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August 17, 2020

Mr. Ron Bonnette, P.E., P.S.
ADR & Associates, Ltd.
88 West Church Street
Newark, Ohio 43055

Reference: MOE - CR 81-1.50 Land Slip
Krebs Hill Road
Monroe County, Ohio
GCI Project No. 20-G-24290

Dear Mr. Bonnette:

As you authorized on behalf of ADR & Associates, Ltd., Geotechnical Consultants, Inc. (GCI) performed a subsurface exploration and prepared this geotechnical engineering letter report for the referenced slope stabilization along County Road 81 in Monroe County, Ohio. GCI performed a prior study for the MOE – CR 81 – 1.55 slip adjacent to the east end of the site and submitted a report on August 2, 2018. Those repairs were made in 2019 and are performing well. Boring findings from the prior study were used for this report. We present our findings and comments below.

PROJECT AND SITE DESCRIPTION

The site is located along County Road 81 (Krebs Hill Road) in Monroe County, Ohio. The subject slip is occurring along the north side of the roadway, just west of the prior slip location. We attached a DeLorme street map in the appendix and a photograph below showing the general site location, and the new to old pavement transition delineating the old and new slip locations fairly well.

View of Roadway Embankment Looking West Across the Slip Area

The site is along a curve in the road with the short radius of the curve along the north side of the road and the long radius along the south side of the road. Roadway grades along County Road 81 fall to the west with surface elevations along the centerline near elevation 1,256 feet at the east end of the slip and 1,252 feet at the west end of the slip. Grades rise south of the roadway alignment at an approximate 2H:1V slope or flatter, and fall to the north with grades between 1H:1V and 1.5H:1V near the top of the slope, and flattening out to about 3H:1V beyond the toe of the slip. There is a near vertical drop of several feet along the north edge of the road where the scarp is present in the east half of the slip.

The slip has impacted about 150 to 160 lineal feet of roadway and is occurring in an irregular pattern with the scarp present along the edge of the roadway and cracking extending into both lanes of the road. The north failing embankment has a tree and underlying brush coverage, with many of the trees leaning as a result of the recent slip. The south embankment has a grass and weed coverage with some trees.

SUBSURFACE EXPLORATION FINDINGS

We mobilized a truck-mounted rotary drill rig (CME-55 with an automatic sampling hammer) to the site on June 30, 2020 and drilled two (2) standard penetration borings (borings B-001-0-20 and B-002-0-20) within the north lane above where the failure is occurring. Boring B-001-0-20 was performed near the east end and boring B-002-0-20 was performed near the west end of the slip. The attached plan shows the approximate boring locations and we attach copies of the boring logs in the appendix, including Boring B-1 that was performed for the CR 81 – 1.55 slip project on August 15, 2018. We describe our findings below; refer to the attached boring logs for more detailed information.

Pavement and Fill Cover

The borings encountered 5 and 7 inches of asphalt over 3 and 2 inches of stone. We encountered fill materials below the pavement cover, extending to depths of 9 feet and 6 feet below grade at boring B-001-0 20 and B-002-0-20 locations, respectively. The fill was visually classified as sandy silt (ODOT A-4a soils), and contained trace asphalt in boring B-001-0-20. Standard penetration testing showed the fill to be soft and hand penetrometer estimates of unconfined compressive strength showed the fill to be medium stiff to very stiff in cohesive consistency.

Natural Soils

Boring B-002-0-20 encountered brown silt and clay (ODOT A-6a soils) below the fill cover, and extending to 9 feet below grade. Standard penetration testing showed the silt and clay to be medium stiff and hand penetrometer estimates of unconfined compressive strength showed the silt and clay to be very stiff in cohesive consistency.

Bedrock

Borings B-001-0-20 and B-002-0-20 encountered sandstone rock below the fill and natural soils at a depth of 9 feet below grade. The sandstone was fine grained and highly weathered, and standard penetration testing resulted in blow-counts of 13 blows per foot in boring B-001-0-20 and 41 to 71 blows per foot in boring B-002-0-20. The sandstone was underlain by shale at depths of 11 and 16 feet below grade, respectively. The shale was highly to moderately weathered and standard penetration testing commonly resulted in 50 blows of the hammer for 5 inches or less of penetration (less penetration with depth). The upper shale in boring B-001-0-20 was more weathered and blow-counts of

19 and 23 blows per foot were obtained. The shale was underlain by intact gray sandstone at boring depths of 42.5 and 41 feet below grade. Our drillers were able to auger 1 to 1.5 feet into the sandstone before encountering auger refusal. Borings B-001-0-20 and B-002-0-20 were terminated in intact sandstone at the refusal depths.

The borings did not encounter groundwater seepage during the drilling process and the drilled boreholes were dry.

LABORATORY TESTING

GCI is in the process of performing a limited laboratory testing program consisting of natural moisture contents and index testing on the soil overburden within the roadway embankment. Results from the testing will be forwarded when completed.

CONCLUSIONS, ANALYSIS AND RECOMMENDATIONS

The borings found soft to very stiff fill materials and natural silt and clay soils over highly weathered sandstone and weathered shale. The borings did not find a definitive slip plane, although based on the site observations and experience with similar local landslips (including the adjacent recently repaired slip at mile marker 1.55), we suspect the slip is occurring atop the rock surface. We feel the slippage conditions were exacerbated as a result of recent wet weather conditions and possibly upslope drainage impediment saturating the embankment soils. The wall will be constructed 16 feet off the centerline of the roadway and about 8 to 12 feet beyond where the borings were performed. Assuming the rock surface has a similar grade to the ground surface, we modeled the top of rock to have an approximate 1H:1V to 1.5H:1V dip to the north. As such, we anticipate that the top of rock could be a little over 17 feet below grade at the wall location.

For the purpose of analysis, we assume the movement is occurring at the anticipated soil/rock interface about 17 feet below the roadway grade. To repair the embankment failure, a soldier pile and lagging retaining wall will be constructed 16 feet north of centerline. For our analysis in design of the retaining wall, we attributed the principal active lateral driving forces on the wall to be associated with the fill and natural soil above the intact rock encountered at a depth of 17 feet, with passive resistance obtained within the underlying sandstone and shale rock. We also accounted for a potential live load surcharge of 250 psf in our analysis.

Given the site constraints, a conventional soldier pile and lagging system with drained backfill behind the lagging is not readily feasible. Rather, lagging will be placed in the upper approximate 2 to 4 feet of the retaining wall and plug piles will be constructed below the lagging to the top of rock. The lagging will have positive drainage backfill and the underlying plug piles will be slightly larger than the space between the soldier pile caissons and placed sufficiently behind the soldier pile caissons to allow a tangent interlocking. Plans show the soldier pile caissons will be 3 feet in diameter and the plug piles will be 42 inches in diameter.

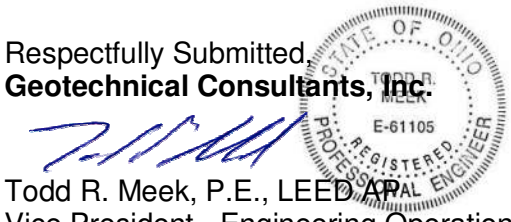
Our analysis included assessing the appropriate soldier pile H- section for the design with the piles spaced at a maximum of 6 feet on center. We present the recommended soldier pile retaining wall design below.

- Use HP 14x89 H-piles for the wall. H-pile steel should have minimum yield strength of 50 ksi.
- Place H-piles in minimum 3-foot diameter Type C concrete filled drilled shafts. H-piles should extend to the bottom of the drilled shaft. Our analysis determined that the minimum drilled shaft length would be 38 feet long and extend a minimum of 10 feet into the competent rock (i.e., 100+ blows per foot material).
- Piles should be spaced a maximum of 6 feet on center, and the wall should extend at least 10 feet laterally beyond the slippage cracks in the pavement.
- Place concrete lagging in the upper 2 to 6 feet of the wall, or to the top of rock, whichever is encountered first. Concrete lagging should be at least 8 inches thick of 3,000 psi minimum strength concrete. Based on our experience with similar projects, the panels should include at least 2 horizontal No. 5 reinforcing bars 3 inches from the top and bottom and 2 vertical No. 5 bars 6 inches inward from the ends.
- Place plug piles behind and between the soldier pile caissons such to create a tangent interlock between the soldier pile and plug pile caissons. The plug piles should be at least 42 inches in diameter to achieve the interlock based on a maximum 6-foot on center soldier pile spacing. Caisson concrete (soldier pile and plug pile) should be placed up to the bottom of the wall panels.
- Place a minimum 18-inch wide drainage medium behind the wall panels consisting of free-draining aggregate wrapped in filter fabric (conforming to ODOT Item 518 – *Drainage of Structures*). The free draining aggregate should be compacted to at least 98% of the Standard Proctor maximum dry density.
- Place a 6-inch perforated corrugated plastic pipe in the bottom of the drainage backfill, and ensure pipe is positively drained.
- Panel backfill below the drainage medium should consist of ODOT 613 – *Low Strength Mortar Backfill*.
- Remaining embankment backfill behind wall and beyond the drainage medium should be placed in accordance with ODOT Item 203 – *Roadway Excavation and Embankment*. **GCI should review proposed fill materials prior to use**. Soft/loose existing embankment materials should be removed to expose firm and stable conditions prior to backfill placement.
- Ensure that the drainage ditch along the south side of the road has proper drainage.

It should be noted that the nature and extent of variations between borings and the proposed retaining wall location might not become evident until construction. If variations then appear evident, including assumed depth to bedrock, it will be necessary to re-evaluate the recommendations of this report.

If you have any questions or need for any additional information, please contact our office. It has been a pleasure to be of service to you on this project, and we hope to continue our services through construction.

Respectfully Submitted,
Geotechnical Consultants, Inc.



Todd R. Meek, P.E., LEED AP
Vice President - Engineering Operations

Attachments: ODOT Quick Reference for Visual Description of Soils
ODOT Classification of Soils
Site Location Map
Boring Location Plan
Test Boring Logs (B-001-0-20, B-002-0-20, and B-1)

Distr: Mr. Ron Bonnette, P.E., P.S. @ ADR & Associates, Ltd. – pdf via email

APPENDIX A.1 - ODOT Quick Reference for Visual Description of Soils

1) STRENGTH OF SOIL:

Non-Cohesive (granular) Soils - Compactness	
Description	**Blows Per Ft.**
Very Loose	≤ 4
Loose	5 – 10
Medium Dense	11 – 30
Dense	31 – 50
Very Dense	> 50

2) COLOR :

If a color is a uniform color throughout, the term is single, modified by an adjective such as light or dark. If the predominate color is shaded by a secondary color, the secondary color procedes the primary color. If two major and distinct colors are swirled throughout the soil, the colors are modified by the term "mottled"

3) PRIMARY COMPONENT

Use **DESCRIPTION** from ODOT Soil Classification Chart on Back

Cohesive (fine grained) Soils - Consistency

Description	Qu (TSF)	Blows Per Ft.	Hand Manipulation
Very Soft	<0.25	<2	Easily penetrates 2" by fist
Soft	0.25-0.5	2 - 4	Easily penetrates 2" by thumb
Medium Stiff	0.5-1.0	5 - 8	Penetrates by thumb with moderate effort
Stiff	1.0-2.0	9 - 15	Readily indents by thumb, but not penetrate
Very Stiff	2.0-4.0	16 - 30	Readily indents by thumbnail
Hard	>4.0	>30	Indent with difficulty by thumbnail

4) COMPONENT MODIFIERS:

Description	Percentage By Weight
Trace	0% - 10%
Little	10% - 20%
Some	20% - 35%
"And"	35% -50%

5) Soil Organic Content

Description	% by Weight
Slightly Organic	2% - 4%
Moderately Organic	4% - 10%
Highly Organic	> 10%

6) Relative Visual Moisture

Description	Criteria	
	Cohesive Soil	**Non-cohesive Soils**
Dry	Powdery; Cannot be rolled; Water content well below the plastic limit	No moisture present
Damp	Leaves very little moisture when pressed between fingers; Crumbles at or before rolled to $^1/_8$"; Water content below plastic limit	Internal moisture, but no to little surface moisture
Moist	Leaves small amounts of moisture when pressed between fingers; Rolled to $^1/_8$" or smaller before crumbling; Water content above plastic limit to -3% of the liquid limit	Free water on surface, moist (shiny) appearance
Wet	Very mushy; Rolled multiple times to $^1/_8$" or smaller before crumbles; Near or above the liquid limit	Voids filled with free water, can be poured from split spoon.

CLASSIFICATION OF SOILS

Ohio Department of Transportation

(The classification of a soil is found by proceeding from top to bottom of the chart. The first classification that the test data fits is the correct classification.)

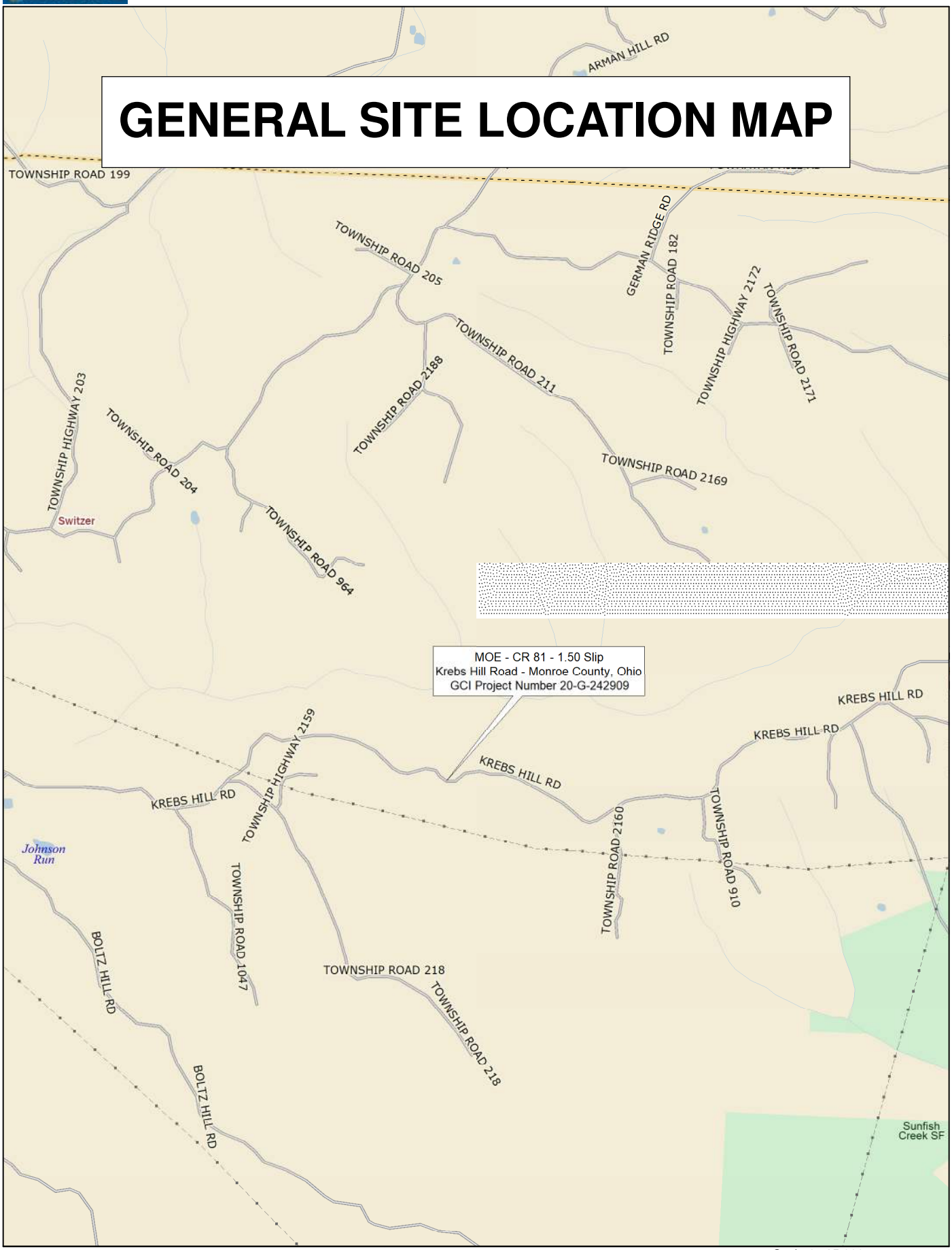
SYMBOL	DESCRIPTION	Classifcation AASHTO	Classifcation OHIO	$LL_0/LL \times 100$*	% Pass #40	% Pass #200	Liquid Limit (LL)	Plastic Index (PI)	Group Index Max.	REMARKS
	Gravel and/or Stone Fragments	A-1-a			40 Max.	15 Max.		6 Max.	0	Min. of 50% combined gravel, cobble and boulder sizes
	Gravel and/or Stone Fragments with Sand	A-1-b			50 Max.	25 Max.		6 Max.	0	
F S	Fine Sand	A-3			51 Min.	10 Max.	NON-PLASTIC		0	
	Coarse and Fine Sand	--	A-4a			35 Max.		6 Max.	0	Min. of 50% combined coarse and fine sand sizes
	Gravel and/or Stone Fragments with Sand and Silt	A-2-4				35 Max.	40 Max.	10 Max.	0	
		A-2-5					41 Min.			
	Gravel and/or Stone Fragments with Sand, Silt and Clay	A-2-6				35 Max.	40 Max.	11 Min.	4	
		A-2-7					41 Min.			
	Sandy Silt	A-4	A-4a	76 Min.		36 Min.	40 Max.	10 Max.	8	Less than 50% silt sizes
	Silt	A-4	A-4a	76 Min.		50 Min.	40 Max.	10 Max.	8	50% or more silt sizes
	Elastic Silt and Clay	A-5		76 Min.		36 Min.	41 Min.	10 Max.	12	
	Silt and Clay	A-6	A-6a	76 Min.		36 Min.	40 Max.	11 - 15	10	
	Silty Clay	A-6	A-6a	76 Min.		36 Min.	40 Max.	16 Min.	16	
	Elastic Clay	A-7-5		76 Min.		36 Min.	41 Min.	≤LL-30	20	
	Clay	A-7-6		76 Min.		36 Min.	41 Min.	>LL-30	20	
	Organic Silt	A-8	A-8b	75 Max.		36 Min.				W/o organics would classify as A-4a or A-4b
	Organic Clay	A-8	A-8b	75 Max.		36 Min.				W/o organics would classify as A-5, A-6a, A-6b, A-7-5 or A-7-6

MATERIAL CLASSIFIED BY VISUAL INSPECTION

- Sod and Topsoil
- Pavement or Base
- Uncontrolled Fill (Describe)
- Bouldery Zone
- Peat, S-Sedimentary W-Woody F-Fibrous L-Loamy & etc

* Only perform the oven-dried liquid limit test and this calculation if organic material is present in the sample.

GENERAL SITE LOCATION MAP



TN
MN (8.8°W)

Scale 1 : 25,000

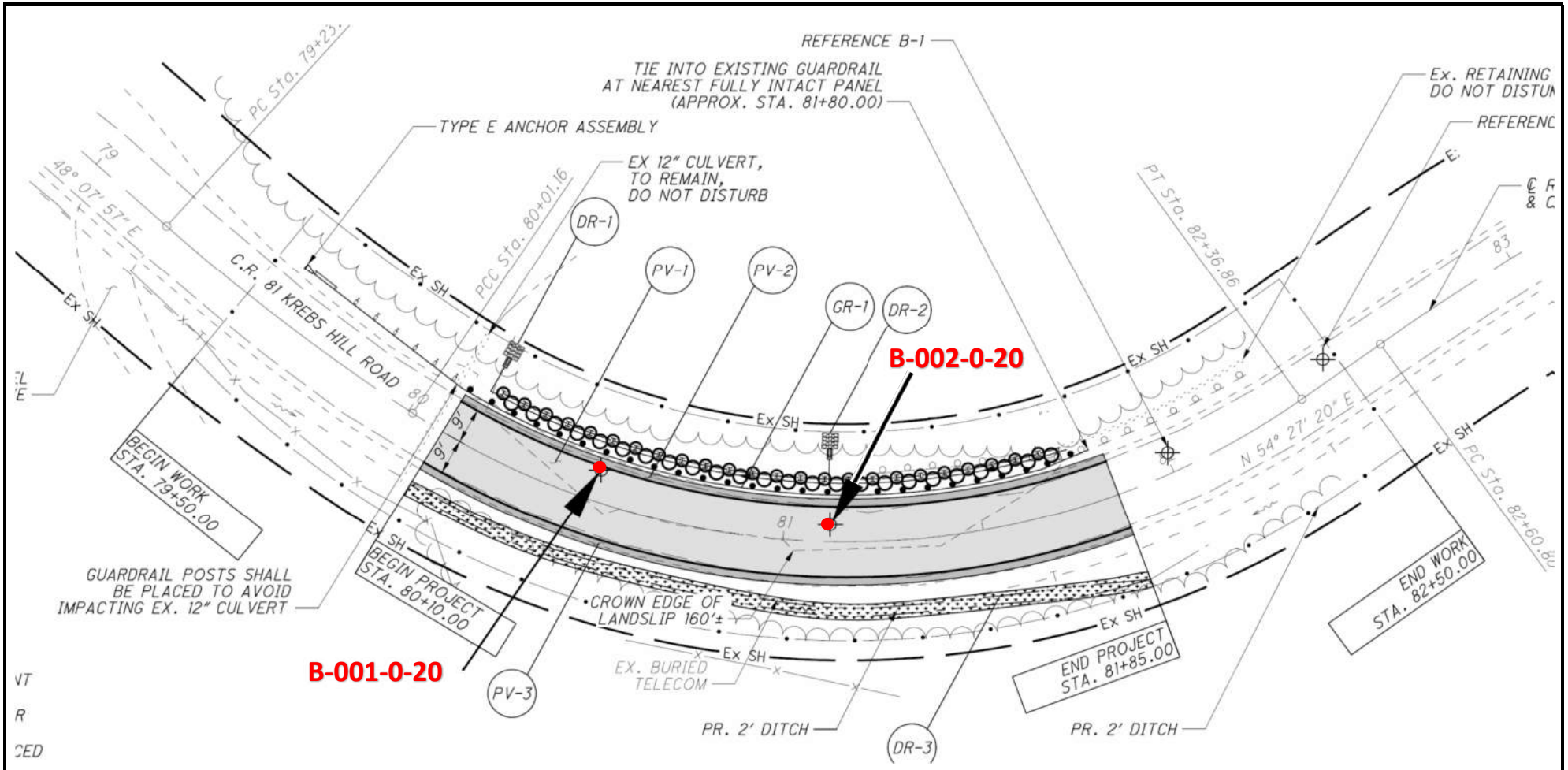
0 600 1200 1800 2400 3000 ft
0 200 400 600 800 1000 m

1" = 2,083.3 ft

Data Zoom 13-0

● Boring Location

BORING LOCATION PLAN - Aerial	
MOE-CR81-1.50 Slip Repair	
Switzerland Township, Monroe County, Ohio	
Aerial obtaind from Google Earth, dated October 2013	
GCI Project No.: 20-G-24290	
Date: 08/10/2020 Drawn By: Jeffrey Holko	
Scale: Not to Scale	



● Boring Location

BORING LOCATION PLAN - Plan
MOE-CR81-1.50 Slip Repair
Switzerland Township, Monroe County, Ohio
Plan obtained from Stage 2 Plans, dated August 6, 2020
GCI Project No.: 20-G-24290
Date: 08/10/2020 Drawn By: Jeffrey Holko
Scale: Not to Scale

PROJECT: MOE-CR 81-01.50	DRILLING FIRM / OPERATOR: GCI / R. PLUMMER	DRILL RIG: CME 45 (87034)-RIG 4	STATION / OFFSET: 80+50	EXPLORATION ID B-001-0-20
TYPE: LANDSLIDE	SAMPLING FIRM / LOGGER: GCI / R. PLUMMER	HAMMER: CME AUTOMATIC	ALIGNMENT:	
PID: 113658 BR ID:	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 1/9/19	ELEVATION: 1252.0 EOB: 43.5 ft.	PAGE 1 OF 2
START: 6/30/20 END: 6/30/20	SAMPLING METHOD: SPT	ENERGY RATIO (%): 79.4	LAT / LONG: Not Recorded	

MATERIAL DESCRIPTION AND NOTES	ELEV. 1252.0	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	INST.
Asphalt (5") over Aggregate Base (3')	1251.3																	
STIFF, BROWN AND GRAY, **SANDY SILT**, SOME SAND, LITTLE GRAVEL, TRACE ASPHALT, FILL, MOIST			3 3 4	9	-	SS-1	3.5	-	-	-	-	-	-	-	-	-	A-4a (V)	
SOFT			1 1 1	3	-	SS-2	1.0	-	-	-	-	-	-	-	-	-	A-4a (V)	
	1243.0	TR	3 6 7	17	-	SS-3		-	-	-	-	-	-	-	-	-	A-6a (V)	
SANDSTONE, BROWN, SEVERELY WEATHERED, FINE GRAINED.	1241.0							-	-	-	-	-	-	-	-	-	Rock (V)	
SHALE, BROWN, SEVERELY TO HIGHLY WEATHERED, ARENACEOUS.			3 8 11	25	-	SS-4		-	-	-	-	-	-	-	-	-	Rock (V)	
			10 17 26	57	-	SS-5		-	-	-	-	-	-	-	-	-	Rock (V)	
GRAY, MODERATELY WEATHERED.			50/4"	-	-	SS-6		-	-	-	-	-	-	-	-	-	Rock (V)	
clay seams		W	50/3"	-	-	SS-7		-	-	-	-	-	-	-	-	-	Rock (V)	

PID: 113658	BR ID:	PROJECT: MOE-CR 81-1.5	STATION / OFFSET: 80+50	START: 6/30/20	END: 6/30/20	PG 2 OF 2	B-001-0-20

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)	INST.
GRAY, MODERATELY WEATHERED. *(continued)*	1222.0	31																
		32																
		33																
MAROON AND GRAY, FRIABLE, ARENACEOUS.		34	50/3"	-	-	SS-8		-	-	-	-	-	-	-	-	-	Rock (V)	
		35																
		36																
		37																
		38																
		39	11 50/3"	-	-	SS-9		-	-	-	-	-	-	-	-	-	Rock (V)	
		40																
		41																
		42																
	1209.5	43																
SANDSTONE, GRAY.	1208.5	EOB																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS AND ASPHALT PATCH

GCI Job No: 20-G-24290

PROJECT: MOE-CR 81-01.50	DRILLING FIRM / OPERATOR: GCI / R. PLUMMER	DRILL RIG: CME 45 (87034)-RIG 4	STATION / OFFSET: 81+15	EXPLORATION ID B-002-0-20
TYPE: LANDSLIDE	SAMPLING FIRM / LOGGER: GCI / R. PLUMMER	HAMMER: CME AUTOMATIC	ALIGNMENT:	
PID: 113658 BR ID:	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 1/9/19	ELEVATION: 1253.0 EOB: 42.5 ft.	PAGE 1 OF 2
START: 6/30/20 END: 6/30/20	SAMPLING METHOD: SPT	ENERGY RATIO (%): 79.4	LAT / LONG: Not Recorded	

MATERIAL DESCRIPTION AND NOTES	ELEV. 1253.0	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	INST.
Asphalt (7") over Aggregate Base (2")	1252.2																	
MEDIUM STIFF, REDDISH BROWN, **SANDY SILT**, SOME SAND, LITTLE GRAVEL, FILL, DAMP			2 2 2	5	-	SS-1	2.75	-	-	-	-	-	-	-	-	-	A-4a (V)	
	1247.0		1 1 2	4	-	SS-2	2.25	-	-	-	-	-	-	-	-	-	A-4a (V)	
MEDIUM STIFF, BROWN, **SILT AND CLAY**, LITTLE SAND, TRACE GRAVEL, DAMP	1244.0	TR	3 15 26	54	-	SS-3	3.5	-	-	-	-	-	-	-	-	-	A-6a (V)	
SANDSTONE, BROWN, HIGHLY WEATHERED, FINE GRAINED.	1237.0							-	-	-	-	-	-	-	-	-	Rock (V)	
			17 31 40	94	-	SS-4		-	-	-	-	-	-	-	-	-	Rock (V)	
SHALE, LIGHT BROWN, GRAY, HIGHLY TO MODERATELY WEATHERED, ARENACEOUS.			25 50/5"	-	-	SS-5		-	-	-	-	-	-	-	-	-	Rock (V)	
REDDISH BROWN, LIGHT BROWN, GRAY, MODERATELY WEATHERED.			50/3"	-	-	SS-6		-	-	-	-	-	-	-	-	-	Rock (V)	
GRAY.			50/2"	-	-	SS-7		-	-	-	-	-	-	-	-	-	Rock (V)	

PID: 113658	BR ID:	PROJECT: MOE-CR 81-1.5	STATION / OFFSET: 81+15	START: 6/30/20	END: 6/30/20	PG 2 OF 2	B-002-0-20

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)	INST.
GRAY. *(continued)*	1223.0	31 32 33																
INTERBEDDED SANDSTONE.		34 35 36 37 38	50/2"	-	-	SS-8		-	-	-	-	-	-	-	-	-	Rock (V)	
		39 40 41	50/1"	-	-	SS-9		-	-	-	-	-	-	-	-	-	Rock (V)	
	1212.0																	
SANDSTONE, GRAY.	1210.5	42 EOB																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS AND ASPHALT PATCH

GCI Job No: 20-G-24290

PROJECT: CR81-1.55 SLIP REPAIR	DRILLING FIRM / OPERATOR: GCI / JAMES PODVIN	DRILL RIG: CME 45 (RIG 2)	STATION / OFFSET:	EXPLORATION ID B-1
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: GCI / JAMES PODVIN	HAMMER: CME AUTOMATIC	ALIGNMENT:	
PID: BR ID:	DRILLING METHOD: 3.5" SSA	CALIBRATION DATE: 8/15/08	ELEVATION: (MSL) EOB: 11.0 ft.	PAGE 1 OF 1
START: 5/9/18 END: 5/9/18	SAMPLING METHOD: SPT	ENERGY RATIO (%): 66.9	LAT / LONG: Not Recorded	

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)	INST.
Asphalt (8")																		
Stone (4")																		
MEDIUM STIFF TO STIFF, BROWN, **CLAY**, LITTLE F-C SAND, TRACE GRAVEL, DAMP high plasticity, contains shale fragments, gray mottling		1	2 3	-	-	SS-S-1	4.50	-	-	-	-	-	-	-	-	-	A-7-6 (V)	
		2																
		3	3 3 4 5	8	-	SS-S-2	2.25	6	11	7	27	49	55	22	33	21	A-7-6 (19)	
		4																
STIFF, GRAY, **CLAY**, TRACE F-C SAND, DAMP high plasticity		5	3 4 5 6	10	-	SS-S-3	1.00	1	4	6	30	59	54	23	31	23	A-7-6 (19)	
	TR	6	50/3"	-	-	SS-S-4	-	-	-	-	-	-	-	-	-	-		
CLAYSTONE, REDDISH BROWN AND LIGHT BROWN, HIGHLY WEATHERED, WEAK, THICK BEDDED, CLAYEY.		7																
		8	50/1"	-	-	SS-S-5	-	-	-	-	-	-	-	-	-	-		
		9																
		10																
Auger Refusal at 11'	EOB	11																

NOTES: AUGER REFUSAL AT 10'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS

GCI Job No: 18-G-21809

GEOTECHNICAL CONSULTANTS INC.

JOB _____

SHEET NO. 1 OF _____

CALCULATED BY _____ DATE _____

CHECKED BY _____ DATE _____

SCALE _____

- WALL 16' OFF ℄
- B-1 7.9' " " (8.2' TO WALL)
- B-2 4.5' " " (12.5' TO WALL)
- EMBANKMENT GRADE ≈ 1H:1V @ B-1 & 1.5H:1V @ B-2
  - ASSUME TOP OF ROCK MIRRORS GROUND SURFACE

BORING	TOP OF HIGHLY WEATHERED ROCK (BORING / WALL)	TOP 50 bpf ROCK (BORING / WALL)
B-1	9' / 17.2'	20' / 28.2'
B-2	9' / 17.3'	14 / 22.3

ACTIVE PRESSURE (0' - 17.2')

- SOFT COHESIVE SOILS

USE $\gamma = 125$ pcf

$\phi = 24°$

$K_a = 0.37$ NAVFAC MANUAL FIG. 6 PG 7.2-67

$\Theta_{@17.2'} = 17.2(125)(0.37) = 796$ PSF

LIVE LOAD ⇒ 250 PSF

$250(0.37) = 92.5$ PSF

PASSIVE PRESSURE

- HIGHLY WEATHERED ROCK

HP = 4.5+ tsf

USE $C \simeq 6{,}000$ psf

$\Theta_p = 2C = 12{,}000$ psf $\quad \Theta'_p = \frac{0.9(12{,}000)}{1.5} = 7{,}200$ psf

- 50+ bpf ROCK ⇒ USE SAME AS ADJACENT 7.55 STUDY

USE $C = 10{,}000$ psf

$\Theta_p = 2C = 20{,}000$ psf $\quad \Theta'_p = \frac{0.9(20{,}000)}{1.5}$

$= 12{,}000$ psf

GEOTECHNICAL CONSULTANTS INC.

JOB _____

SHEET NO. 2 OF _____

CALCULATED BY _____ DATE _____

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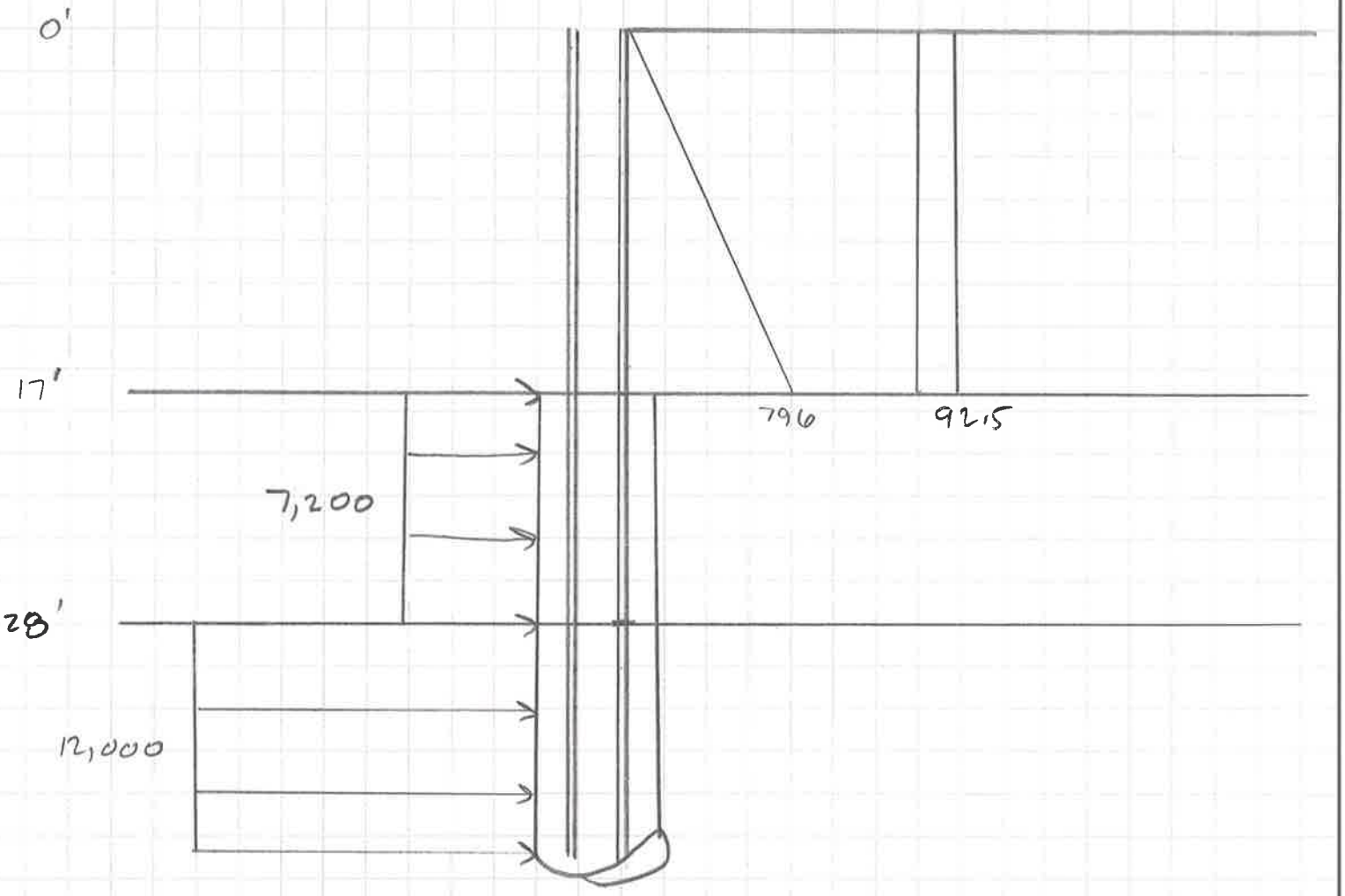
SCALE _____



DESIGN IS H-PILES IN 3' ϕ CAISSONS @ 6' O.C.

$\Sigma F_x = 0$ = DEPTH TO MAX. MOMENT

$7{,}200(3)(D) = \frac{1}{2}(796)(17)(6) + 92.5(17)(6)$

$21{,}600D = 40{,}596 + 9{,}435$

$D = 2.32'$

$\Sigma M_{@3.47}$ = MAX. MOMENT

$7{,}200(3)(2.32)\left(\frac{2.32}{2}\right) - \frac{1}{2}(796)(17)(6)\left(\frac{17}{3}+2.32\right) - 92.5(17)(6)\left(\frac{17}{2}+2.32\right)$

$58{,}130 - 324{,}227 - 102{,}087$

$= 368{,}184$ lb·ft $\left(\frac{1\,K}{1000\,lb}\right)\left(\frac{12\,IN}{FT}\right)$

$= 4{,}418$ K·IN

$S_x = \frac{4{,}418}{0.67(50)} = 131.9\ IN^3$

HP 14×89 = 131 IN^3

O.K.

GEOTECHNICAL CONSULTANTS INC.

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EMBEDMENT DEPTH

$$7{,}200(3)(D)\left(\frac{D}{2}\right) = \frac{1}{2}(796)(17)(6)\left(\frac{17}{3}+D\right) + 92.5(17)(6)\left(\frac{17}{2}+D\right)$$

$$10{,}800\,D^2 = 230{,}044 + 40{,}596D + 9{,}435D + 80{,}198$$

$$10{,}800\,D^2 - 50{,}031D - 310{,}242$$

$$D^2 - 4.63D - 28.7$$

$$D = \frac{4.63 \pm \sqrt{(-4.63)^2 - (4)(1)(-28.7)}}{2(1)}$$

$$= 8.2'$$

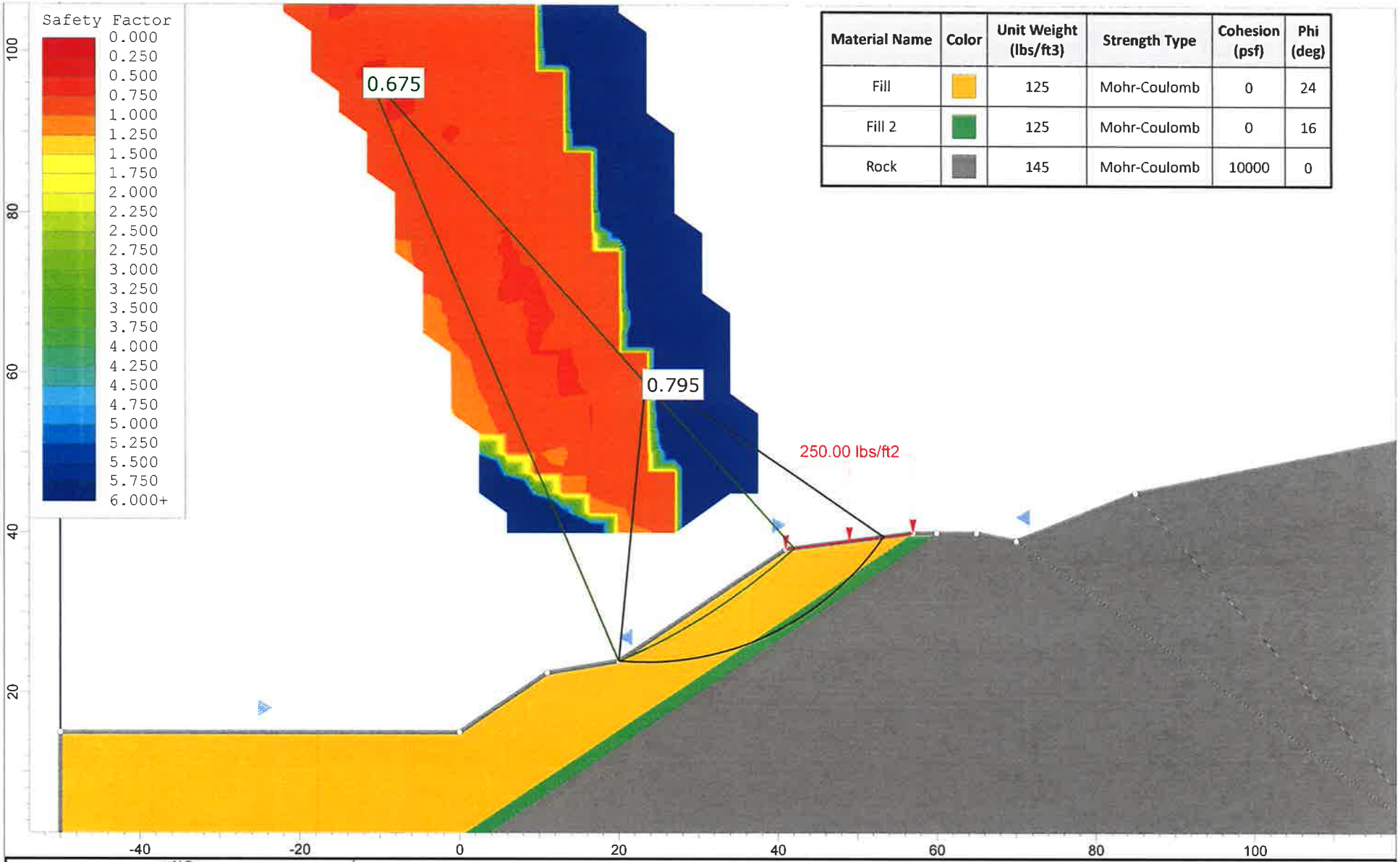
$D' = 1.2D = 9.84' \sim 10'$ $17.2 + 10' = 27.2'$

- JUST ABOVE 50+ bpf ROCK

CALC'S SHOW PASSIVE STRENGTH GAINED IN UPPER, HIGHLY WEATHERED ROCK, BUT ROCK IS ALMOST WEATHERED TO A SOIL-LIKE CONSISTENCY. IN ACCORDANCE WITH ODOT EXPECTATIONS, AND SIMILAR TO THE ADJACENT 7.55 WALL, EXTEND CAISSONS INTO THE MORE COMPETENT ROCK (E.G. 50+ bpf ROCK). THIS WAS ESTIMATED TO BE @ ±28' @ B-1

USE 38' LONG PILES, DOES NOT INCLUDE STICK-UP

HP 14x89 PILES @ 6' O.C. IN 3' ϕ CAISSONS LAGGING / PLUG PILES TO TOP OF HIGHLY WEATHERED ROCK



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Fill		125	Mohr-Coulomb	0	24
Fill 2		125	Mohr-Coulomb	0	16
Rock		145	Mohr-Coulomb	10000	0

CELEBRATING 40 YEARS EST. 1979
GEOTECHNICAL CONSULTANTS INC.
SLIDEINTERPRET 7.038

Project	CR 81-1.50		
Analysis Description			
Drawn By	Ryan D. Folsom, PE	Scale 1:200	Company
Date	8/10/2020, 4:02:12 PM		File Name CR 81-1.50.slim