 0 0	0	83	SS-1	-	-	-	-	-	-	-	-	-	39	A-6b (V)	
			0 0 0	0	100	SS-2	0.25	1	2	15	44	38	40	24	16	32	A-6b (10)	
			0 0 0	0	100	SS-3	1.25	-	-	-	-	-	-	-	-	27	A-6b (V)	
	594.5	W 594.5																
SOFT, GRAYISH-BROWN, **SANDY SILT**, SOME CLAY, WET			1 2 1	4	100	SS-4	-	-	-	-	-	-	-	-	-	25	A-4a (V)	
			5 1 2	4	100	SS-5	-	0	0	40	39	21	25	18	7	25	A-4a (5)	
	589.5																	
MEDIUM DENSE TO DENSE, GRAYISH-BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, WET			5 6 10	23	72	SS-6	-	41	6	28	17	8	NP	NP	NP	11	A-2-4 (0)	
			5 7 15	32	83	SS-7	-	-	-	-	-	-	-	-	-	5	A-2-4 (V)	
	584.5																	
MEDIUM DENSE TO DENSE, BROWN TO RED-BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, WET			9 19 10	42	89	SS-8	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
			11 10 10	29	72	SS-9	-	39	14	26	14	7	NP	NP	NP	16	A-1-b (0)	
			5 9 7	23	83	SS-10	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	
	577.0																	
VERY DENSE, BROWN TO RED-BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, WET	576.0		14 29 32	88	83	SS-11A	-	41	15	22	14	8	NP	NP	NP	11	A-1-b (0)	
						SS-11B	-	62	9	13	11	5	NP	NP	NP	4	A-1-b (0)	
VERY DENSE, GRAY, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, WET	574.5																	
			9 10 14	35	83	SS-12	-	14	6	57	17	6	NP	NP	NP	23	A-3a (0)	

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 12/16/20 08:19 - C:\PW\WORKING\EAST01\D1679058\MOE-7-7.55 10-K BORING LOGS.GPJ

PID: 108676	SFN:	PROJECT: MOE-7-07.55	STATION / OFFSET: 402+31, 133' RT.	START: 8/11/20	END: 8/11/20	PG 2 OF 2	B-004-2-20

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
DENSE, BROWN, **COARSE AND FINE SAND**, LITTLE GRAVEL, LITTLE SILT, TRACE CLAY, WET *(continued)*	573.0																	
	572.0	TR 31																
SHALE, GRAY, SEVERELY WEATHERED, VERY WEAK.			50/6"	-	100	SS-13	-	-	-	-	-	-	-	-	-	11	Rock (V)	
	570.0	32 33																
SILTSTONE, GRAY, MODERATELY WEATHERED, MODERATELY STRONG, MEDIUM TO THICK BEDDED, ARENACEOUS, JOINT DISCONTINUITIES, MODERATELY FRACTURED TO FRACTURED, NARROW, SLIGHTLY ROUGH, INTACT, GOOD SURFACE CONDITIONS; RQD 58%, REC 87%. @ 33' - 33.2': sandstone seam @ 35.2' - 35.7' : qu = 6,872 psi		34	74		100	NQ2-1											CORE	
		35 36 37	40		78	NQ2-2											CORE	
		38 39 40																
	560.7	41	85		95	NQ2-3											CORE	
SANDSTONE, GRAY, SLIGHTLY TO MODERATELY WEATHERED, STRONG, THIN BEDDED, JOINT DISCONTINUITIES, MODERATELY FRACTURED, NARROW, SLIGHTLY ROUGH, INTACT, GOOD SURFACE CONDITIONS; RQD 100%, REC 100%. @ 42.4' - 43.0' - qu = 10,479 psi	560.0	EOB 42 43																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 12.5 LB. BENTONITE POWDER; 94 LB. CEMENT; 50 GAL. WATER

HDR/ODOT
MOE-7-7.75
B-001-0-18

Box 1 of 2

NQ-1 (64-65.5')
REC = 1.35' (90%)
RQD = 0' (0%)

NQ-2 (65.5-69')
REC = 3.35' (96%)
RQD = 0.88' (25%)

NQ-3 (69-74')
REC = 5.0' (100%)
RQD = 1.25' (25%)

HDR/ODOT
MOE-7-7.55
B-001-0-18

Box 2 of 2

NQ-4 (74'-79')

REC: 4.8' (96%)

RQD = 1.75' (35%)

NQ-5 (79'-84')

REC = 5.0' (100%)

RQD = 1.79' (36%)

HDR/ODOT
MOE-7-7.55
B-002-0-18

Box 1 of 2

NQ-1 (63.0'-65.5')	NQ-2 (65.5'-69.75)	NQ-3 (69.75'-73.75')
REC = 2.5' (100%)	REC = 3.7' (87%)	REC = 4.0' (100%)
RQD = 1.0' (40%)	RQD = 2.33' (55%)	RQD = 1.25' (31%)

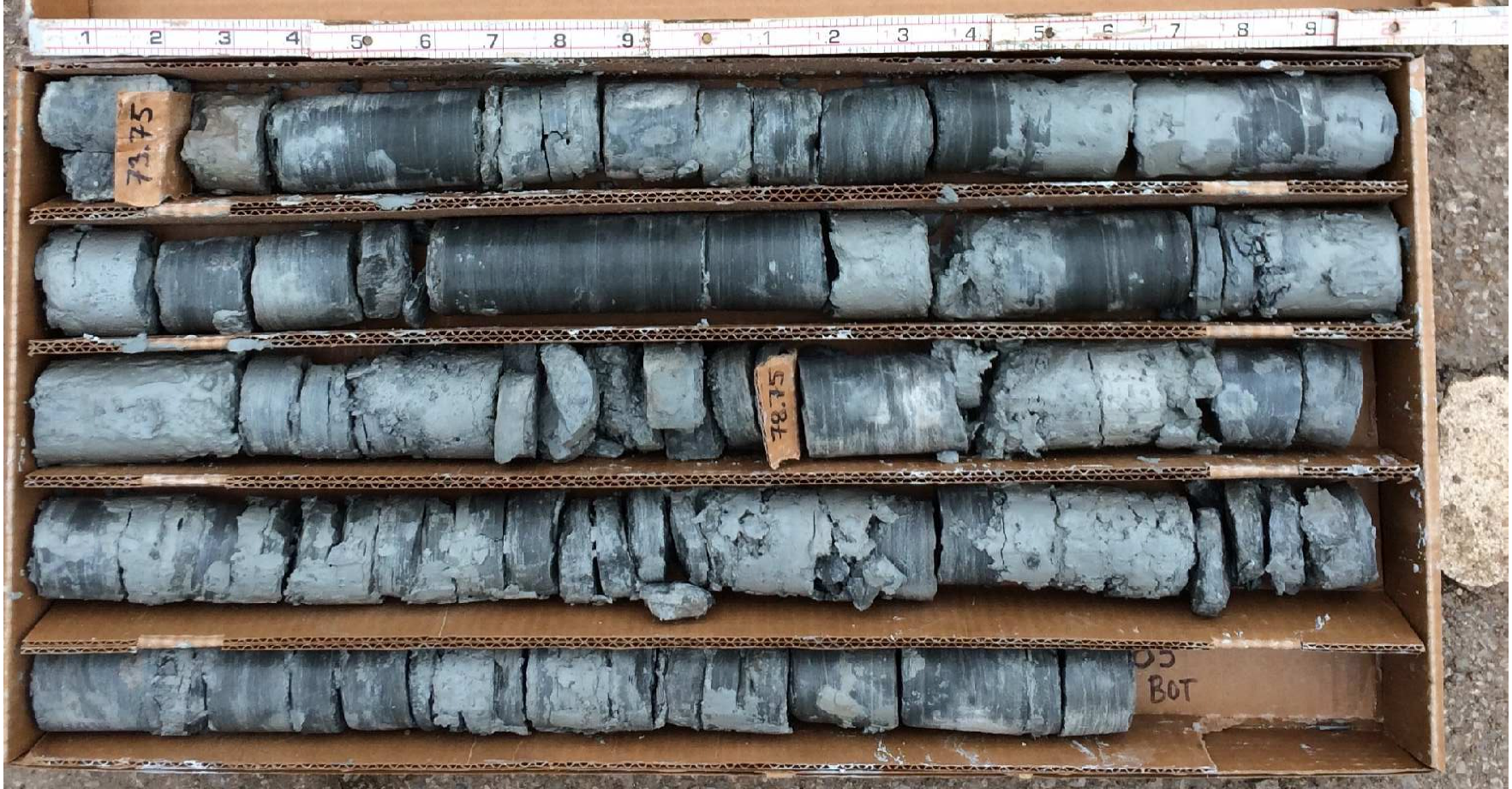
HDR/CDOT

MOE-7-7.55

B-002-0-18

Box 2 of 2

NQ-3 (69.75-73.75)	NQ4 (73.75-78.75)	NQ-5 (78.75-83')
REC = 4.0' (100%)	REC = 4.9 (98%)	REC = 4.25' (100%)
RQD = 1.25' (31%)	RQD = 1.29' (26%)	RQD = 0' (0%)




HDR/ODOT
MOE-7-7.55
B-002-1-20
Box 1 of 1
54.5-64.5
Run
Depth
Rec
RQD
1
54.5-59.5
60/60
37/60
2
59.5-64.5
60/60
53/60


HDR/DOT
PID 108676
Box 1 of 1
MOE-7-7.55
B-002-2-20
34.5 to 44.5
8/11/20
Run Depth Rec RQD
1 34.5-42 87/90 33/90
2 42-44.5 30/30 15/30

HDR/ODOT
MOE-7-7.55
B-003-0-18

Box 1 of 2

NQ-1 (64.5'-68')	NQ-2 (68'-69.5')	NQ-3 (69.5'-74.5')
REC = 3.5' (100%)	REC = 1.5' (100%)	REC = 5.0' (100%)
RQD = 0.42' (12%)	RQD = 0' (0%)	RQD = 1.08' (22%)

HDR/CDOT
MOE-7-7.55
B-003-0-18

Box 2 of 2

NQ-4 (74.5'-79.5')	NQ-5 (79.5'-80.7')	NQ-6 (80.7'-84.5')
REC = 5.0' (100%)	REC = 1.2' (100%)	REC = 3.8' (100%)
RQD = 2.71' (54%)	RQD = 0' (0%)	RQD = 0.58' (15%)

HDR/ODOT
MOE-7-7.55
B-004-0-18

Box 1 of 2

NQ-1 (70.5'-75.5')

REC = 5.0' (100%)
RQD = 1.38' (28%)

NQ-2 (75.5'-80.5')

REC = 4.55' (91%)
RQD = 1.79' (36%)

HDR/ODOT
MOE-7-7.55
B-004-0-18

Box 2 of 2

NQ-3 (80.5'-85.5')
REC = 4.7' (94%)
RQD = 1.0' (20%)

NQ-4 (85.5'-88')
REC = 2.5' (100%)
RQD = 0.67' (27%)

NQ-5 (88'-90.5')
REC = 2.5' (100%)
RQD = 0' (0%)


HDR/ODOT B-004-1-20 Box 1 of 1 MOE-7-7.55 8/10/20
41.3 to 50.3
Run Depth Rec RQD
1 41.3—44.6 39/39 16/39
2 44.6-51.3 81/81 46/81

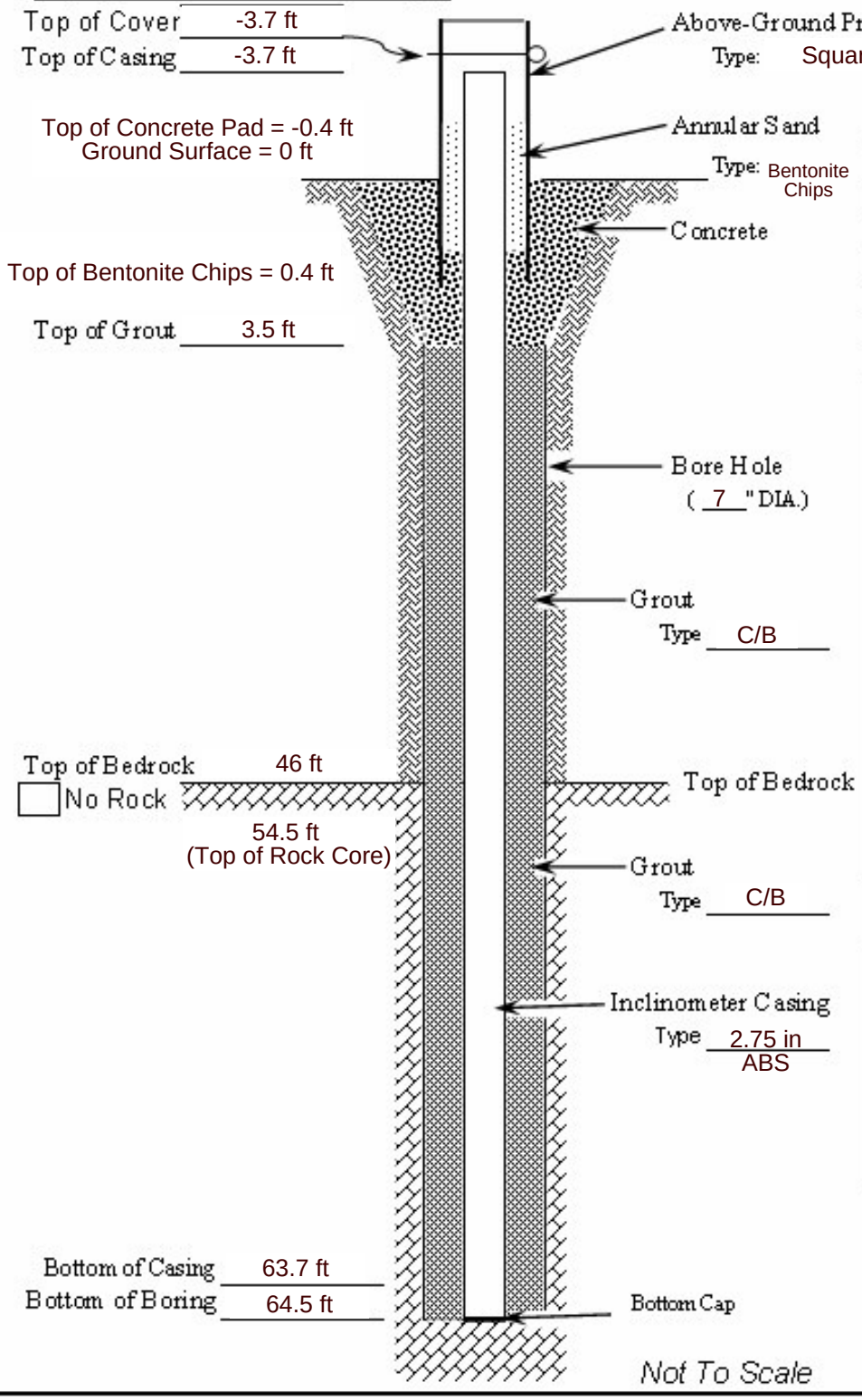

HDR/ODOT
PID 108676
33'-43'
MOE-7-7.55
B-004-2-20
Box 1 of 1
Run Depth Rec RQD
1 33-34.6 19/18 14/18
3 34.6-39.6 47/60 24/60
3 39.6-43 39/41 35/41

Inclinometer Logs and Readings

INCLINOMETER INSTALLATION REPORT

County-Route-Sect.	MOE-7-7.55 (10-K)	Piezometer Number	B-002-1-20
PID Number	108676	Installation Date	8 / 12 / 2020
Ground Elevation	627.7	Inspector Name	A.Baratta
Location: Lat.	39.616651	Long.	-80.930705
Station	400+39	Off-set	62 ft
Off-set Direction	RT		

Depth From Ground Surface (ft)



REMARKS AND NOTES

Water Levels Recordings

Drilling Completion	

A-Axis Azmuth Bearing

A Positive	

INSTALLATION COMMENTS

INSTALLATION COMMENTS

MATERIALS

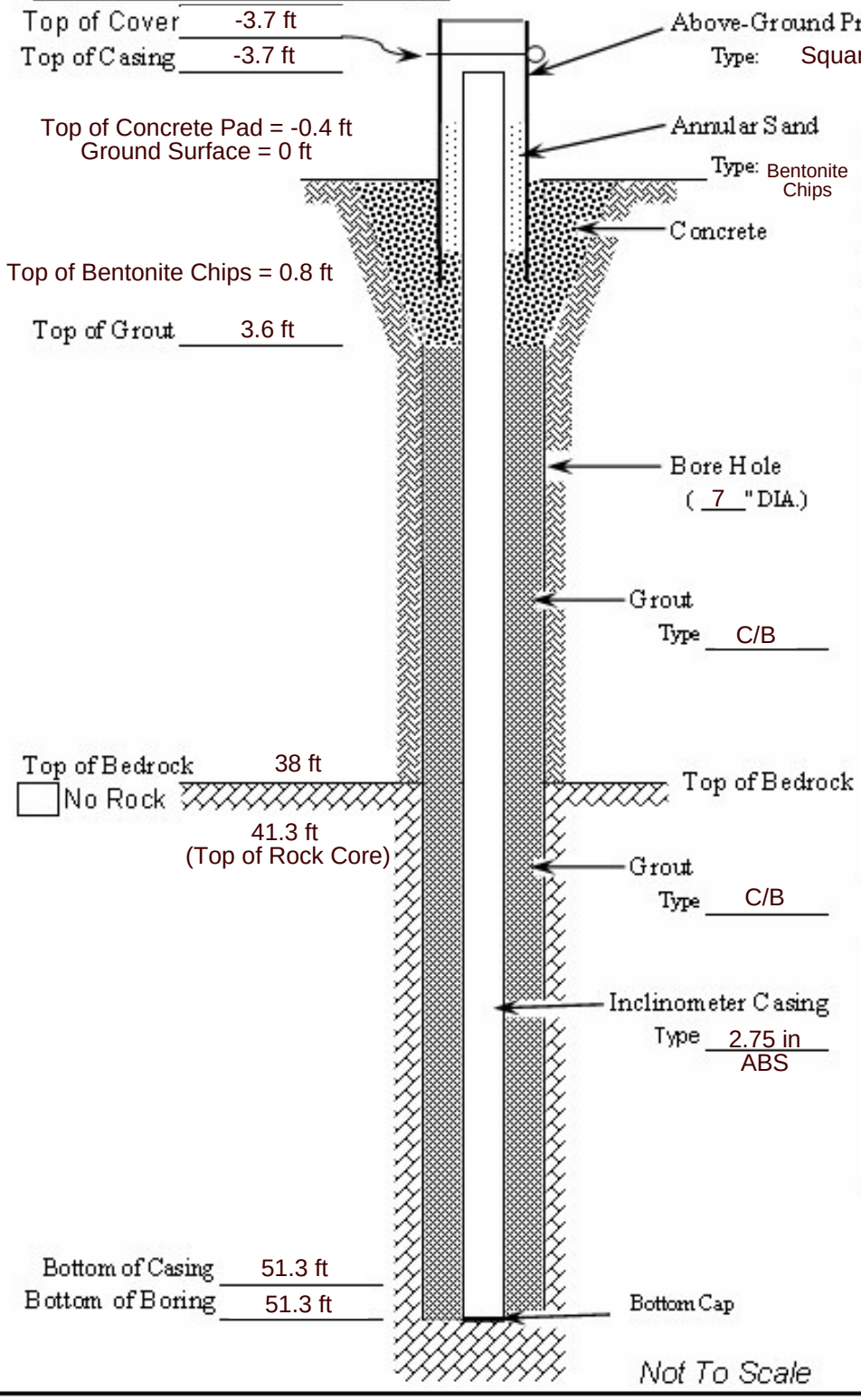
Grout Mix Design

Quik-grout	25	lbs
Portland Cement	94	lbs
Water	50	gal
Inlinometer Pipe	67.4	lft
Protective Cover	(Y) N	

INCLINOMETER INSTALLATION REPORT

County-Route-Sect.	MOE-7-7.55 (10-K)	Piezometer Number	B-004-1-20
PID Number	108676	Installation Date	8 / 11 / 2020
Ground Elevation	612.5	Inspector Name	A.Baratta
Location: Lat.	39.616860	Long.	-80.930032
Station	402+36	Off-set	98 ft
Off-set Direction	RT		

Depth From Ground Surface (ft)



REMARKS AND NOTES

Water Levels Recordings

Drilling Completion	

A-Axis Azmuth Bearing

A Positive	

INSTALLATION COMMENTS

INSTALLATION COMMENTS

MATERIALS

Grout Mix Design

Quik-grout	25	lbs
Portland Cement	94	lbs
Water	50	gal
Inlinometer Pipe	55	lft
Protective Cover	(Y) N	

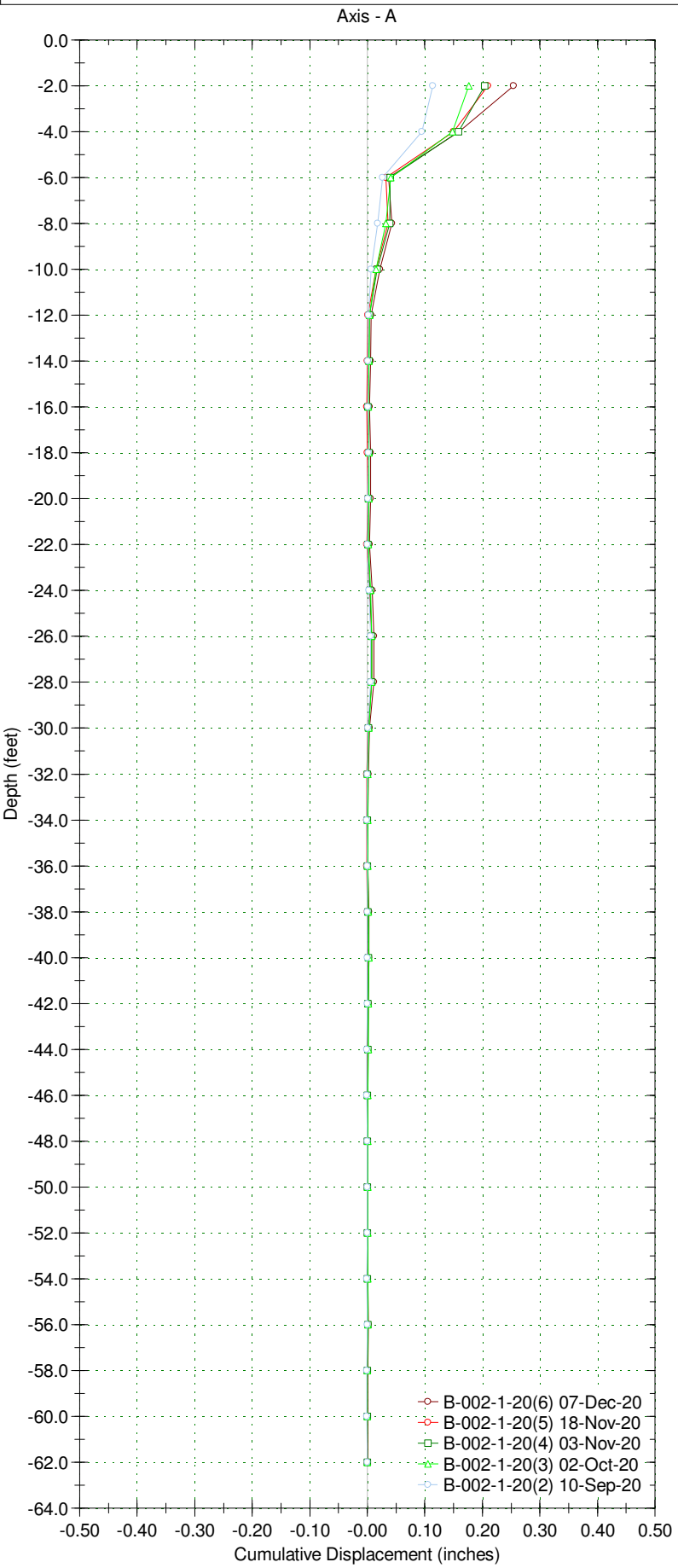
RST Instruments Ltd.

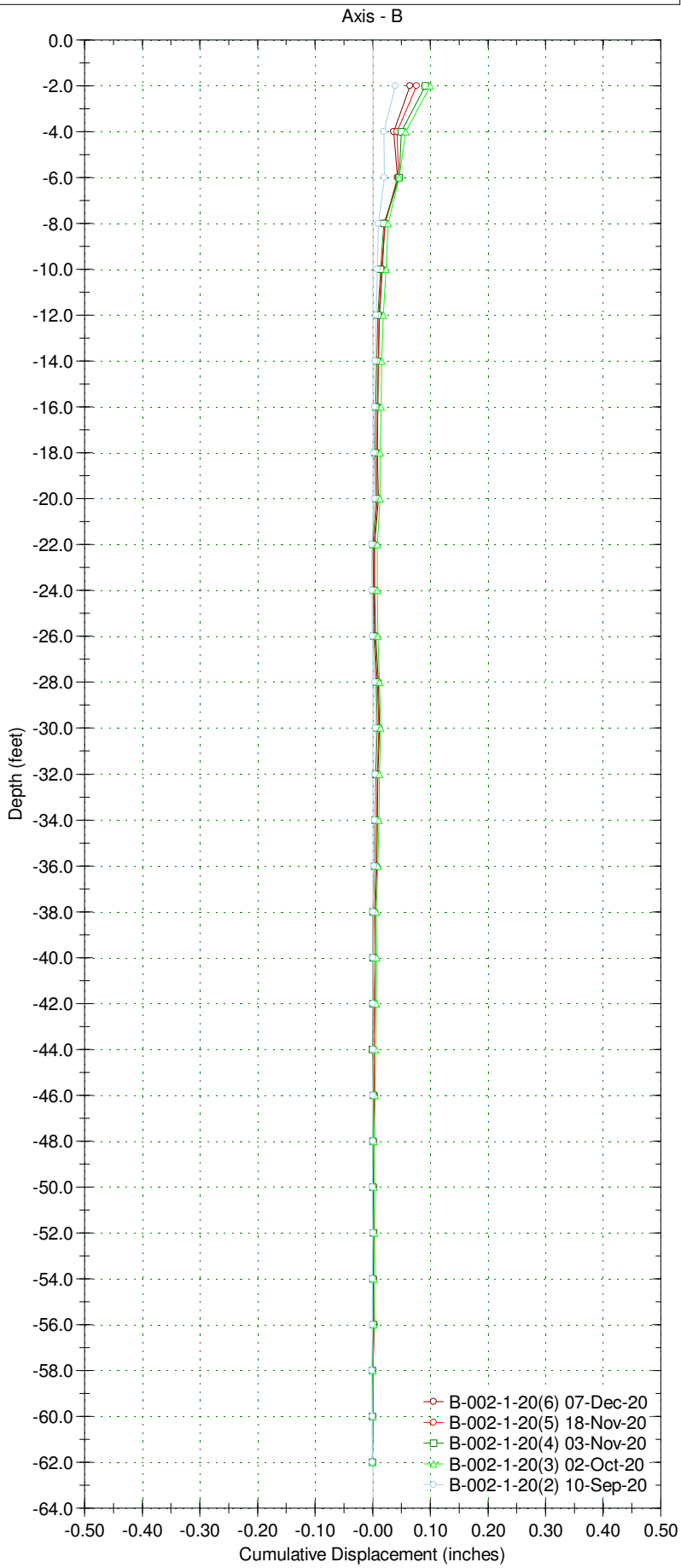
CUMULATIVE DISPLACEMENT

Inclinalysis v. 2.47.5

Borehole : B-002-1-20
Project : Inclinalysis
Location : MOE-7-7.55
Northing :
Easting :
Collar :

Spiral Correction : N/A
Collar Elevation : 0.0 feet
Borehole Total Depth : 62.0 feet
A+ Groove Azimuth :
Base Reading : 2020 Aug 18 08:16
Applied Azimuth : 0.0 degrees





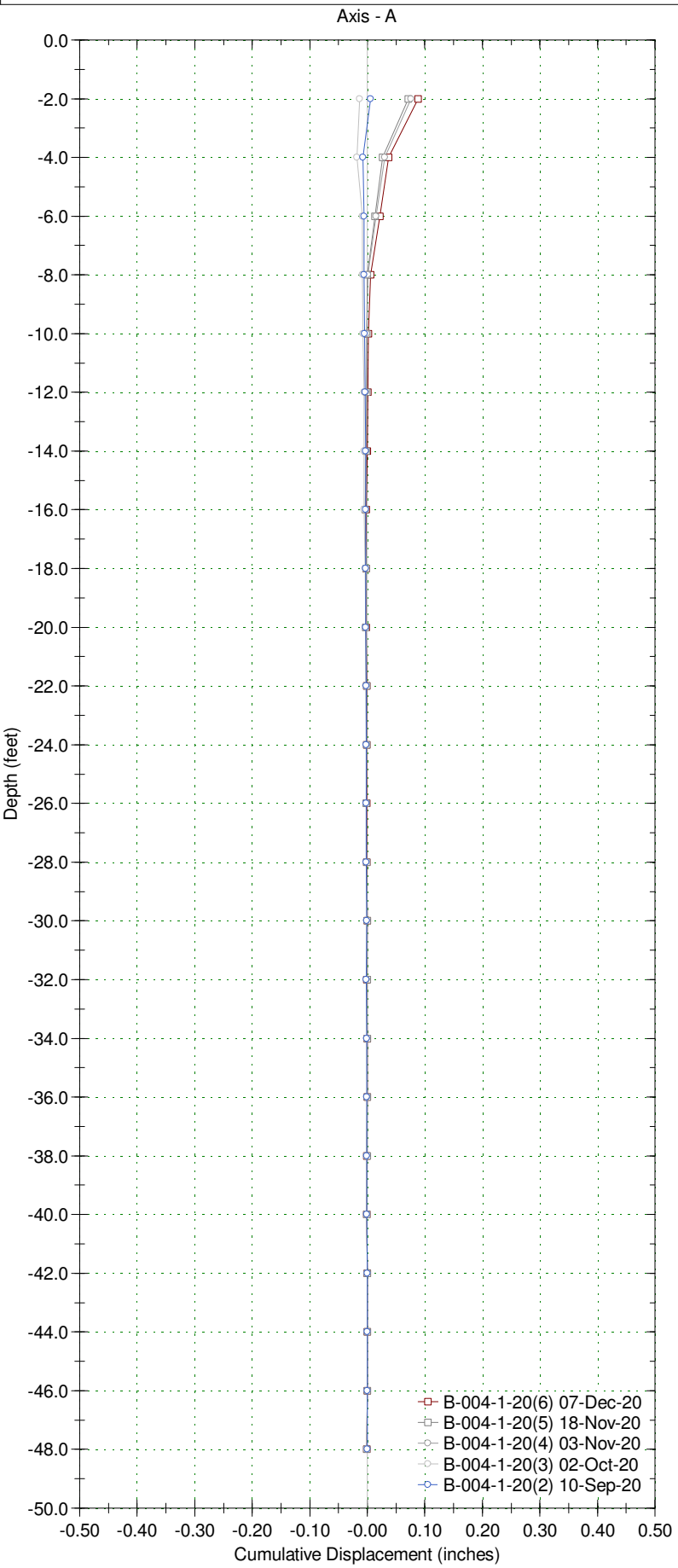
RST Instruments Ltd.

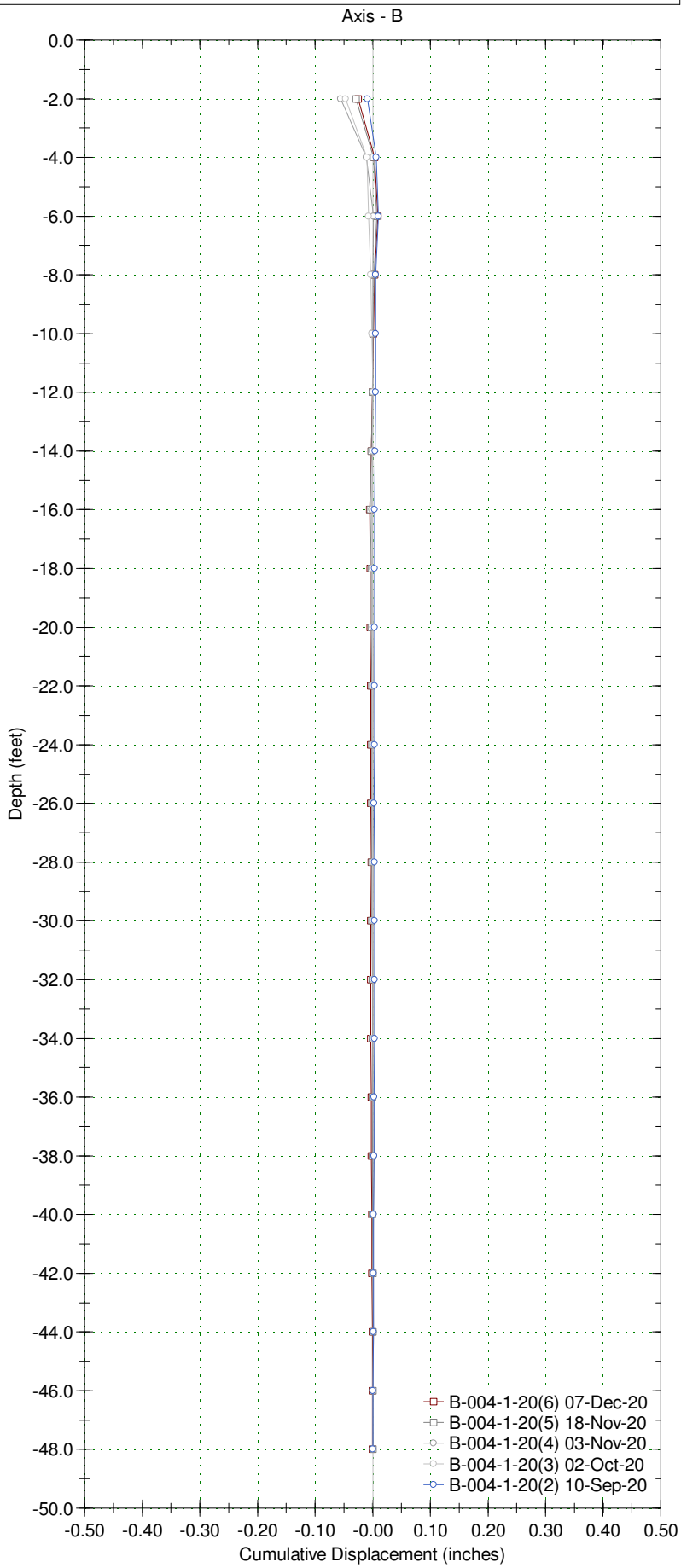
CUMULATIVE DISPLACEMENT

Inclinalysis v. 2.47.5

Borehole : B-004-1-20
Project : Inclinalysis
Location : MOE-7-7.55
Northing :
Easting :
Collar :

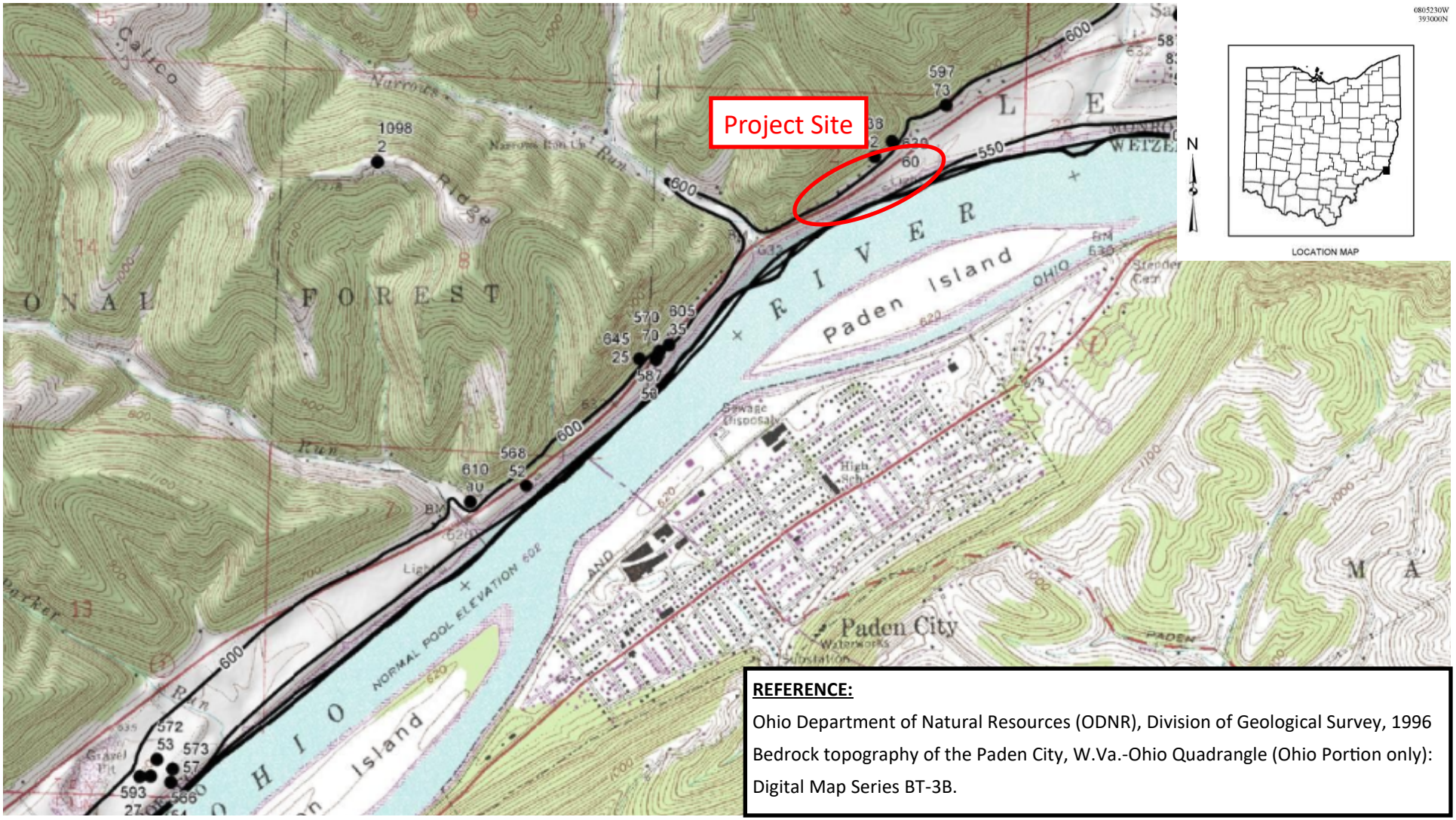
Spiral Correction : N/A
Collar Elevation : 0.0 feet
Borehole Total Depth : 48.0 feet
A+ Groove Azimuth :
Base Reading : 2020 Aug 18 08:51
Applied Azimuth : 0.0 degrees





Bedrock Topography Map

Bedrock Topography Map



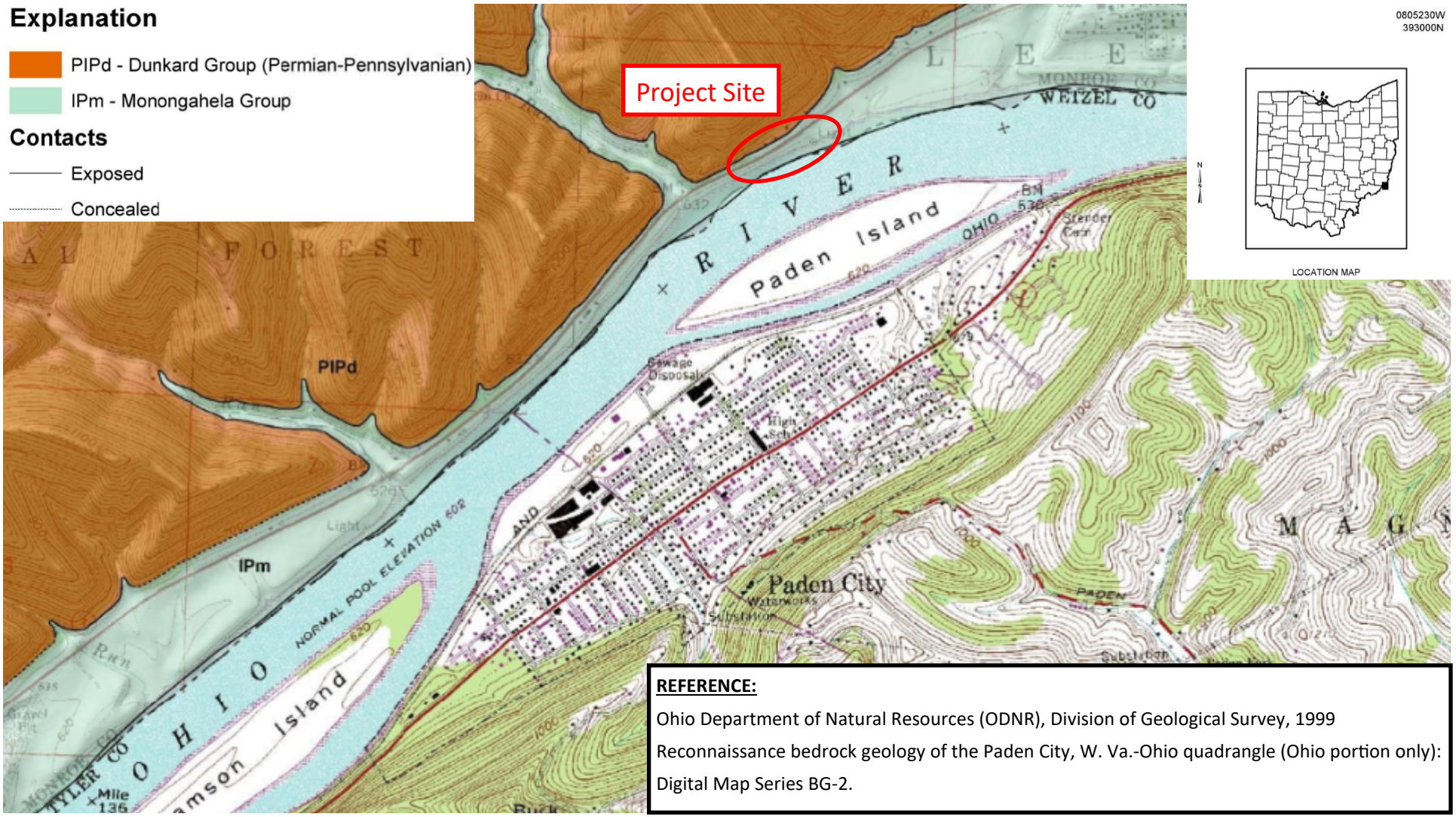
REFERENCE:

Ohio Department of Natural Resources (ODNR), Division of Geological Survey, 1996 Bedrock topography of the Paden City, W.Va.-Ohio Quadrangle (Ohio Portion only): Digital Map Series BT-3B.

1,000 0 1,000 2,000 3,000 4,000 5,000 6,000 7,000 Feet

Bedrock Geology Map

Bedrock Geology Map



REFERENCE:

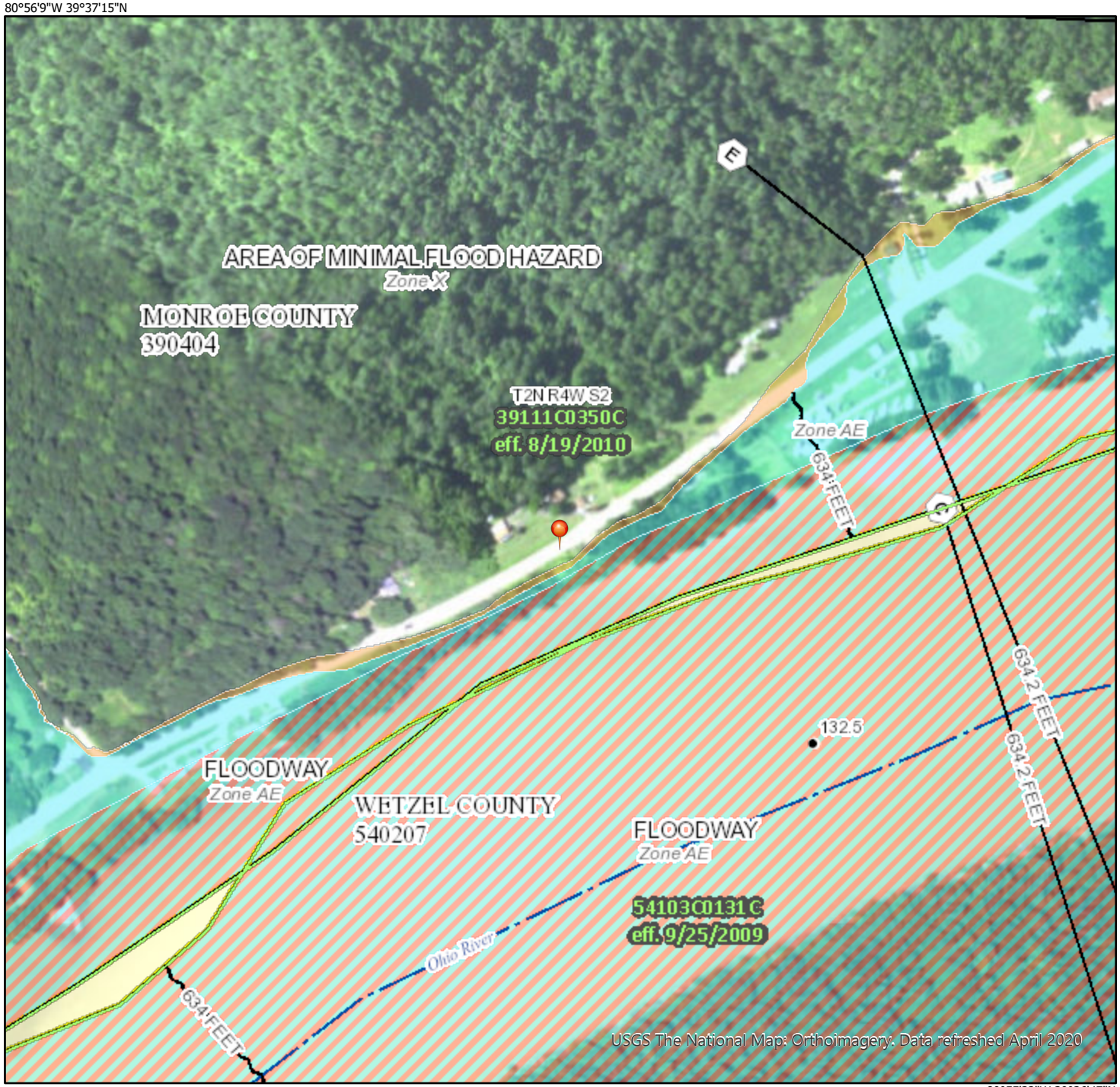
Ohio Department of Natural Resources (ODNR), Division of Geological Survey, 1999 Reconnaissance bedrock geology of the Paden City, W. Va.-Ohio quadrangle (Ohio portion only): Digital Map Series BG-2.

FEMA Flood Map

National Flood Hazard Layer FIRMette

FEMA

80°56'9"W 39°37'15"N



80°55'32"W 39°36'47"N

Feet

0 250 500 1,000 1,500 2,000

1:6,000

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance / Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

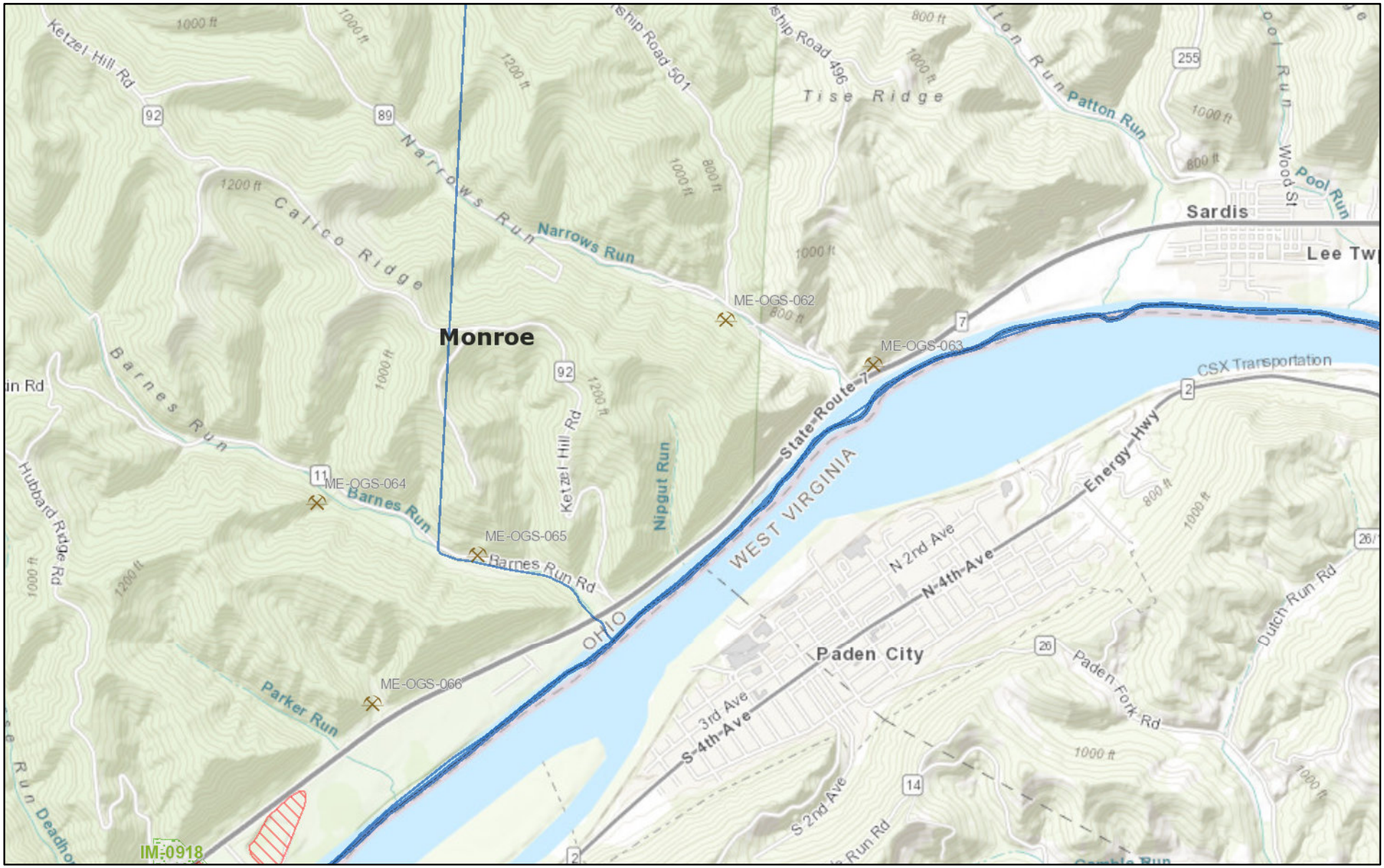
This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 10/9/2020 at 1:35 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Underground Mine Map

MOE-7-7.55 Abandoned Mine Map



December 18, 2020

1:36,112

0 0.3 0.6 1.2 mi

0 0.5 1 2 km

Current

- Air Shaft
- Drift Entry
- Vertical Mine Shaft
- Slope Entry

Past

- Air Shaft
- Drift Entry
- Vertical Mine Shaft
- Slope Entry
- Locations

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri

Ohio Dept. of Natural Resources

Historical Records

MOE-7-(2.06)(2.21)

9999 Carver Road, Suite 210, Cincinnati, OH 45242-5583
(513) 984-7500
hdrinc.com

4/4

SUBGRADE PROFILE
MONROE COUNTY — OHIO
SH. NO. 7. — SEC. S(PT), T-2(PT).
STATE HIGHWAY TESTING LABORATORY

ROAD TO PADEN CITY FERRY
STA. 368+55

BRIDGE ACROSS NARROWS RUN
STA. 384+62 - 385+30

SEC. 39-100

Redesignated as B-001-1-38

Redesignated as B-004-3-38

Compaction = 97.9%.
Maximum Dry Weight = 99.6#/Cu.Ft.
Optimum Moisture = 20.6%.

Compaction = 98.4%.
Dry Wt. Peak = 91.6#/Cu.Ft.
Optimum Moisture = 29.0%.

J.G.J.
H.E.M.
N.L.E.
7-38

26

392 + 00 ℄ SF 625.1
0 - ½' B.M
½ - 4' # 79

395 + 00 - 15' Lt SF 635.8
0 - ½' B.M
½ - 3 Red clay & SS frag # 88
3 - 4.2 Silty clay with rock frag # 84

397 + 00 - 6' Rt SF 642.7
0 - 2' T.S & Fill with SS Frag
2' - 4½ 83
4½ - 7.2 84

400 + 00 ℄ 643.3
0 - ½ T.S. & Fill
½ - 4 83

Redesignated
B-001-1-38

400 + 00 ℄ SF 643.3
Density at 1.0'
103

403 + 00 ℄ 641.2
0 - ½' T.S.
½ - 4' - 83

Redesignated
B-004-3-38

406 + 00 ℄ 635.9
0 - ½ T.S.
½ - 4 83

Sample #73

32

Monroe County. - S.H. 7 - Sec Tz (Pt) (3)

SUMMARY OF TESTS ON SUBGRADE SAMPLES

Mat'l, #16 Sheet #3

Lab. No. So.	Station Number	Represents (Feet)	Mechanical Analysis: Agg. %	C. Sand %	F. Sand %	Silt %	Clay %	Colloids %	Physical Characteristics: Liquid Limit	Plasticity Index	Shrinkage Limit	Shrinkage Ratio	Field Moisture	Remarks
97	12931	340+00-15Rt	8.0-10.5	7.8	6.7	8.1	40.1	37.3		39.6	21.3	/		15.7	
98	12526	222+00-13Rt	6.2.2-6.9.5	1.9	10.2	5.0	44.7	36.2		43.9	24.9			25.2	
99	12527	309+00-15Rt	6.2.6.1-6.2.5	5.5	14.7	19.7	31.0	34.1		36.9	18.9			19.7	
~~100~~	~~12528~~	~~400+00-6~~	~~6.2.1-6.2.2~~	~~1.2~~	~~4.8~~	~~4.2~~	~~41.7~~	~~48.1~~		~~77.7~~	~~27.7~~			~~26.8~~	
101	12932	144+00-15Rt	0-3.5	3.6	6.6	2.5	36.6	50.7		54.4	28.8			30.2	
102	12933	194+00-15Rt	0.5-9.0	4.5	4.2	6.7	37.1	42.5		41.3	20.5			24.4	
103	12529	400+00 ℄	1.0-1.5	11.9	16.7	2.7	33.0	36.7		55.8	33.2			25.2	
		SHEET TOTAL		36.4	62.9	93.9	266.2	290.6		321.3	169.0			167.2	
		SHEET AV.		5.2	9.0	6.3	38.0	41.5	=100.0%	45.9	24.2			23.9	
		GRAND TOTAL		480.8	735.2	404.8	2666.3	2813.1		3421.6	1781.2			1895.4	
		" AV.		6.9	10.4	5.7	37.8	39.9	=100.1	48.6	25.4			27.0	
		Av. of S.T. Av.		6.9	10.1	5.9	37.8	40.1	=100						
				480.8	735.2	404.8	2666.3	2813.1		3421.6	1781.2			1895.4	
				21.0	43.5	16.4	249.1	243.5		304.7	126.4			198.6	
				459.8	691.7	388.4	2417.2	2569.6		3116.9	1654.8			1696.8	
	Grand Total Av.	#16's		459.8	691.7	388.4	2417.2	2569.6		31169	1654.8			1696.8	
				1.1	10.1	5.6	37.2	39.5		48.0	25.5			26.1	
65	samples							1.6							

Redesignated B-001-1-38

Preliminary Wall Profile and Cross-Section at 401+25

9999 Carver Road, Suite 210, Cincinnati, OH 45242-5583 **hdrinc.com**
(513) 984-7500

Preliminary Wall Profile

HORIZONTAL SCALE IN FEET
0

DRAWN
CHECKED

Design Section
Sta. 401+25

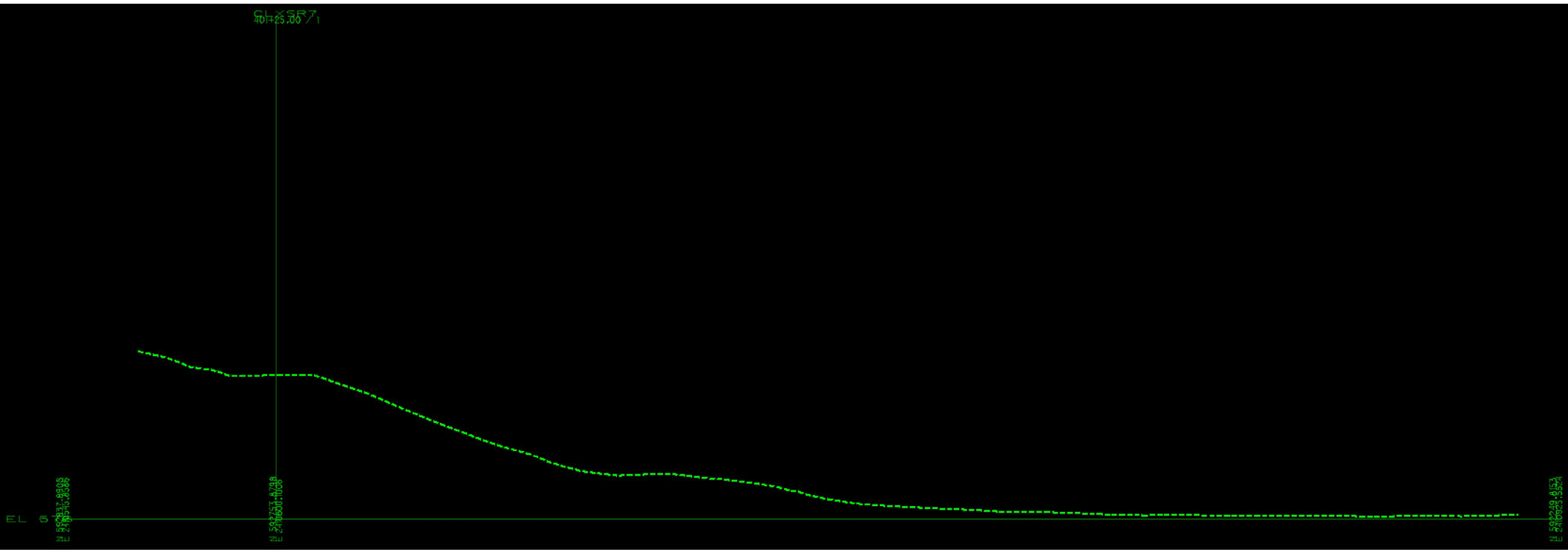
6.29 ft

645
640
635
630
625
620
615
610
605
600

398	399	400	401	402	403
641.63	641.89	642.12	642.31	642.46	642.59
641.69	641.79	641.50	641.51	640.63	641.17
641.63	641.60	640.83	640.97	637.93	639.89
642.75	642.90	642.98	643.06	643.16	643.28
641.36	641.75	640.60	641.57	641.89	641.95
640.80	641.03	640.67	640.16	640.67	640.58
643.33	643.33	643.34	643.37	643.38	643.41
640.18	638.83	639.14	641.05	639.61	639.51
643.43	643.37	643.31			
640.05	640.11	640.81			
638.29	638.55	640.99			

c:\pwworking\eastl01\d171217\108676_BI005.dgn 12/1/2020 5:19:45 PM CWAHLBRI

Design Section Sta. 401+25



Soil Strength Parameter Determination

9999 Carver Road, Suite 210, Cincinnati, OH 45242-5583 **hdrinc.com**
(513) 984-7500

ODOT District 10
MOE-7-7.55

SOIL STRENGTH PARAMETER DETERMINATION

Computed By = AKB
Checked By = DCM

Layer		Undrained Shear Strength (Su) (psf)				Dry Unit Weight (pcf)		Moist Unit Wt. (pcf)		Adopted Short Term Parameters		Long-Term Strength Values					Adopted Long Term Strength Parameters
		PPR	N-values		Tested							N_{60} Value	ODOT GB-7 Correlations				(Back-Calculated from SlopeW)
			Sowers	T and P	Values	Correlation	Tested	Correlation	Tested				Cohesion (psf)	phi (deg)	Cohesion (psf)	phi (deg)	
Layer 1 STIFF COLLUVIUM/FILL	Max	4000	4000	2527	2050	120	112	135	134	Average		Max	19	163	25		Average
	Min	1000	1050	798	723	95	112	110	131	S_u= 1000 psf		Min	6	75	21		c' = 80 psf
	Average	2218	2389	1617	1386	105	112	123	132	Φ = 0 deg		Average	12	126	23		Φ' = 20 deg
	Std Dev	765	687	515	939	7	0	6	2			Std Dev	4	28	1		
										Y_{dry} = 110 pcf							Y_{dry} = 110 pcf
	Avg + Std	2984	3076	2132	2325	112	112	129	134	Y_{moist} = 130 pcf		Avg + Std	16	154	24		Y_{moist} = 130 pcf
	Avg - Std	1453	1702	1102	448	98	112	116	130			Avg - Std	8	98	22		
Layer 2 V. STIFF COLLUVIUM	Max	4000	4000	4000		130		140		Average		Max	52	250	28		Average
	Min	1250	2450	1862		110		125		S_u = 1800 psf		Min	14	143	24		c' = 130 psf
	Average	2313	3641	3120		121		135		Φ = 0 deg		Average	26	186	26		Φ' = 23 deg
	Std Dev	760	531	742		6		4				Std Dev	9	32	1		
										Y_{dry} = 120 pcf							Y_{dry} = 120 pcf
	Avg + Std	3072	4172	3861		127		139		Y_{moist} = 135 pcf		Avg + Std	35	219	27		Y_{moist} = 135 pcf
	Avg - Std	1553	3110	2378		115		131				Avg - Std	16	154	24		
Layer 3 STIFF TO V. STIFF COLLUVIUM	Max	3250	4000	3458	2018	120	106	135	125	Average		Max	26	187	25	1000	17	Average
	Min	1000	1750	1330	2018	110	103	125	125	S_u = 1500 psf		Min	10	114	23	1000	17	c' = 100 psf
	Average	2288	3577	2671	2018	118	105	133	125	Φ = 0 deg		Average	20	165	25	1000	17	Φ' = 22 deg
	Std Dev	763	645	604	N/A	3	2	3	0			Std Dev	5	20	1	N/A	N/A	
										Y_{dry} = 105 pcf							Y_{dry} = 105 pcf
	Avg + Std	3051	4222	3275	N/A	121	107	136	125	Y_{moist} = 125 pcf		Avg + Std	25	185	25	N/A	N/A	Y_{moist} = 125 pcf
	Avg - Std	1526	2932	2067	N/A	115	102	130	125			Avg - Std	16	145	24	N/A	N/A	
Layer 4 SOFT TO M. STIFF ALLUVIUM	Max	1750	2450	2394	1330	125	106	140	129	Average		Max	27	160	24	275	21	Average
	Min	250	75	133	1090	85	98	105	124	S_u = 500 psf		Min	1	15	15	200	20	c' = 80 psf
	Average	782	840	941	1225	108	101	126	126	Φ = 0 deg		Average	8	83	21	238	21	Φ' = 18 deg
	Std Dev	275	584	517	119	10	3	8	2			Std Dev	5	38	2	53	1	
										Y_{dry} = 100 pcf							Y_{dry} = 100 pcf
	Avg + Std	1057	1424	1458	1345	118	104	134	128	Y_{moist} = 125 pcf		Avg + Std	13	121	23	291	21	Y_{moist} = 125 pcf
	Avg - Std	507	256	424	1106	98	98	117	124			Avg - Std	3	44	18	184	20	
Layer 5 HARD RESIDUUM/ WEATHERED ROCK	Max	4500	4000	4000		135		150		Average		Max	114	250	28			Average
	Min	4500	4000	4000		110		130		S_u = 4000 psf		Min	20	250	28			c' = 28 psf
	Average	4500	4000	4000		123		140		Φ = 0 deg		Average	52	250	28			Φ' = 250 deg
	Std Dev	0	0	0		8		5				Std Dev	28	0	0			
										Y_{dry} = 120 pcf								Y_{dry} = 120 pcf
	Avg + Std	4500	4000	4000		131		145		Y_{moist} = 140 pcf		Avg + Std	80	250	28			Y_{moist} = 140 pcf
	Avg - Std	4500	4000	4000		115		135				Avg - Std	23	250	28			

ODOT District 10
MOE-7-7.55

SOIL STRENGTH PARAMETER DETERMINATION

Computed By = AKB
Checked By = DCM

Values for Soil Strength Correlation	
Reference	Value
HI PI (Sowers)	0.25
MD PI (Sowers)	0.175
LO PI (Sowers)	0.075
T&P	0.133

Layer 1

	N_{60}	% Rec	HP	% Gr	% CS	% FS	% Silt	% Clay	LL	PL	PI	% WC		Short-Term Cohesion (psf) N-values PPR	Sowers	T & P	Correlated LT Cohesion (psf) per GB-7	phi (deg)	Midpoint Sample Depth (ft.)	Midpoint Sample Elevation (ft.)	Correlated Dry Unit Wt. (pcf) per GB-7	Correlated Moist Unit Wt. (pcf) per GB-7	Correlated C_c	Assumed Specific Gravity (G_s)	Computed Void Ratio (e)	Strength Testing Dry Unit Wt (pcf)	Moist Unit Wt (pcf)	Qu/UU Su (psf)
Max	19	100	4.0	18	24	12	54	58	61	31	31	33	Max	4000	4000	2527	163	25	21.0	641.2	120	135	0.459	2.72	0.787	112	134	2050
Min	6	0	1.0	0	1	2	22	30	34	21	12	6	Min	1000	1050	798	75	21	1.0	605.5	95	110	0.216	2.65	0.414	112	131	723
Average	12	62	2.2	9	12	6	31	43	44	25	19	21	Average	2218	2389	1617	126	23	8.7	627.6	105	123	0.305	2.70	0.609	112	132	1386
Std Dev	4	25	0.8	6	9	3	10	9	9	3	7	5	Std Dev	765	687	515	28	1	5.2	10.0	7	6	0.084	0.03	0.099	0	2	939
Avg + Std	16	87	3.0	15	20	9	41	52	53	28	26	25	Avg + Std	2984	3076	2132	154	24	13.9	637.6	112	129	0.389	2.73	0.709	112	134	2325
Avg - Std	8	37	1.5	3	3	2	22	34	35	22	12	16	Avg - Std	1453	1702	1102	98	22	3.5	617.6	98	116	0.221	2.66	0.510	112	130	448

Alignment	Surface Elevation	Exploration ID	From		To	Sample ID	N_{60}	% Rec	HP	% Gr	% CS	% FS	% Silt	% Clay	LL	PL	PI	% WC	ODOT Class.	Soil Type	Layer	Short-Term Cohesion (psf) N-values PPR	Sowers	T & P	Correlated LT Cohesion (psf) per GB-7	phi (deg)	Midpoint Sample Depth (ft.)	Midpoint Sample Elevation (ft.)	Correlated Dry Unit Wt. (pcf) per GB-7	Correlated Moist Unit Wt. (pcf) per GB-7	Correlated C_c	Assumed Specific Gravity (G_s)	Computed Void Ratio (e)	Strength Testing Dry Unit Wt (pcf)	Moist Unit Wt (pcf)	Qu/UU su (psf)
SR 7	642.3	B-001-0-18	1.5	-	3	SS-1	17	50	3.5	-	-	-	-	-	-	-	-	19	A-6a	Cohesive	1	3500	2975	2261	157	24	2.0	640.3	105	125		2.72	0.616			
SR 7	642.3	B-001-0-18	4	-	5.5	SS-2	15	0	-	-	-	-	-	-	-	-	-	18	A-6a	Cohesive	1	N/A	2625	1995	150	24	5.0	637.3	100	120		2.72	0.697			
SR 7	642.3	B-001-0-18	6.5	-	8	SS-3	15	67	4	-	-	-	-	-	-	-	-	16	A-6a	Cohesive	1	4000	2625	1995	150	24	7.0	635.3	105	125		2.72	0.616			
SR 7	642.3	B-001-0-18	9	-	10.5	SS-4	15	72	2	6	24	6	27	37	34	22	12	18	A-6a	Cohesive	1	2000	2625	1995	150	24	10.0	632.3	105	125	0.216	2.72	0.616			
SR 7	642.3	B-001-0-18	11.5	-	13	SS-5	17	50	2.25	-	-	-	-	-	-	-	-	19	A-6a	Cohesive	1	2250	2975	2261	157	24	12.0	630.3	115	130		2.72	0.476			
SR 7	642.3	B-001-0-18	14	-	15.5	SS-6	17	67	2	-	-	-	-	-	-	-	-	17	A-6a	Cohesive	1	2000	2975	2261	157	24	15.0	627.3	115	130		2.72	0.476			
SR 7	643.2	B-002-0-18	1.5	-	3	SS-1	12	0	-	18	18	10	23	31	34	22	12	15	A-6a	Cohesive	1	N/A	2100	1596	129	23	2.0	641.2	100	120	0.216	2.72	0.697			
SR 7	643.2	B-002-0-18	3	-	4.5	SS-2	11	56	2.5	-	-	-	-	-	-	-	-	22	A-6a	Cohesive	1	2500	1925	1463	121	23	4.0	639.2	100	120		2.72	0.697			
SR 7	643.2	B-002-0-18	4.5	-	6	SS-3	10	44	1.5	-	-	-	-	-	-	-	-	25	A-6a	Cohesive	1	1500	1750	1330	114	23	5.0	638.2	100	120		2.72	0.697			
SR 7	643.2	B-002-0-18	6	-	7.5	SS-4	11	72	1.75	-	-	-	-	-	-	-	-	19	A-6a	Cohesive	1	1750	1925	1463	121	23	7.0	636.2	105	125		2.72	0.616			
SR 7	643.2	B-002-0-18	7.5	-	9	SS-5	10	50	1.5	-	-	-	-	-	-	-	-	19	A-6a	Cohesive	1	1500	1750	1330	114	23	8.0	635.2	105	125		2.72	0.616			
SR 7	643.2	B-002-0-18	9	-	10.5	SS-6	10	72	2.25	-	-	-	-	-	-	-	-	21	A-6a	Cohesive	1	2250	1750	1330	114	23	10.0	633.2	105	125		2.72	0.616			
SR 7	643.2	B-002-0-18	10.5	-	12	SS-7	12	56	1.75	-	-	-	-	-	-	-	-	19	A-6a	Cohesive	1	1750	2100	1596	129	23	11.0	632.2	110	125		2.72	0.543			
SR 7	643.2	B-002-0-18	12	-	13.5	SS-8	14	83	1.5	-	-	-	-	-	-	-	-	19	A-6a	Cohesive	1	1500	2450	1862	143	24	13.0	630.2	110	125		2.72	0.543			
SR 7	643.2	B-002-0-18	13.5	-	15	SS-9	11	78	1.25	-	-	-	-	-	-	-	-	19	A-6a	Cohesive	1	1250	1925	1463	121	23	14.0	629.2	110	125		2.72	0.543			
SR 7	643.2	B-002-0-18	15	-	16.5	SS-10	11	72	1.5	-	-	-	-	-	-	-	-	21	A-6a	Cohesive	1	1500	1925	1463	121	23	16.0	627.2	110	125		2.72	0.543			
SR 7	627.7	B-002-1-20	0	-	1.5	SS-1	10	83	3.75	-	-	-	-	-	-	-	-	24	A-7-6	Cohesive	1	3750	2500	1330	114	23	1.0	626.7	100	120		2.65	0.654			
SR 7	627.7	B-002-1-20	1.5	-	3	SS-2	10	100	2.75	12	5	2	34	47	51	25	26	20	A-7-6	Cohesive	1	2750	2500	1330	114	23	2.0	625.7	100	120	0.369	2.65	0.654			
SR 7	627.7	B-002-1-20	3	-	4.5	SS-3	6	17	2.25	1	3	3	35	58	61	30	31	19	A-7-5	Cohesive	1	2250	1500	798	75	21	4.0	623.7	95	110	0.459	2.65	0.741			
SR 7	627.7	B-002-1-20	4.5	-	6	SS-4	7	61	1.75	-	-	-	-	-	-	-	-	22	A-7-6	Cohesive	1	1750	1750	931	88	22	5.0	622.7	95	110		2.65	0.741			
SR 7	627.7	B-002-1-20	6	-	7.5	SS-5	10	44	1.25	-	-	-	-	-	-	-	-	23	A-7-6	Cohesive	1	1250	2500	1330	114	23	7.0	620.7	105	125		2.65	0.575			
SR 7	627.7	B-002-1-20	7.5	-	9	SS-6	10	72	2	14	4	3	36	43	44	23	21	21	A-7-6	Cohesive	1	2000	2500	1330	114	23	8.0	619.7	105	125	0.306	2.65	0.575			
SR 7	627.7	B-002-1-20	9	-	10.5	SS-7	13	50	2	-	-	-	-	-	-	-	-	19	A-7-6	Cohesive	1	2000	3250	1729	136	23	10.0	617.7	105	125		2.65	0.575			
SR 7	627.7	B-002-1-20	10.5	-	12	SS-8	16	100	3	-	-	-	-	-	-	-	-	25	A-7-6	Cohesive	1	3000	4000	2128	153	24	11.0	616.7	115	130		2.65	0.438			
SR 7	627.7	B-002-1-20	12	-	13.5	SS-9	16	100	2.25	-	-	-	-	-	-	-	-	23	A-7-6	Cohesive	1	2250	4000	2128	153	24	13.0	614.7	115	130		2.65	0.438			
SR 7	610.1	B-002-2-20	1	-	2.5	SS-1	14	78	2.5	3	4	2	40	51	51	27	24	15	A-7-6	Cohesive	1	2500	3500	1862	143	24	2.0	608.1	100	120	0.369	2.65	0.654			
SR 7	610.1	B-002-2-20	3.5	-	5	SS-2	10	94	4	3	5	2	35	55	56	31	25	25	A-7-5	Cohesive	1	4000	2500	1330	114	23	4.0	606.1	100	120	0.414	2.65	0.654			
SR 7	643.1	B-003-0-18	2	-	3.5	SS-1	10	50	2	14	11	6	24	45	45	24	21	29	A-7-6	Cohesive	1	2000	2500	1330	114	23	3.0	640.1	100	120	0.315	2.65	0.654			
SR 7	643.1	B-003-0-18	3.5	-	5	SS-2	10	50	1.75	-	-	-	-	-	-	-	-	26	A-7-6	Cohesive	1	1750	2500	1330	114	23	4.0	639.1	100	120		2.65	0.654			
SR 7	643.1	B-003-0-18	5	-	6.5	SS-3	6	56	1	-	-	-	-	-	-	-	-	24	A-6a	Cohesive	1	1000	1050	798	75	21	6.0	637.1	95	120		2.72	0.787			
SR 7	643.1	B-003-0-18	6.5	-	8	SS-4	11	61	2.75	-	-	-	-	-	-	-	-	22	A-6a	Cohesive	1	2750	1925	1463	121	23	7.0	636.1	105	125		2.72	0.616			
SR 7	643.1	B-003-0-18	8	-	9.5	SS-5	18	56	1.5	-	-	-	-	-	-	-	-	21	A-6a	Cohesive	1	1500	3150	2394	160	24	9.0	634.1	110	125		2.72	0.543			
SR 7	643.1	B-003-0-18	9.5	-	10.17	ST-6	ST	94	-	-	-	-	-	-	-	-	-	-	A-6a	Cohesive	1	N/A	N/A	N/A			10.0	633.1				2.72				
SR 7	643.1	B-003-0-18	10.5	-	12	SS-7	14	11	-	-	-	-	-	-	-	-	-	6	A-6a	Cohesive	1	N/A	2450	1862	143	24	11.0	632.1	110	125		2.72	0.543			
SR 7	643.1	B-003-0-18	12	-	13.5	SS-8	15	56	3.25	-	-	-	-	-	-	-	-	16	A-6a	Cohesive	1	3250	2625	1995	150	24	13.0	630.1	110	125		2.72	0.543			
SR 7	643.1	B-003-0-18	13.5	-	15	SS-9	14	72	2	-	-	-	-	-	-	-	-	18	A-6a	Cohesive	1	2000	2450	1862	143	24	14.0	629.1	110	125		2.72	0.543			
SR 7	643.1	B-003-0-18	15	-	16.5	SS-10	15	39	1.75	-	-	-	-	-	-	-	-	18	A-6a	Cohesive	1	1750	2625	1995	150	24	16.0	627.1	110	125		2.72	0.543			
SR 7	643.1	B-003-0-18	16.5	-	18	SS-11	17	67	2	-	-	-	-	-	-	-	-	20	A-6a	Cohesive	1	2000	2975	2261	157	24	17.0	626.1	115	130		2.72	0.476			
SR 7	643.1	B-003-0-18	18	-	20	ST-12	ST	83	2	16	22	4	22	36	35	21	14	19	A-6a	Cohesive	1	2000	N/A	N/A			19.0	624.1			0.225	2.72		112	134	723
SR 7	643.1	B-003-0-18	20	-	21.5	SS-13	17	78	2	-	-	-	-	-	-	-	-	20	A-6a	Cohesive	1	2000	2975	2261	157	24	21.0	622.1	120	135		2.72	0.414			
SR 7	643.2	B-004-0-18	1.5	-	3	SS-1	11	11	-	12	24	12	22	30	36	24	12	16	A-6a	Cohesive	1	N/A	1925	1463	121	23	2.0	641.2	100	120	0.234	2.72	0.697			
SR 7	643.2	B-004-0-18	4	-	5.5	SS-2	6	22	1.25	-	-	-	-	-	-	-	-	21	A-6a	Cohesive	1	1250	1050	798	75	21	5.0	638.2	95	110		2.72	0.787			
SR 7	643.2	B-004-0-18	6.5	-	8	SS-3	11	44	2.5	-	-	-	-	-	-	-	-	25	A-6a	Cohesive	1	2500	1925	1463	121	23	7.0	636.2	105	125		2.72	0.616			
SR 7	643.2	B-004-0-18	9	-	10.5	SS-4	15	56	2.5	-	-	-	-	-	-	-	-	22	A-6a	Cohesive	1	2500	2625	1995	150	24	10.0	633.2	105	125		2.72	0.616			
SR 7	643.2	B-004-0-18	11	-	13	ST-5	ST	75	-	8	17	8	24	43	35	22	13	17	A-6a	Cohesive	1	N/A	N/A	N/A			12.0	631.2			0.225	2.72		112	131	2050
SR 7	643.2	B-004-0-18	13	-	14.5	SS-6	19	67	3.5	-	-	-	-	-	-	-	-	18	A-6a	Cohesive	1	3500	3325	2527	163	25	14.0	629.2	115	130		2.72	0.476			
SR 7	643.2	B-004-0-18	15	-	16.5	SS-7	18	67	3.25	-	-	-	-	-	-	-	-	18	A-6a	Cohesive	1	3250	3150	2394	160	24	16.0	627.2	115	130		2.72	0.476			
SR 7	643.2	B-004-0-18	17.5	-	19	SS-8	19	72	2.25	-	-	-	-	-	-	-	-	18	A-6a	Cohesive	1	2250	3325	2527	163	25	18.0	625.2	115	130		2.72	0.476			
SR 7	612.5	B-004-1-20	0	-	1.5	SS-1	6	67	3.5	-	-	-	-	-	-	-	-	33	A-7-6	Cohesive	1	3500	1500	798	75	21	1.0	611.5	95	110		2.65	0.741			
SR 7	612.5	B-004-1-20	1.5	-	3	SS-2	7	72	1.75	-	-	-	-	-	-	-	-	30	A-7-6	Cohesive	1	1750	1750	931	88	22	2.0	610.5	95	110		2.65	0.741			
SR 7	612.5	B-004-1-20	3	-	4.5	SS-3	6	89	2	0	1	8	54	37	45	28	17	32	A-7-6	Cohesive	1	2000	1500	798	75	21	4.0	608.5	95	110	0.315	2.65	0.741			
SR 7	612.5	B-004-1-20	4.5	-	6	SS-4	7	94	1.5	-	-	-	-	-	-	-	-	25	A-7-6	Cohesive	1	1500	1750	931	88	22	5.0	607.5	95	110		2.65	0.741			
SR 7	612.5	B-004-1-20	6	-	7.5	SS-5	6	100	1.5	-	-	-	-	-	-	-	-	26	A-7-6	Cohesive	1	1500	1500	798	75	21	7.0	605.5	95	120		2.65	0.741			

ODOT District 10
MOE-7-7.55

SOIL STRENGTH PARAMETER DETERMINATION

Computed By = AKB
Checked By = DCM

Values for Soil Strength Correlation	
Reference	Value
HI PI (Sowers)	0.25
MD PI (Sowers)	0.175
LO PI (Sowers)	0.075
T&P	0.133

Layer 2

	N_{60}	% Rec	HP	% Gr	% CS	% FS	% Silt	% Clay	LL	PL	PI	% WC		Short-Term Cohesion (psf) N-values PPR	Sowers	T & P	Correlated LT Cohesion (psf) per GB-7	phi (deg)	Midpoint Sample Depth (ft.)	Midpoint Sample Elevation (ft.)	Correlated Dry Unit Wt. (pcf) per GB-7	Correlated Moist Unit Wt. (pcf) per GB-7	Correlated C_c	Assumed Specific Gravity (G_s)	Computed Void Ratio (e)
Max	52	100	4	4	30	7	33	42	35	22	13	24	Max	4000	4000	4000	250	28	33.0	626.2	130	140	0.225	2.72	0.543
Min	14	0	1	1	19	5	27	33	32	20	12	4	Min	1250	2450	1862	143	24	17.0	610.1	110	125	0.198	2.72	0.306
Average	26	75	2	2	23	6	31	38	33	21	12	17	Average	2313	3641	3120	186	26	24.6	618.3	121	135	0.207	2.72	0.406
Std Dev	9	26	1	2	6	1	3	5	2	1	1	3	Std Dev	760	531	742	32	1	4.3	4.3	6	4	0.016	0.00	0.066
Avg + Std	35	101	3	4	29	7	34	43	35	22	13	20	Avg + Std	3072	4172	3861	219	27	28.9	622.6	127	139	0.223	2.72	0.472
Avg - Std	16	49	2	1	16	5	27	34	31	20	12	14	Avg - Std	1553	3110	2378	154	24	20.3	614.1	115	131	0.191	2.72	0.340

Alignment	Surface Elevation	Exploration ID	From		To	Sample ID	N_{60}	% Rec	HP	% Gr	% CS	% FS	% Silt	% Clay	LL	PL	PI	% WC	ODOT Class.	Soil Type	Layer	Short-Term Cohesion (psf) N-values PPR	Sowers	T & P	Correlated LT Cohesion (psf) per GB-7	phi (deg)	Midpoint Sample Depth (ft.)	Midpoint Sample Elevation (ft.)	Correlated Dry Unit Wt. (pcf) per GB-7	Correlated Moist Unit Wt. (pcf) per GB-7	Correlated C_c	Assumed Specific Gravity (G_s)	Computed Void Ratio (e)
SR 7	642.3	B-001-0-18	16.5	-	18	SS-7	29	61	2	-	-	-	-	-	-	-	-	17	A-6a	Cohesive	2	2000	4000	3857	197	26	17.0	625.3	115	130		2.72	0.476
SR 7	642.3	B-001-0-18	19	-	20.5	SS-8	22	83	2.5	-	-	-	-	-	-	-	-	16	A-6a	Cohesive	2	2500	3850	2926	173	25	20.0	622.3	115	130		2.72	0.476
SR 7	642.3	B-001-0-18	21.5	-	23	SS-9	22	67	2	-	-	-	-	-	-	-	-	19	A-6a	Cohesive	2	2000	3850	2926	173	25	22.0	620.3	120	135		2.72	0.414
SR 7	642.3	B-001-0-18	24	-	25.5	SS-10	25	89	3.25	-	-	-	-	-	-	-	-	16	A-6a	Cohesive	2	3250	4000	3325	183	25	25.0	617.3	120	135		2.72	0.414
SR 7	642.3	B-001-0-18	26.5	-	28	SS-11	17	100	2.75	-	-	-	-	-	-	-	-	24	A-6a	Cohesive	2	2750	2975	2261	157	24	27.0	615.3	120	135		2.72	0.414
SR 7	642.3	B-001-0-18	29	-	30.5	SS-12	19	94	4	-	-	-	-	-	-	-	-	19	A-6a	Cohesive	2	4000	3325	2527	163	25	30.0	612.3	120	135		2.72	0.414
SR 7	643.2	B-002-0-18	16.5	-	16.83	SS-11	Refusal	100	1.5	-	-	-	-	-	-	-	-	17	A-6a	Cohesive	2	1500	N/A	N/A	250	28	17.0	626.2				2.72	
SR 7	643.2	B-002-0-18	18	-	19.5	SS-12	26	78	-	-	-	-	-	-	-	-	-	4	A-6a	Cohesive	2	N/A	4000	3458	187	25	19.0	624.2	115	130		2.72	0.476
SR 7	643.2	B-002-0-18	19.5	-	21	SS-13	14	61	2.5	-	-	-	-	-	-	-	-	14	A-6a	Cohesive	2	2500	2450	1862	143	24	20.0	623.2	110	125		2.72	0.543
SR 7	643.2	B-002-0-18	21	-	22.5	SS-14	15	67	2.25	-	-	-	-	-	-	-	-	15	A-6a	Cohesive	2	2250	2625	1995	150	24	22.0	621.2	115	130		2.72	0.476
SR 7	643.2	B-002-0-18	22.5	-	24	SS-15	40	94	1.25	4	30	6	27	33	32	20	12	17	A-6a	Cohesive	2	1250	4000	4000	250	28	23.0	620.2	130	140	0.198	2.72	0.306
SR 7	643.2	B-002-0-18	24	-	25.5	SS-16	17	78	1.5	-	-	-	-	-	-	-	-	18	A-6a	Cohesive	2	1500	2975	2261	157	24	25.0	618.2	120	135		2.72	0.414
SR 7	643.2	B-002-0-18	25.5	-	27	SS-17	52	56	1.5	1	19	7	33	40	32	20	12	17	A-6a	Cohesive	2	1500	4000	4000	250	28	26.0	617.2	130	140	0.198	2.72	0.306
SR 7	643.2	B-002-0-18	27	-	28.5	SS-18	21	50	1.5	-	-	-	-	-	-	-	-	18	A-6a	Cohesive	2	1500	3675	2793	170	25	28.0	615.2	120	135		2.72	0.414
SR 7	643.2	B-002-0-18	28.5	-	30	SS-19	14	56	1.5	-	-	-	-	-	-	-	-	19	A-6a	Cohesive	2	1500	2450	1862	143	24	29.0	614.2	115	130		2.72	0.476
SR 7	643.1	B-003-0-18	21.5	-	23	SS-14	39	100	3.5	-	-	-	-	-	-	-	-	18	A-6a	Cohesive	2	3500	4000	4000	200	28	22.0	621.1	130	140		2.72	0.306
SR 7	643.1	B-003-0-18	23	-	24.5	SS-15	32	100	2.5	-	-	-	-	-	-	-	-	19	A-6a	Cohesive	2	2500	4000	4000	200	26	24.0	619.1	130	140		2.72	0.306
SR 7	643.1	B-003-0-18	24.5	-	26	SS-16	23	0	-	-	-	-	-	-	-	-	-	17	A-6a	Cohesive	2	N/A	4000	3059	177	25	25.0	618.1	120	135		2.72	0.414
SR 7	643.1	B-003-0-18	26	-	27.5	SS-17	19	11	2	-	-	-	-	-	-	-	-	17	A-6a	Cohesive	2	2000	3325	2527	163	25	27.0	616.1	120	135		2.72	0.414
SR 7	643.1	B-003-0-18	27.5	-	29	SS-18	28	100	2.5	-	-	-	-	-	-	-	-	16	A-6a	Cohesive	2	2500	4000	3724	193	26	28.0	615.1	120	135		2.72	0.414
SR 7	643.1	B-003-0-18	29	-	30.5	SS-19	40	100	2.5	-	-	-	-	-	-	-	-	18	A-6a	Cohesive	2	2500	4000	4000	250	28	30.0	613.1	130	140		2.72	0.306
SR 7	643.1	B-003-0-18	30.5	-	32	SS-20	33	100	1.5	-	-	-	-	-	-	-	-	19	A-6a	Cohesive	2	1500	4000	4000	200	27	31.0	612.1	130	140		2.72	0.306
SR 7	643.1	B-003-0-18	32	-	33.2	SS-21A	29	89	3	-	-	-	-	-	-	-	-	18	A-6a	Cohesive	2	3000	4000	3857	197	26	33.0	610.1	120	135		2.72	0.414
SR 7	643.2	B-004-0-18	20	-	21.5	SS-9	23	72	2.75	-	-	-	-	-	-	-	-	16	A-6a	Cohesive	2	2750	4000	3059	177	25	21.0	622.2	120	135		2.72	0.414
SR 7	643.2	B-004-0-18	22.5	-	24	SS-10	22	78	3.5	2	19	5	32	42	35	22	13	18	A-6a	Cohesive	2	3500	3850	2926	173	25	23.0	620.2	120	135	0.225	2.72	0.414
SR 7	643.2	B-004-0-18	25	-	26.5	SS-11	21	67	1.75	-	-	-	-	-	-	-	-	17	A-6a	Cohesive	2	1750	3675	2793	170	25	26.0	617.2	120	135		2.72	0.414

ODOT District 10
MOE-7-7.55

SOIL STRENGTH PARAMETER DETERMINATION

Computed By = AKB
Checked By = DCM

Values for Soil Strength Correlation	
Reference	Value
HI PI (Sowers)	0.25
MD PI (Sowers)	0.175
LO PI (Sowers)	0.075
T&P	0.133

Layer 3

	N_{60}	% Rec	HP	% Gr	% CS	% FS	% Silt	% Clay	LL	PL	PI	% WC		Short-Term Cohesion (psf) N-values PPR	Sowers	T & P	Correlated LT Cohesion (psf) per GB-7	phi (deg)	Midpoint Sample Depth (ft.)	Midpoint Sample Elevation (ft.)	Correlated Dry Unit Wt. (pcf) per GB-7	Correlated Moist Unit Wt. (pcf) per GB-7	Correlated C_c	Assumed Specific Gravity (G_s)	Computed Void Ratio (e)	Strength Testing: Dry Unit Wt (pcf)	Moist Unit Wt (pcf)	Qu/UU Su (psf)	CU Eff. c (psf)	CU Eff. phi (deg)	CU Total c (psf)	CU Total phi (deg)
Max	26	100	3	1	9	7	58	46	50	26	24	29	Max	3250	4000	3458	187	25	36.0	615.2	120	135	0.360	2.72	0.503	106	125	2018	1000	17	1500	12
Min	10	72	1	0	0	1	38	39	31	19	12	18	Min	1000	1750	1330	114	23	15.0	606.7	110	125	0.189	2.65	0.404	103	125	2018	1000	17	1500	12
Average	20	96	2	0	2	4	50	43	38	22	16	23	Average	2288	3577	2671	165	25	27.5	610.2	118	133	0.255	2.70	0.428	105	125	2018	1000	17	1500	12
Std Dev	5	9	1	1	3	3	7	3	6	3	4	3	Std Dev	763	645	604	20	1	7.9	2.5	3	3	0.058	0.03	0.029	2	0	N/A	N/A	N/A	N/A	N/A
Avg + Std	25	105	3	1	5	7	57	47	45	25	20	26	Avg + Std	3051	4222	3275	185	25	35.4	612.6	121	136	0.313	2.73	0.458	107	125	N/A	N/A	N/A	N/A	N/A
Avg - Std	16	87	2	0	-1	1	44	40	32	20	12	20	Avg - Std	1526	2932	2067	145	24	19.6	607.7	115	130	0.197	2.66	0.399	102	125	N/A	N/A	N/A	N/A	N/A

Alignment	Surface Elevation	Exploration ID	From		To	Sample ID	N_{60}	% Rec	HP	% Gr	% CS	% FS	% Silt	% Clay	LL	PL	PI	% WC	ODOT Class.	Soil Type	Layer	Short-Term Cohesion (psf) N-values PPR	Sowers	T & P	Correlated LT Cohesion (psf) per GB-7	phi (deg)	Midpoint Sample Depth (ft.)	Midpoint Sample Elevation (ft.)	Correlated Dry Unit Wt. (pcf) per GB-7	Correlated Moist Unit Wt. (pcf) per GB-7	Correlated C_c	Assumed Specific Gravity (G_s)	Computed Void Ratio (e)	Strength Testing: Dry Unit Wt (pcf)	Moist Unit Wt (pcf)	Qu/UU su (psf)	CU Eff. c (psf)	CU Eff. phi (deg)	CU Total c (psf)	CU Total phi (deg)
SR 7	643.2	B-002-0-18	30.9	-	31.5	SS-20B	23	72	3	-	-	-	-	-	-	-	-	25	A-6a	Cohesive	3	3000	4000	3059	177	25	31.0	612.2	120	135		2.72	0.414							
SR 7	643.2	B-002-0-18	31.5	-	33	SS-21	18	100	1.75	0	1	6	50	43	35	20	15	22	A-6a	Cohesive	3	1750	3150	2394	160	24	32.0	611.2	120	135	0.225	2.72	0.414						
SR 7	643.2	B-002-0-18	33	-	35	ST-22	ST	96	1	1	1	7	52	39	31	19	12	18	A-6a	Cohesive	3	1000	N/A	N/A			34.0	609.2			0.189	2.72		106	125	2018			
SR 7	627.7	B-002-1-20	13.5	-	15.5	ST-10	ST	79	-	1	0	1	52	46	50	26	24	22	A-7-6	Cohesive	3	N/A	N/A	N/A			15.0	612.7			0.36	2.65		103	125		1000	17	1500	12
SR 7	627.7	B-002-1-20	15.5	-	17	SS-11	23	100	3.25	-	-	-	-	-	-	-	-	23	A-7-6	Cohesive	3	3250	4000	3059	177	25	16.0	611.7	115	130		2.65	0.438						
SR 7	627.7	B-002-1-20	17	-	18.5	SS-12	19	100	3	-	-	-	-	-	-	-	-	23	A-7-6	Cohesive	3	3000	4000	2527	163	25	18.0	609.7	115	130		2.65	0.438						
SR 7	627.7	B-002-1-20	18.5	-	20	SS-13	14	100	1.75	-	-	-	-	-	-	-	-	23	A-7-6	Cohesive	3	1750	3500	1862	143	24	19.0	608.7	110	125		2.65	0.503						
SR 7	627.7	B-002-1-20	20	-	21.5	SS-14	10	100	1.5	0	0	3	58	39	40	24	16	27	A-6b	Cohesive	3	1500	1750	1330	114	23	21.0	606.7	115	130	0.27	2.7	0.465						
SR 7	643.1	B-003-0-18	33.5	-	35	SS-22	22	100	2	-	-	-	-	-	-	-	-	25	A-6a	Cohesive	3	2000	3850	2926	173	25	34.0	609.1	120	135		2.72	0.414						
SR 7	643.1	B-003-0-18	35	-	36.5	SS-23	19	100	2.5	-	-	-	-	-	-	-	-	24	A-6a	Cohesive	3	2500	3325	2527	163	25	36.0	607.1	120	135		2.72	0.414						
SR 7	643.2	B-004-0-18	27.5	-	29	SS-12	26	100	3.25	0	9	7	38	46	37	23	14	20	A-6a	Cohesive	3	3250	4000	3458	187	25	28.0	615.2	120	135	0.243	2.72	0.414						
SR 7	643.2	B-004-0-18	30	-	31.5	SS-13	25	100	3	-	-	-	-	-	-	-	-	21	A-6a	Cohesive	3	3000	4000	3325	183	25	31.0	612.2	120	135		2.72	0.414						
SR 7	643.2	B-004-0-18	33	-	34	SS-14B	21	100	1.5	-	-	-	-	-	-	-	-	29	A-6b	Cohesive	3	1500	3675	2793	170	25	34.0	609.2	120	135		2.7	0.404						
SR 7	643.2	B-004-0-18	35	-	36.5	SS-15	21	100	2.25	0	1	1	52	46	37	21	16	23	A-6b	Cohesive	3	2250	3675	2793	170	25	36.0	607.2	120	135	0.243	2.7	0.404						

ODOT District 10
MOE-7-7.55

SOIL STRENGTH PARAMETER DETERMINATION

Computed By = AKB
Checked By = DCM

Values for Soil Strength Correlation	
Reference	Value
HI PI (Sowers)	0.25
MD PI (Sowers)	0.175
LO PI (Sowers)	0.075
T&P	0.133

Layer 4

	N_{60}	% Rec	HP	% Gr	% CS	% FS	% Silt	% Clay	LL	PL	PI	% WC		Short-Term Cohesion (psf) N-values PPR	Sowers	T & P	Correlated LT Cohesion (psf) per GB-7	phi (deg)	Midpoint Sample Depth (ft.)	Midpoint Sample Elevation (ft.)	Correlated Dry Unit Wt. (pcf) per GB-7	Correlated Moist Unit Wt. (pcf) per GB-7	Correlated C_c	Assumed Specific Gravity (G_s)	Computed Void Ratio (e)	Strength Testing: Dry Unit Wt (pcf)	Moist Unit Wt (pcf)	Qu/UU Su (psf)	CU Eff. c (psf)	CU Eff. phi (deg)	CU Total c (psf)	CU Total phi (deg)
Max	27	100	2	50	9	49	55	39	40	24	16	39	Max	1750	2450	2394	160	24	56.0	610.3	125	140	0.270	2.72	0.982	106	129	1330	275	21	1000	12
Min	1	56	0	0	0	8	11	6	24	17	6	14	Min	250	75	133	15	15	2.0	586.1	85	105	0.126	2.70	0.358	98	124	1090	200	20	660	11
Average	8	97	1	3	1	25	43	28	30	19	11	25	Average	782	840	941	83	21	34.1	597.0	108	126	0.179	2.72	0.584	101	126	1225	238	21	830	11
Std Dev	5	8	0	10	2	11	10	8	4	2	3	3	Std Dev	275	584	517	38	2	15.4	5.8	10	8	0.037	0.00	0.161	3	2	119	53	1	240	0
Avg + Std	13	105	1	14	4	36	53	37	34	21	13	29	Avg + Std	1057	1424	1458	121	23	49.5	602.8	118	134	0.216	2.72	0.745	104	128	1345	291	21	1070	12
Avg - Std	3	89	1	-7	-1	14	32	20	26	18	8	22	Avg - Std	507	256	424	44	18	18.7	591.1	98	117	0.142	2.71	0.424	98	124	1106	184	20	590	11

Alignment	Surface Elevation	Exploration ID	From		To	Sample ID	N_{60}	% Rec	HP	% Gr	% CS	% FS	% Silt	% Clay	LL	PL	PI	% WC	ODOT Class.	Soil Type	Layer	Short-Term Cohesion (psf) N-values PPR	Sowers	T & P	Correlated LT Cohesion (psf) per GB-7	phi (deg)	Midpoint Sample Depth (ft.)	Midpoint Sample Elevation (ft.)	Correlated Dry Unit Wt. (pcf) per GB-7	Correlated Moist Unit Wt. (pcf) per GB-7	Correlated C_c	Assumed Specific Gravity (G_s)	Computed Void Ratio (e)	Strength Testing: Dry Unit Wt (pcf)	Moist Unit Wt (pcf)	Qu/UU su (psf)	CU Eff. c (psf)	CU Eff. phi (deg)	CU Total c (psf)	CU Total phi (deg)
SR 7	642.3	B-001-0-18	31.5	-	33	SS-13	10	100	0.75	-	-	-	-	-	-	-	25	A-4a	Cohesive	4	750	750	1330	114	23	32.0	610.3	115	130		2.72	0.476							
SR 7	642.3	B-001-0-18	33	-	34.5	SS-14	12	100	1	-	-	-	-	-	-	-	23	A-4a	Cohesive	4	1000	900	1596	129	23	34.0	608.3	115	130		2.72	0.476							
SR 7	642.3	B-001-0-18	35.5	-	37.5	ST-15	ST	96	0.5	0	0	26	43	31	24	18	6	22	A-4a	Cohesive	4	500	N/A	N/A			37.0	605.3			0.126	2.72		106	129	1322				
SR 7	642.3	B-001-0-18	37.5	-	39	SS-16	10	83	0.75	-	-	-	-	-	-	-	23	A-4a	Cohesive	4	750	750	1330	114	23	38.0	604.3	115	130		2.72	0.476							
SR 7	642.3	B-001-0-18	40	-	41.5	SS-17	7	100	0.5	-	-	-	-	-	-	-	24	A-6a	Cohesive	4	500	1225	931	88	22	41.0	601.3	115	130		2.72	0.476							
SR 7	642.3	B-001-0-18	42.5	-	44.5	ST-18	ST	92	0.75	0	1	16	47	36	31	19	12	26	A-6a	Cohesive	4	750	N/A	N/A			44.0	598.3			0.189	2.72		100	126	1160				
SR 7	642.3	B-001-0-18	44.5	-	46	SS-19	8	100	1	-	-	-	-	-	-	-	25	A-4a	Cohesive	4	1000	600	1064	100	22	45.0	597.3	115	130		2.72	0.476							
SR 7	642.3	B-001-0-18	47	-	48.5	SS-20	4	100	0.75	0	1	33	39	27	24	17	7	24	A-4a	Cohesive	4	750	300	532	50	20	48.0	594.3	105	125	0.126	2.72	0.616							
SR 7	642.3	B-001-0-18	49.5	-	51	SS-21	10	100	1.75	-	-	-	-	-	-	-	24	A-4a	Cohesive	4	1750	750	1330	114	23	50.0	592.3	120	135		2.72	0.414							
SR 7	642.3	B-001-0-18	52	-	53.5	SS-22	4	100	0.75	-	-	-	-	-	-	-	29	A-4a	Cohesive	4	750	300	532	50	20	53.0	589.3	105	125		2.72	0.616							
SR 7	642.3	B-001-0-18	54.5	-	56	SS-23	18	100	0.75	-	-	-	-	-	-	-	32	A-4a	Cohesive	4	750	1350	2394	160	24	55.0	587.3	125	140		2.72	0.358							
SR 7	643.2	B-002-0-18	35	-	36.5	SS-23	12	100	1	-	-	-	-	-	-	-	25	A-6a	Cohesive	4	1000	2100	1596	129	23	36.0	607.2	115	130		2.72	0.476							
SR 7	643.2	B-002-0-18	36.5	-	38	SS-24	12	100	0.75	-	-	-	-	-	-	-	22	A-6a	Cohesive	4	750	2100	1596	129	23	37.0	606.2	115	130		2.72	0.476							
SR 7	643.2	B-002-0-18	38	-	39.5	ST-25	ST	94	1	-	-	-	-	-	-	-	23	A-6a	Cohesive	4	1000	N/A	N/A			39.0	604.2				2.72								
SR 7	643.2	B-002-0-18	39.5	-	41	SS-26	7	94	1	-	-	-	-	-	-	-	23	A-6a	Cohesive	4	1000	1225	931	88	22	40.0	603.2	105	125		2.72	0.616							
SR 7	643.2	B-002-0-18	41.5	-	43	ST-27	ST	100	0.5	0	0	20	48	32	28	17	11	25	A-6a	Cohesive	4	500	N/A	N/A			42.0	601.2			0.162	2.72								
SR 7	643.2	B-002-0-18	43	-	44.5	SS-28	4	100	1	-	-	-	-	-	-	-	23	A-6a	Cohesive	4	1000	700	532	50	20	44.0	599.2	105	125		2.72	0.616							
SR 7	643.2	B-002-0-18	44.5	-	46	SS-29	14	100	1	-	-	-	-	-	-	-	24	A-6a	Cohesive	4	1000	2450	1862	143	24	45.0	598.2	120	135		2.72	0.414							
SR 7	643.2	B-002-0-18	46	-	47.5	SS-30	8	100	0.75	-	-	-	-	-	-	-	23	A-6a	Cohesive	4	750	1400	1064	100	22	47.0	596.2	115	130		2.72	0.476							
SR 7	643.2	B-002-0-18	47.5	-	49	SS-31	7	100	0.75	-	-	-	-	-	-	-	24	A-6a	Cohesive	4	750	1225	931	88	22	48.0	595.2	115	130		2.72	0.476							
SR 7	643.2	B-002-0-18	49	-	50.5	SS-32	7	100	0.75	-	-	-	-	-	-	-	26	A-6a	Cohesive	4	750	1225	931	88	22	50.0	593.2	115	130		2.72	0.476							
SR 7	643.2	B-002-0-18	50.5	-	52	SS-33	8	100	1.25	-	-	-	-	-	-	-	28	A-6a	Cohesive	4	1250	1400	1064	100	22	51.0	592.2	115	130		2.72	0.476							
SR 7	643.2	B-002-0-18	52	-	53.5	SS-34	4	100	0.5	1	0	21	45	33	29	18	11	29	A-6a	Cohesive	4	500	700	532	50	20	53.0	590.2	105	125	0.171	2.72	0.616							
SR 7	643.2	B-002-0-18	53.5	-	55	SS-35	6	100	-	-	-	-	-	-	-	-	32	A-4a	Cohesive	4	N/A	450	798	75	21	54.0	589.2	115	130		2.72	0.476							
SR 7	643.2	B-002-0-18	55	-	56.5	SS-36	17	100	-	7	8	38	29	18	NP	NP	NP	22	A-4a	NP SILT	4	N/A				26	56.0	587.2	115	140	N/A	2.72	0.476							
SR 7	627.7	B-002-1-20	21.5	-	23	SS-15	10	100	0.5	-	-	-	-	-	-	-	25	A-6a	Cohesive	4	500	1750	1330	114	23	22.0	605.7	115	130		2.72	0.476							
SR 7	627.7	B-002-1-20	23	-	24.5	SS-16	1	100	0.5	0	0	21	47	32	32	19	13	23	A-6a	Cohesive	4	500	175	133	15	15	24.0	603.7	95	110	0.198	2.72	0.787							
SR 7	627.7	B-002-1-20	24.5	-	26	SS-17	10	100	0.5	-	-	-	-	-	-	-	24	A-4a	Cohesive	4	500	750	1330	114	23	25.0	602.7	115	130		2.72	0.476							
SR 7	627.7	B-002-1-20	26	-	28	ST-18	ST	100	-	0	0	25	47	28	29	19	10	24	A-4a	Cohesive	4	N/A	N/A	N/A			27.0	600.7			0.171	2.72		100	124		200	20	660	11
SR 7	627.7	B-002-1-20	28	-	29.5	SS-19	6	100	-	-	-	-	-	-	-	-	23	A-4b	Cohesive	4	N/A	450	798	75	21	29.0	598.7	105	125		2.72	0.616							
SR 7	627.7	B-002-1-20	29.5	-	31	SS-20	6	100	-	0	0	18	53	29	29	19	10	27	A-4b	Cohesive	4	N/A	450	798	75	21	30.0	597.7	105	125	0.171	2.72	0.616							
SR 7	627.7	B-002-1-20	31	-	32.5	SS-21	4	100	1	-	-	-	-	-	-	-	28	A-4a	Cohesive	4	1000	300	532	50	20	32.0	595.7	100	120		2.72	0.697							
SR 7	627.7	B-002-1-20	32.5	-	34	SS-22	7	100	0.75	0	0	24	46	30	29	19	10	27	A-4a	Cohesive	4	750	525	931	88	22	33.0	594.7	105	125	0.171	2.72	0.616							
SR 7	627.7	B-002-1-20	34	-	35.5	SS-23	9	100	-	-	-	-	-	-	-	-	27	A-4a	Cohesive	4	N/A	675	1197	107	22	35.0	592.7	115	130		2.72	0.476							
SR 7	627.7	B-002-1-20	35.5	-	37	SS-24	9	100	-	-	-	-	-	-	-	-	25	A-4a	Cohesive	4	N/A	675	1197	107	22	36.0	591.7	115	130		2.72	0.476							
SR 7	627.7	B-002-1-20	37	-	38.5	SS-25	10	100	-	0	0	38	38	24	27	19	8	34	A-4a	Cohesive	4	N/A	750	1330	114	23	38.0	589.7	115	130	0.153	2.72	0.476							
SR 7	627.7	B-002-1-20	38.5	-	40	SS-26	9	100	-	-	-	-	-	-	-	-	26	A-4a	Cohesive	4	N/A	675	1197	107	22	39.0	588.7	115	130		2.72	0.476							
SR 7	610.12	B-002-2-20	6	-	7.5	SS-3	6	100	-	-	-	-	-	-	-	-	29	A-4a	Cohesive	4	N/A	450	798	75	21	7.0	603.1	95	120		2.72	0.787							
SR 7	610.12	B-002-2-20	7.5	-	10	SS-4	10	100	0.5	-	-	-	-	-	-	-	25	A-4a	Cohesive	4	500	750	1330	114	23	9.0	601.1	105	125		2.72	0.616							
SR 7	610.12	B-002-2-20	10	-	12	ST-5	ST	100	0.75	0	0	36	43	21	29	21	8	23	A-4a	Cohesive	4	750	N/A	N/A			11.0	599.1			0.171	2.72		102	126		275	21	1000	12
SR 7	610.12	B-002-2-20	13.5	-	15	SS-6	6	100	-	-	-	-	-	-	-	-	25	A-4a	Cohesive	4	N/A	450	798	75	21	14.0	596.1	95	120		2.72	0.787							
SR 7	610.12	B-002-2-20	16	-	17.5	SS-7	1	100	-	0	0	20	50	30	33	21	12	28	A-6a	Cohesive	4	N/A	175	133	15	15	17.0	593.1	90	110	0.207	2.72	0.886							
SR 7	610.12	B-002-2-20	18.5	-	20	SS-8	7	89	-	-	-	-	-	-	-	-	18	A-2-4	Granular	4	N/A				29	19.0	591.1	105	125		2.71	0.611							
SR 7	610.12	B-002-2-20	21	-	22.5	SS-9	16	100	-	26	4	37	21	12	NP	NP	NP	23	A-2-4	Granular	4	N/A				31	22.0	588.1	115	135	N/A	2.71	0.470							
SR 7	610.12	B-002-2-20	23.5	-	25	SS-10	27	67	-	50	9	24	11	6	NP	NP	NP	14	A-1-b	Granular	4	N/A				33	24.0	586.1	115	135	N/A	2.71	0.470							
SR 7	643.1	B-003-0-18	36.5	-	38.5	ST-24	ST	98	1.25	0	0	14	49	37	31	18	13	23	A-6a	Cohesive	4	1250	N/A	N/A			38.0	605.1			0.189	2.72		103	127	1330				
SR 7	643.1	B-003-0-18	38.5	-	40	SS-25	14	89	0.75	-	-	-	-	-	-	-	24	A-6a	Cohesive	4	750	2450	1862	143	24	39.0	604.1	115	130		2.72	0.476							
SR 7	643.1	B-003-0-18	40	-	41.5	SS-26	8	100	0.5	-	-	-	-	-	-	-	24	A-6a	Cohesive	4	500	1400	1064	100	22	41.0	602.1	115	130		2.72	0.476							
SR 7	643.1	B-003-0-18	41.5	-	43	SS-27	8	100	0.5	0	0	8	55	37	31	19	12	25	A-6a	Cohesive	4	500	1400	1064	100	22	42.0	601.1	115	130	0.189	2.72	0.476							
SR 7	643.1	B-003-0-18	43	-	44.5	SS-28	4	100	0.75	-	-	-	-	-	-	-	23	A-6a	Cohesive	4	750	700	532	50	20	44.0	599.1	105	125		2.72	0.616							
SR 7	643.1	B-003-0-18	44.5	-	46	SS-29	4	100	0.5	-	-	-	-	-	-	-	26	A-6a	Cohesive	4	500	700	532	50	20	45.0	598.1	105	125		2.72	0.616							
SR 7	643.1	B-003-0-18	46	-	47.5	SS-30	6	100	0.5	-	-	-	-	-	-	-	24	A-6a	Cohesive	4	500	1050	798	75	21	47.0	596.1	115	130		2.72	0.476							
SR 7	643.1	B-003-0-18	47.5	-	49	SS-31	6	100	0.5	-	-	-	-	-	-	-	25	A-6a	Cohesive	4	500	1050	798	75	21	48.0	595.1	115	130		2.72	0.476							
SR 7	643.1	B-003-0-18	49	-	50.5	SS-32	7	100	0.75	0	0	8	54	38	30	19	11	27	A-6a	Cohesive	4	750	1225	931	88	22	50.0	593.1	115	130	0.180	2.72	0.476							
SR 7	643.1	B-003-0-18	50.5	-	51.5	SS-33A	8	100	1.25	-	-	-	-	-	-	-	27	A-6a	Cohesive	4	1250	1400	1064	100	22	51.0	592.1	115	130		2.72	0.476							
SR 7	643.1	B-003-0-18	52	-	53.5	SS-34	1	56	-	-	-	-	-	-	-	-	27	A-4a	Cohesive	4	N/A	75	133	15	15	53.0	590.1	100	120		2.72	0.697							
SR 7	643.1	B-003-0-18	53.5	-	55	SS-35	18	89	-	3	5	49	25	18	NP	NP	NP	24	A-4a	NP SILT	4	N/A				27	54.0	589.1	115	140	N/A	2.72	0.476							
SR 7	643.1	B-003-0-18	55	-	56.5	SS-36	14	61	-	-	-	-	-	-	-	-	28	A-4a	Cohesive	4	N/A	1050	1862	143	24	56.0	587.1	120	135		2.72	0.414							
SR 7	643.2	B-004-0-18	37.5	-	39	SS-16	12	100	0.75	0	0	11	50	39	32	20	12	23	A-6a	Cohesive	4	750	2100	1596	129	23	38.0	605.2	115	130	0.198	2.72	0.476							
SR 7	643.2	B-004-0-18	40	-	41.5	ST-17	ST	94	0.75	-	-	-	-	-	-	-	26	A-6a	Cohesive	4	750	N/A	N/A			41.0	602.2				2.72								
SR 7	643.2	B-004-0-18	42.5	-	44	SS-18	10	100	0.75	-	-	-	-	-	-	-	24	A-4a	Cohesive	4	750	750	1330	114	23	43.0	600.2	120	135		2.72	0.414							
SR 7	643.2	B-004-0-18	45	-	46.5	SS-19	7	100	0.75	0	0	29	46	25	24	18	6	23	A-4a	Cohesive	4	750	525	931	88	22	46.0	597.2	115	130	0.126	2.72	0.476							
SR 7	643.2	B-004-0-18	47.5	-	49	SS-20	7	100	0.75	-	-	-	-	-	-	-	25	A-4a	Cohesive	4	750	525	931	88	22	48.0	595.2	115	130		2.72	0.476							
SR 7	643.2	B-004-0-18	50	-	51.5	SS-21	8	100	0.75	-	-	-	-	-	-	-	24	A-4a	Cohesive	4	750	600	1064	100	22	51.0	592.2	115	130		2.72	0.476							
SR 7	643.2	B-004-0-18	52.5	-	54	SS-22	17	100	1	-	-	-	-	-	-	-	25	A-4a	Cohesive	4	1000	1275	2261	157	24	53.0	590.2	125	140		2.72	0.358							
SR 7	612.48	B-004-1-20	7.5	-	9	SS-6	6	100	0.75	-	-	-	-	-	-	-	25	A-6a	Cohesive	4	750	1050	798	75	21	8.0	604.5	95	120		2.72	0.787							
SR 7	612.48	B-004-1-20	9	-	10.5	SS-7	6	100	0.5	0	0	14	49	37	37	22	15	29	A-6a	Cohesive	4	500	1050	798	75	21	10.0	602.5	95	120	0.243	2.72	0.787							
SR 7	612.48	B-004-1-20	10.5	-	12.5	ST-8	ST	100	1	0	0	11	54	35	36	23	13	27	A-6a	Cohesive	4	1000	N/A	N/A			12.0	600.5			0.234	2.72		98	124	1090				
SR 7	612.48	B-004-1-20	12.5	-	14	SS-9	3	100	-	-	-	-	-	-	-	-	25	A-4a	Cohesive	4	N/A	225	399	38	19	13.0	599.5	95	115		2.72	0.787							
SR 7	612.48	B-004-1-20	14	-	15.5	SS-10	3	89	-	0	0	35	40	25	26	18	8	29	A-4a	Cohesive	4	N/A	225	399	38	19	15.0	597.5	95	115	0.144	2.72	0.787							
SR 7	612.48	B-004-1-20	15.5	-	17	SS-11	4	100	-	-	-	-	-	-	-	-	24	A-4a	Cohesive	4	N/A	300	532	50	20	16.0	596.5	95	115		2.72	0.787							
SR 7	612.48	B-004-1-20	17	-	18.5	SS-12	1	94	0.5	-	-	-	-	-	-	-	26	A-6a	Cohesive	4	500	175	133	15	15	18.0	594.5	90	110		2.72	0.886							
SR 7	612.48	B-004-1-20	18.5	-	20	SS-13	9	100	1.25	0	0	23	48	29	34	20	14	27	A-6a	Cohesive	4	1250	1575	1197	107	22	19.0	593.5	110	125	0.216	2.72	0.543							
SR 7	612.48	B-004-1-20	20	-	21.5	SS-14	6	100	-	-	-	-	-	-	-	-	27	A-4a	Cohesive	4	N/A	450	798	75	21	21.0	591.5	105	125		2.72	0.616							
SR 7	612.48	B-004-1-20	21.5	-	23	SS-15	1	100	-	0	0	35	39	26	27	18	9	26	A-4a	Cohesive	4	N/A	75	133	15	15	22.0	590.5	95	110	0.153	2.72	0.787							
SR 7	603.01	B-004-2-20	1	-	2.5	SS-1	1	83	-	-	-	-	-	-	-	-	39	A-6b	Cohesive	4	N/A	175	133	15	15	2.0	601.0	85	105		2.7	0.982							
SR 7	603.01	B-004-2-20	3.5	-	5	SS-2	1	100	0.25	1	2	15	44	38	40	24	16	32	A-6b	Cohesive	4	250	175	133	15	15	4.0	599.0	85	105	0.270	2.7	0.982							
SR 7	603.01	B-004-2-20	6	-	7.5	SS-3	1	100	1.25	-	-	-	-	-	-	-	27	A-6b	Cohesive	4	1250	175	133	15	15	7.0	596.0	85	105		2.7	0.982							
SR 7	603.01	B-004-2-20	8.5	-	10	SS-4	4	100	-	-	-	-	-	-	-	-	25	A-4a	Cohesive	4	N/A	300	532	50	20	9.0	594.0	90	110		2.72	0.886							
SR 7	603.01	B-004-2-20	11	-	12.5	SS-5	4	100	-	0	0	40	39	21	25	18	7	25	A-4a	Cohesive	4	N/A	300	532	50	20	12.0	591.0	95	115	0.135	2.72	0.787							

XX = Omitted as outliers due to soil type
Actual N_{60} values are 0, considered 1 to establish parameters from GB-7 tables.

Values for Soil Strength Correlation	
Reference	Value
HI PI (Sowers)	0.25
MD PI (Sowers)	0.175
LO PI (Sowers)	0.075
T&P	0.133

Layer 5

	N_{60}	% Rec	HP	% Gr	% CS	% FS	% Silt	% Clay	LL	PL	PI	% WC		Short-Term Cohesion (psf) PPR	N-values Sowers	N-values T & P	Correlated LT Cohesion (psf) per GB-7	phi (deg)	Midpoint Sample Depth (ft.)	Midpoint Sample Elevation (ft.)	Correlated Dry Unit Wt. (pcf) per GB-7	Correlated Moist Unit Wt. (pcf) per GB-7	Correlated C_c	Assumed Specific Gravity (G_s)	Computed Void Ratio (e)
Max	114	100	5	63	29	57	53	43	31	21	11	25	Max	4500	4000	4000	250	28	70	589	135	150	0.189	2.72	0.537
Min	20	33	5	0	2	3	7	5	20	16	3	3	Min	4500	4000	4000	250	28	14	571	110	130	0.090	2.65	0.257
Average	52	87	5	27	11	23	25	14	23	18	6	12	Average	4500	4000	4000	250	28	44	581	123	140	0.121	2.71	0.382
Std Dev	28	19	0	17	6	12	13	11	4	2	3	5	Std Dev	0	0	0	0	0	16	5	8	5	0.038	0.01	0.084
Avg + Std	80	106	5	44	17	35	37	25	28	20	8	17	Avg + Std	4500	4000	4000	250	28	60	585	131	145	0.159	2.72	0.466
Avg - Std	23	68	5	11	4	12	12	4	19	16	3	8	Avg - Std	4500	4000	4000	250	28	29	576	115	135	0.083	2.70	0.298

Alignment	Surface Elevation	Exploration ID	From		To	Sample ID	N_{60}	% Rec	HP	% Gr	% CS	% FS	% Silt	% Clay	LL	PL	PI	% WC	ODOT Class.	Soil Type	Layer	Short-Term Cohesion (psf) PPR	N-values Sowers	N-values T & P	Correlated LT Cohesion (psf) per GB-7	phi (deg)	Midpoint Sample Depth (ft.)	Midpoint Sample Elevation (ft.)	Correlated Dry Unit Wt. (pcf) per GB-7	Correlated Moist Unit Wt. (pcf) per GB-7	Correlated C_c	Assumed Specific Gravity (G_s)	Computed Void Ratio (e)
SR 7	642.3	B-001-0-18	57	-	57.67	SS-24	Refusal	100	4.5	0	6	34	39	21	24	18	6	15	A-4a	Cohesive	5	4500	N/A	N/A	250	28	57	585.3			0.126	2.72	
SR 7	642.3	B-001-0-18	59.5	-	59.92	SS-25	Refusal	100	-	-	-	-	-	-	-	-	-	13	Rock		5	N/A	N/A	N/A	250	28	60	582.3					
SR 7	642.3	B-001-0-18	62	-	62.58	SS-26	Refusal	100	-	-	-	-	-	-	-	-	-	5	Rock		5	N/A	N/A	N/A	250	28	62	580.3					
SR 7	643.2	B-002-0-18	56.5	-	57.67	SS-37	Refusal	93	4.5	1	4	9	50	36	29	21	8	14	A-4b	Cohesive	5	4500	N/A	N/A	250	28	57	586.2			0.171	2.72	
SR 7	643.2	B-002-0-18	58	-	58.42	SS-38	Refusal	100	-	-	-	-	-	-	-	-	-	11	Rock		5	N/A	N/A	N/A	250	28	58	585.2					
SR 7	643.2	B-002-0-18	59.5	-	59.92	SS-39	Refusal	100	-	-	-	-	-	-	-	-	-	8	Rock		5	N/A	N/A	N/A	250	28	60	583.2					
SR 7	643.2	B-002-0-18	61	-	61.42	SS-40	Refusal	100	-	-	-	-	-	-	-	-	-	8	Rock		5	N/A	N/A	N/A	250	28	61	582.2					
SR 7	643.2	B-002-0-18	62.5	-	62.75	SS-41	Refusal	100	-	-	-	-	-	-	-	-	-	11	Rock		5	N/A	N/A	N/A	250	28	63	580.2					
SR 7	627.7	B-002-1-20	40	-	41.5	SS-27	61	78	-	-	-	-	-	-	-	-	-	8	A-4a	Cohesive	5	N/A	4000	4000	250	28	41	586.7	135	145		2.72	0.257
SR 7	627.7	B-002-1-20	41.5	-	43	SS-28	91	100	-	23	7	26	29	15	21	16	5	10	A-4a	Cohesive	5	N/A	4000	4000	250	28	42	585.7	135	145	0.099	2.72	0.257
SR 7	627.7	B-002-1-20	43	-	44.5	SS-29	61	44	-	-	-	-	-	-	-	-	-	14	A-2-4	Granular	5	N/A				40	44	583.7	130	150		2.71	0.301
SR 7	627.7	B-002-1-20	44.5	-	46	SS-30	74	83	-	32	12	25	21	10	20	17	3	10	A-2-4	Granular	5	N/A				40	45	582.7	130	150	0.09	2.71	0.301
SR 7	627.7	B-002-1-20	46	-	46.92	SS-31	Refusal	82	-	-	-	-	-	-	-	-	-	17	Rock		5	N/A	N/A	N/A	250	28	46	581.7					
SR 7	627.7	B-002-1-20	47.5	-	48.5	SS-32	Refusal	92	-	22	4	3	53	18	28	19	9	14	Rock		5	N/A	N/A	N/A	250	28	48	579.7			0.162		
SR 7	627.7	B-002-1-20	49	-	49.92	SS-33	Refusal	100	-	-	-	-	-	-	-	-	-	11	Rock		5	N/A	N/A	N/A	250	28	49	578.7					
SR 7	627.7	B-002-1-20	50.5	-	51.17	SS-34	Refusal	100	-	-	-	-	-	-	-	-	-	9	Rock		5	N/A	N/A	N/A	250	28	51	576.7					
SR 7	627.7	B-002-1-20	52	-	52.33	SS-35	Refusal	100	-	-	-	-	-	-	-	-	-	6	Rock		5	N/A	N/A	N/A	250	28	52	575.7					
SR 7	627.7	B-002-1-20	53.5	-	53.67	SS-36	Refusal	100	-	-	-	-	-	-	-	-	-	8	Rock		5	N/A	N/A	N/A	250	28	54	573.7					
SR 7	610.12	B-002-2-20	26	-	27.5	SS-11	42	83	-	34	9	22	22	13	20	17	3	12	A-2-4	Granular	5	N/A				35	27	583.1	120	140	0.09	2.71	0.409
SR 7	610.12	B-002-2-20	28.5	-	30	SS-12	22	100	-	38	9	24	19	10	20	16	4	13	A-2-4	Granular	5	N/A				32	29	581.1	115	135	0.09	2.71	0.470
SR 7	610.12	B-002-2-20	31	-	32.5	SS-13	85	100	-	-	-	-	-	-	-	-	-	9	A-2-4	Granular	5	N/A				40	32	578.1	125	140		2.71	0.353
SR 7	610.12	B-002-2-20	33.5	-	34.42	SS-14	Refusal	100	-	37	16	19	18	10	20	17	3	13	A-2-4	Granular	5	N/A				40	34	576.1			0.09	2.71	
SR 7	643.1	B-003-0-18	56.5	-	58	SS-37	84	72	4.5	0	2	10	45	43	31	20	11	17	A-6a	Cohesive	5	4500	4000	4000	250	28	57	586.1	135	145	0.189	2.72	0.257
SR 7	643.1	B-003-0-18	58	-	59.25	SS-38	Refusal	73	4.5	-	-	-	-	-	-	-	-	13	A-6a	Cohesive	5	4500	N/A	N/A	250	28	59	584.1				2.72	
SR 7	643.1	B-003-0-18	59.5	-	60.42	SS-39	Refusal	45	-	-	-	-	-	-	-	-	-	14	Rock		5	N/A	N/A	N/A	250	28	60	583.1					
SR 7	643.1	B-003-0-18	61	-	61.75	SS-40	Refusal	89	-	-	-	-	-	-	-	-	-	10	Rock		5	N/A	N/A	N/A	250	28	61	582.1					
SR 7	643.1	B-003-0-18	62.5	-	62.92	SS-41	Refusal	100	-	-	-	-	-	-	-	-	-	9	Rock		5	N/A	N/A	N/A	250	28	63	580.1					
SR 7	643.1	B-003-0-18	64	-	64.33	SS-42	Refusal	100	-	-	-	-	-	-	-	-	-	4	Rock		5	N/A	N/A	N/A	250	28	64	579.1					
SR 7	643.2	B-004-0-18	55	-	56.17	SS-23	Refusal	100	-	-	-	-	-	-	-	-	-	20	A-4a	Cohesive	5	N/A	N/A	N/A	250	28	56	587.2				2.72	
SR 7	643.2	B-004-0-18	57.5	-	58.08	SS-24	Refusal	100	-	-	-	-	-	-	-	-	-	3	A-2-4	Granular	5	N/A				40	58	585.2				2.71	
SR 7	643.2	B-004-0-18	60	-	61.5	SS-25	66	78	-	23	21	21	25	10	NP	NP	NP	16	A-2-4	Granular	5	N/A				40	61	582.2	130	150	N/A	2.71	0.301
SR 7	643.2	B-004-0-18	62.5	-	64	SS-26	114	72	4.5	0	13	16	36	35	29	21	8	17	A-4a	Cohesive	5	4500	4000	4000	250	28	63	580.2	135	145	0.171	2.72	0.257
SR 7	643.2	B-004-0-18	65	-	66.5	SS-27	112	83	4.5	-	-	-	-	-	-	-	-	17	A-4a	Cohesive	5	4500	4000	4000	250	28	66	577.2	135	145		2.72	0.257
SR 7	643.2	B-004-0-18	67.5	-	67.75	SS-28	Refusal	100	-	-	-	-	-	-	-	-	-	16	Rock		5	N/A	N/A	N/A	250	28	68	575.2					
SR 7	643.2	B-004-0-18	70	-	70.33	SS-29	Refusal	100	-	-	-	-	-	-	-	-	-	4	Rock		5	N/A	N/A	N/A	250	28	70	573.2					
SR 7	612.48	B-004-1-20	23	-	24.5	SS-16	35	44	-	-	-	-	-	-	-	-	-	10	A-1-a	Granular	5	N/A				35	24	588.5	120	140		2.71	0.409
SR 7	612.48	B-004-1-20	24.5	-	26	SS-17	25	100	-	63	13	12	7	5	22	17	5	19	A-1-a	Granular	5	N/A				33	25	587.5	115	135	0.108	2.71	0.470
SR 7	612.48	B-004-1-20	26	-	27.5	SS-18	38	44	-	-	-	-	-	-	-	-	-	10	A-1-a	Granular	5	N/A				35	27	585.5	120	140		2.71	0.409
SR 7	612.48	B-004-1-20	27.5	-	29	SS-19	25	39	-	-	-	-	-	-	-	-	-	19	A-2-4	Granular	5	N/A				33	28	584.5	115	135		2.71	0.470
SR 7	612.48	B-004-1-20	29	-	30.5	SS-20	20	83	-	36	13	27	15	9	NP	NP	NP	25	A-2-4	Granular	5	N/A				32	30	582.5	115	135	N/A	2.71	0.470
SR 7	612.48	B-004-1-20	31	-	32	SS-21B	46	100	-	40	12	20	20	8	20	16	4	10	A-2-4	Granular	5	N/A				36	32	580.5	120	140	0.09	2.71	0.409
SR 7	612.48	B-004-1-20	32	-	33.5	SS-22	41	100	-	-	-	-	-	-	-	-	-	9	A-2-4	Granular	5	N/A				35	33	579.5	120	140		2.71	0.409
SR 7	612.48	B-004-1-20	33.5	-	35	SS-23	25	100	-	27	29	16	18	10	21	16	5	15	A-2-4	Granular	5	N/A				33	34	578.5	115	135	0.099	2.71	0.470
SR 7	612.48	B-004-1-20	35	-	36.5	SS-24	56	100	-	34	7	32	19	8	NP	NP	NP	16	A-2-4	Granular	5	N/A				39	36	576.5	125	140	N/A	2.71	0.353
SR 7	612.48	B-004-1-20	36.5	-	37.75	SS-25	Refusal	100	-	25	6	41	18	10	NP	NP	NP	11	A-2-4	Granular	5	N/A				40	37	575.5			N/A	2.71	
SR 7	612.48	B-004-1-20	38	-	38.5	SS-26	Refusal	33	-	-	-	-	-	-	-	-	-	9	Rock		5	N/A	N/A	N/A	250	28	38	574.5					
SR 7	612.48	B-004-1-20	39.5	-	39.83	SS-27	Refusal	100	-	-	-	-	-	-	-	-	-	17	Rock		5	N/A	N/A	N/A	250	28	40	572.5					
SR 7	612.48	B-004-1-20	41	-	41.25	SS-28	Refusal	100	-	-	-	-	-	-	-	-	-	18	Rock		5	N/A	N/A	N/A	250	28	41	571.5					
SR 7	603.01	B-004-2-20	13.5	-	15	SS-6	23	72	-	41	6	28	17	8	NP	NP	NP	11	A-2-4	Granular	5	N/A				33	14	589.0	110	130	N/A	2.71	0.537
SR 7	603.01	B-004-2-20	16	-	17.5	SS-7	32	83	-	-	-	-	-	-	-	-	-	5	A-2-4	Granular	5	N/A				34	17	586.0	120	135		2.71	0.409
SR 7	603.01	B-004-2-20	18.5	-	20	SS-8	42	89	-	-	-	-	-	-	-	-	-	12	A-1-b	Granular	5	N/A				35	19	584.0	120	135		2.71	0.409
SR 7	603.01	B-004-2-20	21	-	22.5	SS-9	29	72	-	39	14	26	14	7	NP	NP	NP	16	A-1-b	Granular	5	N/A				34	22	581.0	115	135	N/A	2.71	0.470
SR 7	603.01	B-004-2-20	23.5	-	25	SS-10	23	83	-	-	-	-	-	-	-	-	-	8	A-1-b	Granular	5	N/A				33	24	579.0	115	135		2.71	0.470
SR 7	603.01	B-004-2-20	26	-	27	SS-11A	88	83	-	41	15	22	14	8	NP	NP	NP	11	A-1-b	Granular	5	N/A				40	27	576.0	125	140	N/A	2.71	0.353
SR 7	603.01	B-004-2-20	28.5	-	30	SS-12	35	83	-	14	6	57	17	6	NP	NP	NP	23	A-3a	Granular	5	N/A				35	29	574.0	120	140	N/A	2.65	0.378
SR 7	603.01	B-004-2-20	31	-	31.5	SS-13	Refusal	100	-	-	-	-	-	-	-	-	-	11	Rock		5	N/A	N/A	N/A	250	28	31	572.0					

PROJECT: MOE-7-07.55	DRILLING FIRM / OPERATOR: DHDC / A.U.	DRILL RIG: MOBILE B-57 TRACK RIG	STATION / OFFSET: 398+71, 13' RT.	EXPLORATION ID B-001-0-18
TYPE: LANDSLIDE	SAMPLING FIRM / LOGGER: HDR / S. REED	HAMMER: AUTOMATIC HAMMER	ALIGNMENT: SR-7	
PID: 108676 SFN:	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 2/27/18	ELEVATION: 642.3 (MSL) EOB: 84.0 ft.	PAGE 1 OF 3
START: 8/3/18 END: 8/6/18	SAMPLING METHOD: SPT/ST/NQ	ENERGY RATIO (%): 82.7	LAT / LONG: 39.616541, -80.931318	

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
ASPHALT PAVEMENT (7.5 INCHES)	642.3	1																
641.7		2	4 4 8	17	50	SS-1	3.50	-	-	-	-	-	-	-	-	19	A-6a (V)	
VERY STIFF, REDDISH-BROWN, TRACE TAN, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, DAMP		3																
@ 4.0' - 5.5' : grab sample obtained from auger spoils		4 5 6	4	15	0	SS-2	-	-	-	-	-	-	-	-	-	18	A-6a (V)	
		5																
@ 6.5' : orange-brown and tan		6 7	3 4 7	15	67	SS-3	4.00	-	-	-	-	-	-	-	-	16	A-6a (V)	
1 - Stiff Colluvium/Fill		8 9 10	3 5 6	15	72	SS-4	2.00	6	24	6	27	37	34	22	12	18	A-6a (7)	
@ 11.5' : brown, trace tan, and gray Below 11.5' : some gravel and stone fragments		11 12	3 5 7	17	50	SS-5	2.25	-	-	-	-	-	-	-	-	19	A-6a (V)	
		13 14 15	3 5 7	17	67	SS-6	2.00	-	-	-	-	-	-	-	-	17	A-6a (V)	
		16 17	3 6 15	29	61	SS-7	2.00	-	-	-	-	-	-	-	-	17	A-6a (V)	
2 - V. Stiff Colluvium		18 19 20	9 6 10	22	83	SS-8	2.50	-	-	-	-	-	-	-	-	16	A-6a (V)	
		21 22 23	3 6 10	22	67	SS-9	2.00	-	-	-	-	-	-	-	-	19	A-6a (V)	
		24 25 26	3 7 11	25	89	SS-10	3.25	-	-	-	-	-	-	-	-	16	A-6a (V)	
@ 26.5': brown and gray		27 28 29	3 5 7	17	100	SS-11	2.75	-	-	-	-	-	-	-	-	24	A-6a (V)	
			3 6	19	94	SS-12	4.00	-	-	-	-	-	-	-	-	19	A-6a (V)	

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 12/16/20 08:16 - C:\PWWORKING\EAST01\D1679058\20180730_MOE-7-7.55_2017 10-AA_TYPED LOGS (UPDATED DESCRIPTIONS).G

PID: 108676	SFN:	PROJECT: MOE-7-07.55	STATION / OFFSET: 398+71, 13' RT.	START: 8/3/18	END: 8/6/18	PG 2 OF 3	B-001-0-18

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
	612.3		8															
	611.3	31																
MEDIUM STIFF TO STIFF, OLIVE-BROWN TO GRAY, **SANDY SILT**, SOME CLAY, WET		32	2 4 3	10	100	SS-13	0.75	-	-	-	-	-	-	-	-	25	A-4a (V)	
@ 33.' - 35.0' : Shelby tube was attempted from 33.0' to 35.0', but no sample was recovered. SPT sample was then driven between 33.0' and 34.5'.		33	3 4 5	12	100	SS-14	1.00	-	-	-	-	-	-	-	-	23	A-4a (V)	
		34																
@ 35.5' : Qu = 2643 psf		35																
		36			96	ST-15	0.50	0	0	26	43	31	24	18	6	22	A-4a (8)	
4 - Soft to M. Stiff Alluvium		37																
		38	0 4 3	10	83	SS-16	0.75	-	-	-	-	-	-	-	-	23	A-4a (V)	
		39																
	602.3	40																
MEDIUM STIFF TO STIFF, OLIVE-BROWN TO GRAY, **SILT AND CLAY**, LITTLE SAND, MOIST		41	0 2 3	7	100	SS-17	0.50	-	-	-	-	-	-	-	-	24	A-6a (V)	
		42																
@ 42.5' : Qu = 2320 psf		43			92	ST-18	0.75	0	1	16	47	36	31	19	12	26	A-6a (9)	
	597.8	44																
MEDIUM STIFF, BROWN AND GRAY, **SANDY SILT**, SOME CLAY, WET		45	0 2 4	8	100	SS-19	1.00	-	-	-	-	-	-	-	-	25	A-4a (V)	
		46																
		47																
		48	0 0 3	4	100	SS-20	0.75	0	1	33	39	27	24	17	7	24	A-4a (6)	
		49																
		50	3 4 3	10	100	SS-21	1.75	-	-	-	-	-	-	-	-	24	A-4a (V)	
		51																
		52																
		53	0 0 3	4	100	SS-22	0.75	-	-	-	-	-	-	-	-	29	A-4a (V)	
		54																
		55	3 6 7	18	100	SS-23	0.75	-	-	-	-	-	-	-	-	32	A-4a (V)	
	585.8	56																
HARD, REDDISH-BROWN, **SANDY SILT**, SOME CLAY, DAMP		57	33 50/2"	-	100	SS-24	4.50	0	6	34	39	21	24	18	6	15	A-4a (5)	
5 - Hard Residuum/Weathered Bedrock	583.3	58																
		59																
		TR																
SHALE, REDDISH-BROWN AND GRAY, HIGHLY WEATHERED, VERY WEAK, FISSILE.		60	50/5"	-	100	SS-25	-	-	-	-	-	-	-	-	-	13	Rock (V)	
		61																

PID: 108676	SFN:	PROJECT: MOE-7-07.55	STATION / OFFSET: 398+71, 13' RT.	START: 8/3/18	END: 8/6/18	PG 3 OF 3	B-001-0-18

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
SHALE, REDDISH-BROWN AND GRAY, HIGHLY WEATHERED, VERY WEAK, FISSILE. *(continued)*	580.2	63	42 \ 50/1"	-	100	SS-26	-	-	-	-	-	-	-	-	-	5	Rock (V)	
	578.3	64																
INTERBEDDED SHALE (54%) AND SILTSTONE (46%), MODERATELY FRACTURED, RQD 26%, REC. 98%; **SHALE**, GRAY, HIGHLY WEATHERED, VERY WEAK, VERY FINE GRAINED, LAMINATED TO THIN BEDDED; **SILTSTONE**, GRAY, MODERATELY WEATHERED, VERY WEAK TO WEAK, FINE GRAINED, THIN TO MEDIUM BEDDED, SLIGHTLY ROUGH SURFACES ALONG BEDDING JOINTS.		65	0		90	NQ-1											CORE	
		66																
		67	25		96	NQ-2											CORE	
		68																
		69																
		70																
@ 71.3' : Qu = 156 psi (shale seam) @ 71.5' : Qu = 666 psi (siltstone seam)		71	25		100	NQ-3											CORE	
		72																
		73																
		74																
		75																
		76	35		96	NQ-4											CORE	
		77																
		78																
	563.3	79																
SILTSTONE, GRAY, UNWEATHERED, SLIGHTLY STRONG, FINE GRAINED, LAMINATED TO THIN BEDDED, MODERATELY FRACTURED, ROUGH SURFACES ALONG BEDDING JOINTS; RQD 36%, REC 100%.		80																
		81	36		100	NQ-5											CORE	
		82																
		83																
	558.3	EOB 84																

NOTES: INTRODUCED WATER INTO THE BOREHOLE AT 35.5 FEET TO FACILITATE PISTON TUBE SAMPLING

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH 4 BAGS BENTONITE GROUT; MIXED 80 GAL. WATER

PROJECT: MOE-7-07.55	DRILLING FIRM / OPERATOR: DHDC / A.U.	DRILL RIG: MOBILE B-57 TRACK RIG	STATION / OFFSET: 400+47, 10' RT.	EXPLORATION ID B-002-0-18
TYPE: LANDSLIDE	SAMPLING FIRM / LOGGER: HDR / S. REED	HAMMER: AUTOMATIC HAMMER	ALIGNMENT: SR-7	
PID: 108676 SFN:	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 2/27/18	ELEVATION: 643.2 (MSL) EOB: 83.0 ft.	PAGE 1 OF 3
START: 8/1/18 END: 8/2/18	SAMPLING METHOD: SPT/ST/NQ	ENERGY RATIO (%): 82.7	LAT / LONG: 39.616785, -80.930775	

MATERIAL DESCRIPTION AND NOTES	ELEV. 643.2	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 PAVEMENT (9 INCHES)	642.5	1																
CONCRETE PAVEMENT (6 INCHES)	642.0																	
STIFF, BROWN, **SILT AND CLAY**, SOME SAND, LITTLE GRAVEL, DAMP (FILL)		2	5 4 5	12	0	SS-1	-	18	18	10	23	31	34	22	12	15	A-6a (5)	
@ 1.5' - 3.0' : grab sample obtained from augers	640.2	3	4 3 5	11	56	SS-2	2.50	-	-	-	-	-	-	-	-	22	A-6a (V)	
STIFF, REDDISH-BROWN, **SILT AND CLAY**, SOME TO "AND" SAND, TRACE GRAVEL, DAMP		4	2 3 4	10	44	SS-3	1.50	-	-	-	-	-	-	-	-	25	A-6a (V)	
		5	7 3 5	11	72	SS-4	1.75	-	-	-	-	-	-	-	-	19	A-6a (V)	
		6	2 3 4	10	50	SS-5	1.50	-	-	-	-	-	-	-	-	19	A-6a (V)	
		7																
		8																
Below 9.0' : some stone fragments		9	2 3 4	10	72	SS-6	2.25	-	-	-	-	-	-	-	-	21	A-6a (V)	
		10	2 4 5	12	56	SS-7	1.75	-	-	-	-	-	-	-	-	19	A-6a (V)	
1 - Stiff Colluvium/Fill		11	2 5 5	14	83	SS-8	1.50	-	-	-	-	-	-	-	-	19	A-6a (V)	
		12	2 3 5	11	78	SS-9	1.25	-	-	-	-	-	-	-	-	19	A-6a (V)	
		13	2 3 5	11	72	SS-10	1.50	-	-	-	-	-	-	-	-	21	A-6a (V)	
		14																
		15																
@ 16.5' : sandstone cobbles		16	50/3"	-	100	SS-11	1.50	-	-	-	-	-	-	-	-	17	A-6a (V)	
		17																
@ 18.0' : sandstone fragments embedded in clayey soil matrix		18	30 12 7	26	78	SS-12	-	-	-	-	-	-	-	-	-	4	A-6a (V)	
@ 19.5' : sandstone fragments embedded in clayey soil matrix		19	4 4 6	14	61	SS-13	2.50	-	-	-	-	-	-	-	-	14	A-6a (V)	
		20																
2 - V. Stiff Colluvium		21	3 5 6	15	67	SS-14	2.25	-	-	-	-	-	-	-	-	15	A-6a (V)	
		22																
		23	2 15 14	40	94	SS-15	1.25	4	30	6	27	33	32	20	12	17	A-6a (6)	
		24	2 6 6	17	78	SS-16	1.50	-	-	-	-	-	-	-	-	18	A-6a (V)	
		25																
		26	3 28 10	52	56	SS-17	1.50	1	19	7	33	40	32	20	12	17	A-6a (8)	
		27																
		28	5 6 9	21	50	SS-18	1.50	-	-	-	-	-	-	-	-	18	A-6a (V)	
		29	4 4 6	14	56	SS-19	1.50	-	-	-	-	-	-	-	-	19	A-6a (V)	

PID: 108676	SFN:	PROJECT: MOE-7-07.55	STATION / OFFSET: 400+47, 10' RT.	START: 8/1/18	END: 8/2/18	PG 2 OF 3	B-002-0-18

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
	613.2																	
	612.3	31	5 8 9	23	72	SS-20A	1.75	-	-	-	-	-	-	-	-	-	A-6a (V)	
STIFF TO VERY STIFF, MOTTLED BROWN AND GRAY, **SILT AND CLAY**, TRACE SAND, TRACE GRAVEL, MOIST						SS-20B	3.00	-	-	-	-	-	-	-	-	25	A-6a (V)	
@ 33.0' - 35.0' : Qu = 4036 psf 3 - Stiff to V. Stiff Colluvium		32 33	3 6 7	18	100	SS-21	1.75	0	1	6	50	43	35	20	15	22	A-6a (10)	
		34			96	ST-22	1.00	1	1	7	52	39	31	19	12	18	A-6a (9)	
	608.2	35																
SOFT TO MEDIUM STIFF, GRAY, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, MOIST		36	3 4 5	12	100	SS-23	1.00	-	-	-	-	-	-	-	-	25	A-6a (V)	
		37	3 4 5	12	100	SS-24	0.75	-	-	-	-	-	-	-	-	22	A-6a (V)	
@ 38.0' - 40.0' : Attempted undisturbed shelby tube, but did not recover sample. An SPT sample was then driven from 38.0' to 39.5'		38 39			94	ST-25	1.00	-	-	-	-	-	-	-	-	23	A-6a (V)	
		40	0 2 3	7	94	SS-26	1.00	-	-	-	-	-	-	-	-	23	A-6a (V)	
@ 41.5' - 43.5' : Attempted undisturbed shelby tube, but did not recover sample. An SPT sample was then driven from 41.5' to 43.0'.		41 42			100	ST-27	0.50	0	0	20	48	32	28	17	11	25	A-6a (8)	
		43	0 0 3	4	100	SS-28	1.00	-	-	-	-	-	-	-	-	23	A-6a (V)	
4 - Soft to M. Stiff Alluvium		44 45	2 5 5	14	100	SS-29	1.00	-	-	-	-	-	-	-	-	24	A-6a (V)	
		46	0 2 4	8	100	SS-30	0.75	-	-	-	-	-	-	-	-	23	A-6a (V)	
		47 48	0 3 2	7	100	SS-31	0.75	-	-	-	-	-	-	-	-	24	A-6a (V)	
@ 49.0' : occasional sandy silt seams		49 50	0 2 3	7	100	SS-32	0.75	-	-	-	-	-	-	-	-	26	A-6a (V)	
		51	2 3 3	8	100	SS-33	1.25	-	-	-	-	-	-	-	-	28	A-6a (V)	
		52 W 590.7	0 0 3	4	100	SS-34	0.50	1	0	21	45	33	29	18	11	29	A-6a (8)	
	589.7	53																
LOOSE TO MEDIUM DENSE, GRAY, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL, SLIGHTLY VARVED WITH OCCASIONAL CLAY LAMINATIONS AND THIN BEDS, WET		54	0 2 2	6	100	SS-35	-	-	-	-	-	-	-	-	-	32	A-4a (V)	
		55 56	0 4 8	17	100	SS-36	-	7	8	38	29	18	NP	NP	NP	22	A-4a (2)	
	586.7																	
HARD, GRAY, **SILT**, "AND" CLAY, LITTLE SAND, TRACE GRAVEL, DAMP		57	9 38 50/2"	-	93	SS-37	4.50	1	4	9	50	36	29	21	8	14	A-4b (8)	
	585.2	TR																
CLAYSTONE, BR 5 - Hard Residuum/Weathered Bedrock HIGHLY WEATHERED, VERY WEAK.		58	50/5"	-	100	SS-38	-	-	-	-	-	-	-	-	-	11	Rock (V)	
		59 60	50/5"	-	100	SS-39	-	-	-	-	-	-	-	-	-	8	Rock (V)	
		61	50/5"	-	100	SS-40	-	-	-	-	-	-	-	-	-	8	Rock (V)	

PID: 108676	SFN:	PROJECT: MOE-7-07.55	STATION / OFFSET: 400+47, 10' RT.	START: 8/1/18	END: 8/2/18	PG 3 OF 3	B-002-0-18

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
	581.1																	
	580.2	63	50/3"	-	100	SS-41	-	-	-	-	-	-	-	-	-	11	Rock (V)	
CLAYSTONE, REDDISH-BROWN, SEVERELY TO HIGHLY WEATHERED, VERY WEAK, VERY FINE GRAINED, MEDIUM TO THICK BEDDED, OCCASIONAL CLAY SEAMS, FRACTURED WITH SLICKENSIDED SURFACES ALONG BEDDING JOINTS; RQD 32%, REC 100%.	577.1	64 65	40		100	NQ											CORE	
SHALE, GRAY, UNWEATHERED TO SLIGHTLY WEATHERED, WEAK TO SLIGHTLY STRONG, VERY FINE TO FINE GRAINED, THIN TO MEDIUM BEDDED, CALCAREOUS, SEAMS OF ARGILLACEOUS SHALE, OCCASIONAL SILTSTONE SEAMS, SLIGHTLY FRACTURED WITH ROUGH SURFACES ALONG BEDDING JOINTS; RQD 38%, REC 96%. @ 68.5' : Qu = 860 psi		66 67 68 69	55		87	NQ											CORE	
		70 71 72 73	31		100	NQ											CORE	
	564.4	74 75 76 77 78	26		98	NQ											CORE	
SILTSTONE, GRAY, SLIGHTLY TO MODERATELY WEATHERED, WEAK TO SLIGHTLY STRONG, FINE GRAINED, LAMINATED, OCCASIONAL THIN SHALE PARTINGS AND SEAMS, FRACTURED WITH SLIGHTLY ROUGH SURFACES ALONG BEDDING JOINTS; RQD 0%, REC 100%.		79 80 81	0		100	NQ											CORE	
	560.2	EOB 83																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH 4 BAGS BENTONITE GROUT; MIXED 80 GAL. WATER

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 12/16/20 08:16 - C:\PW\WORKING\EAST01\D1679058\20180730_MOE-7-7.55_2017 10-AA_TYPED LOGS (UPDATED DESCRIPTIONS).G

PROJECT: MOE-7-07.55	DRILLING FIRM / OPERATOR: DHDC / A.U.	DRILL RIG: MOBILE B-57 TRACK RIG	STATION / OFFSET: 401+46, 10' RT.	EXPLORATION ID B-003-0-18
TYPE: LANDSLIDE	SAMPLING FIRM / LOGGER: HDR / S. REED	HAMMER: AUTOMATIC HAMMER	ALIGNMENT: SR-7	
PID: 108676 SFN:	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 2/27/18	ELEVATION: 643.1 (MSL) EOB: 84.5 ft.	PAGE 1 OF 3
START: 7/27/18 END: 8/1/18	SAMPLING METHOD: SPT/ST/NQ	ENERGY RATIO (%): 82.7	LAT / LONG: 39.616928, -80.930476	

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
	643.1																	
ASPHALT PAVEMENT (8.5 INCHES)	642.4																	
CONCRETE PAVEMENT (5 INCHES)	642.0																	
STIFF, BROWNISH-GRAY, **CLAY**, SOME SILT, LITTLE SAND, LITTLE GRAVEL, MOIST (FILL)		1																
		2	2 3 4	10	50	SS-1	2.00	14	11	6	24	45	45	24	21	29	A-7-6 (12)	
		3	3 3 4	10	50	SS-2	1.75	-	-	-	-	-	-	-	-	26	A-7-6 (V)	
	638.1	4																
MEDIUM STIFF TO STIFF, REDDISH-BROWN, TRACE GRAY AND TAN, **SILT AND CLAY**, SOME SAND, LITTLE GRAVEL, SEVERAL SANDSTONE AND SHALE FRAGMENTS THROUGHOUT, DAMP		5	2 2 2	6	56	SS-3	1.00	-	-	-	-	-	-	-	-	24	A-6a (V)	
		6	3 3 5	11	61	SS-4	2.75	-	-	-	-	-	-	-	-	22	A-6a (V)	
		7	2 3 10	18	56	SS-5	1.50	-	-	-	-	-	-	-	-	21	A-6a (V)	
@ 9.5' - 10.3' : pushed tube only 8 inches due to large rock fragment at the bottom. The tube was damaged and rejected.		8			94	ST-6	-	-	-	-	-	-	-	-	-	-	A-6a (V)	
		9	7 4 6	14	11	SS-7	-	-	-	-	-	-	-	-	-	6	A-6a (V)	
		10	3 6 5	15	56	SS-8	3.25	-	-	-	-	-	-	-	-	16	A-6a (V)	
1 - Stiff Colluvium/Fill		11	3 6 4	14	72	SS-9	2.00	-	-	-	-	-	-	-	-	18	A-6a (V)	
		12	3 5 6	15	39	SS-10	1.75	-	-	-	-	-	-	-	-	18	A-6a (V)	
		13	3 5 7	17	67	SS-11	2.00	-	-	-	-	-	-	-	-	20	A-6a (V)	
@ 18.0' - 20.0' : Qu = 1445 psf		14			83	ST-12	2.00	16	22	4	22	36	35	21	14	19	A-6a (6)	
		15	2 5 7	17	78	SS-13	2.00	-	-	-	-	-	-	-	-	20	A-6a (V)	
		16	4 7 21	39	100	SS-14	3.50	-	-	-	-	-	-	-	-	18	A-6a (V)	
2 - V. Stiff Colluvium		17	10 12 11	32	100	SS-15	2.50	-	-	-	-	-	-	-	-	19	A-6a (V)	
		18	8 8 9	23	0	SS-16	-	-	-	-	-	-	-	-	-	17	A-6a (V)	
		19	6 6 8	19	11	SS-17	2.00	-	-	-	-	-	-	-	-	17	A-6a (V)	
@ 24.5' - 26.0' : obtained sample from auger spoils (no SPT recovery)		20	4 8 12	28	100	SS-18	2.50	-	-	-	-	-	-	-	-	16	A-6a (V)	
		21	10 8	40	100	SS-19	2.50	-	-	-	-	-	-	-	-	18	A-6a (V)	

PID: 108676	SFN:	PROJECT: MOE-7-07.55	STATION / OFFSET: 401+46, 10' RT.	START: 7/27/18	END: 8/1/18	PG 2 OF 3	B-003-0-18

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
MEDIUM STIFF TO STIFF, REDDISH-BROWN, TRACE GRAY AND TAN, **SILT AND CLAY**, SOME SAND, LITTLE GRAVEL, SEVERAL SANDSTONE AND SHALE FRAGMENTS THROUGHOUT, DAMP *(continued)*	613.1	31	21															
		32	5 15 9	33	100	SS-20	1.50	-	-	-	-	-	-	-	-	19	A-6a (V)	
	609.9	33	6 11 10	29	89	SS-21A	3.00	-	-	-	-	-	-	-	-	18	A-6a (V)	
						SS-21B	4.50	-	-	-	-	-	-	-	-	-	A-6a (V)	
STIFF TO VERY STIFF, MOTTLED BROWN AND GRAY, **SILT AND CLAY**, LITTLE SAND, MOIST		34	4 7 9	22	100	SS-22	2.00	-	-	-	-	-	-	-	-	25	A-6a (V)	
3 - Stiff to V. Stiff Colluvium		35																
	606.6	36	5 7 7	19	100	SS-23	2.50	-	-	-	-	-	-	-	-	24	A-6a (V)	
MEDIUM STIFF, MOTTLED BROWN AND GRAY, **SILT AND CLAY**, TRACE SAND, MOIST @ 36.5' - 38.5' : Qu = 2660 psf		37			98	ST-24	1.25	0	0	14	49	37	31	18	13	23	A-6a (9)	
		38																
		39	3 4 6	14	89	SS-25	0.75	-	-	-	-	-	-	-	-	24	A-6a (V)	
		40																
		41	1 3 3	8	100	SS-26	0.50	-	-	-	-	-	-	-	-	24	A-6a (V)	
		42	0 2 4	8	100	SS-27	0.50	0	0	8	55	37	31	19	12	25	A-6a (9)	
		43																
		44	0 1 2	4	100	SS-28	0.75	-	-	-	-	-	-	-	-	23	A-6a (V)	
4 - Soft to M. Stiff Alluvium		45	0 0 3	4	100	SS-29	0.50	-	-	-	-	-	-	-	-	26	A-6a (V)	
		46																
		47	0 2 2	6	100	SS-30	0.50	-	-	-	-	-	-	-	-	24	A-6a (V)	
		48	0 2 2	6	100	SS-31	0.50	-	-	-	-	-	-	-	-	25	A-6a (V)	
		49																
		50	0 3 2	7	100	SS-32	0.75	0	0	8	54	38	30	19	11	27	A-6a (8)	
	591.6	51	2 3 3	8	100	SS-33A	1.25	-	-	-	-	-	-	-	-	27	A-6a (V)	
						SS-33B	-	-	-	-	-	-	-	-	-	-	A-4a (V)	
LOOSE TO MEDIUM DENSE, GRAY, **SANDY SILT**, LITTLE CLAY, TRACE GRAVEL, WET		52	0 0 1	1	56	SS-34	-	-	-	-	-	-	-	-	-	27	A-4a (V)	
		53																
		54	0 6 7	18	89	SS-35	-	3	5	49	25	18	NP	NP	NP	24	A-4a (2)	
		55																
	586.6	56	4 4 6	14	61	SS-36	-	-	-	-	-	-	-	-	-	28	A-4a (V)	
HARD, GRAY, **SILT AND CLAY**, LITTLE SAND, DAMP		57	6 20 41	84	72	SS-37	4.50	0	2	10	45	43	31	20	11	17	A-6a (8)	
		58																
5 - Hard Residuum/Weathered Bedrock		59	7 45 50/3"	-	73	SS-38	4.50	-	-	-	-	-	-	-	-	13	A-6a (V)	
	583.6	TR																
CLAYSTONE, REDDISH-BROWN, TRACE GRAY, HIGHLY WEATHERED, VERY WEAK.		60	17 50/5"	-	45	SS-39	-	-	-	-	-	-	-	-	-	14	Rock (V)	
		61																
			29 50/3"	-	89	SS-40	-	-	-	-	-	-	-	-	-	10	Rock (V)	

W 591.6

PID: 108676	SFN:	PROJECT: MOE-7-07.55	STATION / OFFSET: 401+46, 10' RT.	START: 7/27/18	END: 8/1/18	PG 3 OF 3	B-003-0-18

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
CLAYSTONE, REDDISH-BROWN, TRACE GRAY, HIGHLY WEATHERED, VERY WEAK. *(continued)*	581.0	63	50/5"	-	100	SS-41	-	-	-	-	-	-	-	-	-	9	Rock (V)	
	578.6	64	50/4"	-	100	SS-42	-	-	-	-	-	-	-	-	-	4	Rock (V)	
SHALE, GRAY, SEVERELY TO HIGHLY WEATHERED, VERY WEAK TO WEAK, VERY FINE GRAINED, THIN BEDDED, FRACTURED WITH SLIGHTLY ROUGH TO ROUGH SURFACES ALONG HORIZONTAL BEDDING JOINTS, NUMEROUS CLAY SEAMS; RQD 14%, REC 100%.	575.6	65 66 67	12		100	NQ-1											CORE	
SILTSTONE, GRAY, HIGHLY TO MODERATELY WEATHERED, SLIGHTLY STRONG, FINE GRAINED, LAMINATED TO THIN BEDDED, OCCASSIONAL VERY WEAK TO WEAK SHALE SEAMS, FRACTURED WITH SLIGHTLY ROUGH TO ROUGH SURFACES ALONG BEDDING JOINTS; RQD 14%, REC 100%. @ 69.3' - 69.5' : vertical fracture @ 71.2' - 71.3' : vertical fracture @ 72.5' - 72.8' : vertical fracture	568.1	68 69 70 71 72 73 74	0		100	NQ-2											CORE	
			22		100	NQ-3											CORE	
SHALE, GRAY, MODERATELY WEATHERED, WEAK TO SLIGHTLY STRONG, VERY FINE GRAINED, LAMINATED TO THIN BEDDED, SLIGHTLY FRACTURED WITH SLIGHTLY ROUGH TO ROUGH SURFACES ALONG HORIZONTAL BEDDING JOINTS, SEVERAL INTERBEDDED SILTSTONE SEAMS; RQD 54%, REC 100%. @ 75.9' : Qu = 2255 psi	563.1	75 76 77 78 79	54		100	NQ-4											CORE	
SILTSTONE, GRAY, SLIGHTLY WEATHERED, SLIGHTLY STRONG, VERY FINE TO FINE GRAINED, LAMINATED TO THIN BEDDED, OCCASIONAL CROSS-BEDDING IN SILTSTONE, OCCASIONAL SHALE PARTINGS, FRACTURED WITH SLIGHTLY ROUGH TO ROUGH SURFACES ALONG HORIZONTAL BEDDING JOINTS; RQD 43%, REC 100%.	558.6	80 81 82 83 84 EOB	0		100	NQ-5											CORE	
			15		100	NQ-6											CORE	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH 4 BAGS BENTONITE GROUT; MIXED 87 GAL. WATER

PROJECT: MOE-7-07.55	DRILLING FIRM / OPERATOR: DHDC / A.U.	DRILL RIG: MOBILE B-57 TRACK RIG	STATION / OFFSET: 402+45, 10' RT.	EXPLORATION ID B-004-0-18
TYPE: LANDSLIDE	SAMPLING FIRM / LOGGER: HDR / S. REED	HAMMER: AUTOMATIC HAMMER	ALIGNMENT: SR-7	
PID: 108676 SFN:	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 2/27/18	ELEVATION: 643.2 (MSL) EOB: 90.5 ft.	PAGE 1 OF 3
START: 7/26/18 END: 7/26/18	SAMPLING METHOD: SPT/ST/NQ	ENERGY RATIO (%): 82.7	LAT / LONG: 39.617076, -80.930180	

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
ASPHALT PAVEMENT (10 INCHES)	643.2 / 642.4	1																
CONCRETE PAVEMENT (6 INCHES)	641.9	2	4 3 5	11	11	SS-1	-	12	24	12	22	30	36	24	12	16	A-6a (4)	
STIFF, BROWN, **SILT AND CLAY**, "AND" SAND, LITTLE GRAVEL, MOIST (FILL)	639.7	3																
STIFF TO VERY STIFF, REDDISH-BROWN, TRACE GRAY, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, MOIST		4	2 2 2	6	22	SS-2	1.25	-	-	-	-	-	-	-	-	21	A-6a (V)	
		5																
		6																
		7	2 3 5	11	44	SS-3	2.50	-	-	-	-	-	-	-	-	25	A-6a (V)	
1 - Stiff to V. Stiff Colluvium/Fill		8																
		9	3 5 6	15	56	SS-4	2.50	-	-	-	-	-	-	-	-	22	A-6a (V)	
@ 11.0' - 13.0' : Qu = 4100 psf @ 11.0' - 13.0' : rock at tip of sample ST-5 (slightly damaged at bottom)		10																
		11			75	ST-5	-	8	17	8	24	43	35	22	13	17	A-6a (8)	
		12																
		13	5 6 8	19	67	SS-6	3.50	-	-	-	-	-	-	-	-	18	A-6a (V)	
		14																
		15	4 5 8	18	67	SS-7	3.25	-	-	-	-	-	-	-	-	18	A-6a (V)	
		16																
		17																
		18	3 5 9	19	72	SS-8	2.25	-	-	-	-	-	-	-	-	18	A-6a (V)	
	623.7	19																
VERY STIFF, BROWN AND TAN, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, MOIST		20	4 9 8	23	72	SS-9	2.75	-	-	-	-	-	-	-	-	16	A-6a (V)	
		21																
2 - V. Stiff Colluvium		22																
		23	4 6 10	22	78	SS-10	3.50	2	19	5	32	42	35	22	13	18	A-6a (9)	
		24																
		25																
		26	7 7 8	21	67	SS-11	1.75	-	-	-	-	-	-	-	-	17	A-6a (V)	
	616.2	27																
VERY STIFF, REDDISH-BROWN, TRACE GRAY, **SILT AND CLAY**, LITTLE SAND, MOIST		28	4 8 11	26	100	SS-12	3.25	0	9	7	38	46	37	23	14	20	A-6a (10)	
3 - Stiff to V. Stiff Colluvium		29																

PID: 108676	SFN:	PROJECT: MOE-7-07.55	STATION / OFFSET: 402+45, 10' RT.	START: 7/26/18	END: 7/26/18	PG 2 OF 3	B-004-0-18

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 STIFF, REDDISH-BROWN, TRACE GRAY, **SILT AND CLAY**, LITTLE SAND, MOIST *(continued)*	613.2	31	6 9 9	25	100	SS-13	3.00	-	-	-	-	-	-	-	-	21	A-6a (V)	
		32																
	610.2	33	7 7 8	21	100	SS-14A	2.50	-	-	-	-	-	-	-	-	-	A-6a (V)	
STIFF, REDDISH-BROWN TO GRAY, **SILTY CLAY**, TRACE SAND, MOIST		34			-	SS-14B	1.50	-	-	-	-	-	-	-	-	29	A-6b (V)	
		35																
		36	4 7 8	21	100	SS-15	2.25	0	1	1	52	46	37	21	16	23	A-6b (10)	
	605.7	37																
MEDIUM STIFF, GRAYISH-BROWN WITH TRACE REDDISH-BROWN AND GRAY, **SILT AND CLAY**, LITTLE SAND, MOIST		38	3 4 5	12	100	SS-16	0.75	0	0	11	50	39	32	20	12	23	A-6a (9)	
		39																
@ 40.0' - 42.0' : Attempted undisturbed shelby tube, but sample was not recovered. An SPT sample was then driven from 40.0' to 41.5'.		40																
		41			94	ST-17	0.75	-	-	-	-	-	-	-	-	26	A-6a (V)	
	601.2	42																
MEDIUM STIFF, BROWNISH-GRAY, **SANDY SILT**, SOME CLAY, MOIST		43	0 3 4	10	100	SS-18	0.75	-	-	-	-	-	-	-	-	24	A-4a (V)	
		44																
@ 45' : occasional thin wet silty sand seam		45																
		46	0 2 3	7	100	SS-19	0.75	0	0	29	46	25	24	18	6	23	A-4a (7)	
@ 47.5' : slightly varved		47																
		48	0 3 2	7	100	SS-20	0.75	-	-	-	-	-	-	-	-	25	A-4a (V)	
4 - Soft to M. Stiff Alluvium		49																
		50	0 2 4	8	100	SS-21	0.75	-	-	-	-	-	-	-	-	24	A-4a (V)	
W 591.2		51																
		52																
@ 52.5' : several thin wet silty sand seams		53	0 7 5	17	100	SS-22	1.00	-	-	-	-	-	-	-	-	25	A-4a (V)	
		54																
		55																
	587.2	56	8 17 50/2"	-	100	SS-23	-	-	-	-	-	-	-	-	-	20	A-4a (V)	
DENSE, OLIVE-BROWN AND GRAY, **GRAVEL WITH SAND AND SILT**, TRACE CLAY, MOIST TO WET		57																
		58	30 50/1"	-	100	SS-24	-	-	-	-	-	-	-	-	-	3	A-2-4 (V)	
		59																
		60																
		61	11 23 25	66	78	SS-25	-	23	21	21	25	10	NP	NP	NP	16	A-2-4 (0)	
	581.2																	

PID: 108676	SFN:	PROJECT: MOE-7-07.55	STATION / OFFSET: 402+45, 10' RT.	START: 7/26/18	END: 7/26/18	PG 3 OF 3	B-004-0-18

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
HARD, REDDISH-BROWN, TRACE GRAY, **SANDY SILT**, SOME CLAY, DAMP *(continued)*	581.1	63	15 35 48	114	72	SS-26	4.50	0	13	16	36	35	29	21	8	17	A-4a (7)	
5 - Hard Residuum/Weathered Bedrock		64																
		65																
		66	15 34 47	112	83	SS-27	4.50	-	-	-	-	-	-	-	-	17	A-4a (V)	
	575.7	67																
SHALE, BLUISH-GRAY, HIGHLY WEATHERED, WEAK.		TR 68	50/3"	-	100	SS-28	-	-	-	-	-	-	-	-	-	16	Rock (V)	
	572.7	69																
		70	50/4"	-	100	SS-29	-	-	-	-	-	-	-	-	-	4	Rock (V)	
SHALE, GRAY, MODERATELY TO HIGHLY WEATHERED, VERY WEAK TO WEAK, VERY FINE GRAINED, LAMINATED TO THIN BEDDED, OCCASIONAL CALCAREOUS SEAMS, OCCASIONAL CLAY SEAMS, MODERATELY FRACTURED WITH SLIGHTLY ROUGH SURFACES ALONG HORIZONTAL BEDDING JOINTS; RQD 32%, REC 96%.		71																
		72																
		73	28		100	NQ-1											CORE	
		74																
		75																
		76																
		77																
		78	36		91	NQ-2											CORE	
		79																
	562.7	80																
SILTSTONE, GRAY, MODERATELY WEATHERED, WEAK TO SLIGHTLY STRONG, VERY FINE GRAINED, THIN TO MEDIUM BEDDED, OCCASIONAL THIN SHALE PARTINGS, MODERATELY FRACTURED WITH ROUGH SURFACES; RQD 19%, REC 94%. @ 83.0' - 83.5' : Qu = 343 psi (very weak seam) @ 83.5' - 83.7' : high angle fracture		81																
		82																
		83	20		94	NQ-3											CORE	
		84																
		85																
	557.3	86																
SHALE, GRAY, HIGHLY WEATHERED, VERY WEAK TO WEAK, VERY FINE GRAINED, THIN BEDDED, INTERBEDDED ZONES OF SLIGHTLY STRONG CALCAREOUS SHALE, FRACTURED TO MODERATELY FRACTURED WITH SLIGHTLY ROUGH SURFACES ALONG HORIZONTAL BEDDING JOINTS; RQD 15%, REC 100%.		87	27		100	NQ-4											CORE	
		88																
		89	0		100	NQ-5											CORE	
	552.7	EOB 90																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH 3.5 BAGS BENTONITE GROUT; MIXED 80 GAL. WATER

PROJECT: MOE-7-07.55	DRILLING FIRM / OPERATOR: CENTRAL STAR / TS	DRILL RIG: DIEDRICH D-50	STATION / OFFSET: 400+39, 62' RT.
TYPE: LANDSLIDE	SAMPLING FIRM / LOGGER: HDR / AKB	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 7
PID: 108676 SFN:	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 11/26/19	ELEVATION: 627.7 (MSL) EOB: 64.5 ft.
START: 8/12/20 END: 8/12/20	SAMPLING METHOD: SPT / ST / NQ2	ENERGY RATIO (%): 86.8	LAT / LONG: 39.616651, -80.930705

EXPLORATION ID B-002-1-20

MATERIAL DESCRIPTION AND NOTES	ELEV. 627.7	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	INCL.
STIFF TO VERY STIFF, BROWN, **CLAY**, SOME SILT, LITTLE GRAVEL, TRACE SAND, DAMP		1	3 3 4	10	83	SS-1	3.75	-	-	-	-	-	-	-	-	24	A-7-6 (V)	
		2	6 4 3	10	100	SS-2	2.75	12	5	2	34	47	51	25	26	20	A-7-6 (17)	
	624.7	3																
MEDIUM STIFF TO STIFF, BROWN, **ELASTIC CLAY**, "AND" SILT, TRACE GRAVEL, TRACE SAND, DAMP		4	2 2 2	6	17	SS-3	2.25	1	3	3	35	58	61	30	31	19	A-7-5 (20)	
	623.2																	
MEDIUM STIFF TO STIFF, RED-BROWN, **CLAY**, "AND" SILT, LITTLE GRAVEL, TRACE SAND, DAMP		5	2 3 2	7	61	SS-4	1.75	-	-	-	-	-	-	-	-	22	A-7-6 (V)	
1 - Stiff Colluvium/Fill		6	2 3 4	10	44	SS-5	1.25	-	-	-	-	-	-	-	-	23	A-7-6 (V)	
		7	2 3 4	10	72	SS-6	2.00	14	4	3	36	43	44	23	21	21	A-7-6 (13)	
		8	2 3 6	13	50	SS-7	2.00	-	-	-	-	-	-	-	-	19	A-7-6 (V)	
	617.2	9																
STIFF TO VERY STIFF, BROWN TO RED-BROWN, **CLAY**, "AND" SILT, TRACE GRAVEL, TRACE SAND, DAMP		10	5 5 6	16	100	SS-8	3.00	-	-	-	-	-	-	-	-	25	A-7-6 (V)	
		11	5 5 6	16	100	SS-9	2.25	-	-	-	-	-	-	-	-	23	A-7-6 (V)	
		12			79	ST-10	-	1	0	1	52	46	50	26	24	22	A-7-6 (16)	
3 - Stiff to V. Stiff Colluvium		13	6 7 9	23	100	SS-11	3.25	-	-	-	-	-	-	-	-	23	A-7-6 (V)	
		14	5 6 7	19	100	SS-12	3.00	-	-	-	-	-	-	-	-	23	A-7-6 (V)	
		15	4 4 6	14	100	SS-13	1.75	-	-	-	-	-	-	-	-	23	A-7-6 (V)	
	607.7	16																
STIFF, BROWN, **SILTY CLAY**, TRACE SAND, MOIST		17	3 3 4	10	100	SS-14	1.50	0	0	3	58	39	40	24	16	27	A-6b (10)	
	606.2	18																
VERY SOFT TO SOFT, BROWN, **SILT AND CLAY**, SOME SAND, MOIST		19	3 3 4	10	100	SS-15	0.50	-	-	-	-	-	-	-	-	25	A-6a (V)	
		20	0 0 0	0	100	SS-16	0.50	0	0	21	47	32	32	19	13	23	A-6a (9)	
	603.2	21																
MEDIUM STIFF TO STIFF, BROWNISH-GRAY, **SANDY SILT**, SOME CLAY, MOIST		22	2 3 4	10	100	SS-17	0.50	-	-	-	-	-	-	-	-	24	A-4a (V)	
4 - Soft to M. Stiff Alluvium		23			100	ST-18	-	0	0	25	47	28	29	19	10	24	A-4a (8)	
	599.7	W 599.7																
MEDIUM STIFF, BROWNISH-GRAY, **SILT**, SOME CLAY, LITTLE SAND, WET		24	2 2 2	6	100	SS-19	-	-	-	-	-	-	-	-	-	23	A-4b (V)	
		25	2															

PID: 108676	SFN:	PROJECT: MOE-7-07.55	STATION / OFFSET: 400+39, 62' RT.	START: 8/12/20	END: 8/12/20	PG 2 OF 3	B-002-1-20

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)	INCL.
	597.7																	
	596.7	31	2 2	6	100	SS-20	-	0	0	18	53	29	29	19	10	27	A-4b (8)	
SOFT TO MEDIUM STIFF, BROWNISH-GRAY, **SANDY SILT**, SOME CLAY, WET		32	0 0 3	4	100	SS-21	1.00	-	-	-	-	-	-	-	-	28	A-4a (V)	
	593.7	33	2 2 3	7	100	SS-22	0.75	0	0	24	46	30	29	19	10	27	A-4a (8)	
STIFF, GRAY, **SANDY SILT**, SOME CLAY, WET @ 34.0' - 40.5': contains sand seams		34	2 2 4	9	100	SS-23	-	-	-	-	-	-	-	-	-	27	A-4a (V)	
		36	2 3 3	9	100	SS-24	-	-	-	-	-	-	-	-	-	25	A-4a (V)	
		38	2 3 4	10	100	SS-25	-	0	0	38	38	24	27	19	8	34	A-4a (5)	
		39	2 3 3	9	100	SS-26	-	-	-	-	-	-	-	-	-	26	A-4a (V)	
	587.2	40	6 6 36	61	78	SS-27	-	-	-	-	-	-	-	-	-	8	A-4a (V)	
HARD, GRAY AND BROWN, **SANDY SILT**, SOME GRAVEL, LITTLE CLAY, DAMP		42	30 23 40	91	100	SS-28	-	23	7	26	29	15	21	16	5	10	A-4a (2)	
	584.7	43	7 18 24	61	44	SS-29	-	-	-	-	-	-	-	-	-	14	A-2-4 (V)	
DENSE TO VERY DENSE, RED BROWN AND GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, LITTLE [illegible] 5 - Hard Residuum/Weathered Bedrock		45	16 21 30	74	83	SS-30	-	32	12	25	21	10	20	17	3	10	A-2-4 (0)	
	581.7	TR 46	6 50/5"	-	82	SS-31	-	-	-	-	-	-	-	-	-	17	Rock (V)	
CLAYSTONE, GRAY AND RED-BROWN, SEVERELY WEATHERED, VERY WEAK, ARENACEOUS.		48	32 50/6"	-	92	SS-32	-	22	4	3	53	18	28	19	9	14	Rock (V)	
		50	45 50/5"	-	100	SS-33	-	-	-	-	-	-	-	-	-	11	Rock (V)	
		51	35 50/2"	-	100	SS-34	-	-	-	-	-	-	-	-	-	9	Rock (V)	
		52	50/4"	-	100	SS-35	-	-	-	-	-	-	-	-	-	6	Rock (V)	
	574.2	53	50/2"	-	100	SS-36	-	-	-	-	-	-	-	-	-	8	Rock (V)	
SILTSTONE, GRAY, HIGHLY WEATHERED, VERY WEAK TO WEAK, THIN BEDDED, ARGILLACEOUS, CALCAREOUS, JOINT DISCONTINUITIES, FRACTURED TO HIGHLY FRACTURED, OPEN, SLIGHTLY ROUGH TO SLICKENSIDED, BLOCKY, FAIR TO POOR SURFACE CONDITIONS; RQD 69%, REC 100%.	572.1	55																
SILTSTONE, GRAY, MODERATELY WEATHERED, SLIGHTLY STRONG, MEDIUM BEDDED, ARENACEOUS, CALCAREOUS, JOINT DISCONTINUITIES, MODERATELY FRACTURED TO FRACTURED, NARROW, SLIGHTLY ROUGH, FAIR SURFACE CONDITIONS; RQD 76%, REC 100%. @ 56.2' - 56.3': contains shale interbed @ 57.3' - 57.5': contains shale interbed @ 58.5' - 58.9' : qu = 1,675 psi		57	62		100	NQ2-1											CORE	
		61																

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 12/16/20 08:18 - C:\PWWORKING\EAST01\D1679058\MOE-7-7.55 10-K BORING LOGS.GPJ

PID: 108676	SFN:	PROJECT: MOE-7-07.55	STATION / OFFSET: 400+39, 62' RT.	START: 8/12/20	END: 8/12/20	PG 3 OF 3	B-002-1-20

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)	INCL.
	565.6		88		100	NQ2-2											CORE	
@ 64.1' - 64.5': sandstone	563.2	63 64 EOB																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED BENTONITE CHIPS; PUMPED 25 LB. BENTONITE POWDER; 94 LB. CEMENT; 50 GAL. WATER

PROJECT: MOE-7-07.55	DRILLING FIRM / OPERATOR: CENTRAL STAR / TS	DRILL RIG: DIEDRICH D-50	STATION / OFFSET: 400+47, 102' RT.	EXPLORATION ID B-002-2-20
TYPE: RETAINING WALL	SAMPLING FIRM / LOGGER: HDR / AKB	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 7	
PID: 108676 SFN:	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 11/26/19	ELEVATION: 610.1 (MSL) EOB: 44.4 ft.	PAGE 1 OF 2
START: 8/11/20 END: 8/11/20	SAMPLING METHOD: SPT / ST / NQ2	ENERGY RATIO (%): 86.8	LAT / LONG: 39.616568, -80.930611	

MATERIAL DESCRIPTION AND NOTES	ELEV. 610.1	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
STIFF TO VERY STIFF, BROWN, **CLAY**, "AND" SILT, TRACE GRAVEL, TRACE SAND, DAMP			5 5 5	14	78	SS-1	2.50	3	4	2	40	51	51	27	24	15	A-7-6 (16)	
1 - Stiff Colluvium/Fill	606.6																	
STIFF TO VERY STIFF, RED-BROWN, **ELASTIC CLAY**, "AND" SILT, TRACE GRAVEL, TRACE SAND, DAMP			2 4 3	10	94	SS-2	4.00	3	5	2	35	55	56	31	25	25	A-7-5 (17)	
	604.1																	
MEDIUM STIFF TO STIFF, BROWN, **SANDY SILT**, SOME CLAY, MOIST			3 2 2	6	100	SS-3	-	-	-	-	-	-	-	-	-	29	A-4a (V)	
			2 3 4	10	100	SS-4	0.50	-	-	-	-	-	-	-	-	25	A-4a (V)	
					100	ST-5	0.75	0	0	36	43	21	29	21	8	23	A-4a (6)	
4 - Soft to M. Stiff Alluvium			2 2 2	6	100	SS-6	-	-	-	-	-	-	-	-	-	25	A-4a (V)	
	594.1	W 594.1																
VERY SOFT, BROWN, **SILT AND CLAY**, SOME SAND, MOIST			0 0 0	0	100	SS-7	-	0	0	20	50	30	33	21	12	28	A-6a (9)	
	591.6																	
LOOSE TO MEDIUM DENSE, BROWN TRACE GRAY, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, WET			4 2 3	7	89	SS-8	-	-	-	-	-	-	-	-	-	18	A-2-4 (V)	
			5 7 4	16	100	SS-9	-	26	4	37	21	12	NP	NP	NP	23	A-2-4 (0)	
	586.6																	
MEDIUM DENSE, BROWN AND GRAY, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, WET			6 8 11	27	67	SS-10	-	50	9	24	11	6	NP	NP	NP	14	A-1-b (0)	
	584.1																	
DENSE, RED-BROWN AND GRAY, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, WET			13 14 15	42	83	SS-11	-	34	9	22	22	13	20	17	3	12	A-2-4 (0)	
	581.6																	
5 - Hard Residuum/Weathered Bedrock			6 7 8	22	100	SS-12	-	38	9	24	19	10	20	16	4	13	A-2-4 (0)	

PID: 108676	SFN:	PROJECT: MOE-7-07.55	STATION / OFFSET: 400+47, 102' RT.	START: 8/11/20	END: 8/11/20	PG 2 OF 2	B-002-2-20

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
MEDIUM DENSE TO DENSE, RED-BROWN AND GRAY, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, WET *(continued)*	580.1	31																
VERY DENSE, GRAY, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, DAMP	578.1	32	15 30 29	85	100	SS-13	-	-	-	-	-	-	-	-	-	9	A-2-4 (V)	
@ 33.5' - 35': brown and gray, damp	575.7	33																
LIMESTONE, GRAY, HIGHLY WEATHERED, MODERATELY STRONG TO STRONG, THIN BEDDED, MODERATELY FRACTURED, OPEN, VERY ROUGH, VERY BLOCKY, GOOD TO FAIR SURFACE CONDITIONS; RQD 55%, REC 100%.	574.9	TR 34	30 50/5"	-	100	SS-14	-	37	16	19	18	10	20	17	3	13	A-2-4 (0)	
SILTSTONE, BROWN, SEVERELY WEATHERED, VERY WEAK, THIN BEDDED, ARENACEOUS, JOINT DISCONTINUITIES, HIGHLY FRACTURED, NARROW, SLIGHTLY ROUGH, LAMINATED/SHEARED, POOR SURFACE CONDITIONS, OBSERVED IRON STAINING; RQD 0%, REC 90%.	572.7	35 36 37 38 39 40 41	37		97	NQ2-1											CORE	
SILTSTONE, GRAY, MODERATELY WEATHERED, MODERATELY STRONG, THICK BEDDED, ARENACEOUS, CALCAREOUS, JOINT DISCONTINUITIES, MODERATELY FRACTURED TO FRACTURED, NARROW, SLIGHTLY ROUGH, FAIR SURFACE CONDITIONS; RQD 53%, REC 100%. @ 42.9' - 43.3' : qu = 6,495 psi @ 43.7' - 44.1': sandstone seam	565.7	42 43 EOB 44	50		100	NQ2-2											CORE	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 12.5 LB. BENTONITE POWDER; 94 LB. CEMENT; 50 GAL. WATER

PROJECT: MOE-7-07.55	DRILLING FIRM / OPERATOR: CENTRAL STAR / TS	DRILL RIG: DIEDRICH D-50	STATION / OFFSET: 402+36, 98' RT.
TYPE: LANDSLIDE	SAMPLING FIRM / LOGGER: HDR / AKB	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 7
PID: 108676 SFN:	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 11/26/19	ELEVATION: 612.5 (MSL) EOB: 51.3 ft.
START: 8/10/20 END: 8/11/20	SAMPLING METHOD: SPT / ST / NQ2	ENERGY RATIO (%): 86.8	LAT / LONG: 39.616860, -80.930032

EXPLORATION ID B-004-1-20

MATERIAL DESCRIPTION AND NOTES	ELEV. 612.5	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	INCL.
MEDIUM STIFF TO STIFF, BROWN TRACE RED-BROWN, **CLAY**, "AND" SILT, TRACE SAND, MOIST		1	2 2 2	6	67	SS-1	3.50	-	-	-	-	-	-	-	-	33	A-7-6 (V)	
		2	2 2 3	7	72	SS-2	1.75	-	-	-	-	-	-	-	-	30	A-7-6 (V)	
1 - Stiff Colluvium/Fill		3	2 1 3	6	89	SS-3	2.00	0	1	8	54	37	45	28	17	32	A-7-6 (12)	
		4	2 2 3	7	94	SS-4	1.50	-	-	-	-	-	-	-	-	25	A-7-6 (V)	
		5	2 1 3	6	100	SS-5	1.50	-	-	-	-	-	-	-	-	26	A-7-6 (V)	
	605.0	6																
MEDIUM STIFF TO STIFF, BROWN, **SILT AND CLAY**, LTTLE SAND, MOIST		7	2 2 2	6	100	SS-6	0.75	-	-	-	-	-	-	-	-	25	A-6a (V)	
4 - Soft to M. Stiff Alluvium		8	2 2 2	6	100	SS-7	0.50	0	0	14	49	37	37	22	15	29	A-6a (10)	
@ 10.5' - 12.5' : qu = 2		9		100	ST-8	1.00	0	0	11	54	35	36	23	13	27	A-6a (9)		
	600.0	10																
SOFT, GRAY, **SANDY SILT**, SOME CLAY, WET		11	2 1 1	3	100	SS-9	-	-	-	-	-	-	-	-	-	25	A-4a (V)	
		12	1 1 1	3	89	SS-10	-	0	0	35	40	25	26	18	8	29	A-4a (6)	
	595.5	13	0 2 1	4	100	SS-11	-	-	-	-	-	-	-	-	-	24	A-4a (V)	
VERY SOFT TO SOFT, GRAY, **SILT AND CLAY**, SOME SAND, MOIST		14	0 0 0	0	94	SS-12	0.50	-	-	-	-	-	-	-	-	26	A-6a (V)	
	592.5	15	1 2 4	9	100	SS-13	1.25	0	0	23	48	29	34	20	14	27	A-6a (10)	
	W 592.5	16																
VERY SOFT TO SOFT, GRAY, **SANDY SILT**, SOME CLAY, WET		17	2 2 2	6	100	SS-14	-	-	-	-	-	-	-	-	-	27	A-4a (V)	
		18	0 0 0	0	100	SS-15	-	0	0	35	39	26	27	18	9	26	A-4a (6)	
	589.5	19																
MEDIUM DENSE TO DENSE, BROWN, **GRAVEL AND/OR STONE FRAGMENTS**, SOME SAND, TRACE SILT, TRACE CLAY, WET		20	6 10 14	35	44	SS-16	-	-	-	-	-	-	-	-	-	10	A-1-a (V)	
		21	10 9 8	25	100	SS-17	-	63	13	12	7	5	22	17	5	19	A-1-a (0)	
		22	10 11 15	38	44	SS-18	-	-	-	-	-	-	-	-	-	10	A-1-a (V)	
	585.0	23																
MEDIUM DENSE, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, WET		24	10 8 9	25	39	SS-19	-	-	-	-	-	-	-	-	-	19	A-2-4 (V)	
@ 29' - 30.5': trace wood		25	5 5	20	83	SS-20	-	36	13	27	15	9	NP	NP	NP	25	A-2-4 (0)	
		26																
		27																
		28																
		29																

PID: 108676	SFN:	PROJECT: MOE-7-07.55	STATION / OFFSET: 402+36, 98' RT.	START: 8/10/20	END: 8/11/20	PG 2 OF 2	B-004-1-20

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)	INCL.
	582.5		9															
	581.5	31	12			SS-21A	-	-	-	-	-	-	-	-	-	13	A-2-4 (V)	
DENSE, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, DAMP	580.5	32	13 19	46	100	SS-21B	-	40	12	20	20	8	20	16	4	10	A-2-4 (0)	
MEDIUM DENSE TO DENSE, BROWN, **GRAVEL AND/OR STONE FR** WET		33	6 13 15	41	100	SS-22	-	-	-	-	-	-	-	-	-	9	A-2-4 (V)	
	577.5	34	3 6 11	25	100	SS-23	-	27	29	16	18	10	21	16	5	15	A-2-4 (0)	
VERY DENSE, BROWN TRACE RED-BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, WET	575.5	35 36	13 18 21	56	100	SS-24	-	34	7	32	19	8	NP	NP	NP	16	A-2-4 (0)	
VERY DENSE, RED-BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, DAMP	574.5	37	12 43 50/3"	-	100	SS-25	-	25	6	41	18	10	NP	NP	NP	11	A-2-4 (0)	
		TR 38	50/6"	-	33	SS-26	-	-	-	-	-	-	-	-	-	9	Rock (V)	
SHALE, GRAY, SEVERELY WEATHERED, VERY WEAK.		39																
		40	50/4"	-	100	SS-27	-	-	-	-	-	-	-	-	-	17	Rock (V)	
	571.2	41	50/3"	-	100	SS-28	-	-	-	-	-	-	-	-	-	18	Rock (V)	
SILTSTONE, GRAY, HIGHLY WEATHERED, MODERATELY STRONG, MEDIUM BEDDED, JOINT DISCONTINUITIES, MODERATELY FRACTURED TO FRACTURED, NARROW TO TIGHT, SLIGHTLY ROUGH TO VERY ROUGH, LAMINATED, FAIR SURFACE CONDITIONS; RQD 40%, REC 100%. @ 42.5' - 42.9': sandstone seam @ 44.1' - 44.5' : qu = 3,644 psi		42 43 44	41		100	NQ2-1											CORE	
		45 46 47 48	59		100	NQ2-2											CORE	
	563.5	49																
SILTSTONE, GRAY, MODERATELY WEATHERED, MODERATELY STRONG, MEDIUM TO THICK BEDDED, ARENACEOUS, JOINT DISCONTINUITIES, SLIGHTLY FRACTURED TO MODERATELY FRACTURED, NARROW, SLIGHTLY ROUGH, INTACT, GOOD TO FAIR SURFACE CONDITIONS; RQD 89%, REC 100%. @ 50.7': grades to sandstone	561.2	50 EOB 51																

5 - Hard Residuum/Weathered Bedrock

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 25 LB. BENTONITE POWDER; 94 LB. CEMENT; 50 GAL. WATER

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 12/16/20 08:19 - C:\PWWORKING\EAST01\D1679058\MOE-7-7.55 10-K BORING LOGS.GPJ

PROJECT: MOE-7-07.55	DRILLING FIRM / OPERATOR: CENTRAL STAR / TS	DRILL RIG: DIEDRICH D-50	STATION / OFFSET: 402+31, 133' RT.	EXPLORATION ID B-004-2-20
TYPE: RETAINING WALL	SAMPLING FIRM / LOGGER: HDR / AKB	HAMMER: DIEDRICH AUTOMATIC	ALIGNMENT: SR 7	
PID: 108676 SFN:	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 11/26/19	ELEVATION: 603.0 (MSL) EOB: 43.0 ft.	PAGE 1 OF 2
START: 8/11/20 END: 8/11/20	SAMPLING METHOD: SPT / NQ2	ENERGY RATIO (%): 86.8	LAT / LONG: 39.616773, -80.929979	

MATERIAL DESCRIPTION AND NOTES	ELEV. 603.0	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
VERY SOFT TO SOFT, BROWNISH-GRAY, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, MOIST			1 0 0	0	83	SS-1	-	-	-	-	-	-	-	-	-	39	A-6b (V)	
4 - Soft to M. Stiff Alluvium			0 0 0	0	100	SS-2	0.25	1	2	15	44	38	40	24	16	32	A-6b (10)	
			0 0 0	0	100	SS-3	1.25	-	-	-	-	-	-	-	-	27	A-6b (V)	
	594.5	W 594.5																
SOFT, GRAYISH-BROWN, **SANDY SILT**, SOME CLAY, WET			1 2 1	4	100	SS-4	-	-	-	-	-	-	-	-	-	25	A-4a (V)	
			5 1 2	4	100	SS-5	-	0	0	40	39	21	25	18	7	25	A-4a (5)	
	589.5																	
MEDIUM DENSE TO DENSE, GRAYISH-BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, WET			5 6 10	23	72	SS-6	-	41	6	28	17	8	NP	NP	NP	11	A-2-4 (0)	
			5 7 15	32	83	SS-7	-	-	-	-	-	-	-	-	-	5	A-2-4 (V)	
	584.5																	
MEDIUM DENSE TO DENSE, BROWN TO RED-BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, WET			9 19 10	42	89	SS-8	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
			11 10 10	29	72	SS-9	-	39	14	26	14	7	NP	NP	NP	16	A-1-b (0)	
5 - Hard Residuum/Weathered Bedrock			5 9 7	23	83	SS-10	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	
	577.0																	
VERY DENSE, BROWN TO RED-BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, WET	576.0		14 29 32	88	83	SS-11A	-	41	15	22	14	8	NP	NP	NP	11	A-1-b (0)	
						SS-11B	-	62	9	13	11	5	NP	NP	NP	4	A-1-b (0)	
VERY DENSE, GRAY, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, WET	574.5																	
			9 10 14	35	83	SS-12	-	14	6	57	17	6	NP	NP	NP	23	A-3a (0)	

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 12/16/20 08:19 - C:\PW\WORKING\EAST01\D1679058\MOE-7-7.55 10-K BORING LOGS.GPJ

PID: 108676	SFN:	PROJECT: MOE-7-07.55	STATION / OFFSET: 402+31, 133' RT.	START: 8/11/20	END: 8/11/20	PG 2 OF 2	B-004-2-20

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
DENSE, BROWN, **COARSE AND FINE SAND**, LITTLE GRAVEL, LITTLE SILT, TRACE CLAY, WET *(continued)*	573.0																	
	572.0	TR 31																
SHALE, GRAY, SEVERELY WEATHERED, VERY WEAK.			50/6"	-	100	SS-13	-	-	-	-	-	-	-	-	-	11	Rock (V)	
	570.0	32 33																
SILTSTONE, GRAY, MODERATELY WEATHERED, MODERATELY STRONG, MEDIUM TO THICK BEDDED, ARENACEOUS, JOINT DISCONTINUITIES, MODERATELY FRACTURED TO FRACTURED, NARROW, SLIGHTLY ROUGH, INTACT, GOOD SURFACE CONDITIONS; RQD 58%, REC 87%. @ 33' - 33.2': sandstone seam @ 35.2' - 35.7' : qu = 6,872 psi		34	74		100	NQ2-1											CORE	
		35 36 37	40		78	NQ2-2											CORE	
		38 39 40																
	560.7	41	85		95	NQ2-3											CORE	
SANDSTONE, GRAY, SLIGHTLY TO MODERATELY WEATHERED, STRONG, THIN BEDDED, JOINT DISCONTINUITIES, MODERATELY FRACTURED, NARROW, SLIGHTLY ROUGH, INTACT, GOOD SURFACE CONDITIONS; RQD 100%, REC 100%. @ 42.4' - 43.0' - qu = 10,479 psi	560.0	EOB 42 43																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 12.5 LB. BENTONITE POWDER; 94 LB. CEMENT; 50 GAL. WATER

Laboratory Testing

UNCONFINED COMPRESSION TEST
AASHTO T - 208

OHIO DEPARTMENT OF TRANSPORTION
OFFICE OF GEOTECHNICAL ENGINEERING

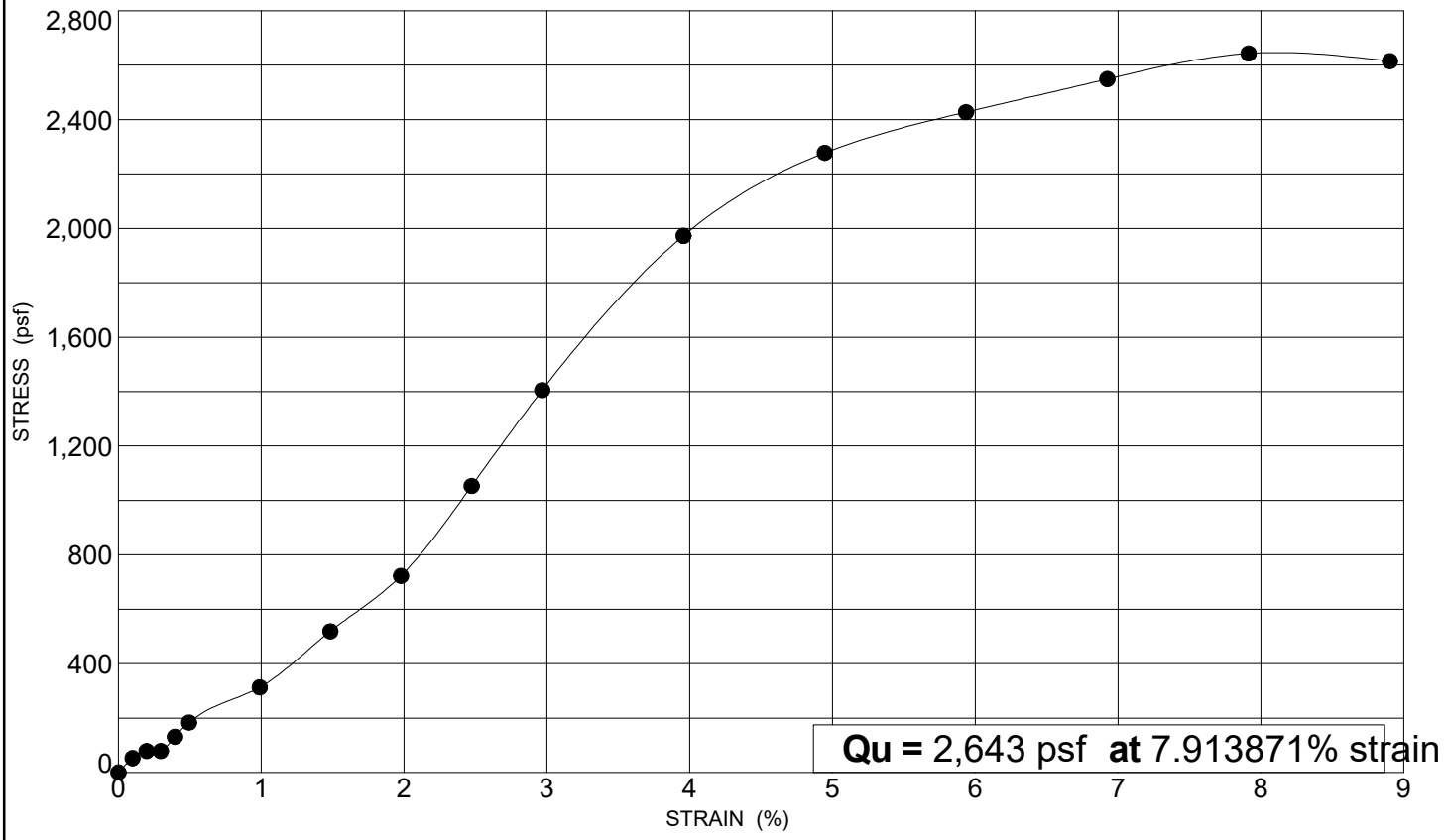
PROJECT MOE-7-7.55 **PID**

OGE NUMBER MOE-7-7.55 **PROJECT TYPE** STRUCTURE FOUNDATION

SAMPLE IDENTIFICATION

BORING ID: B-001-0-18 SAMPLE ID: ST-15

STATION: NOT RECORDED DEPTH: 35.5 - 37.5 feet



SPECIMEN FAILURE SKETCHES OR PHOTOGRAPHS

BEFORE FAILURE

AFTER FAILURE

SPECIMEN DETAILS

HEIGHT: 6.065 inches

DIAMETER: 2.844 inches

WET UNIT WT: 129.21 pcf

DRY UNIT WT: 105.91 pcf

TESTED BY: MOH 8/23/2018

CLASSIFICATION RESULTS

GRADATION (%)

GR	CS	FS	SI	CL
0	0	26	43	31

ATTERBERG LIMITS			MOISTURE
LL	PL	PI	WC
24	18	6	22

ODOT CLASS: A-4a HP (tsf): 1.5-2.0

DESCRIPTION: SILTY CLAY with SAND

OHDOT UNCONFINED COMPRESSION - OH DOT.GDT - 8/26/18 17:35 - \\DHDCINCFS01\DVALMA\GINT\PROJECTS\MOE-7-7.55.GPJ

UNCONFINED COMPRESSION TEST
AASHTO T - 208

OHIO DEPARTMENT OF TRANSPORTION
OFFICE OF GEOTECHNICAL ENGINEERING

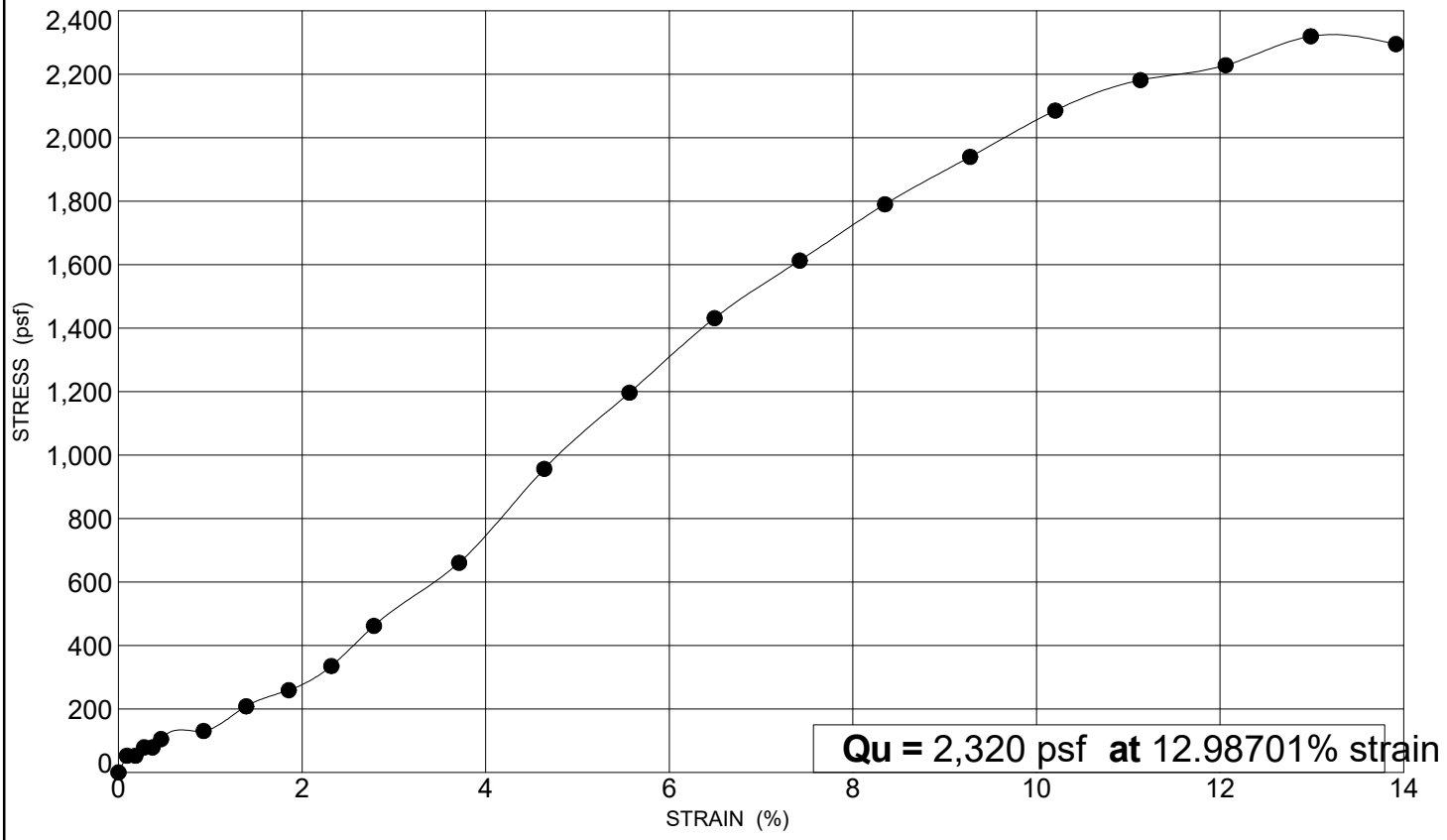
PROJECT MOE-7-7.55 **PID**

OGE NUMBER MOE-7-7.55 **PROJECT TYPE** STRUCTURE FOUNDATION

SAMPLE IDENTIFICATION

BORING ID: B-001-0-18 SAMPLE ID: ST-18

STATION: NOT RECORDED DEPTH: 42.5 - 44.5 feet



SPECIMEN FAILURE SKETCHES OR PHOTOGRAPHS

BEFORE FAILURE

AFTER FAILURE

SPECIMEN DETAILS

HEIGHT: 6.468 inches

DIAMETER: 2.840 inches

WET UNIT WT: 126.16 pcf

DRY UNIT WT: 100.13 pcf

TESTED BY: MOH 8/23/2018

CLASSIFICATION RESULTS

GRADATION (%)

GR	CS	FS	SI	CL
0	1	16	47	36

ATTERBERG LIMITS			MOISTURE
LL	PL	PI	WC
31	19	12	26

ODOT CLASS: A-6a HP (tsf): 1.0

DESCRIPTION: LEAN CLAY with SAND

OHDOT UNCONFINED COMPRESSION - OH DOT.GDT - 8/26/18 17:36 - \\DHDCINCFS01\DVALMA\GINT\PROJECTS\MOE-7-7.55.GPJ

UNCONFINED COMPRESSION TEST
AASHTO T - 208

OHIO DEPARTMENT OF TRANSPORTION
OFFICE OF GEOTECHNICAL ENGINEERING

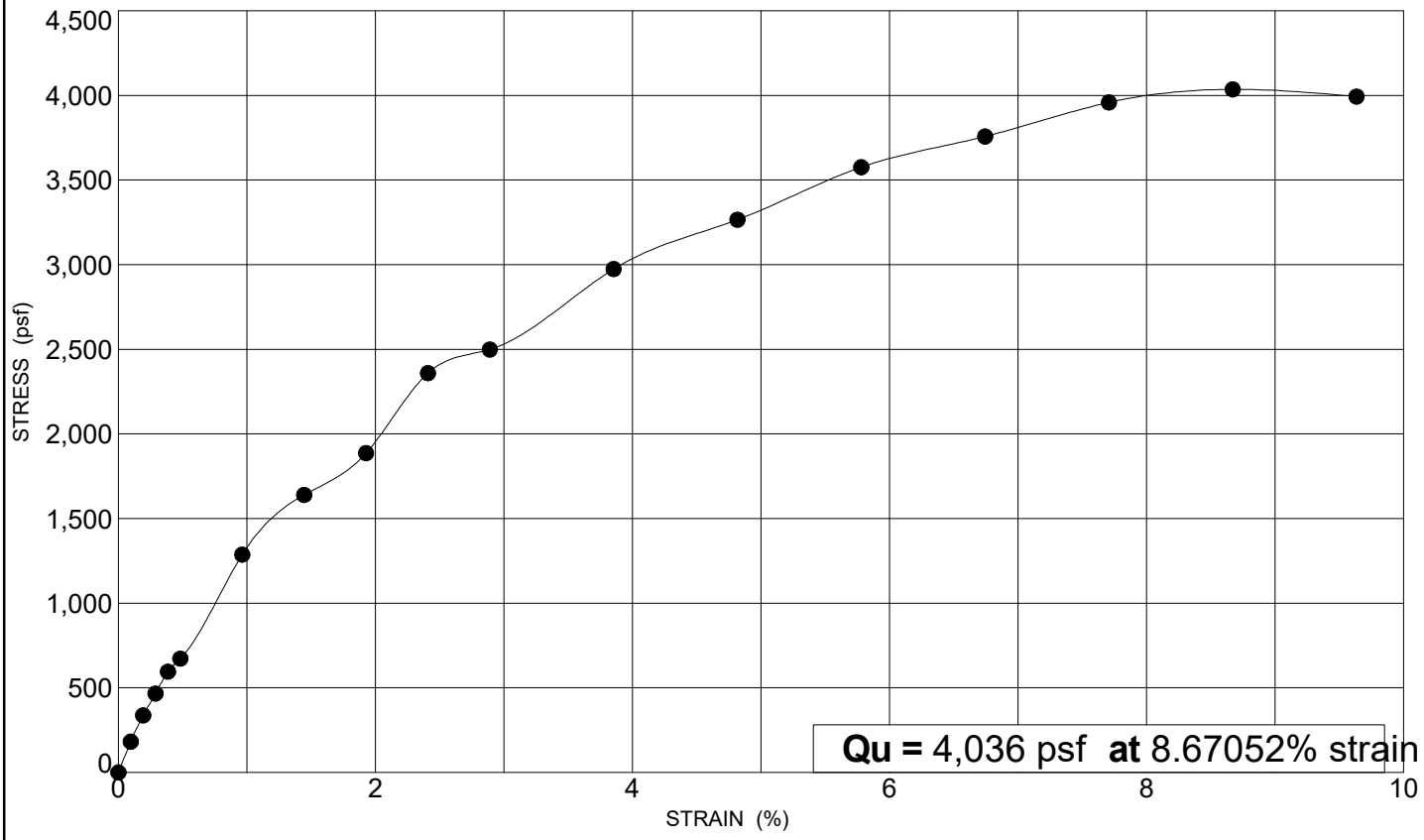
PROJECT MOE-7-7.55 **PID**

OGE NUMBER MOE-7-7.55 **PROJECT TYPE** STRUCTURE FOUNDATION

SAMPLE IDENTIFICATION

BORING ID: B-002-0-18 SAMPLE ID: ST-22

STATION: NOT RECORDED DEPTH: 33.0 - 35.0 feet



SPECIMEN FAILURE SKETCHES OR PHOTOGRAPHS

BEFORE FAILURE

AFTER FAILURE

SPECIMEN DETAILS

HEIGHT: 6.228 inches

DIAMETER: 2.862 inches

WET UNIT WT: 124.90 pcf

DRY UNIT WT: 106.30 pcf

TESTED BY: MOH 8/10/2018

CLASSIFICATION RESULTS

GRADATION (%)

GR	CS	FS	SI	CL
1	1	7	52	39

ATTERBERG LIMITS MOISTURE

LL	PL	PI	WC
31	19	12	18

ODOT CLASS: A-6a HP (tsf): 1.5

DESCRIPTION: LEAN CLAY

OHDOT UNCONFINED COMPRESSION - OH DOT.GDT - 8/15/18 12:03 - \\DHDCINCFS01\DVALMA\GINT\PROJECTS\MOE-7-7.55.GPJ

CONSOLIDATED UNDRAINED TRIAXIAL TEST ON COHESIVE SOILS

AASHTO T 297 & ASTM D4767

CTL ENGINEERING, INC.

2860 Fisher Road Columbus, Ohio 43204

Client: HDR Engineering, Inc
PID NO. 108676
Project: MOE-7-7.55 (Task 10-K)
Location: Monroe County, Ohio
Project No. 20050114COL
County, Rt. & Sec.: MOE-7-7.55
Station & Offset: NA
Sample ID: B-002-1-20, ST-10, 13.5'-15.5'
Lab Code No. 20050114COL
Reviewed by: SM

Sample Type	Shelby Tube	
Date Set-up:	8/25/2020	8/25/2020
Date Sheared:	9/1/2020	9/1/2020
Avg. Sample Height (in.):	5.7957	5.7757
Avg. Sample Diameter (in.):	2.8500	2.8500
Height-to-diameter ratio:	2.03	2.03
Wet Density (pcf):	125.2	124.6
Dry Density (pcf):	103.0	103.3
Void Ratio:	0.636	0.631
Specific Gravity (assumed):	2.7	2.7
Moisture Content (%):	21.6	20.6
Cross Sectional Area (ft^2):	0.044	0.044
Volume (ft^3):	0.02	0.02
Confining Pressure (psf):	1872	3744
Rate of Axial Strain (%/min):	0.2071	0.2078
Compressive Strength (psf):	4699	5708
Minor Principal Stress at Failure (psf):	1872	3744
Major Principal Stress at Failure (psf):	6571	9452
Failure Criterian (%):	Deviator Stress at 15% Axial Strain	
β:	0.97	0.96
Specimen Saturation:	Wet Method	

POST SHEAR
1872 psf

POST SHEAR
3744 psf

Grading (ASTM D422)

% Agg:	1
% Sand.:	1
% Silt:	52
% Clay:	46

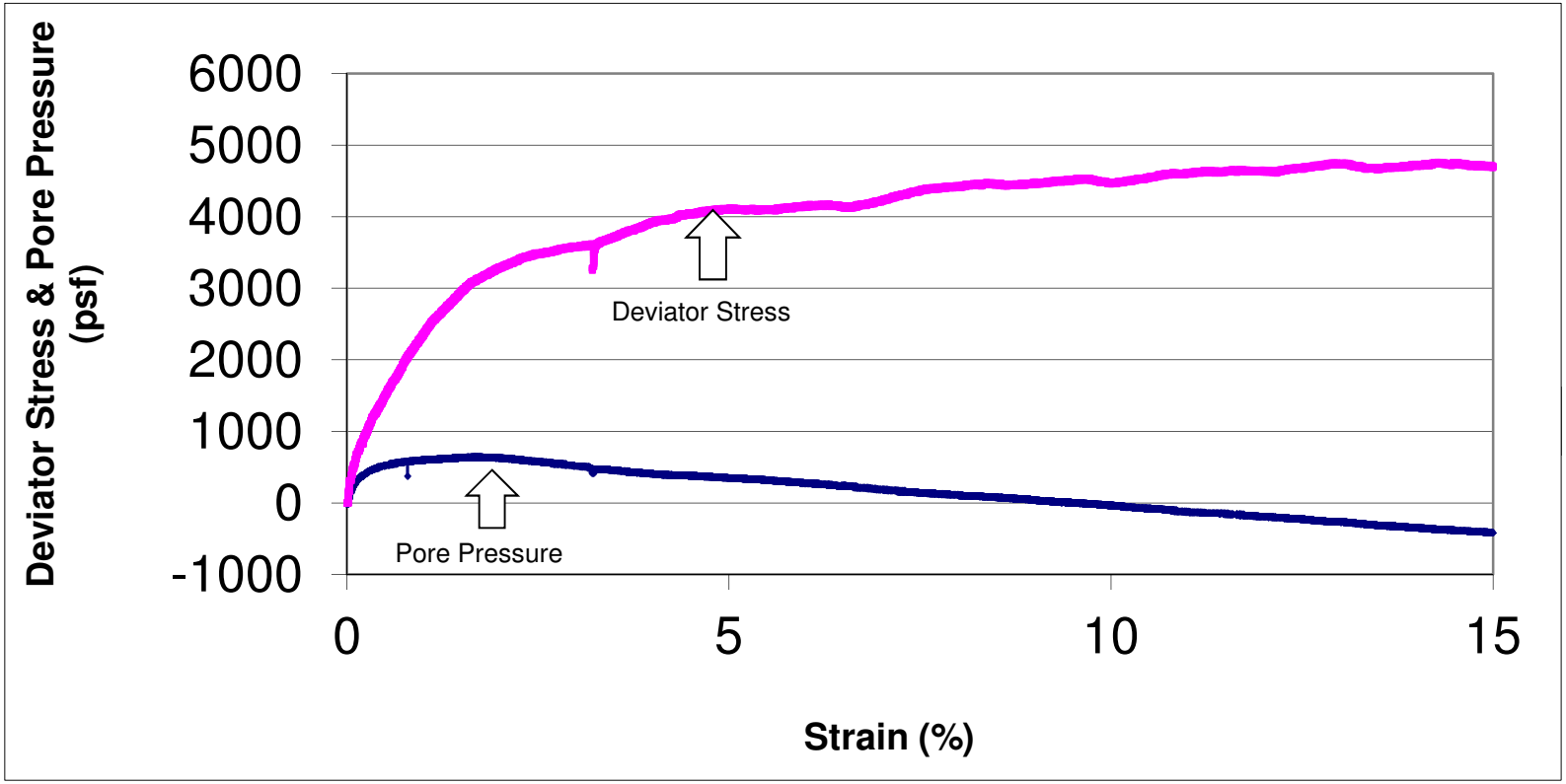
Atterberg Limits (ASTM D 4318)

L.L.:	50
P.L.:	26
P.I.:	24

Visual Description: Brown, Clay, "and" Silt, trace sand, trace gravel, damp

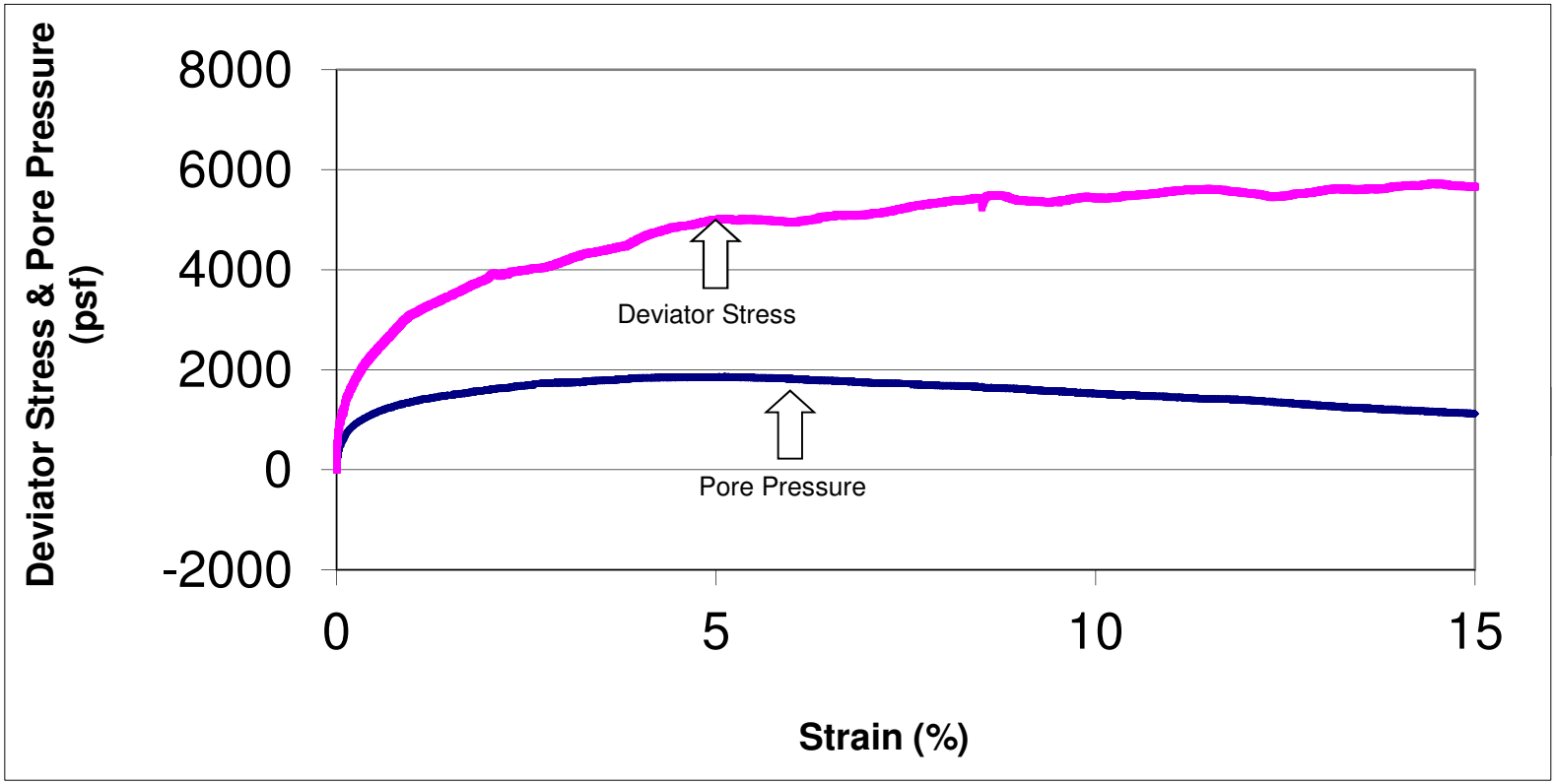
Deviator Stress & Pore Pressure vs. Strain

CLIENT:	HDR Engineering, Inc	Sample ID:	B-002-1-20, ST-10, 13.5'-15.5'
PROJECT:	MOE-7-7.55 (Task 10-K)	Confining Pressure (psf):	1872
LOCATION:	Monroe County, Ohio		
PROJECT #:	20050114COL		



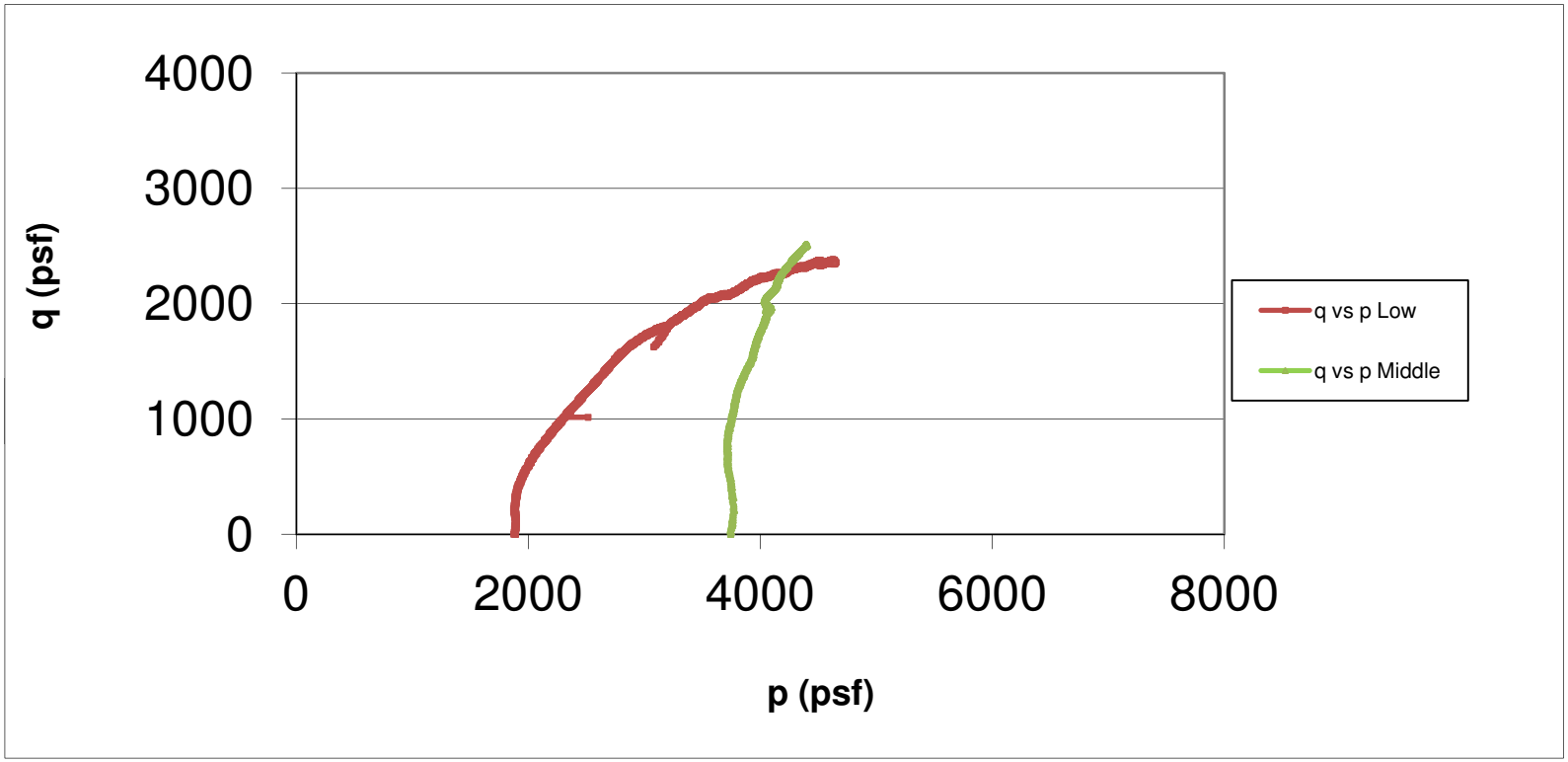
Deviator Stress & Pore Pressure vs. Strain

CLIENT:	HDR Engineering, Inc	Sample ID:	B-002-1-20, ST-10, 13.5'-15.5'
PROJECT:	MOE-7-7.55 (Task 10-K)	Confining Pressure (psf):	3744
LOCATION:	Monroe County, Ohio		
PROJECT #:	20050114COL		



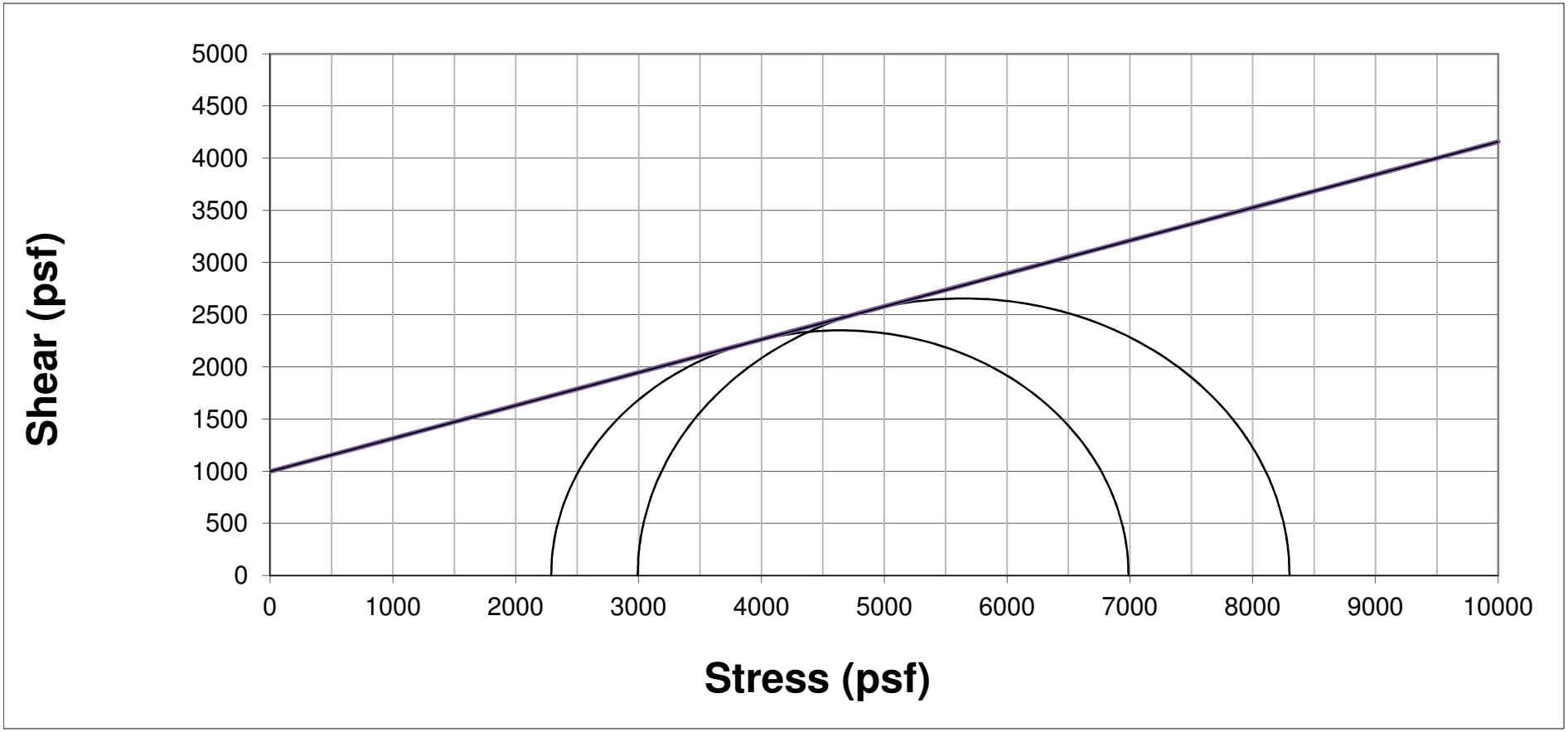
q vs. p

CLIENT:	HDR Engineering, Inc	Sample ID:	B-002-1-20, ST-10, 13.5'-15.5'	
PROJECT:	MOE-7-7.55 (Task 10-K)	Confining Pressure (psf):	Low	Middle
LOCATION:	Monroe County, Ohio		1872	3744
PROJECT #:	20050114COL			



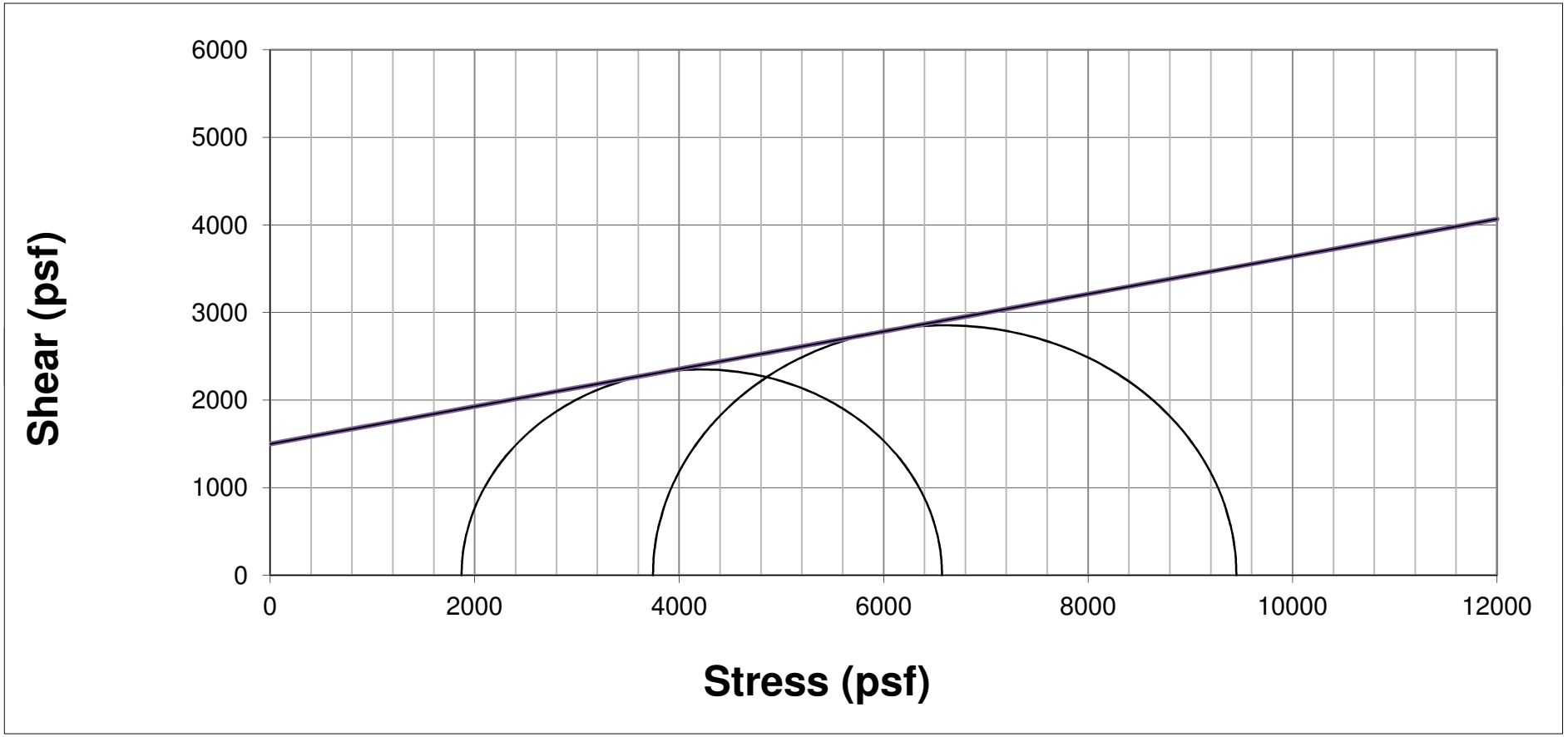
Mohr Circle Effective Stress

CLIENT:	HDR Engineering, Inc	Sample ID:	B-002-1-20, ST-10, 13.5'-15.5'	
PROJECT:	MOE-7-7.55 (Task 10-K)	Confining Pressure (psf):	1872	3744
LOCATION:	Monroe County, Ohio	Cohesion(psf):	1000	
PROJECT #:	20050114COL	Angle of Friction(°):	17	



Mohr Circle Total Stress

CLIENT:	HDR Engineering, Inc	Sample ID:	B-002-1-20, ST-10, 13.5'-15.5'	
PROJECT:	MOE-7-7.55 (Task 10-K)	Confining Pressure (psf):	1872	3744
LOCATION:	Monroe County, Ohio	Cohesion(psf):	1500	
PROJECT #:	20050114COL	Angle of Friction(°):	12	



CONSOLIDATED UNDRAINED TRIAXIAL TEST ON COHESIVE SOILS
AASHTO T 297 & ASTM D4767

CTL ENGINEERING, INC.
2860 Fisher Road Columbus, Ohio 43204

Client: HDR Engineering, Inc
PID NO. 108676
Project: MOE-7-7.55 (10-K)
Location: Monroe County, Ohio
Project No. 20050114COL
County, Rt. & Sec.: MOE-7-7.55
Station and Offset: NA
Sample ID: B-002-1-20, ST-18, 26'-28'
Lab Code No. NA
Reviewed by: SM

Sample Type	Shelby Tube		
Date Set-up:	8/21/2020	8/21/2020	8/21/2020
Date Sheared:	8/24/2020	8/24/2020	8/25/2020
Avg. Sample Height (in.):	5.8420	5.8333	5.7993
Avg. Sample Diameter (in.):	2.8750	2.8750	2.8750
Height-to-diameter ratio:	2.03	2.03	2.02
Wet Density (pcf):	122.1	124.5	125.3
Dry Density (pcf):	98.2	99.7	100.8
Void Ratio:	0.747	0.721	0.702
Specific Gravity (assumed):	2.75	2.75	2.75
Moisture Content (%):	24.3	24.9	24.3
Cross Sectional Area (ft^2):	0.045	0.045	0.045
Volume (ft^3):	0.02	0.02	0.02
Confining Pressure (psf):	1584	3312	6624
Rate of Axial Strain (%/min):	0.2054	0.2057	0.2069
Compressive Strength (psf):	2414	3338	4904
Minor Principal Stress at Failure (psf):	1584	3312	6624
Major Principal Stress at Failure (psf):	3998	6650	11528
Failure Criterian (%):	Deviator Stress @ 15% Axial Strain		
β:	0.99	0.95	0.97
Specimen Saturation:	Wet Method		

POST SHEAR
1584 psf

POST SHEAR
3312 psf

POST SHEAR
6624 psf

Grading (ASTM D422)

% Agg:	0
% Sand.:	25
% Silt:	47
% Clay:	28

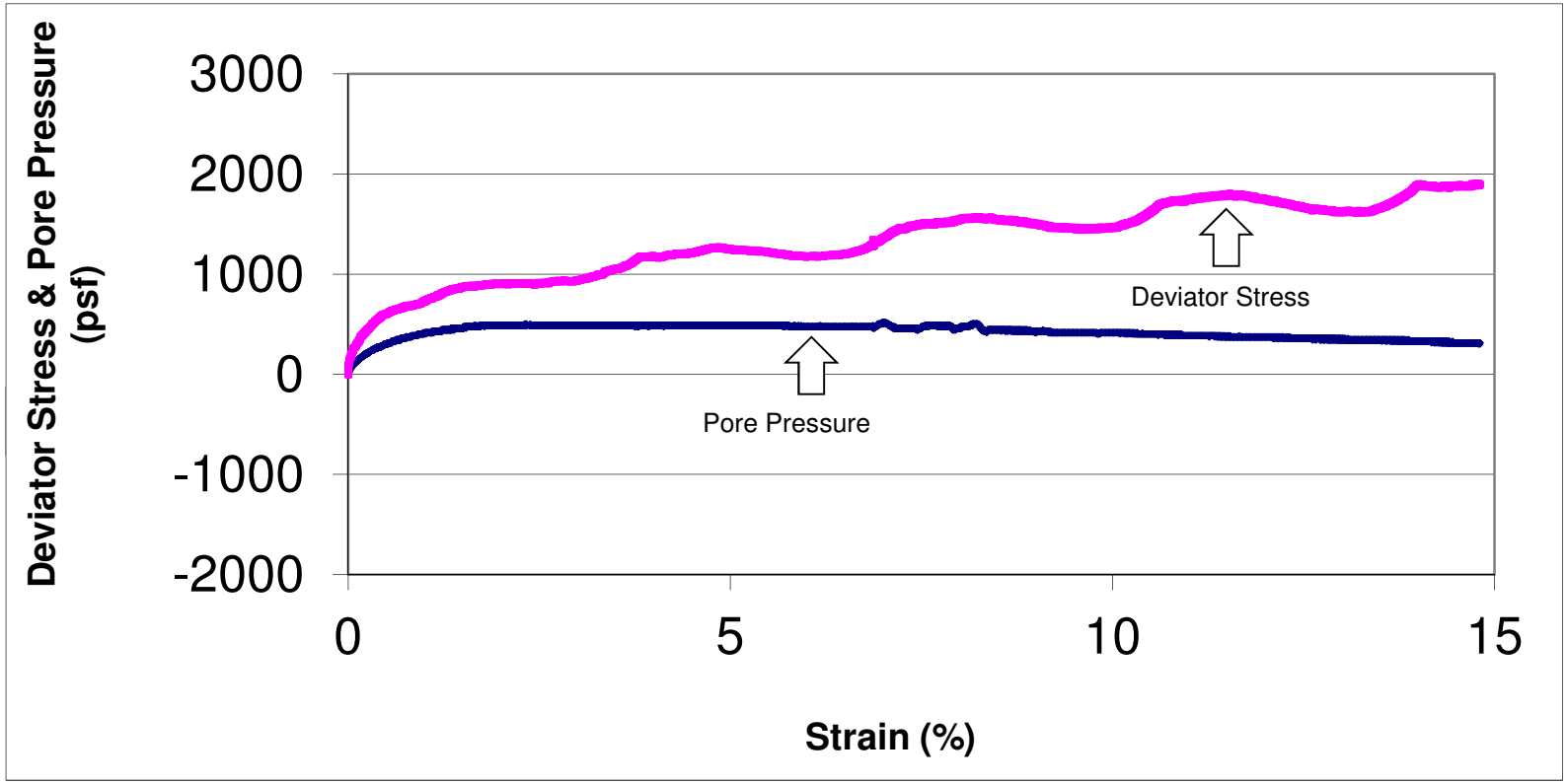
Atterberg Limits (ASTM D 4318)

L.L.:	29
P.L.:	19
P.I.:	10

Visual Description: Brown Sandy Silt (A-4a), Some Clay,

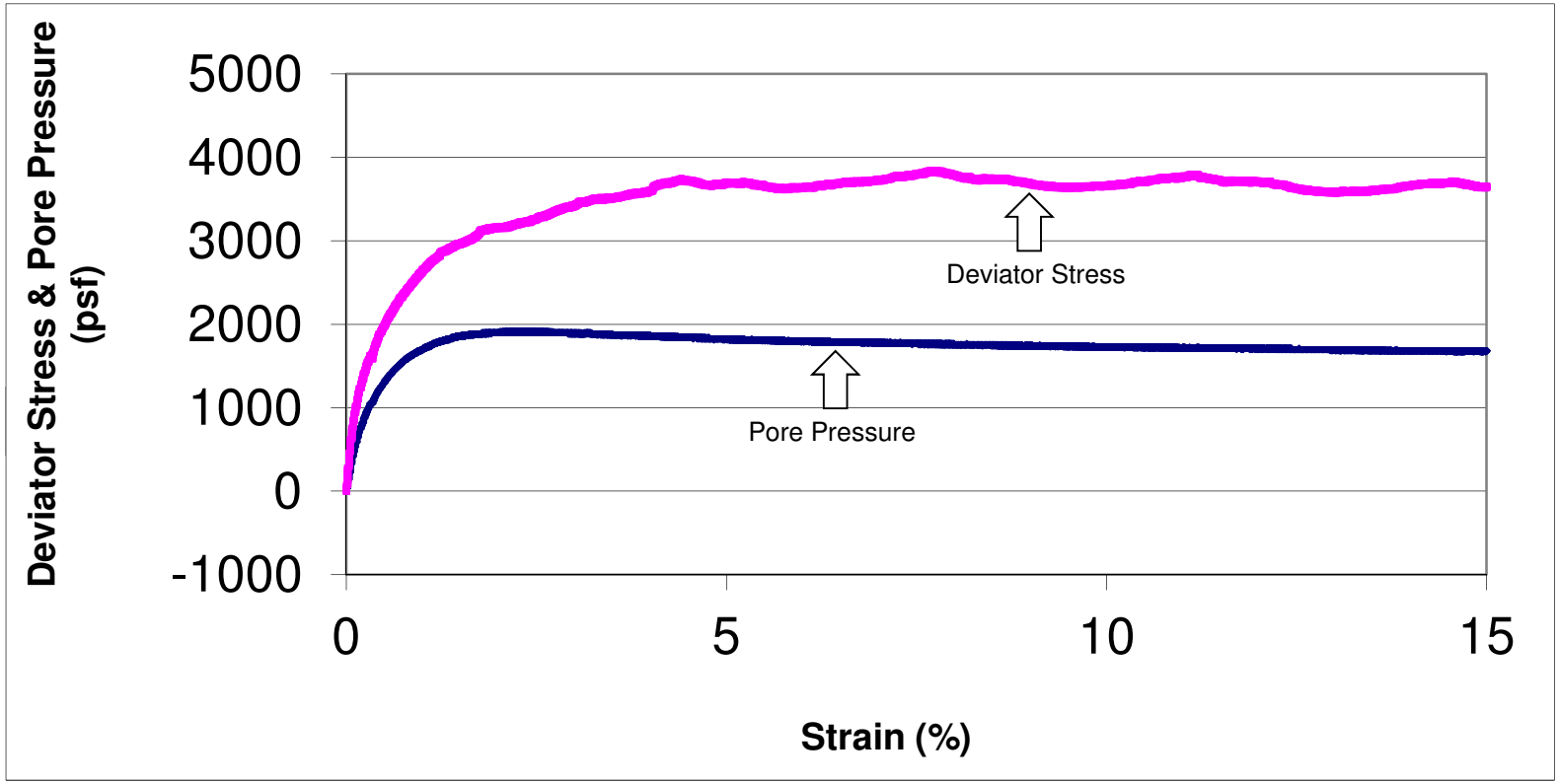
Deviator Stress & Pore Pressure vs. Strain

CLIENT:	HDR Engineering, Inc	Sample ID:	B-002-1-20, ST-18, 26'-28'
PROJECT:	MOE-7-07.55 (Task 10-K)	Confining Pressure (psf):	1584
LOCATION:	Monroe County, Ohio		
PROJECT #:	20050114COL		



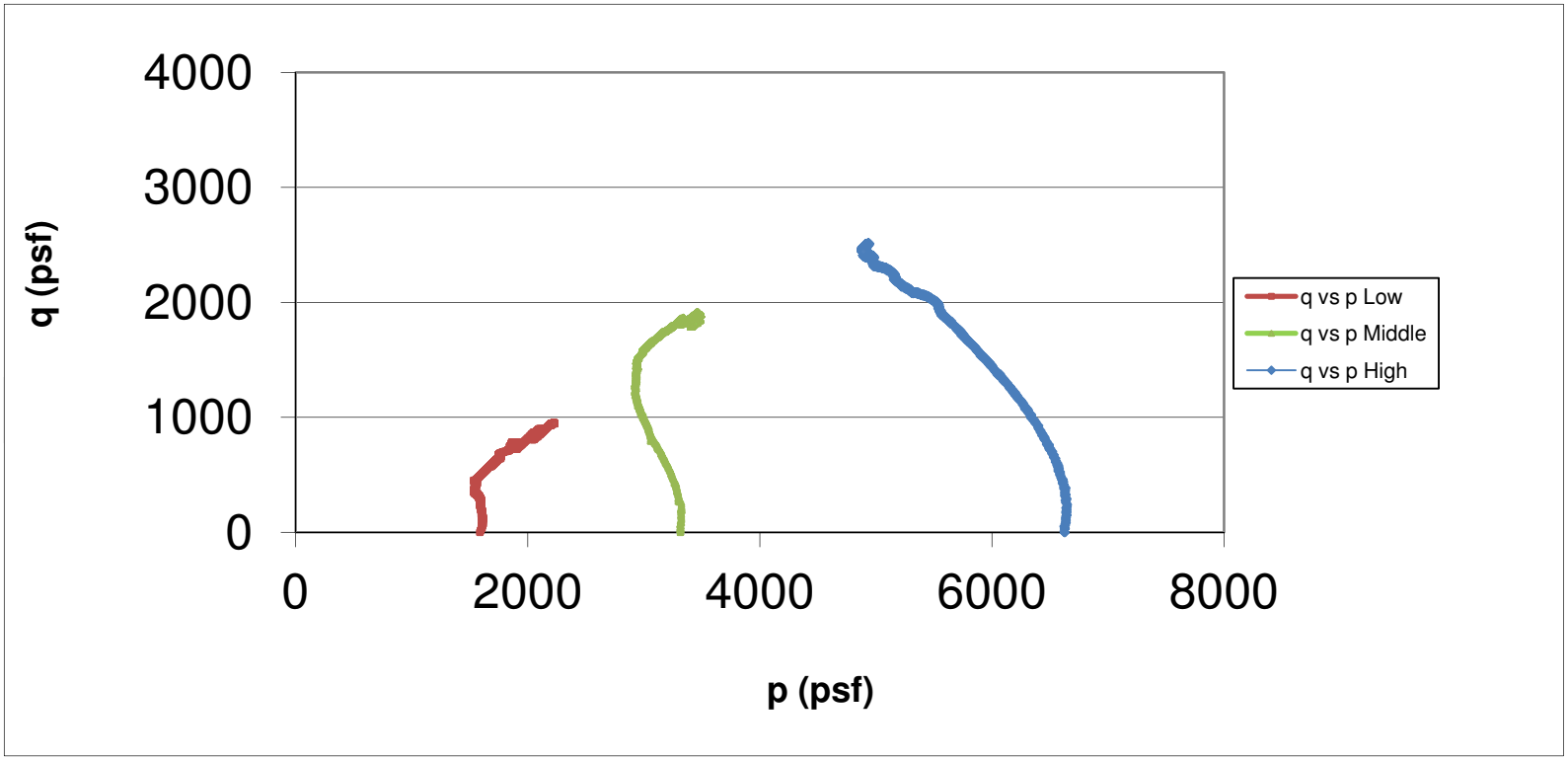
Deviator Stress & Pore Pressure vs. Strain

CLIENT:	HDR Engineering, Inc	Sample ID:	B-002-1-20, ST-18, 26'-28'
PROJECT:	MOE-7-07.55 (Task 10-K)	Confining Pressure (psf):	3312
LOCATION:	Monroe County, Ohio		
PROJECT #:	20050114COL		



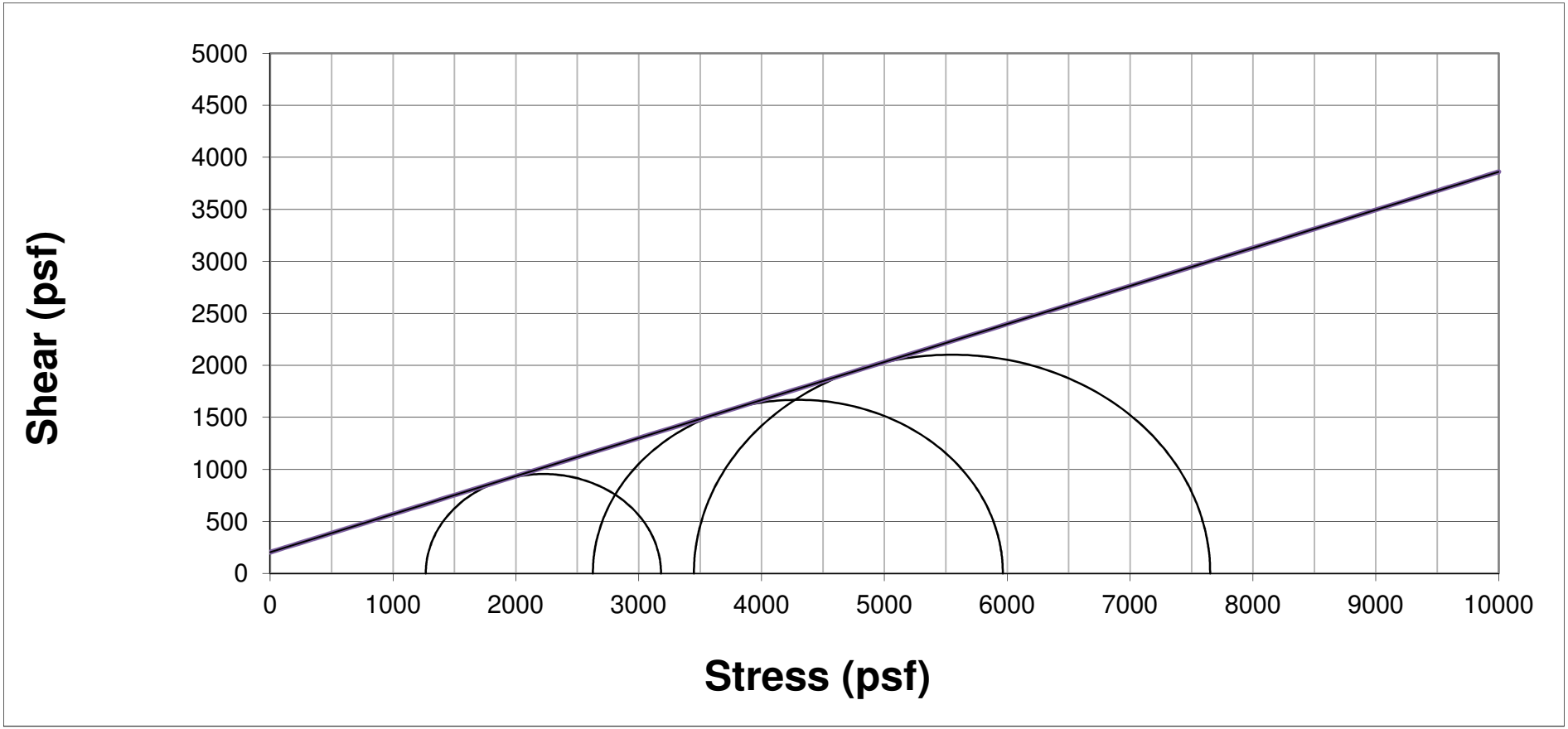
q vs. p

CLIENT:	HDR Engineering, Inc	Sample ID:	B-002-1-20, ST-18, 26'-28'		
PROJECT:	MOE-7-07.55 (Task 10-K)	Confining Pressure (psf):	Low	Middle	High
LOCATION:	Monroe County, Ohio		1584	3312	6624
PROJECT #:	20050114COL				



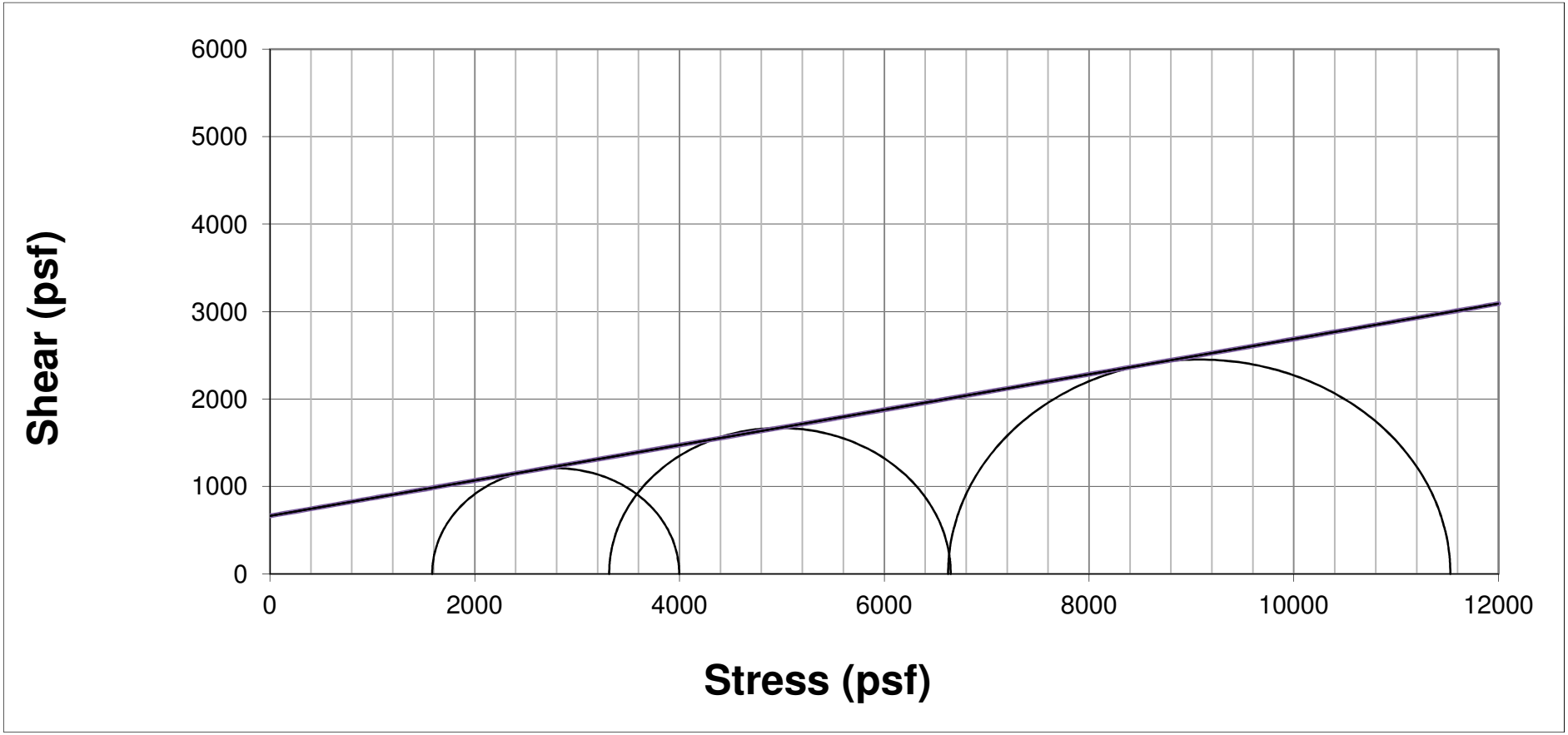
Mohr Circle Effective Stress

CLIENT:	HDR Engineering, Inc	Sample ID:	B-002-1-20, ST-18, 26'-28'		
PROJECT:	MOE-7-07.55 (Task 10-K)	Confining Pressure (psf):	1584	3312	6624
LOCATION:	Monroe County, Ohio	Cohesion(psf):	200		
PROJECT #:	20050114COL	Angle of Friction(°):	20		



Mohr Circle Total Stress

CLIENT:	HDR Engineering, Inc	Sample ID:	B-002-1-20, ST-18, 26'-28'		
PROJECT:	MOE-7-07.55 (Task 10-K)	Confining Pressure (psf):	1584	3312	6624
LOCATION:	Monroe County, Ohio	Cohesion(psf):	660		
PROJECT #:	20050114COL	Angle of Friction(°):	11		



CONSOLIDATED UNDRAINED TRIAXIAL TEST ON COHESIVE SOILS

AASHTO T 297 & ASTM D4767

CTL ENGINEERING, INC.

2860 Fisher Road Columbus, Ohio 43204

Client: HDR Engineering, Inc
PID NO. 108676
Project: MOE-7-7.55 (10-K)
Location: Monroe County, Ohio
Project No. 20050114COL
County, Rt. & Sec.: MOE-7-7.55
Station & Offset: NA
Sample ID: B-002-2-20, ST-5, 10'-12'
Lab Code No. NA
Reviewed by: SM

Sample Type	Shelby Tube		
Date Set-up:	8/28/2020	8/28/2020	8/28/2020
Date Sheared:	9/1/2020	9/1/2020	9/1/2020
Avg. Sample Height (in.):	5.7517	5.7943	5.7023
Avg. Sample Diameter (in.):	2.8750	2.8750	2.8750
Height-to-diameter ratio:	2.00	2.02	1.98
Wet Density (pcf):	126.9	124.5	126.6
Dry Density (pcf):	103.0	101.2	102.7
Void Ratio:	0.666	0.696	0.671
Specific Gravity (assumed):	2.75	2.75	2.75
Moisture Content (%):	23.2	23.1	23.2
Cross Sectional Area (ft^2):	0.045	0.045	0.045
Volume (ft^3):	0.02	0.02	0.02
Confining Pressure (psf):	720	1440	2880
Rate of Axial Strain (%/min):	0.2086	0.2071	0.2104
Compressive Strength (psf):	2805	3206	3901
Minor Principal Stress at Failure (psf):	720	1440	2880
Major Principal Stress at Failure (psf):	3525	4646	6781
Failure Criterian (%):	Deviator Stress @ 15 % Axial Strain		
β:	0.99	0.98	0.97
Specimen Saturation:	Wet Method		

Grading (ASTM D422)

% Agg:	0
% Sand.:	36
% Silt:	43
% Clay:	21

Atterberg Limits (ASTM D 4318)

L.L.:	29
P.L.:	21
P.I.:	8

Visual Description: Brown Sandy Silt (A-4a), Some Clay, Moist

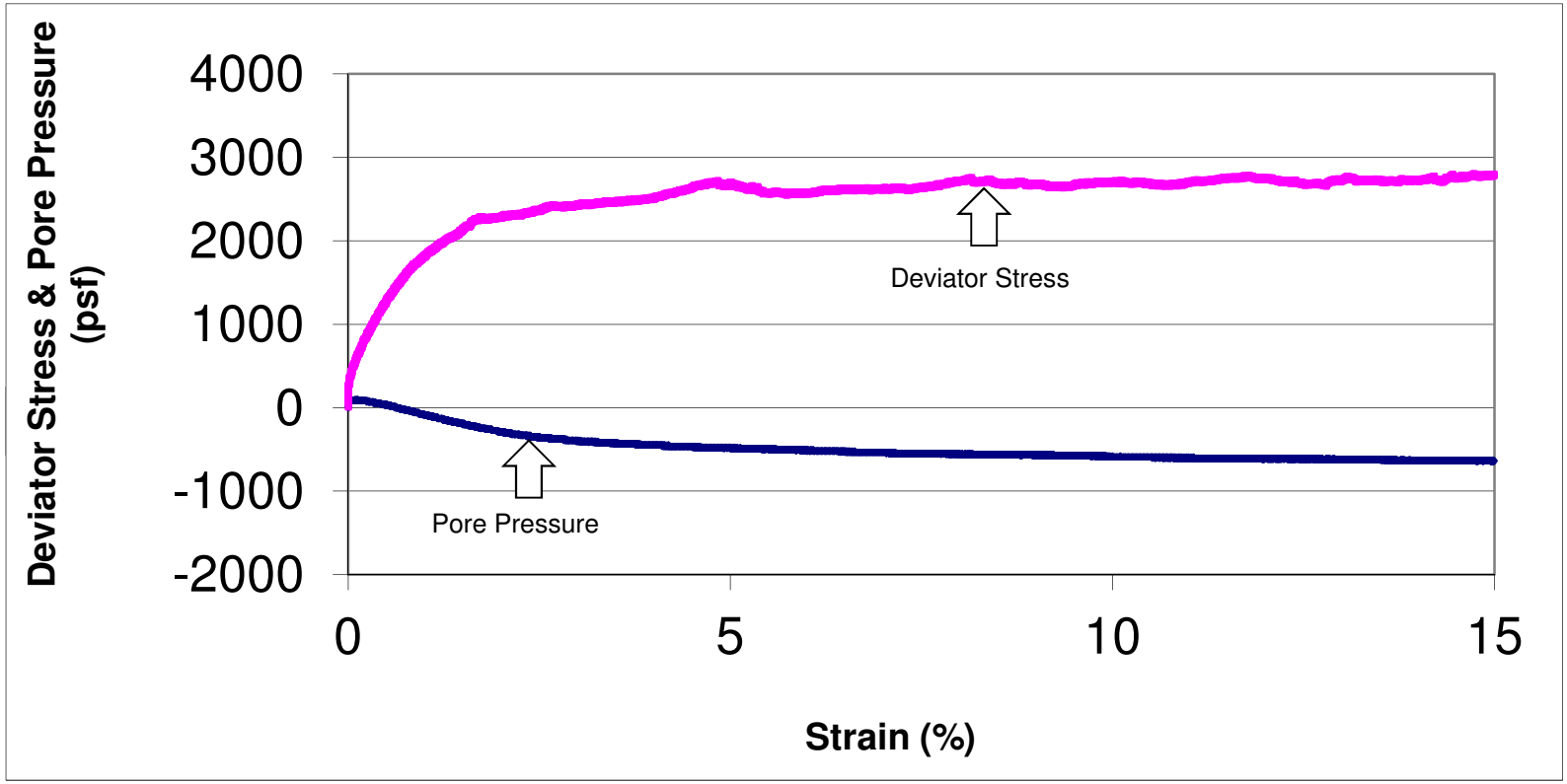
POST SHEAR
720 psf

POST SHEAR
1440 psf

POST SHEAR
2880 psf

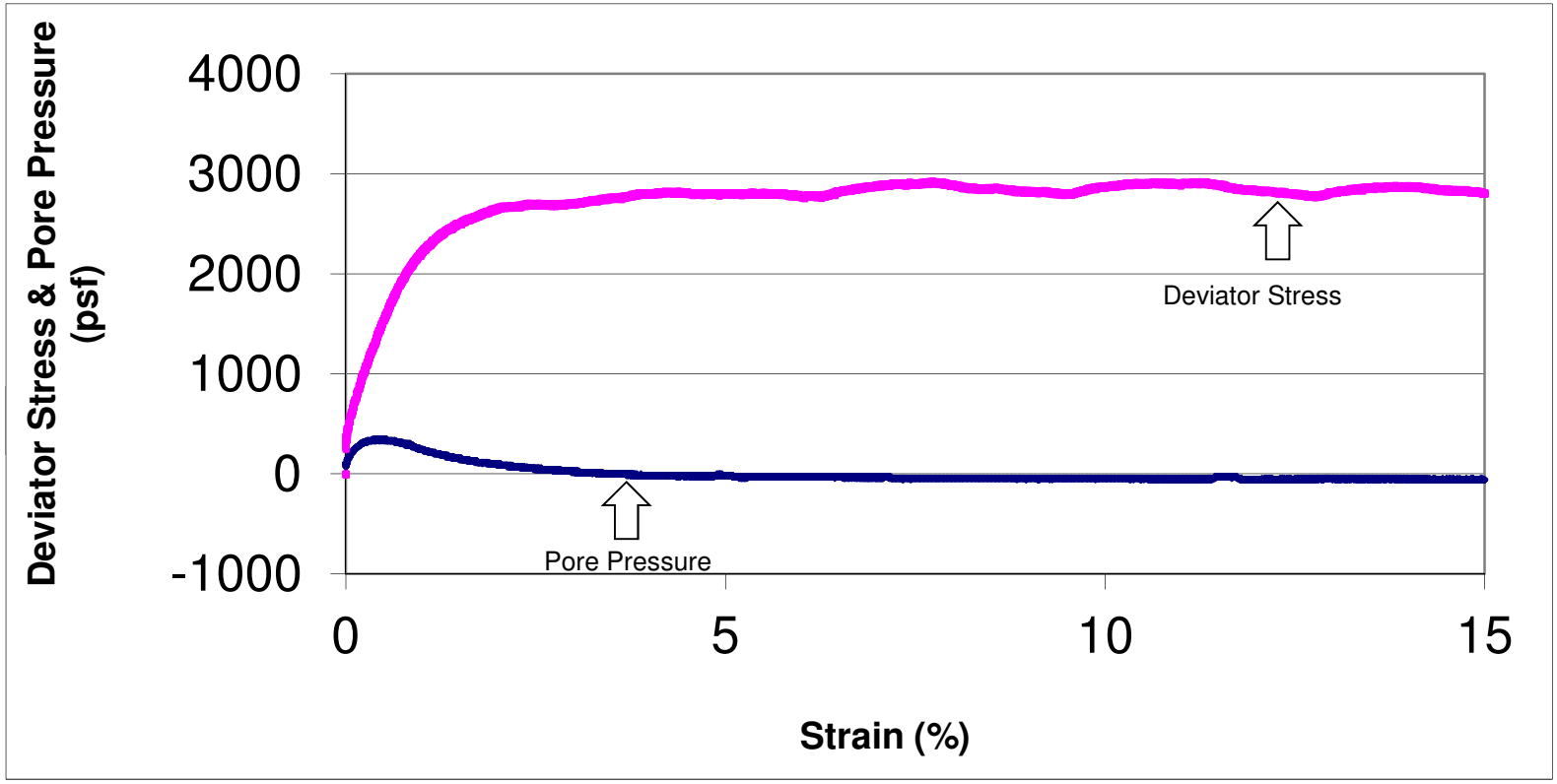
Deviator Stress & Pore Pressure vs. Strain

CLIENT:	HDR Engineering, Inc	Sample ID:	B-002-2-20, ST-5, 10'-12'
PROJECT:	MOE-7-07.55 (Task 10-K)	Confining Pressure (psf):	720
LOCATION:	Monroe County, Ohio		
PROJECT #:	20050114COL		



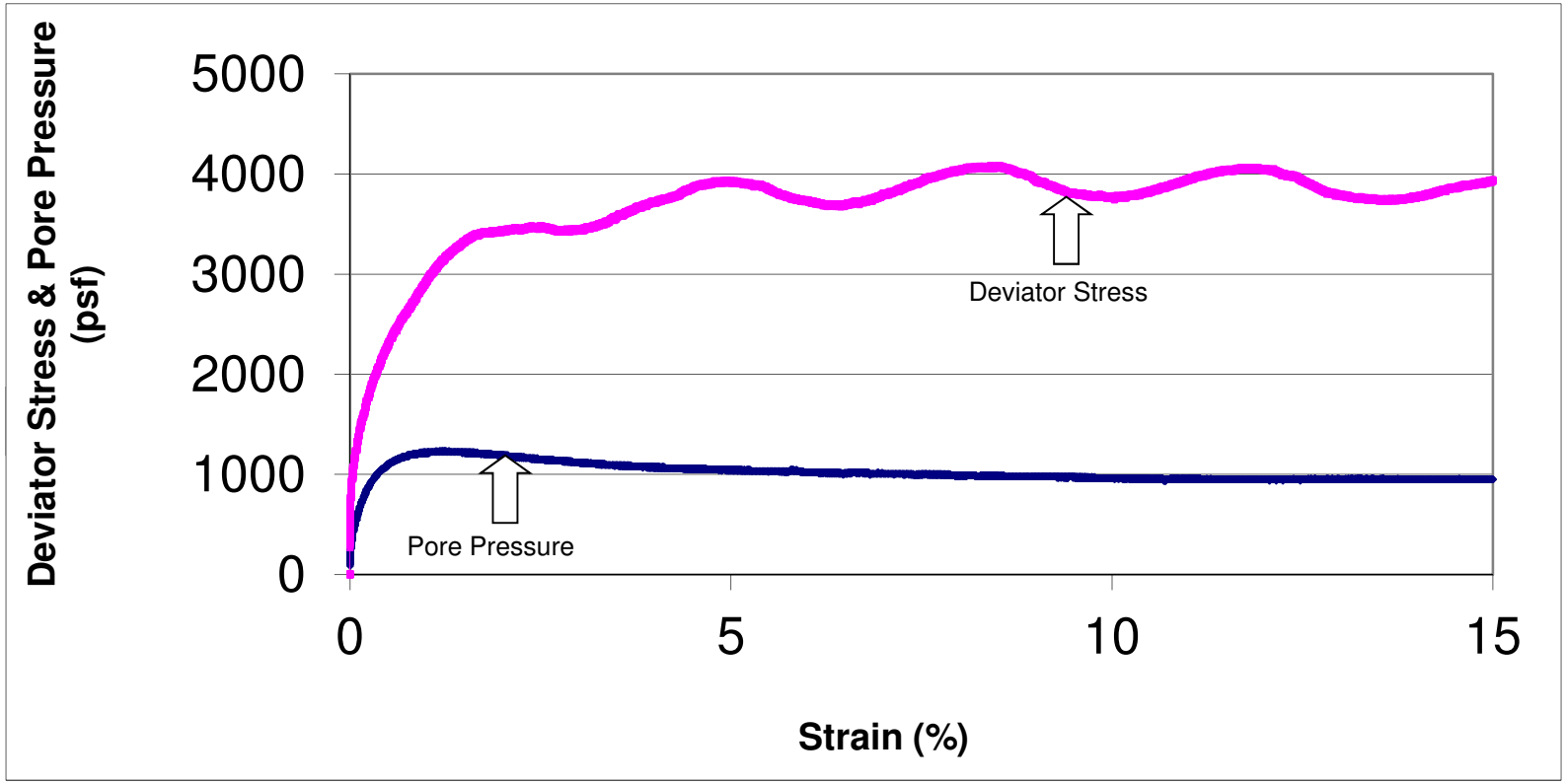
Deviator Stress & Pore Pressure vs. Strain

CLIENT:	HDR Engineering, Inc	Sample ID:	B-002-2-20, ST-5, 10'-12'
PROJECT:	MOE-7-07.55 (Task 10-K)	Confining Pressure (psf):	1440
LOCATION:	Monroe County, Ohio		
PROJECT #:	20050114COL		



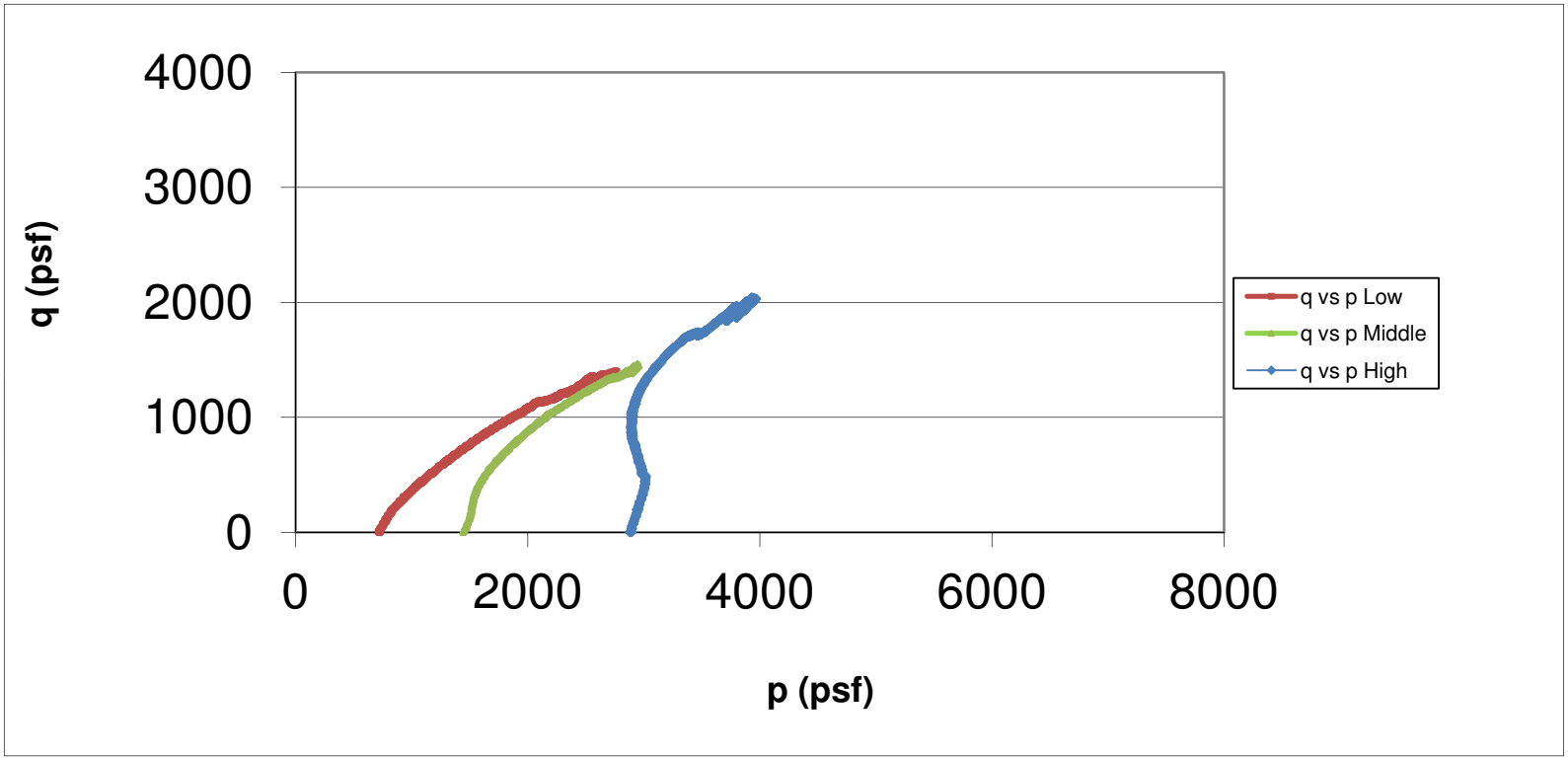
Deviator Stress & Pore Pressure vs. Strain

CLIENT:	HDR Engineering, Inc	Sample ID:	B-002-2-20, ST-5, 10'-12'
PROJECT:	MOE-7-07.55 (Task 10-K)	Confining Pressure (psf):	2880
LOCATION:	Monroe County, Ohio		
PROJECT #:	20050114COL		



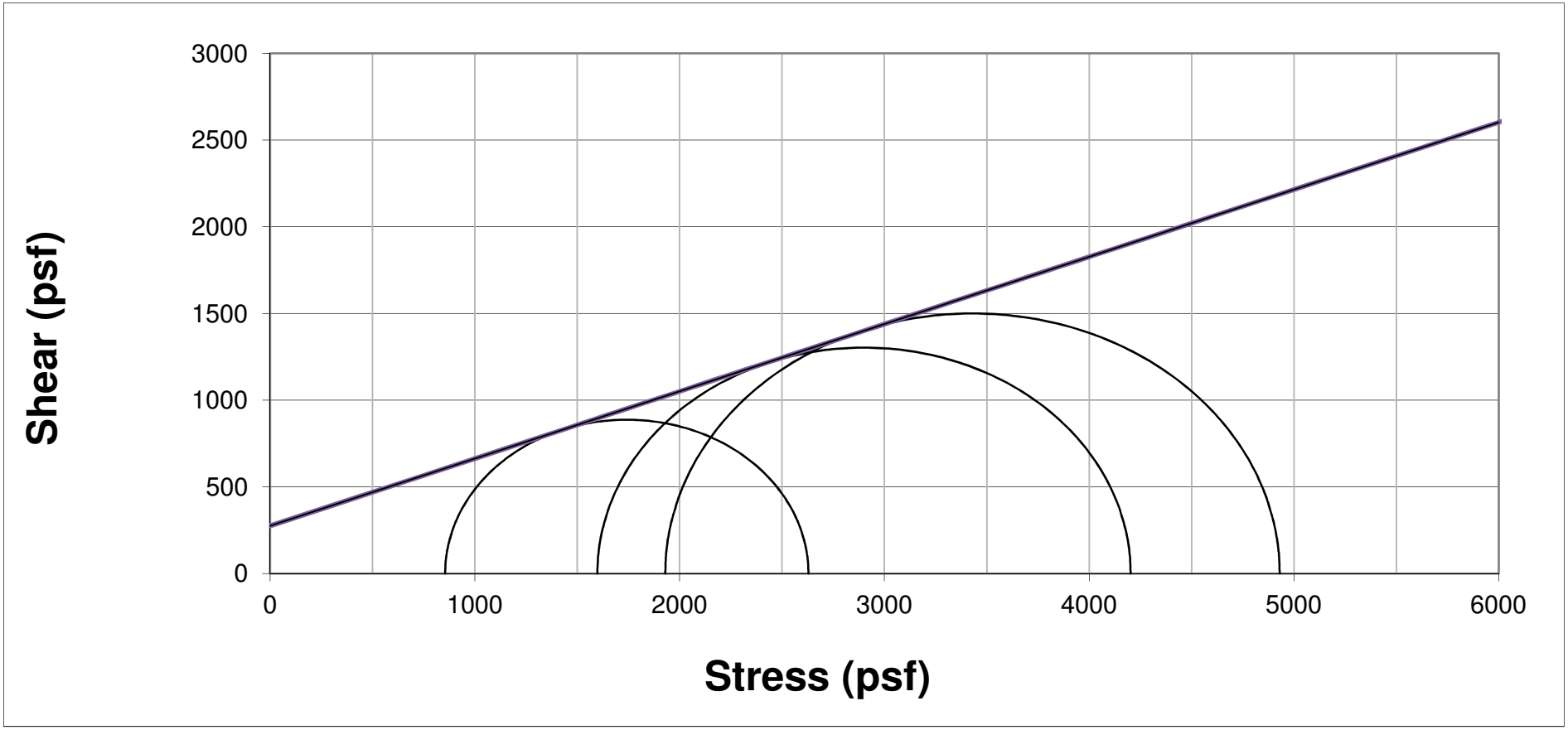
q vs. p

CLIENT:	HDR Engineering, Inc	Sample ID:	B-002-2-20, ST-5, 10'-12'		
PROJECT:	MOE-7-07.55 (Task 10-K)	Confining Pressure (psf):	Low	Middle	High
LOCATION:	Monroe County, Ohio		720	1440	2880
PROJECT #:	20050114COL				



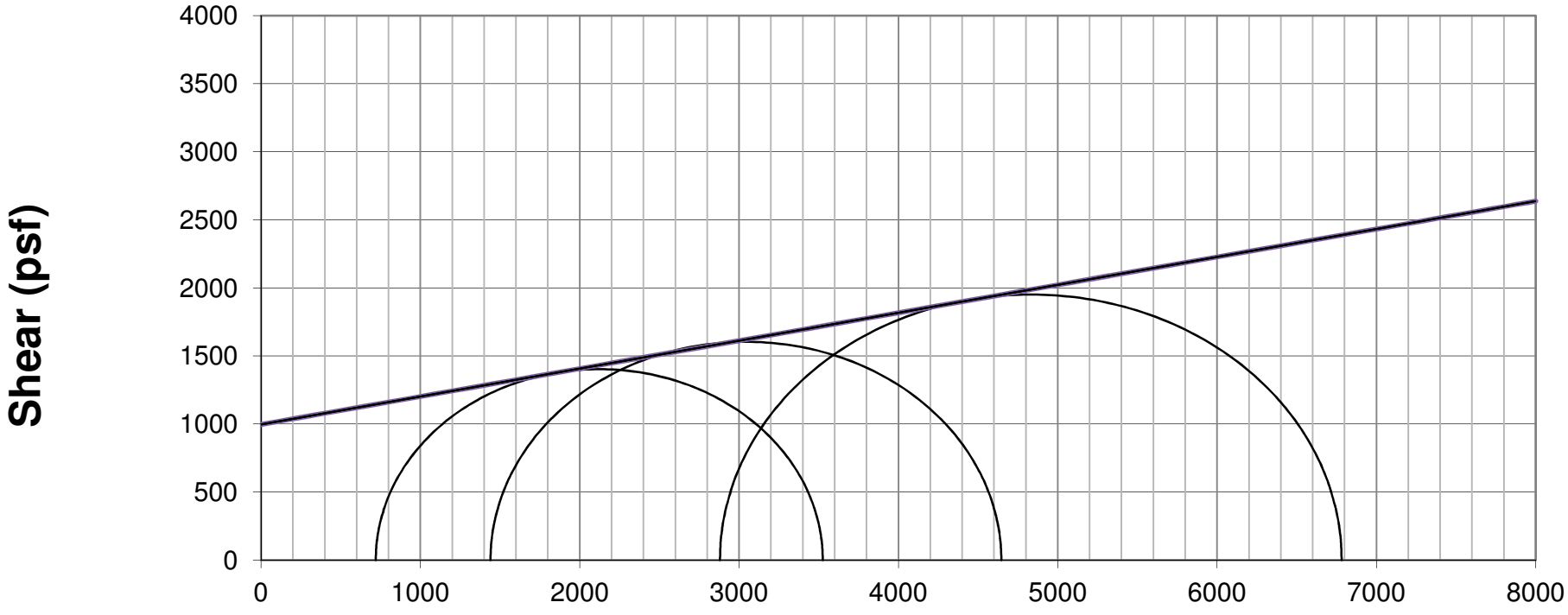
Mohr Circle Effective Stress

CLIENT:	HDR Engineering, Inc	Sample ID:	B-002-2-20, ST-5, 10'-12'		
PROJECT:	MOE-7-07.55 (Task 10-K)	Confining Pressure (psf):	720	1440	2880
LOCATION:	Monroe County, Ohio	Cohesion(psf):	275		
PROJECT #:	20050114COL	Angle of Friction(°):	21		



Mohr Circle Total Stress

CLIENT:	HDR Engineering, Inc	Sample ID:	B-002-2-20, ST-5, 10'-12'		
PROJECT:	MOE-7-07.55 (Task 10-K)	Confining Pressure (psf):	720	1440	2880
LOCATION:	Monroe County, Ohio	Cohesion(psf):	1000		
PROJECT #:	20050114COL	Angle of Friction(°):	11.5		



UNCONFINED COMPRESSION TEST
AASHTO T - 208

OHIO DEPARTMENT OF TRANSPORTION
OFFICE OF GEOTECHNICAL ENGINEERING

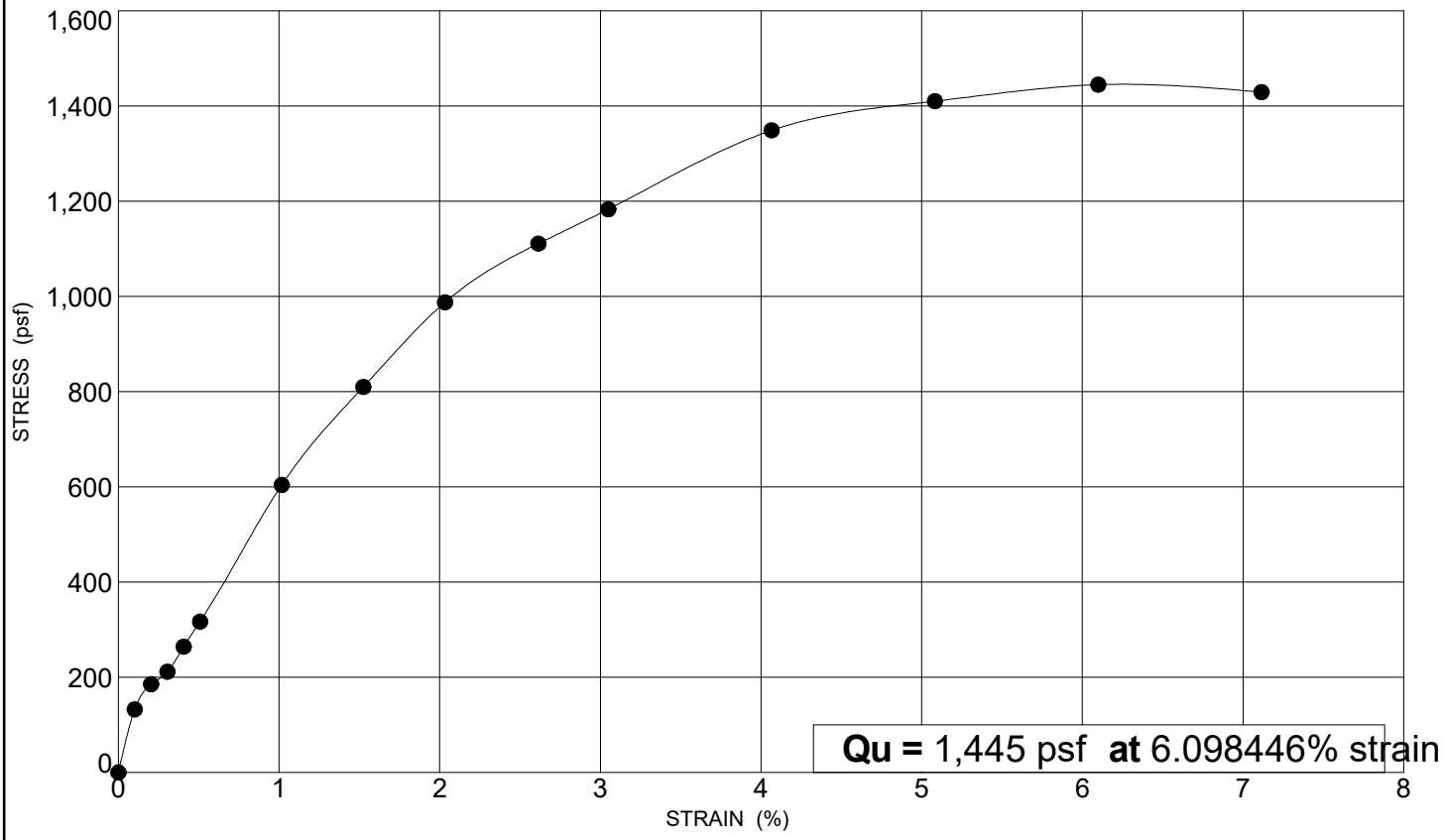
PROJECT MOE-7-7.55 **PID**

OGE NUMBER MOE-7-7.55 **PROJECT TYPE** STRUCTURE FOUNDATION

SAMPLE IDENTIFICATION

BORING ID: B-003-0-18 SAMPLE ID: ST-12

STATION: NOT RECORDED DEPTH: 18.0 - 20.0 feet



SPECIMEN FAILURE SKETCHES OR PHOTOGRAPHS

BEFORE FAILURE

AFTER FAILURE

SPECIMEN DETAILS

HEIGHT: 6.887 inches

DIAMETER: 2.833 inches

WET UNIT WT: 133.80 pcf

DRY UNIT WT: 112.34 pcf

TESTED BY: MOH 8/10/2018

CLASSIFICATION RESULTS

GRADATION (%)

GR	CS	FS	SI	CL
16	22	4	22	36

ATTERBERG LIMITS			MOISTURE
LL	PL	PI	WC
35	21	14	19

ODOT CLASS: A-6a HP (tsf): 1.0

DESCRIPTION: SANDY LEAN CLAY

UNCONFINED COMPRESSION TEST
AASHTO T - 208

OHIO DEPARTMENT OF TRANSPORTION
OFFICE OF GEOTECHNICAL ENGINEERING

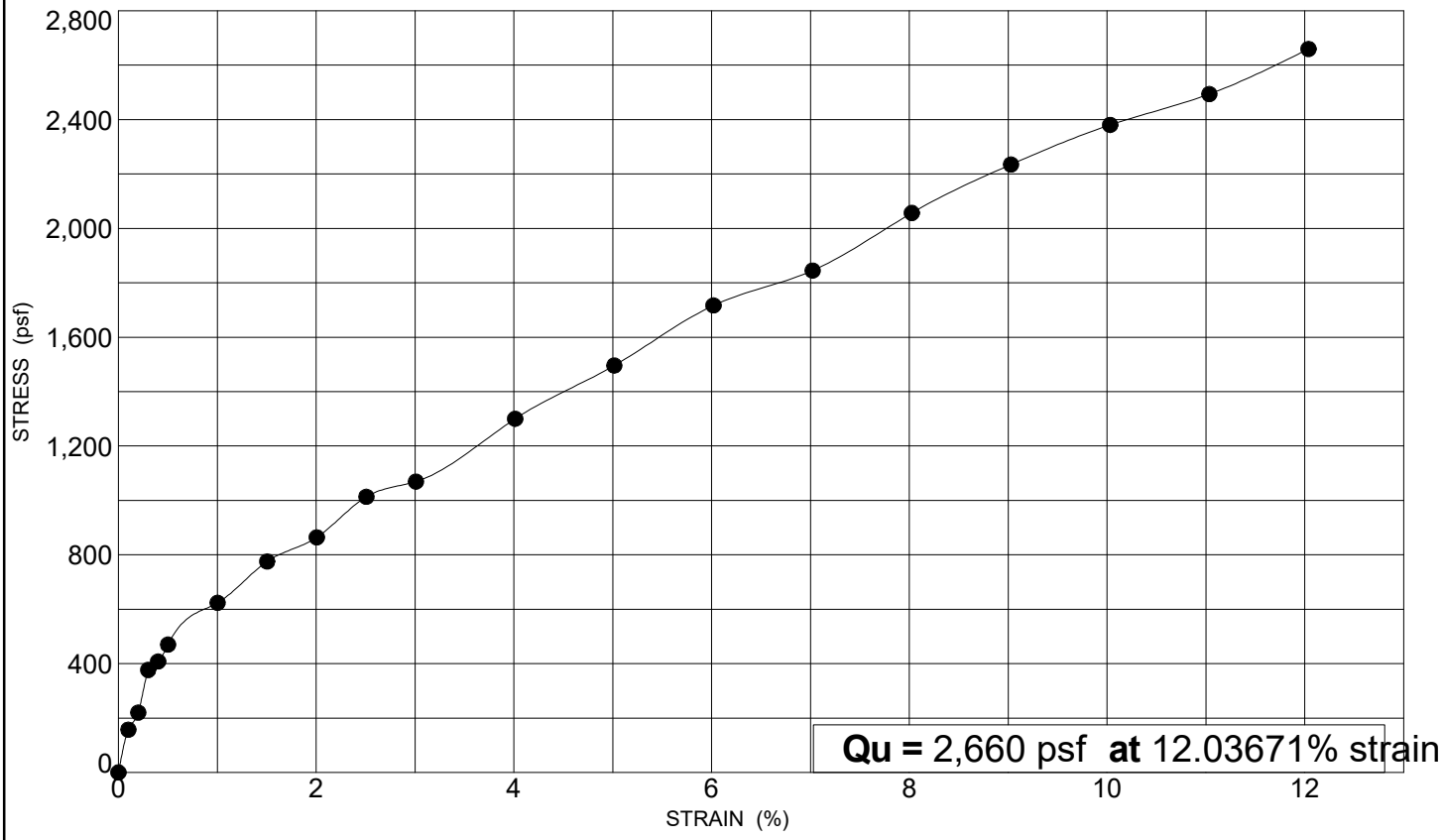
PROJECT MOE-7-7.55 **PID**

OGE NUMBER MOE-7-7.55 **PROJECT TYPE** STRUCTURE FOUNDATION

SAMPLE IDENTIFICATION

BORING ID: B-003-0-18 SAMPLE ID: ST-24

STATION: NOT RECORDED DEPTH: 36.5 - 38.5 feet



SPECIMEN FAILURE SKETCHES OR PHOTOGRAPHS

BEFORE FAILURE

AFTER FAILURE

SPECIMEN DETAILS

HEIGHT: 5.982 inches

DIAMETER: 2.600 inches

WET UNIT WT: 126.90 pcf

DRY UNIT WT: 103.42 pcf

TESTED BY: MOH 8/10/2018

CLASSIFICATION RESULTS

GRADATION (%)

GR	CS	FS	SI	CL
0	0	14	49	37

ATTERBERG LIMITS			MOISTURE
LL	PL	PI	WC
31	18	13	23

ODOT CLASS: A-6a HP (tsf): 1.75

DESCRIPTION: LEAN CLAY

OHDOT UNCONFINED COMPRESSION - OH DOT.GDT - 8/15/18 12:04 - \\DHDCINCFS01\DVALMA\GINT\PROJECTS\MOE-7-7.55.GPJ

UNCONFINED COMPRESSION TEST
AASHTO T - 208

OHIO DEPARTMENT OF TRANSPORTION
OFFICE OF GEOTECHNICAL ENGINEERING

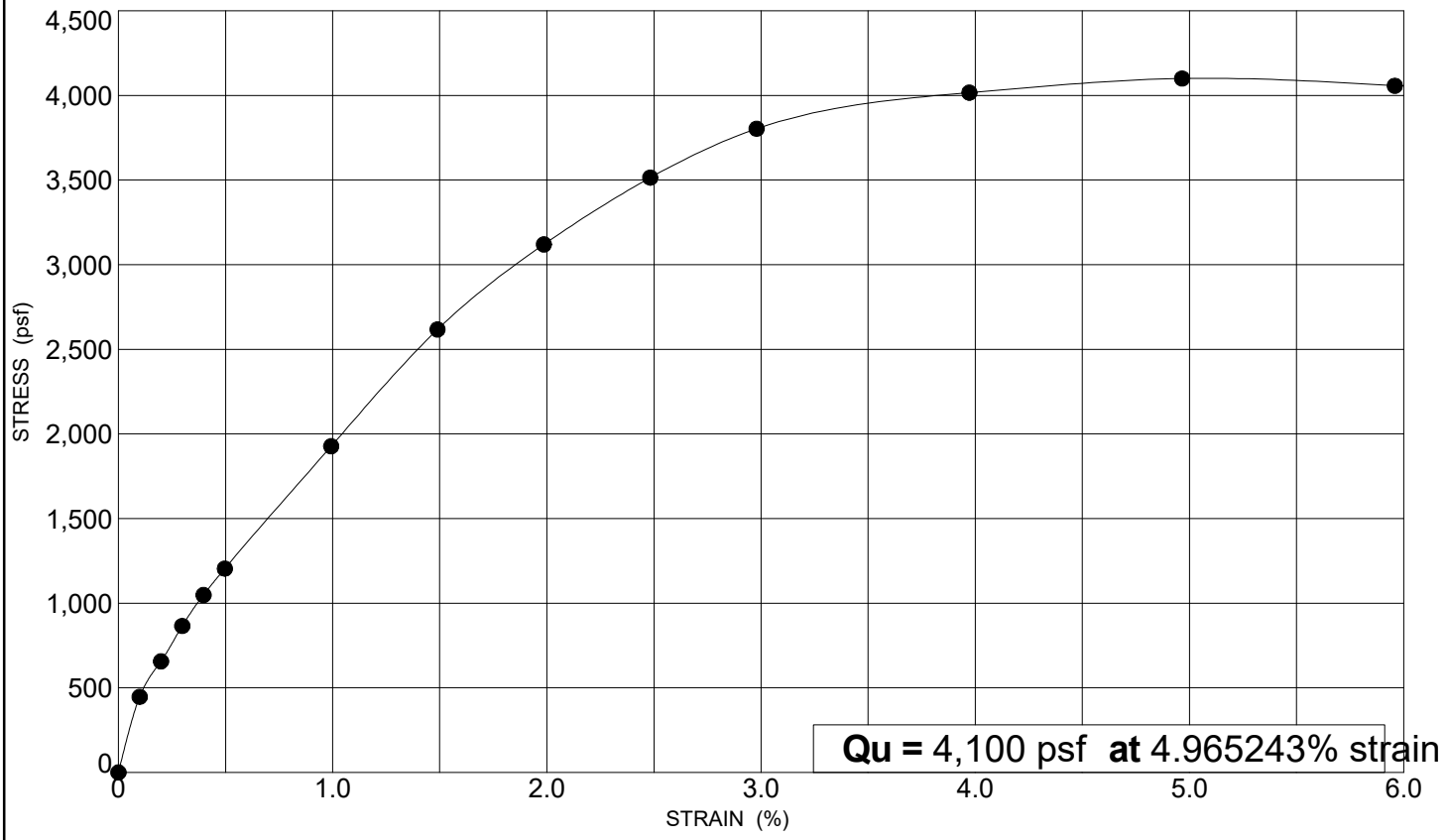
PROJECT MOE-7-7.55 **PID**

OGE NUMBER MOE-7-7.55 **PROJECT TYPE** STRUCTURE FOUNDATION

SAMPLE IDENTIFICATION

BORING ID: B-004-0-18 SAMPLE ID: ST-5

STATION: NOT RECORDED DEPTH: 11.0 - 13.0 feet



SPECIMEN FAILURE SKETCHES OR PHOTOGRAPHS

BEFORE FAILURE

AFTER FAILURE

SPECIMEN DETAILS

HEIGHT: 6.042 inches

DIAMETER: 2.845 inches

WET UNIT WT: 130.90 pcf

DRY UNIT WT: 112.17 pcf

TESTED BY: MOH 7/30/2018

CLASSIFICATION RESULTS

GRADATION (%)

GR	CS	FS	SI	CL
8	17	8	24	43

ATTERBERG LIMITS			MOISTURE
LL	PL	PI	WC
35	22	13	17

ODOT CLASS: A-6a HP (tsf): 4.0

DESCRIPTION: SANDY LEAN CLAY

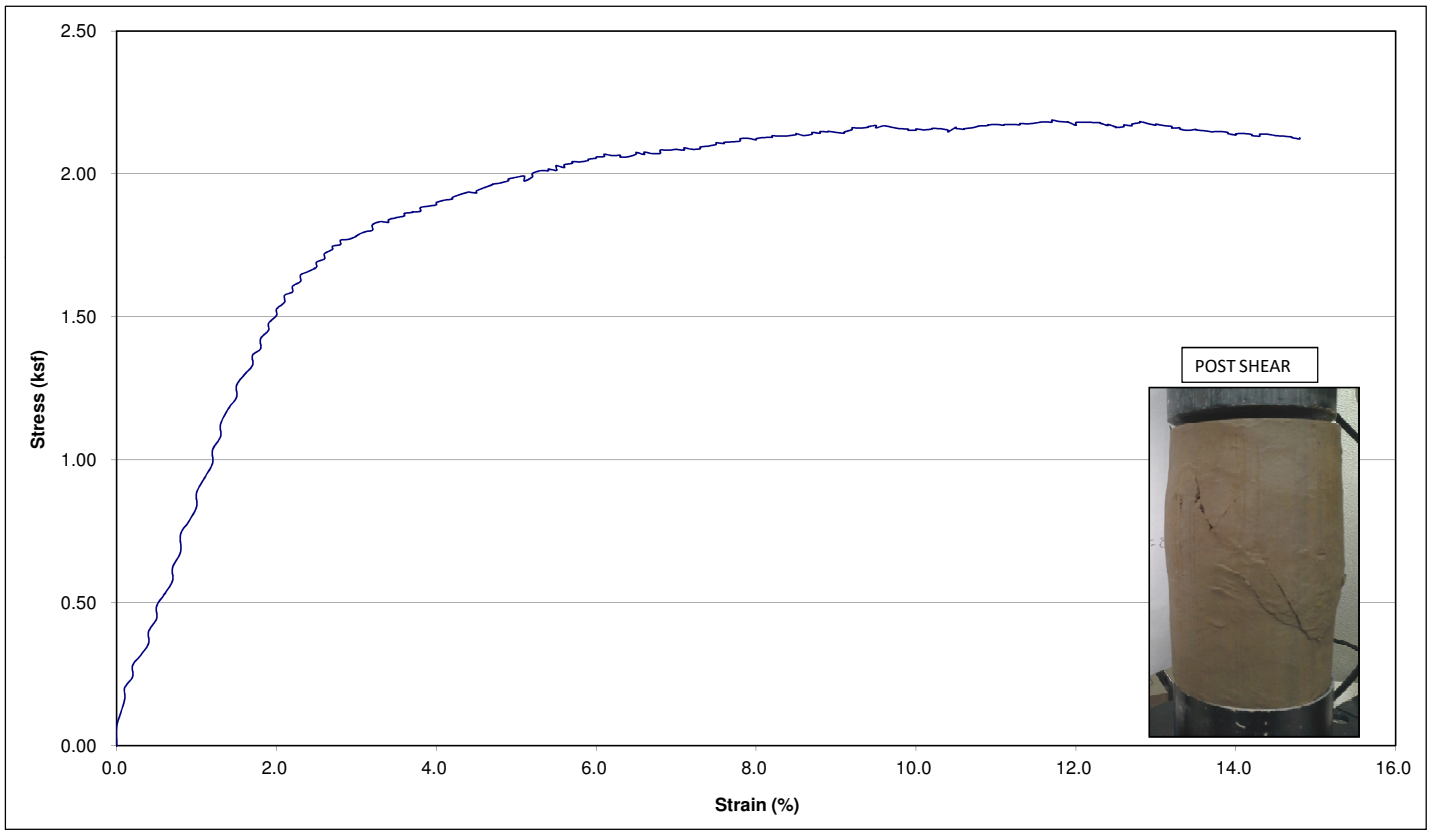
Unconfined Compression Test Results
ASTM D 2166, D 5102

CTL ENGINEERING, INC.
2860 Fisher Road Columbus, Ohio 43204

Sample ID:	B-004-1-20, ST-8, 10.5'-12.5'
Avg. Sample Height (in.):	5.79
Avg. Sample Diameter (in.):	2.88
Height-to-diameter ratio:	2.02
Ultimate Strength (ksf):	2.19
Shear Strength (Ksf):	1.09
Avg. Rate of Strain to Failure(%):	1.93
Strain at Failure (%):	11.70
Initial Dry Density (pcf):	97.57
Moisture Content (%):	27.1 (Obtained Post Shear)
Visual Description:	Brown Silt and Clay (A-6a), moist
Degree of Saturation:	NA
Sensitivity:	NA
Failure Type:	Diagonal Shear

Client:	HDR Engineering, Inc.	
Project:	MOE-7-7.55 (10-K)	
Location:	Monroe County, Ohio	
Project No.	20050114COL	
Lab Code No.	N/A	
Date Tested:	8/31/2020	
Reviewed by:	SM	

ASTM D 4318	**ASTM D 6913**	
LL: 36	Gravel (%): 0	Silt(%): 54
PL: 23	Sand(%): 11	Clay(%): 35



CTL ENGINEERING INC

DHDC
Engineering Consulting Services, Inc.

2390 Advanced Business Center Drive
Columbus, Ohio 43228
Office: 614.527.7656
ww.dhdcinc.com

Project: MOE-7-7.55
SR-7 Landslide Stabilization

Unconfined Compressive Strength (ASTM D7012)

B-001-0-18; NQ-3; 71.3' – 71.8'
Average Diameter: 1.819"
Average Height: 4.143"
Bulk Density: 154.2 pcf
Unconfined Compressive Strength: 156 psi and 666 psi (see note below)

Note: L/D ratio ~ 2.3

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Note: Top 1.5" of the sample consisted of soft shale and the lower 2.6" of sample consisted of moderately hard shale. During the test, the upper portion of the samples crushed at about 405 lbs. and the lower portion crushed at 1,730 lbs.

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MOE-7-7.55

PROJECT NAME: SR-7 Landslide Stabilization

Unconfined Compressive Strength (ASTM D7012)

B-002-0-18; NQ-2; 68.5'-68.9'
Average Diameter: 1.797"
Average Height: 3.651"
Wet Density: 162.7 pcf
Dry Density: 156.4 pcf
Unconfined Compressive Strength: 860 psi

Note: L/D ratio ~ 2.03

PROJECT NO:	20050114COL
DATE:	9/3/2020

UNIAXIAL COMPRESSIVE STRENGTH OF INTACT ROCK CORE - ASTM D 7012

Method C

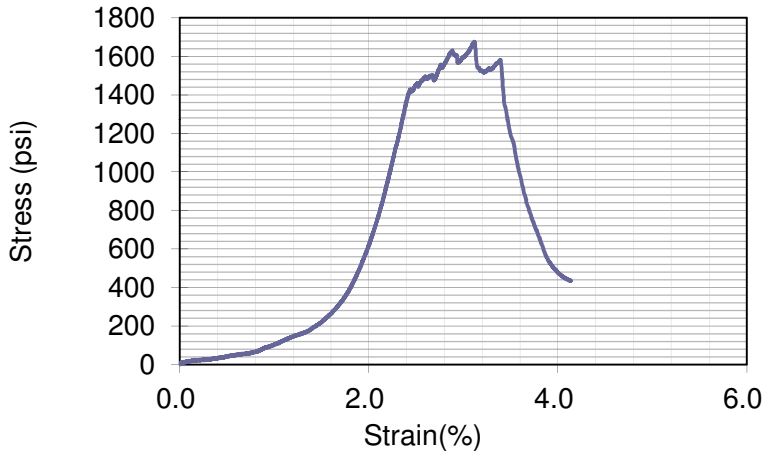
BORING NUMBER	B-002-1-20	TOP DEPTH(FT)	58.5	BOTTOM DEPTH(FT)	58.9
SAMPLE NUMBER	R-1	DISTRICT	10	PID NO.	108676
COUNTY	MOE	ROUTE	7	SECTION	7.55 (10-K)

FORMATION	Pennsylvanian Age
DESCRIPTION	Siltstone, Gray, Moderately Weathered,Slightly Strong
MOISTURE CONDITION	As Received

MEASUREMENT	LENGTH(INCHES)	DIAMETER(INCHES)
1	4.115	1.982
2	4.114	1.993
3	4.111	1.982
AVERAGE	4.113	1.986

LENGTH/DIAMETER	2.1
CORRECTION FACTOR	1
AREA(IN^2)	3.1
MASS (GRAMS)	546.2
UNIT WEIGHT(LBS/FT^3)	163.4

RATE OF LOADING (in/min)
0.17
COMPRESSIVE STRENGTH (PSI)
1,675
Equip. ID - 68897
NON-CONFORMANCES - None
TIME OF TEST (MINUTES)
1:00
LOADING DIRECTION
PERP. TO BEDDING
TECHNICIAN - MW
TEMPERATURE - Room



BEFORE TESTING

AFTER TESTING

Physical Appearance after Test - Sample sheared through middle portion - No signs of cracking, spalling or shearing at the platen-specimen interface

PROJECT NO:	20050114COL
DATE:	9/3/2020

UNIAXIAL COMPRESSIVE STRENGTH OF INTACT ROCK CORE - ASTM D 7012

Method C

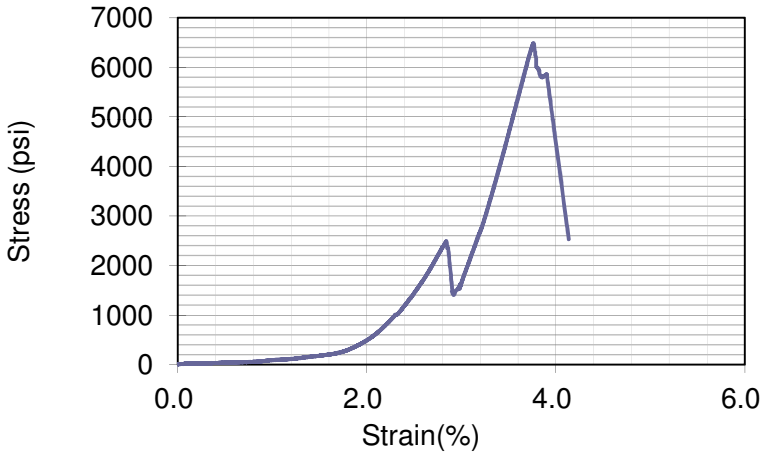
BORING NUMBER	B-002-2-20	TOP DEPTH(FT)	42.9	BOTTOM DEPTH(FT)	43.3
SAMPLE NUMBER	R-2	DISTRICT	10	PID NO.	108676
COUNTY	MOE	ROUTE	7	SECTION	7.55 (10-K)

FORMATION	Pennsylvanian Age
DESCRIPTION	Siltstone, Gray, Moderately Weathered,Moderately Strong
MOISTURE CONDITION	As Received

MEASUREMENT	LENGTH(INCHES)	DIAMETER(INCHES)
1	4.085	1.988
2	4.114	1.974
3	4.108	1.991
AVERAGE	4.102	1.984

LENGTH/DIAMETER	2.1
CORRECTION FACTOR	1
AREA(IN^2)	3.1
MASS (GRAMS)	545.4
UNIT WEIGHT(LBS/FT^3)	163.8

RATE OF LOADING (in/min)
0.14
COMPRESSIVE STRENGTH (PSI)
6,495
Equip. ID - 68897
NON-CONFORMANCES - None
TIME OF TEST (MINUTES)
3:07
LOADING DIRECTION
PERP. TO BEDDING
TECHNICIAN - MW
TEMPERATURE - Room



BEFORE TESTING

AFTER TESTING

Physical Appearance after Test - Sample sheared through middle portion - No signs of cracking, spalling or shearing at the platen-specimen interface

DHDC
Engineering Consulting Services, Inc.

2390 Advanced Business Center Drive
Columbus, Ohio 43228
Office: 614.527.7656
ww.dhdcinc.com

MOE-7-7.55

PROJECT NAME: SR-7 Landslide Stabilization

Unconfined Compressive Strength (ASTM D7012)

B-003-0-18; NQ-4; 75.9'-76.5'

Average Diameter: 1.796"
Average Height: 3.779"
Wet Density: 166.1 pcf
Dry Density: 159.7 pcf
Unconfined Compressive Strength: 2,255 psi

Note: L/D ratio ~ 2.1

DHDC
Engineering Consulting Services, Inc.

2390 Advanced Business Center Drive
Columbus, Ohio 43228
Office: 614.527.7656
ww.dhdcinc.com

Project Name: **MOE-7-7.55**

Unconfined Compressive Strength (ASTM D7012)

B-004-0-18; NQ-3; 83.0'- 83.5'

Average Diameter: 1.772"
Average Height: 3.809"
Wet Density: 164.3 pcf
Dry Density: 157.9 pcf
Unconfined Compressive Strength: 343 psi

Note: L/D ratio ~ 2.1

PROJECT NO:	20050114COL
DATE:	9/3/2020

UNIAXIAL COMPRESSIVE STRENGTH OF INTACT ROCK CORE - ASTM D 7012

Method C

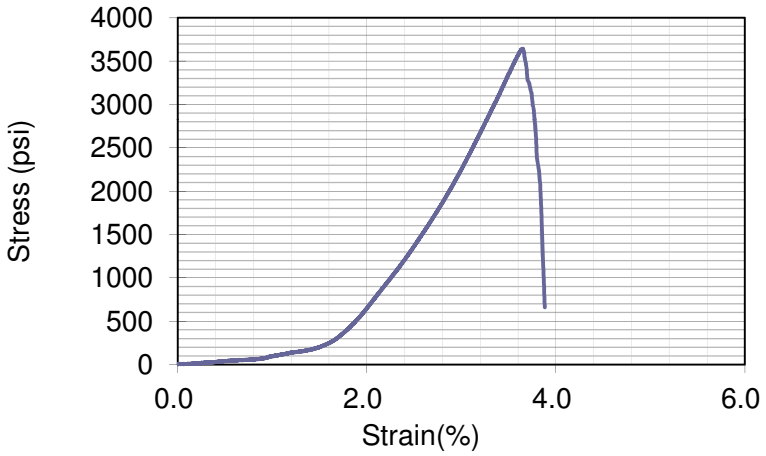
BORING NUMBER	B-004-1-20	TOP DEPTH(FT)	44.1	BOTTOM DEPTH(FT)	44.5
SAMPLE NUMBER	R-1	DISTRICT	10	PID NO.	108676
COUNTY	MOE	ROUTE	7	SECTION	7.55 (10-K)

FORMATION	Pennsylvanian Age
DESCRIPTION	Siltstone, Gray, Highly Weathered,Moderatly Strong
MOISTURE CONDITION	As Received

MEASUREMENT	LENGTH(INCHES)	DIAMETER(INCHES)
1	4.085	1.988
2	4.085	1.980
3	4.085	1.986
AVERAGE	4.085	1.985

LENGTH/DIAMETER	2.1
CORRECTION FACTOR	1
AREA(IN^2)	3.1
MASS (GRAMS)	543.1
UNIT WEIGHT(LBS/FT^3)	163.7

RATE OF LOADING (in/min)
0.18
COMPRESSIVE STRENGTH (PSI)
3,644
Equip. ID - 68897
NON-CONFORMANCES - None
TIME OF TEST (MINUTES)
22:19
LOADING DIRECTION
PERP. TO BEDDING
TECHNICIAN - MW
TEMPERATURE - Room



BEFORE TESTING

AFTER TESTING

Physical Appearance after Test - Sample sheared through middle portion - No signs of cracking, spalling or shearing at the platen-specimen interface

PROJECT NO:	20050114COL
DATE:	9/3/2020

UNIAXIAL COMPRESSIVE STRENGTH OF INTACT ROCK CORE - ASTM D 7012

Method C

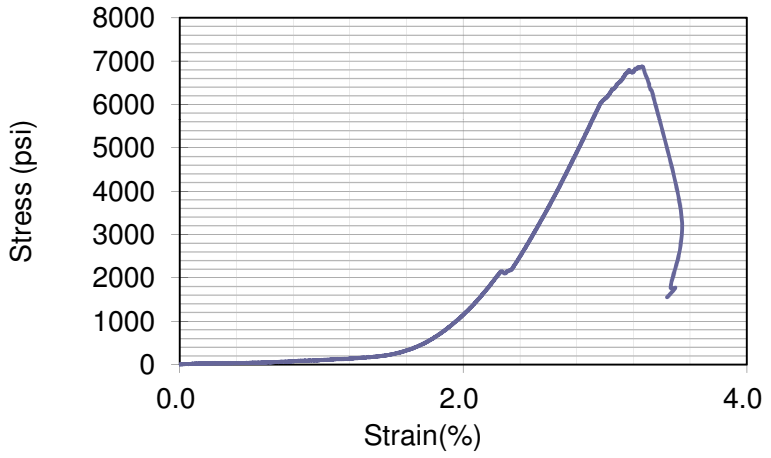
BORING NUMBER	B-004-2-20	TOP DEPTH(FT)	35.2	BOTTOM DEPTH(FT)	35.7
SAMPLE NUMBER	R-2	DISTRICT	10	PID NO.	108676
COUNTY	MOE	ROUTE	7	SECTION	7.55 (10-K)

FORMATION	Pennsylvanian Age
DESCRIPTION	Siltstone, Gray, Moderately Weathered,Moderatly Strong
MOISTURE CONDITION	As Received

MEASUREMENT	LENGTH(INCHES)	DIAMETER(INCHES)
1	4.105	1.993
2	4.102	1.989
3	4.101	1.978
AVERAGE	4.103	1.987

LENGTH/DIAMETER	2.1
CORRECTION FACTOR	1
AREA(IN^2)	3.1
MASS (GRAMS)	546.0
UNIT WEIGHT(LBS/FT^3)	163.6

RATE OF LOADING (in/min)
0.20
COMPRESSIVE STRENGTH (PSI)
6,872
Equip. ID - 68897
NON-CONFORMANCES - None
TIME OF TEST (MINUTES)
19:55
LOADING DIRECTION
PERP. TO BEDDING
TECHNICIAN - MW
TEMPERATURE - Room



BEFORE TESTING

AFTER TESTING

Physical Appearance after Test - Sample sheared through middle portion - No signs of cracking, spalling or shearing at the platen-specimen interface

PROJECT NO:	20050114COL
DATE:	9/3/2020

UNIAXIAL COMPRESSIVE STRENGTH OF INTACT ROCK CORE - ASTM D 7012

Method C

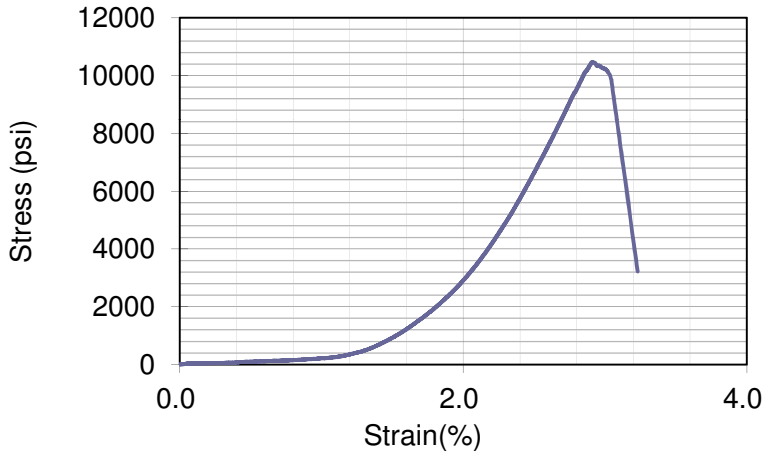
BORING NUMBER	B-004-2-20	TOP DEPTH(FT)	42.4	BOTTOM DEPTH(FT)	43.0
SAMPLE NUMBER	R-3	DISTRICT	10	PID NO.	108676
COUNTY	MOE	ROUTE	7	SECTION	7.55 (10-K)

FORMATION	Pennsylvanian Age
DESCRIPTION	Sandstone, Gray, Slightly Weathered, Strong
MOISTURE CONDITION	As Received

MEASUREMENT	LENGTH(INCHES)	DIAMETER(INCHES)
1	4.091	1.990
2	4.096	1.991
3	4.093	1.990
AVERAGE	4.093	1.990

LENGTH/DIAMETER	2.1
CORRECTION FACTOR	1
AREA(IN^2)	3.1
MASS (GRAMS)	540.4
UNIT WEIGHT(LBS/FT^3)	161.6

RATE OF LOADING (in/min)
0.13
COMPRESSIVE STRENGTH (PSI)
10,479
Equip. ID - 68897
NON-CONFORMANCES - None
TIME OF TEST (MINUTES)
23:45
LOADING DIRECTION
PERP. TO BEDDING
TECHNICIAN - MW
TEMPERATURE - Room



BEFORE TESTING

AFTER TESTING

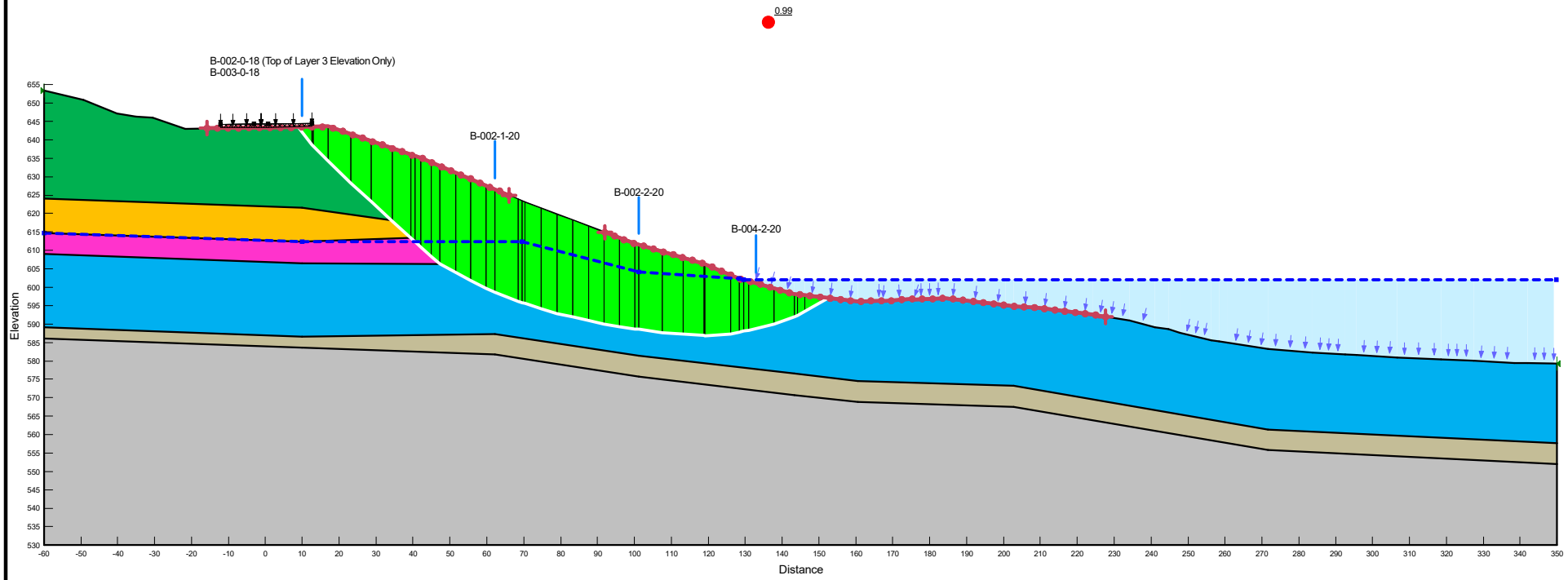
Physical Appearance after Test - Sample sheared through middle portion - No signs of cracking, spalling or shearing at the platen-specimen interface

Slope Stability Analyses

Station 401+25
Existing Conditions

9999 Carver Road, Suite 210, Cincinnati, OH 45242-5583 **hdrinc.com**
(513) 984-7500

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	1. Stiff Colluvium	Mohr-Coulomb	130	80	20
	2. V. Stiff Colluvium	Mohr-Coulomb	135	130	23
	3. Stiff to V. Stiff Colluvium	Mohr-Coulomb	125	100	22
	4. Soft to M. Stiff Alluvium	Mohr-Coulomb	125	80	18
	5. Hard Residuum/Weathered Rock	Mohr-Coulomb	140	250	28
	Bedrock	Bedrock (Impenetrable)			

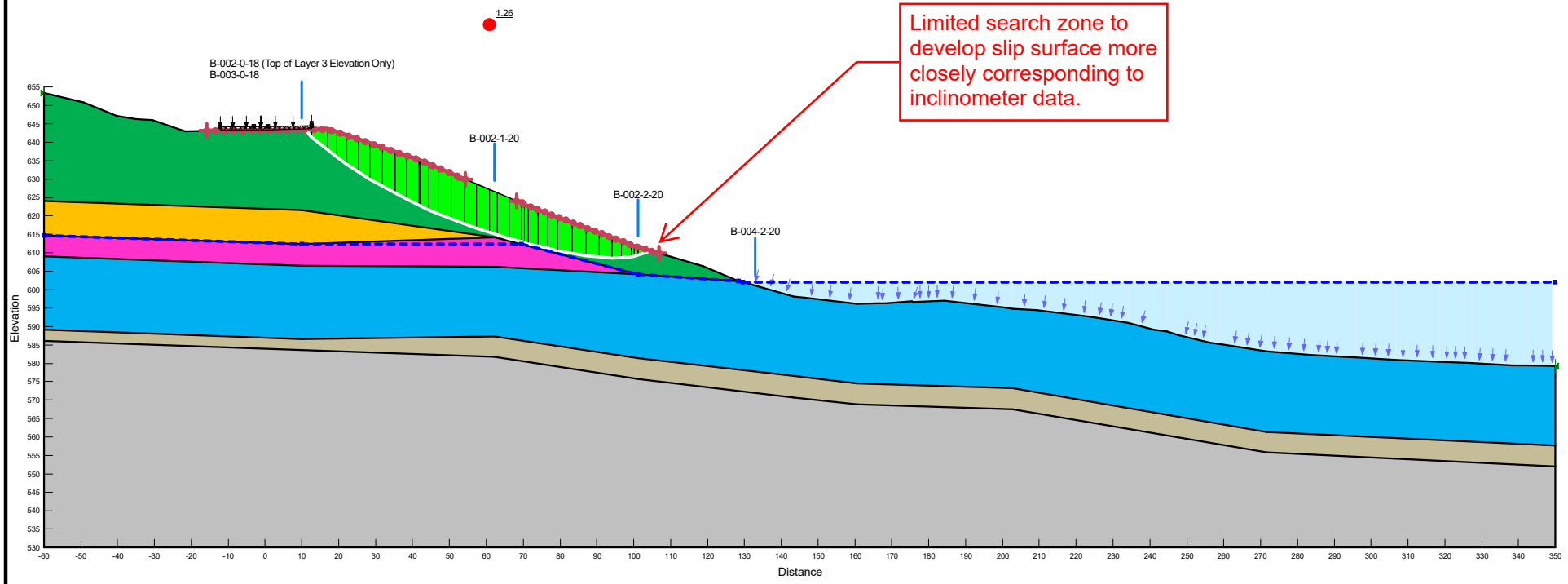


Existing Condition - Sta. 401+25 (Existing)

20200908_MOE-7-7.55.gsz

12/16/2020 1:510

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	1. Stiff Colluvium	Mohr-Coulomb	130	80	20
	2. V. Stiff Colluvium	Mohr-Coulomb	135	130	23
	3. Stiff to V. Stiff Colluvium	Mohr-Coulomb	125	100	22
	4. Soft to M. Stiff Alluvium	Mohr-Coulomb	125	80	18
	5. Hard Residuum/Weathered Rock	Mohr-Coulomb	140	250	28
	Bedrock	Bedrock (Impenetrable)			



Existing Condition (2) - Sta. 401+25 (Existing)

20200908_MOE-7-7.55.gsz

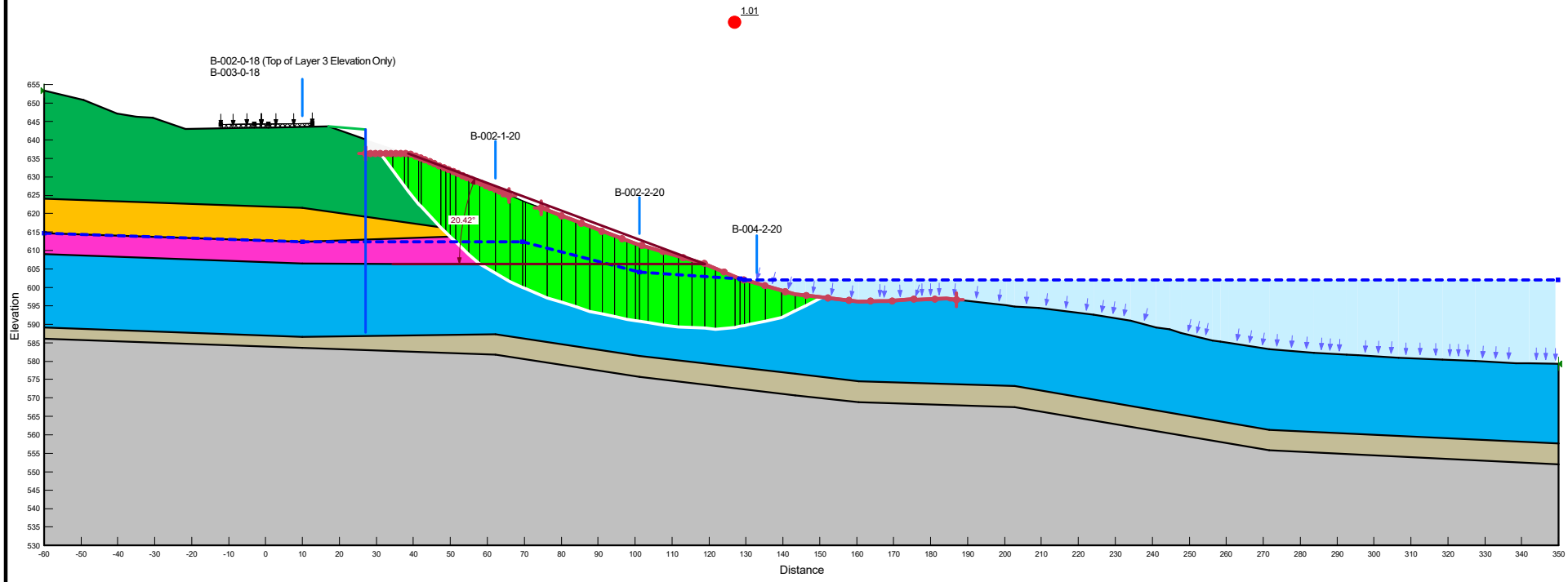
12/16/2020 1:510

Station 401+25
Downslope Stability

9999 Carver Road, Suite 210, Cincinnati, OH 45242-5583
(513) 984-7500
hdrinc.com

FS < 1.3

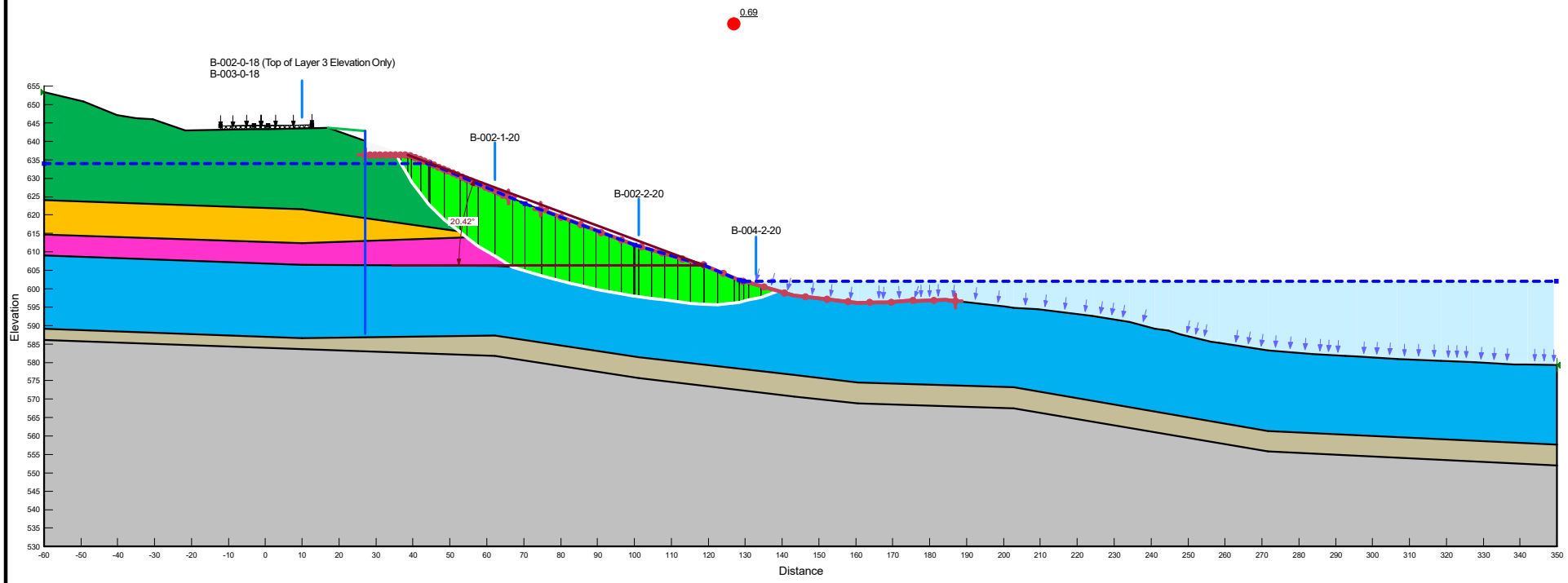
Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	1. Stiff Colluvium	Mohr-Coulomb	130	80	20
	2. V. Stiff Colluvium	Mohr-Coulomb	135	130	23
	3. Stiff to V. Stiff Colluvium	Mohr-Coulomb	125	100	22
	4. Soft to M. Stiff Alluvium	Mohr-Coulomb	125	80	18
	5. Hard Residuum/Weathered Rock	Mohr-Coulomb	140	250	28
	Bedrock	Bedrock (Impenetrable)			



Downslope Stability - Sta. 401+25 (Proposed)	
20200908_MOE-7-7.55.gsz	
12/16/2020	1:510

Rapid drawdown FS < 1.1

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	1. Stiff Colluvium	Mohr-Coulomb	130	80	20
	2. V. Stiff Colluvium	Mohr-Coulomb	135	130	23
	3. Stiff to V. Stiff Colluvium	Mohr-Coulomb	125	100	22
	4. Soft to M. Stiff Alluvium	Mohr-Coulomb	125	80	18
	5. Hard Residuum/Weathered Rock	Mohr-Coulomb	140	250	28
	Bedrock	Bedrock (Impenetrable)			



Downslope Stability (RDD) - Sta. 401+25 (Proposed)	
20200908_MOE-7-7.55.gsz	
12/16/2020	1:510

UA SLOPE Analyses

Station 401+25
Existing Conditions

UA Slope Program Version 2.3 - C:\Users\abaratta\Desktop\20201130_MOE-7-7.55_UA Slope Existing Condition.ua3

File Run Options Help

Calculated Results

Factor of Safety: 0.99

Force per Shaft: 0.000 lb

Acting Point X: 25.000 ft Y: 0.000 ft

Analysis Unit System

(•) English ( ) Metric

Number of Vertical Sections and Soil Layers

Vertical Section Num: 15 Soil Layer Num: 6

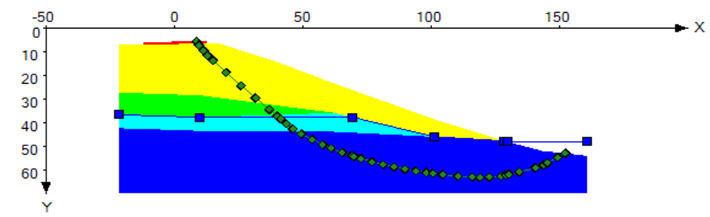
Analysis Method

( ) Total Stress (•) Effective Stress

Soil Properties

	Cohesion (psf)	Friction Angle	Total Unit Weight (pcf)
Layer1	0.1	0.0	250.0
Layer2	200.0	28.0	120.0
Layer3	80.0	20.0	130.0
Layer4	130.0	23.0	135.0
Layer5	100.0	22.0	125.0
▸ Layer6	80.0	19.0	125.0

Chart (Double-Click for More Options)



Slope Profile Vertical Sections

	Section 1	Section 2	Section 3	Section 4	Section 5	Section 6	Section 7	Section 8	Section 9	Section 10	Section 11	Section 12	Section 13	Section 14
▸ X (ft)	-21.60	-12.10	-12.10	10.00	12.70	12.70	17.00	27.00	27.00	38.60	62.20	101.20	128.40	143.30
Y1 (ft)	7.00	6.90	5.90	5.50	5.50	6.50	6.40	9.80	9.80	13.70	23.40	38.50	47.70	51.90
Y2 (ft)	7.00	6.90	6.90	6.50	6.50	6.50	6.40	9.80	9.80	13.70	23.40	38.50	47.70	51.90
Y3 (ft)	7.00	6.90	6.90	6.50	6.50	6.50	6.40	9.80	9.80	13.70	23.40	38.50	47.70	51.90
Y4 (ft)	27.30	27.60	27.60	28.40	28.80	28.80	29.40	30.80	30.80	32.50	35.80	45.90	47.70	51.90
Y5 (ft)	36.60	36.90	36.90	37.70	37.60	37.60	37.40	37.10	37.10	36.70	35.80	45.90	47.70	51.90
Y6 (ft)	42.30	42.60	42.60	43.40	43.40	43.40	43.50	43.50	43.50	43.60	43.80	45.90	47.70	51.90
Y7 (ft)	70.00	70.00	70.00	70.00	70.00	70.00	70.00	70.00	70.00	70.00	70.00	70.00	70.00	70.00

Coordinates of Crest X: -3.00 ft Y: 6.70 ft Coordinates of Toe X: 160.50 ft Y: 53.90 ft

Drilled Shaft Information

(•) Calculate without Drilled Shaft

( ) Automatic Load Transfer Factor

( ) Manually Defined Load Transfer Factor

[ ] Anchor (On/Off)

Anchor force: 50000.0 lb

Anchor angle: 30.00

Anchor spacing: 8.00 ft

Auto ( ) On (•) Off 0.000 (n)

Xmin 10.00 Diameter: 3.00 ft

Xmax 20.00 CTC Spacing: 6.00 ft

XDelta 2.00 X Coordinate: 25.00 ft

[ ] Auto Save Data

Run

Pore Water Pressure

Pore Pressure Options: ( ) No Pore Pressure ( ) Constant Ratio (•) Specified phreatic surface

	Point 1	Point 2	Point 3	Point 4	Point 5	Point 6	Point 7
▸ X (ft)	-21.60	10.00	69.50	101.20	128.40	129.60	160.50
Y (ft)	36.60	37.70	37.70	45.90	47.70	48.00	48.00

Slip Surface

	Point 1	Point 2	Point 3	Point 4	Point 5	Point 6	Point 7	Point 8	Point 9	Point 10	Point 11	Point 12	Point 13	Point 14	Point 15	Point 16	Point 17	Po
▸ X (ft)	8.50	9.51	11.35	12.85	15.00	20.07	25.89	31.51	36.90	39.99	41.34	43.50	46.07	49.40	53.64	57.81	61.05	65.1
Y (ft)	5.60	7.18	9.57	11.50	13.69	18.74	24.31	29.44	34.35	37.16	38.40	40.36	42.63	44.76	47.02	49.24	50.82	52.5

Station 401+25
Post-Construction Conditions

UA Slope Program Version 2.3 - C:\Users\abaratta\Desktop\20201130_MOE-7-7.55_UA Slope New Wall.ua3

File Run Options Help

Calculated Results

Factor of Safety: 1.15

Force per Shaft: 59554.023 lb

Acting Point X: 27.000 ft Y: 19.343 ft

Analysis Unit System

(•) English ( ) Metric

Number of Vertical Sections and Soil Layers

Vertical Section Num: 15 Soil Layer Num: 6

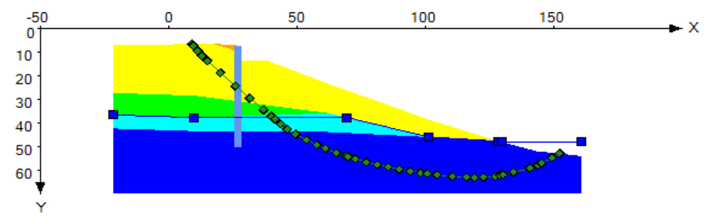
Analysis Method

( ) Total Stress (•) Effective Stress

Soil Properties

	Cohesion (psf)	Friction Angle	Total Unit Weight (pcf)
Layer1	0.1	0.0	250.0
Layer2	200.0	28.0	120.0
Layer3	80.0	20.0	130.0
Layer4	130.0	23.0	135.0
Layer5	100.0	22.0	125.0
Layer6	80.0	19.0	125.0

Chart (Double-Click for More Options)



Slope Profile Vertical Sections

	Section 1	Section 2	Section 3	Section 4	Section 5	Section 6	Section 7	Section 8	Section 9	Section 10	Section 11	Section 12	Section 13	Section 14
X (ft)	-21.60	-12.10	-12.10	10.00	12.70	12.70	17.00	27.00	27.00	38.60	62.20	101.20	128.40	143.30
Y1 (ft)	7.00	6.90	6.90	6.50	6.50	6.50	6.40	7.20	13.70	17.30	23.40	38.50	47.70	51.90
Y2 (ft)	7.00	6.90	6.90	6.50	6.50	6.50	6.40	7.20	13.70	13.70	23.40	38.50	47.70	51.90
Y3 (ft)	7.00	6.90	6.90	6.50	6.50	6.50	6.40	9.80	13.70	13.70	23.40	38.50	47.70	51.90
Y4 (ft)	27.30	27.60	27.60	28.40	28.80	28.80	29.40	30.80	30.80	32.50	35.80	45.90	47.70	51.90
Y5 (ft)	36.60	36.90	36.90	37.70	37.60	37.60	37.40	37.10	37.10	36.70	35.80	45.90	47.70	51.90
Y6 (ft)	42.30	42.60	42.60	43.40	43.40	43.40	43.50	43.50	43.50	43.60	43.80	45.90	47.70	51.90
Y7 (ft)	70.00	70.00	70.00	70.00	70.00	70.00	70.00	70.00	70.00	70.00	70.00	70.00	70.00	70.00

Coordinates of Crest X: -3.00 ft Y: 6.70 ft Coordinates of Toe X: 160.50 ft Y: 53.90 ft

Drilled Shaft Information

( ) Calculate without Drilled Shaft

( ) Automatic Load Transfer Factor

(•) Manually Defined Load Transfer Factor

[ ] Anchor (On/Off)

Anchor force: 0.00 lb

Anchor angle: 0.00

Anchor spacing: 0.00 ft

Auto ( ) On (•) Off 0.000 (n)

Xmin 0.00 Diameter: 3.00 ft

Xmax 0.00 CTC Spacing: 6.00 ft

XDelta 0.00 X Coordinate: 27.00 ft

[ ] Auto Save Data

Run

Pore Water Pressure

Pore Pressure Options: ( ) No Pore Pressure ( ) Constant Ratio (•) Specified phreatic surface

	Point 1	Point 2	Point 3	Point 4	Point 5	Point 6	Point 7
X (ft)	-21.60	10.00	69.50	101.20	128.40	129.60	160.50
Y (ft)	36.60	37.70	37.70	45.90	47.70	48.00	48.00

Slip Surface

	Point 1	Point 2	Point 3	Point 4	Point 5	Point 6	Point 7	Point 8	Point 9	Point 10	Point 11	Point 12	Point 13	Point 14	Point 15	Point 16	Point 17	Po
X (ft)	9.00	9.51	11.35	12.85	15.00	20.07	25.89	31.51	36.90	39.99	41.34	43.50	46.07	49.40	53.64	57.81	61.05	65.1
Y (ft)	6.50	7.18	9.57	11.50	13.69	18.74	24.31	29.44	34.35	37.16	38.40	40.36	42.63	44.76	47.02	49.24	50.82	52.5

Wall Calculations

Earth Pressure Coefficients

	Deg	Rad	
Shear Resistance, Φ =	26	0.4573	
Wall Friction , δ^A =	0.0	0.0000	
Wall Slope, θ =	90	1.5708	
Backfill Slope, β =	4.8	0.0838	
Revised Backfill Slope, β =	4.80	0.0838	
Backfill Condition	INFINITE		
Horz. Backslope Dist.	10		feet
Wall Height (H)	6.5		feet
Slope Height (h)	0.8		feet
I =	3.52		degrees

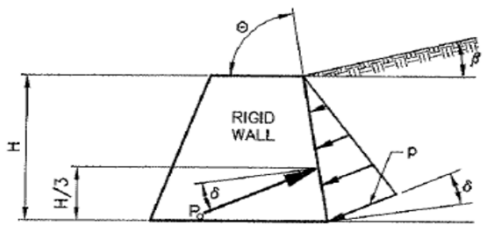


Figure 3.11.5.3-1—Notation for Coulomb Active Earth Pressure

$$K_a = \frac{\sin^2(\theta+\Phi)}{(\sin^2(\theta)*\sin(\theta-\delta)*[1+\sqrt{(\sin(\Phi+\delta)*\sin(\Phi-\beta))/(\sin(\theta-\delta)*\sin(\theta+\beta))}]^2)}$$

K_a = **0.410**

At-Rest Earth Coefficient

$K_o = (1- \sin(\phi))*(1+\sin(\beta))$

K_o = **0.605**

Notes:

A. *Wall friction neglected*

B. *Figure and Equation for Active Earth Pressure from AASHTO 3.11.5.3 (LRFD Design Manual).*

C. *The wall backfill will consist of proposed fill and cohesive overburden. Using the soil layer thicknesses and respective soil parameters as determined by backcalculation in SlopeW, a weighted average was determined and assumed for the entire backfill (c' = 130 psf and φ' = 23°, per backcalculated UA Slope Values). The parameters were converted to equivalent soil strength parameters c' = 0 psf and φ'= 26° for computing earth pressures based on a 1 degree increase in friction angle for every 50 psf decrease in cohesion up to 150 psf (Ref: Hall's Thesis).*

	Top Elev	Thickness (ft)	Cohesion (psf)	Phi (deg)	Unit Wt (pcf)
Item 203	642.8	2.6	200	28	120
Stiff Colluvium	640.2	3.9	80	20	130
Bottom of Wall	636.3				
Weighted Value		6.5	130	23	125

Soil Lateral Design Profile

	Top Elev	Depth (ft)	Cohesion (psf)	Phi (deg)	Unit Wt (pcf)
Stiff Colluvium	632.0	10.8	1000	0	130
V. Stiff Colluvium	619.2	23.6	1800	0	135
Stiff to V. Stiff Colluvium (Above GWT)	612.9	29.9	1500	0	125
Stiff to V. Stiff Colluvium (Below GWT)	612.3	30.5	1500	0	62.6
Soft to M. Stiff Alluvium	606.5	36.3	500	0	62.6
Hard Residuum	586.8	56.0	4000	0	77.6
Bedrock	583.0	59.8	N/A	N/A	N/A

Depths referenced below the top of wall, starting at the lowered ground surface.

Wall Loading Computations

Earth Pressure Model = CONVENTIONAL *(Conventional or UA SLOPE)* UA SLOPE

1) Soil Unit Weight = 125 pcf *Weighted Average Along Cantilevered Wall Height*

2) Determine Coefficient of Earth Pressure (K)

Restraint Condition = ACTIVE *(Active or At-Rest)*

Ka = 0.410

3) Determine Equivalent Fluid Weight (G_H)

G_H = $(\gamma_m) * (K_a)$

G_H = 51 *For application to CONVENTIONAL Earth Pressure Model*

4) Artificially Lowered Ground Surface (ODOT GB-7, pgs. 27 and 28) for FS_{dh} < 1.30

Lowered Ground Surface (ft) = 4.3 = dt (tan(β_{dh})

β_{dh} = 20.42 = steepness of the slope downhill of the drilled shaft

FS_{dh} = 1.01 = Factor of Safety down slope of the proposed wall

d_t = 11.6 = depth below bench to the shear surface at the location of the drilled shaft

5) Determine Lateral Thrust

Conventional Earth Pressure Theory

Exposed Wall Height (H) = 6.5 feet

Wall Height (H) + GS_{AL} = 10.8

P = $1/2 * G_H * H^2$

P = 2996 lbs/ft.

UA SLOPE

Depth from T/Wall to Slip Plane = 18.1 feet

Force Per Shaft = 59554 lbs./shaft

6) Determine horizontal force per shaft *(center-to-center pile spacing)*

Assumed Shaft Spacing = 6 feet

P_{SH} = P*(Shaft Spacing) *(earth loading)*

P_{SH} = 17975 lbs/shaft

7) Determine live-load traffic surcharge force (P_s)

Does traffic surcharge apply? YES

Distance from drilled shafts to traffic loading = 5 feet

Half depth from top/wall to shear plane = 9.05 feet

Is distance from drilled shafts to traffic loading > half depth to shear plane? NO

Surcharge Pressure (q_s) = 250 psf

P_s = Ka * qs * H

P_s =	1108	lbs/foot	*(surcharge resolved to distributed load)*	1853 lbs/foot
P_s =	6646	lbs/ shaft		11119 lbs/ shaft

8) Resolve horizontal earth force to distributed triangular load (for LPILE)

w = $2*P_{SH}/H$

w =	3323	lbs/foot per shaft (Earth - Service Limit)		6581 lbs/foot per shaft
w =	277	lbs/inch per shaft (Earth - Service Limit)		548 lbs/inch per shaft
γ_E =	1.5	*Earth Load Factor*		
w =	$(2*P_{SH}/H)*\gamma_E$			
w =	415	lbs/inch per shaft (Earth - Strength Limit)		823 lbs/inch per shaft

9) Resolve surcharge to distributed rectangular load (for LPILE)

w = P_S/H

w =	614	lbs/foot per shaft (surcharge - unfactored)		614 lbs/foot per shaft
w =	51	lbs/inch per shaft (surcharge - unfactored)		51 lbs/inch per shaft
γ_S =	1.75	*Surcharge Load Factor - Strength I*		
w =	$(P_S/L)*\gamma_S$			
w =	90	lbs/inch per shaft (Surcharge - Strength I)		90 lbs/inch per shaft

Distributed Lateral Loads for LPILE

CONVENTIONAL		
Depth (ft.)	**Service (psi)**	**Strength-I (psi)**
0	51	90
10.8	328	505

Distributed Lateral Loads for LPILE

UA SLOPE		
Depth (ft.)	**Service (psi)**	**Strength-I (psi)**
0	51	90
18.1	600	912

10) Modification of p-y curves (ODOT GB-7, pg. 27)

βa = $0.64*(S/D)^{0.34}$ *(Ref: Reese, Isenhower, & Wang - 2006)*

D = 3 *Shaft Diameter or Pile Flange Width (feet)*

β_a = 0.81

LPILE Analyses
(W 24 x 162)

Steel Beam and Cross-Section Properties

Assumed Pile Shape W 24x162

Pile Availability

AISC Member Producers	3	
Non-Member Producers	1	

Shaft Geometry

Shaft Diameter	36	in.
Longest Beam Dimension	28.178006	in.
Clear Distance	3.9109972	in.

Steel Beam Geometry

Beam Depth (D)	25	in.
Web Thickness (t_w)	0.705	in.
Flange Width (B_f)	13.0	in.
Flange Thickness (t_f)	1.22	in.
Area of Steel (A_s)	47.7	in^2

Steel Properties

Yield Strength of Steel	50	ksi
Moment of Inertia (I_{xx}) of Steel	5170	in^4
Modulus of Elasticity of Steel (E)	29000	ksi
Modulus of Elasticity of Steel (E)	29000000	psi
EI (Steel Only)	1.499E+11	$lb*in^2$
Section Modulus (S_x)	414	in^3
Section Modulus (Z_x)	468	in^3
Shear-Buckling Coefficient (k)	5	
Ratio of Shear-Buckling Resistance (C)	1	
D/t_w	35.460993	
$1.12\sqrt{Ek/F_{yw}}$	60.313846	
$1.40\sqrt{Ek/F_{yw}}$	75.392307	

Determined by AASHTO LRFD Bridge Specifications Eqn's 6.10.9.3.2-4, 6.10.9.3.2-5, and 6.10.9.3.2-6

Shear Capacity Calculation

$V_u \le \phi V_{cr}$

$\phi_v =$ 1 *AASHTO LRFD Bridge Design Spec's 6.5.4.2*

$V_u =$ *shear in web due to factored permanent and construction loads applied to noncompact section (kips)*

$V_{cr} =$ *shear buckling resistance determined from Equation 6.10.9.3.3-1 (AASHTO LRFD Bridge Design Spec's)*

$V_n = V_{cr} = CV_p$

$V_p = 0.58F_{yw}Dt_w$

$V_p =$ *plastic shear force (kips)*

$C =$ *ratio of shear-buckling resistance to shear yield strength determined by AASHTO Eqn's 6.10.9.3.2-4, 6.10.9.3.2-5, 6.10.9.3.2-5, or 6.10.9.3.2-6*

$V_p =$ 0.58 * 50 * 25 * 0.705

$V_p =$ 511.1 kips

$\phi V_{cr} = \phi * C * V_p$

$\phi V_{cr} =$ 1 * 1 * 511.1

$\phi V_{cr} =$ 511.1 kips

$V_u =$ 64.293 kips *(from LPILE)*

$V_u =$ kips *(from PYWALL)*

$V_u < \phi V_{cr}$ **OK**

Flexure Capacity Calculation

$M_u \le \phi M_n$

$\phi_b =$ 1 *AASHTO LRFD Bridge Design Spec's 6.5.4.2*

$M_u =$ *Moment due to the factored loads*

$M_n =$ *Nominal flexural resistance of a section*

$S_x =$ *Elastic section modulus about the x-axis*

$\phi M_n = \phi * F_y * S_x$

$\phi M_n =$ 1 * 50 * 414

$\phi M_n =$ 20700 in*kips

$M_u =$ 9425.9 in*kips *(from LPILE)*

$M_u =$ in*kips *(from PYWALL)*

$M_u < \phi M_n$ **OK**

Deflection Criteria

Wall Height Above Rock = 55 ft. Exposed Wall Height = 6.5 ft.

Wall Height Above Rock = 660 in. Exposed Wall Height = 78 in.

1.) *Per ODOT GB-7, pile-head deflection in the service limit state limited to 1% or less of the shaft length above bedrock, or 1% of total drilled shaft length if not embedded in bedrock.*

2.) *Following industry acceptance criteria, limit wall deflection to 1% of exposed wall height where ODOT landslide criteria does not govern. Alternatively, limit wall deflection to 1.5% of the exposed wall height in accordance with NCDOT guidelines. Use 1.5% wall deflection for PYWALL software.*

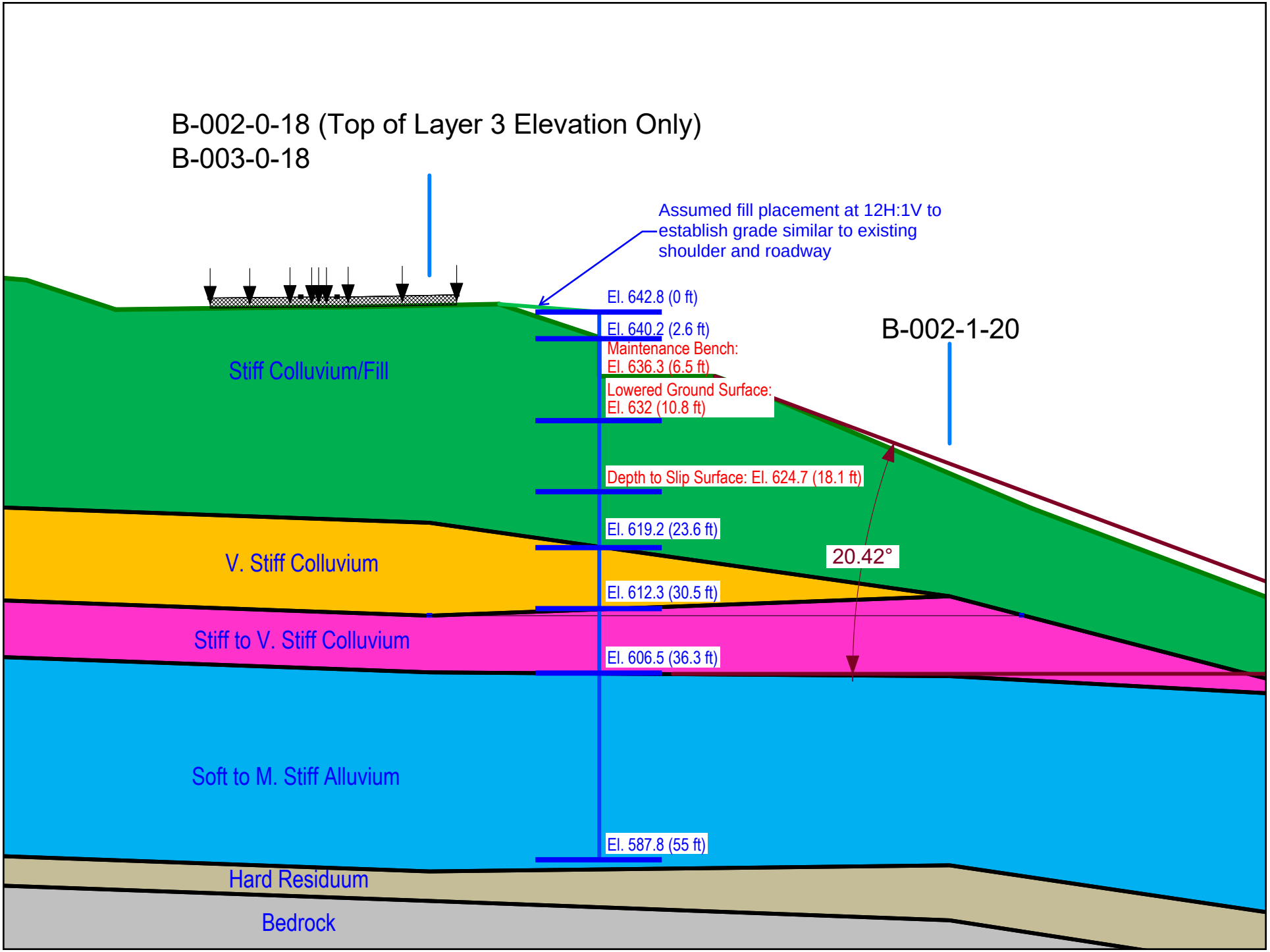
ODOT Landslide Criteria Governs YES

1% Wall Height **OR** 2 inches- LPILE 2 in. $\delta =$ 1.927 in. *(from LPILE)*

1.5% Wall Height - PYWALL in. $\delta =$ in. *(from PYWALL)*

Drilled Shafts Located Within 10 feet of Edge of Pavement YES

LPILE Design Profile


B-002-0-18 (Top of Layer 3 Elevation Only)
B-003-0-18
Assumed fill placement at 12H:1V to establish grade similar to existing shoulder and roadway
El. 642.8 (0 ft)
El. 640.2 (2.6 ft)
Maintenance Bench: El. 636.3 (6.5 ft)
Lowered Ground Surface: El. 632 (10.8 ft)
B-002-1-20
Stiff Colluvium/Fill
Depth to Slip Surface: El. 624.7 (18.1 ft)
El. 619.2 (23.6 ft)
V. Stiff Colluvium
20.42°
El. 612.3 (30.5 ft)
Stiff to V. Stiff Colluvium
El. 606.5 (36.3 ft)
Soft to M. Stiff Alluvium
El. 587.8 (55 ft)
Hard Residuum
Bedrock

Service Limit Analyses

```
================================================================================

                    LPile for Windows, Version 2019-11.002

                 Analysis of Individual Piles and Drilled Shafts
                Subjected to Lateral Loading Using the p-y Method
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================================================================================

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--------------------------------------------------------------------------------
                             Files Used for Analysis
--------------------------------------------------------------------------------

Path to file locations:
\pwworking\east01\d1836521\

Name of input data file:
20201130_MOE-7-7.55_Service Load.lp11

Name of output report file:
20201130_MOE-7-7.55_Service Load.lp11

Name of plot output file:
20201130_MOE-7-7.55_Service Load.lp11

Name of runtime message file:
20201130_MOE-7-7.55_Service Load.lp11



--------------------------------------------------------------------------------
```

Date and Time of Analysis

Date: December 2, 2020 Time: 14:23:47

Problem Title

Project Name: MOE-7-7.55

Job Number:

Client: ODOT D10

Engineer: A. Baratta

Description: Service Loading

Program Options and Settings

Computational Options:
- Conventional Analysis

Engineering Units Used for Data Input and Computations:
- US Customary System Units (pounds, feet, inches)

Analysis Control Options:

- Maximum number of iterations allowed	=	500
- Deflection tolerance for convergence	=	1.0000E-05 in
- Maximum allowable deflection	=	100.0000 in
- Number of pile increments	=	100

Loading Type and Number of Cycles of Loading:
- Static loading specified

- Analysis uses p-y modification factors for p-y curves
- Analysis uses layering correction (Method of Georgiadis)
- Analysis includes loading by one distributed lateral load acting on pile
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected

- Input of moment resistance at the pile tip not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
- Output files use decimal points to denote decimal symbols.
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (nodal spacing of output points) = 1
- No p-y curves to be computed and reported for user-specified depths
- Print using wide report formats

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 55.000 ft
Depth of ground surface below top of pile = 10.8000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	36.0000
2	55.000	36.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is an elastic pile
Cross-sectional Shape = Circular Pile
Length of section = 55.000000 ft
Width of top of section = 36.000000 in
Width of bottom of section = 36.000000 in

```
   Top Area                                          =    47.700000 sq. in
   Bottom Area                                       =    47.700000 sq. in
   Moment of Inertia at Top                          =        5170. in^4
   Moment of Inertia at Bottom                       =        5170. in^4
   Elastic Modulus                                   =    29000000. psi



--------------------------------------------------------------------------------
                       Ground Slope and Pile Batter Angles
--------------------------------------------------------------------------------

Ground Slope Angle                                   =        0.000 degrees
                                                     =        0.000 radians

Pile Batter Angle                                    =        0.000 degrees
                                                     =        0.000 radians


--------------------------------------------------------------------------------
                       Soil and Rock Layering Information
--------------------------------------------------------------------------------

The soil profile is modelled using 6 layers

Layer 1 is stiff clay without free water

   Distance from top of pile to top of layer         =    10.800000 ft
   Distance from top of pile to bottom of layer      =    23.600000 ft
   Effective unit weight at top of layer             =   130.000000 pcf
   Effective unit weight at bottom of layer          =   130.000000 pcf
   Undrained cohesion at top of layer                =  1000.000000 psf
   Undrained cohesion at bottom of layer             =  1000.000000 psf
   Epsilon-50 at top of layer                        =     0.007000
   Epsilon-50 at bottom of layer                     =     0.007000


Layer 2 is stiff clay without free water

   Distance from top of pile to top of layer         =    23.600000 ft
   Distance from top of pile to bottom of layer      =    29.900000 ft
   Effective unit weight at top of layer             =   135.000000 pcf
   Effective unit weight at bottom of layer          =   135.000000 pcf
   Undrained cohesion at top of layer                =        1800. psf
   Undrained cohesion at bottom of layer             =        1800. psf
   Epsilon-50 at top of layer                        =     0.007000
```

```
   Epsilon-50 at bottom of layer                        =     0.007000


Layer 3 is stiff clay without free water

   Distance from top of pile to top of layer            =    29.900000 ft
   Distance from top of pile to bottom of layer         =    30.500000 ft
   Effective unit weight at top of layer                =   125.000000 pcf
   Effective unit weight at bottom of layer             =   125.000000 pcf
   Undrained cohesion at top of layer                   =        1500. psf
   Undrained cohesion at bottom of layer                =        1500. psf
   Epsilon-50 at top of layer                           =     0.007000
   Epsilon-50 at bottom of layer                        =     0.007000


Layer 4 is stiff clay without free water

   Distance from top of pile to top of layer            =    30.500000 ft
   Distance from top of pile to bottom of layer         =    36.300000 ft
   Effective unit weight at top of layer                =    62.600000 pcf
   Effective unit weight at bottom of layer             =    62.600000 pcf
   Undrained cohesion at top of layer                   =        1500. psf
   Undrained cohesion at bottom of layer                =        1500. psf
   Epsilon-50 at top of layer                           =     0.007000
   Epsilon-50 at bottom of layer                        =     0.007000


Layer 5 is soft clay, p-y criteria by Matlock, 1970

   Distance from top of pile to top of layer            =    36.300000 ft
   Distance from top of pile to bottom of layer         =    56.000000 ft
   Effective unit weight at top of layer                =    62.600000 pcf
   Effective unit weight at bottom of layer             =    62.600000 pcf
   Undrained cohesion at top of layer                   =   500.000000 psf
   Undrained cohesion at bottom of layer                =   500.000000 psf
   Epsilon-50 at top of layer                           =     0.020000
   Epsilon-50 at bottom of layer                        =     0.020000


Layer 6 is stiff clay without free water

   Distance from top of pile to top of layer            =    56.000000 ft
   Distance from top of pile to bottom of layer         =    59.800000 ft
   Effective unit weight at top of layer                =    77.600000 pcf
   Effective unit weight at bottom of layer             =    77.600000 pcf
   Undrained cohesion at top of layer                   =        4000. psf
   Undrained cohesion at bottom of layer                =        4000. psf
```

```
   Epsilon-50 at top of layer                          =     0.004000
   Epsilon-50 at bottom of layer                       =     0.004000


 (Depth of the lowest soil layer extends 4.800 ft below the pile tip)
```

Summary of Input Soil Properties

Layer Num.	Soil Type Name (p-y Curve Type)	Layer Depth ft	Effective Unit Wt. pcf	Undrained Cohesion psf	E50 or krm
1	Stiff Clay	10.8000	130.0000	1000.0000	0.00700
	w/o Free Water	23.6000	130.0000	1000.0000	0.00700
2	Stiff Clay	23.6000	135.0000	1800.	0.00700
	w/o Free Water	29.9000	135.0000	1800.	0.00700
3	Stiff Clay	29.9000	125.0000	1500.	0.00700
	w/o Free Water	30.5000	125.0000	1500.	0.00700
4	Stiff Clay	30.5000	62.6000	1500.	0.00700
	w/o Free Water	36.3000	62.6000	1500.	0.00700
5	Soft	36.3000	62.6000	500.0000	0.02000
	Clay	56.0000	62.6000	500.0000	0.02000
6	Stiff Clay	56.0000	77.6000	4000.	0.00400
	w/o Free Water	59.8000	77.6000	4000.	0.00400

---

p-y Modification Factors for Group Action

Distribution of p-y modifiers with depth defined using 2 points

Point No.	Depth X ft	p-mult	y-mult
1	10.800	0.8100	1.0000
2	60.000	0.8100	1.0000

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Distributed Lateral Loading Used For All Load Cases

Distributed lateral load intensity defined using 2 points

Point No.	Depth X in	Dist. Load lb/in
1	0.000	51.000
2	217.200	600.000

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length	Run Analysis
1	1	V = 0.0000 lbs	M = 0.0000 in-lbs	0.0000000	Yes	Yes

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with
specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

---

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Moment-curvature properties were derived from elastic section properties

---

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	10.8000	0.00	N.A.	No	0.00	188372.
2	23.6000	8.6493	Yes	No	188372.	198014.
3	29.9000	16.7391	Yes	No	386385.	19807.
4	30.5000	17.3419	Yes	No	406193.	209294.
5	36.3000	50.6137	No	No	615487.	253292.
6	56.0000	45.2000	No	No	868778.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head = 0.0 lbs
Applied moment at pile head = 0.0 in-lbs
Axial thrust load on pile head = 0.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness in-lb^2	Soil Res. p lb/inch	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	1.9270	1.22E-05	-1.16E-07	-0.00721	4.26E-08	1.50E+11	0.00	0.00	55.1706
0.5500	1.8794	1202.	405.4146	-0.00721	4.1836	1.50E+11	0.00	0.00	67.6823
1.1000	1.8317	5351.	907.1695	-0.00721	18.6318	1.50E+11	0.00	0.00	84.3646
1.6500	1.7841	13176.	1519.	-0.00721	45.8748	1.50E+11	0.00	0.00	101.0470
2.2000	1.7365	25403.	2241.	-0.00721	88.4425	1.50E+11	0.00	0.00	117.7293
2.7500	1.6889	42757.	3073.	-0.00721	148.8649	1.50E+11	0.00	0.00	134.4116
3.3000	1.6414	65967.	4015.	-0.00721	229.6722	1.50E+11	0.00	0.00	151.0939
3.8500	1.5938	95758.	5067.	-0.00720	333.3943	1.50E+11	0.00	0.00	167.7762
4.4000	1.5463	132858.	6230.	-0.00720	462.5613	1.50E+11	0.00	0.00	184.4586
4.9500	1.4988	177993.	7502.	-0.00719	619.7032	1.50E+11	0.00	0.00	201.1409
5.5000	1.4513	231889.	8885.	-0.00718	807.3500	1.50E+11	0.00	0.00	217.8232
6.0500	1.4040	295274.	10378.	-0.00717	1028.	1.50E+11	0.00	0.00	234.5055
6.6000	1.3567	368873.	11980.	-0.00716	1284.	1.50E+11	0.00	0.00	251.1878
7.1500	1.3095	453415.	13693.	-0.00714	1579.	1.50E+11	0.00	0.00	267.8702
7.7000	1.2624	549625.	15516.	-0.00712	1914.	1.50E+11	0.00	0.00	284.5525
8.2500	1.2155	658230.	17449.	-0.00709	2292.	1.50E+11	0.00	0.00	301.2348
8.8000	1.1688	779957.	19493.	-0.00706	2716.	1.50E+11	0.00	0.00	317.9171
9.3500	1.1224	915532.	21646.	-0.00702	3188.	1.50E+11	0.00	0.00	334.5994
9.9000	1.0762	1065682.	23909.	-0.00698	3710.	1.50E+11	0.00	0.00	351.2818
10.4500	1.0303	1231135.	26283.	-0.00693	4286.	1.50E+11	0.00	0.00	367.9641
11.0000	0.9847	1412616.	27623.	-0.00687	4918.	1.50E+11	-346.3506	2321.	384.6464
11.5500	0.9396	1595765.	27884.	-0.00680	5556.	1.50E+11	-360.5691	2533.	401.3287
12.1000	0.8949	1780689.	28163.	-0.00673	6200.	1.50E+11	-374.2412	2760.	418.0110
12.6500	0.8508	1967520.	28464.	-0.00665	6850.	1.50E+11	-387.3469	3005.	434.6934
13.2000	0.8072	2156414.	28790.	-0.00656	7508.	1.50E+11	-399.8652	3270.	451.3757
13.7500	0.7642	2347551.	29146.	-0.00646	8173.	1.50E+11	-411.7744	3556.	468.0580
14.3000	0.7220	2541140.	29535.	-0.00635	8847.	1.50E+11	-423.0519	3867.	484.7403
14.8500	0.6804	2737416.	29962.	-0.00623	9531.	1.50E+11	-433.6740	4206.	501.4227
15.4000	0.6397	2936643.	30432.	-0.00611	10224.	1.50E+11	-443.6163	4577.	518.1050
15.9500	0.5998	3139115.	30948.	-0.00597	10929.	1.50E+11	-452.8534	4983.	534.7873
16.5000	0.5608	3345156.	31516.	-0.00583	11647.	1.50E+11	-461.3591	5429.	551.4696
17.0500	0.5228	3555123.	32140.	-0.00568	12378.	1.50E+11	-469.1063	5922.	568.1519
17.6000	0.4859	3769403.	32826.	-0.00552	13124.	1.50E+11	-476.0675	6467.	584.8343
18.1500	0.4500	3988422.	32399.	-0.00535	13886.	1.50E+11	-482.2149	7072.	244.0586
18.7000	0.4153	4197066.	30004.	-0.00517	14613.	1.50E+11	-487.5206	7748.	0.00
19.2500	0.3818	4384475.	26772.	-0.00498	15265.	1.50E+11	-491.9561	8504.	0.00
19.8000	0.3496	4550453.	23513.	-0.00478	15843.	1.50E+11	-495.4913	9355.	0.00
20.3500	0.3187	4694848.	20234.	-0.00458	16346.	1.50E+11	-498.0937	10315.	0.00
20.9000	0.2892	4817546.	16941.	-0.00437	16773.	1.50E+11	-499.7287	11406.	0.00
21.4500	0.2610	4918476.	13641.	-0.00415	17124.	1.50E+11	-500.3583	12651.	0.00
22.0000	0.2343	4997610.	10340.	-0.00394	17400.	1.50E+11	-499.9410	14082.	0.00
22.5500	0.2091	5054966.	7046.	-0.00371	17599.	1.50E+11	-498.4303	15735.	0.00
23.1000	0.1853	5090611.	3765.	-0.00349	17724.	1.50E+11	-495.7740	17660.	0.00

23.6500	0.1630	5104661.	-49.5693	-0.00327	17773.	1.50E+11	-660.0696	26730.	0.00
24.2000	0.1422	5089957.	-4388.	-0.00304	17721.	1.50E+11	-654.5341	30387.	0.00
24.7500	0.1228	5046742.	-8683.	-0.00282	17571.	1.50E+11	-647.0803	34772.	0.00
25.3000	0.1049	4975340.	-12922.	-0.00260	17322.	1.50E+11	-637.5595	40097.	0.00
25.8500	0.08851	4876167.	-17091.	-0.00238	16977.	1.50E+11	-625.7807	46662.	0.00
26.4000	0.07350	4749734.	-21174.	-0.00217	16537.	1.50E+11	-611.4900	54910.	0.00
26.9500	0.05986	4596664.	-25154.	-0.00196	16004.	1.50E+11	-594.3352	65525.	0.00
27.5000	0.04757	4417706.	-29008.	-0.00177	15381.	1.50E+11	-573.8043	79617.	0.00
28.0500	0.03655	4213752.	-32714.	-0.00158	14671.	1.50E+11	-549.1060	99151.	0.00
28.6000	0.02676	3985879.	-36239.	-0.00140	13877.	1.50E+11	-518.9159	127981.	0.00
29.1500	0.01813	3735403.	-39537.	-0.00123	13005.	1.50E+11	-480.7456	175029.	0.00
29.7000	0.01058	3463985.	-42539.	-0.00107	12060.	1.50E+11	-428.9346	267561.	0.00
30.2500	0.00404	3173883.	-44997.	-9.21E-04	11050.	1.50E+11	-315.8754	516077.	0.00
30.8000	-0.00158	2870021.	-45202.	-7.88E-04	9992.	1.50E+11	253.7236	1060406.	0.00
31.3500	-0.00636	2577211.	-43159.	-6.68E-04	8973.	1.50E+11	365.4368	378977.	0.00
31.9000	-0.01040	2300320.	-40568.	-5.61E-04	8009.	1.50E+11	419.6093	266280.	0.00
32.4500	-0.01377	2041707.	-37676.	-4.65E-04	7108.	1.50E+11	456.9542	219046.	0.00
33.0000	-0.01654	1802999.	-34565.	-3.81E-04	6277.	1.50E+11	485.5832	193728.	0.00
33.5500	-0.01879	1585443.	-31284.	-3.06E-04	5520.	1.50E+11	508.7064	178646.	0.00
34.1000	-0.02058	1390046.	-27863.	-2.41E-04	4840.	1.50E+11	527.9590	169282.	0.00
34.6500	-0.02197	1217647.	-24325.	-1.83E-04	4239.	1.50E+11	544.2971	163508.	0.00
35.2000	-0.02300	1068958.	-20686.	-1.33E-04	3722.	1.50E+11	558.3287	160194.	0.00
35.7500	-0.02373	944590.	-16961.	-8.86E-05	3289.	1.50E+11	570.4587	158693.	0.00
36.3000	-0.02417	845070.	-14264.	-4.92E-05	2942.	1.50E+11	246.9096	67414.	0.00
36.8500	-0.02437	756306.	-13091.	-1.40E-05	2633.	1.50E+11	108.5964	29405.	0.00
37.4000	-0.02436	672273.	-12374.	1.75E-05	2341.	1.50E+11	108.5705	29419.	0.00
37.9500	-0.02414	592969.	-11659.	4.53E-05	2064.	1.50E+11	108.2533	29592.	0.00
38.5000	-0.02376	518380.	-10946.	6.98E-05	1805.	1.50E+11	107.6746	29911.	0.00
39.0500	-0.02322	448482.	-10238.	9.11E-05	1561.	1.50E+11	106.8591	30369.	0.00
39.6000	-0.02256	383238.	-9536.	1.09E-04	1334.	1.50E+11	105.8276	30964.	0.00
40.1500	-0.02178	322604.	-8842.	1.25E-04	1123.	1.50E+11	104.5976	31697.	0.00
40.7000	-0.02091	266527.	-8156.	1.38E-04	927.9463	1.50E+11	103.1839	32571.	0.00
41.2500	-0.01996	214944.	-7480.	1.48E-04	748.3545	1.50E+11	101.5993	33595.	0.00
41.8000	-0.01895	167787.	-6815.	1.57E-04	584.1712	1.50E+11	99.8539	34780.	0.00
42.3500	-0.01789	124979.	-6163.	1.63E-04	435.1317	1.50E+11	97.9565	36140.	0.00
42.9000	-0.01679	86439.	-5523.	1.68E-04	300.9482	1.50E+11	95.9134	37697.	0.00
43.4500	-0.01567	52077.	-4897.	1.71E-04	181.3110	1.50E+11	93.7293	39474.	0.00
44.0000	-0.01454	21797.	-4286.	1.73E-04	75.8886	1.50E+11	91.4067	41505.	0.00
44.5500	-0.01339	-4501.	-3691.	1.73E-04	15.6710	1.50E+11	88.9457	43834.	0.00
45.1000	-0.01225	-26925.	-3113.	1.72E-04	93.7411	1.50E+11	86.3433	46516.	0.00
45.6500	-0.01112	-45587.	-2552.	1.71E-04	158.7165	1.50E+11	83.5935	49627.	0.00
46.2000	-0.01000	-60608.	-2010.	1.68E-04	211.0141	1.50E+11	80.6855	53269.	0.00
46.7500	-0.00889	-72114.	-1487.	1.65E-04	251.0750	1.50E+11	77.6024	57585.	0.00
47.3000	-0.00781	-80240.	-985.9600	1.62E-04	279.3667	1.50E+11	74.3193	62786.	0.00
47.8500	-0.00675	-85129.	-507.0706	1.59E-04	296.3872	1.50E+11	70.7987	69185.	0.00
48.4000	-0.00572	-86934.	-52.3847	1.55E-04	302.6704	1.50E+11	66.9849	77288.	0.00
48.9500	-0.00471	-85820.	375.8765	1.51E-04	298.7946	1.50E+11	62.7913	87956.	0.00

49.5000	-0.00373	-81972.	774.7418	1.47E-04	285.3960	1.50E+11	58.0770	102815.	0.00
50.0500	-0.00277	-75594.	1140.	1.44E-04	263.1895	1.50E+11	52.5917	125382.	0.00
50.6000	-0.00183	-66925.	1465.	1.41E-04	233.0069	1.50E+11	45.8186	165193.	0.00
51.1500	-9.12E-04	-56260.	1736.	1.38E-04	195.8755	1.50E+11	36.3264	262814.	0.00
51.7000	-1.03E-05	-44012.	1863.	1.36E-04	153.2349	1.50E+11	2.3039	1481174.	0.00
52.2500	8.79E-04	-31665.	1752.	1.34E-04	110.2448	1.50E+11	-35.8767	269400.	0.00
52.8000	0.00176	-20880.	1485.	1.33E-04	72.6958	1.50E+11	-45.2115	169645.	0.00
53.3500	0.00263	-12064.	1165.	1.32E-04	42.0035	1.50E+11	-51.7183	129645.	0.00
53.9000	0.00350	-5502.	806.6215	1.32E-04	19.1549	1.50E+11	-56.8846	107166.	0.00
54.4500	0.00437	-1417.	416.7956	1.32E-04	4.9333	1.50E+11	-61.2445	92452.	0.00
55.0000	0.00524	0.00	0.00	1.32E-04	0.00	1.50E+11	-65.0572	40967.	0.00

* The above values of total stress are combined axial and bending stresses.

Output Summary for Load Case No. 1:

Pile-head deflection = 1.92696074 inches
Computed slope at pile head = -0.00721314 radians
Maximum bending moment = 5104661. inch-lbs
Maximum shear force = -45202. lbs
Depth of maximum bending moment = 23.65000000 feet below pile head
Depth of maximum shear force = 30.80000000 feet below pile head
Number of iterations = 34
Number of zero deflection points = 2

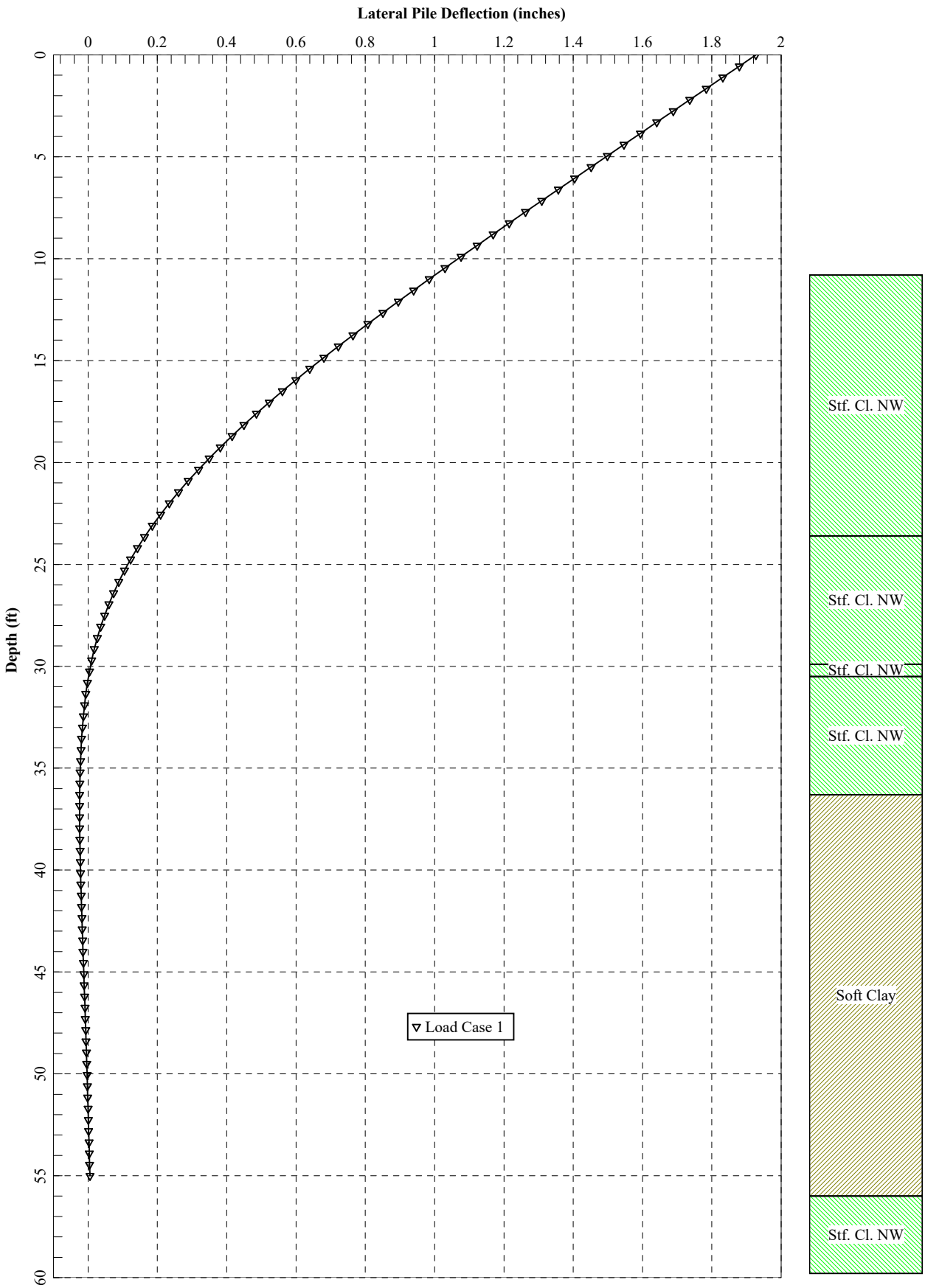
Pile-head Deflection vs. Pile Length for Load Case 1

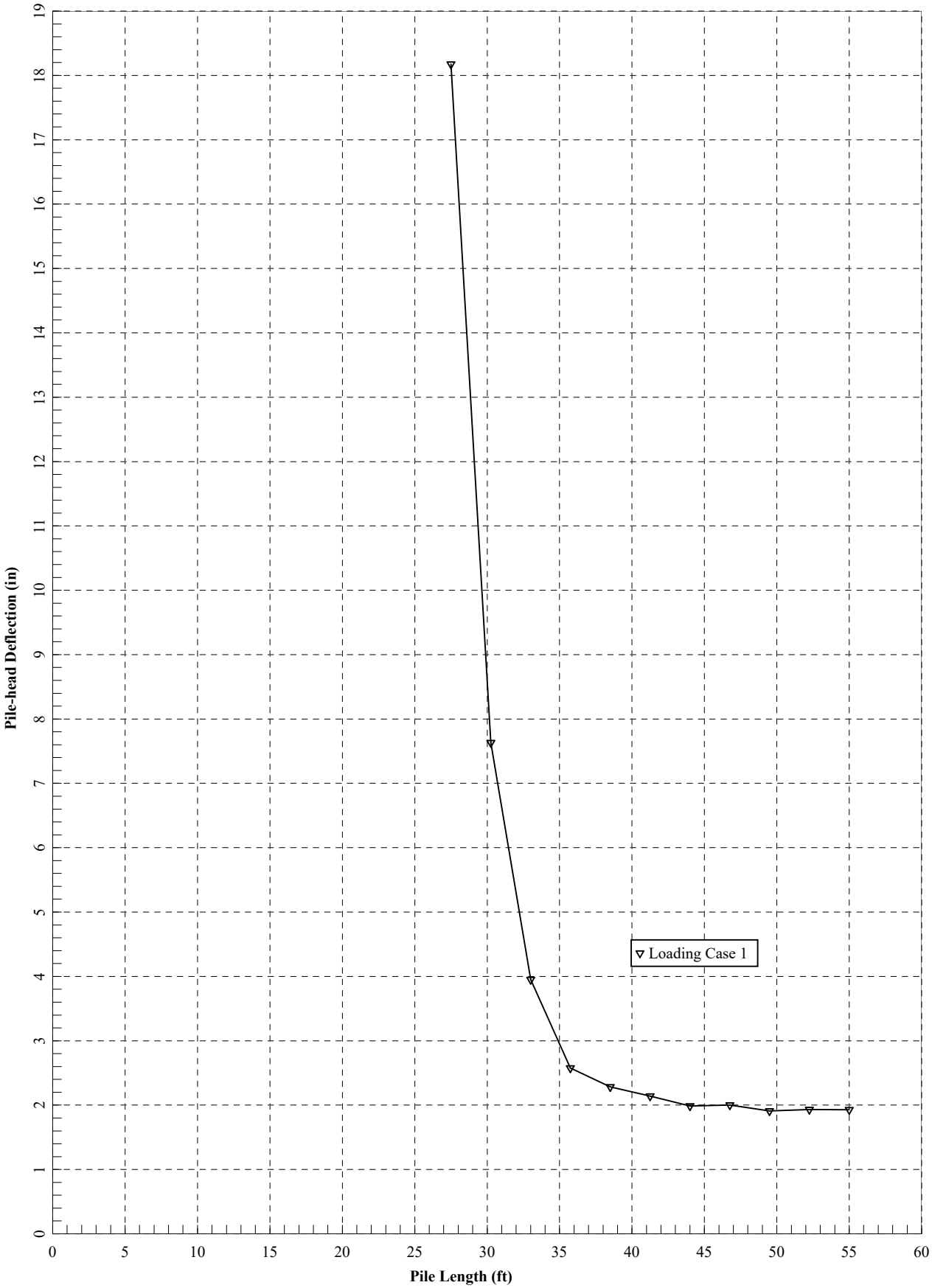
Boundary Condition Type 1, Shear and Moment

Shear = 0. lbs
Moment = 0. in-lbs
Axial Load = 0. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
55.00000	1.92696074	5104661.	-45202.
52.25000	1.93239347	5088860.	-45206.
49.50000	1.91038620	5067323.	-45127.
46.75000	2.00117229	5207955.	-46357.

```
   44.00000    1.98762577      5074828.       -47687.
   41.25000    2.14007933      5034038.       -51110.
   38.50000    2.28340319      4946965.       -53519.
   35.75000    2.57575719      4716118.       -54640.
   33.00000    3.95084559      4079463.       -54444.
   30.25000    7.63325902      3456441.       -52403.
   27.50000   18.17571288      2872124.       -49081.

--------------------------------------------------------------------------------
            Summary of Pile-head Responses for Conventional Analyses
--------------------------------------------------------------------------------

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians


Load Load                Load                  Axial    Pile-head  Pile-head  Max Shear Max Moment
Case Type   Pile-head    Type     Pile-head   Loading  Deflection  Rotation    in Pile    in Pile
 No.  1      Load 1       2        Load 2       lbs      inches     radians      lbs      in-lbs
---- ----- ---------- ---------- ---------- ---------- ---------- ---------- ---------- ----------
  1  V, lb       0.00  M, in-lb        0.00       0.00     1.9270   -0.00721    -45202.   5104661.


Maximum pile-head deflection = 1.9269607360 inches
Maximum pile-head rotation   = -0.0072131443 radians = -0.413283 deg.

The analysis ended normally.
```


Lateral Pile Deflection (inches)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
Load Case 1
Stf. Cl. NW
Stf. Cl. NW
Stf. Cl. NW
Stf. Cl. NW
Soft Clay
Stf. Cl. NW



55 feet pile length - 6.5 feet cantilever = 48.5 feet
Use minimum drilled shaft length of 48.5 feet.

Strength Limit Analyses

```
================================================================================

                     LPile for Windows, Version 2019-11.002

                 Analysis of Individual Piles and Drilled Shafts
                Subjected to Lateral Loading Using the p-y Method
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--------------------------------------------------------------------------------
                            Files Used for Analysis
--------------------------------------------------------------------------------

Path to file locations:
\pwworking\east01\d1836521\

Name of input data file:
20201130_MOE-7-7.55_Strength Load.lp11

Name of output report file:
20201130_MOE-7-7.55_Strength Load.lp11

Name of plot output file:
20201130_MOE-7-7.55_Strength Load.lp11

Name of runtime message file:
20201130_MOE-7-7.55_Strength Load.lp11
```

Date and Time of Analysis

Date: December 2, 2020 Time: 14:24:45

Problem Title

Project Name: MOE-7-7.55

Job Number:

Client: ODOT D10

Engineer: A. Baratta

Description: Strength Loading

Program Options and Settings

Computational Options:
- Conventional Analysis

Engineering Units Used for Data Input and Computations:
- US Customary System Units (pounds, feet, inches)

Analysis Control Options:

- Maximum number of iterations allowed	=	500
- Deflection tolerance for convergence	=	1.0000E-05 in
- Maximum allowable deflection	=	100.0000 in
- Number of pile increments	=	100

Loading Type and Number of Cycles of Loading:
- Static loading specified

- Analysis uses p-y modification factors for p-y curves
- Analysis uses layering correction (Method of Georgiadis)
- Analysis includes loading by one distributed lateral load acting on pile
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Input of moment resistance at the pile tip not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
- Output files use decimal points to denote decimal symbols.
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (nodal spacing of output points) = 1
- No p-y curves to be computed and reported for user-specified depths
- Print using wide report formats

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 55.000 ft
Depth of ground surface below top of pile = 10.8000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	36.0000
2	55.000	36.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is an elastic pile		
Cross-sectional Shape	=	Circular Pile
Length of section	=	55.000000 ft
Width of top of section	=	36.000000 in
Width of bottom of section	=	36.000000 in
Top Area	=	47.700000 sq. in
Bottom Area	=	47.700000 sq. in
Moment of Inertia at Top	=	5170. in^4
Moment of Inertia at Bottom	=	5170. in^4
Elastic Modulus	=	29000000. psi

Ground Slope and Pile Batter Angles

Ground Slope Angle	=	0.000 degrees
	=	0.000 radians
Pile Batter Angle	=	0.000 degrees
	=	0.000 radians

Soil and Rock Layering Information

The soil profile is modelled using 6 layers

Layer 1 is stiff clay without free water

Distance from top of pile to top of layer	=	10.800000 ft
Distance from top of pile to bottom of layer	=	23.600000 ft
Effective unit weight at top of layer	=	130.000000 pcf
Effective unit weight at bottom of layer	=	130.000000 pcf
Undrained cohesion at top of layer	=	1000.000000 psf
Undrained cohesion at bottom of layer	=	1000.000000 psf
Epsilon-50 at top of layer	=	0.007000

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   Epsilon-50 at bottom of layer                      =     0.007000


Layer 2 is stiff clay without free water

   Distance from top of pile to top of layer          =    23.600000 ft
   Distance from top of pile to bottom of layer       =    29.900000 ft
   Effective unit weight at top of layer              =   135.000000 pcf
   Effective unit weight at bottom of layer           =   135.000000 pcf
   Undrained cohesion at top of layer                 =        1800. psf
   Undrained cohesion at bottom of layer              =        1800. psf
   Epsilon-50 at top of layer                         =     0.007000
   Epsilon-50 at bottom of layer                      =     0.007000


Layer 3 is stiff clay without free water

   Distance from top of pile to top of layer          =    29.900000 ft
   Distance from top of pile to bottom of layer       =    30.500000 ft
   Effective unit weight at top of layer              =   125.000000 pcf
   Effective unit weight at bottom of layer           =   125.000000 pcf
   Undrained cohesion at top of layer                 =        1500. psf
   Undrained cohesion at bottom of layer              =        1500. psf
   Epsilon-50 at top of layer                         =     0.007000
   Epsilon-50 at bottom of layer                      =     0.007000


Layer 4 is stiff clay without free water

   Distance from top of pile to top of layer          =    30.500000 ft
   Distance from top of pile to bottom of layer       =    36.300000 ft
   Effective unit weight at top of layer              =    62.600000 pcf
   Effective unit weight at bottom of layer           =    62.600000 pcf
   Undrained cohesion at top of layer                 =        1500. psf
   Undrained cohesion at bottom of layer              =        1500. psf
   Epsilon-50 at top of layer                         =     0.007000
   Epsilon-50 at bottom of layer                      =     0.007000


Layer 5 is soft clay, p-y criteria by Matlock, 1970

   Distance from top of pile to top of layer          =    36.300000 ft
   Distance from top of pile to bottom of layer       =    56.000000 ft
   Effective unit weight at top of layer              =    62.600000 pcf
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   Effective unit weight at bottom of layer            =    62.600000 pcf
   Undrained cohesion at top of layer                  =   500.000000 psf
   Undrained cohesion at bottom of layer               =   500.000000 psf
   Epsilon-50 at top of layer                          =     0.020000
   Epsilon-50 at bottom of layer                       =     0.020000


Layer 6 is stiff clay without free water

   Distance from top of pile to top of layer           =    56.000000 ft
   Distance from top of pile to bottom of layer        =    59.800000 ft
   Effective unit weight at top of layer               =    77.600000 pcf
   Effective unit weight at bottom of layer            =    77.600000 pcf
   Undrained cohesion at top of layer                  =        4000. psf
   Undrained cohesion at bottom of layer               =        4000. psf
   Epsilon-50 at top of layer                          =     0.004000
   Epsilon-50 at bottom of layer                       =     0.004000


 (Depth of the lowest soil layer extends 4.800 ft below the pile tip)
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Summary of Input Soil Properties

Layer Num.	Soil Type Name (p-y Curve Type)	Layer Depth ft	Effective Unit Wt. pcf	Undrained Cohesion psf	E50 or krm
1	Stiff Clay w/o Free Water	10.8000 23.6000	130.0000 130.0000	1000.0000 1000.0000	0.00700 0.00700
2	Stiff Clay w/o Free Water	23.6000 29.9000	135.0000 135.0000	1800. 1800.	0.00700 0.00700
3	Stiff Clay w/o Free Water	29.9000 30.5000	125.0000 125.0000	1500. 1500.	0.00700 0.00700
4	Stiff Clay w/o Free Water	30.5000 36.3000	62.6000 62.6000	1500. 1500.	0.00700 0.00700
5	Soft Clay	36.3000 56.0000	62.6000 62.6000	500.0000 500.0000	0.02000 0.02000
6	Stiff Clay w/o Free Water	56.0000 59.8000	77.6000 77.6000	4000. 4000.	0.00400 0.00400

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p-y Modification Factors for Group Action

Distribution of p-y modifiers with depth defined using 2 points

Point No.	Depth X ft	p-mult	y-mult
1	10.800	0.8100	1.0000
2	60.000	0.8100	1.0000

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Distributed Lateral Loading Used For All Load Cases

Distributed lateral load intensity defined using 2 points

Point No.	Depth X in	Dist. Load lb/in
1	0.000	90.000
2	217.200	912.000

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length	Run Analysis
1	1	V = 0.0000 lbs	M = 0.0000 in-lbs	0.0000000	Yes	Yes

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with
specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

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Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Moment-curvature properties were derived from elastic section properties

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Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	10.8000	0.00	N.A.	No	0.00	188372.
2	23.6000	8.6493	Yes	No	188372.	198014.
3	29.9000	16.7391	Yes	No	386385.	19807.

4	30.5000	17.3419	Yes	No	406193.	209294.
5	36.3000	50.6137	No	No	615487.	253292.
6	56.0000	45.2000	No	No	868778.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals
for Layer n. Layering correction equivalent depths are computed only
for soil types with both shallow-depth and deep-depth expressions for
peak lateral load transfer. These soil types are soft and stiff clays,
non-liquefied sands, and cemented c-phi soil.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head = 0.0 lbs
Applied moment at pile head = 0.0 in-lbs
Axial thrust load on pile head = 0.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness in-lb^2	Soil Res. p lb/inch	Soil Spr. Es*h lb/inch	Distrib. Lat. Load lb/inch
0.00	4.4522	3.06E-06	-2.32E-07	-0.01528	1.06E-08	1.50E+11	0.00	0.00	96.2445
0.5500	4.3513	2096.	697.0338	-0.01528	7.2982	1.50E+11	0.00	0.00	114.9779
1.1000	4.2504	9201.	1538.	-0.01528	32.0339	1.50E+11	0.00	0.00	139.9558
1.6500	4.1496	22402.	2544.	-0.01528	77.9952	1.50E+11	0.00	0.00	164.9337
2.2000	4.0487	42788.	3715.	-0.01528	148.9703	1.50E+11	0.00	0.00	189.9116
2.7500	3.9478	71446.	5051.	-0.01528	248.7474	1.50E+11	0.00	0.00	214.8895
3.3000	3.8470	109465.	6552.	-0.01527	381.1144	1.50E+11	0.00	0.00	239.8674
3.8500	3.7462	157932.	8218.	-0.01527	549.8597	1.50E+11	0.00	0.00	264.8453
4.4000	3.6455	217936.	10048.	-0.01526	758.7713	1.50E+11	0.00	0.00	289.8232
4.9500	3.5448	290565.	12043.	-0.01525	1012.	1.50E+11	0.00	0.00	314.8011
5.5000	3.4442	376906.	14203.	-0.01523	1312.	1.50E+11	0.00	0.00	339.7790
6.0500	3.3437	478048.	16528.	-0.01522	1664.	1.50E+11	0.00	0.00	364.7569
6.6000	3.2433	595080.	19018.	-0.01519	2072.	1.50E+11	0.00	0.00	389.7348
7.1500	3.1431	729087.	21673.	-0.01516	2538.	1.50E+11	0.00	0.00	414.7127
7.7000	3.0432	881160.	24492.	-0.01513	3068.	1.50E+11	0.00	0.00	439.6906
8.2500	2.9434	1052386.	27477.	-0.01509	3664.	1.50E+11	0.00	0.00	464.6685

8.8000	2.8440	1243853.	30626.	-0.01503	4331.	1.50E+11	0.00	0.00	489.6464
9.3500	2.7450	1456648.	33940.	-0.01498	5072.	1.50E+11	0.00	0.00	514.6243
9.9000	2.6464	1691861.	37419.	-0.01491	5890.	1.50E+11	0.00	0.00	539.6022
10.4500	2.5482	1950579.	41063.	-0.01483	6791.	1.50E+11	0.00	0.00	564.5801
11.0000	2.4507	2233890.	43436.	-0.01473	7778.	1.50E+11	-435.0185	1172.	589.5580
11.5500	2.3537	2523932.	44477.	-0.01463	8787.	1.50E+11	-453.6206	1272.	614.5359
12.1000	2.2575	2820985.	45562.	-0.01451	9822.	1.50E+11	-471.6436	1379.	639.5138
12.6500	2.1622	3125349.	46695.	-0.01438	10881.	1.50E+11	-489.0679	1493.	664.4917
13.2000	2.0677	3437355.	47880.	-0.01424	11968.	1.50E+11	-505.8732	1615.	689.4696
13.7500	1.9743	3757359.	49120.	-0.01408	13082.	1.50E+11	-522.0382	1745.	714.4475
14.3000	1.8819	4085743.	50421.	-0.01391	14225.	1.50E+11	-537.5412	1885.	739.4254
14.8500	1.7907	4422922.	51787.	-0.01372	15399.	1.50E+11	-552.3594	2036.	764.4033
15.4000	1.7008	4769338.	53223.	-0.01352	16605.	1.50E+11	-566.4694	2198.	789.3812
15.9500	1.6123	5125463.	54732.	-0.01330	17845.	1.50E+11	-579.8469	2374.	814.3591
16.5000	1.5253	5491804.	56321.	-0.01306	19120.	1.50E+11	-592.4672	2564.	839.3370
17.0500	1.4399	5868899.	57994.	-0.01281	20433.	1.50E+11	-604.3047	2770.	864.3149
17.6000	1.3561	6257319.	59756.	-0.01255	21786.	1.50E+11	-615.3332	2995.	889.2928
18.1500	1.2742	6657674.	59820.	-0.01226	23180.	1.50E+11	-625.5264	3240.	371.0008
18.7000	1.1943	7046941.	56885.	-0.01196	24535.	1.50E+11	-634.8578	3508.	0.00
19.2500	1.1164	7408554.	52667.	-0.01164	25794.	1.50E+11	-643.3000	3803.	0.00
19.8000	1.0406	7742144.	48396.	-0.01131	26955.	1.50E+11	-650.8243	4128.	0.00
20.3500	0.9671	8047385.	44079.	-0.01096	28018.	1.50E+11	-657.4002	4487.	0.00
20.9000	0.8959	8323989.	39722.	-0.01060	28981.	1.50E+11	-662.9953	4884.	0.00
21.4500	0.8271	8571713.	35331.	-0.01023	29843.	1.50E+11	-667.5744	5327.	0.00
22.0000	0.7609	8790358.	30913.	-0.00985	30605.	1.50E+11	-671.0998	5821.	0.00
22.5500	0.6971	8979770.	26476.	-0.00946	31264.	1.50E+11	-673.5298	6376.	0.00
23.1000	0.6360	9139842.	22027.	-0.00906	31822.	1.50E+11	-674.8186	7002.	0.00
23.6500	0.5776	9270520.	16811.	-0.00865	32276.	1.50E+11	-905.6311	10349.	0.00
24.2000	0.5218	9361748.	10833.	-0.00824	32594.	1.50E+11	-905.9623	11459.	0.00
24.7500	0.4688	9413513.	4858.	-0.00783	32774.	1.50E+11	-904.4326	12734.	0.00
25.3000	0.4185	9425880.	-1099.	-0.00741	32817.	1.50E+11	-900.9295	14209.	0.00
25.8500	0.3709	9399003.	-7027.	-0.00700	32724.	1.50E+11	-895.3185	15931.	0.00
26.4000	0.3261	9333126.	-12910.	-0.00659	32494.	1.50E+11	-887.4343	17962.	0.00
26.9500	0.2839	9228593.	-18733.	-0.00618	32130.	1.50E+11	-877.0702	20386.	0.00
27.5000	0.2445	9085854.	-24478.	-0.00578	31634.	1.50E+11	-863.9601	23321.	0.00
28.0500	0.2077	8905481.	-30127.	-0.00538	31006.	1.50E+11	-847.7514	26938.	0.00
28.6000	0.1735	8688180.	-35657.	-0.00499	30249.	1.50E+11	-827.9607	31498.	0.00
29.1500	0.1418	8434813.	-41042.	-0.00462	29367.	1.50E+11	-803.8970	37418.	0.00
29.7000	0.1126	8146428.	-46251.	-0.00425	28363.	1.50E+11	-774.5190	45416.	0.00
30.2500	0.08568	7824305.	-51043.	-0.00390	27241.	1.50E+11	-677.5877	52194.	0.00
30.8000	0.06108	7472666.	-55369.	-0.00356	26017.	1.50E+11	-633.4198	68443.	0.00
31.3500	0.03865	7093436.	-59353.	-0.00324	24697.	1.50E+11	-573.8244	97986.	0.00
31.9000	0.01828	6689210.	-62841.	-0.00294	23289.	1.50E+11	-483.2341	174450.	0.00
32.4500	-1.43E-04	6263934.	-64293.	-0.00265	21809.	1.50E+11	43.3753	2003289.	0.00

33.0000	-0.01675	5840548.	-62542.	-0.00239	20335.	1.50E+11	487.1255	191962.	0.00
33.5500	-0.03166	5438381.	-59022.	-0.00214	18934.	1.50E+11	579.5789	120834.	0.00
34.1000	-0.04499	5061460.	-54991.	-0.00191	17622.	1.50E+11	641.9682	94186.	0.00
34.6500	-0.05684	4712503.	-50594.	-0.00169	16407.	1.50E+11	690.3537	80156.	0.00
35.2000	-0.06733	4393619.	-45906.	-0.00149	15297.	1.50E+11	730.3356	71589.	0.00
35.7500	-0.07654	4106547.	-40973.	-0.00131	14297.	1.50E+11	764.5789	65926.	0.00
36.3000	-0.08456	3852781.	-37212.	-0.00113	13414.	1.50E+11	374.8362	29255.	0.00
36.8500	-0.09146	3615342.	-35419.	-9.66E-04	12587.	1.50E+11	168.7593	12178.	0.00
37.4000	-0.09731	3385255.	-34293.	-8.12E-04	11786.	1.50E+11	172.2828	11685.	0.00
37.9500	-0.1022	3162673.	-33147.	-6.68E-04	11011.	1.50E+11	175.1078	11311.	0.00
38.5000	-0.1061	2947718.	-31984.	-5.33E-04	10263.	1.50E+11	177.3342	11029.	0.00
39.0500	-0.1092	2740487.	-30808.	-4.08E-04	9541.	1.50E+11	179.0392	10820.	0.00
39.6000	-0.1115	2541056.	-29622.	-2.92E-04	8847.	1.50E+11	180.2843	10671.	0.00
40.1500	-0.1131	2349478.	-28429.	-1.84E-04	8180.	1.50E+11	181.1192	10572.	0.00
40.7000	-0.1139	2165789.	-27232.	-8.47E-05	7540.	1.50E+11	181.5845	10518.	0.00
41.2500	-0.1142	1990011.	-26033.	6.80E-06	6928.	1.50E+11	181.7142	10503.	0.00
41.8000	-0.1138	1822147.	-24835.	9.07E-05	6344.	1.50E+11	181.5370	10524.	0.00
42.3500	-0.1130	1662192.	-23638.	1.67E-04	5787.	1.50E+11	181.0771	10577.	0.00
42.9000	-0.1116	1510124.	-22445.	2.37E-04	5258.	1.50E+11	180.3551	10662.	0.00
43.4500	-0.1099	1365912.	-21258.	3.01E-04	4756.	1.50E+11	179.3888	10778.	0.00
44.0000	-0.1077	1229515.	-20078.	3.58E-04	4281.	1.50E+11	178.1934	10923.	0.00
44.5500	-0.1051	1100880.	-18907.	4.09E-04	3833.	1.50E+11	176.7817	11098.	0.00
45.1000	-0.1023	979945.	-17745.	4.55E-04	3412.	1.50E+11	175.1647	11304.	0.00
45.6500	-0.09913	866641.	-16595.	4.95E-04	3017.	1.50E+11	173.3516	11541.	0.00
46.2000	-0.09574	760887.	-15458.	5.31E-04	2649.	1.50E+11	171.3495	11813.	0.00
46.7500	-0.09212	662598.	-14334.	5.63E-04	2307.	1.50E+11	169.1644	12120.	0.00
47.3000	-0.08831	571677.	-13225.	5.90E-04	1990.	1.50E+11	166.8002	12466.	0.00
47.8500	-0.08434	488023.	-12133.	6.13E-04	1699.	1.50E+11	164.2592	12855.	0.00
48.4000	-0.08022	411523.	-11058.	6.33E-04	1433.	1.50E+11	161.5420	13291.	0.00
48.9500	-0.07598	342060.	-10001.	6.49E-04	1191.	1.50E+11	158.6471	13780.	0.00
49.5000	-0.07165	279508.	-8964.	6.63E-04	973.1432	1.50E+11	155.5705	14331.	0.00
50.0500	-0.06723	223733.	-7948.	6.74E-04	778.9539	1.50E+11	152.3059	14952.	0.00
50.6000	-0.06275	174592.	-6954.	6.83E-04	607.8633	1.50E+11	148.8436	15656.	0.00
51.1500	-0.05821	131934.	-5984.	6.90E-04	459.3463	1.50E+11	145.1701	16458.	0.00
51.7000	-0.05364	95601.	-5039.	6.95E-04	332.8457	1.50E+11	141.2670	17381.	0.00
52.2500	-0.04904	65420.	-4120.	6.98E-04	227.7696	1.50E+11	137.1096	18451.	0.00
52.8000	-0.04443	41213.	-3230.	7.01E-04	143.4874	1.50E+11	132.6646	19708.	0.00
53.3500	-0.03980	22784.	-2370.	7.02E-04	79.3252	1.50E+11	127.8871	21209.	0.00
53.9000	-0.03516	9926.	-1543.	7.03E-04	34.5582	1.50E+11	122.7155	23035.	0.00
54.4500	-0.03052	2413.	-751.9613	7.03E-04	8.4022	1.50E+11	117.0631	25314.	0.00
55.0000	-0.02588	0.00	0.00	7.03E-04	0.00	1.50E+11	110.8039	14128.	0.00

* The above values of total stress are combined axial and bending stresses.

Output Summary for Load Case No. 1:

```
Pile-head deflection             =     4.45217254 inches
Computed slope at pile head      =    -0.01528389 radians
Maximum bending moment           =      9425880. inch-lbs
Maximum shear force              =       -64293. lbs
Depth of maximum bending moment  =    25.30000000 feet below pile head
Depth of maximum shear force     =    32.45000000 feet below pile head
Number of iterations             =             36
Number of zero deflection points =              1
```

Pile-head Deflection vs. Pile Length for Load Case 1

Boundary Condition Type 1, Shear and Moment

```
Shear      =              0. lbs
Moment     =              0. in-lbs
Axial Load =              0. lbs
```

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
55.00000	4.45217254	9425880.	-64293.
52.25000	4.53632811	9375599.	-66219.
49.50000	4.68101514	9197092.	-69545.
46.75000	5.37067990	9135682.	-75527.
44.00000	5.94497803	8683792.	-79889.
41.25000	7.27334701	8363931.	-84936.
38.50000	8.59819090	8049460.	-88074.
35.75000	10.93637353	7538406.	-88383.
33.00000	20.17336722	6442320.	-86136.

Summary of Pile-head Responses for Conventional Analyses

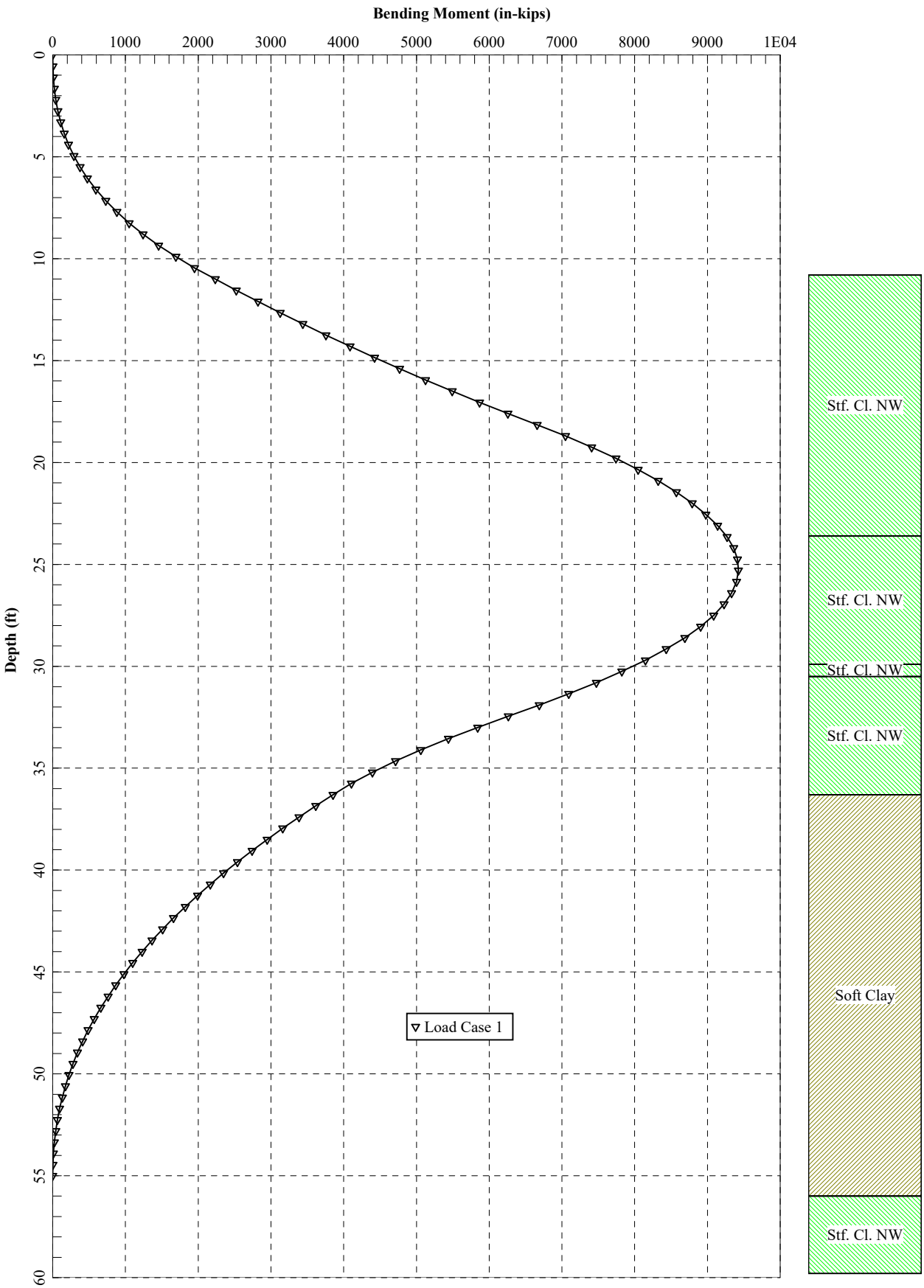
Definitions of Pile-head Loading Conditions:

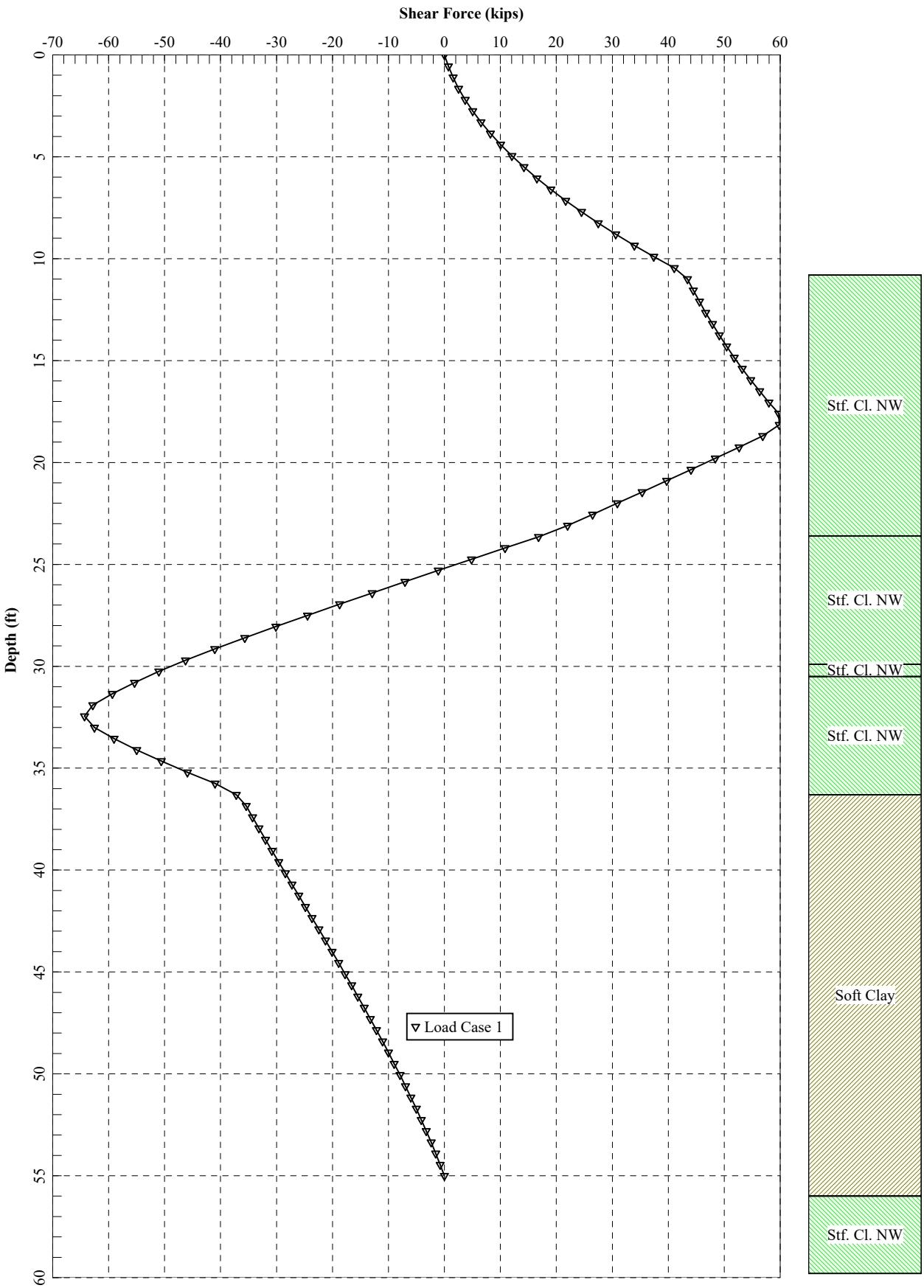
Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

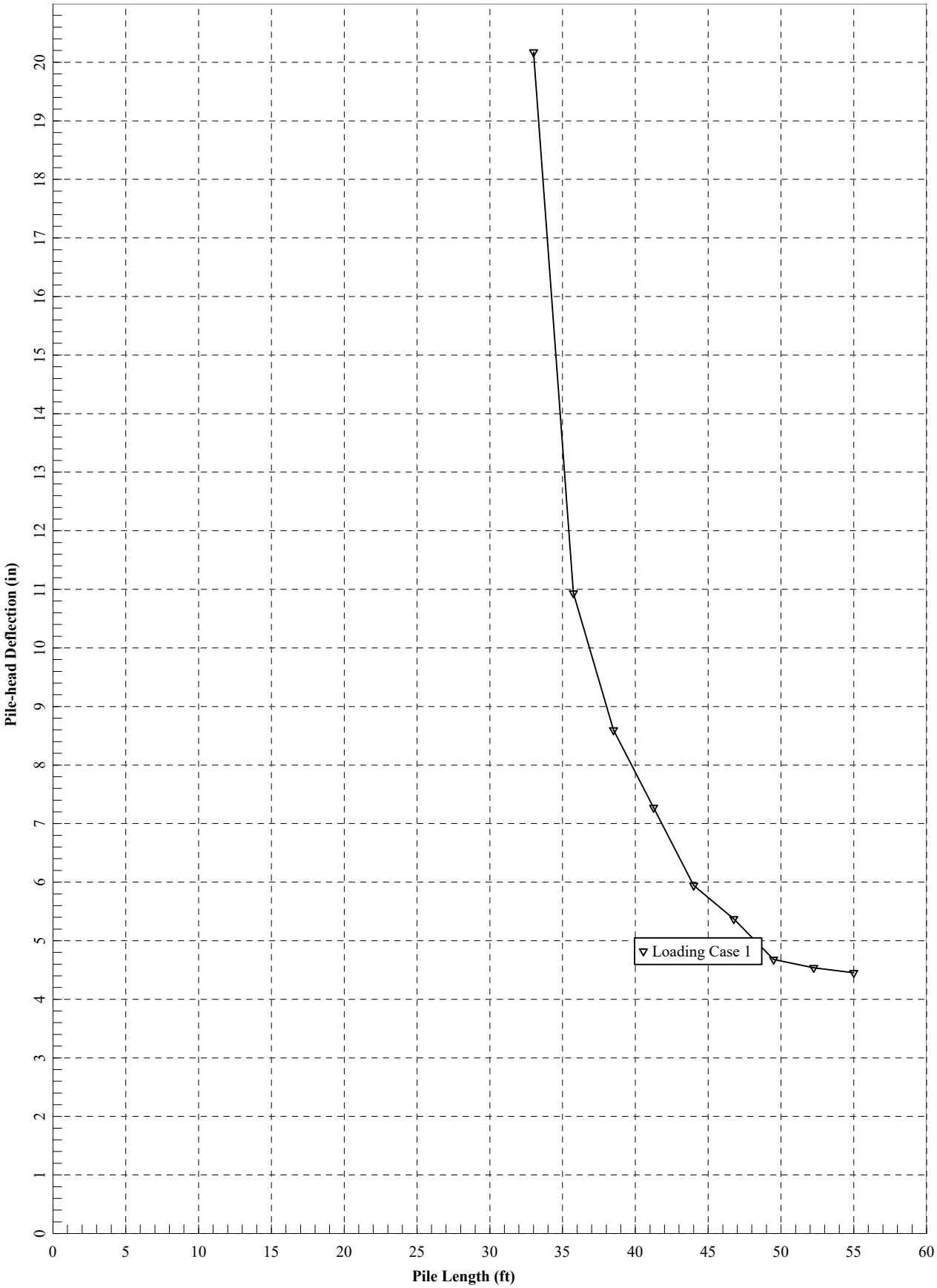
Load Case No.	Load Type 1	Pile-head Load 1	Load Type 2	Pile-head Load 2	Axial Loading lbs	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	V, lb	0.00	M, in-lb	0.00	0.00	4.4522	-0.01528	-64293.	9425880.

Maximum pile-head deflection = 4.4521725408 inches
Maximum pile-head rotation = -0.0152838937 radians = -0.875703 deg.

The analysis ended normally.

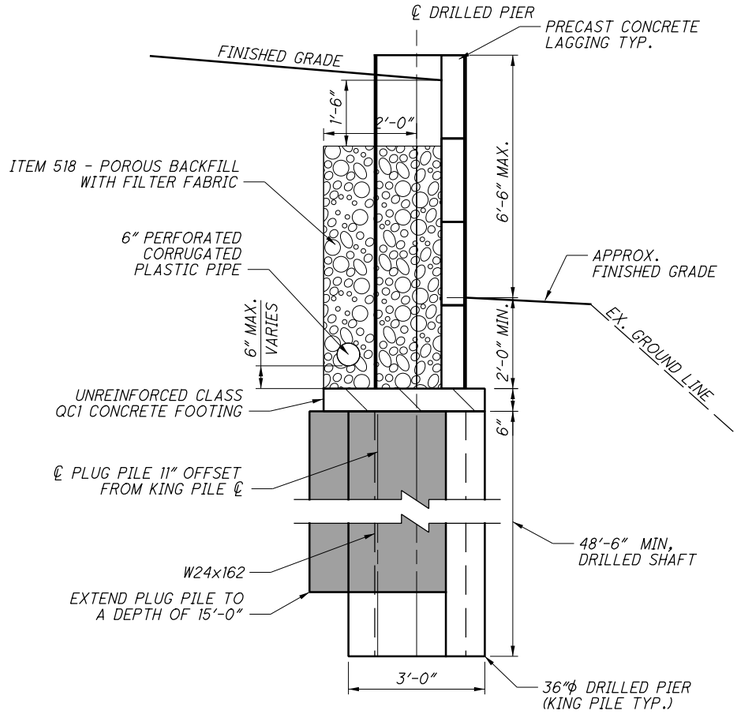

Bending Moment (in-kips)
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
1E04
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
Load Case 1
Stf. Cl. NW
Stf. Cl. NW
Stf. Cl. NW
Stf. Cl. NW
Soft Clay
Stf. Cl. NW


Shear Force (kips)
-70
-60
-50
-40
-30
-20
-10
0
10
20
30
40
50
60
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
Load Case 1
Stf. Cl. NW
Stf. Cl. NW
Stf. Cl. NW
Stf. Cl. NW
Soft Clay
Stf. Cl. NW

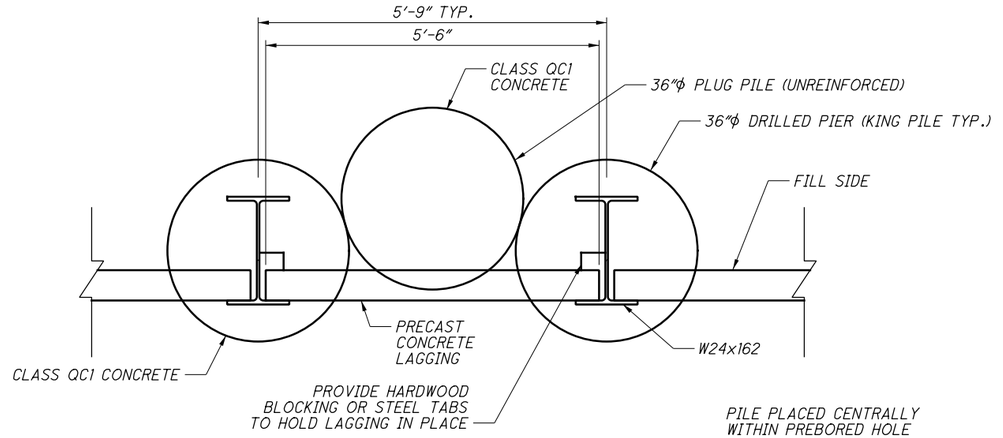


55 feet pile length - 6.5 feet cantilever = 48.5 feet
Use minimum drilled shaft length of 48.5 feet.

Soldier Pile Lagging Wall Detail

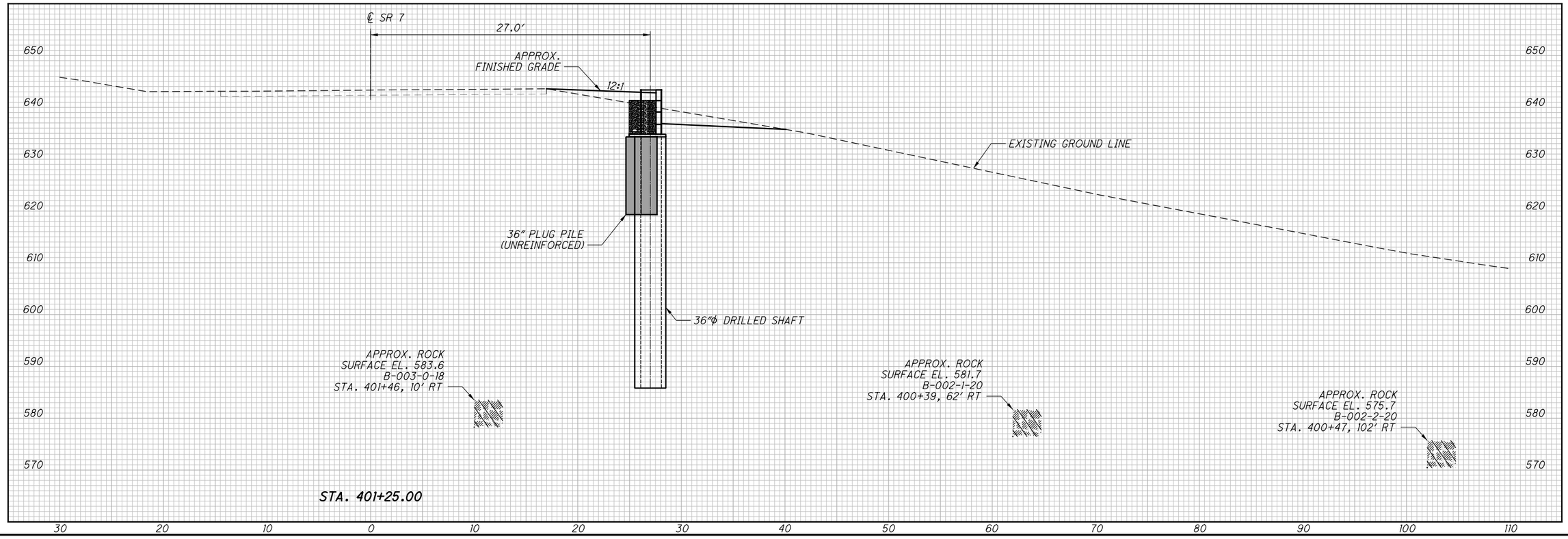


TYPICAL SECTION
NOT TO SCALE



PLAN - RETAINING WALL
NOT TO SCALE

BORING	STATION	OFFSET	APPROXIMATE SURFACE ELEVATION	APPROXIMATE ROCK SURFACE ELEVATION
B-001-0-18	398+71	13' RT	642.3	583.3
B-002-0-18	400+47	10' RT	643.2	585.2
B-002-1-20	400+39	62' RT	627.7	581.7
B-002-2-20	400+47	102' RT	610.1	575.7
B-003-0-18	401+46	10' RT	643.1	583.6
B-004-0-18	402+45	10' RT	643.2	575.7
B-004-1-20	402+36	98' RT	612.5	574.5
B-004-2-20	402+31	133' RT	603.0	572.0



STA. 401+25.00

HORIZONTAL SCALE IN FEET
0 2.5 5 10

CALCULATED CLW
CHECKED DMV

SOLDIER PILE AND LAGGING WALL DETAILS
CRITICAL SECTION STA. 401+25.00

MOE-7-7.55

1 / 1