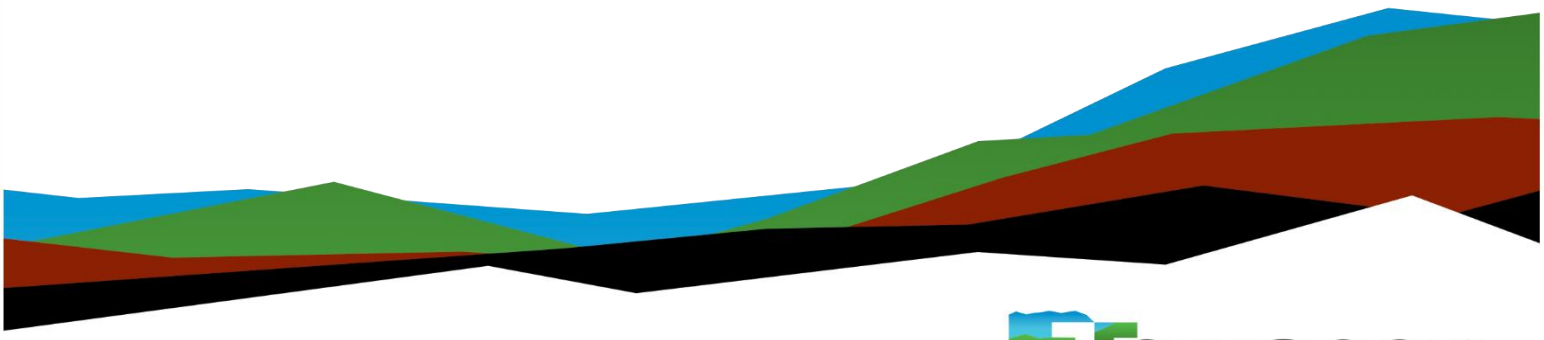
MOT-Vandalia Bikeway Connector MSE Walls (PID 111388)

Report of Geotechnical Explorations & Findings

November 10, 2023 | Terracon Project No. N1225269

Prepared for:

LJB, Inc.
2500 Newmark Drive
Miamisburg, Ohio 45342



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November 10, 2023

LJB, Inc.
2500 Newmark Drive
Miamisburg, Ohio 45342

Attn: Mr. Daniel Springer, PE, PMP-Project Manager
P: 937-259-5131
E: DSpringer@ljbinc.com

Re: Report of Geotechnical Explorations & Findings
MOT-Vandalia Bikeway Connector MSE Walls (PID 111388)
US-40
Vandalia, Ohio
Terracon Project No. N1225269

Dear Mr. Springer:

We have completed the scope of services for the above-referenced project in general accordance with Terracon Proposal No. PN1225269 dated August 31, 2022. This report presents the findings of the subsurface exploration and provides the results of analyses performed for the planned Mechanically Stabilized Earth Walls (MSEW).

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,

Terracon

Munal Pandey, E.I.
Senior Staff Engineer

David W. Westendorf, P.E.
11/10/2023
Principal/Group Manager

Table of Contents

Attachments

Refer to each Attachment for a listing of contents.

Introduction

This report presents the results of our subsurface exploration and findings performed for the proposed Mechanically Stabilized Earth Walls (MSEW) for the bikeway project to be located on the north side of US-40 in Vandalia, Ohio. The bikeway is part of Taylorsville Metropark Improvements. The purpose of these services was to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Short-term groundwater conditions
- Seismic site classification per IBC
- MSEW Wall Analyses including global and external stability

The geotechnical engineering Scope of Services for this project included the advancement of four (4) test borings, laboratory testing, engineering analysis, and preparation of this report. Borings were advanced to depths ranging between 35 to 40 feet below the existing ground surface.

Drawings showing the site and boring locations are shown on the **Site Location** and **Exploration Plan**, respectively. The results of the laboratory testing performed on select soil samples obtained from the site during our field exploration are included on the boring logs and as separate graphs in the **Exploration Results** section.

Project Description

Our Scope of Services is based on our understanding of the project as described by LJB and ODOT Specifications for Geotechnical Explorations (SGE). The project includes the construction of two Mechanically Stabilized Earth (MSE) retaining walls on the north side of US-40 for the proposed bikeway connector to the existing Great Miami River Bike Trail in Taylorsville Metro Park, Vandalia, Ohio. Terracon reviewed the MSE Wall Drawing Set (Sheets 119 to 123, dated 7/29/2022 and prepared by LJB) for the information on proposed wall dimensions and planned grading.

MSE Wall No. 1 is approximately 250 feet long and is located on the west side of the existing railway tracks extending between Sta. 100 + 27.70 to Sta. 102+ 77.70. Grading work involves fill placement ranging between 4’ 9” to 8’ 3” along the proposed wall alignment.

MSE Wall No. 2 is approximately 265 feet long and is located on the east side of the existing railway tracks extending between Sta. 200+ 18.11 to Sta. 202+ 83.11. Grading

work involves fill placement ranging between 3’ 5” to 24’ 1” along the proposed wall alignment.

A pedestrian/bikeway bridge will be constructed spanning over the existing railway tracks. Structure foundation analyses and recommendations for the proposed bridge is beyond our current scope of study and were previously performed by others.

Site Reconnaissance and Exploration

Field reconnaissance was performed by Terracon personnel on December 29, 2022. The surrounding land usage consists of Taylorsville Metropark improvements (bike trails, landscape areas, parking lot, etc.) and US-40, including a roadway bridge spanning over the railroad tracks. The embankment slope is grass-covered with dense trees closer to the railway tracks along the alignment of MSE Wall #1 and sparse trees along the alignment of MSE Wall #2.

Four (4) test borings were performed by Terracon on 1/16/2023 and 1/17/2023. Two borings (for MSE Wall #1 on the west side of the railway track) were drilled on the northern lane of the US-40 Highway to characterize the existing embankment soils and underlying natural soils. Two borings (for MSE Wall #2 on the east side of the railway track) were drilled in the greenspace areas of Taylorsville Metropark along the approximate wall alignment.

The test borings were drilled using a Diedrich D-50 (Terracon Drill Rig #932) track-mounted drill rig. The test borings were drilled to depths of 35 to 40 feet below the existing ground surface. All four test borings terminated in native granular soils of glacial outwash origin. The drill rig utilized continuous-flight hollow-stem augers and split-spoon sampling. Drilling and sampling procedures were performed in general accordance with the ODOT Specifications for Geotechnical Exploration (SGE). The average drill rod energy ratio (ER) for the drill rig was determined to be 85 percent (calibration date 9/2/2022). Groundwater levels were observed during and at the completion of the drilling activities at each test boring location. No long-term (24-hour) water level readings were obtained at the test boring locations. Upon completion of the drilling activities and following water level observations, the boreholes were backfilled with a mixture of bentonite chips and soil cuttings. The pavement borings (B-001-0-23 and B-002-0-23) were patched with cold-mix asphalt at the surface.

Findings

MSE Wall #1 (Sta. 100+27.70 to Sta. 102+77.70)**:**

Test borings (B-001-0-23 and B-002-0-23) were performed upslope of the MSE Wall #1 alignment and encountered approximately 16.5 to 17.5 inches of asphaltic concrete at the

surface. Under the surficial layer, the test borings encountered existing fill to a depth of approximately 11 feet below the pavement surface at Borings B-001-0-23 and B-002-0-23. The existing fill is associated with the embankment construction of US-40. The existing fill consisted of cohesive soils in the form of silt and clay (A-6a), silty clay (A-6b), and granular soils in the form of sandy silt (A-4a). The consistency of the cohesive fill ranged between stiff to very stiff and the relative density of the granular fill ranged between medium dense to dense.

The native overburden soils encountered in the borings consisted of coarse and fine sand (A-3a), sandy silt (A-4a), silt (A-4b), fine sand (A-3), silt and clay (A-6a), and silty clay (A-6b), and clay (A-7-6). The cohesive overburden soils ranged in consistency from stiff to hard and the cohesionless soils ranged in relative density from medium dense to very dense.

Groundwater was encountered in Boring B-001-0-23 at 22 feet below the existing grade (corresponding elevation 826.9 feet MSL) during drilling, and at 16 feet below the existing grade (corresponding elevation 832.9 feet MSL) immediately after drilling. Groundwater was not observed in Boring B-002-0-23 during and immediately after drilling.

MSE Wall #2 (Sta. 200+18.11 to Sta. 202+83.11)**:**

Test borings (B-003-0-23 and B-004-0-23) were performed along the approximate MSE Wall #2 alignment and encountered approximately 2 to 3 inches of topsoil. Underlying the topsoil, the test borings encountered native overburden soils consisting of gravel and stone (A-1-b), coarse and fine sand (A-3-a), A-4-a (sandy silt), silt and clay (A-6a), and silty clay (A-6b).

The cohesive overburden soils ranged in consistency from medium stiff to stiff and the cohesionless soils ranged in relative density primarily from medium dense to very dense with occasional very loose to loose layers.

Groundwater was encountered in Boring B-003-0-23 at 19 feet below the ground surface (corresponding elevation 792.2 feet MSL) during drilling. The groundwater depth in Boring B-004-023 was 21 feet below the ground surface (corresponding elevation 794.8 feet MSL) during drilling.

Analyses and Recommendations

The MSE wall footprint area needs to be prepared in the leveling pad, soil reinforcement, and select granular backfill areas. Due to the existing site topography and planned grading, the MSE wall will be constructed in a cut section. This means that the excavation behind the wall needs to be supported temporarily to construct the wall. The Contractor is responsible for supporting the wall excavation.

The proposed MSE walls can be supported by the on-site soils. The foundation soils of the MSE walls are the soil beneath the MSE wall units and the entire geogrid reinforced zone. We recommend that the near-surface topsoil, soft soil, existing fill, or soils containing organics be completely removed prior to the MSE wall and leveling pad construction. The prepared subgrade for the MSE wall reinforced zone should extend a minimum of 3 feet beyond the outer edges of the MSE wall and across the entire reinforced zone. Following excavation to the base of the undercut, the exposed surface should be inspected and densified using a vibratory smooth drum compactor. The existing fill materials will likely become disturbed during construction activities; therefore, a minimum 12-inch undercut backfilled with compacted granular material Type C should be placed across the reinforced zone subgrade. This layer of compacted Type C granular material will help provide a stable working surface during the initial wall construction.

Terracon performed embankment settlement analyses to check the settlement caused by the proposed construction on foundation soils. Terracon also performed MSEW analyses for external stability and global stability following the design guideline of AASHTO 2017-2020 using MSEW+ software program developed by ADAMA Engineering.

Embankment Settlement

Construction of both walls will require the placement of new fill on the existing embankment slopes. The proposed exposed height of MSE Wall #1 ranges from approximately 4’ 9” to 8’ 3”, and the exposed height of MSE Wall #2 ranges from approximately 3’ 5” to 24’ 1”.

Settlement analyses have been performed considering the existing soil conditions and the planned construction. The MSE wall foundation soil parameters used were based on the soil index properties from the completed laboratory test program and published correlation of soil index properties. Settlement analyses were performed at each wall for the planned construction. Settlement of the foundation soils yielded an anticipated maximum total settlement of 0.5 inches for Wall #1 and 1.7 inches for Wall #2. Differential settlement along the wall is anticipated to be within 1/100. Both the total and differential settlement is within tolerable limits.

Please refer to the **Supporting Information** section for the settlement analysis calculation/results.

MSEW Analysis

Per typical ODOT practice, the MSE wall construction will involve the use of granular backfill soil (reinforced zone) and thin metallic strips to form a gravity mass capable of supporting or restraining large, imposed loads. The backfill material should consist of compacted select granular fill in the reinforced zone, behind the MSE panel facing. The

MSE wall should be designed to satisfy internal and external stability. For external stability, a vertical reinforced soil structure must satisfy the same external design criteria as a conventional retaining wall. Terracon has performed geotechnical analyses for external stability, which include sliding as a rigid body at or below the base, overturning (eccentricity), bearing capacity failure, and rotation slip-surface failure (global stability). The design of the MSE wall structure for internal stability is typically performed by the contractor/manufacturer. Terracon did not perform internal stability analyses for this project.

FHWA criteria indicate that reinforcement lengths in mechanically stabilized earth walls should have a minimum length of 70 percent of the total wall height or a minimum value of 8 feet, whichever is greater. The vertical MSE retaining structures must be designed to resist lateral earth pressures and surcharge pressures transferred from the traffic surcharge (a minimum of 250 psf for traffic loading or 150 psf for trail loading should be applied).

The design of this type of system requires that the interface friction should resist the soil pressure from the backfill layer between reinforcements, that the reinforcement length is adequate to support the interface friction and provide a stable mass, and that the reinforcement is strong enough to resist the tensile forces that develop. The length of reinforcements must be extended beyond the zone of Rankine failure. We recommend select granular backfill be placed behind and within the vertical reinforced soil structure in accordance with ODOT specification SS-840.

The external and global stability of the MSE walls were evaluated with the MSEW+ software. The capacity demand ratios (CDR) were calculated for the bearing capacity and the sliding resistance of the MSE walls using LRFD methods outlined by AASHTO. The CDR value is defined as the factored resistance divided by the factored loads; thus a CDR value greater than 1.0 indicates the factored resistance is greater than the factored loads. The calculated CDR values for sliding and bearing failure were greater than 1.0. Bearing and sliding resistance factors of 0.65 and 1.0, respectively, were used in the calculations. The calculated eccentricity was within the middle one-quarter of the reinforcement length which is considered acceptable. The factor of safety values against global stability failures was considered acceptable.

A summary is listed below. The results of the MSEW analyses are attached in the **Supporting Information** section of the report.

Case	Strap Length /Wall Height (%)[1]	Sliding	Bearing Failure	Eccentricity	Long-term Global Stability
Minimum Required Value	70%	CDR≥1.0	CDR≥1.0	e/L≤0.25	FS≥1.3
MSE Wall #1 Results	70%	1.69	1.21	0.13	2.5
MSE Wall #2 Results	70%	2.24	2.21	0.09	1.6

1. Height includes MSE Wall Height- up to 9’ for MSE Wall #1 and up to 24 ft for MSE Wall #2.
2. Live Load L = 150 psf for pedestrian/bikeway traffic was considered.

Based on the MSE wall analyses, the recommended minimum MSE wall reinforcement strap length for global and external stability corresponds to the minimum AASHTO Reinforcement length of 70% of the total MSE wall height.

General Comments

Our analysis and opinions are based on our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials, or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in

accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly affect excavation cost. Any parties charged with estimating excavation costs should seek their site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety and cost estimating including excavation support and dewatering requirements/design are the responsibility of others. Construction and site development has the potential to affect adjacent properties. Such impacts can include damages due to vibration, modification of groundwater/surface water flow during construction, foundation movement due to undermining or subsidence from excavation, as well as noise or air quality concerns. Evaluation of these items on nearby properties is commonly associated with the contractor's means and methods and is not addressed in this report. The owner and contractor should consider a preconstruction/precondition survey of the surrounding development. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

Figures

Contents:

Attachments

Site Location and Exploration Plans

Contents:

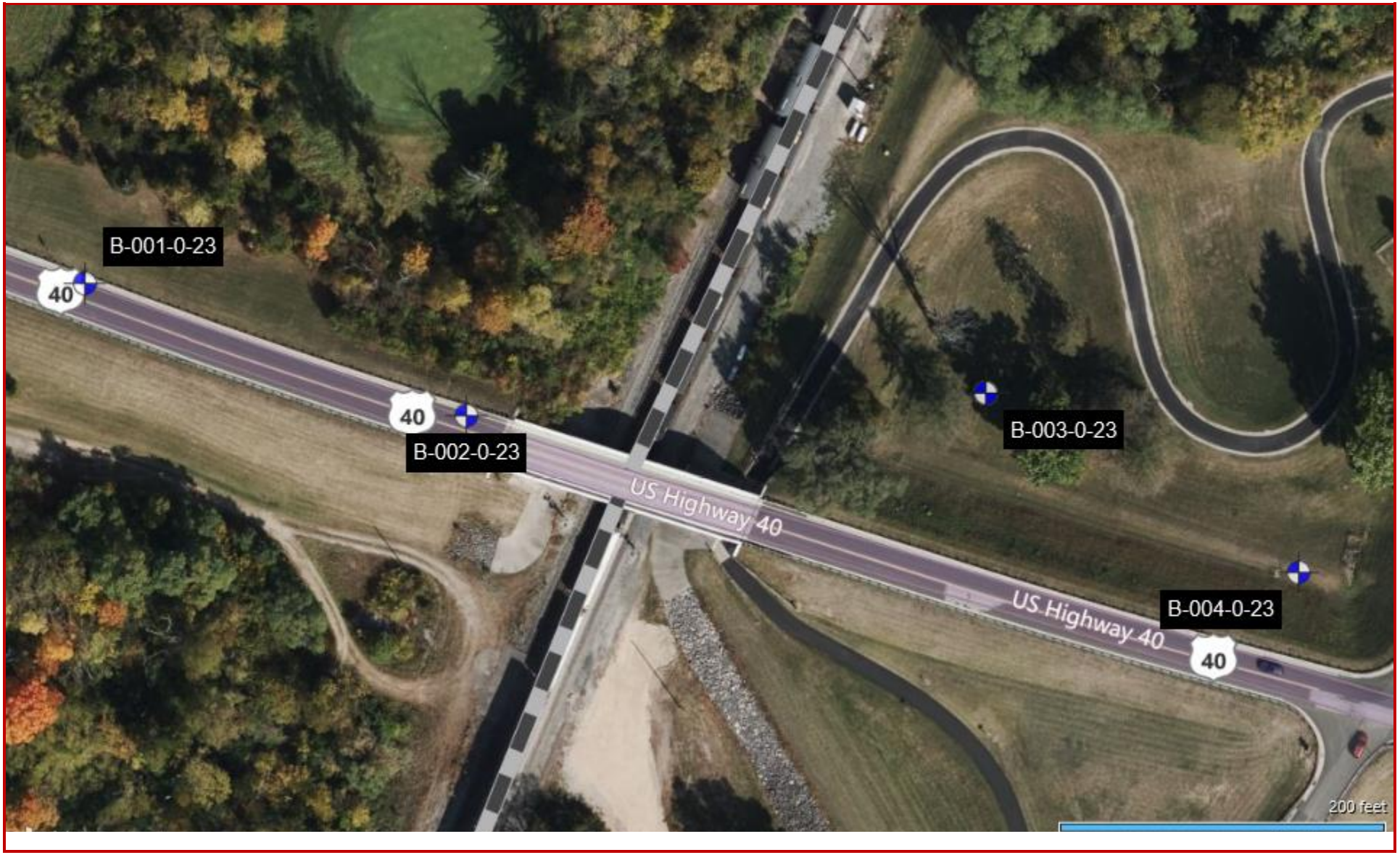
Site Location Plan
Exploration Plan

Note: All attachments are one page unless noted above.

Site Location

THE DIAGRAM IS FOR GENERAL LOCATION ONLY AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES MAP PROVIDED BY MICROSOFT BING MAPS

Exploration Plan



Exploration and Laboratory Results

Contents:

Boring Logs (B-001-0-23-through B-004-0-23)

Atterberg Limits

Grain-Size Distribution (4 pages)

Note: All attachments are one page unless noted above.

PROJECT: MOT-VANDALIA BIKEWAY
TYPE: RETAINING WALL
PID: 111388 SFN:
START: 1/16/23 END: 1/16/23

DRILLING FIRM / OPERATOR: TERRACON / AR
SAMPLING FIRM / LOGGER: TERRACON / JL
DRILLING METHOD: 3.25" HSA
SAMPLING METHOD: SPT

DRILL RIG: DIEDRICH D50
HAMMER: AUTOMATIC HAMMER
CALIBRATION DATE: 9/2/22
ENERGY RATIO (%): 85

STATION / OFFSET: 45+60, 30' RT.
ALIGNMENT: US-40
ELEVATION: 848.9 (MSL) EOB: 35.0 ft.
LAT / LONG: 39.876872, -84.172321

EXPLORATION ID B-001-0-23

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 (3.5 INCHES)	848.6																	
CONCRETE (9 INCHES)	847.9																	
AGGREGATE BASE (5 INCHES)	847.4																	
STIFF, BROWN TRACE GRAY, **SILTY CLAY**, TRACE SAND, DAMP (FILL)	845.4		17 6 4	14	83	SS-1	2.00	-	-	-	-	-	-	-	-	8	A-6b (V)	
VERY STIFF, BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, DRY (FILL)			5 9 11	28	100	SS-2	4.00	9	11	18	34	28	25	16	9	15	A-4a (5)	
			8 6 10	23	100	SS-3	3.50	-	-	-	-	-	-	-	-	11	A-4a (V)	
@8.5'; WITH ASPHALT FRAGMENTS AND CONCRETE FRAGMENTS	837.9		12 50	-	56	SS-4	3.00	-	-	-	-	-	-	-	-	13	A-4a (V)	
VERY STIFF TO HARD, BROWN, **SILT AND CLAY**, SOME SAND, LITTLE GRAVEL, DAMP TO MOIST			8 6 8	20	33	SS-5	-	14	10	18	30	28	30	17	13	13	A-6a (6)	
@13.5'; NO RECOVERY DUE TO COBBLES	830.4		8 13 14	38	0	SS-6	-	-	-	-	-	-	-	-	-	-	A-6a (V)	
		▼	7 8 8	23	83	SS-7	2.00	-	-	-	-	-	-	-	-	12	A-6a (V)	
MEDIUM DENSE, BROWN, **COARSE AND FINE SAND**, SOME SILT, LITTLE GRAVEL, TRACE CLAY, DAMP	825.4		5 6 5	16	67	SS-8	-	19	17	35	21	8	NP	NP	NP	16	A-3a (0)	
HARD, DARK BROWN, **SANDY SILT**, SOME CLAY, LITTLE GRAVEL, WET		W 826.9	7 11 15	37	100	SS-9	4.50	17	11	16	33	23	19	13	6	11	A-4a (4)	
			15 17 17	48	28	SS-10	-	-	-	-	-	-	-	-	-	18	A-4a (V)	
	813.9	EOB	8 14 17	44	100	SS-11	4.50	11	12	18	34	25	21	13	8	10	A-4a (5)	

NOTES: CAVE-IN AT 24'; GROUNDWATER ENCOUNTERED AT 22' DURING DRILLING AND 16' AFTER DRILLING;
ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED ASPHALT PATCH; AUGER CUTTINGS MIXED WITH BENTONITE CHIPS

PROJECT: MOT-VANDALIA BIKEWAY
TYPE: RETAINING WALL
PID: 111388 SFN:
START: 1/16/23 END: 1/16/23

DRILLING FIRM / OPERATOR: TERRACON / AR
SAMPLING FIRM / LOGGER: TERRACON / JL
DRILLING METHOD: 3.25" HSA
SAMPLING METHOD: SPT

DRILL RIG: DIEDRICH D50
HAMMER: AUTOMATIC HAMMER
CALIBRATION DATE: 9/2/22
ENERGY RATIO (%): 85

STATION / OFFSET: 47+80, 30' RT.
ALIGNMENT: US-40
ELEVATION: 850.3 (MSL) EOB: 35.0 ft.
LAT / LONG: 39.876650, -84.171486

EXPLORATION ID B-002-0-23

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 (3.5 INCHES)	850.3																	
CONCRETE (10 INCHES)	850.0																	
AGGREGATE BASE (3 INCHES)	849.2																	
VERY STIFF TO HARD, BROWN TRACE GRAY, **SILTY CLAY**, LITTLE TO SOME SAND, DAMP (FILL)	848.9		8 10 13	33	72	SS-1	2.00	-	-	-	-	-	-	-	-	7	A-6b (V)	
			7 6 7	18	100	SS-2	3.50	-	-	-	-	-	-	-	-	12	A-6b (V)	
VERY STIFF, BROWN, **SILT AND CLAY**, LITTLE GRAVEL, SOME SAND, DRY (FILL)	844.3		5 8 8	23	100	SS-3	2.50	17	12	18	30	23	25	14	11	11	A-6a (4)	
			9 8 7	21	100	SS-4	3.00	-	-	-	-	-	-	-	-	10	A-6a (V)	
STIFF TO VERY STIFF, BROWN TO DARK BROWN, **SILTY CLAY**, TRACE GRAVEL, SOME SAND, DAMP	839.3		3 4 5	13	100	SS-5	1.50	-	-	-	-	-	-	-	-	11	A-6b (V)	
			4 4 5	13	100	SS-6	2.00	5	9	15	35	36	37	18	19	16	A-6b (11)	
	831.8		2 3 4	10	28	SS-7	2.50	-	-	-	-	-	-	-	-	13	A-6b (V)	
STIFF, BROWN, **CLAY**, SOME SILT, LITTLE SAND, DAMP			3 3 4	10	22	SS-8	1.50	0	2	17	34	47	50	19	31	27	A-7-6 (18)	
VERY STIFF, BROWN, **SANDY SILT**, LITTLE TO SOME GRAVEL, LITTLE CLAY, DAMP	826.8		4 5 7	17	28	SS-9	3.00	-	-	-	-	-	-	-	-	11	A-4a (V)	
			6 8 11	27	100	SS-10	4.00	24	10	17	30	19	22	14	8	11	A-4a (3)	
	815.3	EOB	4 5 9	20	100	SS-11	4.00	12	12	19	38	19	21	13	8	11	A-4a (4)	

NOTES: CAVE-IN AT 16'; GROUNDWATER NOT ENCOUNTERED DURING AND AFTER DRILLING;
ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED ASPHALT PATCH; AUGER CUTTINGS MIXED WITH BENTONITE CHIPS

PROJECT: MOT-VANDALIA BIKEWAY
TYPE: RETAINING WALL
PID: 111388 SFN:
START: 1/17/23 END: 1/17/23

DRILLING FIRM / OPERATOR: TERRACON / AR
SAMPLING FIRM / LOGGER: TERRACON / JL
DRILLING METHOD: 3.25" HSA
SAMPLING METHOD: SPT

DRILL RIG: DIEDRICH D50
HAMMER: AUTOMATIC HAMMER
CALIBRATION DATE: 9/2/22
ENERGY RATIO (%): 85

STATION / OFFSET: 54+70, 20' RT.
ALIGNMENT: US-40
ELEVATION: 811.2 (MSL) EOB: 40.0 ft.
LAT / LONG: 39.876688, -84.170349

EXPLORATION ID B-003-0-23

MATERIAL DESCRIPTION AND NOTES	ELEV. 811.2	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
TOPSOIL (3 INCHES)	811.0																	
STIFF, REDDISH BROWN, **SILT AND CLAY**, SOME SAND, LITTLE GRAVEL, DAMP			1 1 2	4	100	SS-1	1.00	-	-	-	-	-	-	-	-	34	A-6a (V)	
	805.2		5 5 6	16	100	SS-2	2.00	11	10	18	32	29	29	16	13	16	A-6a (6)	
STIFF, BROWN, **SANDY SILT**, LITTLE GRAVEL, LITTLE CLAY, DRY			4 7 5	17	28	SS-3	2.00	-	-	-	-	-	-	-	-	12	A-4a (V)	
	800.2		5 6 6	17	28	SS-4	-	18	14	19	33	16	20	15	5	13	A-4a (3)	
DENSE, BROWN TO GRAYISH BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT, TRACE CLAY, DRY			7 14 23	52	100	SS-5	-	-	-	-	-	-	-	-	-	19	A-1-b (V)	
			17 17 13	43	28	SS-6	-	44	29	12	8	7	NP	NP	NP	5	A-1-b (0)	
@16.0'; LOOSE			6 3 2	7	17	SS-7	-	-	-	-	-	-	-	-	-	13	A-1-b (V)	
	792.7																	
HARD, DARK GRAY TO BROWN, **SANDY SILT**, LITTLE GRAVEL, LITTLE CLAY, TRACE IRON OXIDE CONCRETIONS, DAMP		W 792.2	17 21 24	64	100	SS-8	4.50	15	13	21	36	15	20	14	6	10	A-4a (3)	
	787.7																	
VERY DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT, TRACE CLAY, DAMP TO MOIST			20 24 20	62	11	SS-9	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	
			50	-	83	SS-10	-	39	32	25	1	3	NP	NP	NP	8	A-1-b (0)	
			24 42 33	106	83	SS-11	-	-	-	-	-	-	-	-	-	4	A-1-b (V)	
			39 21 27	68	22	SS-12	-	43	21	23	8	5	NP	NP	NP	5	A-1-b (0)	
	771.2	EOB																

NOTES: CAVE-IN AT 31'; GROUNDWATER ENCOUNTERED AT 19' DURING DRILLING AND NOT ENCOUNTERED AFTER DRILLING;
ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH BENTONITE CHIPS

PROJECT: MOT-VANDALIA BIKEWAY	DRILLING FIRM / OPERATOR: TERRACON / AR	DRILL RIG: DIEDRICH D50	STATION / OFFSET: 52+80, 60' RT.	EXPLORATION ID B-004-0-23
TYPE: RETAINING WALL	SAMPLING FIRM / LOGGER: TERRACON / JL	HAMMER: AUTOMATIC HAMMER	ALIGNMENT: US-40	
PID: 111388 SFN:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 9/2/22	ELEVATION: 815.8 (MSL) EOB: 40.0 ft.	PAGE 1 OF 1
START: 1/17/23 END: 1/17/23	SAMPLING METHOD: SPT	ENERGY RATIO (%): 85	LAT / LONG: 39.876387, -84.169664	

MATERIAL DESCRIPTION AND NOTES	ELEV. 815.8	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
TOPSOIL (2 INCHES)	815.6																	
STIFF, BROWN, **SILTY CLAY**, TRACE SAND, DAMP (FILL)			5 5 4	13	28	SS-1	-	-	-	-	-	-	-	-	-	11	A-6b (V)	
	812.3																	
MEDIUM DENSE, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, TRACE SILT, TRACE CLAY, DAMP			5 5 5	14	67	SS-2	-	-	-	-	-	-	-	-	-	6	A-1-b (V)	
			6 8 9	24	28	SS-3	-	48	25	17	6	4	NP	NP	NP	6	A-1-b (0)	
			5 3 6	13	28	SS-4	-	-	-	-	-	-	-	-	-	18	A-1-b (V)	
			6 7 9	23	67	SS-5	-	45	20	20	10	5	NP	NP	NP	9	A-1-b (0)	
			7 7 4	16	56	SS-6	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
	799.8																	
MEDIUM STIFF TO STIFF, DARK BROWN, **SILTY CLAY**, SOME SAND, TRACE GRAVEL, DAMP			3 4 5	13	100	SS-7	1.50	4	4	23	28	41	40	22	18	22	A-6b (10)	
			2 2 3	7	28	SS-8	1.00	-	-	-	-	-	-	-	-	13	A-6b (V)	
		W 794.8																
	792.3																	
VERY LOOSE, BROWN TRACE RED, **SANDY SILT**, SOME GRAVEL, LITTLE CLAY, WET			0 0 0	0	28	SS-9	-	23	19	9	36	13	NP	NP	NP	50	A-4a (3)	
	787.3																	
DENSE TO VERY DENSE, BROWN, **COARSE AND FINE SAND**, LITTLE TO SOME SILT, TRACE TO LITTLE GRAVEL, TRACE CLAY, TRACE IRON OXIDE CONCRETIONS, DAMP			15 18 18	51	100	SS-10	-	-	-	-	-	-	-	-	-	17	A-3a (V)	
			10 17 9	37	100	SS-11	-	-	-	-	-	-	-	-	-	8	A-3a (V)	
			50/5"	-	80	SS-12	-	-	-	-	-	-	-	-	-	7	A-3a (V)	
	775.8	EOB																

NOTES: GROUNDWATER ENCOUNTERED AT 21' DURING DRILLING AND NOT ENCOUNTERED AFTER DRILLING;

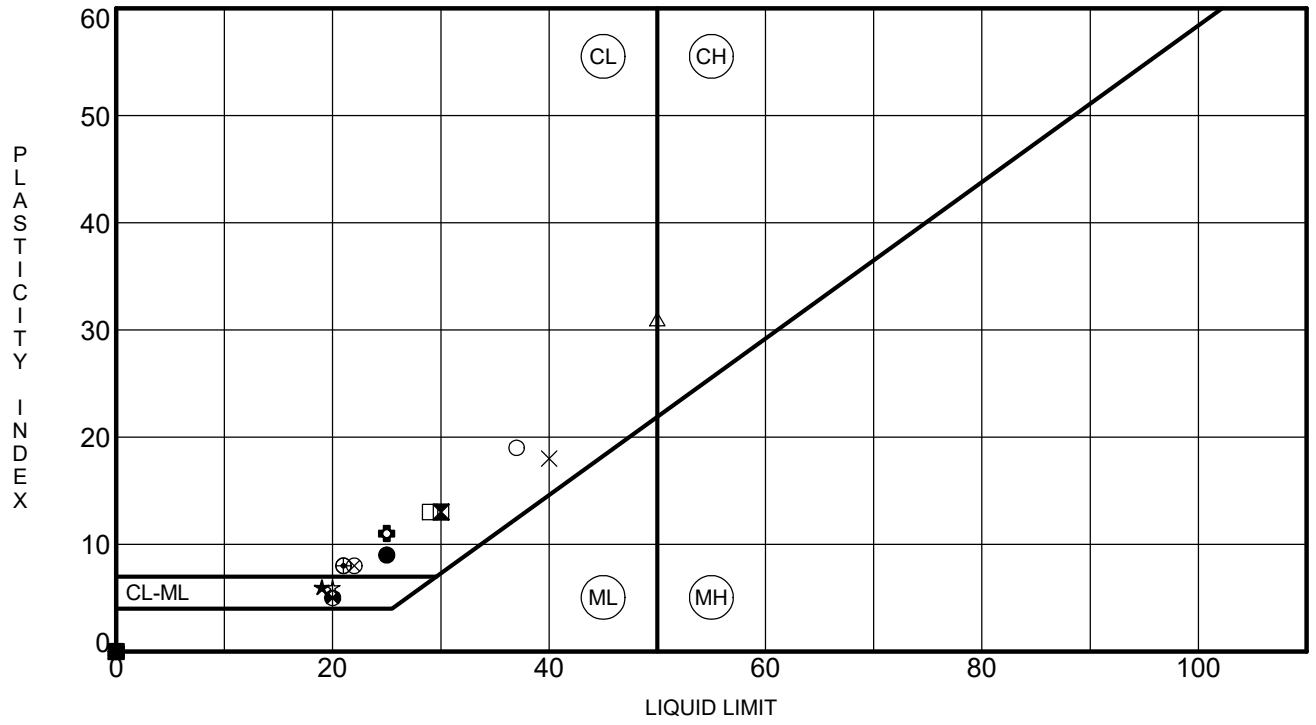
ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH BENTONITE CHIPS

ATTERBERG LIMITS' RESULTS

OHIO DEPARTMENT OF TRANSPORTION
OFFICE OF GEOTECHNICAL ENGINEERING

PROJECT MOT-VANDALIA BIKEWAY **PID** 111388

OGE NUMBER N1225269 **PROJECT TYPE** STRUCTURE FOUNDATION



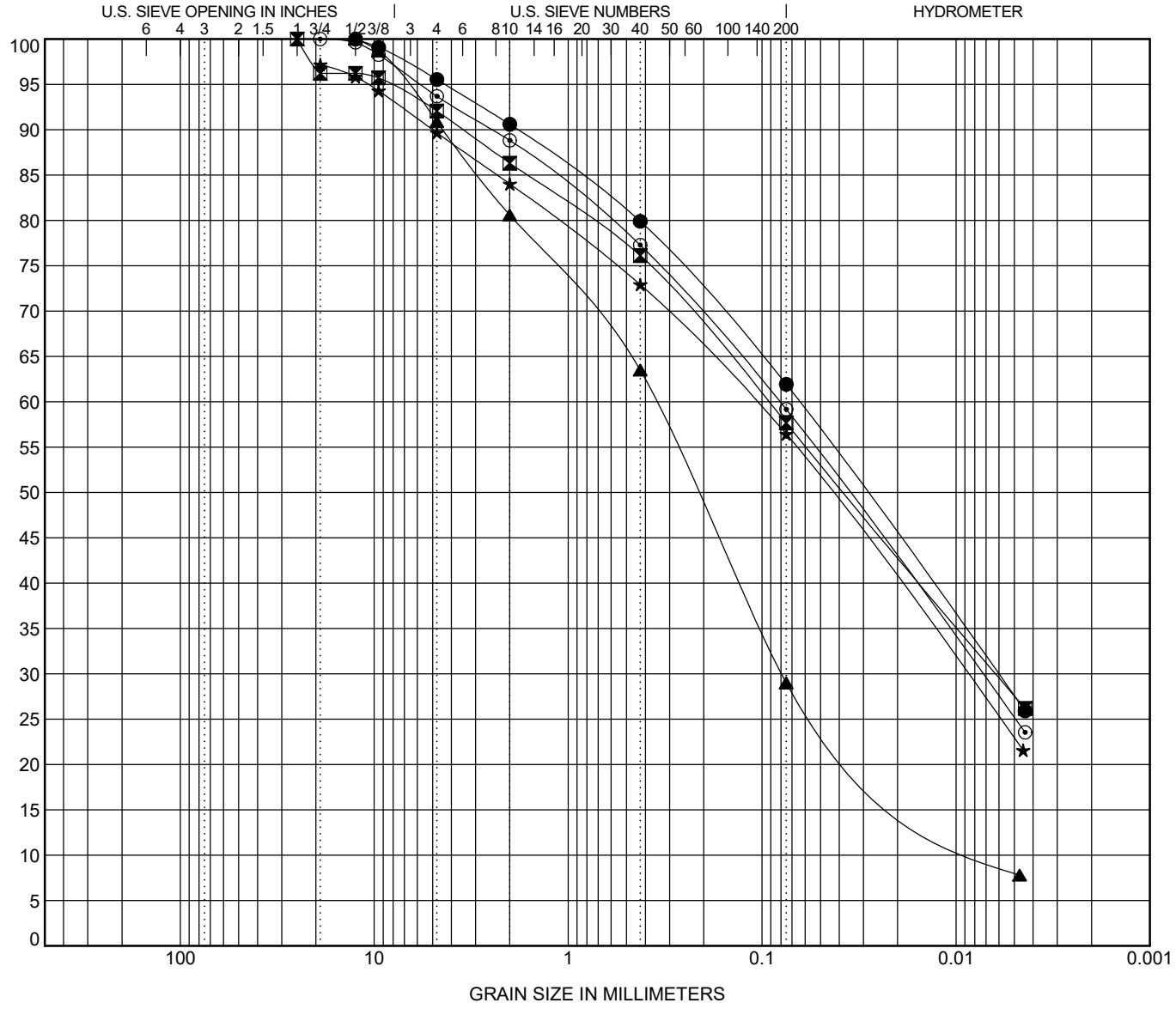
	Specimen Identification		LL	PL	PI	Fines	Classification
●	B-001-0-23	3.5	25	16	9	62	SANDY LEAN CLAY(CL)
⊠	B-001-0-23	11.0	30	17	13	58	SANDY LEAN CLAY(CL)
▲	B-001-0-23	18.5	NP	NP	NP	29	SILTY SAND(SM)
★	B-001-0-23	23.5	19	13	6	56	SANDY SILTY CLAY(CL-ML)
⊙	B-001-0-23	33.5	21	13	8	59	SANDY LEAN CLAY(CL)
✿	B-002-0-23	6.0	25	14	11	53	SANDY LEAN CLAY(CL)
○	B-002-0-23	13.5	37	18	19	71	LEAN CLAY with SAND(CL)
△	B-002-0-23	18.5	50	19	31	81	FAT CLAY with SAND(CH)
⊗	B-002-0-23	28.5	22	14	8	49	CLAYEY SAND with GRAVEL(SC)
⊕	B-002-0-23	33.5	21	13	8	57	SANDY LEAN CLAY(CL)
□	B-003-0-23	3.5	29	16	13	61	SANDY LEAN CLAY(CL)
⊛	B-003-0-23	8.5	20	15	5	49	SILTY, CLAYEY SAND(SC-SM)
◕	B-003-0-23	13.5	NP	NP	NP	15	SILTY SAND with GRAVEL(SM)
☆	B-003-0-23	18.5	20	14	6	51	SANDY SILTY CLAY(CL-ML)
⊠	B-003-0-23	28.5	NP	NP	NP	4	POORLY GRADED SAND with GRAVEL(SP)
■	B-003-0-23	38.5	NP	NP	NP	13	SILTY SAND with GRAVEL(SM)
◆	B-004-0-23	6.0	NP	NP	NP	10	WELL-GRADED SAND with SILT and GRAVEL(SW-SM)
◇	B-004-0-23	11.0	NP	NP	NP	15	SILTY SAND with GRAVEL(SM)
×	B-004-0-23	16.0	40	22	18	69	SANDY LEAN CLAY(CL)
✖	B-004-0-23	23.5	NP	NP	NP	49	SILTY SAND(SM)

GRAIN SIZE DISTRIBUTION

OHIO DEPARTMENT OF TRANSPORTION
OFFICE OF GEOTECHNICAL ENGINEERING

PROJECT MOT-VANDALIA BIKEWAY **PID** 111388

OGE NUMBER N1225269 **PROJECT TYPE** STRUCTURE FOUNDATION



COBBLES	GRAVEL	SAND		SILT	CLAY
		coarse	fine		

Specimen Identification			ODOT (Modified AASHTO) ~ USCS Classification	LL	PL	PI
●	B-001-0-23	3.5	A-4a ~ SANDY LEAN CLAY(CL)	25	16	9
⊠	B-001-0-23	11.0	A-6a ~ SANDY LEAN CLAY(CL)	30	17	13
▲	B-001-0-23	18.5	A-3a ~ SILTY SAND(SM)	NP	NP	NP
★	B-001-0-23	23.5	A-4a ~ SANDY SILTY CLAY(CL-ML)	19	13	6
⊙	B-001-0-23	33.5	A-4a ~ SANDY LEAN CLAY(CL)	21	13	8

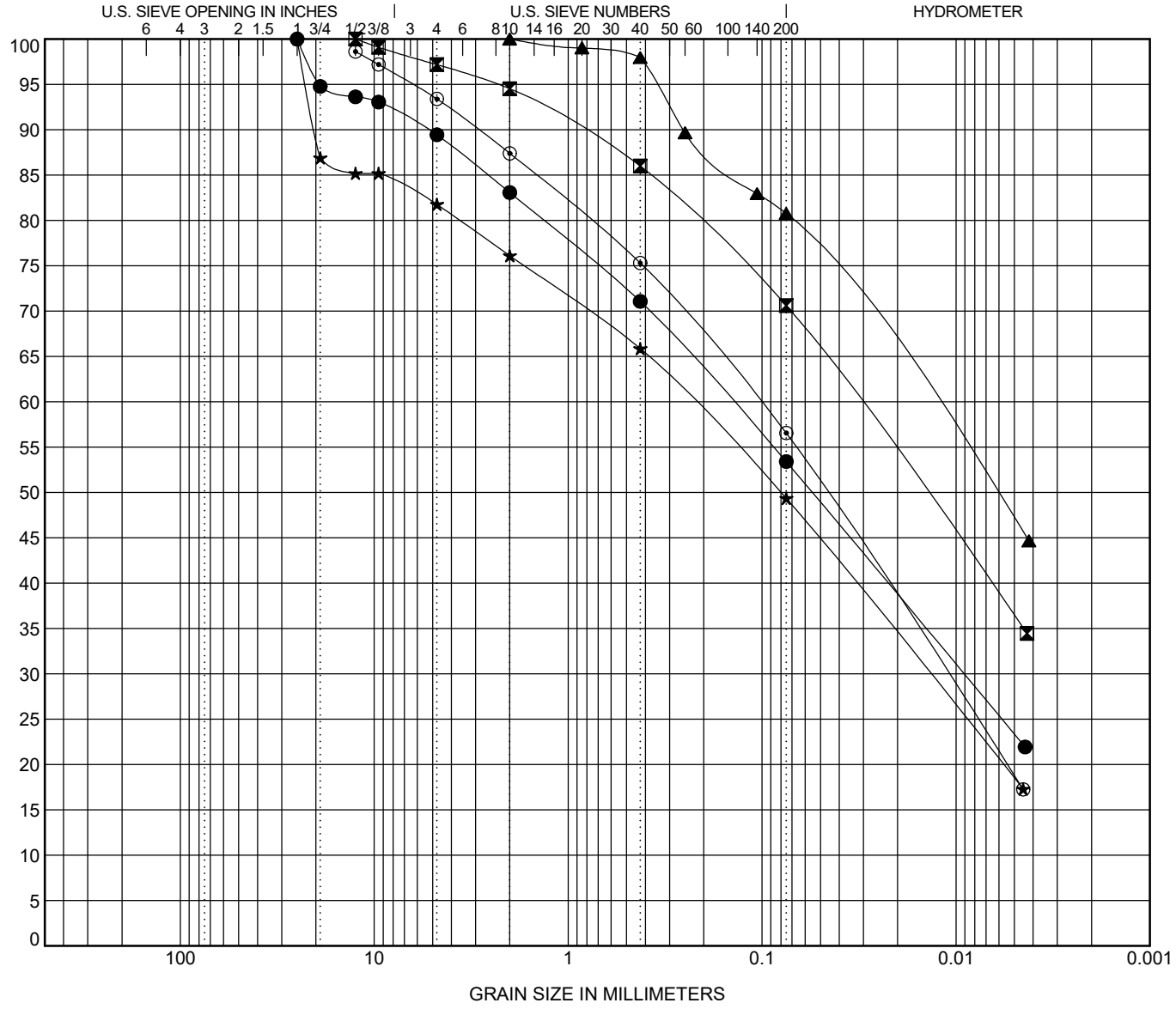
Specimen Identification			D90	D50	D30	D10	%G	%CS	%FS	%M	%C	Cc	Cu
●	B-001-0-23	3.5	1.833	0.029	0.006		9	11	18	34	28		
⊠	B-001-0-23	11.0	3.484	0.038	0.006		14	10	18	30	28		
▲	B-001-0-23	18.5	4.405	0.216	0.079	0.006	19	17	35	21	8	2.79	56.93
★	B-001-0-23	23.5	4.993	0.045	0.009		17	11	16	33	23		
⊙	B-001-0-23	33.5	2.465	0.036	0.007		11	12	18	34	25		

GRAIN SIZE DISTRIBUTION

OHIO DEPARTMENT OF TRANSPORTION
OFFICE OF GEOTECHNICAL ENGINEERING

PROJECT MOT-VANDALIA BIKEWAY **PID** 111388

OGE NUMBER N1225269 **PROJECT TYPE** STRUCTURE FOUNDATION



COBBLES	GRAVEL	SAND		SILT	CLAY
		coarse	fine		

Specimen Identification			ODOT (Modified AASHTO) ~ USCS Classification	LL	PL	PI
●	B-002-0-23	6.0	**A-6a ~ SANDY LEAN CLAY(CL)**	**25**	**14**	**11**
⊠	B-002-0-23	13.5	**A-6b ~ LEAN CLAY with SAND(CL)**	**37**	**18**	**19**
▲	B-002-0-23	18.5	**A-7-6 ~ FAT CLAY with SAND(CH)**	**50**	**19**	**31**
★	B-002-0-23	28.5	**A-4a ~ CLAYEY SAND with GRAVEL(SC)**	**22**	**14**	**8**
⊙	B-002-0-23	33.5	**A-4a ~ SANDY LEAN CLAY(CL)**	**21**	**13**	**8**

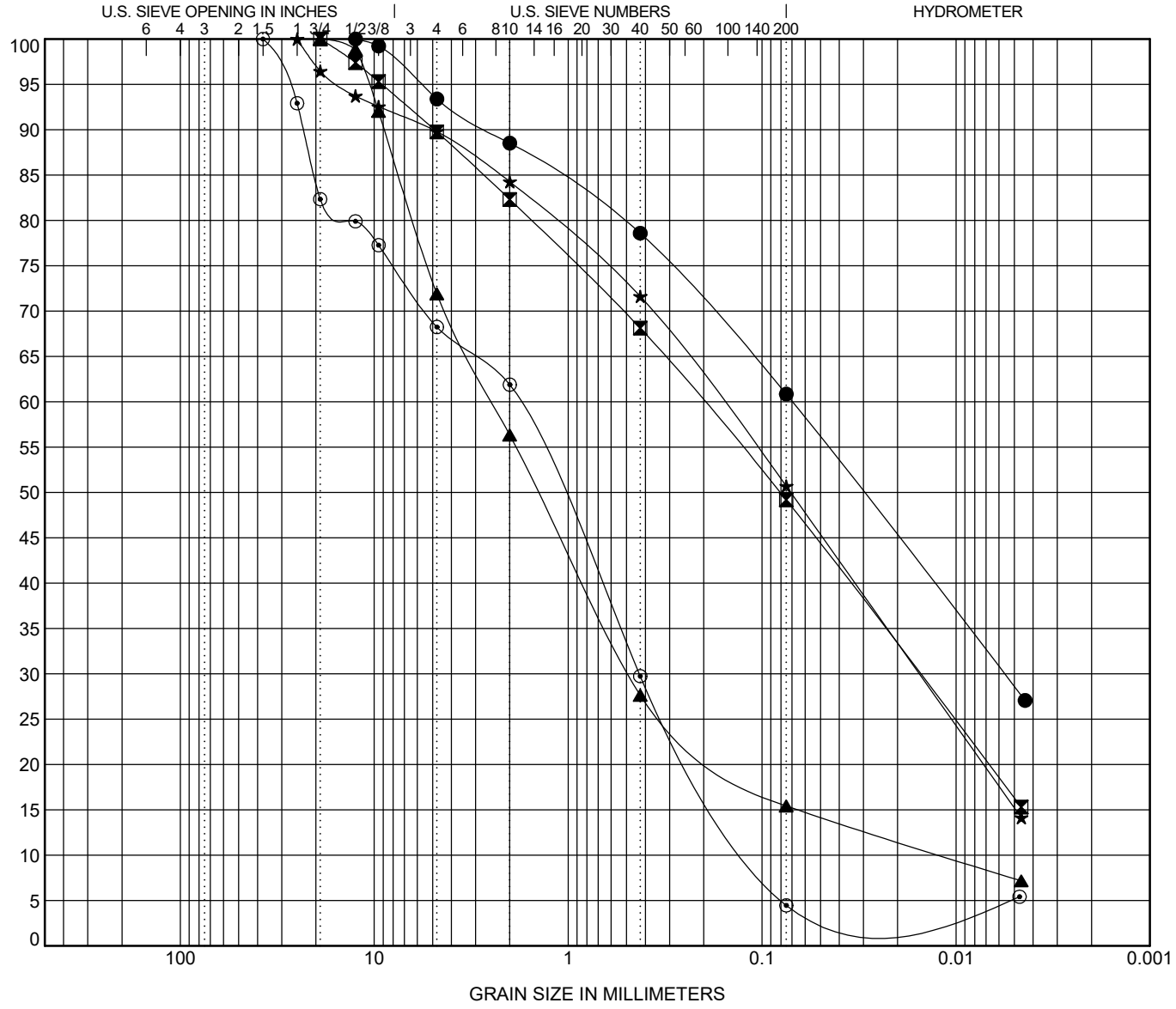
Specimen Identification			D90	D50	D30	D10	%G	%CS	%FS	%M	%C	Cc	Cu
●	B-002-0-23	6.0	**5.289**	**0.055**	**0.009**		**17**	**12**	**18**	**30**	**23**		
⊠	B-002-0-23	13.5	**0.88**	**0.015**			**5**	**9**	**15**	**35**	**36**		
▲	B-002-0-23	18.5	**0.255**	**0.006**			**0**	**2**	**17**	**34**	**47**		
★	B-002-0-23	28.5	**20.275**	**0.08**	**0.014**		**24**	**10**	**17**	**30**	**19**		
⊙	B-002-0-23	33.5	**2.912**	**0.047**	**0.011**		**12**	**12**	**19**	**38**	**19**		

GRAIN SIZE DISTRIBUTION

OHIO DEPARTMENT OF TRANSPORTION
OFFICE OF GEOTECHNICAL ENGINEERING

PROJECT MOT-VANDALIA BIKEWAY **PID** 111388

OGE NUMBER N1225269 **PROJECT TYPE** STRUCTURE FOUNDATION



COBBLES	GRAVEL	SAND		SILT	CLAY
		coarse	fine		

Specimen Identification			ODOT (Modified AASHTO) ~ USCS Classification	LL	PL	PI
●	B-003-0-23	3.5	**A-6a ~ SANDY LEAN CLAY(CL)**	**29**	**16**	**13**
⊠	B-003-0-23	8.5	**A-4a ~ SILTY, CLAYEY SAND(SC-SM)**	**20**	**15**	**5**
▲	B-003-0-23	13.5	**A-1-b ~ SILTY SAND with GRAVEL(SM)**	**NP**	**NP**	**NP**
★	B-003-0-23	18.5	**A-4a ~ SANDY SILTY CLAY(CL-ML)**	**20**	**14**	**6**
⊙	B-003-0-23	28.5	**A-1-b ~ POORLY GRADED SAND with GRAVEL(SP)**	**NP**	**NP**	**NP**

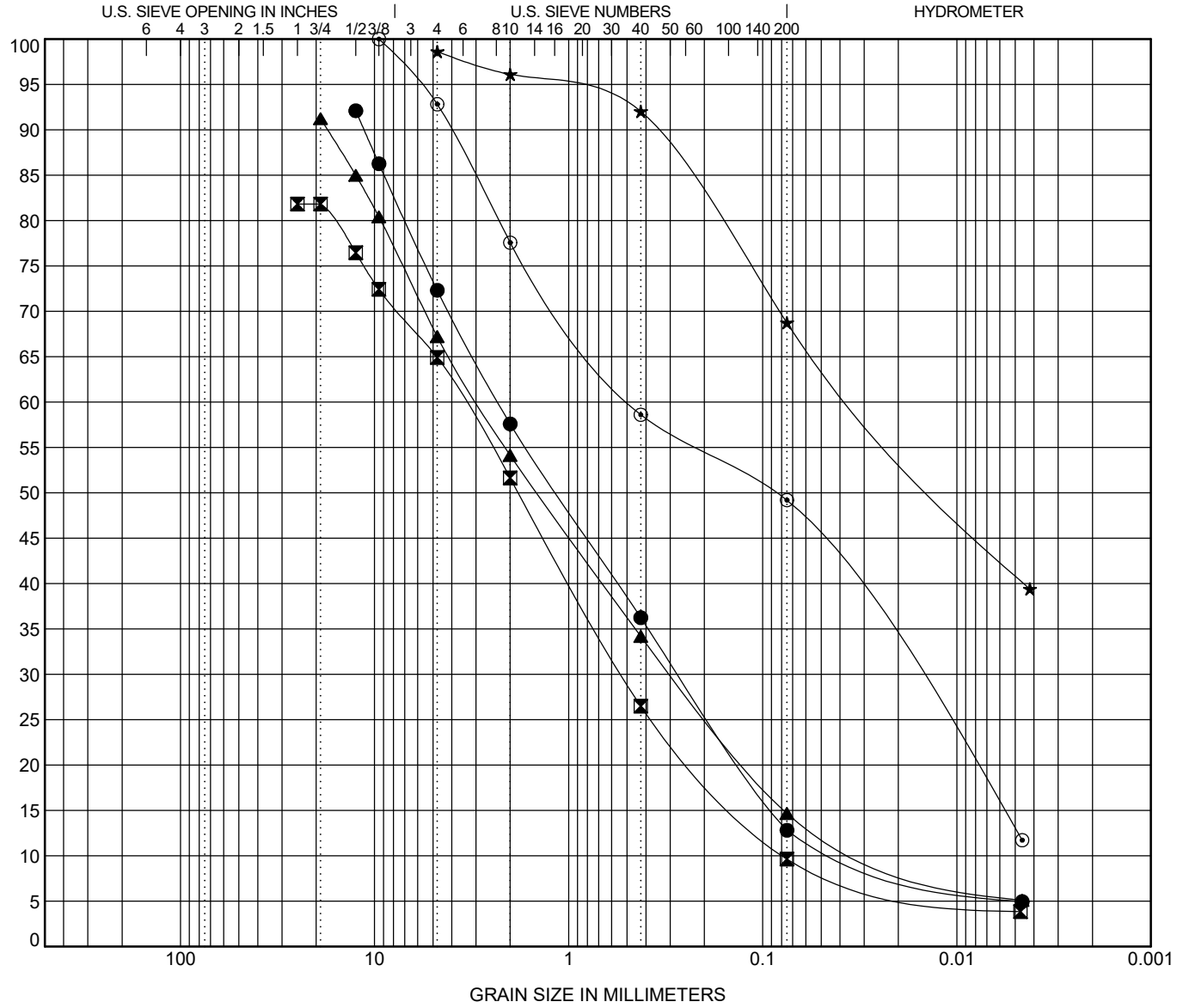
Specimen Identification			D90	D50	D30	D10	%G	%CS	%FS	%M	%C	Cc	Cu
●	B-003-0-23	3.5	**2.602**	**0.03**	**0.006**		**11**	**10**	**18**	**32**	**29**		
⊠	B-003-0-23	8.5	**4.895**	**0.081**	**0.015**		**18**	**14**	**19**	**33**	**16**		
▲	B-003-0-23	13.5	**8.86**	**1.421**	**0.483**	**0.012**	**44**	**29**	**12**	**8**	**7**	**7.94**	**204.71**
★	B-003-0-23	18.5	**4.988**	**0.071**	**0.015**		**15**	**13**	**21**	**36**	**15**		
⊙	B-003-0-23	28.5	**23.177**	**1.128**	**0.43**	**0.011**	**39**	**32**	**25**	**-1**	**5**	**9.23**	**166.33**

GRAIN SIZE DISTRIBUTION

OHIO DEPARTMENT OF TRANSPORTION
OFFICE OF GEOTECHNICAL ENGINEERING

PROJECT MOT-VANDALIA BIKEWAY **PID** 111388

OGE NUMBER N1225269 **PROJECT TYPE** STRUCTURE FOUNDATION



COBBLES	GRAVEL	SAND		SILT	CLAY
		coarse	fine		

Specimen Identification			ODOT (Modified AASHTO) ~ USCS Classification	LL	PL	PI
●	B-003-0-23	38.5	A-1-b ~ SILTY SAND with GRAVEL(SM)	NP	NP	NP
⊠	B-004-0-23	6.0	A-1-b ~ WELL-GRADED SAND with SILT and GRAVEL(SW-SM)	NP	NP	NP
▲	B-004-0-23	11.0	A-1-b ~ SILTY SAND with GRAVEL(SM)	NP	NP	NP
★	B-004-0-23	16.0	A-6b ~ SANDY LEAN CLAY(CL)	40	22	18
⊙	B-004-0-23	23.5	A-4a ~ SILTY SAND(SM)	NP	NP	NP

Specimen Identification			D90	D50	D30	D10	%G	%CS	%FS	%M	%C	Cc	Cu
●	B-003-0-23	38.5	11.327	1.153	0.268	0.028	43	21	23	8	5	1.13	83.39
⊠	B-004-0-23	6.0		1.81	0.528	0.078	48	25	17	6	4	1.04	44.25
▲	B-004-0-23	11.0	17.494	1.453	0.293	0.019	45	20	20	10	5	1.51	153.12
★	B-004-0-23	16.0	0.365	0.012			4	4	23	28	41		
⊙	B-004-0-23	23.5	4.049	0.087	0.018		23	19	9	36	13		

Supporting Information

Contents:

Embankment Settlement Calculations

MSEW+ Analyses Results

ODOT Soil Classification System

Geotechnical Profile Sheets

MSE Wall #1 Settlement Calculations

Squish - Cover Sheet and Input Summary

PROJECT INFORMATION

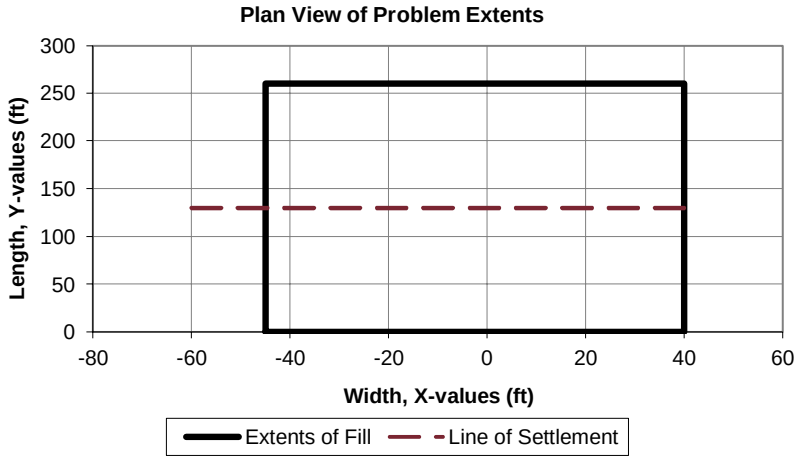
Project Name:	**Vandalia Bikeway Connector**
Project Number:	**N1225269**
Location or Station:	**US-40, Vandalia, Ohio**
Notes/Description:	**MSE Wall #1 (B-1 and B-2)--Wall Sta. 102+ 76.61**
Date of Analysis:	**February 13, 2023**

SUMMARY OF FILL/EMBANKMENT INPUT

Embankments Block Types:	Existing =	1	Proposed =	1	Surcharge = 0

Line of Settlement Calcs:	Beginning X =	-60	Ending X =	40
(20 points along this line.)	Beginning Y =	130	Ending Y =	130

The graph to the right shows the plan view of the problem extent as well as the line along which stresses and settlement are calculated. See the "Fill" sheet for additional information and graphs of the modeled blocks.



SUMMARY OF SOIL INPUT

Total Number of Soil Layers	2
Timeframe for Secondary	20 years
Primary Assumed Complete at	95%
Stress to Induce Secondary	0 psf
Rebound after surcharge	Excluded
Secondary Reduction Method	None
Total Number of Time Steps	4000
Maximum Beta	0.15
Maximum Calculated Time (days)	150
Preconsolidation Pressure Method	OCR
Stress Distribution Method	Boussinesq

Time Dependent Soil Layers	1

Secondary Reduction Method - Explanation

No reduction in secondary consolidation has been made. Any surcharges will not decrease the amount of secondary settlement.

See the input and output sheets from Squish for additional information. The results of this program should be independently verified.

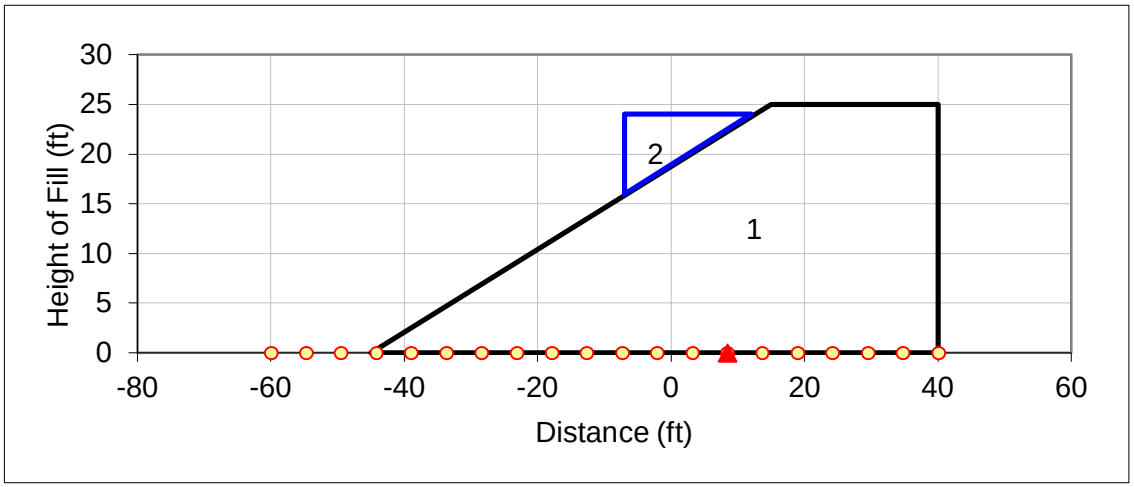
Squish - Embankment Fill Input

		Block Number	1	2
		Fill Type	Existing	Proposed
		γ (pcf)	120.0	125.0
Bottom of Block (ft)		Left X	-45	-7
		Left Z	0	16
		Right X	40	-7
		Right Z	0	16
Top of Block (ft)		Left X	15	-7
		Left Z	25	24
		Right X	40	12
		Right Z	25	24
Calculated Slopes		Left Side Slope	2.4H:1V	Vertical
		Right Side Slope	Vertical	2.38H:1V

Line of Settlement Calculations (ft)	Left X	-60
	Left Y	130
	Right X	40
	Right Y	130
	Number of Points	*20*
Length of Embankment (ft)		260
Horizontal Slice Thickness (ft)		0.1

☑ Display the Block Numbers on the Graph?

Calculate Settlement and Time for Settlement to Occur



Squish - Subsurface Profile Input Values

Depth to Groundwater (ft)	5
σ_p' Option	OCR

Calculate Settlement and Time for Settlement

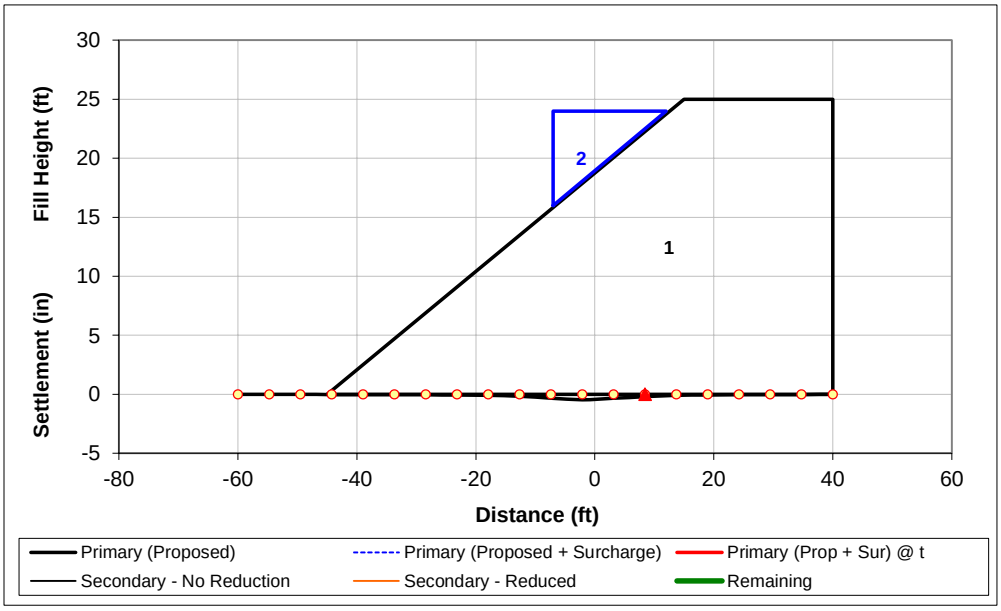
Time for Secondary Consol (years)	20
Assume Primary Complete at Ui =	95%
Min. $\Delta\sigma$' to Induce Secondary (psf) =	0
Rebound after surcharge	Exclude
Secondary Consol Reduction Method	None

Number of Time Steps	4000
Maximum Beta (finite difference)	0.15
Max Time Calculated (days)	*150*
Stress distribution method	● Boussinesq ○ Westergaard

Layer Thickness		Settlement Parameters						Time Rate of Settlement Values					Wicks	Strength Values	
Top (ft)	Bottom (ft)	γ (pcf)	Cεc	Cεr	OCR	Cα	Cαr	Time Dependent	Cv (ft^2/day)	k (ft/day)	Top Drained	Bottom Drained	C_h (ft^2/day)	s	m
0	12	125	0.025	0.025	1.0	0.003	0.0003	**Yes**	1	1	Yes	No			
12	40	120	0.016	0.016	1.0			No							

Squish - Settlement Results

Evaluate Effective Stresses at t = 150.0 **days**



Block	Fill Type
1	Existing
2	Proposed

Items to Graph

Primary Consolidation

- ☑ Proposed Only
- ☐ Final P + S
- ☐ P+S at t = 150 days

Secondary Consolidation

- ☐ No Reduction
- ☐ With Reduction
- ☐ **Total Remaining**

Location of Point		Proposed Embankment (t = ∞)				
X (ft)	Y (ft)	Primary (in)				
Maximum Values		***0.5***				
-60.0	130	0.0				
-54.7	130	0.0				
-49.5	130	0.0				
-44.2	130	0.0				
-38.9	130	0.0				
-33.7	130	0.0				
-28.4	130	0.0				
-23.2	130	0.1				
-17.9	130	0.1				
-12.6	130	0.2				
-7.4	130	0.3				
-2.1	130	0.5				
3.2	130	0.3				
8.4	130	0.2				
13.7	130	0.1				
18.9	130	0.1				
24.2	130	0.0				
29.5	130	0.0				
34.7	130	0.0				
40.0	130	0.0				

MSE Wall #2 Settlement Calculations

Squish - Cover Sheet and Input Summary

PROJECT INFORMATION

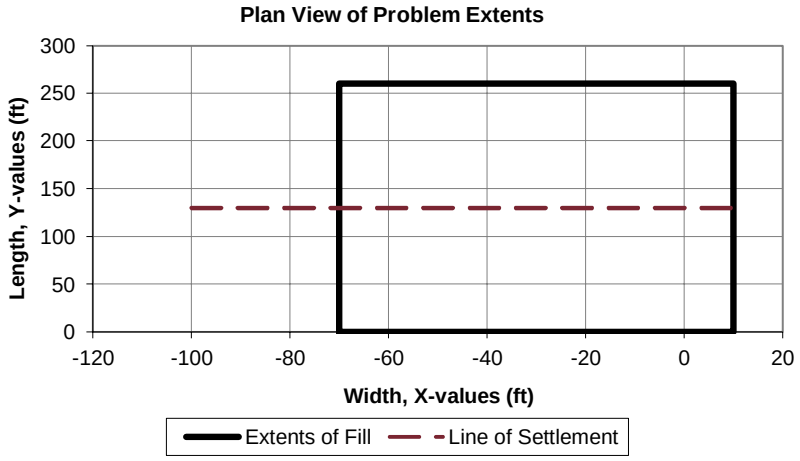
Project Name:	**Vandalia Bikeway Connector**
Project Number:	**N1225269**
Location or Station:	**US-40, Vandalia, Ohio**
Notes/Description:	**MSE Wall #2 (B-3 and B-4)--Wall Sta. 200+91.69**
Date of Analysis:	**February 13, 2023**

SUMMARY OF FILL/EMBANKMENT INPUT

Embankments Block Types:	Existing =	1	Proposed =	5	Surcharge = 0

Line of Settlement Calcs:	Beginning X =	-100	Ending X =	10
(25 points along this line.)	Beginning Y =	130	Ending Y =	130

The graph to the right shows the plan view of the problem extent as well as the line along which stresses and settlement are calculated. See the "Fill" sheet for additional information and graphs of the modeled blocks.



SUMMARY OF SOIL INPUT

Total Number of Soil Layers	3
Time Dependent Soil Layers	1

Timeframe for Secondary	20 years
Primary Assumed Complete at	95%
Stress to Induce Secondary	0 psf
Rebound after surcharge	Excluded
Secondary Reduction Method	None

Secondary Reduction Method - Explanation

No reduction in secondary consolidation has been made. Any surcharges will not decrease the amount of secondary settlement.

Total Number of Time Steps	4000
Maximum Beta	0.15
Maximum Calculated Time (days)	150
Preconsolidation Pressure Method	OCR
Stress Distribution Method	Boussinesq

See the input and output sheets from Squish for additional information. The results of this program should be independently verified.

Squish - Embankment Fill Input

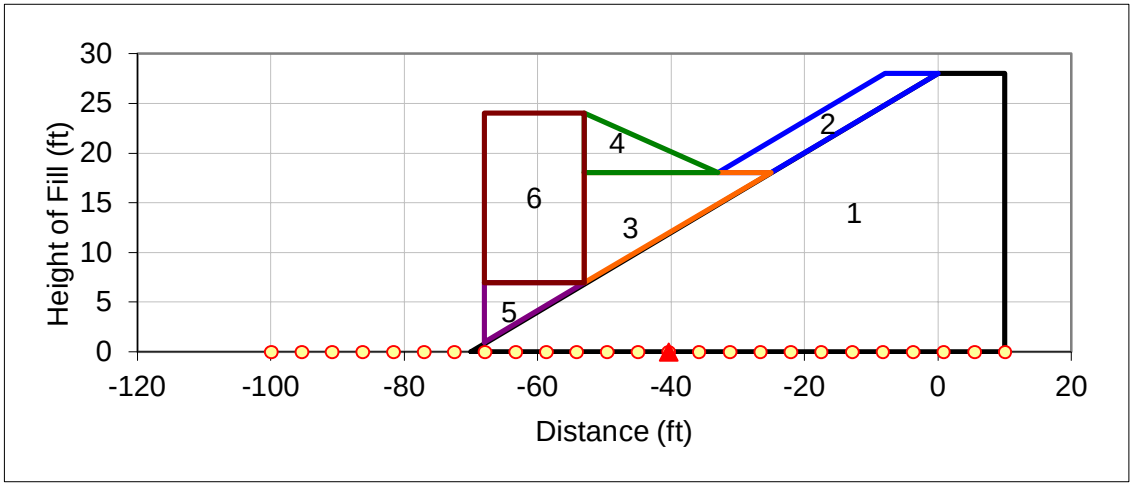
	Block Number	1	2	3	4	5	6
	Fill Type	Existing	Proposed	Proposed	Proposed	Proposed	Proposed
	γ (pcf)	125.0	125.0	125.0	125.0	125.0	125.0
Bottom of Block (ft)	Left X	-70	-33	-53	-53	-68	-68
	Left Z	0	18	7	18	1	7
	Right X	10	-25	-53	-33	-68	-53
	Right Z	0	18	7	18	1	7
Top of Block (ft)	Left X	0	-8	-53	-53	-68	-68
	Left Z	28	28	18	24	7	24
	Right X	10	0	-25	-53	-53	-53
	Right Z	28	28	18	24	7	24
Calculated Slopes	Left Side Slope	2.5H:1V	2.5H:1V	Vertical	Vertical	Vertical	Vertical
	Right Side Slope	Vertical	2.5H:1V	2.55H:1V	-3.33H:1V	2.5H:1V	Vertical

Line of Settlement Calculations (ft)	Left X	-100
	Left Y	130
	Right X	10
	Right Y	130
	Number of Points	*25*

Length of Embankment (ft)	260
Horizontal Slice Thickness (ft)	0.1

☑ Display the Block Numbers on the Graph?

Calculate Settlement and Time for Settlement to Occur



Squish - Subsurface Profile Input Values

Depth to Groundwater (ft)	17
σ_p' Option	OCR

Calculate Settlement and Time for Settlement

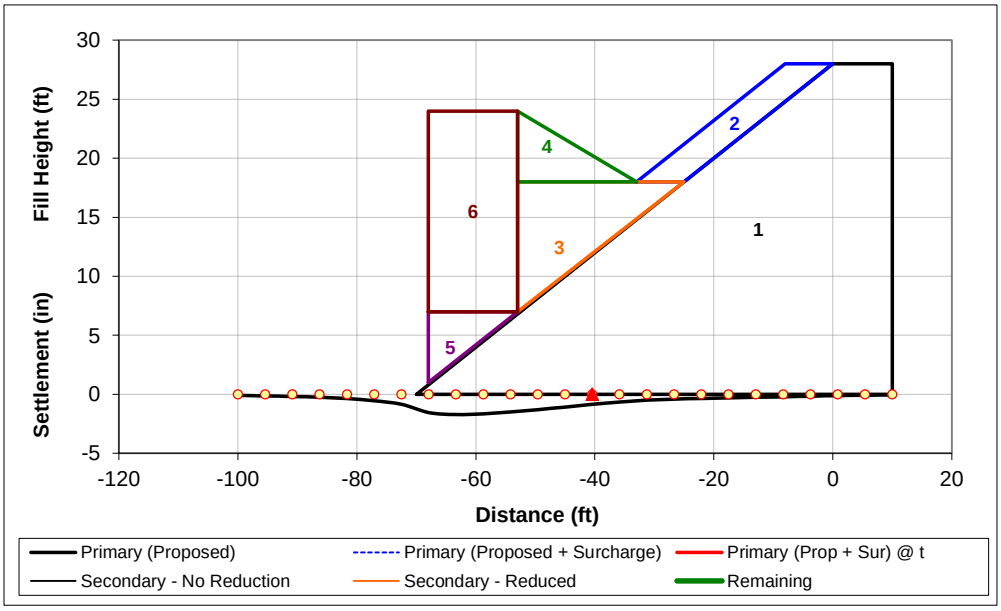
Time for Secondary Consol (years)	20
Assume Primary Complete at Ui =	95%
Min. $\Delta\sigma$' to Induce Secondary (psf) =	0
Rebound after surcharge	Exclude
Secondary Consol Reduction Method	None

Number of Time Steps	4000
Maximum Beta (finite difference)	0.15
Max Time Calculated (days)	*150*
Stress distribution method	● Boussinesq ○ Westergaard

Layer Thickness		*Settlement Parameters*						*Time Rate of Settlement Values*					*Wicks*	*Strength Values*	
Top (ft)	Bottom (ft)	γ (pcf)	Cεc	Cεr	OCR	Cα	Cαr	Time Dependent	Cv (ft^2/day)	k (ft/day)	Top Drained	Bottom Drained	C_h (ft^2/day)	s	m
0	11	125	0.010	0.010	1.0	0.003	0.0003	**Yes**	1	1	Yes	Yes			
11	23	120	0.025	0.025	1.0			No							
23	50	125	0.008	0.008	1.0										

Squish - Settlement Results

Evaluate Effective Stresses at t = 150.0 **days**



Block	Fill Type
1	Existing
2	Proposed
3	Proposed
4	Proposed
5	Proposed
6	Proposed

Items to Graph

Primary Consolidation

- ☑ Proposed Only
- ☐ Final P + S
- ☐ P+S at t = 150 days

Secondary Consolidation

- ☐ No Reduction
- ☐ With Reduction
- ☐ **Total Remaining**

Location of Point		Proposed Embankment (t = ∞)				
X (ft)	Y (ft)	Primary (in)				
Maximum Values		***1.7***				
-100.0	130	0.1				
-95.4	130	0.1				
-90.8	130	0.2				
-86.3	130	0.3				
-81.7	130	0.4				
-77.1	130	0.5				
-72.5	130	0.9				
-67.9	130	1.5				
-63.3	130	1.7				
-58.8	130	1.7				
-54.2	130	1.5				
-49.6	130	1.3				
-45.0	130	1.1				
-40.4	130	0.9				
-35.8	130	0.7				
-31.3	130	0.5				
-26.7	130	0.4				
-22.1	130	0.4				
-17.5	130	0.3				
-12.9	130	0.3				
-8.3	130	0.2				
-3.8	130	0.2				
0.8	130	0.1				
5.4	130	0.1				
10.0	130	0.1				

MSE Wall #1- MSEW+ Analysis

FHWA-NHI-10-024
MOT-Vandalia Bikeway (PID 111388)

MSEW+: Update # 2022.01

PROJECT IDENTIFICATION

Title: MOT-Vandalia Bikeway (PID 111388)
Project Number: N1225269
Client: LJB Inc.
Designer: SK/DWW
Station Number: MSE Wall #1

Description:

Relevant Borings B-1 and B-2; Maximum Wall Exposed Height = 8' 3"

Company's information:

Name: Terracon Consultants, Inc
Street: 611 Lunken Park Drive

Cincinnati, OH 45226
Telephone #:
Fax #:
E-Mail:

File path and name: N:\Projects\2022\N1225269\Working Files\Calculations-An.....
.....alia Bikeway-SK.BENp

Original date and time of creating this file: Thu Feb 09 11:24:47 2023

PROGRAM MODE:

ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight,	γ	120.0 lb/ft ^{3}
Design value of internal angle of friction,	ϕ	34.0 °

RETAINED SOIL

Unit weight,	γ	120.0 lb/ft ^{3}
Design value of internal angle of friction,	ϕ	26.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight,	$\gamma_{equiv.}$	125.0 lb/ft ^{3}
Equivalent internal angle of friction,	$\phi_{equiv.}$	26.0 °
Equivalent cohesion,	$c_{equiv.}$	100.0 lb/ft ^{2}

Water table does not affect bearing capacity

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.2827 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.3905 (if batter is less than 10°, Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

BEARING CAPACITY

Bearing capacity is controlled by general shear.
Bearing capacity factors (calculated by MSEW): Nc = 0.00 N γ= 8.24

SEISMICITY

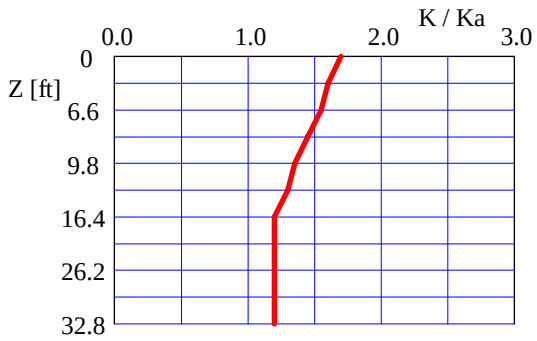
Not Applicable

INPUT DATA: Metal strips (Analysis)

D A T A	Metal strip type #1	Metal strip type #2	Metal strip type #3	Metal strip type #4	Metal strip type #5
Yield strength of steel, Fy [kips/in ²]	65.3	N/A	N/A	N/A	N/A
Gross width of strip, b [in]	2.0	N/A	N/A	N/A	N/A
Vertical spacing, Sv [ft]	Varies	N/A	N/A	N/A	N/A
Design cross section area, Ac [in ²]	0.23	N/A	N/A	N/A	N/A
Ribbed steel strips.					
Uniformity Coefficient of reinforced soil, Cu = D60/D10 = 4.0					
Friction angle along reinforcement-soil interface, ρ					
@ the top	60.97	N/A	N/A	N/A	N/A
@ 19.7 ft or below	32.00	N/A	N/A	N/A	N/A
Pullout resistance factor, F*					
@ the top	1.80	N/A	N/A	N/A	N/A
@ 19.7 ft or below	0.62	N/A	N/A	N/A	N/A
Scale-effect correction factor, α	1.00	N/A	N/A	N/A	N/A

Variation of Lateral Earth Pressure Coefficient With Depth

Z	K / Ka
0 ft	1.70
3.3 ft	1.60
6.6 ft	1.55
9.8 ft	1.45
13.1 ft	1.35
16.4 ft	1.30
19.7 ft	1.20



INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd 11.25 [ft] { Embedded depth is E = 3.00 ft, and height above top of finished bottom grade is H = 8.25 ft }
Soil in front of the wall is inclined at 3H:1V. Hs = 6.56 ft.

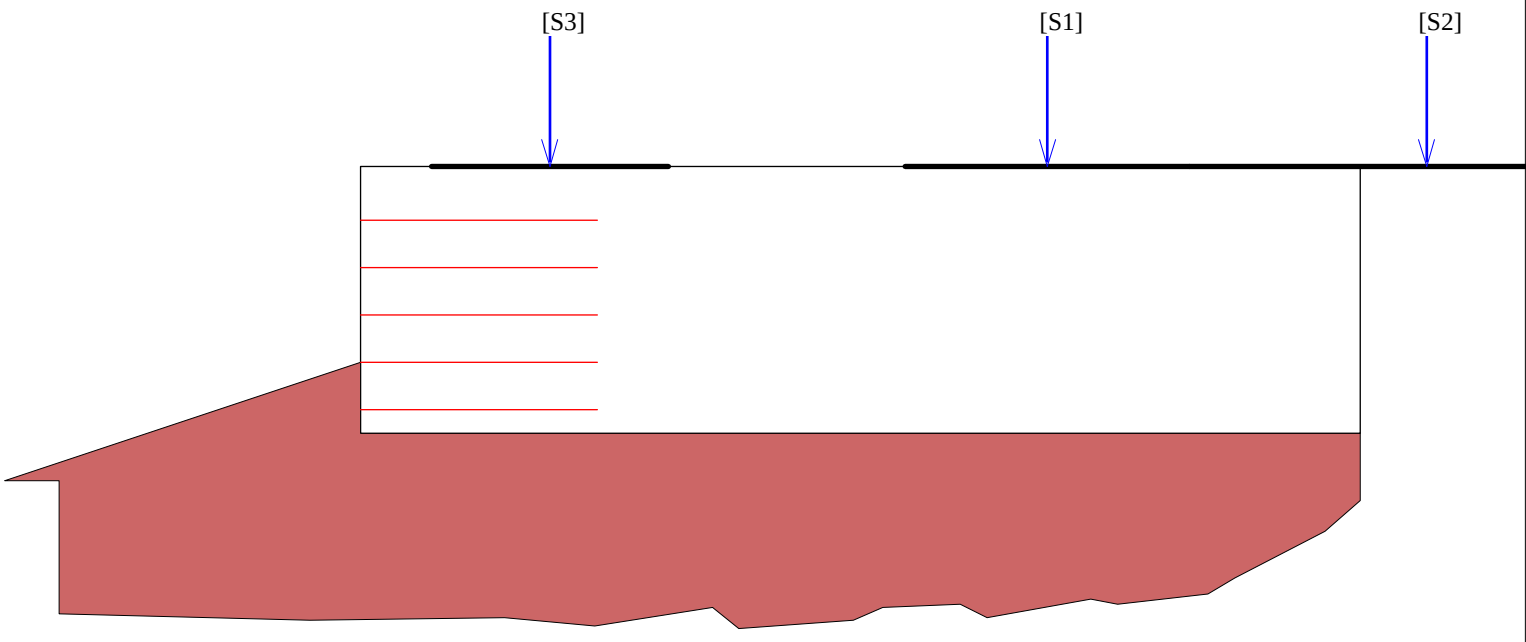
Batter, ω 0.0 [deg]
Backslope, β 0.0 [deg]
Backslope rise 0.0 [ft] Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

U N I F O R M S U R C H A R G E
Uniformly distributed dead load is 0.0 [lb/ft ²]

OTHER EXTERNAL LOAD(S)
[S1] Strip Load, Pv-d = 312.5 and Pv-l = 0.0 [lb/ft].
Footing width, b=12.0 [ft]. Distance of center of footing from wall face, d = 29.0 [ft] @ depth of 0.0 [ft] below soil surface.
[S2] Strip Load, Pv-d = 625.0 and Pv-l = 0.0 [lb/ft].
Footing width, b=20.0 [ft]. Distance of center of footing from wall face, d = 45.0 [ft] @ depth of 0.0 [ft] below soil surface.
[S3] Strip Load, Pv-d = 0.0 and Pv-l = 150.0 [lb/ft].
Footing width, b=10.0 [ft]. Distance of center of footing from wall face, d = 8.0 [ft] @ depth of 0.0 [ft] below soil surface.

ANALYZED REINFORCEMENT LAYOUT:

S1= Sloping Embankment Load (5' tall) = 0.5 X 5 x 125 = 312.5 psf/feet
S2= Pavement Embankment (S2)= 5 x 125 = 625 psf/feet
S3= Live load for pedestrian/bikeway traffic = 150 psf/feet



SCALE:

0 2 4 6 [ft]

FHWA-NHI-10-024 – Load and Resisting Factors

INTERNAL STABILITY

Load factor for vertical earth pressure, EV:	$\gamma_{p\text{-}EV}$	1.35
Load factor for earthquake loads, EQ:	$\gamma_{p\text{-}EQ}$	1.00
Load factor for live load surcharge, LS: (Same as in External Stability).	$\gamma_{p\text{-}LS}$	1.75
Load factor for dead load surcharge, ES: (Same as in External Stability).	$\gamma_{p\text{-}ES}$	1.50

Resistance factor for reinforcement tension	ϕ	Static	Combined static/seismic
Metal Strips:		0.75	1.00

Resistance factor for reinforcement tension in connectors	ϕ	Static	Combined static/seismic
Metal Strips:		0.75	1.00

Resistance factor for reinforcement pullout	ϕ	0.90	1.20

EXTERNAL STABILITY

Load factor for vertical earth pressure, EV			Static	Combined Static/Seismic	
Sliding and Eccentricity	$\gamma_{p\text{-}EV}$	1.00	$\gamma_{p\text{-}EQ}$	1.00
Bearing Capacity	$\gamma_{p\text{-}EV}$	1.35	$\gamma_{p\text{-}EQ}$	1.35

Load factor of active lateral earth pressure, EH	$\gamma_{p\text{-}EH}$	1.50
Load factor of active lateral earth pressure during earthquake (does not multiply P_{AE} and P_{IR}):	$(\gamma_{p\text{-}EH})_{EQ}$	1.50
Load factor for earthquake loads, EQ (multiplies P_{AE} and P_{IR}):	$\gamma_{p\text{-}EQ}$	1.00

Resistance factor for shear resistance along common interfaces			Static	Combined Static/Seismic	
Reinforced Soil and Foundation	ϕ_τ	1.00		1.00
Reinforced Soil and Reinforcement	ϕ_τ	1.00		1.00

Resistance factor for bearing capacity of shallow foundation		Static	Combined Static/Seismic
	ϕ_b	0.65	0.65

ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity, CDR = 1.21, factored bearing load = 2255 lb/ft².
Foundation Interface: Direct sliding, CDR = 1.679, Eccentricity, e/L = 0.1272, CDR-overturning = 3.93

#	METAL STRIP Elevation [ft]	Length [ft]	Type #	CONNECTION CDR [pullout resistance]	CDR [connection break]	CDR [metal strip strength]	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	1.00	10.00	1	N/A	3.06	3.40	3.397	1.214	2.208	0.1060	---
2	3.00	10.00	1	N/A	3.64	4.04	4.040	1.116	2.728	0.0693	---
3	5.00	10.00	1	N/A	4.62	5.13	5.131	1.000	3.567	0.0404	---
4	7.00	10.00	1	N/A	6.57	7.30	7.299	0.993	5.145	0.0193	---
5	9.00	10.00	1	N/A	9.84	10.93	10.931	0.848	9.207	0.0059	---

GLOBAL/COMPOUND STABILITY ANALYSIS (Using Bishop method and ROR = 0.0)

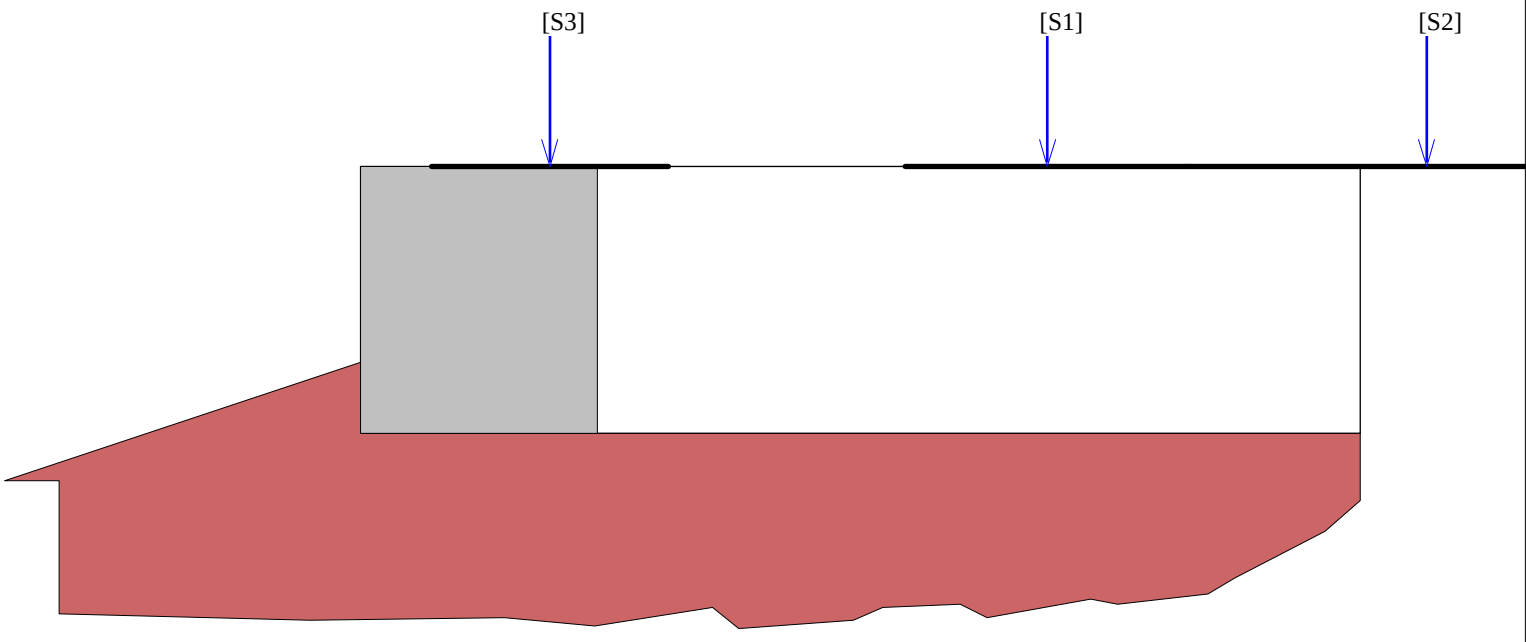
For the specified search grid, the calculated minimum Fs is 2.552
(it corresponds to a critical circle at Xc = 3.95, Yc = 35.00 and R = 35.94 [ft]).

BEARING CAPACITY for GIVEN LAYOUT

	STATIC	SEISMIC	UNITS
(Water table does not affect bearing capacity)			
Factored bearing resistance, q-n	2734	N/A	[lb/ft ²]
Factored bearing load, σ_V	2254.9	N/A	[lb/ft ²]
Eccentricity, e	0.92	N/A	[ft]
Eccentricity, e/L	0.092	N/A	
CDR calculated	1.21	N/A	
Base length	10.00	N/A	[ft]

Unfactored applied bearing pressure = (Unfactored R) / [L - 2 * (Unfactored e)] =
Unfactored R = 13604.99 [lb/ft], L = 10.00, Unfactored e = 0.83 [ft], and Sigma = 1629.94 [lb/ft ²]

S1= Sloping Embankment Load (5' tall) = 0.5 X 5 x 125 = 312.5 psf/feet
S2= Pavement Embankment (S2)= 5 x 125 = 625 psf/feet
S3= Live load for pedestrian/bikeway traffic = 150 psf/feet



SCALE:

0 2 4 6 [ft]

DIRECT SLIDING for GIVEN LAYOUT (for METAL STRIPS reinforcements)

Along reinforced and foundation soils interface: CDR-static = 1.679

#	Metal strip Elevation [ft]	Metal strip Length [ft]	CDR Static	CDR Seismic	Metal strip Type #	Product name
1	1.00	10.00	2.208	N/A	1	---
2	3.00	10.00	2.728	N/A	1	---
3	5.00	10.00	3.567	N/A	1	---
4	7.00	10.00	5.145	N/A	1	---
5	9.00	10.00	9.207	N/A	1	---

ECCENTRICITY for GIVEN LAYOUT (for Simplified Method)

At interface with foundation: e/L static = 0.1272; Overturning: CDR-static = 3.93

#	Metal strip Elevation [ft]	Metal strip Length [ft]	e / L Static	e / L Seismic	Metal strip Type #	Product name
1	1.00	10.00	0.1060	N/A	1	---
2	3.00	10.00	0.0693	N/A	1	---
3	5.00	10.00	0.0404	N/A	1	---
4	7.00	10.00	0.0193	N/A	1	---
5	9.00	10.00	0.0059	N/A	1	---

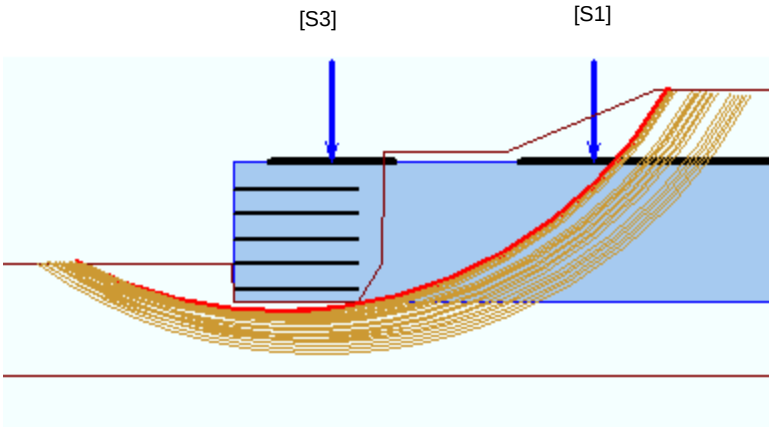
GLOBAL/COMPOUND STABILITY ANALYSIS (Using Bishop method and ROR = 0.0)

For the specified search grid, the calculated minimum Fs is 2.552
(it corresponds to a critical circle at Xc = 3.95, Yc = 35.00 and R = 35.94 [ft] where (x=0, y=0) is taken at the TOE or
Xc = 103.95, Yc = 1035.00 and R = 35.94 [ft] when the terrain coordinate system is used as shown in the table below.)

TERRAIN/WATER PROFILE

Point	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11
Soil layer #1:	γ = 125.00 [lb/ft ^{3}]			ϕ = 26.0°		c = 100.00 [lb/ft ^{2}]					
x [ft]	0.0	6.6	13.1	19.7	26.2	88.0	100.0	112.0	112.1	122.0	134.0
y [ft]	998.0	998.0	998.0	998.0	998.0	998.0	998.0	998.0	1007.0	1007.0	1012.0
Soil layer #2	γ = 125.00 [lb/ft ^{3}]			ϕ = 28.0°		c = 150.00 [lb/ft ^{2}]					
x [ft]	0.0	6.6	13.1	19.7	26.2	275.6	282.1	288.7	295.3	311.7	328.1
y [ft]	989.0	989.0	989.0	989.0	989.0	989.0	989.0	989.0	989.0	989.0	989.0

S1= Sloping Embankment Load (5' tall) = 0.5 X 5 x 125 = 312.5 psf/feet
S3= Live load for pedestrian/bikeway traffic = 150 psf/feet



MSE Wall #2- MSEW+ Analysis

AASHTO 2017-2020
MOT-Vandalia Bikeway (PID 111388)

MSEW+: Update # 2022.01

PROJECT IDENTIFICATION

Title:	MOT-Vandalia Bikeway (PID 111388)
Project Number:	N1225269
Client:	LJB Inc.
Designer:	SK/DWW
Station Number:	200+91.69

Description:

Relevant Borings B-3 and B-4; Maximum Wall Exposed Height = 24' 1"

Company's information:

Name: Terracon Consultants, Inc
Street: 611 Lunken Park Drive

Cincinnati, OH 45226
Telephone #:
Fax #:
E-Mail:

File path and name: N:\Projects\2022\N1225269\Working Files\Calculations-An.....
.....alia Bikeway-SK.BENp

Original date and time of creating this file: Thu Feb 09 11:24:47 2023

PROGRAM MODE:

ANALYSIS
of a SIMPLE STRUCTURE
using METAL STRIPS as reinforcing material.

SOIL DATA

REINFORCED SOIL

Unit weight, γ	125.0 lb/ft ³
Design value of internal angle of friction, ϕ	32.0 °

RETAINED SOIL

Unit weight, γ	125.0 lb/ft ³
Design value of internal angle of friction, ϕ	30.0 °

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{equiv.}$	125.0 lb/ft ³
Equivalent internal angle of friction, $\phi_{equiv.}$	34.0 °
Equivalent cohesion, $c_{equiv.}$	0.0 lb/ft ²

Water table does not affect bearing capacity

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.3073 (if batter is less than 10°, Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Ka (external stability) = 0.2994 (eq. 17 is utilized to calculate Ka for all batters)
(For external stability user specified δ = 17.00°)

BEARING CAPACITY

Bearing capacity is controlled by general shear.
Bearing capacity factors (calculated by MSEW): Nc = 19.19 N γ= 18.69

SEISMICITY

Not Applicable

FOR EXTERNAL STABILITY

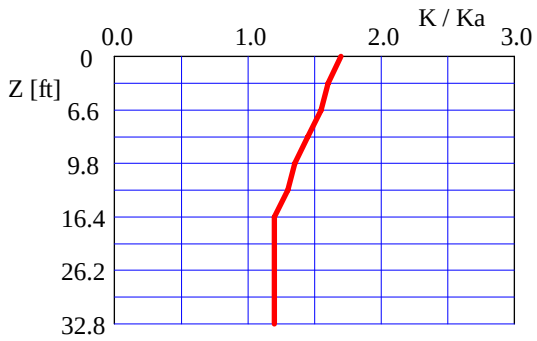
Ka = 0.2994 In Coulomb equation for Ka, Omega was taken as ZERO and backslope inclined at angle I.

INPUT DATA: Metal strips (Analysis)

D A T A	Metal strip type #1	Metal strip type #2	Metal strip type #3	Metal strip type #4	Metal strip type #5
Yield strength of steel, Fy [kips/in ²]	65.3	N/A	N/A	N/A	N/A
Gross width of strip, b [in]	2.0	N/A	N/A	N/A	N/A
Vertical spacing, Sv [ft]	Varies	N/A	N/A	N/A	N/A
Design cross section area, Ac [in ²]	0.23	N/A	N/A	N/A	N/A
Ribbed steel strips.					
Uniformity Coefficient of reinforced soil, Cu = D60/D10 = 4.0					
Friction angle along reinforcement-soil interface, ρ					
@ the top	60.97	N/A	N/A	N/A	N/A
@ 19.7 ft or below	32.00	N/A	N/A	N/A	N/A
Pullout resistance factor, F*					
@ the top	1.80	N/A	N/A	N/A	N/A
@ 19.7 ft or below	0.62	N/A	N/A	N/A	N/A
Scale-effect correction factor, α	1.00	N/A	N/A	N/A	N/A

Variation of Lateral Earth Pressure Coefficient With Depth

Z	K / Ka
0 ft	1.70
3.3 ft	1.60
6.6 ft	1.55
9.8 ft	1.45
13.1 ft	1.35
16.4 ft	1.30
19.7 ft	1.20



INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd 27.00 [ft] { Embedded depth is E = 3.00 ft, and height above top of finished bottom grade is H = 24.00 ft }
Soil in front of wall is inclined at 18.0°, Hs = 24.00 ft. and bs = 0.00 ft.

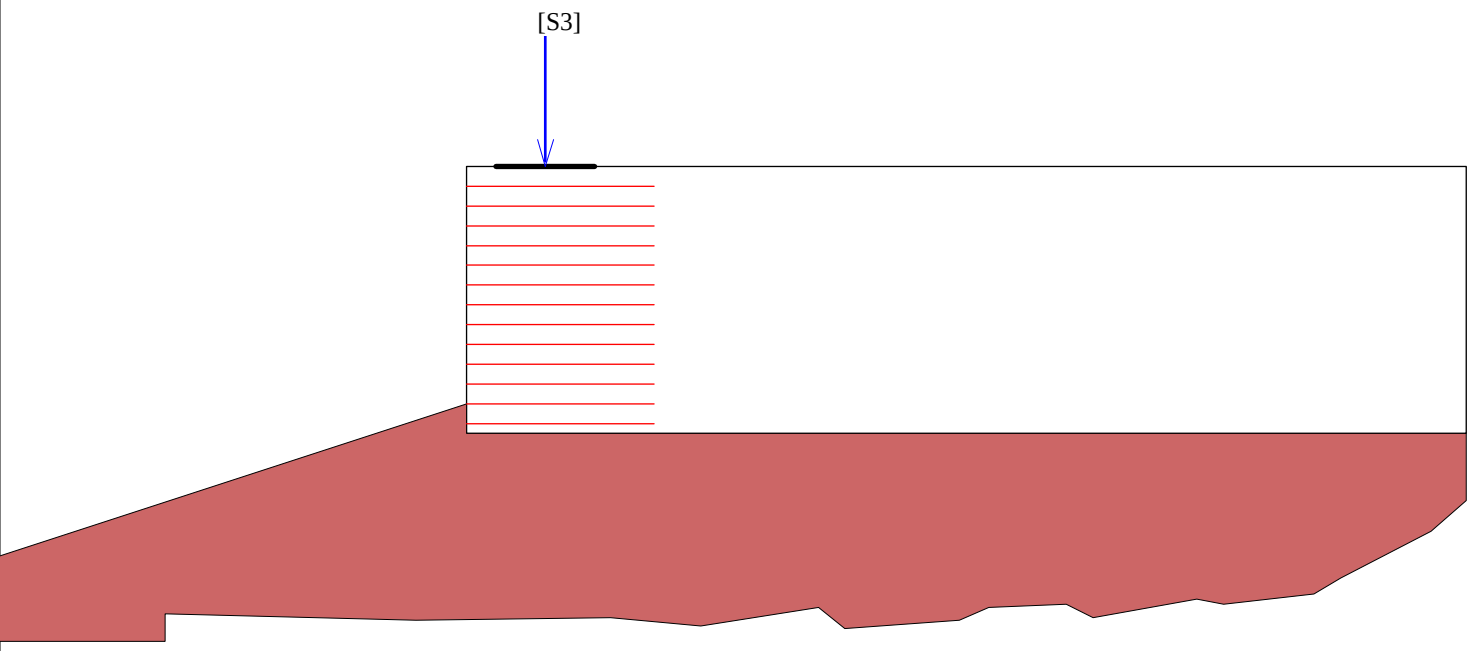
Batter, ω 0.0 [deg]
Backslope, β 0.0 [deg]
Backslope rise 0.0 [ft] Broken back equivalent angle, I = 0.00° (see Fig. 25 in DEMO 82)

U N I F O R M S U R C H A R G E
Uniformly distributed dead load is 0.0 [lb/ft ²]

OTHER EXTERNAL LOAD(S)
[S3] Strip Load, Pv-d = 0.0 and Pv-l = 150.0 [lb/ft].
Footing width, b=10.0 [ft]. Distance of center of footing from wall face, d = 8.0 [ft] @ depth of 0.0 [ft] below soil surface.

ANALYZED REINFORCEMENT LAYOUT:

S3= Live load for pedestrian/bikeway traffic = 150 psf/feet



SCALE:

0 2 4 6 8 10[ft]

AASHTO 2017-2020 – Load and Resisting Factors

INTERNAL STABILITY

Load factor for vertical earth pressure, EV:	$\gamma_{p\text{-}EV}$	1.35
Load factor for earthquake loads, EQ:	$\gamma_{p\text{-}EQ}$	1.00
Load factor for live load surcharge, LS: (Same as in External Stability).	$\gamma_{p\text{-}LS}$	1.75
Load factor for dead load surcharge, ES: (Same as in External Stability).	$\gamma_{p\text{-}ES}$	1.50

Resistance factor for reinforcement tension	ϕ	Static	Combined static/seismic
Metal Strips:		0.75	1.00

Resistance factor for reinforcement tension in connectors	ϕ	Static	Combined static/seismic
Metal Strips:		0.75	1.00

Resistance factor for Metal Strips pullout	ϕ	1.00	1.00

EXTERNAL STABILITY

Load factor for vertical earth pressure, EV			Static	Combined Static/Seismic	
Sliding and Eccentricity	$\gamma_{p\text{-}EV}$	1.00	$\gamma_{p\text{-}EQ}$	1.00
Bearing Capacity	$\gamma_{p\text{-}EV}$	1.35	$\gamma_{p\text{-}EQ}$	1.35

Load factor of active lateral earth pressure, EH	$\gamma_{p\text{-}EH}$	1.50
Load factor of active lateral earth pressure during earthquake (does not multiply P_{AE} and P_{IR}):	$(\gamma_{p\text{-}EH})_{EQ}$	1.50
Load factor for earthquake loads, EQ (multiplies P_{AE} and P_{IR}):	$\gamma_{p\text{-}EQ}$	1.00

Resistance factor for shear resistance along common interfaces		Static	Combined Static/Seismic	
Reinforced Soil and Foundation	ϕ_τ	1.00		1.00
Reinforced Soil and Reinforcement	ϕ_τ	1.00		1.00

Resistance factor for bearing capacity of shallow foundation		Static	Combined Static/Seismic
	ϕ_b	0.65	0.65

ANALYSIS: CALCULATED FACTORS (Static conditions)

Bearing capacity, CDR = 2.21, factored bearing load = 5652 lb/ft².
Foundation Interface: Direct sliding, CDR = 2.238, Eccentricity, e/L = 0.0896, CDR-overturning = 4.10

METAL STRIP				CONNECTION						
#	Elevation [ft]	Length [ft]	Type #	CDR [connection break]	CDR Strength	Metal strip strength CDR	Pullout resistance CDR	Direct sliding CDR	Eccentricity e/L	Product name
1	1.00	19.00	1	1.28	1.42	1.424	1.535	2.317	0.0818	---
2	3.00	19.00	1	1.39	1.54	1.542	1.434	2.494	0.0672	---
3	5.00	19.00	1	1.51	1.68	1.681	1.334	2.704	0.0539	---
4	7.00	19.00	1	1.65	1.83	1.833	1.223	2.955	0.0419	---
5	9.00	19.00	1	1.77	1.97	1.971	1.263	3.262	0.0312	---
6	11.00	19.00	1	1.92	2.13	2.130	1.288	3.646	0.0219	---
7	13.00	19.00	1	2.13	2.37	2.366	1.292	4.140	0.0140	---
8	15.00	19.00	1	2.40	2.67	2.667	1.365	4.798	0.0075	---
9	17.00	19.00	1	2.75	3.06	3.060	1.449	5.719	0.0025	---
10	19.00	19.00	1	3.30	3.66	3.662	1.525	7.101	-0.0011	---
11	21.00	19.00	1	4.23	4.70	4.702	1.602	9.405	-0.0032	---
12	23.00	19.00	1	6.14	6.82	6.822	1.678	14.011	-0.0037	---
13	25.00	19.00	1	10.11	11.24	11.236	1.488	27.832	-0.0026	---

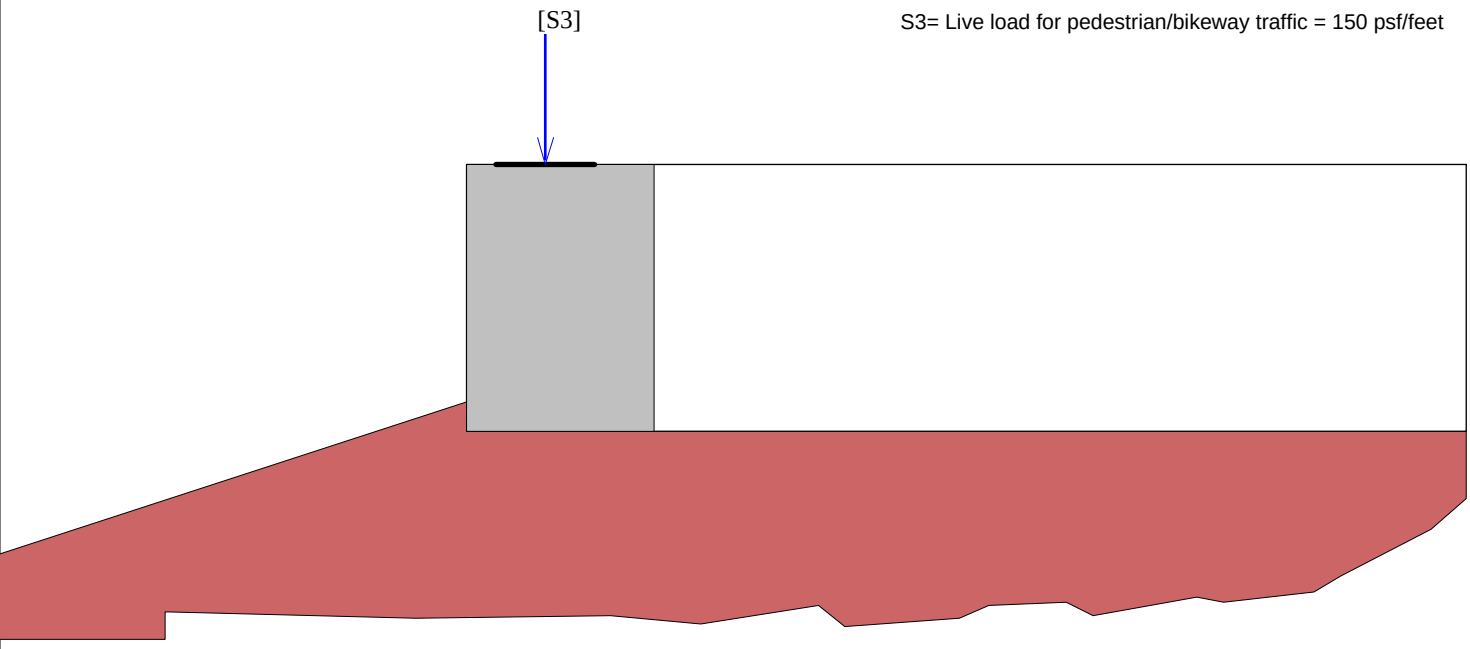
GLOBAL/COMPOUND STABILITY ANALYSIS (Using Bishop method and ROR = 0.0)

For the specified search grid, the calculated minimum Fs is 1.577
(it corresponds to a critical circle at Xc = -1.05, Yc = 37.11 and R = 42.18 [ft]).

BEARING CAPACITY for GIVEN LAYOUT – Using AASHTO 2017-2020 method

	STATIC	SEISMIC	UNITS
(Water table does not affect bearing capacity)			
Factored bearing resistance, q-n	12465	N/A	[lb/ft ²]
Factored bearing load, σ_V	5652.2	N/A	[lb/ft ²]
Eccentricity, e	1.29	N/A	[ft]
Eccentricity, e/L	0.068	N/A	
CDR calculated	2.21	N/A	
Base length	19.00	N/A	[ft]

Unfactored applied bearing pressure = (Unfactored R) / [L - 2 * (Unfactored e)] =
Unfactored R = 68263.83 [lb/ft], L = 19.00, Unfactored e = 1.17 [ft], and Sigma = 4096.64 [lb/ft ²]



SCALE:

0 2 4 6 8 10[ft]

DIRECT SLIDING for GIVEN LAYOUT (for METAL STRIPS reinforcements)

Along reinforced and foundation soils interface: CDR-static = 2.238

#	Metal strip Elevation [ft]	Metal strip Length [ft]	CDR Static	CDR Seismic	Metal strip Type #	Product name
1	1.00	19.00	2.317	N/A	1	---
2	3.00	19.00	2.494	N/A	1	---
3	5.00	19.00	2.704	N/A	1	---
4	7.00	19.00	2.955	N/A	1	---
5	9.00	19.00	3.262	N/A	1	---
6	11.00	19.00	3.646	N/A	1	---
7	13.00	19.00	4.140	N/A	1	---
8	15.00	19.00	4.798	N/A	1	---
9	17.00	19.00	5.719	N/A	1	---
10	19.00	19.00	7.101	N/A	1	---
11	21.00	19.00	9.405	N/A	1	---
12	23.00	19.00	14.011	N/A	1	---
13	25.00	19.00	27.832	N/A	1	---

ECCENTRICITY for GIVEN LAYOUT (for Simplified Method)

At interface with foundation: e/L static = 0.0896; Overturning: CDR-static = 4.10

#	Metal strip Elevation [ft]	Metal strip Length [ft]	e / L Static	e / L Seismic	Metal strip Type #	Product name
1	1.00	19.00	0.0818	N/A	1	---
2	3.00	19.00	0.0672	N/A	1	---
3	5.00	19.00	0.0539	N/A	1	---
4	7.00	19.00	0.0419	N/A	1	---
5	9.00	19.00	0.0312	N/A	1	---
6	11.00	19.00	0.0219	N/A	1	---
7	13.00	19.00	0.0140	N/A	1	---
8	15.00	19.00	0.0075	N/A	1	---
9	17.00	19.00	0.0025	N/A	1	---
10	19.00	19.00	-0.0011	N/A	1	---
11	21.00	19.00	-0.0032	N/A	1	---
12	23.00	19.00	-0.0037	N/A	1	---
13	25.00	19.00	-0.0026	N/A	1	---

GLOBAL/COMPOUND STABILITY ANALYSIS (Using Bishop method and ROR = 0.0)

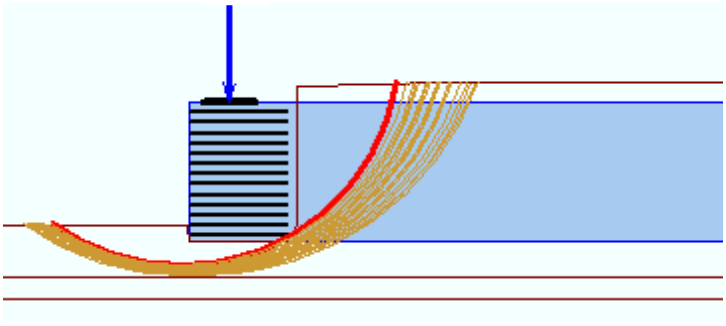
For the specified search grid, the calculated minimum Fs is 1.577
(it corresponds to a critical circle at Xc = -1.05, Yc = 37.11 and R = 42.18 [ft] where (x=0, y=0) is taken at the TOE or
Xc = 98.95, Yc = 1037.11 and R = 42.18 [ft] when the terrain coordinate system is used as shown in the table below.)

TERRAIN/WATER PROFILE

Point	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11
Soil layer #1:	γ = 125.00 [lb/ft ^{3}]			ϕ = 26.0°		c = 100.00 [lb/ft ^{2}]					
x [ft]	0.0	6.6	13.1	19.7	26.2	88.0	100.0	121.0	121.1	122.0	150.0
y [ft]	998.0	998.0	998.0	998.0	998.0	998.0	998.0	998.0	1025.0	1025.0	1026.0
Soil layer #2	γ = 125.00 [lb/ft ^{3}]			ϕ = 34.0°		c = 0.00 [lb/ft ^{2}]					
x [ft]	0.0	6.6	13.1	19.7	26.2	275.6	282.1	288.7	295.3	311.7	328.1
y [ft]	988.0	988.0	988.0	988.0	988.0	988.0	988.0	988.0	988.0	988.0	988.0
Soil layer #3:	γ = 120.00 [lb/ft ^{3}]			ϕ = 26.0°		c = 50.00 [lb/ft ^{2}]					
x [ft]	0.0	6.6	13.1	19.7	26.2	275.6	282.1	288.7	295.3	311.7	328.1
y [ft]	984.0	984.0	984.0	984.0	984.0	984.0	984.0	984.0	984.0	984.0	984.0

S3= Live load for pedestrian/bikeway traffic = 150 psf/feet

[S3]



ODOT Soil Classification

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		$LL_O/LL \times 100$*	% Pass #40	% Pass #200	Liquid Limit (LL)	Plastic Index (PI)	Group Index Max.	REMARKS
		AASHTO	OHIO							
	Gravel and/or Stone Fragments	A-1-a			30 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	
	Fine Sand	A-3			51 Min.	10 Max.	NON-PLASTIC		0	
	Coarse and Fine Sand	--	A-3a			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	75 Min.		36 Min.	40 Max.	10 Max.	8	Less than 50% silt sizes
	Silt	A-4	A-4b	75 Min.		50 Min.	40 Max.	10 Max.	8	50% or more silt sizes
	Elastic Silt and Clay	A-5		75 Min.		36 Min.	41 Min.	10 Max.	12	
	Silt and Clay	A-6	A-6a	75 Min.		36 Min.	40 Max.	11 - 15	10	
	Silty Clay	A-6	A-6b	75 Min.		36 Min.	40 Max.	16 Min.	16	
	Elastic Clay	A-7-5		75 Min.		36 Min.	41 Min.	$\leq$LL-30	20	
	Clay	A-7-6		75 Min.		36 Min.	41 Min.	>LL-30	20	
	Organic Silt	A-8	A-8a	74 Max.		36 Min.				W/o organics would classify as A-4a or A-4b
	Organic Clay	A-8	A-8b	74 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

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

Geotechnical Profile Sheets

PROJECT DESCRIPTION

THE PROJECT INCLUDES THE CONSTRUCTION OF TWO MECHANICALLY STABILIZED EARTH (MSE) RETAINING WALLS ON THE NORTH SIDE OF US-40 FOR THE PROPOSED BIKEWAY CONNECTOR TO THE EXISTING GREAT MIAMI RIVER BIKE TRAIL IN TAYLORSVILLE METRO PARK, VANDALIA, MONTGOMERY COUNTY, OHIO.

GEOLOGY

OUR EXPERIENCE NEAR THE VICINITY OF THE PROPOSED SITE AND A REVIEW OF GEOLOGIC MAPS INDICATED SUBSURFACE CONDITIONS CONSISTING OF MAN-PLACED FILL UNDERLAIN BY NATIVE COHESIVE AND COHESIONLESS OVERBURDEN SOILS OF GLACIAL OUTWASH ORIGIN. THE TEST BORINGS PERFORMED FOR THIS STUDY ENCOUNTERED EXISTING FILL UNDERLAIN BY SOILS OF GLACIAL ORIGIN. THE MAN-PLACED FILL IS ASSOCIATED WITH THE EMBANKMENT CONSTRUCTION OF US-40 HIGHWAY. ACCORDING TO BEDROCK GEOLOGY MAPS, THE SUBSURFACE SOILS AT THE SITE ARE UNDERLAIN BY ORDOVICIAN AGE BEDROCK BELONGING TO THE CINCINNATI GROUP FORMATION PRIMARILY CONSISTING OF INTERBEDDED SHALE AND LIMESTONE. BEDROCK WAS NOT ENCOUNTERED WITHIN THE MAXIMUM EXPLORATION DEPTH (40 FEET) OF THE TEST BORINGS.

RECONNAISSANCE

FIELD RECONNAISSANCE WAS COMPLETED ON DECEMBER 29, 2022, BY TERRACON PERSONNEL. DURING THE FIELD RECONNAISSANCE, TERRACON DID NOT IDENTIFY ANY VISUAL SIGNS OF GEOHAZARDS WITHIN THE PROJECT AREA.

SUBSURFACE EXPLORATION

A TOTAL OF FOUR BORINGS (B-001-0-23 TO B-004-0-23) WERE PERFORMED BY TERRACON ON 1/16/2023 AND 1/17/2023. THE TEST BORINGS WERE DRILLED USING A DIEDRICH D-50 (TERRACON DRILL RIG #932) TRACK-MOUNTED DRILL RIG. THE TEST BORINGS WERE DRILLED TO DEPTHS OF 35 TO 40 FEET BELOW THE EXISTING GROUND SURFACE. ALL FOUR TEST BORINGS TERMINATED IN NATIVE GRANULAR SOILS OF GLACIAL OUTWASH ORIGIN. THE DRILL RIG UTILIZED CONTINUOUS-FLIGHT HOLLOW-STEM AUGERS AND SPLIT-SPOON SAMPLING. DRILLING AND SAMPLING PROCEDURES WERE PERFORMED IN GENERAL ACCORDANCE WITH THE ODOT SPECIFICATIONS FOR GEOTECHNICAL EXPLORATION (SGE). THE AVERAGE DRILL ROD ENERGY RATIO (ER) FOR THE DRILL RIG WAS DETERMINED TO BE 85 PERCENT (CALIBRATION DATE 9/2/2022).

EXPLORATION FINDINGS

THE SUBSURFACE PROFILE IN THE TEST BORINGS GENERALLY CONSISTS OF A MIXTURE OF GRANULAR AND COHESIVE SOILS THROUGHOUT THE EXPLORATION DEPTH. THE SOILS CONSISTED OF A MIXTURE OF A-1-A, A-1-B, A-6A, A-4A, A-3A, A-7-6 AND A-6B. AT MSE WALL #1 (WALL STA. 100+27.70 TO STA. 102+77.70), THE SOIL PROFILE CONSISTS PRIMARILY OF SILT AND CLAY WITH VARYING AMOUNTS OF SAND AND GRAVEL. THESE SOILS WERE GENERALLY STIFF TO HARD IN CONSISTENCY. AT MSE WALL #2 (WALL STA. 200+18.11 TO STA. 202+83.11), THE SOIL PROFILE CONSISTS OF VARIABLE AMOUNT OF GRAVEL, SAND, SILT, AND CLAY. THE COHESIVE SOILS WERE GENERALLY MEDIUM STIFF TO STIFF IN TERMS OF CONSISTENCY, AND THE COHESIONLESS SOILS WERE GENERALLY MEDIUM DENSE TO VERY DENSE IN TERMS OF RELATIVE DENSITY, EXCEPT FOR A VERY LOOSE SANDY SILT (A-4-A) STRATUM ENCOUNTERED BETWEEN 23.5 AND 28.5 FEET AT BORING B-004-0-23.

GROUNDWATER WAS ENCOUNTERED IN TEST BORINGS B-001-0-23, B-003-0-23, AND B-004-0-23 DURING DRILLING AT RESPECTIVE DEPTHS OF 22, 19, AND 21 FEET BELOW THE GROUND SURFACE. GROUNDWATER WAS NOT OBSERVED IN BORING B-002-0-23 DURING AND IMMEDIATELY AFTER DRILLING. ALL TEST BORINGS WERE BACKFILLED IMMEDIATELY UPON COMPLETION WITH BENTONITE CHIPS AND SOIL CUTTINGS. THE PAVEMENT BORINGS (B-001-0-23 AND B-002-0-23) WERE PATCHED WITH COLD-MIX ASPHALT AT THE SURFACE.

SPECIFICATIONS

THIS GEOTECHNICAL EXPLORATION WAS PERFORMED IN ACCORDANCE WITH THE STATE OF OHIO, DEPARTMENT OF TRANSPORTATION, OFFICE OF GEOTECHNICAL ENGINEERING, SPECIFICATIONS OF GEOTECHNICAL EXPLORATIONS, DATED JULY, 2022.

AVAILABLE INFORMATION

THE SOIL, BEDROCK, AND GROUNDWATER INFORMATION COLLECTED FOR THIS SUBSURFACE EXPLORATION THAT CAN BE CONVENIENTLY DISPLAYED ON THE SOIL PROFILE SHEETS HAS BEEN PRESENTED. GEOTECHNICAL REPORTS, IF PREPARED, ARE AVAILABLE FOR REVIEW ON THE OFFICE OF CONTRACT SALES WEBSITE.

LEGEND

DESCRIPTION	ODOT CLASS	CLASSIFIED MECH./VISUAL	
GRAVEL/STONE FRAGMENTS W/SAND	A-1-b	5	7
COARSE AND FINE SAND	A-3a	1	3
SANDY SILT	A-4a	8	5
SILT AND CLAY	A-6a	3	4
SILTY CLAY	A-6b	2	7
SILT	A-7-6	1	0
	TOTAL	20	26
SOD AND TOPSOIL = X = APPROXIMATE THICKNESS	VISUAL		
PAVEMENT OR BASE = X = APPROXIMATE THICKNESS	VISUAL		

BORING LOCATION - PLAN VIEW.

DRIVE SAMPLE AND/OR ROCK CORE BORING PLOTTED TO VERTICAL SCALE ONLY. HORIZONTAL BAR INDICATES A CHANGE IN STRATIGRAPHY.

WC — INDICATES WATER CONTENT IN PERCENT.

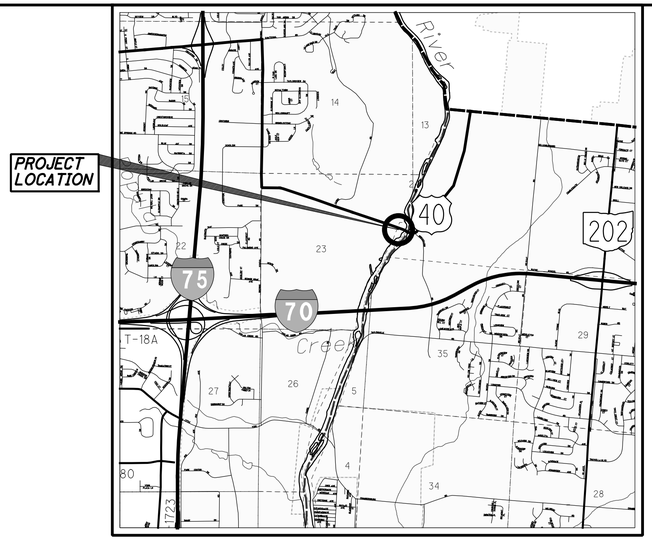
N_{60} — INDICATES STANDARD PENETRATION RESISTANCE NORMALIZED TO 60% DRILL ROD ENERGY RATIO.

X/Y/Z — NUMBER OF BLOWS FOR STANDARD PENETRATION TEST (SPT):
X= NUMBER OF BLOWS FOR FIRST 6 INCHES.
Y= NUMBER OF BLOWS FOR SECOND 6 INCHES.
Z= NUMBER OF BLOWS FOR THIRD 6 INCHES.

W — INDICATES FREE WATER ELEVATION.

INDICATES STATIC WATER ELEVATION.

SS — INDICATES A SPLIT SPOON SAMPLE.



LOCATION MAP

SCALE IN MILES

0 1 2 3 4

PARTICLE SIZE DEFINITIONS

12"	3"	2.0 mm	0.42 mm	0.074 mm	0.005 mm
BOULDERS	COBBLES	GRAVEL	COARSE SAND	FINE SAND	SILT	CLAY
		No. 10 SIEVE	No. 40 SIEVE	No. 200 SIEVE		

RECON. - MP 12/29/22
DRILLING - AR 1/16/23-1/17/23
DRAWN - KM 2/16/23
REVIEWED - DWW 2/16/23

GEOTECHNICAL PROFILE - RETAINING WALLS
VANDALIA BIKEWAY

DESIGN AGENCY: Terracon

DESIGNER: SK
REVIEWER: DWW 02-16-23
PROJECT ID: 111388
SUBSET: 1 TOTAL: 9
SHEET: 163 TOTAL: 171

MOT-VANDALIA-BIKEWAY

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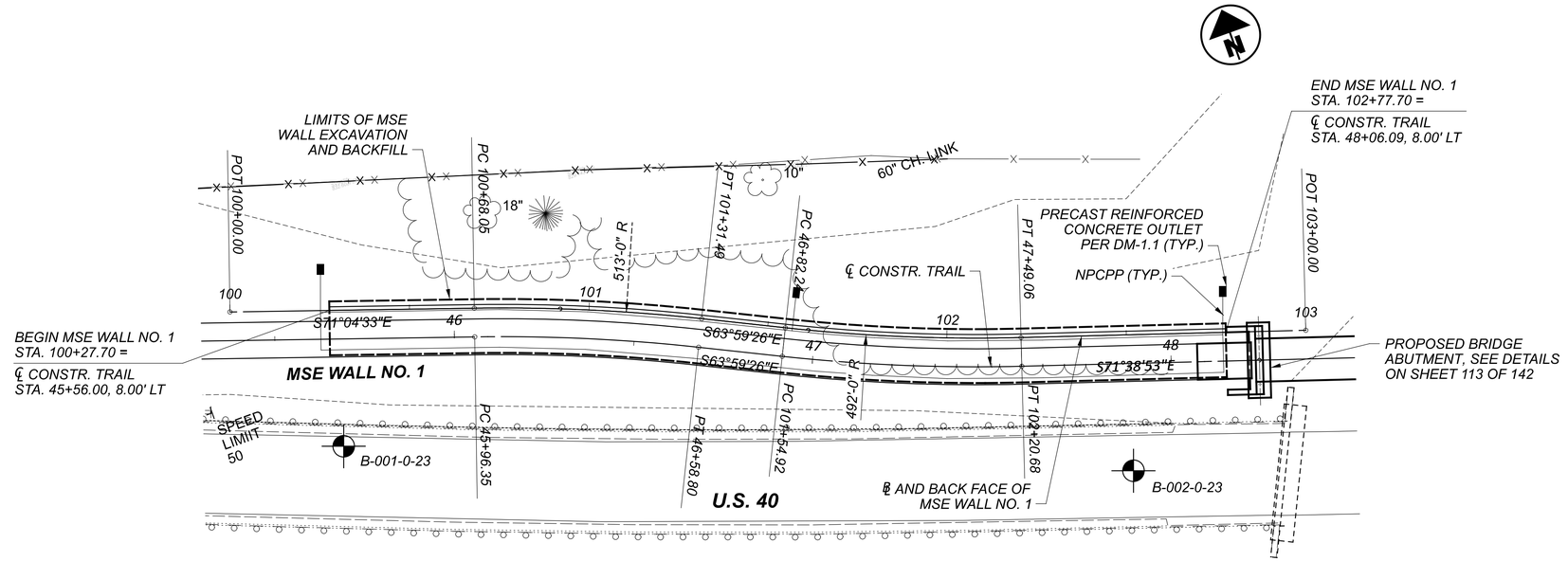

MSE WALL NO. 1 PLAN

GEOTECHNICAL PROFILE - RETAINING WALLS
RETAINING WALL NO. 1

MOT-VANDALIA BIKEWAY

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DESIGN AGENCY
Terracon
Expect more

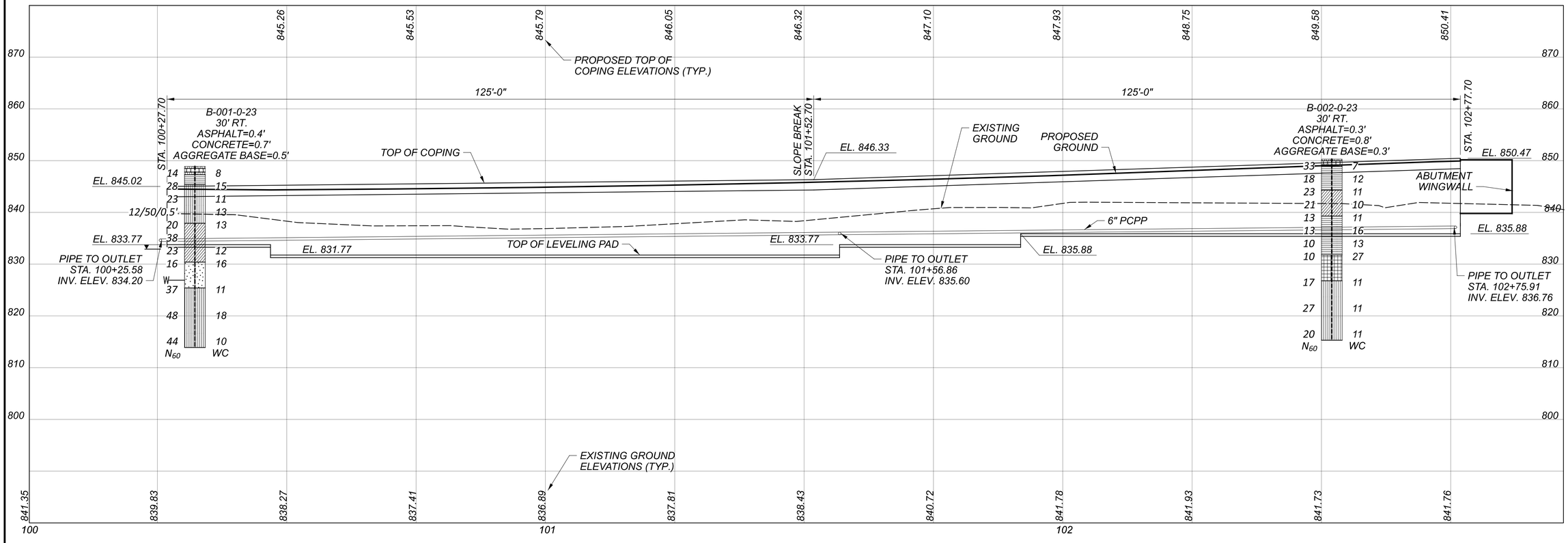
DESIGNER
SK

REVIEWER
DWW 02-16-23

PROJECT ID
111388

SUBSET 2 | TOTAL 9

SHEET 164 | TOTAL 171



MSE WALL NO. 1 ELEVATION

MOT-VANDALIA BIKEWAY

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GEOTECHNICAL PROFILE - RETAINING WALLS
RETAINING WALL NO. 1 ELEVATION

DESIGN AGENCY
Terracon

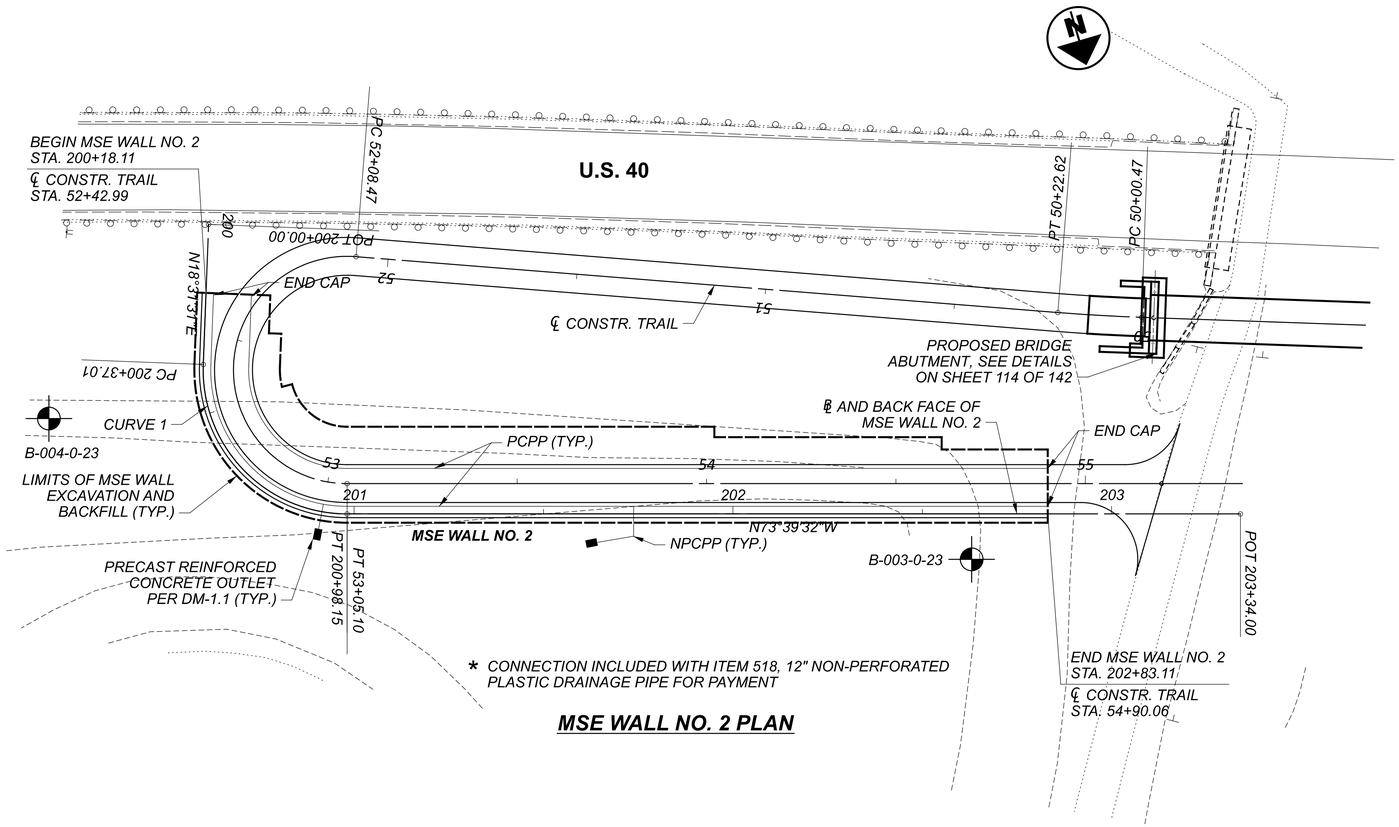
DESIGNER
SK

REVIEWER
DWW 02-16-23

PROJECT ID
111388

SUBSET 3 | TOTAL 9

SHEET 165 | TOTAL 171



* CONNECTION INCLUDED WITH ITEM 518, 12" NON-PERFORATED PLASTIC DRAINAGE PIPE FOR PAYMENT

MSE WALL NO. 2 PLAN

MOT-VANDALIA BIKEWAY

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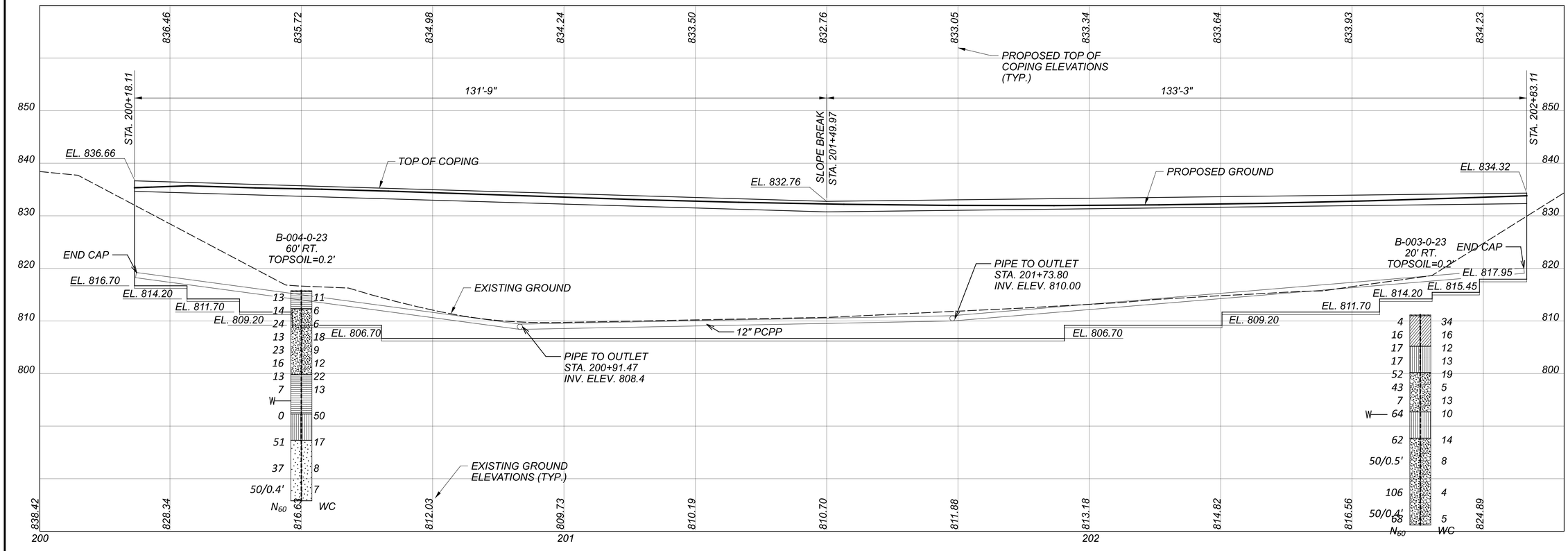
GEOTECHNICAL PROFILE - RETAINING WALLS
RETAINING WALL NO. 2

DESIGN AGENCY
Terracon

DESIGNER	SK
REVIEWER	DWW 02-16-23
PROJECT ID	111388
SUBSET / TOTAL	4 / 9
SHEET / TOTAL	166 / 171



MSE WALL NO. 2 ELEVATION

MOT-VANDALIA BIKEWAY

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GEOTECHNICAL PROFILE - RETAINING WALLS
RETAINING WALL NO. 2 ELEVATION

DESIGN AGENCY
Terracon
Consult with us

DESIGNER	SK
REVIEWER	DWW 02-16-23
PROJECT ID	111388
SUBSET / TOTAL	5 / 9
SHEET / TOTAL	167 / 171

MODEL: COVER SHEET PAPERSIZE: 34x22 (in.) DATE: 11/10/2023 TIME: 1:27:40 PM USER: bcmilner
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PROJECT: MOT-VANDALIA BIKEWAY
TYPE: RETAINING WALL
PID: 111388 SFN:
START: 1/16/23 END: 1/16/23

DRILLING FIRM / OPERATOR: TERRACON / AR
SAMPLING FIRM / LOGGER: TERRACON / JL
DRILLING METHOD: 3.25" HSA
SAMPLING METHOD: SPT

DRILL RIG: DIEDRICH D50
HAMMER: AUTOMATIC HAMMER
CALIBRATION DATE: 9/2/22
ENERGY RATIO (%): 85

STATION / OFFSET: 45+60, 30' RT.
ALIGNMENT: US-40
ELEVATION: 848.9 (MSL) EOB: 35.0 ft.
LAT / LONG: 39.876872, -84.172321

EXPLORATION ID B-001-0-23

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 848.9	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 (3.5 INCHES)	848.6																	
CONCRETE (9 INCHES)	847.9																	
AGGREGATE BASE (5 INCHES)	847.4																	
STIFF, BROWN TRACE GRAY, **SILTY CLAY**, TRACE SAND, DAMP (FILL)	845.4		17 6 4	14	83	SS-1	2.00	-	-	-	-	-	-	-	-	8	A-6b (V)	
VERY STIFF, BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, DRY (FILL)			5 9 11	28	100	SS-2	4.00	9	11	18	34	28	25	16	9	15	A-4a (5)	
			8 6 10	23	100	SS-3	3.50	-	-	-	-	-	-	-	-	11	A-4a (V)	
@8.5'; WITH ASPHALT FRAGMENTS AND CONCRETE FRAGMENTS	837.9		12 50	-	56	SS-4	3.00	-	-	-	-	-	-	-	-	13	A-4a (V)	
VERY STIFF TO HARD, BROWN, **SILT AND CLAY**, SOME SAND, LITTLE GRAVEL, DAMP TO MOIST			8 6 8	20	33	SS-5	-	14	10	18	30	28	30	17	13	13	A-6a (6)	
@13.5'; NO RECOVERY DUE TO COBBLES			8 13 14	38	0	SS-6	-	-	-	-	-	-	-	-	-	-	A-6a (V)	
		▼	7 8 8	23	83	SS-7	2.00	-	-	-	-	-	-	-	-	12	A-6a (V)	
MEDIUM DENSE, BROWN, **COARSE AND FINE SAND**, SOME SILT, LITTLE GRAVEL, TRACE CLAY, DAMP	830.4		5 6 5	16	67	SS-8	-	19	17	35	21	8	NP	NP	NP	16	A-3a (0)	
		W 826.9																
HARD, DARK BROWN, **SANDY SILT**, SOME CLAY, LITTLE GRAVEL, WET	825.4		7 11 15	37	100	SS-9	4.50	17	11	16	33	23	19	13	6	11	A-4a (4)	
			15 17 17	48	28	SS-10	-	-	-	-	-	-	-	-	-	18	A-4a (V)	
	813.9	EOB	8 14 17	44	100	SS-11	4.50	11	12	18	34	25	21	13	8	10	A-4a (5)	

NOTES: CAVE-IN AT 24'; GROUNDWATER ENCOUNTERED AT 22' DURING DRILLING AND 16' AFTER DRILLING;
ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED ASPHALT PATCH; AUGER CUTTINGS MIXED WITH BENTONITE CHIPS

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH.DOT.GDT - 2/15/23 16:43 - N:\PROJECTS\2022\N1225269\WORKING FILES\LABORATORY-FIELD DATA-BORING LOGS\N1225269 MOT-VANDALIA BIKE.GPJ

SHEET 168 | TOTAL 171
SUBSET 6 | TOTAL 9
PROJECT ID 111388
REVIEWER DWW 02-16-23
DESIGNER SK
DESIGN AGENCY Terracon Explore with us

GEOTECHNICAL PROFILE - RETAINING WALLS
BORING LOG B-001-0-23

MOT-VANDALIA BIKEWAY

MODEL: B-002-0-23 PAPERSIZE: 34x22 (in.) DATE: 11/10/2023 TIME: 1:34:57 PM USER: bcmilner
Z:\HCN Projects\AutoCAD\2022\122\1225269\111388_ZL001.dgn

PROJECT: MOT-VANDALIA BIKEWAY
TYPE: RETAINING WALL
PID: 111388 SFN:
START: 1/16/23 END: 1/16/23

DRILLING FIRM / OPERATOR: TERRACON / AR
SAMPLING FIRM / LOGGER: TERRACON / JL
DRILLING METHOD: 3.25" HSA
SAMPLING METHOD: SPT

DRILL RIG: DIEDRICH D50
HAMMER: AUTOMATIC HAMMER
CALIBRATION DATE: 9/2/22
ENERGY RATIO (%): 85

STATION / OFFSET: 47+80, 30' RT.
ALIGNMENT: US-40
ELEVATION: 850.3 (MSL) EOB: 35.0 ft.
LAT / LONG: 39.876650, -84.171486

EXPLORATION ID B-002-0-23
PAGE 1 OF 1

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 (3.5 INCHES)	850.3																	
CONCRETE (10 INCHES)	850.0																	
AGGREGATE BASE (3 INCHES)	849.2																	
VERY STIFF TO HARD, BROWN TRACE GRAY, **SILTY CLAY**, LITTLE TO SOME SAND, DAMP (FILL)	848.9		8 10 13	33	72	SS-1	2.00	-	-	-	-	-	-	-	-	7	A-6b (V)	
			7 6 7	18	100	SS-2	3.50	-	-	-	-	-	-	-	-	12	A-6b (V)	
VERY STIFF, BROWN, **SILT AND CLAY**, LITTLE GRAVEL, SOME SAND, DRY (FILL)	844.3		5 8 8	23	100	SS-3	2.50	17	12	18	30	23	25	14	11	11	A-6a (4)	
			9 8 7	21	100	SS-4	3.00	-	-	-	-	-	-	-	-	10	A-6a (V)	
STIFF TO VERY STIFF, BROWN TO DARK BROWN, **SILTY CLAY**, TRACE GRAVEL, SOME SAND, DAMP	839.3		3 4 5	13	100	SS-5	1.50	-	-	-	-	-	-	-	-	11	A-6b (V)	
			4 4 5	13	100	SS-6	2.00	5	9	15	35	36	37	18	19	16	A-6b (11)	
			2 3 4	10	28	SS-7	2.50	-	-	-	-	-	-	-	-	13	A-6b (V)	
STIFF, BROWN, **CLAY**, SOME SILT, LITTLE SAND, DAMP	831.8		3 3 4	10	22	SS-8	1.50	0	2	17	34	47	50	19	31	27	A-7-6 (18)	
VERY STIFF, BROWN, **SANDY SILT**, LITTLE TO SOME GRAVEL, LITTLE CLAY, DAMP	826.8		4 5 7	17	28	SS-9	3.00	-	-	-	-	-	-	-	-	11	A-4a (V)	
			6 8 11	27	100	SS-10	4.00	24	10	17	30	19	22	14	8	11	A-4a (3)	
	815.3	EOB	4 5 9	20	100	SS-11	4.00	12	12	19	38	19	21	13	8	11	A-4a (4)	

NOTES: CAVE-IN AT 16'; GROUNDWATER NOT ENCOUNTERED DURING AND AFTER DRILLING;
ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED ASPHALT PATCH; AUGER CUTTINGS MIXED WITH BENTONITE CHIPS

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT.GDT - 2/15/23 16:43 - N:\PROJECTS\2022\N1225269\WORKING FILES\LABORATORY-FIELD DATA-BORING LOGS\N1225269 MOT-VANDALIA BIKE.GPJ

SHEET	TOTAL	SUBSET	TOTAL	PROJECT ID	REVIEWER	DESIGNER	DESIGN AGENCY
169	171	7	9	111388	DWW 02-16-23	SK	Terracon

GEOTECHNICAL PROFILE - RETAINING WALLS
BORING LOG B-002-0-23

MODEL: B-003-0-23 PAPERSIZE: 34x22 (in.) DATE: 11/10/2023 TIME: 1:38:53 PM USER: bcmilner
Z:\HCN Projects\AutoCAD\2022\122\1225269\111388_ZL001.dgn

PROJECT: MOT-VANDALIA BIKEWAY
TYPE: RETAINING WALL
PID: 111388 SFN:
START: 1/17/23 END: 1/17/23

DRILLING FIRM / OPERATOR: TERRACON / AR
SAMPLING FIRM / LOGGER: TERRACON / JL
DRILLING METHOD: 3.25" HSA
SAMPLING METHOD: SPT

DRILL RIG: DIEDRICH D50
HAMMER: AUTOMATIC HAMMER
CALIBRATION DATE: 9/2/22
ENERGY RATIO (%): 85

STATION / OFFSET: 54+70, 20' RT.
ALIGNMENT: US-40
ELEVATION: 811.2 (MSL) EOB: 40.0 ft.
LAT / LONG: 39.876688, -84.170349

EXPLORATION ID B-003-0-23
PAGE 1 OF 1

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
TOPSOIL (3 INCHES)	811.0																	
STIFF, REDDISH BROWN, **SILT AND CLAY**, SOME SAND, LITTLE GRAVEL, DAMP			1 1 2	4	100	SS-1	1.00	-	-	-	-	-	-	-	-	34	A-6a (V)	
	805.2		5 5 6	16	100	SS-2	2.00	11	10	18	32	29	29	16	13	16	A-6a (6)	
STIFF, BROWN, **SANDY SILT**, LITTLE GRAVEL, LITTLE CLAY, DRY			4 7 5	17	28	SS-3	2.00	-	-	-	-	-	-	-	-	12	A-4a (V)	
	800.2		5 6 6	17	28	SS-4	-	18	14	19	33	16	20	15	5	13	A-4a (3)	
DENSE, BROWN TO GRAYISH BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT, TRACE CLAY, DRY			7 14 23	52	100	SS-5	-	-	-	-	-	-	-	-	-	19	A-1-b (V)	
			17 17 13	43	28	SS-6	-	44	29	12	8	7	NP	NP	NP	5	A-1-b (0)	
@16.0'; LOOSE			6 3 2	7	17	SS-7	-	-	-	-	-	-	-	-	-	13	A-1-b (V)	
	792.7																	
HARD, DARK GRAY TO BROWN, **SANDY SILT**, LITTLE GRAVEL, LITTLE CLAY, TRACE IRON OXIDE CONCRETIONS, DAMP		W 792.2	17 21 24	64	100	SS-8	4.50	15	13	21	36	15	20	14	6	10	A-4a (3)	
	787.7																	
VERY DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, TRACE SILT, TRACE CLAY, DAMP TO MOIST			20 24 20	62	11	SS-9	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	
			50	-	83	SS-10	-	39	32	25	1	3	NP	NP	NP	8	A-1-b (0)	
			24 42 33	106	83	SS-11	-	-	-	-	-	-	-	-	-	4	A-1-b (V)	
	771.2	EOB	39 21 27	68	22	SS-12	-	43	21	23	8	5	NP	NP	NP	5	A-1-b (0)	

NOTES: CAVE-IN AT 31'; GROUNDWATER ENCOUNTERED AT 19' DURING DRILLING AND NOT ENCOUNTERED AFTER DRILLING;
ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH BENTONITE CHIPS

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT.GDT - 2/15/23 16:43 - N:\PROJECTS\2022\N1225269\WORKING FILES\LABORATORY-FIELD DATA-BORING LOGS\N1225269 MOT-VANDALIA BIKE.GPJ

SHEET	TOTAL	SUBSET	TOTAL	PROJECT ID	REVIEWER	DESIGNER	DESIGN AGENCY
170	171	8	9	111388	DWW 02-16-23	SK	Terracon

GEOTECHNICAL PROFILE - RETAINING WALLS
BORING LOG B-003-0-23

MODEL: B-004-0-23 PAPERSIZE: 34x22 (in.) DATE: 11/10/2023 TIME: 1:42:04 PM USER: bcmilner
Z:\HCN Projects\AutoCAD\2022\122\1225269\111388_ZL001.dgn

PROJECT: MOT-VANDALIA BIKEWAY
TYPE: RETAINING WALL
PID: 111388 SFN:
START: 1/17/23 END: 1/17/23

DRILLING FIRM / OPERATOR: TERRACON / AR
SAMPLING FIRM / LOGGER: TERRACON / JL
DRILLING METHOD: 3.25" HSA
SAMPLING METHOD: SPT

DRILL RIG: DIEDRICH D50
HAMMER: AUTOMATIC HAMMER
CALIBRATION DATE: 9/2/22
ENERGY RATIO (%): 85

STATION / OFFSET: 52+80, 60' RT.
ALIGNMENT: US-40
ELEVATION: 815.8 (MSL) EOB: 40.0 ft.
LAT / LONG: 39.876387, -84.169664

EXPLORATION ID B-004-0-23
PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 815.8	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
TOPSOIL (2 INCHES)	815.6																	
STIFF, BROWN, **SILTY CLAY**, TRACE SAND, DAMP (FILL)			5 5 4	13	28	SS-1	-	-	-	-	-	-	-	-	-	11	A-6b (V)	
	812.3																	
MEDIUM DENSE, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, TRACE SILT, TRACE CLAY, DAMP			5 5 5	14	67	SS-2	-	-	-	-	-	-	-	-	-	6	A-1-b (V)	
			6 8 9	24	28	SS-3	-	48	25	17	6	4	NP	NP	NP	6	A-1-b (0)	
			5 3 6	13	28	SS-4	-	-	-	-	-	-	-	-	-	18	A-1-b (V)	
			6 7 9	23	67	SS-5	-	45	20	20	10	5	NP	NP	NP	9	A-1-b (0)	
			7 7 4	16	56	SS-6	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	
	799.8																	
MEDIUM STIFF TO STIFF, DARK BROWN, **SILTY CLAY**, SOME SAND, TRACE GRAVEL, DAMP			3 4 5	13	100	SS-7	1.50	4	4	23	28	41	40	22	18	22	A-6b (10)	
			2 2 3	7	28	SS-8	1.00	-	-	-	-	-	-	-	-	13	A-6b (V)	
		W 794.8																
	792.3																	
VERY LOOSE, BROWN TRACE RED, **SANDY SILT**, SOME GRAVEL, LITTLE CLAY, WET			0 0 0	0	28	SS-9	-	23	19	9	36	13	NP	NP	NP	50	A-4a (3)	
	787.3																	
DENSE TO VERY DENSE, BROWN, **COARSE AND FINE SAND**, LITTLE TO SOME SILT, TRACE TO LITTLE GRAVEL, TRACE CLAY, TRACE IRON OXIDE CONCRETIONS, DAMP			15 18 18	51	100	SS-10	-	-	-	-	-	-	-	-	-	17	A-3a (V)	
			10 17 9	37	100	SS-11	-	-	-	-	-	-	-	-	-	8	A-3a (V)	
			50/5"	-	80	SS-12	-	-	-	-	-	-	-	-	-	7	A-3a (V)	
	775.8	EOB																

NOTES: GROUNDWATER ENCOUNTERED AT 21' DURING DRILLING AND NOT ENCOUNTERED AFTER DRILLING;
ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH BENTONITE CHIPS

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT.GDT - 2/15/23 16:43 - N:\PROJECTS\2022\N122\1225269\WORKING FILES\LABORATORY-FIELD DATA-BORING LOGS\N1225269 MOT-VANDALIA BIKE.GPJ

SHEET	SUBSET	PROJECT ID	REVIEWER	DESIGNER	DESIGN AGENCY
171 TOTAL 171	9 TOTAL 9	111388	DWW 02-16-23	SK	Terracon Explore with us

GEOTECHNICAL PROFILE - RETAINING WALLS
BORING LOG B-004-0-23