Abutment Retaining Wall Report
I-275 Bridge over Elm Street
Knox County, Tennessee
S&ME Project No. 22430250
TDOT P.E. No. 47I275-F2-002
TDOT Pin No. 124437.00
Federal Project No. BR-I-275-3(136)
S&ME Project No. 22430250

PREPARED FOR:

HDR, Inc.
120 Brentwood Commons Way, Suite 525
Brentwood, Tennessee 37027

PREPARED BY:

S&ME, Inc.
1413 Topside Road
Knoxville, TN 37777

June 9, 2023

June 9, 2023

HDR, Inc.
120 Brentwood Commons Way, Suite 525
Brentwood, Tennessee 37027

Attention: Stan King, PE, PLS

Reference: **Report of Geotechnical Services**
I-275 – Bridge over Elm Street Abutment Retaining Walls
Knox County, Tennessee
TDOT P.E. No. 47I275-F2-002
TDOT Pin No. 124437.00
Federal Project No. BR-I-275-3(136)
S&ME Proposal No. 22430250

Dear Mr. King

S&ME, Inc. (S&ME) has completed our evaluation of the abutment retaining walls for the I-275 Bridge over Elm Street in Knoxville, Tennessee. We performed the exploration in general accordance with S&ME Proposal No. 22430250 dated November 10, 2022, and the Geotech Subconsultant Agreement between our firms dated December 7, 2021.

This report presents our understanding of the project, documents our findings, and presents our recommendations for the above referenced retaining walls. S&ME, Inc. appreciates the opportunity to be of service to HDR, and we look forward to helping you through project completion. Please contact us if you have any questions.

Sincerely,

S&ME, Inc.

Daniel Boles
Jun 9 2023 3:47 PM

DocuSign

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Appendices

1.0 Executive Summary

S&ME, Inc. (S&ME) has completed our evaluation for the I-275 bridge over Elm Street in Knoxville Tennessee. This report includes a site assessment and recommendations specific to the abutment retaining walls. Please see our bridge report for recommendations regarding the bridge.

This summary is presented for the convenience of the reader. The full report text should be studied and understood before preparing an estimation of quantities or preparing designs based on this report, as it contains important information and recommendations that are not included in this brief summary.

The existing foundations for Bents 1 and 3 are planned to be used to support the new retaining wall dead, live, and longitudinal loads (braking and temperature). The existing foundations are a combination of shallow footings bearing on bedrock and driven concrete piles bearing on bedrock. Based on our review of the subsurface information, the provided bridge plans (existing and proposed), and project discussions, the planned loads on the existing foundations are less than or essentially the same as the original foundation design loads. Given the existing bridge foundations are performing adequately and the new design loads are essentially the same or less than the original design loads, we believe reuse of the existing bridge foundations is appropriate. Additionally, TDOT Structures Division has reviewed the existing foundations for reuse as part of the proposed foundation system and has advised that no further investigations are required.

New shallow foundations between the existing foundations for the project are assumed to only carry the precast cap and retaining wall or pier wall loads for the new bridge. Based on our review of the subsurface information collected for the bridge, and the provided bridge plans and loads, we recommend shallow foundation support for the new bridge abutment retaining walls and pier wall on the underlying hard residual silts and clays and very dense weathered rock (weathered shale); soils and weathered rock with SPT N-values of 30 bpf and greater. Any fill material needs to be excavated to get down to the hard residual soils. We anticipate the shallow foundations for the new wing walls will bear on firm to very stiff fill and residual soils.

2.0 Introduction

Initial project information was provided to us by Mr. Stan King, PE, PLS of HDR via phone and email correspondence with Mr. Jeff Doubrava, PE, of S&ME between June 28 and June 30, 2022. Mr. King provided us with a PDF document of notes from a scoping meeting held between HDR and TDOT on April 13, 2022. The notes contain an outline of the planned scope discussed during that meeting along with a site location plan and conceptual bridge plan and elevation drawings. Subsequently, in March and April 2023, Mr. Carter Bearden provided bridge layout sheets and foundations loadings.

We understand that the existing I-275 Bridge over Elm Street will be replaced. The existing bridge is approximately 180 feet long and 144 feet wide carrying 8 lanes of traffic along I-275 over Elm Street. The existing bridge is composed of four spans, each approximately 25, 42, 41, and 25 feet long respectively. The planned bridge will be the same width with only two spans. Each of the spans of the planned bridge will be approximately 42 feet in length for an overall bridge length of about 84 feet. The shortened overall length of the new bridge will be accomplished by bringing the bridge abutments closer to Elm Street. Maintaining the existing vertical clearance under I-75 is required.

The existing slopes adjacent to the existing abutments will be eliminated as the new abutments will be located along the existing Bridge Bents 1 and 3 adjacent to either side of Elm Street and new abutment retaining walls will

be constructed. The existing foundations for Bents 1 and 3 will be maintained and incorporated into the new bridge abutments. The existing foundations are assumed to carry all the superstructure dead, live and wind loads. New shallow foundations between the existing foundations are assumed to only carry the precast cap and retaining wall loads. Longitudinal loads (braking and temperature) are assumed to be resisted by retaining walls through integral end bents. The foundations for existing Bent 1 are a combination of shallow spread footings and piles, while existing Bent 3 is supported on piles. The provided maximum service and strength bearing pressures for the new footings, as well as the maximum service and strength bearing pressures and loads on the existing footings and piles are included in Appendix I. The maximum service and strength bearing pressures for the new footings range from 2.78 to 3.25 and 3.47 to 4.06 kips per square foot (ksf), respectively.

We understand that the new foundations will be constructed while the existing bridge is still in service. The contractor will need to protect the existing bridge structure and foundations as well as provide shoring as needed.

3.0 Geology

The project site lies within the Appalachian Valley and Ridge Physiographic Province of East Tennessee. This Province is characterized by elongated, northeasterly-trending ridges formed on highly resistant sandstone and shale. Between ridges, broad valleys and rolling hills are formed primarily on less resistant limestone, dolomite, and shale.

Published geologic information indicates this site is underlain by bedrock of the Ottosee Shale formation of the Chickamauga Group. This formation is primarily composed of calcareous shale with minor amounts of coarsely crystalline, fossiliferous limestone (i.e. marble). The Ottosee Shale formation typically weathers to produce a tan or yellowish-brown clay residual soil with weathered shale fragments.

The boundary between soil and rock is not sharply defined in this geologic setting and there often is a transitional zone, termed "weathered rock" overlying competent bedrock. Weathering is facilitated by fractures, joints, and the presence of less resistant rock types. Consequently, the profile of the weathered rock and hard rock is quite irregular and erratic, even over short horizontal distances. Also, it is not unusual to find lenses and boulders of hard rock and/or zones of weathered rock within the soil mantle well above the general bedrock level.

Since the bedrock underlying this site contains carbonate rock (i.e. limestone/dolomite), it is susceptible to the hazards of irregular weathering, cave and cavern conditions, and overburden sinkholes. Carbonate rock, while appearing very hard and resistant, is soluble in slightly acidic water. This characteristic, plus differential weathering of the bedrock mass is responsible for these hazards. Of these hazards, the occurrence of sinkholes is potentially the most damaging to overlying soil-supported structures. Sinkholes occur primarily due to differential weathering of the bedrock and flushing or raveling of overburden soil into the cavities within the bedrock. This loss of solids creates a cavity, or dome, in the overburden. Growth of the cavity over time, or excavation over the dome, can create a condition in which rapid subsidence, or collapse, of the roof of the dome occurs.

A certain degree of risk with respect to sinkhole formation and subsidence should be considered with any site located within geologic areas underlain by potentially soluble rock units. While a rigorous effort to assess the potential for sinkhole formation on this site was beyond the scope of this evaluation, our borings did not encounter obvious indications of sinkhole development. In addition, we did not observe any surface signs of sinkhole activity at the site. However, some closed depressions, which denote past sinkhole activity, are shown on the United States Geological Survey (USGS) topographic map in the area of the site. It is our opinion the risk of sinkhole development at this site is comparable to other sites located within similar geologic settings which have

been developed successfully. However, the owner must be willing to accept the risk of future sinkhole development at this site.

4.0 Subsurface Exploration Procedures

The procedures used by S&ME, Inc. for field sampling and testing are in general accordance with ASTM procedures and established engineering practice in the State of Tennessee. Appendix II contains brief descriptions of the procedures used in this exploration.

S&ME, Inc. drilled 12 soil test borings for the project. The boring locations were requested based on assumed stations and offsets, as the alignment drawings for the new bridge were not yet available at the time of our exploration. Therefore, the boring locations were staked by members of our staff using approximate means, measuring distances and estimating right angles relative to onsite landmarks. Due to the approximate methods used to lay out the borings, the borings may not be located within the exact alignment of the structure. These borings are still close enough to provide relevant subsurface information.

A Diedrich-D50 drill rig with an automatic hammer was used to drill the borings. The borings were generally advanced from the ground surface with hollow-stem augering techniques coupled with Standard Penetration Testing (SPT) and split-spoon sampling. Rock coring was not performed in the abutment wing wall borings.

Undisturbed soil samples were collected for subsequent laboratory testing from selected borings. After each boring was completed, we measured the groundwater level, if present. The borings were backfilled with a borehole closure device and the auger cuttings.

The approximate boring locations are depicted on the abutment wall sheets in Appendix I. Our interpretation of the boring data obtained during our subsurface exploration is presented in the Test Boring Records and on Profile View on the abutment wall sheets. A summary of the boring locations is presented in Table 4-1.

Table 4-1 Locations of Retaining Wall Borings

Boring Number	SR-115 Station Number	Offset (feet)	Boring Ground Surface Elevation (feet)	Boring Depth (feet)
B-01	55+39	75 RT	902	50.1
B-02	55+04	75 RT	902	37.8
B-03	55+41	20 RT	902	32.8
B-04	55+05	12 RT	902	33.3
B-05	55+40	22 LT	903	39.8
B-06	55+06	22 LT	903	39.6
B-07	55+39	75 LT	904	49.5
B-08	55+04	76 LT	904	39.7
B-09	55+93	65 RT	922	30
B-10	54+38	63 RT	921	30
B-11	56+01	65 LT	922	40
B-12	54+41	64 LT	921	30

5.0 Subsurface Conditions

5.1 Test Boring Summary

The subsurface conditions encountered in the test borings are briefly summarized in Table 5-1. For a full description of the subsurface conditions along with the results of our moisture content and index property laboratory testing, please refer to the Test Boring Records in Appendix II.

Table 5-1 Summary of Test Borings Drilled for Retaining Walls

Boring Number Station, Offset	Ground Surface Elevation, Boring Depth	Soil Origin	General Soil Description	SPT N - Value Range or Rock REC/RQD Range	Surface Material
B-01 I-275 Sta. 55+39, 75 RT	EL. 902 ft 50.1 ft	FILL: 1.2 ft to 3 ft	CH	8	Asphalt, 4 in Aggregate Base, 10 in
		RESIDUUM: 3 ft to 21.4 ft	SC, WR	100+	
		ROCK: 21.4 ft to 50.1 ft	Calcareous Shale	94 – 100/68 - 96	
B-02 I-275 Sta. 55+04, 75 RT	EL. 902 ft 37.8 ft	FILL: 1.5 ft to 3 ft	CH	12	Asphalt, 7 in Aggregate Base, 11 in
		RESIDUUM: 3 ft to 7.6 ft	WR	100+	
		ROCK: 7.6 ft to 37.8 ft	Calcareous Shale	92 -100, 40 - 95	
B-03 I-275 Sta. 55+41, 20 RT	EL. 902 ft 32.8 ft	FILL: 0.9 ft to 1.5 ft	CH	14	Concrete, 11 in
		RESIDUUM: 1.5 ft to 13.7 ft	ML, WR	30 – 100+	
		ROCK: 13.7 ft to 32.8 ft	Calcareous Shale	82 – 100, 64 - 100	
B-04 I-275 Sta. 55+05, 12 RT	EL. 902 ft 33.3 ft	FILL: 0.9 ft to 5.5 ft	CH	4 – 8	Concrete, 11 in
		RESIDUUM: 5.5 ft to 15.4 ft	ML, WR	26 – 100+	
		ROCK: 15.4 ft to 33.3 ft	Calcareous Shale	100, 70 - 100	
B-05 I-275 Sta. 55+40 22 LT	EL. 903 ft 39.8 ft	FILL: 0.9 ft to 4 ft	CH	5	Concrete, 11 in
		RESIDUUM: 4 ft to 14.4 ft	ML, WR	61 – 100+	
		ROCK: 14.4 ft to 39.8 ft	Calcareous Shale	75 – 100, 0 – 96	
B-06 I-275 Sta. 55+06 22 LT	EL. 903 ft 39.6 ft	FILL: 0.9 ft to 4 ft	CH	13	Concrete, 11 in
		RESIDUUM: 4 ft to 17.6 ft	WR	22 – 100+	
		ROCK: 17.6 feet to 39.6 ft	Calcareous Shale	90 – 100, 40 – 100	
B-07 I-275 Sta. 55+39 75 LT	EL. 904 ft 49.5 ft	FILL: 1 ft to 3 ft	CH	9	Concrete, 10 in Aggregate Base, 2 in
		RESIDUUM: 3 ft to 24.4 ft	WR	100+	
		ROCK: 24.4 ft to 49.5 ft	Calcareous Shale	88 – 100, 60 – 100	

Boring Number Station, Offset	Ground Surface Elevation, Boring Depth	Soil Origin	General Soil Description	SPT N - Value Range or Rock REC/RQD Range	Surface Material
B-08 I-275 Sta. 55+04 76 LT	EL. 904 ft 39.7 ft	FILL: 1.3 ft to 3 ft	CH	7	Concrete, 10 in Aggregate Base, 6 in
		RESIDUUM: 3 ft to 12.3 ft	CH, WR	51 – 100+	
		ROCK 12.3 ft to 39.7 ft	Calcareous Shale	90 – 100, 62 – 90	
B-09 Sta. 55+93, 65 RT	EL. 922 ft 30 ft	FILL: 1.9 ft to 8 ft	CH	5 - 8	Asphalt, 8 in Concrete, 8 in Aggregate Base, 7 in
		RESIDUUM: 8 ft to 30 ft	CH, ML	8 – 21	
B-10 Sta. 54+38, 63 RT	EL. 921 ft 30 ft	FILL: 2 ft to 17.5 ft	GP, CL, CH	4 - 44	Asphalt 20 in Aggregate Base 4 in
		RESIDUUM: 17.5 ft to 30 ft	CH	10 – 16	
B-11 Sta. 56+01, 65 LT	EL. 922 ft 40 ft	FILL: 1.2 ft to 5.5 ft	CH	6 - 28	Asphalt 1 in Concrete 8 in Aggregate Base 6 in
		RESIDUUM: 5.5 ft to 40 ft	CH, CL	2 – 20	
B-12 Sta. 54+41, 64 LT	EL. 921 ft 30 ft	FILL: 1.5 ft to 17 ft	CH	3 - 6	Asphalt 16 in Aggregate Base 2 in
		RESIDUUM: 17 ft to 30 ft	CH	14 – 19	

5.2 Groundwater

Groundwater was encountered in test boring B-11 at the time of drilling at a depth of 29 feet beneath the existing ground surface (approximately elevation 893 feet). Groundwater was not encountered in the remaining borings at the time of drilling. It should be noted that groundwater levels can fluctuate with seasonal, climatic, and environmental changes. Therefore, groundwater may be encountered at different depths at some future time.

6.0 Laboratory Testing

Laboratory tests were performed on representative samples obtained during the field exploration phase of this project. We conducted moisture content, Atterberg limits, and grain size analysis on selected samples to aid our soil classification and to aid in determining soil strength parameters. The resulting soil descriptions are shown on the Test Boring Records in Appendix II.

In addition to the index property testing performed on split spoon samples, unconsolidated undrained triaxial compression testing and one dimensional consolidation testing was performed on undisturbed Shelby tube samples obtained during the field exploration. The laboratory test results and a brief description of the laboratory test procedures are presented in Appendix III.

7.0 Engineering Analyses

Bearing capacity, sliding, global stability and settlement analyses of the proposed retaining walls were performed. The results of our analyses are included in Appendix IV. A discussion of the analyses methods and results is presented in the following paragraphs.

7.1 Nominal Bearing Capacity

We performed an evaluation of the nominal bearing capacity of the subsurface material supporting the abutment walls. The analyses were performed using LRFD criteria for a cast in place (CIP) cantilever wall. The results of the analysis indicate a nominal bearing capacity of 11.5 kips per square foot (ksf) for the CIP cantilever walls bearing on hard residual soils and weathered rock with SPT N-values of 30 bpf and greater and a nominal bearing capacity of 8.5 ksf for the CIP wing walls bearing on stiff fill and residual soils. Since the foundations will be supported on hard residual soils and very dense weathered rock with SPT N-values of 30 bpf and greater, settlement should not be a significant concern. We expect excavation depths for shallow foundations in the general vicinity of our borings will be near the respective top of the hard soils and very dense weathered rock residuum elevations encountered in the borings as shown in Table 7-1.

Table 7-1 Depths and Elevations to 30+ bpf Residual Soils and Weathered Rock

Boring	Approximate Ground Surface Elevation (feet)	Depth to Very Dense Weathered Rock Residuum (feet)	Elevation of Top of Very Dense Weathered Rock Residuum (feet)
B-01	902	3	899
B-02	902	3	899
B-03	902	3.5	898.5
B-04	902	8	894
B-05	903	4	899
B-06	903	4	899
B-07	904	3	901
B-08	904	4.5	899.5

7.2 Sliding and Overturning

With light weight concrete used as the wall backfill once the concrete backfill sets the sliding and overturning should not be an issue as the concrete should not exert any lateral pressure on the wall. However, during construction the pressures from the fluid light weight concrete backfill will need to be considered. This is discussed further subsequently in the Recommendations Section of this report.

7.3 Global Stability

7.3.1 Methodology

The cross-sections were evaluated based on the existing slope geometry, the subsurface data and estimated retaining wall design parameters based on the laboratory testing and our experience in the geologic setting. Stability of the selected cross-sections was assessed using a two-dimensional limit equilibrium modeling technique which simplifies the failure or "slip" surfaces by dividing the slope into vertical "slices" and fitting line segments or arcs of various radii and centers, or plane slip surfaces, to the slope. Various surfaces are then checked to determine the slip surface with the smallest ratio of resisting forces (soil strength and pile shear resistance) to driving forces (mass of the soil and water and traffic loading). The computer program SLIDE 2 (2021) was used to perform the analyses. We used the Spencer method to evaluate the stability of the cross-sections analyzed.

7.3.2 Material Strength Parameters

The test boring data and the laboratory test data from the project were reviewed and the subsurface boundary conditions developed for the selected cross-sections. Table 7-1 presents the material properties used in our analyses. In accordance with AASHTO guidelines, the global stability of the selected cross sections was analyzed for drained (effective stress) and undrained (total stress).

Table 7-2: Material Strength Parameters

Material Type	Unit Weight, γ (pcf)	Effective Stress		Total Stress	
		Cohesion, C′ (psf)	Friction Angle, Φ′ (degrees)	Cohesion, C (psf)	Friction Angle, Φ (degrees)
Fill	120	100	26	1000	0
Residuum	120	100	28	1500	0
Weathered Shale	130	0	35	2000	0
Lightweight Cellular Concrete	35	10,000	0	10,000	0

7.3.3 Global Stability Results

The results of our global stability analyses are summarized in Table 7-3. The factors of safety are determined as the ratio of the summation of the resisting forces divided by the driving forces acting on the most critical failure surface as determined by SLIDE 2018.

Table 7-3: Slope Stability Analyses Results

I-275 Station	Estimated Factor of Safety (Spencer Method)
54+72.41 – Effective Stress	1.8
54+72.41 – Total Stress	3.1
55+56.41 – Effective Stress	1.9
55+56.41 – Total Stress	2.7

Based on the AASHTO LRFD Bridge Design Manual, 9th Edition, Section C11.6.2.3, the selection of the resistance factor for use in overall stability should take into account the presence of infrastructure that would be impacted by a wall failure. For cases where walls support critical infrastructure, the resistance factor of 0.65 should be used (FOS ~ 1.5). Otherwise, a resistance factor of 0.75 may be used (FOS ~ 1.3).

8.0 Recommendations

8.1 Acceptable Wall Types

The retaining wall shall be a cast-in-place concrete cantilever wall.

8.2 Other Design Requirements

For level ground surfaces in front of the wall (Elm Street), a minimum top of foundation embedment depth of 2 feet below the proposed ground surface at the front face of the wall will be required to satisfy FHWA minimum wall embedment depth requirements and for global stability.

Once the lightweight cellular concrete backfill sets, sliding should not be an issue as the concrete will not exert any lateral pressure on the wall. However, during construction the pressures from the fluid light weight concrete backfill will need to be considered. The following options may be considered:

- The wall can be designed to resist the full fluid pressure of the light weight concrete backfill;
- The wall can be braced during construction to resist the temporary concrete fluid pressure;
- The concrete backfill could be placed in lifts to reduce temporary fluid pressures on the walls.

Additionally, in preparation for placing the light weight concrete wall backfill, we recommend the existing abutment slopes be benched to eliminate the potential sloping slip surface between the concrete backfill and existing abutment slope. The concrete backfill should bear on generally level surfaces.

The wall designer must provide for a drainage layer behind the wall with adequate drainage provided via vertical drains and weep holes.

9.0 Limitations of Report

This report has been prepared for the exclusive use of the Tennessee Department of Transportation and their designers for specific application to the project referenced in this report. Our conclusions and recommendations have been prepared using generally accepted standards of geotechnical engineering practice in the State of Tennessee. No other warranty is expressed or implied. S&ME, Inc. is not responsible for the conclusions, opinions, or recommendations of others based on this data.

Because of the proportionately large influence that minor strata changes and fill composition can have on slope stability, it is difficult to assess the stability of existing slopes based on drilling and laboratory test data. Conventional drilling and sampling may not disclose the presence of thin soft seams or the orientation of joints and bedding that can significantly impact the stability of existing slopes. Further, groundwater can have a significant effect on the long term performance of a slope. Given these unknowns, it is necessary to point out that there is an element of risk associated with the evaluation of slopes. Even though our analyses reflect the use of standard practices combined with prudent judgment, long-term performance is not completely certain.

Our conclusions and recommendations are based on the design information furnished to us, the data obtained during the geotechnical exploration, the laboratory test results, and our past experience. They do not reflect variations in the subsurface conditions that are likely to exist between our borings and in unexplored areas of the site due to the inherent variability of the subsurface conditions in this geologic region and past land use. If such variations are found during construction, re-evaluating our conclusions and recommendations will be necessary.

If changes are made in the location or elevation of the planned retaining wall, the recommendations contained in this report will not be considered valid unless our firm has reviewed the changes and modified or verified our recommendations in writing. You should give us the opportunity to review the final design plans and the applicable portions of the project specifications when the designers complete the design. This review will allow us to check whether these documents are consistent with the intent of our recommendations.

For more information on the use and limitations of this report, please read the ASFE document included in Appendix V.

Appendices

Appendix I

Retaining Wall Sheets

P.E. NO.: 47I275-F2-002

PROJECT NO.	YEAR	SHEET NO.
BR-I-275-3(136)	2023	1 OF 4

REVISIONS

NO.	DATE	BY	BRIEF DESCRIPTION

ACCEPTABLE WALL TYPE

CAST-IN-PLACE CANTILEVER WALL

THE RETAINING WALL(S) SHALL BE ONE OF THE WALL TYPE(S) AS LISTED ABOVE OR ON FORTHCOMING "RETAINING WALL DETAIL-GEOMETRIC LAYOUT" SHEET(S). ANY PROPRIETARY RETAINING WALL SYSTEM SHALL BE LISTED AS PRE-APPROVED IN OPL 38.

RETAINING WALL DESIGN NOTES

UNLESS SPECIFICALLY STATED OTHERWISE IN THE CONTRACT PLANS, THE BIDDING FOR, THE DESIGN OF AND THE CONSTRUCTION OF RETAINING WALLS SHOWN IN THE PLANS SHALL BE GOVERNED BY THE TENNESSEE DEPARTMENT OF TRANSPORTATION SPECIAL PROVISION 624 REGARDING RETAINING WALLS. THIS SPECIAL PROVISION SHALL BE CONSIDERED AS ONE OF THOSE DOCUMENTS WHICH THE BIDDER/CONTRACTOR HAS EXAMINED AND MADE HIMSELF FAMILIAR WITH AS DESCRIBED IN SECTION 102.04 - EXAMINATION OF THE SITE, THE WORK, THE PLANS, AND THE SPECIFICATIONS IN THE TDOT STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION.

EXCAVATION FOR THE WALL AND/OR ITS FOOTING SHALL NOT BE ACCOMPLISHED UNTIL THE CONTRACTOR HAS SUBMITTED WALL DESIGNS AND CALCULATIONS AND HAS BEEN ISSUED AN APPROVED SET OF WALL PLANS AND HAS LABOR AND MATERIAL RESOURCES AVAILABLE TO BEGIN AND CONTINUE WALL CONSTRUCTION IMMEDIATELY AFTER EXCAVATION.

THIS WALL SHALL BE DESIGNED IN ACCORDANCE WITH LRFD DESIGN PROCEDURES AND REQUIREMENTS AS DESCRIBED IN:

- AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, 2020

FOR PROPRIETARY WALL SYSTEMS THAT HAVE BEEN APPROVED AS SHOWN IN OPL 38, THE WALL DESIGNER SHALL BE RESPONSIBLE FOR PROVIDING WALL DESIGNS INCORPORATING MATERIALS AND COMPONENTS (I.E. REINFORCEMENT CONNECTION DEVICES, SPECIFIC MANUFACTURER AND PROPERTIES OF GEOGRID) AS WAS ORIGINALLY SUBMITTED AND APPROVED BY TDOT, IF A MATERIAL AND/OR COMPONENT OF THE WALL SYSTEM HAVE BEEN MODIFIED FROM THE ORIGINALLY APPROVED SYSTEM, A WALL DESIGN AND SET OF PLANS AND CALCULATIONS FOR THIS WALL SYSTEM CANNOT BE SUBMITTED FOR REVIEW AND APPROVAL UNTIL THE WALL SYSTEM DESIGNER WHO ORIGINALLY SUBMITTED THE WALL SYSTEM FOR APPROVAL BY TDOT SUBMITS A REQUEST FOR RE-APPROVAL UTILIZING THE MODIFIED ELEMENTS OF THE WALL. THIS SUBMITTAL DOES NOT GUARANTEE APPROVAL OF THE MODIFIED SYSTEM. IF THIS RE-APPROVAL PROCESS DOES NOT MEET THE CONTRACTOR'S SCHEDULE OR IF THE MODIFIED SYSTEM IS NOT APPROVED, THE CONTRACTOR/WALL DESIGNER SHALL PROVIDE A WALL DESIGN FOR ONE OF THE APPROVED SYSTEMS AT NO CHANGE IN CONTRACT PRICE FOR THE RETAINING WALL AND NO CHANGE IN PROJECT SCHEDULE REQUIREMENTS WILL BE ALLOWED.

THE WALL DESIGNER SHALL PROVIDE RETAINING WALL PLANS, DETAILS AND CALCULATIONS AS REQUIRED BY SPECIAL PROVISION 624 AND AS REQUIRED HEREIN.

- THE WALL DESIGNER SHALL UTILIZE THE GEOTECHNICAL PARAMETERS AND RESISTANCE FACTORS AS PROVIDED FOR EACH PROJECT RETAINING WALL ON THE "RETAINING WALL DETAIL" SHEET(S) TO PREPARE AND SUBMIT DESIGN CALCULATIONS. LOAD FACTORS AND OTHER PERTINENT DESIGN REQUIREMENTS PROVIDED IN AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, 2020 AND INTERIMS SHALL BE USED FOR NON-MSE WALLS

- CALCULATIONS FOR BOTH INTERNAL AND EXTERNAL STABILITY (SLIDING, ECCENTRICITY, AND BEARING CAPACITY-GLOBAL STABILITY AND SETTLEMENT BEING THE EXCEPTIONS) SHALL BE PROVIDED FOR EACH CRITICAL WALL SECTION WHICH DEMONSTRATES THE REQUIRED CAPACITY TO DEMAND RATIO OF 1.0 IS MET UTILIZING THE DESIGN PARAMETERS PROVIDED. FOR MSE WALLS, THE WALL DESIGNER MUST ADJUST THE REINFORCEMENT LENGTHS BEYOND THOSE MINIMUM REQUIRED LENGTHS, IF REQUIRED, TO MEET BOTH INTERNAL AND EXTERNAL REQUIREMENTS. THE WALL DESIGNER/CONTRACTOR PLANS MUST INCLUDE ANY FOUNDATION IMPROVEMENTS AS REQUIRED HEREIN ON THE WALL DESIGNER/CONTRACTOR'S WALL ELEVATION VIEWS AND ANY CROSS-SECTIONAL DETAIL DRAWINGS.

- UNLESS OTHERWISE STATED, THE WALL DESIGNER CAN ASSUME THAT MINIMUM GLOBAL STABILITY AND SETTLEMENT CRITERIA IS ACHIEVED WITH A WALL DESIGN MEETING OTHER MINIMUM EXTERNAL STABILITY REQUIREMENTS AND ASSUMING WALL FOUNDATION BEARING IMPROVEMENTS ARE MET. WHILE THE WALL DESIGNER'S DESIGN MUST DEMONSTRATE COMPLIANCE WITH EXTERNAL STABILITY REQUIREMENTS AS DISCUSSED ABOVE, THE WALL DESIGNER PROVIDES CERTIFICATION (BY SIGNING AND STAMPING BY PROFESSIONAL ENGINEER REGISTERED IN STATE OF TENNESSEE) OF THE WALLS, PLANS, AND CALCULATIONS "FOR INTERNAL STABILITY ONLY".

- LOAD COMBINATIONS STRENGTH I, EXTREME EVENT I, AND EXTREME EVENT II SHALL BE EVALUATED AS GIVEN IN AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, 2020 AND INTERIMS.

NOTE REGARDING CONSTRUCTION SLOPES

THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAKING THE EXCAVATION IN ACCORDANCE WITH OSHA AND OTHER APPLICABLE STATE AND LOCAL REGULATIONS REGARDING CONSTRUCTION SLOPES AND TRENCHES. IN ADDITION TO FOLLOWING APPLICABLE REGULATORY REQUIREMENTS, AS A MINIMUM REQUIREMENT, ALL TEMPORARY CONSTRUCTION SLOPES SHALL BE PLACED AT A MAXIMUM OF A 1:1 SLOPE IN SOIL AND SHALL NOT BE LEFT OPEN WITHOUT SHORING FOR ANY LONGER THAN ABSOLUTELY NECESSARY. THE CONTRACTOR BUILDING THE WALL SHALL ENSURE THAT THESE TEMPORARY BACK SLOPES ARE NOT AND DO NOT BECOME UNSTABLE. IF SLOPE IS UNSTABLE, BECOMES UNSTABLE, IS CUT STEEPER THAN A 1:1 SLOPE OR IS UNACCEPTABLE FOR ANOTHER REASON, THEN TEMPORARY SHORING SHALL BE USED. ANY UNUSUAL SOIL CONDITIONS OTHER THAN THOSE ASSUMED SHOULD BE REPORTED TO THE PROJECT ENGINEER.

PIN NO.: 124437.00

TABLE 1-DESIGN REQUIREMENTS AND PARAMETERS

DESCRIPTION	CIP WALLS	NOTE
DESIGN LIFE	75 YEARS	
SEISMIC ACCELERATION COEFFICIENTS		
As	✳	
S_{DS}	✳	
S_{D1}	✳	
EFFECTIVE (DRAINED) FRICTION ANGLE		
RETAINED BACKFILL-UNCLASSIFIED SITE OR BORROW SOIL	28 °	
RETAINED BACKFILL-SELECT BACKFILL	34 ° TO MAX 40 °	1
LIGHTWEIGHT CELLULAR CONCRETE	NOT APPLICABLE	1
UNIT WEIGHT		
LIGHTWEIGHT CELLULAR CONCRETE	35 POUNDS PER CUBIC FOOT	
SELECT BACKFILL MATERIAL	VARIES	1A
DESIGN BASIS		
COEFFICIENT OF SLIDING FRICTION	SEE TABLE 3	3
NOMINAL BEARING RESISTANCE	SEE TABLE 3	3
MINIMUM LENGTH OF SOIL REINFORCEMENT, L	NOT APPLICABLE	2,2A,2B
LIMITING ECCENTRICITY	B/3 (SOIL), 9B/20 (ROCK)	
RESISTANCE FACTORS		
SLIDING-STATIC	1.0	4
SLIDING-COMBINED STATIC+EARTHQUAKE	1.0	4
BEARING-STATIC	0.55	5
BEARING-COMBINED STATIC+EARTHQUAKE	0.8	5
PULLOUT RESISTANCE OF METALLIC REINFORCEMENT		
STATIC -STEEL STRIP REINFORCEMENTS -STEEL GRID REINFORCEMENTS	NOT APPLICABLE	6
COMBINED STATIC/EARTHQUAKE -STEEL STRIP REINFORCEMENTS -STEEL GRID REINFORCEMENTS	NOT APPLICABLE	6
PULLOUT RESISTANCE OF GEOSYNTHETIC REINFORCEMENT		
STATIC -GEOTEXTILES AND GEOGRIDS -GEOSTRIP REINFORCEMENTS	NOT APPLICABLE	6
COMBINED STATIC/EARTHQUAKE -GEOTEXTILES AND GEOGRIDS -GEOSTRIP REINFORCEMENTS	NOT APPLICABLE	6
TENSILE RESISTANCE OF METALLIC REINFORCEMENTS AND CONNECTORS		
STATIC -STRIP REINFORCEMENT -GRID REINFORCEMENT	NOT APPLICABLE	7 7,8
COMBINED STATIC/EARTHQUAKE -STRIP REINFORCEMENT -GRID REINFORCEMENT	NOT APPLICABLE	7 7,8
TENSILE RESISTANCE OF GEOSYNTHETIC REINFORCEMENTS AND CONNECTORS		
STATIC -GEOTEXTILE AND GEOGRID REINFORCEMENTS -GEOSTRIP REINFORCEMENTS	NOT APPLICABLE	
COMBINED STATIC/EARTHQUAKE -GEOTEXTILE AND GEOGRID REINFORCEMENTS -GEOSTRIP REINFORCEMENTS	NOT APPLICABLE	

NOTES FOR TABLE 1

NO.	NOTE
1	A MAXIMUM FRICTION ANGLE OF 34 DEGREES CAN BE ASSUMED FOR MATERIAL MEETING SPECIFICATIONS IN SECTION F, PART 1. MATERIALS OF TENNESSEE DEPARTMENT OF TRANSPORTATION SPECIAL PROVISION 624 REGARDING RETAINING WALLS. A HIGHER FRICTION ANGLE THAN 34 DEGREES CAN BE UTILIZED IF THE CONTRACTOR SUBMITS INDEPENDENT TESTING AND IT IS VERIFIED BY TDOT. HOWEVER, IN NO CASE SHALL THE FRICTION ANGLE FOR ANALYSIS EXCEED 40-DEGREES. INDEPENDENT TESTING MUST BE VERIFIED ANNUALLY.
1A	SELECT BACKFILL UNIT WEIGHT TO BE DETERMINED BY CONTRACTOR/DESIGNER DEPENDING ON ACTUAL BACKFILL MATERIAL USED. SELECT BACKFILL IS DEFINED AS MATERIAL MEETING SPECIFICATIONS IN SECTION F, PART 1. MATERIALS OF TENNESSEE DEPARTMENT OF TRANSPORTATION SPECIAL PROVISION 624 REGARDING RETAINING WALLS. IN ORDER TO UTILIZE Φ FOR SELECT BACKFILL DESIGN, SELECT BACKFILL MUST BE PLACED FOR A MINIMUM ZONE FORMED BY A 1:1 SLOPE FROM 2 FEET BEHIND THE BOTTOM OF BACK OF WALL FOOTING OR REINFORCED SOIL ZONE FOR MSE WALLS UP TO FINISHED GRADE.
2	H IS DESIGN HEIGHT OF THE WALL AND IS DEFINED AS THE DIFFERENCE IN ELEVATION BETWEEN THE FINISHED GRADE AT THE TOP OF THE WALL AND THE TOP OF LEVELING PAD OR BOTTOM OF FOOTING FOR NON-MSE WALLS. THE TOP OF THE LEVELING PAD SHALL ALWAYS BE BELOW THE MINIMUM EMBEDMENT REFERENCE LINE AS INDICATED ON THE PLANS FOR THAT LOCATION. THE LENGTH OF THE SOIL REINFORCEMENT, L, IS MEASURED FROM THE BACKFACE OF THE WALL FACING UNIT. IN CASE OF GRID TYPE REINFORCEMENTS THE LENGTH OF THE SOIL REINFORCEMENT IS MEASURED FROM THE BACKFACE OF THE WALL FACING UNIT TO THE LAST FULL TRANSVERSE MEMBER. FOR MODULAR BLOCKFACING UNITS, THE TOTAL LENGTH OF THE REINFORCEMENT, Br AS MEASURED FROM THE FRONT FACE OF THE WALL IS THE LENGTH L AS DEFINED ABOVE PLUS THE WIDTH OF THE MODULAR BLOCK UNIT (THE HORIZONTAL DIMENSION OF THE BLOCK UNIT MEASURED PERPENDICULAR TO THE WALL FACE).
2A	WALL DESIGNER MUST ADJUST THE REINFORCEMENT LENGTHS BEYOND THOSE MINIMUM REQUIRED LENGTHS, IF REQUIRED, TO MEET BOTH INTERNAL AND EXTERNAL STABILITY REQUIREMENTS. MINIMUM REINFORCEMENT LENGTHS MAY BE REQUIRED FOR GLOBAL STABILITY. THIS REQUIREMENT WILL BE SHOWN IN THE PLANS.
2B	ALL DESIGN SECTION REINFORCEMENT LENGTHS SHALL BE EQUAL.
3	THESE VALUES WILL BE PROVIDED IN TABLES 2 AND/OR 3
4	PASSIVE RESISTANCE SHALL NOT BE CONSIDERED IN EVALUATION OF SLIDING RESISTANCE. NO SHEAR KEYS NOR DOWELS WILL BE PERMITTED. FOR CAST-IN-PLACE CONCRETE CANTILEVER WALLS, THE FOOTING SHALL BE UNIFORM IN THICKNESS THROUGHOUT THE DESIGN SECTION.
5	FOR ALL LIMIT STATES, THE DESIGN LOADING FOR THE RETAINING WALL SYSTEM SHALL NOT EXCEED THE FACTORED BEARING RESISTANCE, WHICH IS THE PRODUCT OF THE NOMINAL BEARING RESISTANCE SPECIFIED IN TABLES 2 AND/OR 3 AND THE APPROPRIATE RESISTANCE FACTOR.
6	LIVE LOAD DUE TO VEHICULAR TRAFFIC SHALL BE INCLUDED IN THE COMPUTATIONS TO DETERMINE THE MAXIMUM TENSILE FORCES IN REINFORCEMENT LAYERS, BUT SHALL BE NEGLECTED IN THE COMPUTATIONS FOR PULLOUT RESISTANCE.
7	APPLY TO GROSS CROSS-SECTION LESS SACRIFICIAL AREA. FOR SECTIONS WITH HOLES, REDUCE GROSS AREA IN ACCORDANCE WITH ARTICLE 6.8.3 OF AASHTO (2020) AND APPLY TO NET SECTION LESS SACRIFICIAL AREA.
8	APPLIES TO GRID REINFORCEMENTS CONNECTED TO A RIGID FACING ELEMENT, E.G., A CONCRETE PANEL OR BLOCK. FOR GRID REINFORCEMENTS CONNECTED TO A FLEXIBLE FACING MAT OR WHICH ARE CONTINUOUS WITH THE FACING MAT, USE THE RESISTANCE FACTOR FOR STRIP REINFORCEMENTS.

✳ ✳ THIS BOX IS TO BE REMOVED AFTER STRUCTURES DIVISION INSERTS SEISMIC VALUES, REVISES THE ACCEPTABLE WALL TYPES TO SATISFY THE FASCIA REQUIREMENTS, AND INSERTS THE DEFLECTION VALUES (IF APPLICABLE).

SEISMIC
WALL DESIGN IS TO INCLUDE EXTREME EVENT I STATE LOADS. THE TDOT STRUCTURES DIVISION WILL PROVIDE GROUND MOTION VALUES (As, SDS, AND SD1) FOR THE SITE.

WALL FASCIA REQUIREMENTS
THE ACCEPTABLE WALL TYPES LISTED ARE FOR GEOTECHNICAL RECOMMENDATIONS ONLY. AESTHETIC REQUIREMENTS MAY NECESSITATE A REEVALUATION OF THE ACCEPTABLE WALL TYPES. FASCIA REQUIREMENTS SHALL BE DETERMINED BY THE TDOT STRUCTURES DIVISION.

DEFLECTION
TDOT STRUCTURES DIVISION SHALL DETERMINE THE ALLOWABLE LATERAL DEFLECTION OF PILE SUPPORTED WALLS, MEASURED AT THE PILE HEAD, AND INSERT THE REQUIREMENT IN THE "OTHER DESIGN REQUIREMENTS" NOTES.

TABLE 2- NO MSE WALLS ARE ACCEPTABLE FOR THIS SITE

TABLE 3-FOUNDATION PARAMETERS AND REQUIREMENTS FOR GRAVITY OR SEMI-GRAVITY WALLS

STATION LIMITS	FOUNDATION BEARING CONDITION REQUIREMENT	NOMINAL BEARING RESISTANCE (psf)	COEFFICIENT OF SLIDING FRICTION
54+72.41 AND 55+56.41 (CANTILEVER WALLS)	HARD RESIDUAL SOILS AND WEATHERED ROCK WITH SPT N-VALUES OF 30 BPF AND GREATER	11,500	0.65
54+45 TO 54+72.41 AND 55+56.41 TO 55+84 (WING WALLS)	STIFF FILL AND RESIDUAL SOILS	8,500	0.65

OTHER DESIGN REQUIREMENTS

THE WALL DESIGNER MUST PROVIDE FOR A DRAINAGE LAYER BEHIND THE WALL STEM WITH ADEQUATE DRAINAGE PROVIDED VIA WEEP HOLES.

ALL WALL ELEMENTS SHALL BE WITHIN TDOT ROW.

ALL CONSTRUCTION MUST STAY WITHIN TDOT ROW, SLOPE EASEMENT, AND CONSTRUCTION EASEMENT.

THE CONTRACTOR SHALL COORDINATE AND PERFORM ALL UTILITY RELOCATION SO THAT IT DOES NOT INTERFERE WITH THE RETAINING WALL INSTALLATION.

THE CONTRACTOR IS RESPONSIBLE FOR MAINTAINING AND PRESERVING THE INTEGRITY AND FUNCTION OF THE ROADWAY DURING CONSTRUCTION AND THROUGHOUT THE DESIGN LIFE OF THE WALL.

FOUNDATION SUBGRADE OBSERVATIONS SHOULD BE PERFORMED BY THE GEOTECHNICAL ENGINEER, OR THEIR DESIGNATE, IN ORDER TO CONFIRM THE RECOMMENDATIONS PROVIDED IN THIS REPORT ARE CONSISTENT WITH THE SIGHT CONDITIONS ENCOUNTERED.

NEW FOUNDATIONS SHALL BE CONNECTED TO THE EXISTING FOUNDATIONS AND PILE CAPS AS SHOWN ON THE PLANS.

LIGHT WEIGHT CELLULAR CONCRETE SHALL BE USED FOR WALL BACKFILL. THE WALL SHALL BE BRACED DURING CONSTRUCTION TO RESIST THE TEMPORARY CONCRETE FLUID PRESSURE. THE LIGHT WEIGHT CELLULAR CONCRETE MAY BE PLACED IN LIFTS TO REDUCE THE TEMPORARY FLUID PRESSURES ON THE WALL.

THE EXISTING ABUTMENT SLOPES SHOULD BE BENCHED TO ELIMINATE THE POTENTIAL SLOPING SLIP SURFACE BETWEEN THE LIGHT WEIGHT CELLULAR CONCRETE BACKFILL AND EXISTING ABUTMENT SLOPE. THE LIGHT WEIGHT CELLULAR CONCRETE BACKFILL SHOULD BEAR ON GENERALLY LEVEL SURFACES.

SEALED BY

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

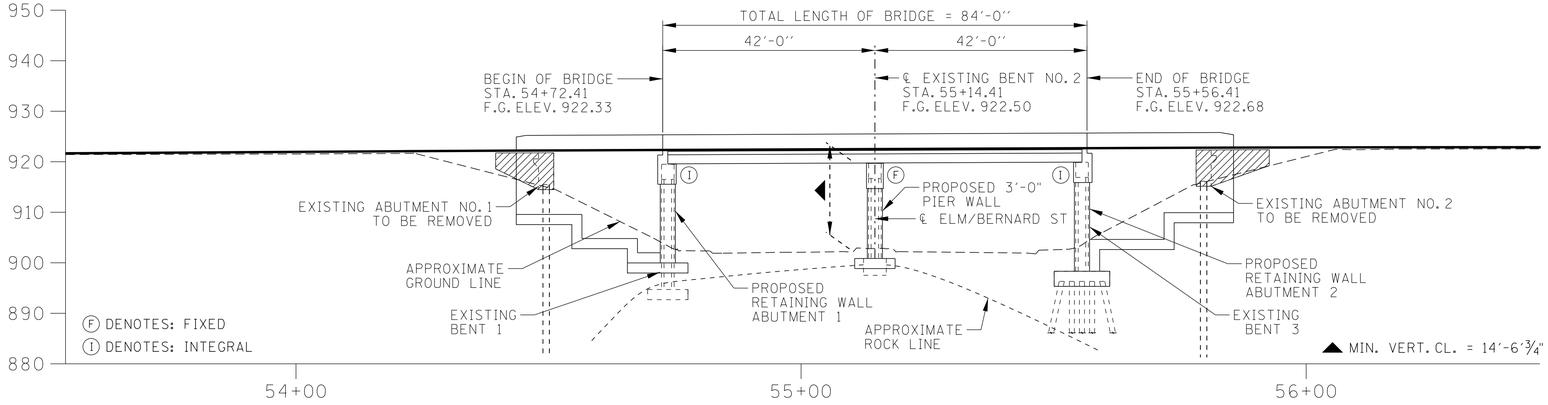
GEOTECHNICAL WALL DESIGN
NOTES AND REQUIREMENTS
I-275 OVER ELM/BERNARD STREET
STA. 55+14.41
BRIDGE ID. NO. 47I02750003
KNOX COUNTY
2023

P.E. NO.: 47I275-F2-002

PROJECT NO.	YEAR	SHEET NO.
BR-I-275-3(136)	2023	2 OF 4

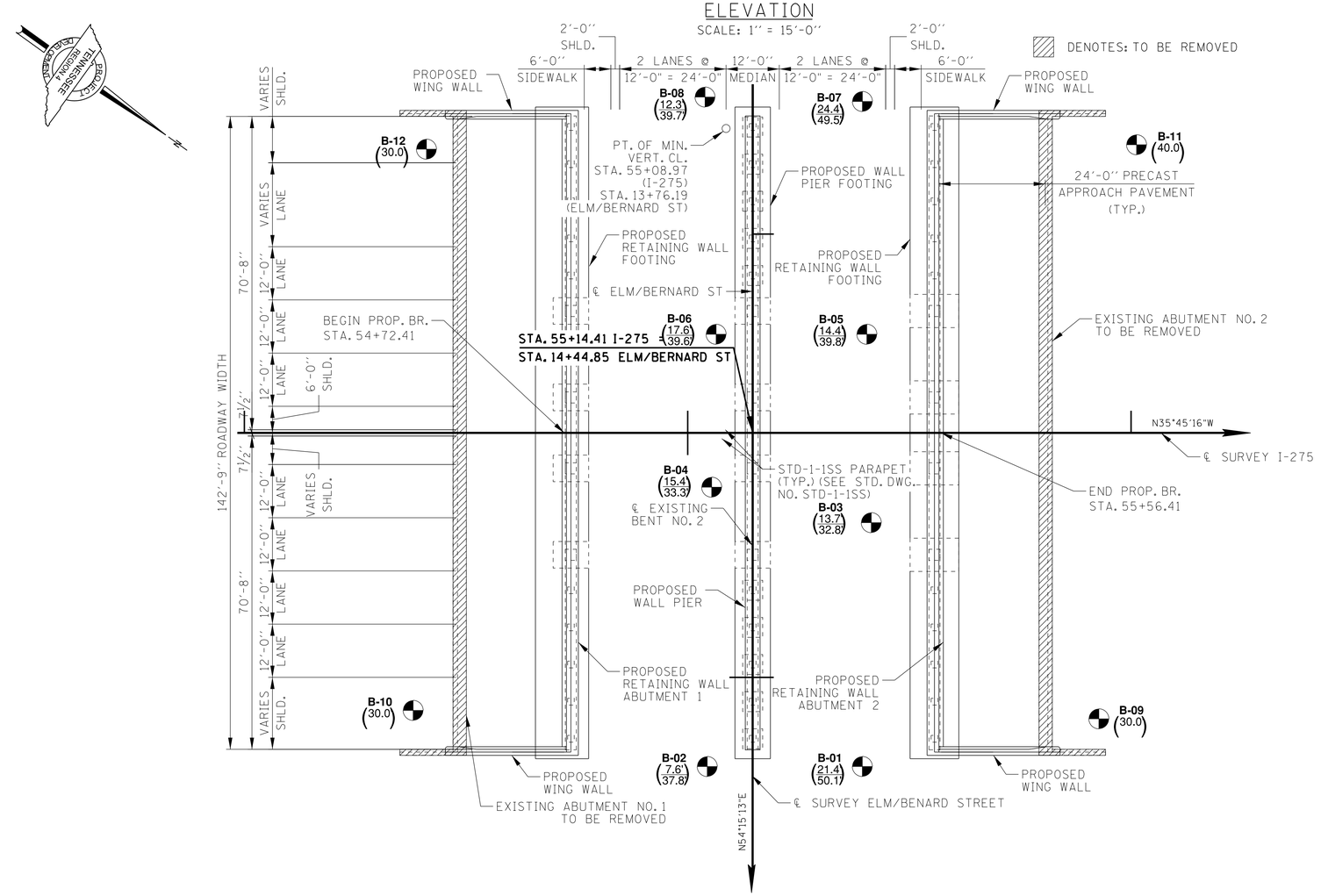
REVISIONS

NO.	DATE	BY	BRIEF DESCRIPTION



ELEVATION

SCALE: 1" = 15'-0"



PLAN

SCALE: 1" = 15'-0"

PT.	STATION	OFFSET DISTANCE	GROUND ELEVATION (MSL FT)	ROCK ELEVATION (MSL FT)
B-01	55+39	75' R	902	880.6
B-02	55+04	75' R	902	894.4
B-03	55+41	20' R	902	888.3
B-04	55+05	12' R	902	886.6
B-05	55+40	22' L	903	888.6
B-06	55+06	22' L	903	885.4
B-07	55+39	75' L	904	879.6
B-08	55+04	76' L	904	891.7
B-09	55+93	65' R	922	N/A
B-10	54+38	63' R	921	N/A
B-11	56+01	65' L	922	N/A
B-12	54+41	64' L	921	N/A

LEGEND: BORING LOCATIONS

- B-152 - BORING I.D.
  (24.5) - DEPTH TO REFUSAL (ABOVE LINE)
  (70.3) - BOTTOM OF HOLE (BELOW LINE)
- B-152 (24.5) - BORING I.D. - DEPTH TO REFUSAL
- B-152 (24.5) - BORING I.D. - TERMINATION DEPTH (NO REFUSAL)

SEALED BY

2025 ADT = 74920
70'-8" ROADWAY (NB℄SB) WITH STD-1-1SS PARAPET
DESIGN SPEED = 55 MPH
STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

GEOTECHNICAL FOUNDATION DATA
WALLS
I-275 OVER ELM/BERNARD STREET
STA. 55+14.41
BRIDGE ID. NO. 47I02750003
KNOX COUNTY
2023

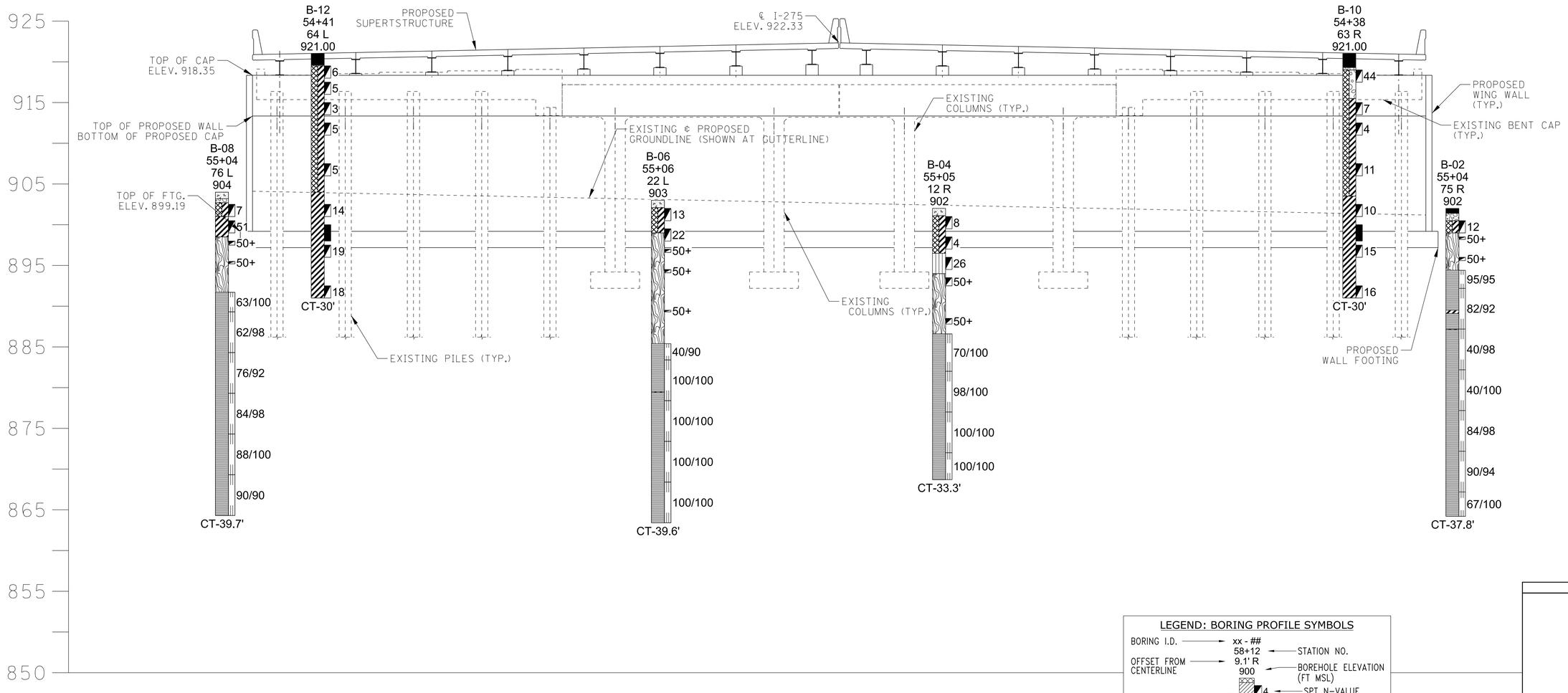
PIN NO.: 124437.00
DESIGN BY: Ryan S. Gadsey DATE: 4/5/23
DRAWN BY: Ryan S. Gadsey DATE: 4/5/23
SUPERVISED BY: B. Evan Graves DATE: 4/5/23
CHECKED BY: Carter D. Bearden DATE: 4/5/23

P.E. NO.: 47I275-F2-002

PROJECT NO.	YEAR	SHEET NO.
BR-I-275-3(136)	2023	3 OF 4

REVISIONS

NO.	DATE	BY	BRIEF DESCRIPTION



PROPOSED RETAINING WALL ABUTMENT 1 TYPICAL SECTION

(LOOKING FORWARD ON SURVEY)

NOTE: ALL ELEVATIONS PROVIDED ARE APPROXIMATE.

LEGEND: BORING PROFILE SYMBOLS

- BORING I.D. → xx - ##
- OFFSET FROM CENTERLINE → 58+12 STATION NO.; 9.1' R; 900 BOREHOLE ELEVATION (FT MSL)
- WATER LEVEL AT TIME OF DRILLING
- 4 SPT N-VALUE; 11 SPT SYMBOL
- LITHOLOGY GRAPHIC
- 66/100 RQD/REC
- TERMINATION → CT-9.8'
  - BT=BORING TERMINATED
  - CT=CORING TERMINATED

- ASPHALT
- CONCRETE
- AGGREGATE BASE
- FILL (TYPE A)
- FAT CLAY (CH) (TYPE A)
- LEAN CLAY (CL) (TYPE A)
- WEATHERED ROCK (TYPE D)
- GRAVELLY SILT (ML) (TYPE A)
- CALCAREOUS SHALE (TYPE B)

SEALED BY

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

GEOTECHNICAL ABUTMENT PROFILE
WALL - ABUTMENT 1
I-275 OVER ELM/BERNARD STREET
STA. 55+14.41
BRIDGE ID. NO. 47I02750003
KNOX COUNTY
2023

PIN NO.: 124437.00

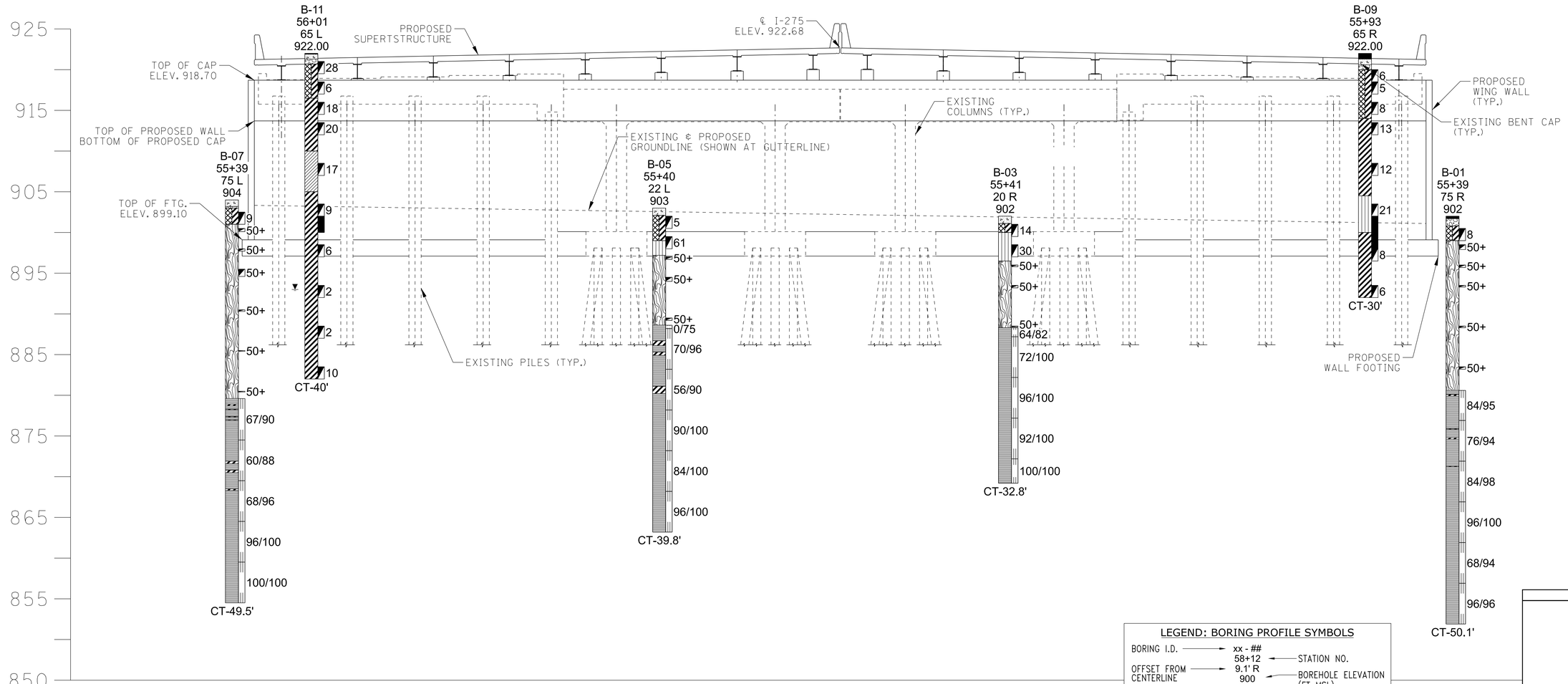
DESIGN BY:	Ryan S. Gadsey	DATE:	4/5/23
DRAWN BY:	Ryan S. Gadsey	DATE:	4/5/23
SUPERVISED BY:	B. Evan Graves	DATE:	4/5/23
CHECKED BY:	Carter D. Bearden	DATE:	4/5/23

P.E. NO.: 47I275-F2-002

PROJECT NO.	YEAR	SHEET NO.
BR-I-275-3(136)	2023	4 OF 4

REVISIONS

NO.	DATE	BY	BRIEF DESCRIPTION

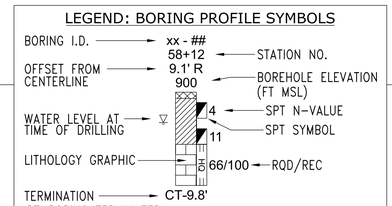


PROPOSED RETAINING WALL ABUTMENT 2 TYPICAL SECTION

(LOOKING FORWARD ON SURVEY)

NOTE: ALL ELEVATIONS PROVIDED ARE APPROXIMATE.

LEGEND: BORING PROFILE SYMBOLS



SEALED BY

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

GEOTECHNICAL ABUTMENT PROFILE
WALL - ABUTMENT 2
I-275 OVER ELM/BERNARD STREET
STA. 55+14.41
BRIDGE ID. NO. 47I02750003
KNOX COUNTY
2023

PIN NO.: 124437.00

DESIGN BY:	Ryan S. Gadsey	DATE: 4/5/23
DRAWN BY:	Ryan S. Gadsey	DATE: 4/5/23
SUPERVISED BY:	B. Evan Graves	DATE: 4/5/23
CHECKED BY:	Carter D. Bearden	DATE: 4/5/23

Appendix II

Field Exploration Procedures

Test Boring/Pit Record Legend

Test Boring Records

Rock Core Photos

HOLLOW STEM AUGERING PROCEDURES
WITH STANDARD PENETRATION RESISTANCE TESTING
AASHTO T 206

The borings were advanced using auger drilling techniques. At regular intervals, soil samples were obtained with a standard 1.4-inch I.D., 2.0-inch O.D., split-tube sampler. The sampler was initially seated 6 inches to penetrate any loose cuttings and then driven an additional foot with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final foot is the standard penetration resistance. Standard penetration resistance, when properly evaluated, is an index to the soil's strength and density. The criteria used during this exploration are presented on the Test Boring Record Legend.

Representative portions of the soil samples, thus obtained, were placed in sealed containers and transported to the laboratory. The engineer selected samples for laboratory testing. The Test Boring Records in this Appendix provide the soil descriptions and penetration resistances.

Soil drilling and sampling equipment may not be capable of penetrating hard cemented soils, thin rock seams, large boulders, waste materials, weathered rock, or sound continuous rock. Refusal is the term applied to materials that cannot be penetrated with soil drilling equipment or where the standard penetration resistance exceeds 100 blows per foot. Core drilling is needed to determine the character and continuity of the refusal materials.

UNDISTURBED SAMPLING PROCEDURES
AASHTO T 207

Relatively undisturbed samples were obtained for laboratory testing. A 3-inch O.D., 16-gauge, steel tube was slowly and uniformly pushed into the soil at the desired sampling level. The tube was then removed from the ground and the encased soil was sealed at the ends to prevent loss of moisture. The depth at which undisturbed samples were taken is indicated on the Test Boring Records.

ROCK CORING PROCEDURES
AASHTO T 225

Refusal materials were explored using a diamond-studded bit fastened to a double tube core barrel. An NQ2-size bit was used during this exploration, which obtains core samples approximately 2 inches in diameter. The materials recovered were placed in a sample box. Our engineer classified the type and hardness of the rock, core recovery, and Rock Quality Designation (RQD). Core recovery is the sample length recovered divided by the length drilled, and RQD is the sample length recovered in pieces 4 inches or longer divided by the length drilled. Both core recovery and RQD are expressed as percentages. Rock hardness, where applicable, was judged based on the following criteria:

Rock Hardness	Criteria
Very Soft	Rock disintegrates or easily compresses when touched; can be hard to very hard soil
Soft	Rock is coherent but breaks very easily with thumb pressure at sharp edges and crumbles with firm hand pressure.
Moderately Hard	Small pieces can be broken off along sharp edges by hard considerable thumb pressure; can be broken with light hammer blows.
Hard	Rock cannot be broken by thumb pressure, but can be broken by moderate hammer blows.
Very Hard	Rock can only be broken by heavy hammer blows.

TEST BORING/PIT RECORD LEGEND

FINE AND COARSE GRAINED SOIL INFORMATION

COARSE GRAINED SOILS (SANDS & GRAVELS)

N	Relative Density
0-4	Very Loose
5-10	Loose
11-20	Firm
21-30	Very Firm
31-50	Dense
Over 50	Very Dense

FINE GRAINED SOILS (SILTS & CLAYS)

N	Consistency	Qu, KSF Estimated
0-1	Very Soft	0-0.5
2-4	Soft	0.5-1
5-8	Firm	1-2
9-15	Stiff	2-4
16-30	Very Stiff	4-8
Over 31	Hard	8+

PARTICLE SIZE

Boulders	Greater than 300 mm (12 in)
Cobbles	75 mm to 300 mm (3 to 12 in)
Gravel	4.74 mm to 75 mm (3/16 to 3 in)
Coarse Sand	2 mm to 4.75 mm
Medium Sand	0.425 mm to 2 mm
Fine Sand	0.075 mm to 0.425 mm
Silts & Clays	Less than 0.075 mm

The **STANDARD PENETRATION TEST** as defined by ASTM D 1586 is a method to obtain a disturbed soil sample for examination and testing and to obtain relative density and consistency information. A standard 1.4-inch I.D./2-inch O.D. split-barrel sampler is driven three 6-inch increments with a 140 lb. hammer falling 30 inches. The hammer can either be of a trip, free-fall design, or actuated by a rope and cathead. The blow counts required to drive the sampler the final two increments are added together and designate the N-value defined in the above tables.

ROCK PROPERTIES

ROCK QUALITY DESIGNATION (RQD)

Percent RQD	Quality
0-25	Very Poor
25-50	Poor
50-75	Fair
75-90	Good
90-100	Excellent

ROCK HARDNESS

Very Hard:	Rock can be broken by heavy hammer blows
Hard:	Rock cannot be broken by thumb pressure, but can be broken by moderate hammer blows.
Moderately Hard:	Small pieces can be broken off along sharp edges by considerable hard thumb pressure; can be broken with light hammer blows.
Soft:	Rock is coherent but breaks very easily with thumb pressure at sharp edges and crumbles with firm hand pressure.
Very Soft:	Rock disintegrates or easily compresses when touched; can be hard to very hard soil.

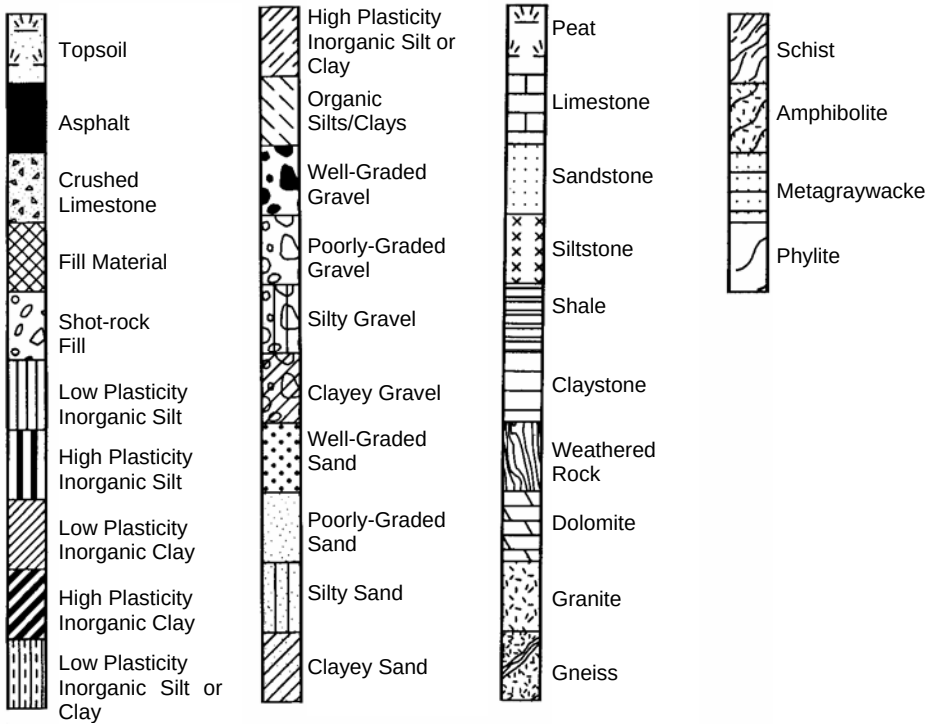
$$\text{RQD} = \frac{\text{Sum of 4 in. and longer Rock Pieces Recovered}}{\text{Length of Core Run}} \times 100 = \frac{43\ \text{RQD}}{\text{NQ}}$$

$$\text{Recovery} = \frac{\text{Length of Rock Core Recovered}}{\text{Length of Core Run}} \times 100 = \frac{\text{NQ}}{63\ \text{REC}}$$

Core Diameter	Inches
BQ	1-7/16
NQ	1-7/8
HQ	2-1/2

SYMBOLS

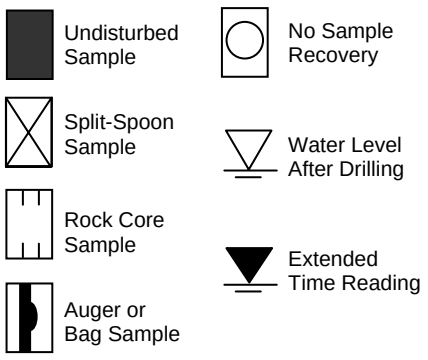
KEY TO MATERIAL TYPES



SOIL PROPERTY SYMBOLS

N:	Standard Penetration, BPF
M:	Moisture Content, %
LL:	Liquid Limit, %
PI:	Plasticity Index, %
Qp:	Pocket Penetrometer Value, TSF
Qu:	Unconfined Compressive Strength Estimated Qu, TSF
γ_D:	Dry Unit Weight, PCF
F:	Fines Content

SAMPLING SYMBOLS



TEST BORING RECORD

BORING NO.: B-01
I-275
STATION NO.: 55+39
OFFSET: 75 R

PROJECT: I-275 Bridge over Elm Street		JOB NO: 22430250	SHEET 1 OF 2
PROJECT LOCATION: Knox County, Tennessee			
ELEVATION: 902 feet ±	BORING STARTED: 12/21/2022	RIG TYPE: Diedrich D-50	BORING DIA. (IN): 3-1/4"
DRILLING METHOD: Rock Core	BORING COMPLETED: 12/21/2022	HAMMER: Automatic	CORE DIA.: NQ=1-7/8 in

GROUNDWATER:
Dry ATD

Remarks:

G	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	L	S	R	M	PI	STANDARD PENETRATION RESISTANCE (N) 0 10 20 30 40 50 60 70 80 90 100 BLOWS/6"
	902.0	0							
	901.7		0.3' Asphalt, 4 inches						
	900.8		1.2' Aggregate base, 10 inches	Fill					
			FAT CLAY, (CH), few rock fragments, trace sand, firm, orange brown with tan gray, mottled, moist						3 - 3 - 5 **(8)**
	899.0		3'	Residuum			4.2	14	(REC:0.8)
			CLAYEY SAND WITH GRAVEL (SC), very dense, tan brown, dry						>> 46 - 50/1" **(50+)**
	896.5	5	5.5'						(REC:0.6)
			WEATHERED ROCK, sampled as shale fragments, little clayey silt, very dense, tan brown, dry						>> 50/4" **(50+)**
	894.0		8'						(REC:0.2)
			WEATHERED ROCK, sampled as shale fragments, very dense, tan brown, dry						>> 50/2" **(50+)**
		10							(REC:0.2)
	890.0		12'						
			WEATHERED ROCK, sampled as shale fragments, few silt, very dense, gray with tan brown, dry						>> 50/2" **(50+)**
		15							(REC:0.2)
	885.0		17'						
			WEATHERED ROCK, sampled as shale fragments, few clayey silt, very dense, tan brown, dry						>> 50/4" **(50+)**
		20							(REC:0.3)
	880.6		21.4' *Auger refusal at 21.4 feet, began NQ coring*						
	880.1		21.9'	Bedrock					
	879.9		22.1' CALCAREOUS SHALE, gray, bedded, continuous, good quality, 75° to 80° bedding angle, slightly weathered to fresh, medium						**RUN 1** (NQ) RUN - 3.7' - Depth from 21.4' to 25.1' RQD - 84% REC - 95%
		25	Soil seam						25.1' / 876.9' msl
	875.9		26.1'						
	875.8		26.2' CALCAREOUS SHALE, gray, bedded, continuous, good quality, 75° to 80° bedding angle, slightly weathered to fresh, medium						**RUN 2** (NQ) RUN - 5.0' - Depth from 25.1' to 30.1' RQD - 76% REC - 94%
	874.8		27.2'						
	874.6		27.4'						
			Soil seam						
		30							30.1' / 871.9' msl
	871.3		30.7' CALCAREOUS SHALE, gray, bedded, continuous, good quality, 75° to 80°						
	871.2		30.8'						

BORING RECORD S&ME - SPLIT LITHOLOGY 22430250.GPJ 2016.GDT 4/13/23

Borehole ID: B-01

Logged by: Joshua Baines

TEST BORING RECORD

BORING NO.: B-01
I-275
STATION NO.: 55+39
OFFSET: 75 R

PROJECT: I-275 Bridge over Elm Street		JOB NO: 22430250	SHEET 2 OF 2
PROJECT LOCATION: Knox County, Tennessee			
ELEVATION: 902 feet ±	BORING STARTED: 12/21/2022	RIG TYPE: Diedrich D-50	BORING DIA. (IN): 3-1/4"
DRILLING METHOD: Rock Core	BORING COMPLETED: 12/21/2022	HAMMER: Automatic	CORE DIA.: NQ=1-7/8 in

GROUNDWATER:
Dry ATD

Remarks:

G	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	L	S	R M PI	STANDARD PENETRATION RESISTANCE (N) 0 10 20 30 40 50 60 70 80 90 100	BLOWS/6"
			bedding angle, slightly weathered to fresh, medium					
			Soil seam					
		35	CALCAREOUS SHALE, gray, bedded, continuous, good quality, 75° to 80° bedding angle, slightly weathered to fresh, medium				**RUN 3** (NQ) RUN - 5.0' - Depth from 30.1' to 35.1' RQD - 84% REC - 98%*(Continued)*	35.1' / 866.9' msl
			Soil seam				**RUN 4** (NQ) RUN - 5.0' - Depth from 35.1' to 40.1' RQD - 96% REC - 100%	
		40	CALCAREOUS SHALE, gray, bedded, continuous, fair quality to excellent quality, 80° to 85° bedding angle, moderately weathered to fresh, medium*(Continued)*					40.1' / 861.9' msl
							RUN 5 (NQ) RUN - 5.0' - Depth from 40.1' to 45.1' RQD - 68% REC - 94%	
		45						45.1' / 856.9' msl
							RUN 6 (NQ) RUN - 5.0' - Depth from 45.1' to 50.1' RQD - 96% REC - 96%	
	851.9	50	*Coring terminated at 50.1 feet*					50.1' / 851.9' msl
		55						
		60						

BORING RECORD S&ME - SPLIT LITHOLOGY 22430250.GPJ 2016.GDT 4/13/23

Borehole ID: B-01

Logged by: Joshua Baines

TEST BORING RECORD

BORING NO.: B-02
I-275
STATION NO.: 55+04
OFFSET: 75 R

PROJECT: I-275 Bridge over Elm Street		JOB NO: 22430250	SHEET 1 OF 2
PROJECT LOCATION: Knox County, Tennessee			
ELEVATION: 902 feet ±	BORING STARTED: 12/22/2022	RIG TYPE: Diedrich D-50	BORING DIA. (IN): 3-1/4"
DRILLING METHOD: Rock Core	BORING COMPLETED: 12/22/2022	HAMMER: Automatic	CORE DIA.: NQ=1-7/8 in

GROUNDWATER:
Dry ATD

Remarks:

G	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	L	S	R	M	PI	STANDARD PENETRATION RESISTANCE (N) 0 10 20 30 40 50 60 70 80 90 100	BLOWS/6"
	902.0	0								
	901.4	0.6'	Asphalt, 7 inches							
	900.5	1.5'	Aggregate base, 11 inches							
			FAT CLAY, (CH), little shale fragments, stiff, purple with red brown, moist	Fill					12	3 - 2 - 10 **(12)**
	899.0	3'	WEATHERED ROCK, sampled as shale fragments, very dense, tan brown, dry	Residuum					>>	(REC:0.9) 50/4" **(50+)**
		5								(REC:0.2)
									>>	50/5" **(50+)**
										(REC:0.3)
	894.4	7.6'	*Auger refusal at 7.6 feet, began NQ coring*							
			CALCAREOUS SHALE, gray with tan, continuous, excellent quality to good quality, 80° to 85° bedding angle, slightly weathered to fresh, medium	Bedrock						
		10								
	889.5	12.5'								
	889.1	12.9'	Soil seam							
			CALCAREOUS SHALE, gray with tan, continuous, good quality, 80° to 85° bedding angle, slightly weathered to fresh, medium							
	887.2	14.8'								
	887.1	14.9'	Soil seam							
			CALCAREOUS SHALE, gray with tan, continuous, poor quality to good quality, 80° to 85° bedding angle, slightly weathered to fresh, medium							
		15								
		20								
		25								
	872.2	30	29.8'							

RUN 1 (NQ)
RUN - 2.2' - Depth from 7.6' to 9.8'
RQD - 95%
REC - 95%
9.8' / 892.2' msl

RUN 2 (NQ)
RUN - 5.0' - Depth from 9.8' to 14.8'
RQD - 82%
REC - 92%
14.8' / 887.2' msl

RUN 3 (NQ)
RUN - 5.0' - Depth from 14.8' to 19.8'
RQD - 40%
REC - 98%
19.8' / 882.2' msl

RUN 4 (NQ)
RUN - 5.0' - Depth from 19.8' to 24.8'
RQD - 40%
REC - 100%
24.8' / 877.2' msl

RUN 5 (NQ)
RUN - 5.0' - Depth from 24.8' to 29.8'
RQD - 84%
REC - 98%
29.8' / 872.2' msl

BORING RECORD S&ME - SPLIT LITHOLOGY 22430250.GPJ 2016.GDT 4/13/23

Borehole ID: B-02

Logged by: Joshua Baines

TEST BORING RECORD

BORING NO.: B-02
I-275
STATION NO.: 55+04
OFFSET: 75 R

PROJECT: I-275 Bridge over Elm Street		JOB NO: 22430250	SHEET 2 OF 2
PROJECT LOCATION: Knox County, Tennessee			
ELEVATION: 902 feet ±	BORING STARTED: 12/22/2022	RIG TYPE: Diedrich D-50	BORING DIA. (IN): 3-1/4"
DRILLING METHOD: Rock Core	BORING COMPLETED: 12/22/2022	HAMMER: Automatic	CORE DIA.: NQ=1-7/8 in

GROUNDWATER:
Dry ATD

Remarks:

G	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	L	S	
			CALCAREOUS SHALE, gray with tan, continuous, excellent quality to fair quality, 70° to 85° bedding angle, slightly weathered to fresh, medium *(Continued)*			**RUN 6** (NQ) RUN - 5.0' - Depth from 29.8' to 34.8' RQD - 90% REC - 94% *(Continued)* — 34.8' / 867.2' msl
	864.2	35	*Coring terminated at 37.8 feet*			**RUN 7** (NQ) RUN - 3.0' - Depth from 34.8' to 37.8' RQD - 67% REC - 100% — 37.8' / 864.2' msl
		40				
		45				
		50				
		55				
		60				

BORING RECORD S&ME - SPLIT LITHOLOGY 22430250.GPJ 2016.GDT 4/13/23

Borehole ID: B-02

Logged by: Joshua Baines

TEST BORING RECORD

BORING NO.: B-03
I-275
STATION NO.: 55+41
OFFSET: 20 R

PROJECT: I-275 Bridge over Elm Street		JOB NO: 22430250	SHEET 1 OF 2
PROJECT LOCATION: Knox County, Tennessee			
ELEVATION: 902 feet ±	BORING STARTED: 12/29/2022	RIG TYPE: Diedrich D-50	BORING DIA. (IN): 3-1/4"
DRILLING METHOD: Hollow Stem Auger	BORING COMPLETED: 12/29/2022	HAMMER: Automatic	CORE DIA.: NQ=1-7/8 in

GROUNDWATER:
Dry ATD

Remarks:

G	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	L	S	R	M	PI	STANDARD PENETRATION RESISTANCE (N) 0 10 20 30 40 50 60 70 80 90 100	BLOWS/6"
	902.0	0								
	901.1	0.9'	Concrete, 11 inches							
	900.5	1.5'	SANDY FAT CLAY WITH GRAVEL, (CH), trace sand, stiff, brown, slightly moist	Fill					14	6 - 2 - 12 **(14)**
	900.0	2'	FAT CLAY, (CH), trace sand, stiff, tan brown with, slightly moist	Residuum					30	36 - 18 - 12 **(30)**
	896.5	5.5'	GRAVELLY SILT, (ML), stiff to very stiff, tan brown, dry, Shale fragments						>>	50/2" **(50+)**
			WEATHERED ROCK, sampled as shale fragments, very dense, tan brown, dry, Shale fragments						>>	50/3" **(50+)**
	888.3	13.7'	*Auger refusal at 13.7 feet, began NQ coring*	Bedrock					>>	50/1" **(50+)**
	885.8	16.2'	CALCAREOUS SHALE, gray with tan, bedded, fairly continuous to continuous, fair quality to excellent, 75° to 80° bedding angle, moderately weathered to fresh, medium							
			CALCAREOUS SHALE, gray, bedded, continuous, excellent quality, 75° to 80° bedding angle, slightly weathered to fresh, medium							
	873.2	28.8'								
	872.2	29.8'	CALCAREOUS SHALE, gray with tan, bedded, continuous, fair quality, 75° to 80° bedding angle, slightly weathered to fresh, medium							

RUN 1 (NQ)
RUN - 1.1' - Depth from 13.7' to 14.8'
RQD - 64%
REC - 82%
14.8' / 887.2' msl

RUN 2 (NQ)
RUN - 5.0' - Depth from 14.8' to 19.8'
RQD - 72%
REC - 100%
19.8' / 882.2' msl

RUN 3 (NQ)
RUN - 5.0' - Depth from 19.8' to 24.8'
RQD - 96%
REC - 100%
24.8' / 877.2' msl

RUN 4 (NQ)
RUN - 5.0' - Depth from 24.8' to 29.8'
RQD - 92%
REC - 100%
29.8' / 872.2' msl

(REC:1.3) (REC:0.8) (REC:0.2) (REC:0.2)

BORING RECORD S&ME - SPLIT LITHOLOGY 22430250.GPJ 2016.GDT 4/13/23

Borehole ID: B-03

Logged by: David Abston

TEST BORING RECORD

BORING NO.: B-03
I-275
STATION NO.: 55+41
OFFSET: 20 R

PROJECT: I-275 Bridge over Elm Street		JOB NO: 22430250	SHEET 2 OF 2
PROJECT LOCATION: Knox County, Tennessee			
ELEVATION: 902 feet ±	BORING STARTED: 12/29/2022	RIG TYPE: Diedrich D-50	BORING DIA. (IN): 3-1/4"
DRILLING METHOD: Hollow Stem Auger	BORING COMPLETED: 12/29/2022	HAMMER: Automatic	CORE DIA.: NQ=1-7/8 in

GROUNDWATER:
Dry ATD

Remarks:

G	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	L	S
	869.2		CALCAREOUS SHALE, gray, bedded, continuous, excellent quality, 75° to 80° bedding angle, slightly weathered to fresh, medium *(Continued)*		
		35	*Coring terminated at 32.8 feet*		
			RUN 5 (NQ) RUN - 3.0' - Depth from 29.8' to 32.8' RQD - 100% REC - 100% *(Continued)*		
			32.8' / 869.2' msl		
		40			
		45			
		50			
		55			
		60			

BORING RECORD S&ME - SPLIT LITHOLOGY 22430250.GPJ 2016.GDT 4/13/23

Borehole ID: B-03

Logged by: David Abston

TEST BORING RECORD

BORING NO.: B-04
I-275
STATION NO.: 55+05
OFFSET: 12 R

PROJECT: I-275 Bridge over Elm Street		JOB NO: 22430250	SHEET 1 OF 2
PROJECT LOCATION: Knox County, Tennessee			
ELEVATION: 902 feet ±	BORING STARTED: 12/28/2022	RIG TYPE: Diedrich D-50	BORING DIA. (IN): 3-1/4"
DRILLING METHOD: Hollow Stem Auger	BORING COMPLETED: 12/29/2022	HAMMER: Automatic	CORE DIA.: NQ=1-7/8 in

GROUNDWATER:
Dry ATD

Remarks:

G	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	L	S	R	M	PI	STANDARD PENETRATION RESISTANCE (N) BLOWS/6"
	902.0	0	Concrete, 11 inches						
	901.1	0.9'	SANDY FAT CLAY WITH GRAVEL, (CH), trace sand, firm, brown, slightly moist	Fill					
	899.0	3'	FAT CLAY, (CH), trace sand, soft, brown with red brown, slightly moist						
	896.5	5.5'	GRAVELLY SILT, (ML), very stiff, tan brown, dry, Shale fragments	Residuum					
	894.0	8'	WEATHERED ROCK, sampled as shale fragments, very dense, tan brown, dry, Shale fragments						
	886.6	15.4'	*Auger refusal at 15.4 feet, began NQ coring*	Bedrock					
	885.0	17'	CALCAREOUS SHALE, gray with tan, bedded, incompetent, poor quality, 75° to 80° bedding angle, moderately weathered to fresh, medium						
			CALCAREOUS SHALE, gray, bedded, continuous, excellent quality, 75° to 80° bedding angle, slightly weathered to fresh, medium						

0 10 20 30 40 50 60 70 80 90 100

8 — 7 - 4 - 4 **(8)** — *(REC:0.5)*
4 — 2 - 2 - 2 **(4)** — *(REC:0.8)*
26 — 29 - 12 - 14 **(26)** — *(REC:0.6)*
28 - 50 **(50+)** — *(REC:0.8)*
>> — 36 - 50/2" **(50+)** — *(REC:0.6)*

RUN 1 (NQ)
RUN - 4.6' - Depth from 15.4' to 20'
RQD - 70%
REC - 100%

20' / 882.0' msl

RUN 2 (NQ)
RUN - 5.0' - Depth from 20' to 25'
RQD - 98%
REC - 100%

25' / 877.0' msl

RUN 3 (NQ)
RUN - 5.0' - Depth from 25' to 30'
RQD - 100%
REC - 100%

30' / 872.0' msl

BORING RECORD S&ME - SPLIT LITHOLOGY 22430250.GPJ 2016.GDT 4/13/23

Borehole ID: B-04

Logged by: David Abston

TEST BORING RECORD

BORING NO.: B-04
I-275
STATION NO.: 55+05
OFFSET: 12 R

PROJECT: I-275 Bridge over Elm Street		JOB NO: 22430250	SHEET 2 OF 2
PROJECT LOCATION: Knox County, Tennessee			
ELEVATION: 902 feet ±	BORING STARTED: 12/28/2022	RIG TYPE: Diedrich D-50	BORING DIA. (IN): 3-1/4"
DRILLING METHOD: Hollow Stem Auger	BORING COMPLETED: 12/29/2022	HAMMER: Automatic	CORE DIA.: NQ=1-7/8 in

GROUNDWATER:
Dry ATD

Remarks:

G	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	L	S
	868.7		*Coring terminated at 33.3 feet*		
		35	**RUN 4** (NQ) RUN - 3.3' - Depth from 30' to 33.3' RQD - 100% REC - 100%*(Continued)*		33.3' / 868.7' msl
		40			
		45			
		50			
		55			
		60			

BORING RECORD S&ME - SPLIT LITHOLOGY 22430250.GPJ 2016.GDT 4/13/23

Borehole ID: B-04

Logged by: David Abston

TEST BORING RECORD

BORING NO.: B-05
I-275
STATION NO.: 55+40
OFFSET: 22 L

PROJECT: I-275 Bridge over Elm Street		JOB NO: 22430250	SHEET 1 OF 2
PROJECT LOCATION: Knox County, Tennessee			
ELEVATION: 903 feet ±	BORING STARTED: 12/29/2022	RIG TYPE: Diedrich D-50	BORING DIA. (IN): 3-1/4"
DRILLING METHOD: Hollow Stem Auger	BORING COMPLETED: 12/29/2022	HAMMER: Automatic	CORE DIA.: NQ=1-7/8 in

GROUNDWATER:
Dry ATD

Remarks:

G	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	L	S	R	M	PI	STANDARD PENETRATION RESISTANCE (N) BLOWS/6"
	903.0	0	Concrete, 11 inches						
	902.1	0.9'	SANDY FAT CLAY WITH GRAVEL, (CH), trace sand, firm, brown, slightly moist	Fill					5 — 7 - 2 - 3 **(5)** (REC:0.2)
	899.0	4'	GRAVELLY SILT, (ML), hard, tan brown, dry, Shale fragments	Residuum					61 — 8 - 33 - 28 **(61)** (REC:0.9)
	897.2	5.8'	WEATHERED ROCK, sampled as shale fragments, very dense, tan brown, dry, Shale fragments						>> 50/3" **(50+)** (REC:0.3)
		10							>> 50/5" **(50+)** (REC:0.4)
	888.6	14.4'	*Auger refusal at 14.4 feet, began NQ coring*	Bedrock					>> 50/4" **(50+)** (REC:0.0)
		15							14.8' / 888.2' msl
	886.7	16.3'	CALCAREOUS SHALE, gray with tan, bedded, incompetent to continuous, very poor quality to fair quality, 75° to 80° bedding angle, moderately weathered, medium						**RUN 1** (NQ) RUN - 0.4' - Depth from 14.4' to 14.8' RQD - 0% REC - 75%
	886.1	16.9'							
	885.3	17.7'							
	884.9	18.1'							
			Soil seam						
		20	CALCAREOUS SHALE, gray with tan, bedded, continuous, fair quality, 75° to 80° bedding angle, slightly weathered to fresh, medium						**RUN 2** (NQ) RUN - 5.0' - Depth from 14.8' to 19.8' RQD - 70% REC - 96%
									19.8' / 883.2' msl
	881.1	21.9'							**RUN 3** (NQ) RUN - 5.0' - Depth from 19.8' to 24.8' RQD - 56% REC - 90%
	880.2	22.8'	Soil seam						
		25	CALCAREOUS SHALE, gray with tan, bedded, continuous, fair quality, 75° to 80° bedding angle, slightly weathered to fresh, medium						24.8' / 878.2' msl
			Soil seam						**RUN 4** (NQ) RUN - 5.0' - Depth from 24.8' to 29.8' RQD - 90% REC - 100%
		30	CALCAREOUS SHALE, gray with tan, bedded, continuous, fair quality to excellent quality, 75° to 80° bedding angle, slightly weathered to fresh, medium						29.8' / 873.2' msl

BORING RECORD S&ME - SPLIT LITHOLOGY 22430250.GPJ 2016.GDT 4/13/23

Borehole ID: B-05

Logged by: David Abston

TEST BORING RECORD

BORING NO.: B-05
I-275
STATION NO.: 55+40
OFFSET: 22 L

PROJECT: I-275 Bridge over Elm Street		JOB NO: 22430250	SHEET 2 OF 2
PROJECT LOCATION: Knox County, Tennessee			
ELEVATION: 903 feet ±	BORING STARTED: 12/29/2022	RIG TYPE: Diedrich D-50	BORING DIA. (IN): 3-1/4"
DRILLING METHOD: Hollow Stem Auger	BORING COMPLETED: 12/29/2022	HAMMER: Automatic	CORE DIA.: NQ=1-7/8 in

GROUNDWATER:
Dry ATD

Remarks:

G	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	L	S	
		35	CALCAREOUS SHALE, gray with tan, bedded, continuous, fair quality to excellent quality, 75° to 80° bedding angle, slightly weathered to fresh, medium *(Continued)*			**RUN 5** (NQ) RUN - 5.0' - Depth from 29.8' to 34.8' RQD - 84% REC - 100% *(Continued)* — 34.8' / 868.2' msl
						RUN 6 (NQ) RUN - 5.0' - Depth from 34.8' to 39.8' RQD - 96% REC - 100%
	863.2	40	*Coring terminated at 39.8 feet*			39.8' / 863.2' msl
		45				
		50				
		55				
		60				

BORING RECORD S&ME - SPLIT LITHOLOGY 22430250.GPJ 2016.GDT 4/13/23

Borehole ID: B-05

Logged by: David Abston

TEST BORING RECORD

BORING NO.: B-06
I-275
STATION NO.: 55+06
OFFSET: 22 L

PROJECT: I-275 Bridge over Elm Street		JOB NO: 22430250	SHEET 1 OF 2
PROJECT LOCATION: Knox County, Tennessee			
ELEVATION: 903 feet ±	BORING STARTED: 12/27/2022	RIG TYPE: Diedrich D-50	BORING DIA. (IN): 3-1/4"
DRILLING METHOD: Hollow Stem Auger	BORING COMPLETED: 12/28/2022	HAMMER: Automatic	CORE DIA.: NQ=1-7/8 in

GROUNDWATER:
Dry ATD

Remarks:

G	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	L	S	R	M	PI	STANDARD PENETRATION RESISTANCE (N) 0 10 20 30 40 50 60 70 80 90 100	BLOWS/6"
	903.0	0	Concrete, 11 inches							
	902.1	0.9'	FAT CLAY, (CH), trace sand, stiff to soft, brown with red brown, slightly moist	Fill					13	8 - 6 - 7 **(13)**
										(REC:0.8)
	899.0	4'	WEATHERED ROCK, sampled as shale fragments, medium dense to very dense, tan brown, dry, Shale fragments	Residuum					22	2 - 2 - 20 **(22)**
		5								*(REC:0.9)*
									>>	50/5" **(50+)**
										(REC:0.4)
									>>	50/5" **(50+)**
		10								*(REC:0.3)*
									>>	50/2" **(50+)**
		15								*(REC:0.2)*
	885.4	17.6'	*Auger refusal at 17.6 feet, began NQ coring*	Bedrock						
			CALCAREOUS SHALE, gray, bedded, continuous, poor quality to excellent quality, 75° to 80° bedding angle, moderately weathered to fresh, medium							
		20								
	879.5	23.5'								
	879.4	23.6'	Soil seam							
			CALCAREOUS SHALE, gray, bedded, continuous, excellent quality, 75° to 80° bedding angle, fresh, medium							
		25								
		30								

RUN 1 (NQ)
RUN - 2.0' - Depth from 17.6' to 19.6'
RQD - 40%
REC - 90%
19.6' / 883.4' msl

RUN 2 (NQ)
RUN - 5.0' - Depth from 19.6' to 24.6'
RQD - 100%
REC - 100%
24.6' / 878.4' msl

RUN 3 (NQ)
RUN - 5.0' - Depth from 24.6' to 29.6'
RQD - 100%
REC - 100%
29.6' / 873.4' msl

BORING RECORD S&ME - SPLIT LITHOLOGY 22430250.GPJ 2016.GDT 4/13/23

Borehole ID: B-06

Logged by: David Abston

TEST BORING RECORD

BORING NO.: B-06
I-275
STATION NO.: 55+06
OFFSET: 22 L

PROJECT: I-275 Bridge over Elm Street		JOB NO: 22430250	SHEET 2 OF 2
PROJECT LOCATION: Knox County, Tennessee			
ELEVATION: 903 feet ±	BORING STARTED: 12/27/2022	RIG TYPE: Diedrich D-50	BORING DIA. (IN): 3-1/4"
DRILLING METHOD: Hollow Stem Auger	BORING COMPLETED: 12/28/2022	HAMMER: Automatic	CORE DIA.: NQ=1-7/8 in

GROUNDWATER:
Dry ATD

Remarks:

G	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	L	S	
		35	CALCAREOUS SHALE, gray, bedded, continuous, excellent quality, 75° to 80° bedding angle, fresh, medium *(Continued)*			**RUN 4** (NQ) RUN - 5.0' - Depth from 29.6' to 34.6' RQD - 100% REC - 100% *(Continued)*
						34.6' / 868.4' msl
						RUN 5 (NQ) RUN - 5.0' - Depth from 34.6' to 39.6' RQD - 100% REC - 100%
	863.4	40	*Coring terminated at 39.6 feet*			
						39.6' / 863.4' msl
		45				
		50				
		55				
		60				

BORING RECORD S&ME - SPLIT LITHOLOGY 22430250.GPJ 2016.GDT 4/13/23

Borehole ID: B-06

Logged by: David Abston

TEST BORING RECORD

BORING NO.: B-07
I-275
STATION NO.: 55+39
OFFSET: 75 L

PROJECT: I-275 Bridge over Elm Street		JOB NO: 22430250	SHEET 1 OF 2
PROJECT LOCATION: Knox County, Tennessee			
ELEVATION: 904 feet ±	BORING STARTED: 12/20/2022	RIG TYPE: Diedrich D-50	BORING DIA. (IN): 3-1/4"
DRILLING METHOD: Rock Core	BORING COMPLETED: 12/20/2022	HAMMER: Automatic	CORE DIA.: NQ=1-7/8 in

GROUNDWATER:
Dry ATD

Remarks:

G	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	L	S	R	M	PI	STANDARD PENETRATION RESISTANCE (N) BLOWS/6"
	904.0	0							
	903.2	0.8'	Concrete, 10 inches						
	903.0	1'	Aggregate base, 2 inches	Fill					
	901.0	3'	FAT CLAY WITH GRAVEL, (CH), little shell fragments, stiff, red brown with gray, moist	Residuum					2 - 3 - 6 **(9)** (REC:0.8)
		5	WEATHERED ROCK, sampled as shale fragments, very dense, tan brown, dry						50/5" **(50+)** (REC:0.4)
	896.0	8'	WEATHERED ROCK, sampled as shale fragments, few silty clay, very dense, tan brown with red brown, dry						50/3" **(50+)** (REC:0.3)
		10							17 - 50/4" **(50+)** (REC:0.7)
	892.0	12'	WEATHERED ROCK, sampled as shale fragments, few silt, very dense, tan brown with red brown, dry						50/2" **(50+)** (REC:0.2)
		15							
	887.0	17'	WEATHERED ROCK, sampled as shale fragments, few silt, very dense, gray with tan brown, dry						50/1" **(50+)** (REC:0.1)
		20							
	882.0	22'	WEATHERED ROCK, sampled as shale fragments, few silt, very dense, gray brown, dry						50/1" **(50+)** (REC:0.1)
	879.6	24.4'	*Auger refusal at 24.4 feet, began NQ coring*	Bedrock					
	878.9	25.1'	CALCAREOUS SHALE, gray, bedded, fairly continuous, fair quality, 75° to 80° bedding angle, slightly weathered to fresh, medium						
	878.7	25.3'							
	878.3	25.7'							
	878.2	25.8'							
	877.4	26.6'							
	877.3	26.7'							
	877.0	27'							
	876.9	27.1'	Soil seam						
		30	CALCAREOUS SHALE, gray, bedded, fairly continuous, fair quality, 75° to 80° bedding angle, slightly weathered to						

RUN 1 (NQ)
RUN - 5.1' - Depth from 24.4' to 29.5'
RQD - 67%
REC - 90%

29.5' / 874.5' msl

BORING RECORD S&ME - SPLIT LITHOLOGY 22430250.GPJ 2016.GDT 4/13/23

Borehole ID: B-07

Logged by: Joshua Baines

TEST BORING RECORD

BORING NO.: B-07
I-275
STATION NO.: 55+39
OFFSET: 75 L

PROJECT: I-275 Bridge over Elm Street		JOB NO: 22430250	SHEET 2 OF 2
PROJECT LOCATION: Knox County, Tennessee			
ELEVATION: 904 feet ±	BORING STARTED: 12/20/2022	RIG TYPE: Diedrich D-50	BORING DIA. (IN): 3-1/4"
DRILLING METHOD: Rock Core	BORING COMPLETED: 12/20/2022	HAMMER: Automatic	CORE DIA.: NQ=1-7/8 in

GROUNDWATER:
Dry ATD

Remarks:

G	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	L	S
	871.9		32.1' fresh, medium		
	871.6		32.4' Soil seam		
	870.8		33.2' CALCAREOUS SHALE, gray, bedded, fairly continuous, fair quality, 75° to 80° bedding angle, slightly weathered to fresh, medium		
	870.5		33.5' Soil seam		
	868.5	35	35.5' CALCAREOUS SHALE, gray, bedded, fairly continuous, fair quality, 75° to 80° bedding angle, slightly weathered to fresh, medium		
	868.3		35.7' Soil seam		
		40	CALCAREOUS SHALE, gray, bedded, fairly continuous, fair quality, 75° to 80° bedding angle, slightly weathered to fresh, medium *(Continued)*		
			Soil seam		
		45	CALCAREOUS SHALE, gray, bedded, fairly continuous, fair quality, 75° to 80° bedding angle, slightly weathered to fresh, medium		
			Soil seam		
	854.5	50	CALCAREOUS SHALE, gray, bedded, fairly continuous, fair quality, 75° to 80° bedding angle, slightly weathered to fresh, medium		
			Soil seam		
		55	CALCAREOUS SHALE, gray, bedded, continuous, fair quality to excellent quality, 80° to 85° bedding angle, slightly weathered to fresh, medium		
			Coring terminated at 49.5 feet		
		60			

RUN 2 (NQ)
RUN - 5.0' - Depth from 29.5' to 34.5'
RQD - 60%
REC - 88%*(Continued)*
34.5' / 869.5' msl

RUN 3 (NQ)
RUN - 5.0' - Depth from 34.5' to 39.5'
RQD - 68%
REC - 96%
39.5' / 864.5' msl

RUN 4 (NQ)
RUN - 5.0' - Depth from 39.5' to 44.5'
RQD - 96%
REC - 100%
44.5' / 859.5' msl

RUN 5 (NQ)
RUN - 5.0' - Depth from 44.5' to 49.5'
RQD - 100%
REC - 100%
49.5' / 854.5' msl

BORING RECORD S&ME - SPLIT LITHOLOGY 22430250.GPJ 2016.GDT 4/13/23

Borehole ID: B-07

Logged by: Joshua Baines

TEST BORING RECORD

BORING NO.: B-08
I-275
STATION NO.: 55+04
OFFSET: 76 L

PROJECT: I-275 Bridge over Elm Street		JOB NO: 22430250	SHEET 1 OF 2
PROJECT LOCATION: Knox County, Tennessee			
ELEVATION: 904 feet ±	BORING STARTED: 12/22/2022	RIG TYPE: Diedrich D-50	BORING DIA. (IN): 3-1/4"
DRILLING METHOD: Rock Core	BORING COMPLETED: 12/22/2022	HAMMER: Automatic	CORE DIA.: NQ=1-7/8 in

GROUNDWATER:
Dry ATD

Remarks:

G	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	L	S	R	M	PI	STANDARD PENETRATION RESISTANCE (N) 0 10 20 30 40 50 60 70 80 90 100	BLOWS/6"
	904.0	0								
	903.2	0.8'	Concrete, 10 inches							
	902.7	1.3'	Aggregate base, 6 inches	Fill						
	901.0	3'	FAT CLAY, (CH), little rock fragments, firm, dark brown with tan, moist	Residuum					7	3 - 4 - 3 **(7)**
										(REC:0.8)
			FAT CLAY, (CH), little shale fragments, hard, purple with red brown, moist						51	2 - 9 - 42 **(51)**
	898.5	5.5'								*(REC:1.1)*
			WEATHERED ROCK, sampled as shale fragments, very dense, tan brown, dry						>>	50/4" **(50+)**
										(REC:0.3)
									>>	50/4" **(50+)**
										(REC:0.3)
	891.7	12.3'	*Auger refusal at 12.3 feet, began NQ coring*	Bedrock						
			CALCAREOUS SHALE, gray, fairly continuous to continuous, fair quality to good quality, 75° to 85° bedding angle, slightly weathered to fresh, medium							

RUN 1 (NQ)
RUN - 2.4' - Depth from 12.3' to 14.7'
RQD - 63%
REC - 100%

14.7' / 889.3' msl

RUN 2 (NQ)
RUN - 5.0' - Depth from 14.7' to 19.7'
RQD - 62%
REC - 98%

19.7' / 884.3' msl

RUN 3 (NQ)
RUN - 5.0' - Depth from 19.7' to 24.7'
RQD - 76%
REC - 92%

24.7' / 879.3' msl

RUN 4 (NQ)
RUN - 5.0' - Depth from 24.7' to 29.7'
RQD - 84%
REC - 98%

29.7' / 874.3' msl

BORING RECORD S&ME - SPLIT LITHOLOGY 22430250.GPJ 2016.GDT 4/13/23

Borehole ID: B-08

Logged by: Joshua Baines

TEST BORING RECORD

BORING NO.: B-08
I-275
STATION NO.: 55+04
OFFSET: 76 L

PROJECT: I-275 Bridge over Elm Street		JOB NO: 22430250	SHEET 2 OF 2
PROJECT LOCATION: Knox County, Tennessee			
ELEVATION: 904 feet ±	BORING STARTED: 12/22/2022	RIG TYPE: Diedrich D-50	BORING DIA. (IN): 3-1/4"
DRILLING METHOD: Rock Core	BORING COMPLETED: 12/22/2022	HAMMER: Automatic	CORE DIA.: NQ=1-7/8 in

GROUNDWATER:
Dry ATD

Remarks:

G	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	L	S	
	869.3	35	34.7' CALCAREOUS SHALE, gray, continuous, excellent quality, 75° to 85° bedding angle, fresh, medium last 0.5 feet of run could not be retrieved from boring	Bedrock		**RUN 5** (NQ) RUN - 5.0' - Depth from 29.7' to 34.7' RQD - 88% REC - 100%*(Continued)* — 34.7' / 869.3' msl **RUN 6** (NQ) RUN - 5.0' - Depth from 34.7' to 39.7' RQD - 90% REC - 90%
	864.3	40	*Coring terminated at 39.7 feet*			39.7' / 864.3' msl
		45				
		50				
		55				
		60				

BORING RECORD S&ME - SPLIT LITHOLOGY 22430250.GPJ 2016.GDT 4/13/23

Borehole ID: B-08

Logged by: Joshua Baines

TEST BORING RECORD

BORING NO.: B-09
I-275
STATION NO.: 55+93
OFFSET: 65 R

PROJECT: I-275 Bridge over Elm Street		JOB NO: 22430250	SHEET 1 OF 1
PROJECT LOCATION: Knox County, Tennessee			
ELEVATION: 922 feet ±	BORING STARTED: 12/13/2022	RIG TYPE: Diedrich D-50	BORING DIA. (IN): 3-1/4"
DRILLING METHOD: Hollow Stem Auger	BORING COMPLETED: 12/13/2022	HAMMER: Automatic	

GROUNDWATER:
Dry ATD

Remarks:

G	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	L	S	R	M	PI	STANDARD PENETRATION RESISTANCE (N) 0 10 20 30 40 50 60 70 80 90 100	BLOWS/6"
	922.0	0								
	921.3	0.7'	Asphalt, 8 inches							
	920.6	1.4'	Concrete, 8 inches							
	920.1	1.9'	Aggregate base, 7 inches	Fill						
	918.5	3.5'	FAT CLAY, (CH), trace rock fragments, firm, orange brown with tan, moist						6	2 - 3 - 3 **(6)**
			FAT CLAY, (CH), trace rock fragments, firm, orange tan with brown tan, moist						5	(REC:1.1) 2 - 2 - 3 **(5)**
	916.5	5.5'	FAT CLAY, (CH), few chert, firm, orange brown with tan, moist							(REC:0.6)
									8	3 - 3 - 5 **(8)**
	914.0	8'	FAT CLAY, (CH), few silt, stiff, tan brown with red orange, moist, black staining	Residuum						(REC:1.3)
									13	2 - 5 - 8 **(13)**
		10								(REC:1.3)
	909.5	12.5'	FAT CLAY, (CH), few silt, stiff, tan brown with brown, moist							
									12	4 - 5 - 7 **(12)**
		15								(REC:1.4)
	904.5	17.5'	SILT, (ML), little clay, very stiff, tan brown with brown, relict structure, slightly moist							
									21	7 - 10 - 11 **(21)**
		20								(REC:1.4)
	900.0	22'	FAT CLAY, (CH), few silt, firm, tan brown with red, moist, black staining				44.1	47		(REC:2.0)
										(REC:2.0)
		25							8	3 - 3 - 5 **(8)**
	894.5	27.5'	FAT CLAY, (CH), firm, dark brown with red tan, mottled, moist, black staining							(REC:1.5)
HC										
	892.0	30	*Boring terminated at 30 feet*						6	2 - 3 - 3 **(6)**
										(REC:1.5)

BORING RECORD S&ME - SPLIT LITHOLOGY 22430250.GPJ 2016.GDT 4/13/23

Borehole ID: B-09

Logged by: Joshua Baines

TEST BORING RECORD

BORING NO.: B-10
I-275
STATION NO.: 54+38
OFFSET: 63 R

PROJECT: I-275 Bridge over Elm Street		JOB NO: 22430250	SHEET 1 OF 1
PROJECT LOCATION: Knox County, Tennessee			
ELEVATION: 921 feet ±	BORING STARTED: 12/12/2022	RIG TYPE: Diedrich D-50	BORING DIA. (IN): 3-1/4"
DRILLING METHOD: Hollow Stem Auger	BORING COMPLETED: 12/12/2022	HAMMER: Automatic	

GROUNDWATER:
Dry ATD

Remarks:

G	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	L	S	R	M	PI	STANDARD PENETRATION RESISTANCE (N) 0 10 20 30 40 50 60 70 80 90 100	BLOWS/6"
	921.0	0								
	919.3	1.7'	Asphalt, 20 inches							
	919.0	2'	Aggregate base, 4 inches	Fill						
			POORLY GRADED GRAVEL, (GP), trace clay, dense, red brown with gray, dry				7		44	4 - 8 - 36 **(44)**
										(REC:0.6)
	915.5	5								
		5.5'	LEAN CLAY WITH GRAVEL, (CL), firm, red brown with brown, moist				22.1		7	3 - 3 - 4 **(7)**
	913.0	8'								*(REC:0.3)*
			FAT CLAY, (CH), soft, red brown with tan orange, moist, black staining				24.7	24	4	2 - 2 - 2 **(4)**
										(REC:0.9)
	908.5	10								
		12.5'	FAT CLAY, (CH), few rock fragments, stiff, red brown to tan brown, moist, black staining				16.9		11	6 - 5 - 6 **(11)**
										(REC:0.9)
	903.5	15								
		17.5'	FAT CLAY, (CH), few silt, trace weathered rock fragments, stiff, tan brown with dark brown orange, moist, black staining	Residuum			20.3		10	2 - 4 - 6 **(10)**
										(REC:1.5)
	898.5	20								
		22.5'	FAT CLAY, (CH), little silt, stiff, tan brown with white orange, relict structure, moist				32.1		15	5 - 6 - 9 **(15)**
										(REC:1.4)
	893.5	25								
HC		27.5'	FAT CLAY, (CH), little silt, trace shale fragments, very stiff, tan brown with dark brown orange, relict structure, moist				30.7	56	16	4 - 7 - 9 **(16)**
	891.0	30	*Boring terminated at 30 feet*							*(REC:1.5)*

BORING RECORD S&ME - SPLIT LITHOLOGY 22430250.GPJ 2016.GDT 4/13/23

Borehole ID: B-10

Logged by: Joshua Baines

TEST BORING RECORD

BORING NO.: B-11
I-275
STATION NO.: 56+01
OFFSET: 65 L

PROJECT: I-275 Bridge over Elm Street		JOB NO: 22430250	SHEET 1 OF 2
PROJECT LOCATION: Knox County, Tennessee			
ELEVATION: 922 feet ±	BORING STARTED: 12/19/2022	RIG TYPE: Diedrich D-50	BORING DIA. (IN): 3-1/4"
DRILLING METHOD: Hollow Stem Auger	BORING COMPLETED: 12/19/2022	HAMMER: Automatic	

GROUNDWATER:
Dry ATD
▼ 29.00

Remarks:

G	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	L	S	R	M	PI	STANDARD PENETRATION RESISTANCE (N) 0 10 20 30 40 50 60 70 80 90 100	BLOWS/6"
	922.0	0								
	921.9	0.1'	Asphalt, 1 inch							
	921.3	0.7'	Concrete, 8 inches							
	920.7	1.3'	Aggregate base, 6 inches	Fill			4		28	10 - 15 - 13 **(28)**
	919.0	3'	FAT CLAY WITH GRAVEL, (CH), little sand, very stiff, orange brown with brown, slightly moist				22		6	(REC:0.7) 3 - 2 - 4 **(6)**
	916.5	5.5'	FAT CLAY, (CH), few sand, firm, orange brown with tan, moist							(REC:1.2)
			FAT CLAY, (CH), few sand, very stiff, orange brown with tan, relict structure, slightly moist	Residuum			30.5		18	6 - 8 - 10 **(18)**
	914.0	8'	FAT CLAY, (CH), few sand, very stiff, orange brown with tan white, mottled, slightly moist				31.3		20	(REC:1.2) 7 - 9 - 11 **(20)**
	910.0	12'	LEAN CLAY, (CL), few silt, very stiff, orange brown with tan brown, relict structure, slightly moist				33.2		17	(REC:1.5) 3 - 7 - 10 **(17)**
	905.0	17'	FAT CLAY, (CH), few sand, stiff, orange brown with tan, relict structure, moist				40.5		9	(REC:1.4) 3 - 3 - 6 **(9)**
							32.6	27		(REC:1.5)
	900.0	22'	FAT CLAY, (CH), firm, tan brown with brown, moist				37.1		6	(REC:2.0) 3 - 3 - 3 **(6)**
	895.0	27'	FAT CLAY, (CH), few weathered rock fragments, very soft, tan brown with brown, moist to very moist				70.9	39	2	(REC:1.3) 1 - 1 - 1 **(2)**
										(REC:1.4)

BORING RECORD S&ME - SPLIT LITHOLOGY 22430250.GPJ 2016.GDT 4/13/23

Borehole ID: B-11

Logged by: Joshua Baines

TEST BORING RECORD

BORING NO.: B-11
I-275
STATION NO.: 56+01
OFFSET: 65 L

PROJECT: I-275 Bridge over Elm Street		JOB NO: 22430250	SHEET 2 OF 2
PROJECT LOCATION: Knox County, Tennessee			
ELEVATION: 922 feet ±	BORING STARTED: 12/19/2022	RIG TYPE: Diedrich D-50	BORING DIA. (IN): 3-1/4"
DRILLING METHOD: Hollow Stem Auger	BORING COMPLETED: 12/19/2022	HAMMER: Automatic	

GROUNDWATER:
Dry ATD
29.00

Remarks:

G	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	L	S	R	M	PI	STANDARD PENETRATION RESISTANCE (N) 0 10 20 30 40 50 60 70 80 90 100	BLOWS/6"
	890.0		32' FAT CLAY WITH GRAVEL, (CH), weathered rock fragments, very soft to stiff, tan brown with brown, wet				64.3		2	0 - 1 - 1 **(2)**
		35								*(REC:1.5)*
	882.0	40	*Boring terminated at 40 feet*						10	0 - 2 - 8 **(10)**
										(REC:0.7)
		45								
		50								
		55								
		60								

BORING RECORD S&ME - SPLIT LITHOLOGY 22430250.GPJ 2016.GDT 4/13/23

Borehole ID: B-11

Logged by: Joshua Baines

TEST BORING RECORD

BORING NO.: B-12
I-275
STATION NO.: 54+41
OFFSET: 64 L

PROJECT: I-275 Bridge over Elm Street		JOB NO: 22430250	SHEET 1 OF 1
PROJECT LOCATION: Knox County, Tennessee			
ELEVATION: 921 feet ±	BORING STARTED: 12/19/2022	RIG TYPE: Diedrich D-50	BORING DIA. (IN): 3-1/4"
DRILLING METHOD: Hollow Stem Auger	BORING COMPLETED: 12/19/2022	HAMMER: Automatic	

GROUNDWATER:
Dry ATD

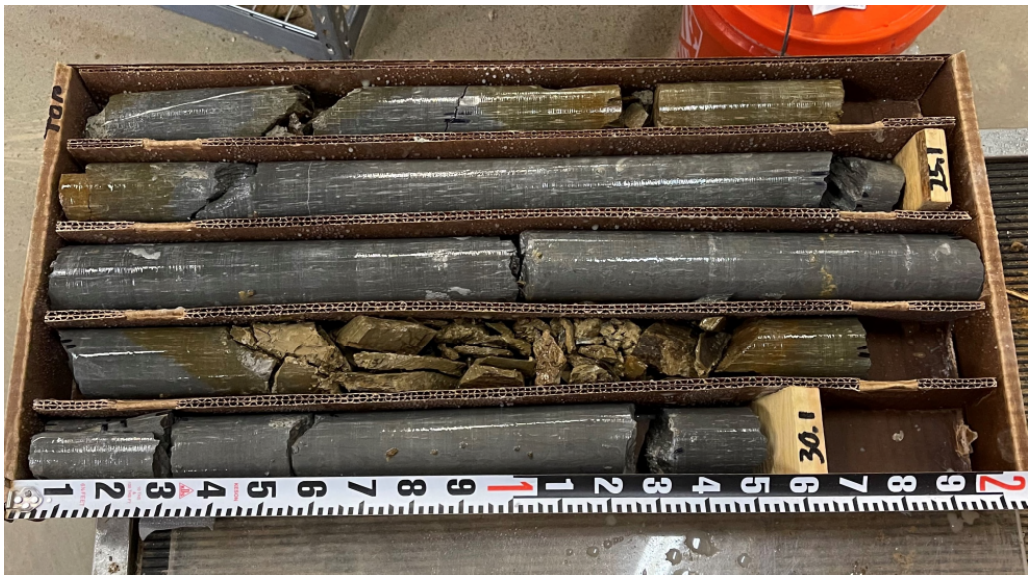
Remarks:

G	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	L	STANDARD PENETRATION RESISTANCE (N)	BLOWS/6"
	921.0	0	Asphalt, 16 inches	Fill		
	919.6	1.4'	Aggregate base, 2 inches			
	919.5	1.5'	FAT CLAY, (CH), firm, red brown with brown gray, moist		6	2 - 3 - 3 **(6)**
	918.0	3'	FAT CLAY, (CH), few rock fragments, firm, red brown with brown, moist		5	(REC:0.9)
						2 - 1 - 4 **(5)**
					3	(REC:1.2)
						2 - 1 - 2 **(3)**
	913.0	8'	FAT CLAY, (CH), trace rock fragments, firm, red brown with brown tan, moist		5	(REC:0.0)
						2 - 2 - 3 **(5)**
HC	909.0	12'	FAT CLAY, (CH), trace rock fragments, firm, red brown with gray tan, moist		5	(REC:1.5)
						2 - 2 - 3 **(5)**
	904.0	17'	FAT CLAY, (CH), few silt, stiff, tan brown with dark brown orange, mottled, moist, black staining	Residuum	14	(REC:1.0)
						4 - 6 - 8 **(14)**
	899.0	22'	FAT CLAY, (CH), very stiff, tan brown with red, moist, black staining		19	(REC:1.3)
						4 - 7 - 12 **(19)**
	894.0	27'	FAT CLAY, (CH), very stiff, red brown with brown tan, mottled, moist, black staining		18	(REC:2.0)
						6 - 8 - 10 **(18)**
	891.0	30	*Boring terminated at 30 feet*			(REC:1.4)

BORING RECORD S&ME - SPLIT LITHOLOGY 22430250.GPJ 2016.GDT 4/13/23

Borehole ID: B-12

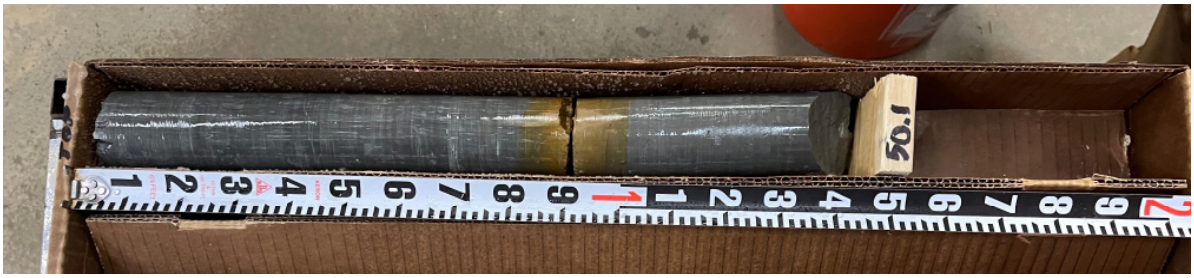
Logged by: Joshua Baines



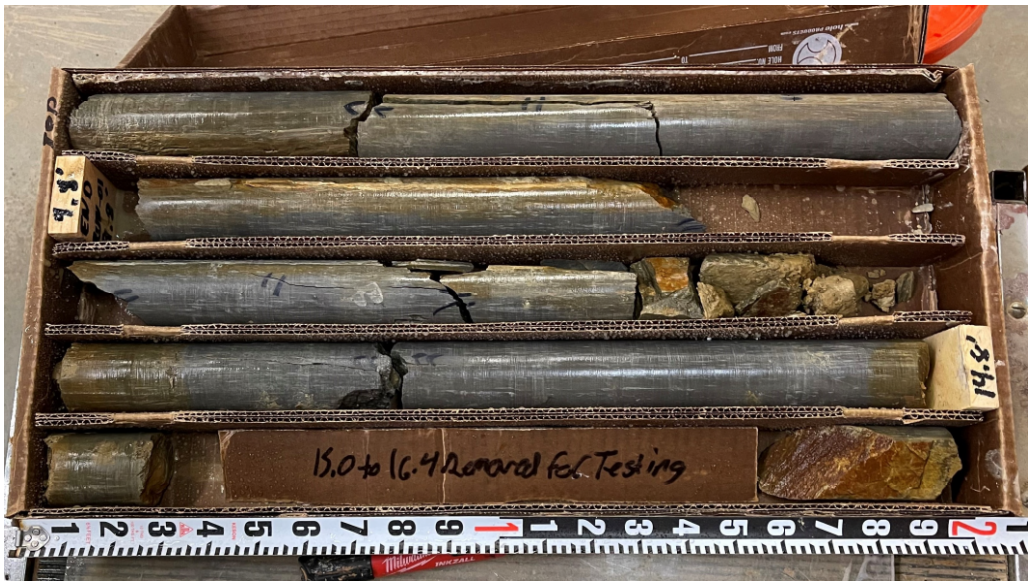
BORING B-01, I-275, STATION 55+39, 75 FEET RIGHT: BOX 1 OF 4				
RUN	**DEPTH (FT)**	**RQD (%)**	**RECOVERY (%)**	**ROCK DESCRIPTION**
1	21.4-25.1	84	95	CALCAREOUS SHALE, gray, continuous, good quality, 75 to 80 degree bedding, slight weathering to fresh, medium hard
2	25.1-30.1	76	94	

BORING B-01, I-275, STATION 55+39, 75 FEET RIGHT: BOX 2 OF 4				
RUN	**DEPTH (FT)**	**RQD (%)**	**RECOVERY (%)**	**ROCK DESCRIPTION**
3	30.1-35.1	84	98	CALCAREOUS SHALE, gray, continuous, fair to excellent quality, 75 to 85 degree bedding, slight weathering to fresh, medium hard
4	35.1-40.1	96	100	

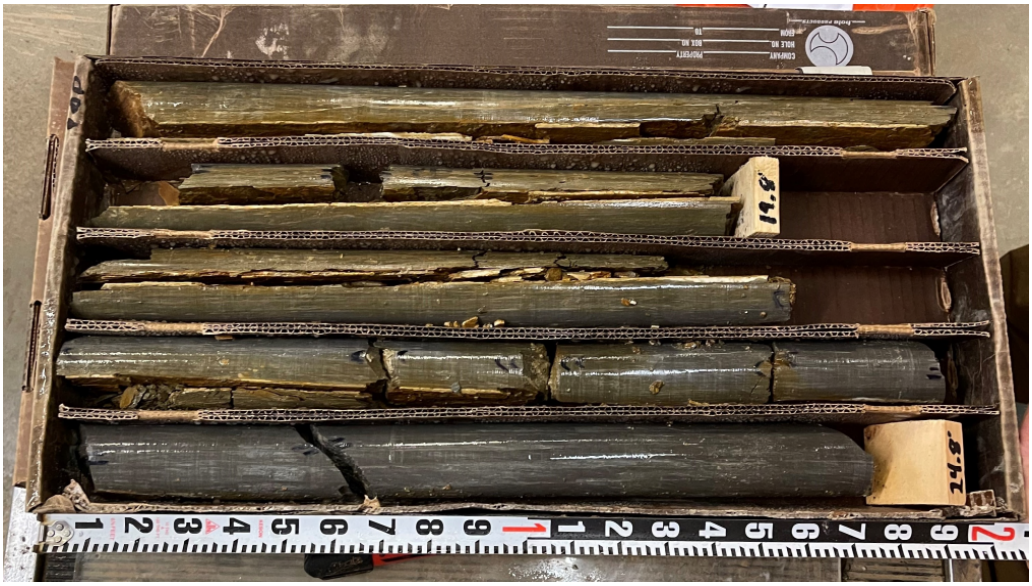
BORING B-01, I-275, STATION 55+39, 75 FEET RIGHT: BOX 3 OF 4				
RUN	**DEPTH (FT)**	**RQD (%)**	**RECOVERY (%)**	**ROCK DESCRIPTION**
4 (cont'd)	35.1-40.1	96	100	CALCAREOUS SHALE, gray, continuous, fair to excellent quality, 80 to 85 degree bedding, slight weathering to fresh, medium hard
5	40.1-45.1	68	94	
6	45.1-50.1	96	96	



BORING B-01, I-275, STATION 55+39, 75 FEET RIGHT: BOX 4 OF 4				
RUN	**DEPTH (FT)**	**RQD (%)**	**RECOVERY (%)**	**ROCK DESCRIPTION**
6 (cont'd)	45.1-50.1	96	96	CALCAREOUS SHALE, gray, continuous, fair to excellent quality, 80 to 85 degree bedding, slight weathering to fresh, medium hard

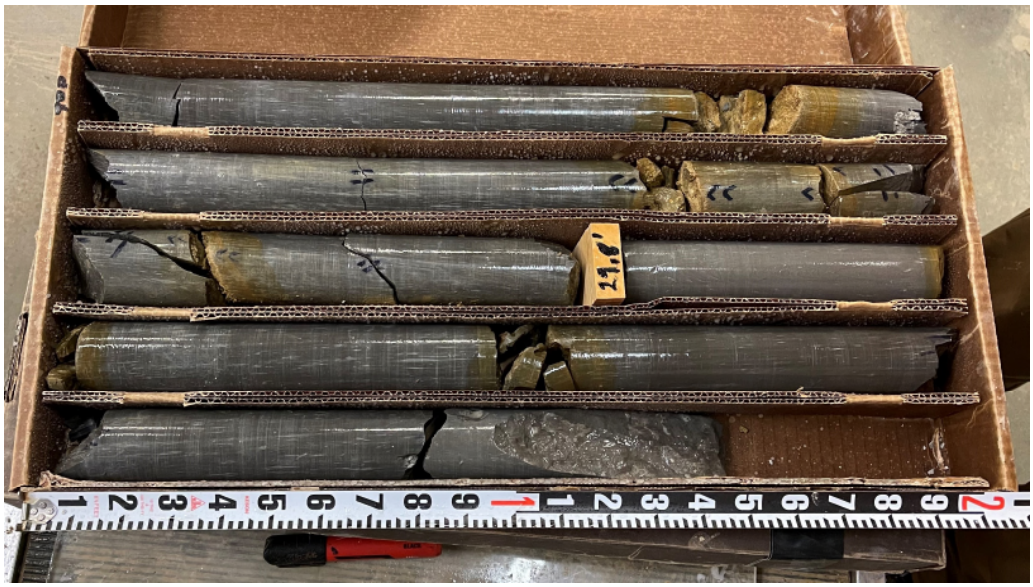


BORING B-02, I-275, STATION 55+04, 75 FEET RIGHT: BOX 1 OF 4				
RUN	**DEPTH (FT)**	**RQD (%)**	**RECOVERY (%)**	**ROCK DESCRIPTION**
1	7.6-9.8	95	95	CALCAREOUS SHALE, gray with tan, continuous, excellent to good quality, 80 to 85 degree bedding, slight weathering to fresh, medium hard
2	9.8-14.8	82	92	
3	14.8-19.8	40	98	



BORING B-02, I-275, STATION 55+04, 75 FEET RIGHT: BOX 2 OF 4				
RUN	**DEPTH (FT)**	**RQD (%)**	**RECOVERY (%)**	**ROCK DESCRIPTION**
3 (cont'd)	14.8-19.8	40	98	CALCAREOUS SHALE, gray with tan, continuous, poor quality, 80 to 85 degree bedding, slight weathering to fresh, medium hard
4	19.8-24.8	40	100	

SEE TEST BORING RECORDS FOR FULL DESCRIPTION OF ROCK CORE



BORING B-02, I-275, STATION 55+04, 75 FEET RIGHT: BOX 3 OF 4				
RUN	**DEPTH (FT)**	**RQD (%)**	**RECOVERY (%)**	**ROCK DESCRIPTION**
5	24.8-29.8	84	96	CALCAREOUS SHALE, gray with tan, continuous, good to excellent quality, 80 to 85 degree bedding, slight weathering to fresh, medium hard
6	29.8-34.8	90	94	

BORING B-02, I-275, STATION 55+04, 75 FEET RIGHT: BOX 4 OF 4				
RUN	**DEPTH (FT)**	**RQD (%)**	**RECOVERY (%)**	**ROCK DESCRIPTION**
6 (cont'd)	39.8-34.8	90	94	CALCAREOUS SHALE, gray with tan, continuous, excellent to fair quality, 80 to 85 degree bedding, slight weathering to fresh, medium hard
7	34.8-37.8	67	100	

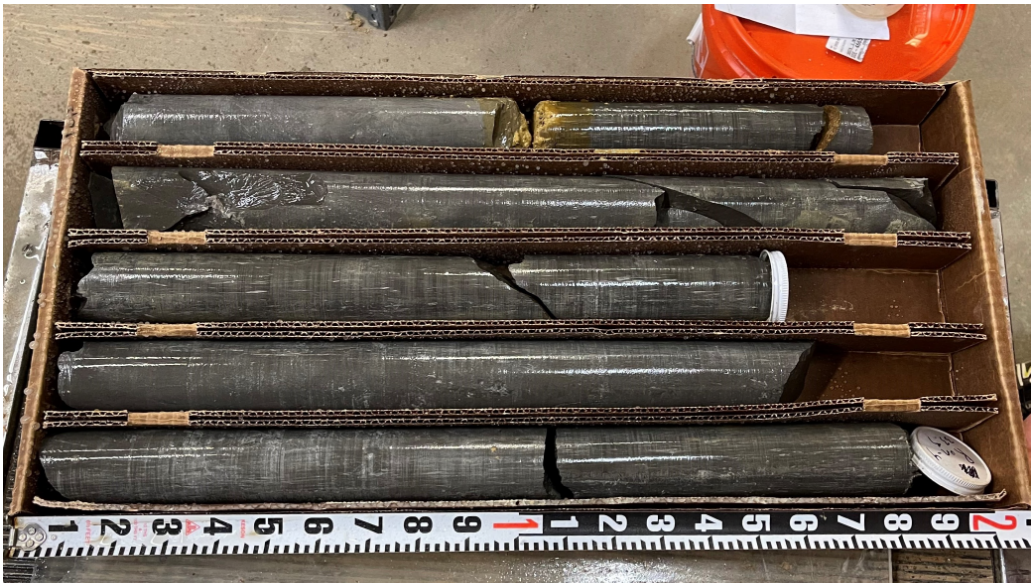
SEE TEST BORING RECORDS FOR FULL DESCRIPTION OF ROCK CORE

BORING B-03, I-275, STATION 55+41, 20 FEET RIGHT: BOX 1 OF 2				
RUN	**DEPTH (FT)**	**RQD (%)**	**RECOVERY (%)**	**ROCK DESCRIPTION**
1	13.7-14.8	64	82	CALCAREOUS SHALE, gray with tan, fairly continuous to continuous, fair to excellent quality, 75 to 80 degree bedding, moderately weathering to fresh, medium hard
2	14.8-19.8	72	100	
3	19.8-24.8	96	100	

SEE TEST BORING RECORDS FOR FULL DESCRIPTION OF ROCK CORE

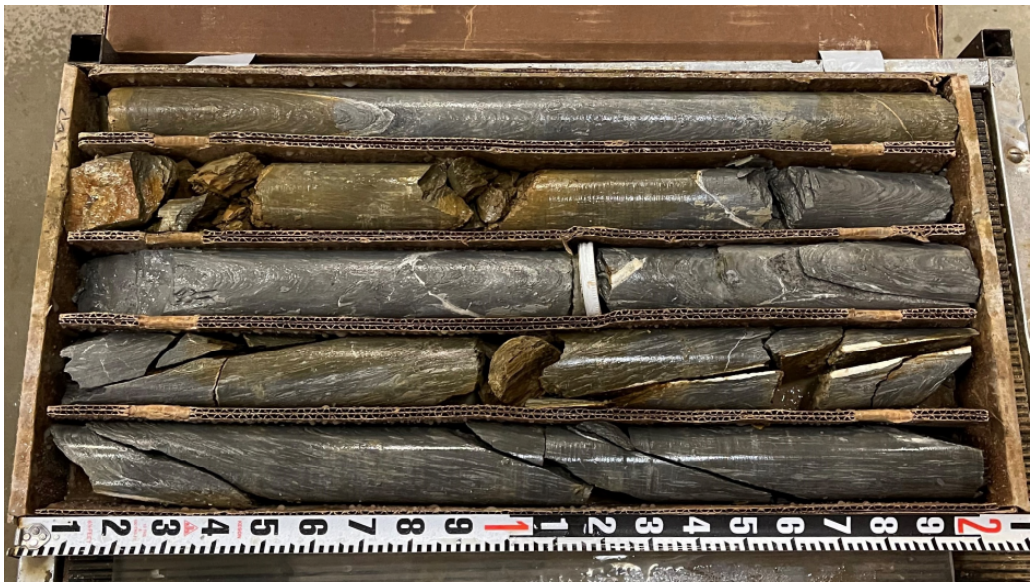
BORING B-03, I-275, STATION 55+41, 20 FEET RIGHT: BOX 2 OF 2				
RUN	**DEPTH (FT)**	**RQD (%)**	**RECOVERY (%)**	**ROCK DESCRIPTION**
3 (cont'd)	19.8-24.8	96	100	CALCAREOUS SHALE, gray with tan, continuous, fair to excellent quality, 75 to 80 degree bedding, slight weathering to fresh, medium hard
4	24.8-29.8	92	100	
5	29.8-32.8	100	100	

BORING B-04, I-275, STATION 55+05, 12 FEET RIGHT: BOX 1 OF 2				
RUN	**DEPTH (FT)**	**RQD (%)**	**RECOVERY (%)**	**ROCK DESCRIPTION**
1	15.7-20	70	100	CALCAREOUS SHALE, gray with tan, continuous, poor to excellent quality, 75 to 80 degree bedding, moderately weathering to fresh, medium hard
2	20-25	98	100	

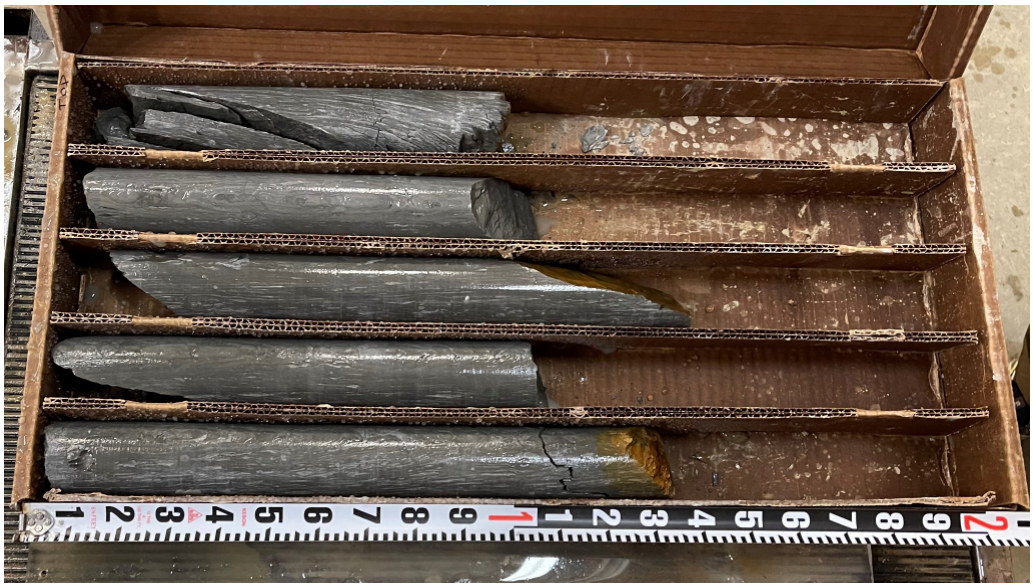


BORING B-04, I-275, STATION 55+05, 12 FEET RIGHT: BOX 2 OF 2				
RUN	**DEPTH (FT)**	**RQD (%)**	**RECOVERY (%)**	**ROCK DESCRIPTION**
3	25-30	100	100	CALCAREOUS SHALE, gray, continuous, excellent quality, 75 to 80 degree bedding, slight weathering to fresh, medium hard
4	30-33.3	100	100	

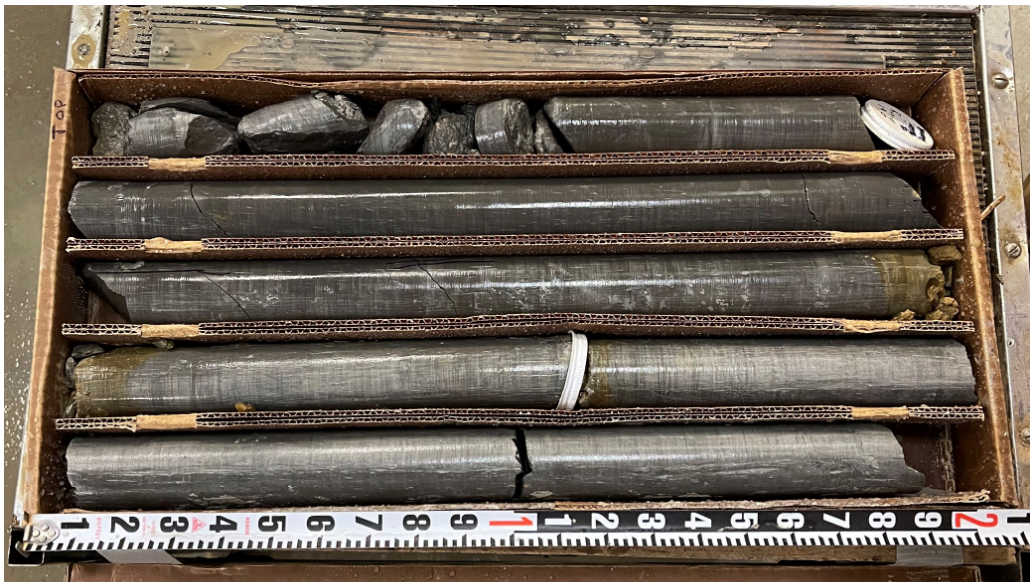
BORING B-05, I-275, STATION 55+40, 22 FEET LEFT: BOX 1 OF 3				
RUN	**DEPTH (FT)**	**RQD (%)**	**RECOVERY (%)**	**ROCK DESCRIPTION**
1	14.4-14.8	0	75	CALCAREOUS SHALE, gray with tan, incompetent to continuous, very poor to fair quality, 75 to 80 degree bedding, moderate weathering to fresh, medium hard
2	14.8-19.8	70	96	
3	19.8-24.8	56	90	



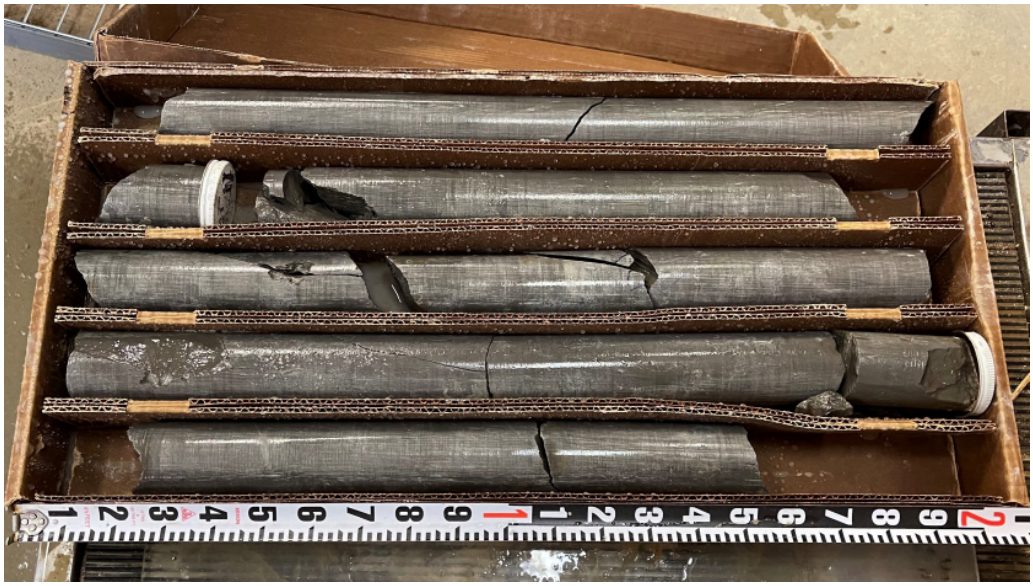
BORING B-05, I-275, STATION 55+40, 22 FEET LEFT: BOX 2 OF 3				
RUN	**DEPTH (FT)**	**RQD (%)**	**RECOVERY (%)**	**ROCK DESCRIPTION**
4	24.8-29.8	90	100	CALCAREOUS SHALE, gray with tan, continuous, poor quality, 80 to 85 degree bedding, slight weathering to fresh, medium hard
5	29.8-34.8	84	100	



BORING B-05, I-275, STATION 55+40, 22 FEET LEFT: BOX 3 OF 3				
RUN	**DEPTH (FT)**	**RQD (%)**	**RECOVERY (%)**	**ROCK DESCRIPTION**
6	34.8-39.8	96	100	CALCAREOUS SHALE, gray with tan, continuous, excellent quality, 75 to 80 degree bedding, slight weathering to fresh, medium hard



BORING B-06, I-275, STATION 55+06, 22 FEET LEFT: BOX 1 OF 3				
RUN	**DEPTH (FT)**	**RQD (%)**	**RECOVERY (%)**	**ROCK DESCRIPTION**
1	17.6-19.6	40	90	CALCAREOUS SHALE, gray, continuous, poor to fair quality, 75 to 80 degree bedding, moderate weathering to fresh, medium hard
2	19.6-24.6	100	100	
3	24.6-29.6	100	100	



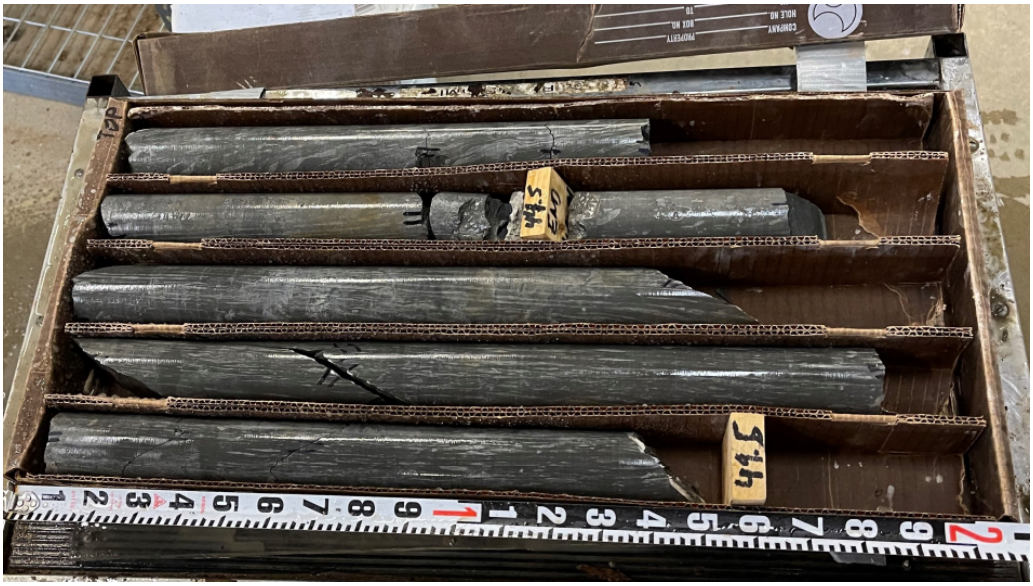
BORING B-06, I-275, STATION 55+06, 22 FEET LEFT: BOX 2 OF 3				
RUN	**DEPTH (FT)**	**RQD (%)**	**RECOVERY (%)**	**ROCK DESCRIPTION**
3 (cont'd)	24.6-29.6	100	100	CALCAREOUS SHALE, gray, continuous, excellent quality, 75 to 80 degree bedding, fresh, medium hard
4	29.6-34.6	100	100	
5	34.6-39.6	100	100	

BORING B-06, I-275, STATION 55+06, 22 FEET LEFT: BOX 3 OF 3				
RUN	**DEPTH (FT)**	**RQD (%)**	**RECOVERY (%)**	**ROCK DESCRIPTION**
5 (cont'd)	34.6-39.6	100	100	CALCAREOUS SHALE, gray, continuous, excellent quality, 75 to 80 degree bedding, fresh, medium hard

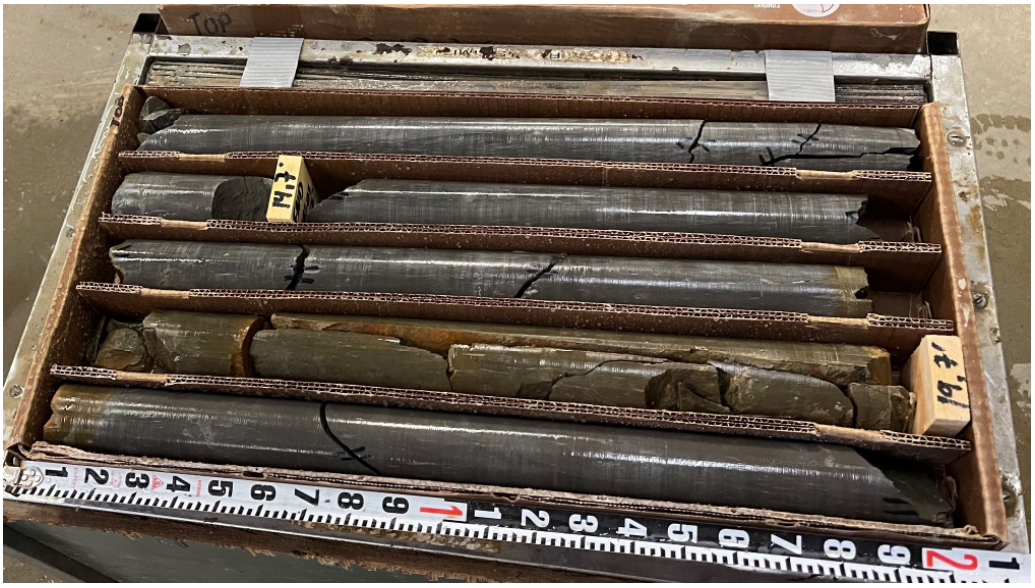
BORING B-07, I-275, STATION 55+39, 75 FEET LEFT: BOX 1 OF 3				
RUN	**DEPTH (FT)**	**RQD (%)**	**RECOVERY (%)**	**ROCK DESCRIPTION**
1	24.4-29.5	67	90	CALCAREOUS SHALE, gray, continuous to fairly continuous, fair quality, 75 to 80 degree bedding, slightly weathering to fresh, medium hard
2	29.5-34.5	60	88	

BORING B-07, I-275, STATION 55+39, 75 FEET LEFT: BOX 2 OF 3				
RUN	**DEPTH (FT)**	**RQD (%)**	**RECOVERY (%)**	**ROCK DESCRIPTION**
2 (cont'd)	29.5-34.5	60	88	CALCAREOUS SHALE, gray, fairly continuous to continuous, fair to excellent quality, 75 to 85 degree bedding, slightly weathering to fresh, medium hard
3	34.5-39.5	68	96	
4	39.5-44.5	96	100	

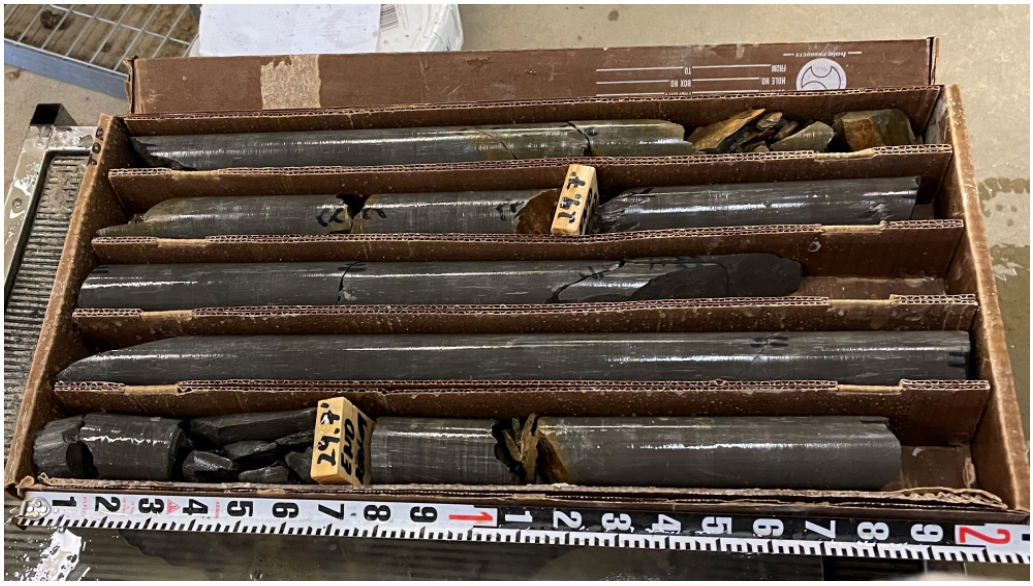
SEE TEST BORING RECORDS FOR FULL DESCRIPTION OF ROCK CORE



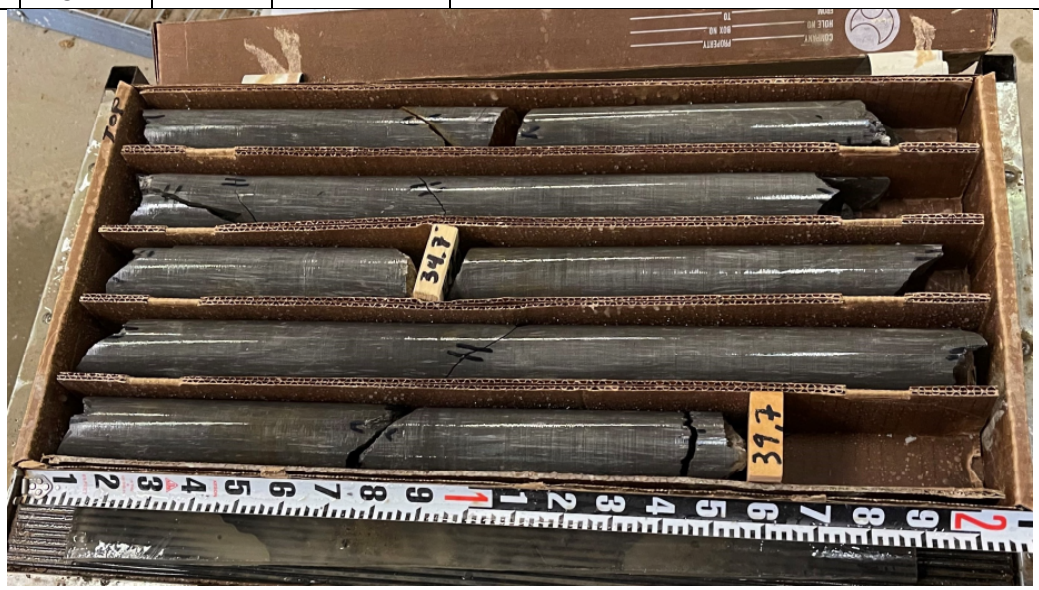
BORING B-07, I-275, STATION 55+39, 75 FEET LEFT: BOX 3 OF 3				
RUN	**DEPTH (FT)**	**RQD (%)**	**RECOVERY (%)**	**ROCK DESCRIPTION**
4 (cont'd)	39.5-44.5	96	100	CALCAREOUS SHALE, gray, continuous, excellent quality, 80 to 85 degree bedding, slightly weathering to fresh, medium hard
5	44.5-49.5	100	100	



BORING B-08, I-275, STATION 55+04, 76 FEET LEFT: BOX 1 OF 3				
RUN	**DEPTH (FT)**	**RQD (%)**	**RECOVERY (%)**	**ROCK DESCRIPTION**
1	12.3-14.7	63	100	CALCAREOUS SHALE, gray, continuous, fair to good quality, 75 to 85 degree bedding, slightly weathering to fresh, medium hard
2	14.7-19.7	62	98	
3	19.7-24.7	76	92	



BORING B-08, I-275, STATION 55+04, 76 FEET LEFT: BOX 2 OF 3				
RUN	**DEPTH (FT)**	**RQD (%)**	**RECOVERY (%)**	**ROCK DESCRIPTION**
3 (cont'd)	19.7-24.7	76	92	CALCAREOUS SHALE, gray, continuous, good to excellent quality, 75 to 85 degree bedding, slightly weathering to fresh, medium hard
4	24.7-29.7	84	98	
5	29.7-34.7	88	100	



BORING B-08, I-275, STATION 55+04, 76 FEET LEFT: BOX 3 OF 3				
RUN	**DEPTH (FT)**	**RQD (%)**	**RECOVERY (%)**	**ROCK DESCRIPTION**
5 (cont'd)	29.7-34.7	88	100	CALCAREOUS SHALE, gray, continuous, excellent quality, 75 to 85 degree bedding, fresh, medium hard
6	34.7-39.7	90	90	

Appendix III

Laboratory Test Procedures

Laboratory Test Results

NATURAL MOISTURE
AASHTO T 265

The moisture content of soils is an indicator of various physical properties, including strength and compressibility. Selected samples obtained during exploratory drilling were taken from their sealed containers. Each sample was weighed and then placed in an oven heated to 110ºC ± 5ºC. The sample remained in the oven until the free moisture had evaporated. The dried sample was removed from the oven, allowed to cool, and re-weighed. The moisture content was computed by dividing the weight of evaporated water by the weight of the dry sample. The results, expressed as a percent, are shown on the attached Laboratory Test Results Summary.

ATTERBERG LIMITS DETERMINATION
AASHTO T89/T90

Representative samples were subjected to Atterberg limits testing to determine the soil's plasticity characteristics. The plasticity index (PI) is the range of moisture content over which the soil deforms as a plastic material. The liquid limit (LL) marks the transition from the plastic state to the liquid state. The plastic limit (PL) marks the transition from the plastic state to the solid state.

To determine the liquid limit, a soil specimen is wetted until it is in a viscous fluid state. A portion of this soil is then placed in a brass cup of standardized dimensions, and a groove made through the middle of the soil specimen with a grooving tool of standardized dimensions. The cup is attached to a cam that lifts the cup 10 mm, and then allows the cup to fall and strike a rubber base of standardized hardness. The cam is rotated at approximately 2 drops per second until the two halves of the soil specimen come in contact at the bottom of the groove along a distance of 13 mm. The number of blows required to make this degree of contact is recorded, and a portion of the specimen is subjected to a moisture content determination. Additional water is added to the remainder of the specimen, and the grooving process and cam action process repeated. This testing sequence is repeated until the soil flows as a heavy viscous fluid. The number of blows vs. moisture content is then plotted on semi-logarithmic graph paper, and the moisture content corresponding to 25 blows is designated the liquid limit.

The plastic limit is the lowest moisture content at which the soil is sufficiently plastic to be manually rolled into threads 3 mm in diameter. It is determined by taking a pat of soil remaining from the liquid limit test, and repeatedly rolling, kneading, and air drying the specimen until the soil breaks into threads approximately 3 mm in diameter and 3 to 10 mm long. The moisture content of these soil threads is then determined, and is designated the plastic limit. The results of these tests are presented on the Laboratory Test Results Summary.

GRAIN SIZE TEST PROCEDURES
AASHTO T 88

The grain size distribution of soil particles is an indicator of certain physical properties including permeability, compaction characteristics, consolidation, shrinkage and swelling, liquefaction, and other engineering properties. For this project, grain size distribution of soils was needed to determine AASHTO classifications of the soil. The soil specimen is dried then passed through a series of nested sieves. The portion of soil retained on each sieve is weighted and the percent of the total sample retained is computed. The percent passing the number 200 sieve is provided on the Laboratory Test Results

Summary. Hydrometer analyses were also performed and grain size distribution curves were developed. The Particle Size Analysis of Soils test reports are included in this Appendix.

CONSOLIDATION TEST PROCEDURES
AASHTO T 216

The consolidation test provides data for estimating the settlement and time rate of settlement of soil in response to structural loads. Eight representative undisturbed samples were selected for testing. A section of each sampling tube approximately 4 inches long was cut and the soil sample was extruded with a hydraulic ram. The cut section was trimmed into a disc 2.5 inches in diameter and 1 inch thick. The disc was confined around its perimeter by a stainless steel ring and on each end by porous stones. The sample was placed in the testing device and subjected to incrementally increasing vertical load. The resulting deformations were measured with a dial gauge accurate to 0.0001 inches. The test results are presented in graphical form, with pressure on the x-axis and void ratio on the y-axis, on the Consolidation Test Reports.

TRIAXIAL TEST
AASHTO T 296

The triaxial test is used to determine the shear strength (cohesion) and internal angle of friction of cohesive and cohesionless soils. A section of the representative undisturbed samples approximately 6 inches long was extruded from the sampling tube. Each sample was encased in a rubber membrane and placed into the triaxial chamber. For unconsolidated undrained tests, the valve is closed and the pressure increase is measured during performance of the test. Axial loads are applied to the sample and load and deformation values are recorded at specific strain increments. The test results are provided on the Triaxial Shear Test Reports.

Boring Number	Mainline Station Offset	Sample Depth (ft)	Sample Type	Natural Moisture Content (%)	Atterberg Limits			Grain Size	USCS Class.	AASHTO Class.	Specific Gravity	Unit Weight (lb/ft^3)	Unconsolidated Undrained Testing	
					LL	PL	PI	Percent Finer than No. 200 Sieve					ϕ	Shear Strength (psf)
B-01		1	SPT											
		3.5	SPT	4.2	31	17	14	34.3	SC	A-2-7	2.65			
		6	SPT											
		8.5	SPT											
		13.5	SPT											
		18.5	SPT											
B-09		1	SPT											
		3.5	SPT											
		6	SPT											
		8.5	SPT											
		13.5	SPT											
		18.5	SPT											
		20	UD											
		22	UD	44.1	80	33	47	95.4	CH	A-7-5	2.848	110.6	0	1410
		24	SPT											
		28.5	SPT											
B-10		1	SPT	7										
		2	SPT	22.1										
		6	SPT	24.7	46	22	24	75.5	CL	A-7-6	2.65			
		8.5	SPT	16.9										
		13.5	SPT	203										
		18.5	SPT	32.1										
		21	UD											
		23.5	SPT	30.7										
		28.5	SPT											

Boring Number	Mainline Station Offset	Sample Depth (ft)	Sample Type	Natural Moisture Content (%)	Atterberg Limits			Grain Size	USCS Class.	AASHTO Class.	Specific Gravity	Unit Weight (lb/ft^3)	Unconsolidated Undrained Testing	
					LL	PL	PI	Percent Finer than No. 200 Sieve					ϕ	Shear Strength (psf)
B-11		1	SPT	4										
		3.5	SPT	22										
		6	SPT	30.5										
		8.5	SPT	31.3										
		13.5	SPT	33.2										
		18.5	SPT	40.5										
		20	UD	36.9	55	28	27	81.1	CH	A-7-6	2.75	119.8	0	1990
		23.5	SPT	37.7										
		28.5	SPT	709										
		33.5	SPT	64.3										
		38.5	SPT											

Form No: TR-D2216-T265-1
Revision No. 1
Revision Date: 08/16/17

LABORATORY DETERMINATION OF WATER CONTENT

Quality Assurance *ASTM D 2216* ☐ *AASHTO T 265* ☑

S&ME, Inc. - Knoxville: 1413 Topside Road, Louisville, TN 37777

Project #:	22430250	Report Date:	2/10/2023
Project Name:	I-275 Over Elm Street	Test Date(s):	1/26-29/2023
Client Name:	HDR		
Client Address:	120 Brentwood Commons Way, Suite 525, Brentwood, TN		
Sampled by:	S&ME, Inc.	Sample Date(s):	12/12-21/2022
Sampling Method:	Split Spoon	Log # :	43-3763

Method: **A (1%)** ☐ **B (0.1%)** ☐ Balance ID. 18435 Calibration Date: 2/18/2022 Oven ID. 12872 Calibration Date: 7/21/2022

Boring No.	Sample No.	Sample Depth	Tare #	Tare Weight	Tare Wt.+ Wet Wt	Tare Wt. + Dry Wt	Water Weight	Percent Moisture	Note
		ft		grams	grams	grams	grams	%	
B-01	SS-02	3.50	N5	31.44	81.28	79.29	1.99	4.2%	
B-10	SS-01	1.00	412	24.95	168.77	159.40	9.37	7.0%	
B-10	SS-02	3.50	406	25.15	129.25	110.41	18.84	22.1%	
B-10	SS-03	6.00	C-21	30.39	75.04	66.21	8.83	24.7%	
B-10	SS-04	8.50	421	25.23	179.31	157.05	22.26	16.9%	
B-10	SS-05	13.50	400	24.76	178.08	152.22	25.86	20.3%	
B-10	SS-06	18.50	410	25.22	203.75	160.35	43.40	32.1%	
B-10	SS-07	23.50	10-7	183.53	396.55	346.53	50.02	30.7%	
B-11	SS-01	1.00	434	25.12	184.81	178.69	6.12	4.0%	
B-11	SS-02	3.50	413	34.39	234.31	198.31	36.00	22.0%	
B-11	SS-03	6.00	418	25.02	189.49	151.06	38.43	30.5%	
B-11	SS-04	8.50	423	24.75	190.58	151.02	39.56	31.3%	
B-11	SS-05	13.50	445	25.21	159.97	126.41	33.56	33.2%	
B-11	SS-06	18.50	407	25.18	155.19	117.71	37.48	40.5%	
B-11	SS-07	23.50	Lee-B	33.04	201.48	155.92	45.56	37.1%	
B-11	SS-08	28.50	LP-1	42.74	282.28	182.94	99.34	70.9%	
B-11	SS-09	33.50	3K	40.29	230.43	156.01	74.42	64.3%	

Notes / Deviations / References

AASHTO T265: Laboratory Determination of Moisture Content of Soil

Kim Gonzalez — *Technician Name* — 1/27/2023 — *Date*

Lindsey Deskins — *Technical Responsibility* — Lindsey Deskins — *Signature* — Lab Services Manager — *Position* — 2/10/2023 — *Date*

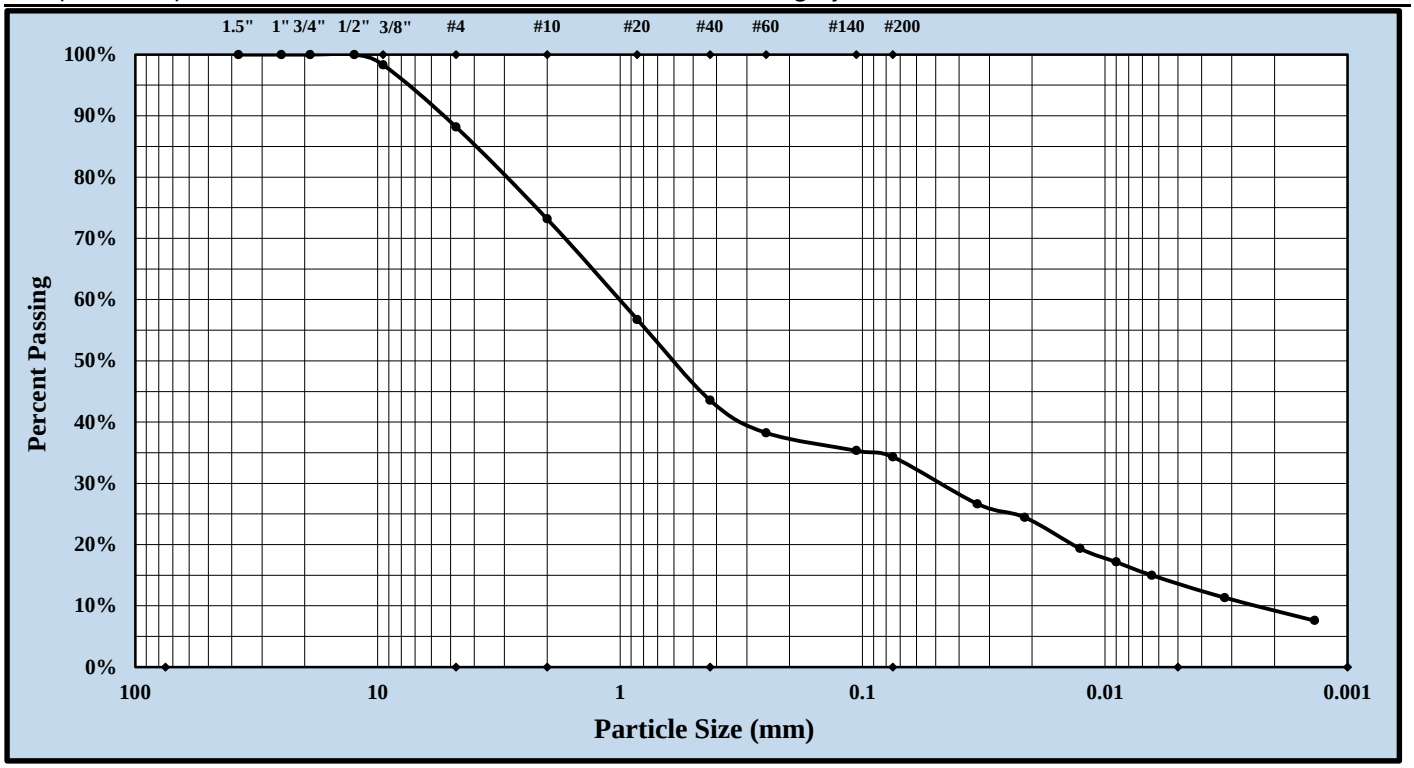
Form No. TR-D422-3
Revision No. 2
Revision Date: 08/29/17

PARTICLE SIZE ANALYSIS OF SOIL

Log No. 43-3763 *AASHTO T 88*

S&ME, Inc. - Knoxville: 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	22430250	Report Date:	2/10/2023
Project Name:	I-275 Over Elm Street	Test Date(s):	1/31/2023
Client Name:	HDR		
Address:	120 Brentwood Commons Way, Suite 525, Brentwood, TN		
Sample ID:	B-01	Sample #: SS-02	Sample Date: 12/21/22
Location:	Boreholes	Depth:	3.50 ft
Sample Description:	CLAYEY SAND WITH GRAVEL (SC), gray		**A-2-7**



		Fine Sand	< 0.425 mm and > 0.075 mm (#200)
Gravel	< 75 mm and > 2.00 mm (#10)	Silt	< 0.075 and > 0.002 mm
Coarse Sand	< 2.00 mm and > 0.425 mm (#40)	Clay	< 0.002 mm

Maximum Particle Size:	1/2 in	Gravel:	26.8%	Silt	25.1%
Silt & Clay (% Passing #200):	34.3%	Total Sand:	38.9%	Clay	9.2%
Assumed Specific Gravity	2.650	Moisture Content	4.2%		
Liquid Limit	31	Plastic Limit	17	Plastic Index	14
Coarse Sand:	29.6%			Fine Sand:	9.2%

Description of Sand and Gravel: Rounded ☐ Angular ☒ Hard & Durable ☒ Soft ☐ Weathered & Friable ☐

Mechanical Stirring Apparatus A | Dispersion Period: 1 min. | Dispersing Agent: Sodium Hexametaphosphate: 40 g./ Liter

References / Comments / Deviations: AASHTO T 88, T 89, T 90, M 145

Victoria Igoe	Victoria Igoe	Associate Project Manager	2/10/2023
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D4318-T89-90
Revision No. 1
Revision Date: 7/26/17

LIQUID LIMIT, PLASTIC LIMIT, & PLASTIC INDEX

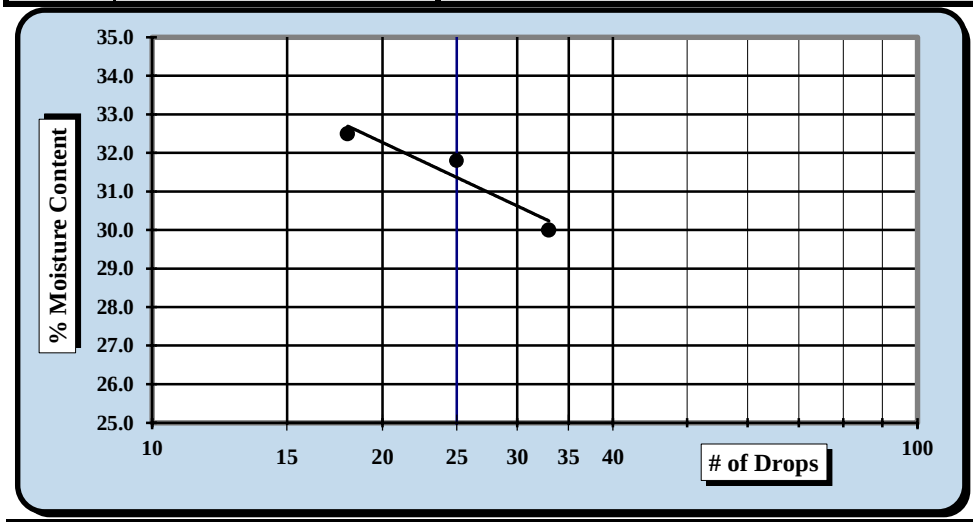
Quality Assurance ASTM D4318 ☐ AASHTO T 89 ☒ AASHTO T 90 ☒

S&ME, Inc. - Knoxville: 1413 Topside Road, Louisville, TN 37777

Project #:	22430250	Report Date:	2/10/2023
Project Name:	I-275 Over Elm Street	Test Date(s)	1/30/2023
Client Name:	HDR		
Client Address:	120 Brentwood Commons Way, Suite 525, Brentwood, TN		
Boring #:	B-01	Sample #: SS-02	Sample Date: 12/21/2022
Log #:	43-3763		Depth: 3.50 ft
Description:	CLAYEY SAND WITH GRAVEL (SC), gray		

Type and Specification	*S&ME ID #*	*Cal Date:*	*Type and Specification*	*S&ME ID #*	*Cal Date:*
Balance (0.01 g)	18435	2/18/2022	Grooving tool	16015	8/15/2022
LL Apparatus	18414	8/10/2022	No. 40 Sieve	31697	9/16/2022
Oven	12872	7/21/2022			

Pan #		Liquid Limit						Plastic Limit		
	Tare #:	15	5	24				A2		
A	Tare Weight	15.26	15.29	15.33				15.87		
B	Wet Soil Weight + A	29.74	30.72	31.45				24.09		
C	Dry Soil Weight + A	26.40	27.00	27.50				22.90		
D	Water Weight (B-C)	3.34	3.72	3.95				1.19		
E	Dry Soil Weight (C-A)	11.14	11.71	12.17				7.03		
F	% Moisture (D/E)*100	30.0%	31.8%	32.5%				16.9%		
N	# OF DROPS	33	25	18				*Moisture Contents determined by AASHTO T 265*		
LL	LL = **F** * FACTOR									
Ave.	*Average*							**16.9%**		



One Point Liquid Limit

N	Factor	N	Factor
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.99	29	1.018
24	0.995	30	1.022
25	1.000		

NP, Non-Plastic ☐

Liquid Limit	**31**
Plastic Limit	**17**
Plastic Index	**14**
Group Symbol	**CL**

Multipoint Method ☑
One-point Method ☐

Wet Preparation ☐ Dry Preparation ☑ Air Dried ☑

Notes / Deviations / References: **Group symbol is for minus No. 40 portion only.**

AASHTO T90: Determining the Plastic Limit & Plastic Index of Soils *AASHTO T89: Determining the Liquid Limit of Soils*

Kim Gonzalez	1/31/2023	Lindsey Deskins	2/10/2023
Technician Name	*Date*	*Technical Responsibility*	*Date*

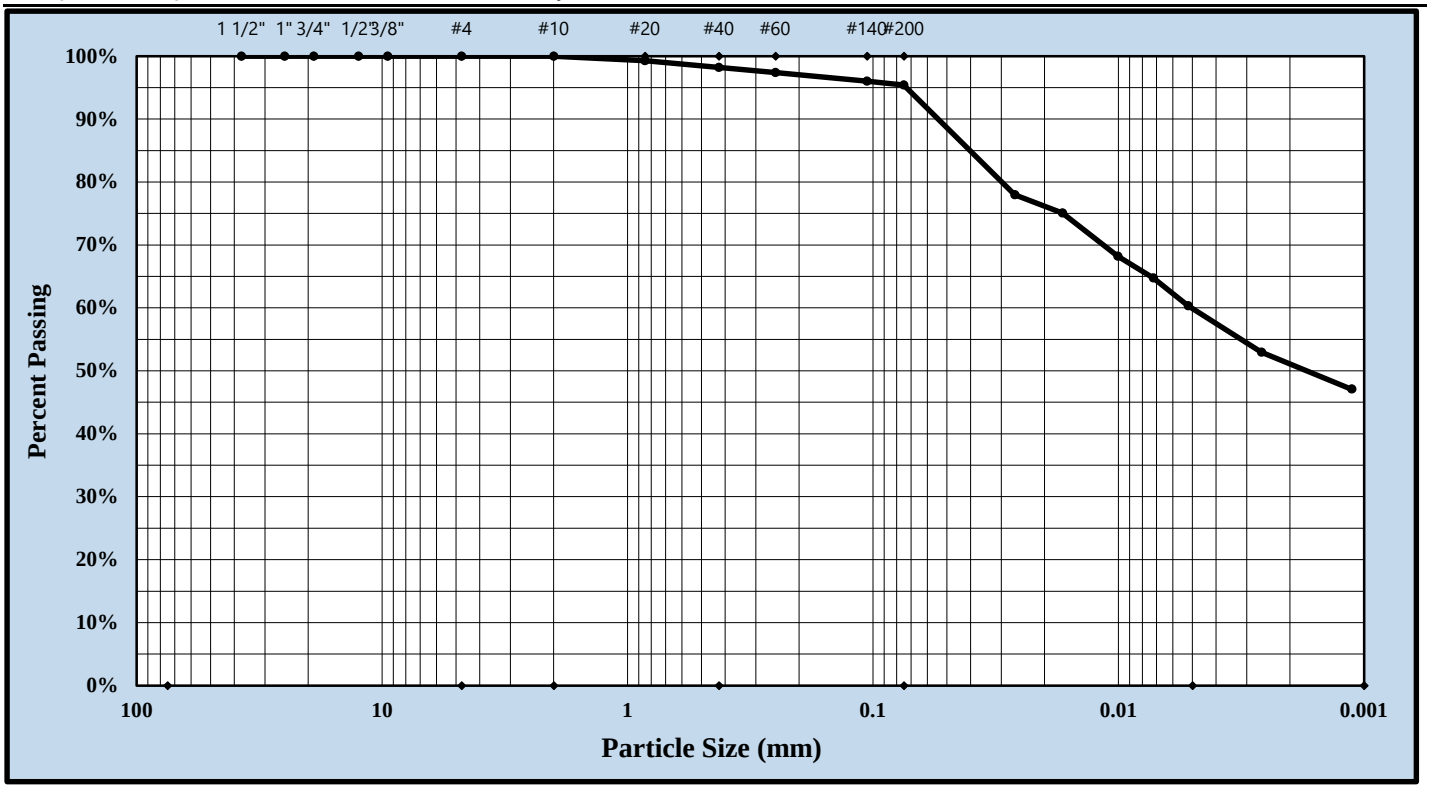
Form No. TR-D422-2
Revision No. 2LEXdAASHTO
Revision Date: 01/30/23

PARTICLE SIZE ANALYSIS OF SOIL

AASHTO T88

S&ME, Inc. - Lexington: 2020 Liberty Road, Suite 105, Lexington, KY 40505

Project #:	22430250	Report Date:	1/26/23
Project Name:	I-275 Bridge over Elm Street	Test Date(s):	1/23/23
Client Name:	HDR Engineering, Inc.		
Client Address:	2517 Sir Barton Way, Suite 400, Lexington, KY		
Type:	UD	Sample Date:	01/16/23
Location:	B-09	Depth (ft.):	22.0 - 24.0
Sample Description:	FAT CLAY (CH) (A-7-5), yellow brown		



AASHTO M145 PARTICLE SIZES			
Gravel	< 75 mm and > 2.00 mm (#10)	Silt Size	< 0.075 and > 0.005 mm
Coarse Sand	< 2.00 mm and >0.425 mm (#40)	Clay Size	< 0.005 mm
Fine Sand	< 0.425 mm and > 0.075 mm (#200)		

Nom. Maximum Particle Size:	#20	Gravel:	0.0%	Silt Size:	35.5%
Silt & Clay (% Passing #200):	95.4%	Total Sand:	4.6%	Clay Size:	59.9%
Apparent Relative Density:	2.848	Moisture Content:	44.1%		
Liquid Limit:	80	Plastic Limit:	33	Plastic Index:	47
Coarse Sand:	1.8%			Fine Sand:	2.8%

Description of Sand and Gravel	Rounded ☐	Angular ☒	Hard & Durable ☒	Soft ☐	Weathered & Friable ☐		
Mechanical Stirring Apparatus A	Dispersion Period:	1 min.	Dispersing Agent:	Sodium Hexametaphosphate:	40 g./ Liter		

References / Comments / Deviations:

Jacob Folsom	Jacob Folsom	Lab Services Manager	2/13/2023
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D4318-T89-90
Revision No. 1 LEXb
Revision Date: 05/16/22

LIQUID LIMIT, PLASTIC LIMIT, & PLASTIC INDEX

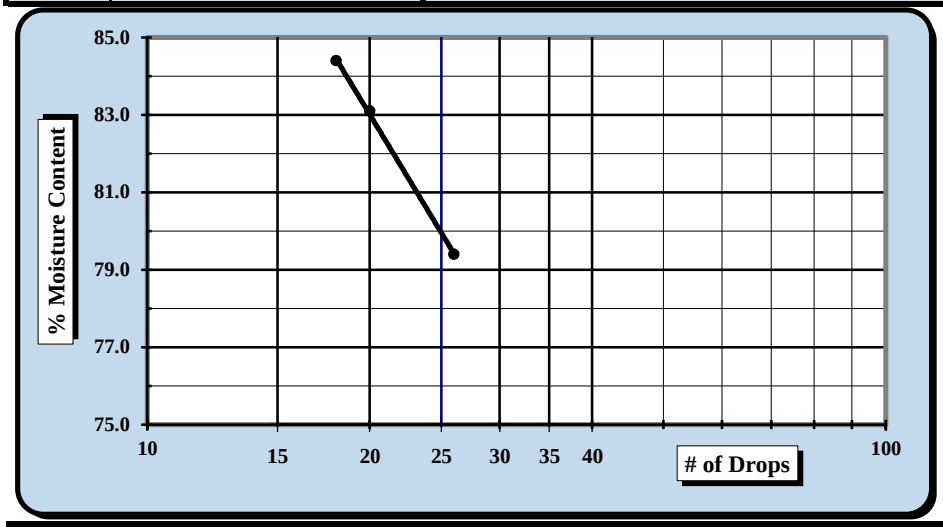
ASTM D 4318 ☒ AASHTO T 89 ☐ AASHTO T 90 ☐

S&ME, Inc. - Lexington: 2020 Liberty Road, Suite 105, Lexington, KY 40505

Project #:	22430250	Report Date:	04/13/23
Project Name:	I-275 Bridge over Elm Street	Test Date(s)	01/23/23
Client Name:	HDR Engineering, Inc.		
Client Address:	2517 Sir Barton Way, STE 400, Lexington, KY		
		Sample Date:	01/26/23
Location:	B-09	Depth (ft):	22.0 - 24.0
Sample Description:	FAT CLAY (CH) (A-7-5), yellow brown		

Type and Specification	*S&ME ID #*	*Cal Date:*	*Type and Specification*	*S&ME ID #*	*Cal Date:*
Balance (0.01 g)	32707	01/19/22	Grooving tool	2022.12.22A	12/22/22
LL Apparatus	33653	01/04/23			
Oven (brown)	24438	10/25/22			

		Liquid Limit						Plastic Limit		
A	Tare Weight	16.89	16.79	16.93				16.75	16.44	
B	Wet Soil Weight + A	26.02	24.15	26.17				22.80	22.72	
C	Dry Soil Weight + A	21.98	20.81	21.94				21.30	21.16	
D	Water Weight (B-C)	4.04	3.34	4.23				1.50	1.56	
E	Dry Soil Weight (C-A)	5.09	4.02	5.01				4.55	4.72	
F	% Moisture (D/E)*100	79.4%	83.1%	84.4%				33.0%	33.1%	
N	# OF DROPS	26	20	18				*Moisture Contents determined by ASTM D 2216*		
LL	LL = **F** * FACTOR									
Ave.	*Average*							**33.1%**		



One Point Liquid Limit			
N	**Factor**	**N**	**Factor**
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.99	29	1.018
24	0.995	30	1.022
25	1.000		

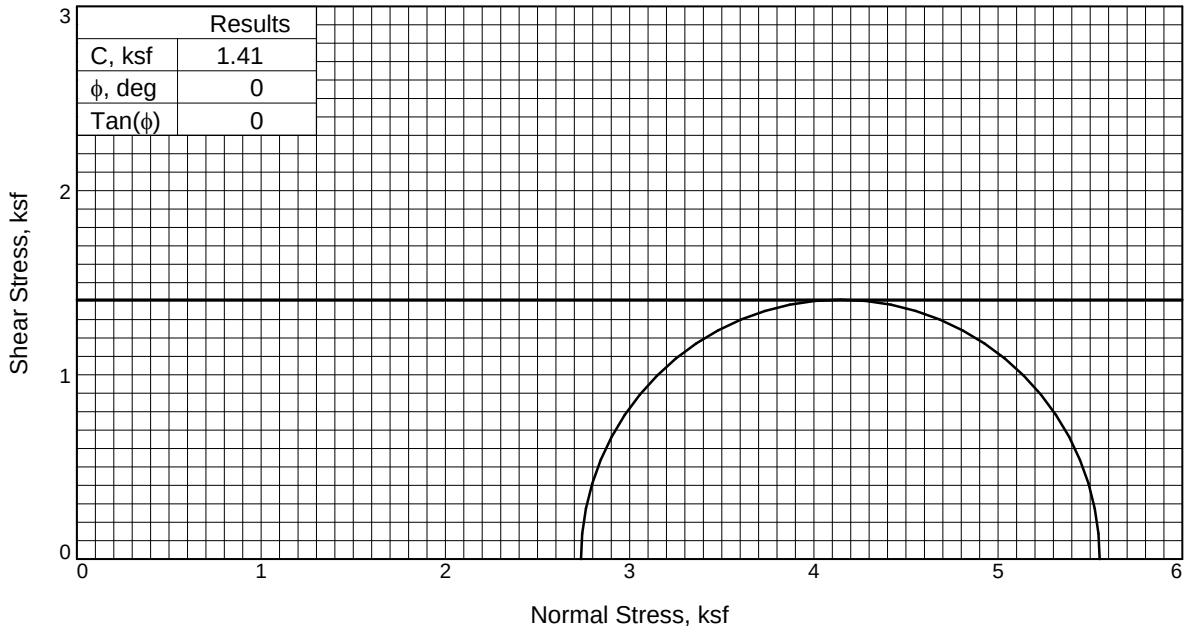
NP, Non-Plastic	☐
Liquid Limit	**80**
Plastic Limit	**33**
Plastic Index	**47**
Group Symbol	**CH***
Multipoint Method	☒
One-point Method	☐

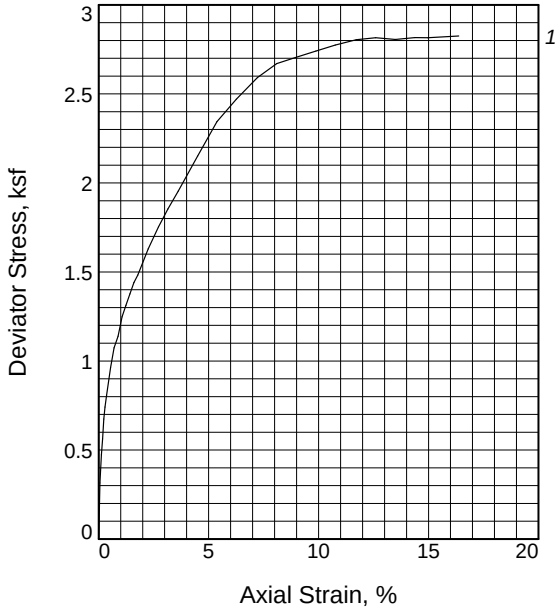
Wet Preparation ☐ Dry Preparation ☒ Air Dried ☒ *Est. the % retained on the #40 Sieve:* <5%

Notes / Deviations / References: *Classification listed here applies only to portion passing No. 40 sieve.

A. Harrod/JL Supervising	1/20/2023	Jacob Folsom	4/13/2023
Technician Name	*Date*	*Technical Responsibility*	*Date*

C & phi are not test results but an interpretation of the test results. The designer is responsible for interpreting test data as provided by S&ME.





Sample No.		1
Initial	Water Content, %	45.0
	Dry Density, pcf	76.3
	Saturation, %	96.3
	Void Ratio	1.3296
	Diameter, in.	2.853
	Height, in.	5.558
At Test	Water Content, %	45.0
	Dry Density, pcf	76.3
	Saturation, %	96.3
	Void Ratio	1.3296
	Diameter, in.	2.853
	Height, in.	5.558
Strain rate, %/min.		0.50
Back Pressure, psi		0.00
Cell Pressure, psi		19.00
Fail. Stress, ksf		2.82
Strain, %		12.6
Ult. Stress, ksf		2.82
Strain, %		15.0
σ_1 Failure, ksf		5.55
σ_3 Failure, ksf		2.74

Type of Test:
Unconsolidated Undrained

Sample Type: Intact

Description: FAT CLAY (CH) (A-7-5), yellow brown

LL= 80 **PL=** 33 **PI=** 47

Specific Gravity= 2.848

Remarks: Failure criterion is peak deviator stress.

Client: HDR Engineering, Inc.

Project: I-275 Bridge over Elm Street

Source of Sample: B-09 **Depth:** 22.0 - 24.0 ft.

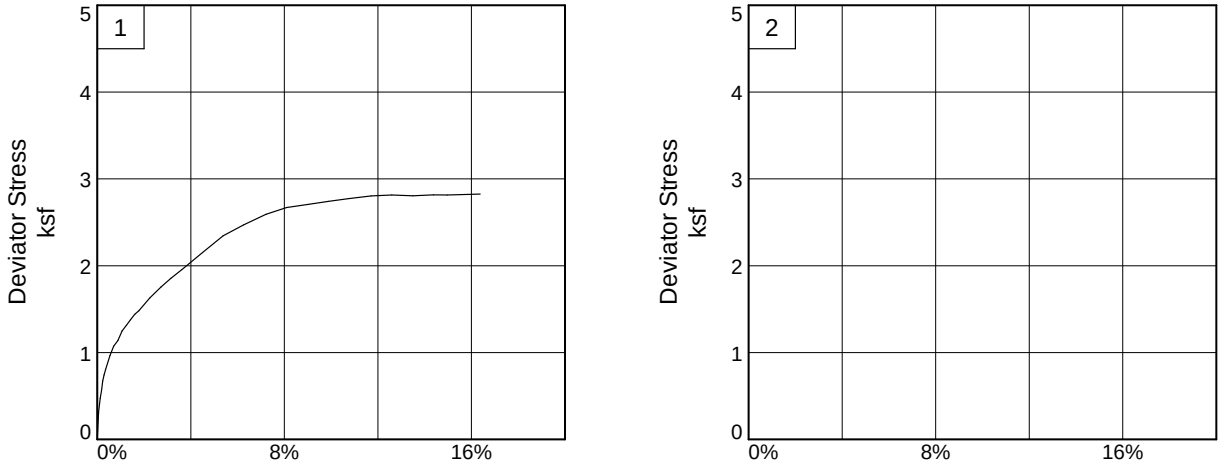
Proj. No.: 22430250 **Date Sampled:** 01/16/2023

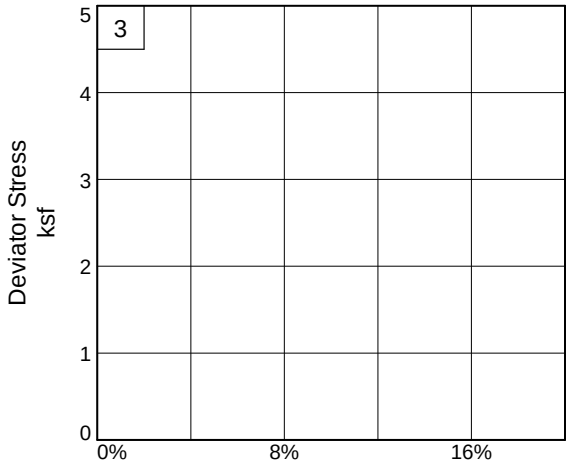
TRIAXIAL SHEAR TEST REPORT
S&ME, Inc.
Lexington, Kentucky

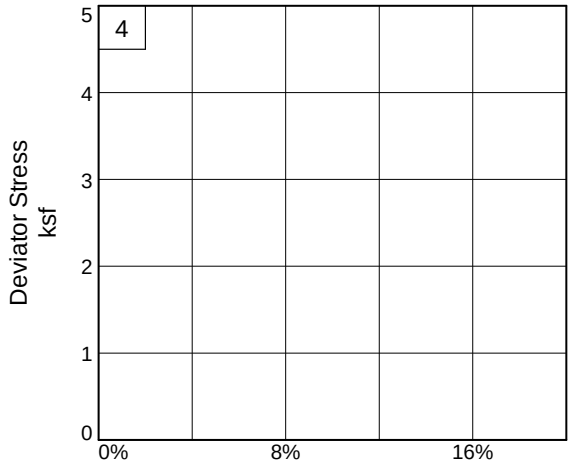
Figure 1 of 2

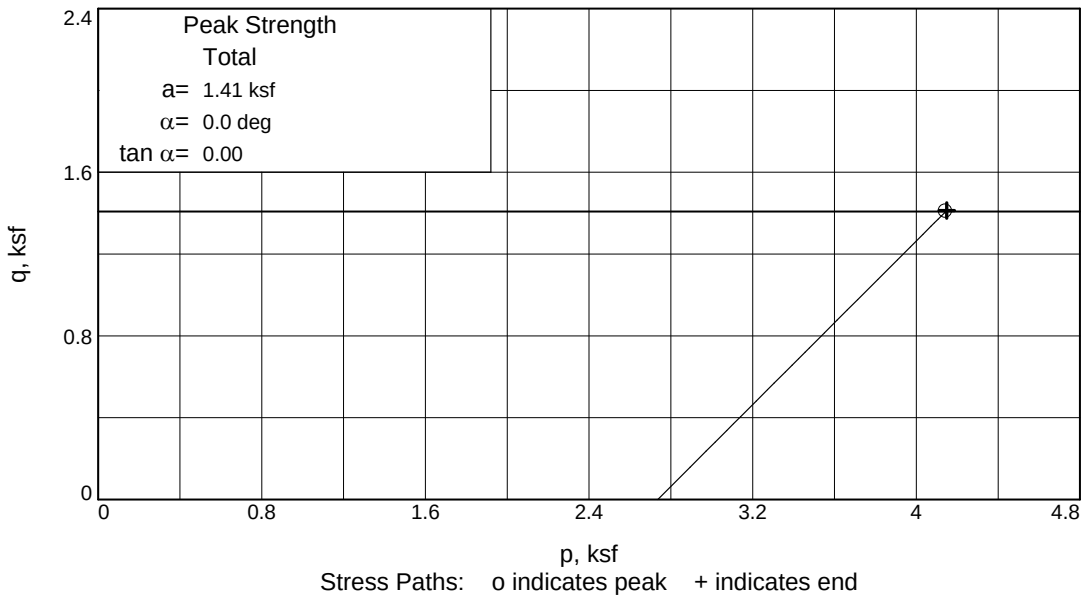
Tested By: J. LaMothe **Checked By:** J. Folsom 01/31/2023

C & phi are not test results but an interpretation of the test results. The designer is responsible for interpreting test data as provided by S&ME.







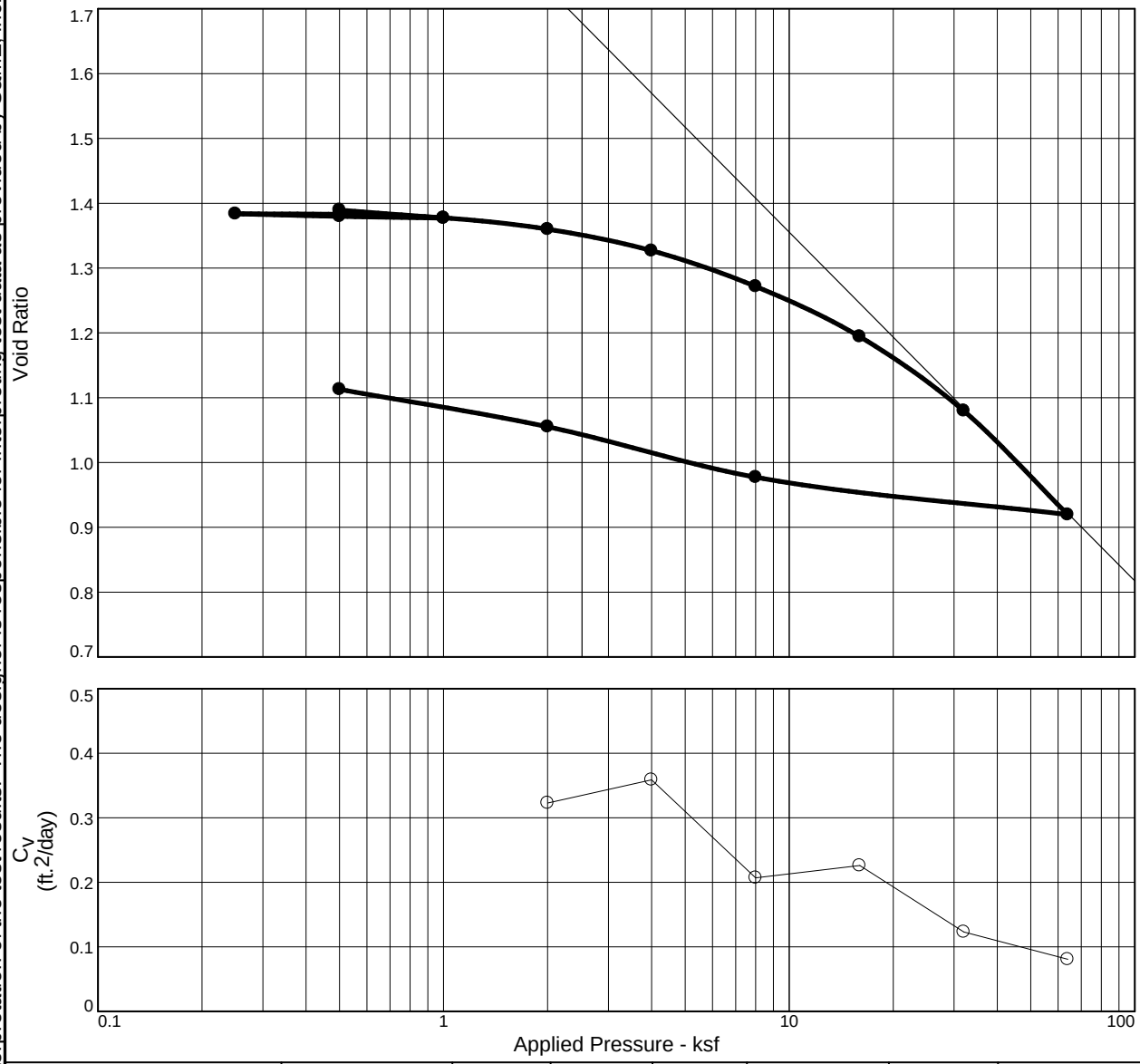


Client: HDR Engineering, Inc.
Project: I-275 Bridge over Elm Street
Source of Sample: B-09 **Depth:** 22.0 - 24.0 ft.
Project No.: 22430250 **Figure** 2 of 2

S&ME, Inc.

Tested By: J. LaMothe **Checked By:** J. Folsom 01/31/2023

ASTM D2435 CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	P_c (ksf)	C_c	Initial Void Ratio
Saturation	Moisture							
90.4 %	44.1 %	74.5	80	47	2.848	11.7	0.54	1.388

MATERIAL DESCRIPTION	USCS	AASHTO
FAT CLAY (CH), yellow brown	CH	A-7-5

Project No. 22430250 **Client:** HDR Engineering, Inc.

Project: I-275 Bridge over Elm Street

Source of Sample: B-09 **Depth:** 22.0 - 24.0 ft.

S&ME, Inc.

Lexington, Kentucky

Remarks:

Inundated at the seating load.
150 psf required to control swell.

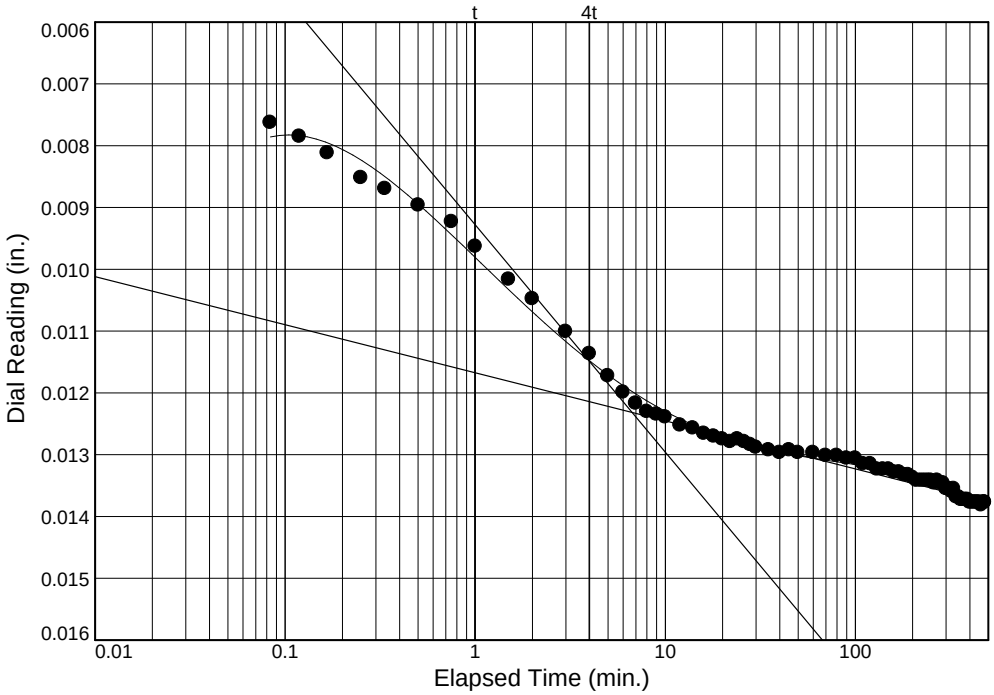
Figure 1

Tested By: J. LaMothe **Checked By:** J. Folsom 01/31/2023

Dial Reading vs. Time

Project No.: 22430250
Project: I-275 Bridge over Elm Street

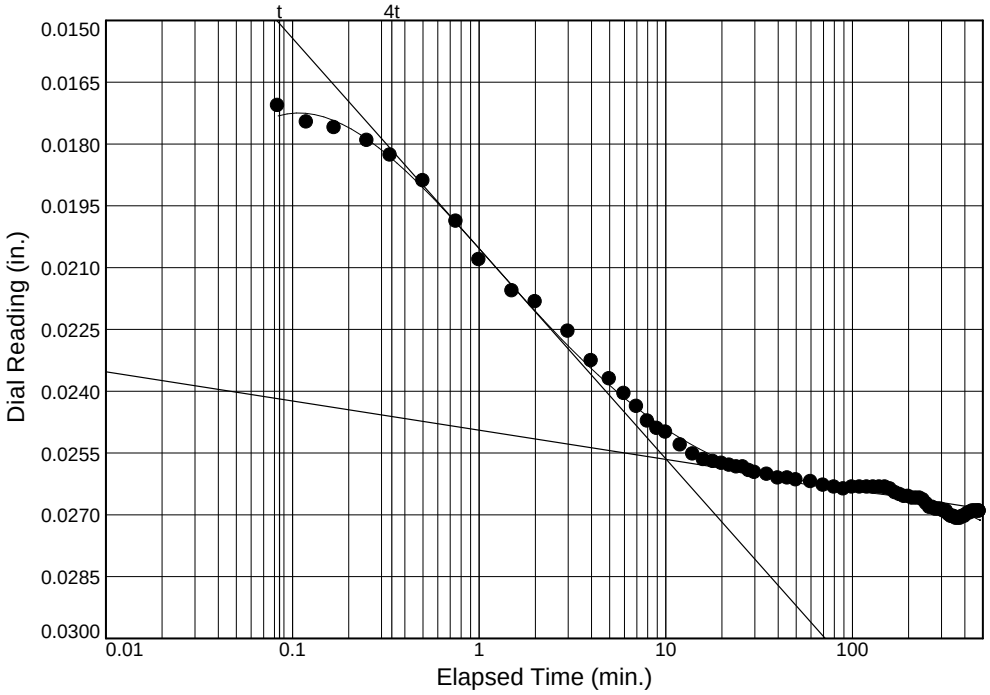
Source of Sample: B-09 Depth: 22.0 - 24.0 ft.



Load No.= 7
Load= 2.00 ksf
D_0 = 0.0081
D_{50} = 0.0102
D_{100} = 0.0123
T_{50} = 1.38 min.

C_v @ T_{50}
0.323 ft.^{2}/day

C_α = 0.002



Load No.= 8
Load= 4.00 ksf
D_0 = 0.0163
D_{50} = 0.0210
D_{100} = 0.0257
T_{50} = 1.21 min.

C_v @ T_{50}
0.359 ft.^{2}/day

C_α = 0.002

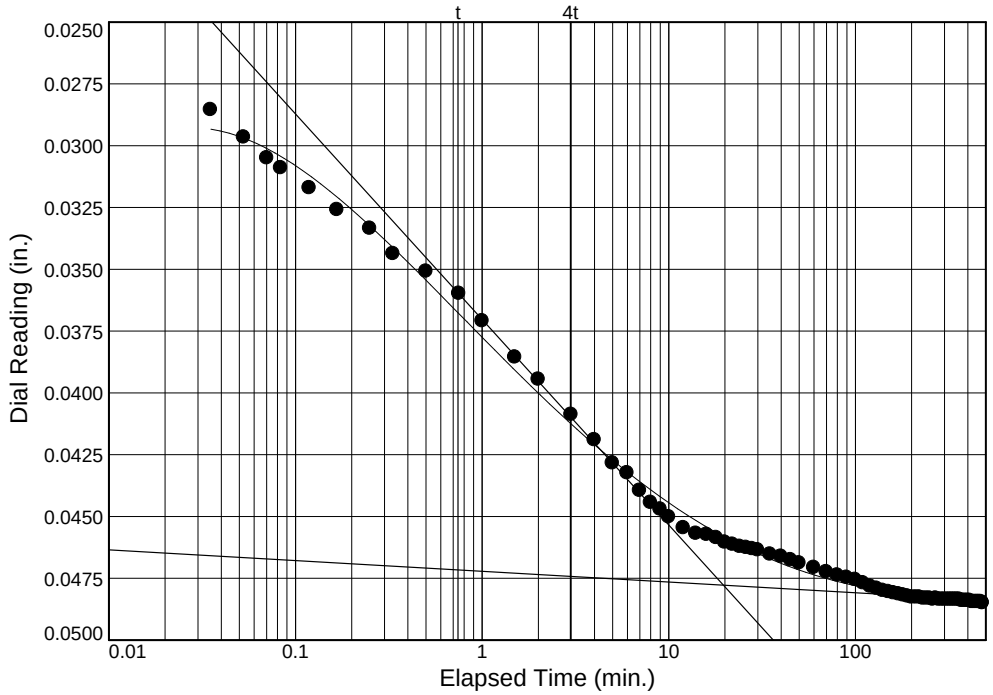
Figure 2

S&ME, Inc.

Dial Reading vs. Time

Project No.: 22430250
Project: I-275 Bridge over Elm Street

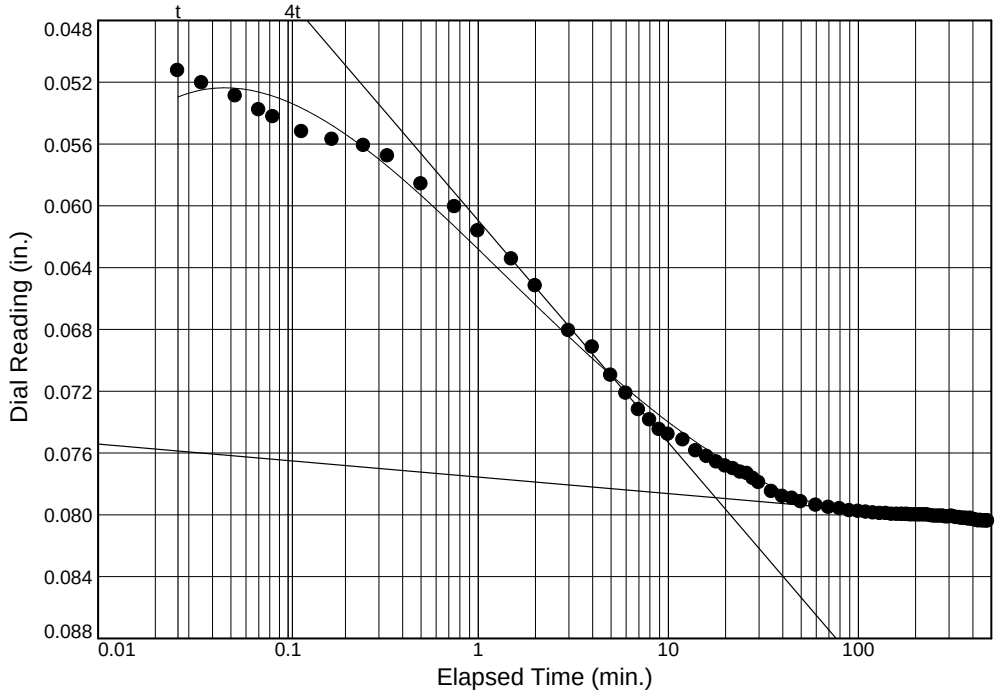
Source of Sample: B-09 Depth: 22.0 - 24.0 ft.



Load No.= 9
Load= 8.00 ksf
D_0 = 0.0323
D_{50} = 0.0400
D_{100} = 0.0478
T_{50} = 2.01 min.

C_v @ T_{50}
0.207 ft.^{2}/day

C_α = 0.001



Load No.= 10
Load= 16.00 ksf
D_0 = 0.0525
D_{50} = 0.0657
D_{100} = 0.0789
T_{50} = 1.74 min.

C_v @ T_{50}
0.226 ft.^{2}/day

C_α = 0.003

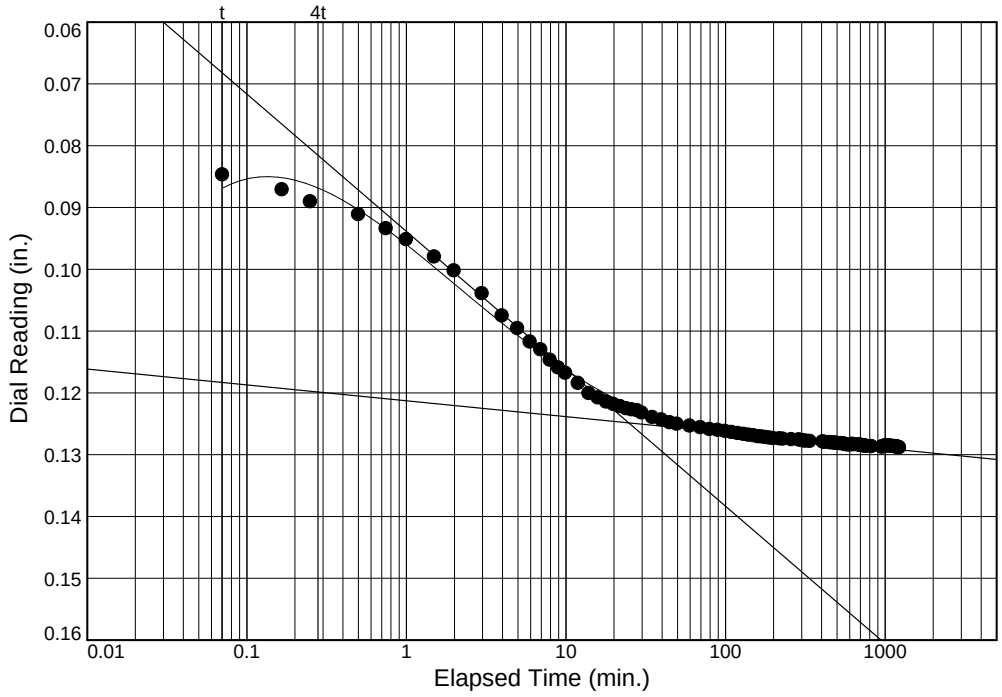
Figure 3

S&ME, Inc.

Dial Reading vs. Time

Project No.: 22430250
Project: I-275 Bridge over Elm Street

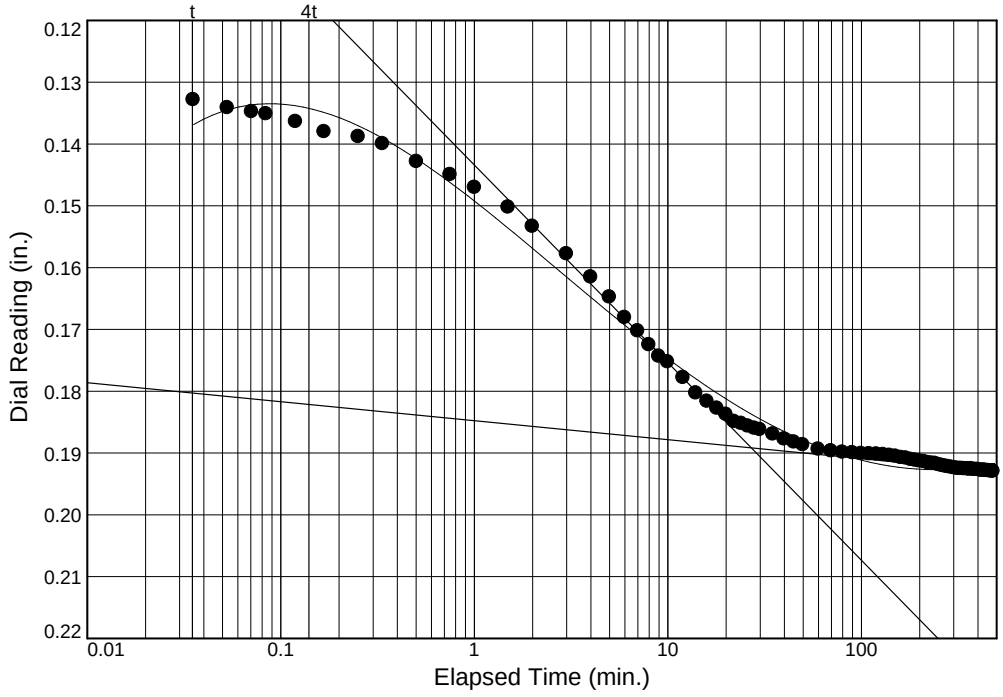
Source of Sample: B-09 Depth: 22.0 - 24.0 ft.



Load No.= 11
Load= 32.00 ksf
D_0 = 0.0870
D_{50} = 0.1059
D_{100} = 0.1249
T_{50} = 2.92 min.

C_v @ T_{50}
0.123 ft.^{2}/day

C_α = 0.006



Load No.= 12
Load= 64.00 ksf
D_0 = 0.1397
D_{50} = 0.1644
D_{100} = 0.1892
T_{50} = 3.86 min.

C_v @ T_{50}
0.081 ft.^{2}/day

C_α = 0.008

Figure 4

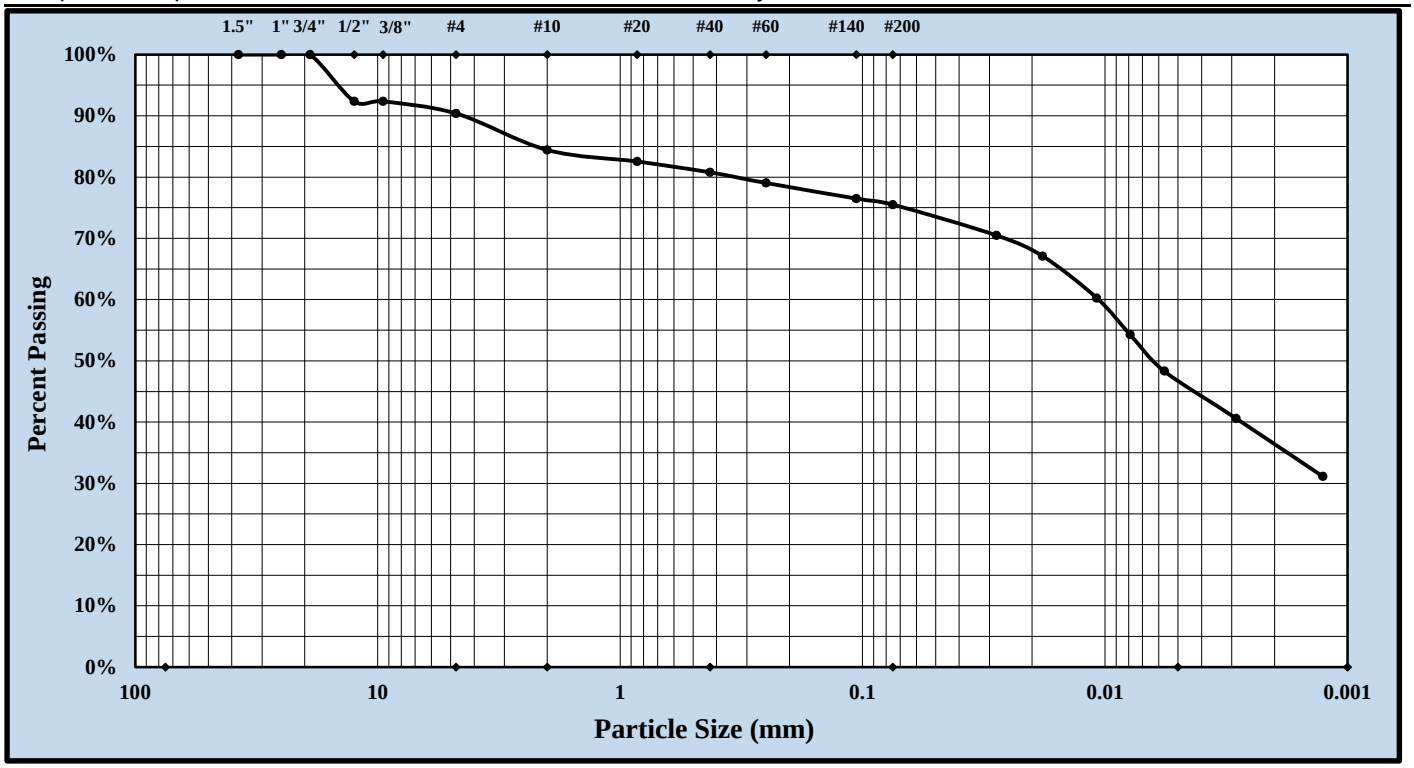
Form No. TR-D422-3
Revision No. 2
Revision Date: 08/29/17

PARTICLE SIZE ANALYSIS OF SOIL

Log No. 43-3763 *AASHTO T 88*

S&ME, Inc. - Knoxville: 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	22430250	Report Date:	2/10/2023
Project Name:	I-275 Over Elm Street	Test Date(s):	1/31/2023
Client Name:	HDR		
Address:	120 Brentwood Commons Way, Suite 525, Brentwood, TN		
Sample ID:	B-10	Sample #: SS-03	Sample Date: 12/12/22
Location:	Boreholes		Depth: 6.00 ft
Sample Description:	LEAN CLAY WITH GRAVEL (CL), yellowish brown		**A-7-6**



		Fine Sand	< 0.425 mm and > 0.075 mm (#200)
Gravel	< 75 mm and > 2.00 mm (#10)	Silt	< 0.075 and > 0.002 mm
Coarse Sand	< 2.00 mm and > 0.425 mm (#40)	Clay	< 0.002 mm

Maximum Particle Size:	3/4 in	Gravel:	15.6%	Silt	39.0%
Silt & Clay (% Passing #200):	75.5%	Total Sand:	8.9%	Clay	36.5%
Assumed Specific Gravity	2.650	Moisture Content	24.7%		
Liquid Limit	46	Plastic Limit	22	Plastic Index	24
Coarse Sand:	3.6%			Fine Sand:	5.3%

Description of Sand and Gravel: Rounded ☐ Angular ☒ Hard & Durable ☒ Soft ☐ Weathered & Friable ☐

Mechanical Stirring Apparatus A | Dispersion Period: 1 min. | Dispersing Agent: Sodium Hexametaphosphate: 40 g./ Liter

References / Comments / Deviations: AASHTO T 88, T 89, T 90, M 145

Victoria Igoe	Victoria Igoe	Associate Project Manager	2/10/2023
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D4318-T89-90
Revision No. 1
Revision Date: 7/26/17

LIQUID LIMIT, PLASTIC LIMIT, & PLASTIC INDEX

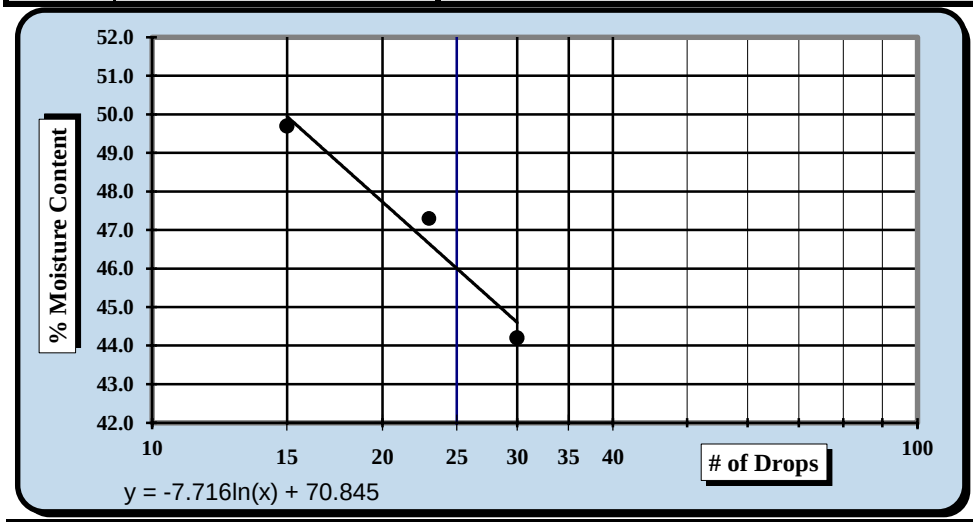
Quality Assurance ASTM D4318 ☐ AASHTO T 89 ☒ AASHTO T 90 ☒

S&ME, Inc. - Knoxville: 1413 Topside Road, Louisville, TN 37777

Project #:	22430250	Report Date:	2/10/2023
Project Name:	I-275 Over Elm Street	Test Date(s)	1/30/2023
Client Name:	HDR		
Client Address:	120 Brentwood Commons Way, Suite 525, Brentwood, TN		
Boring #:	B-10	Sample #: SS-03	Sample Date: 12/12/2022
Log #:	43-3763		Depth: 6.00 ft
Description:	LEAN CLAY WITH GRAVEL (CL), yellowish brown		

Type and Specification	*S&ME ID #*	*Cal Date:*	*Type and Specification*	*S&ME ID #*	*Cal Date:*
Balance (0.01 g)	18435	2/18/2022	Grooving tool	16015	8/15/2022
LL Apparatus	18414	8/10/2022	No. 40 Sieve	31697	9/16/2022
Oven	12872	7/21/2022			

Pan #		Liquid Limit						Plastic Limit		
	Tare #:	14	20	10				1		
A	Tare Weight	15.39	15.35	15.34				15.25		
B	Wet Soil Weight + A	29.82	31.33	31.45				23.85		
C	Dry Soil Weight + A	25.40	26.20	26.10				22.30		
D	Water Weight (B-C)	4.42	5.13	5.35				1.55		
E	Dry Soil Weight (C-A)	10.01	10.85	10.76				7.05		
F	% Moisture (D/E)*100	44.2%	47.3%	49.7%				22.0%		
N	# OF DROPS	30	23	15				*Moisture Contents determined by AASHTO T 265*		
LL	LL = **F** * FACTOR									
Ave.	*Average*							**22.0%**		



One Point Liquid Limit

N	Factor	N	Factor
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.99	29	1.018
24	0.995	30	1.022
25	1.000		

NP, Non-Plastic ☐

Liquid Limit	**46**
Plastic Limit	**22**
Plastic Index	**24**
Group Symbol	**CL**

Multipoint Method ☑
One-point Method ☐

Wet Preparation ☐ Dry Preparation ☑ Air Dried ☑

Notes / Deviations / References: **Group symbol is for minus No. 40 portion only.**

AASHTO T90: Determining the Plastic Limit & Plastic Index of Soils *AASHTO T89: Determining the Liquid Limit of Soils*

Kim Gonzalez	1/31/2023	Lindsey Deskins	2/10/2023
Technician Name	*Date*	*Technical Responsibility*	*Date*

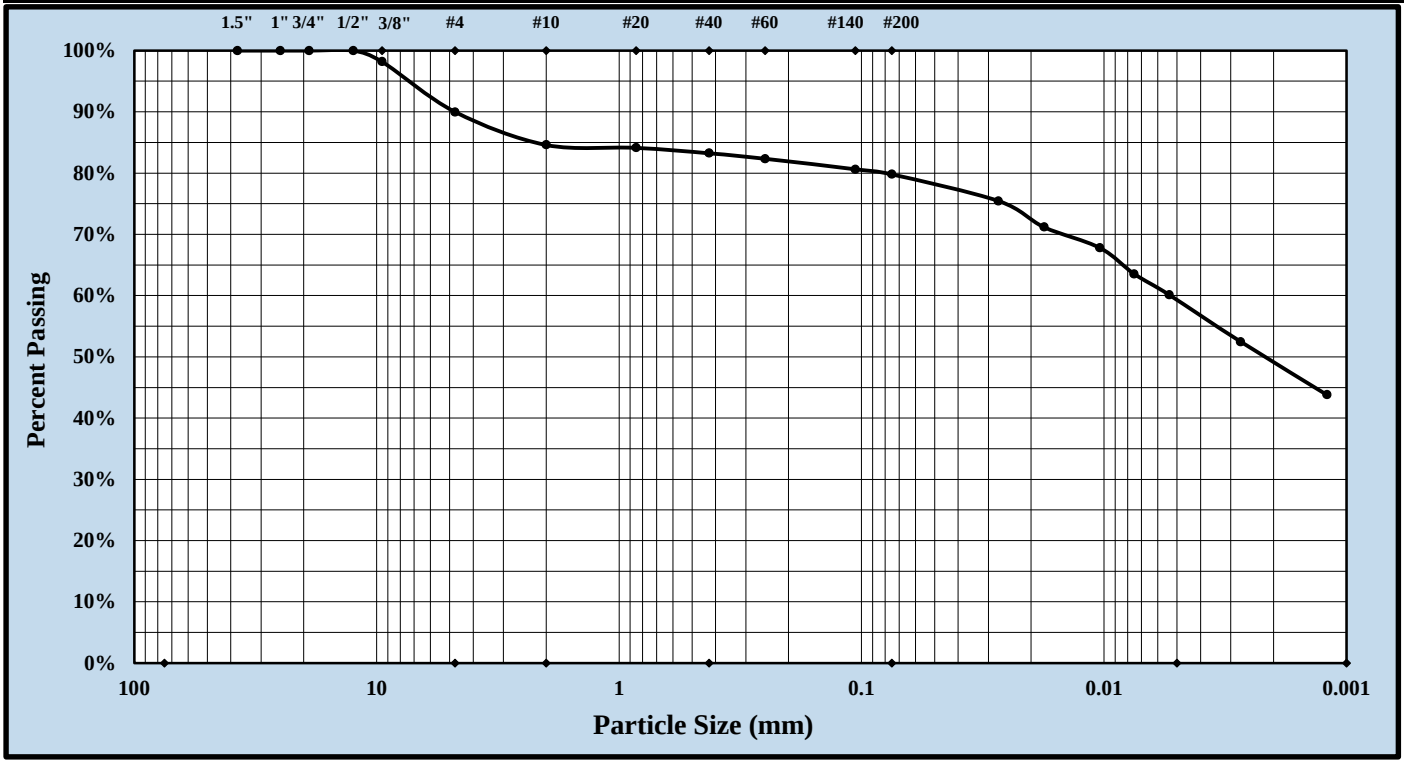
Form No. TR-D422-3
Revision No. 2
Revision Date: 08/29/17

PARTICLE SIZE ANALYSIS OF SOIL

Log No. 43-3763 *AASHTO T 88*

S&ME, Inc. - Knoxville: 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	22430250	Report Date:	2/10/2023
Project Name:	I-275 on Elm Street	Test Date(s):	1/31/2023
Client Name:	HDR		
Address:	120 Brentwood Commons Way, Suite 525, Brentwood, TN		
Sample ID:	B-10	Sample #: SS-7	Sample Date: 12/12/22
Location:	Boreholes		Depth: 23.50 ft
Sample Description:	FAT CLAY WITH GRAVEL (CH), reddish brown		**A-7-6**



		Fine Sand	< 0.425 mm and > 0.075 mm (#200)
Gravel	< 75 mm and > 2.00 mm (#10)	Silt	< 0.075 and > 0.002 mm
Coarse Sand	< 2.00 mm and > 0.425 mm (#40)	Clay	< 0.002 mm

Maximum Particle Size:	1/2 in	Gravel:	15.4%	Silt	30.4%
Silt & Clay (% Passing #200):	79.8%	Total Sand:	4.8%	Clay	49.4%
Assumed Specific Gravity	2.650	Moisture Content	30.7%		
Liquid Limit	95	Plastic Limit	39	Plastic Index	56
Coarse Sand:	1.4%			Fine Sand:	3.5%

Description of Sand and Gravel: Rounded ☐ Angular ☒ Hard & Durable ☒ Soft ☐ Weathered & Friable ☐

Mechanical Stirring Apparatus A | Dispersion Period: 1 min. | Dispersing Agent: Sodium Hexametaphosphate: 40 g./ Liter

References / Comments / Deviations: AASHTO T 88, T 89, T 90, M 145

Victoria Igoe	Victoria Igoe	Associate Project Manager	2/10/2023
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D4318-T89-90
Revision No. 1
Revision Date: 7/26/17

LIQUID LIMIT, PLASTIC LIMIT, & PLASTIC INDEX

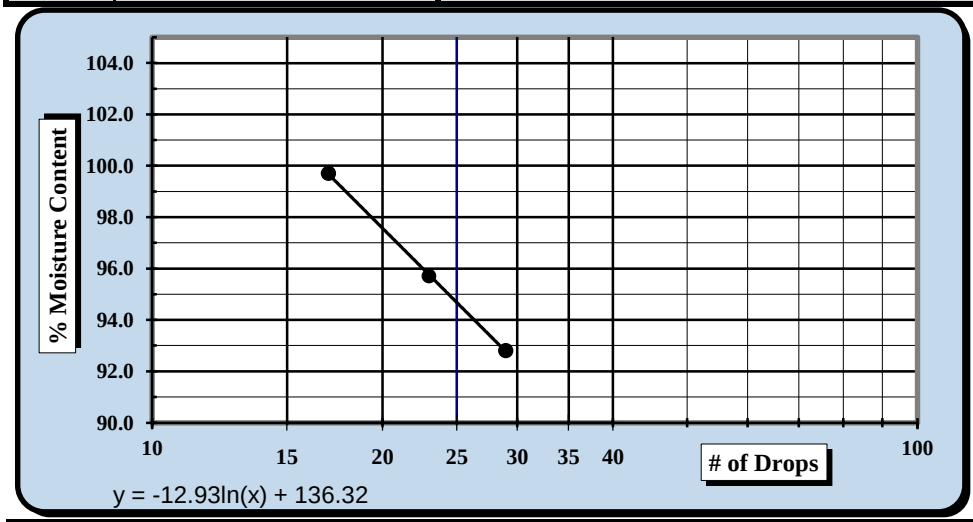
Quality Assurance ASTM D4318 ☐ AASHTO T 89 ☒ AASHTO T 90 ☒

S&ME, Inc. - Knoxville: 1413 Topside Road, Louisville, TN 37777

Project #:	22430250	Report Date:	2/10/2023
Project Name:	I-275 Over Elm Street	Test Date(s)	1/28/2022
Client Name:	HDR		
Client Address:	120 Brentwood Commons Way, Suite 525, Brentwood, TN		
Boring #:	B-10	Sample #: SS-07	Sample Date: 12/12/2022
Log #:	43-3763		Depth: 23.50 ft
Description:	FAT CLAY WITH GRAVEL (CH), reddish brown		

Type and Specification	*S&ME ID #*	*Cal Date:*	*Type and Specification*	*S&ME ID #*	*Cal Date:*
Balance (0.01 g)	18435	2/18/2022	Grooving tool	16015	8/15/2022
LL Apparatus	18414	8/10/2022	No. 40 Sieve	31697	9/16/2022
Oven	12872	7/21/2022			

Pan #		Liquid Limit						Plastic Limit		
	Tare #:	4	12	B4				22		
A	Tare Weight	15.37	15.49	15.64				15.35		
B	Wet Soil Weight + A	29.29	30.07	31.04				23.93		
C	Dry Soil Weight + A	22.59	22.94	23.35				21.52		
D	Water Weight (B-C)	6.70	7.13	7.69				2.41		
E	Dry Soil Weight (C-A)	7.22	7.45	7.71				6.17		
F	% Moisture (D/E)*100	92.8%	95.7%	99.7%				39.1%		
N	# OF DROPS	29	23	17				*Moisture Contents determined by AASHTO T 265*		
LL	LL = **F** * FACTOR									
Ave.	*Average*							**39.1%**		



One Point Liquid Limit

N	Factor	N	Factor
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.99	29	1.018
24	0.995	30	1.022
25	1.000		

NP, Non-Plastic ☐

Liquid Limit	**95**
Plastic Limit	**39**
Plastic Index	**56**
Group Symbol	**CH**

Multipoint Method ☑
One-point Method ☐

Wet Preparation ☐ Dry Preparation ☑ Air Dried ☑

Notes / Deviations / References: **Group symbol is for minus No. 40 portion only.**

AASHTO T90: Determining the Plastic Limit & Plastic Index of Soils *AASHTO T89: Determining the Liquid Limit of Soils*

Kim Gonzalez	1/2/2023	Lindsey Deskins	2/10/2023
Technician Name	*Date*	*Technical Responsibility*	*Date*

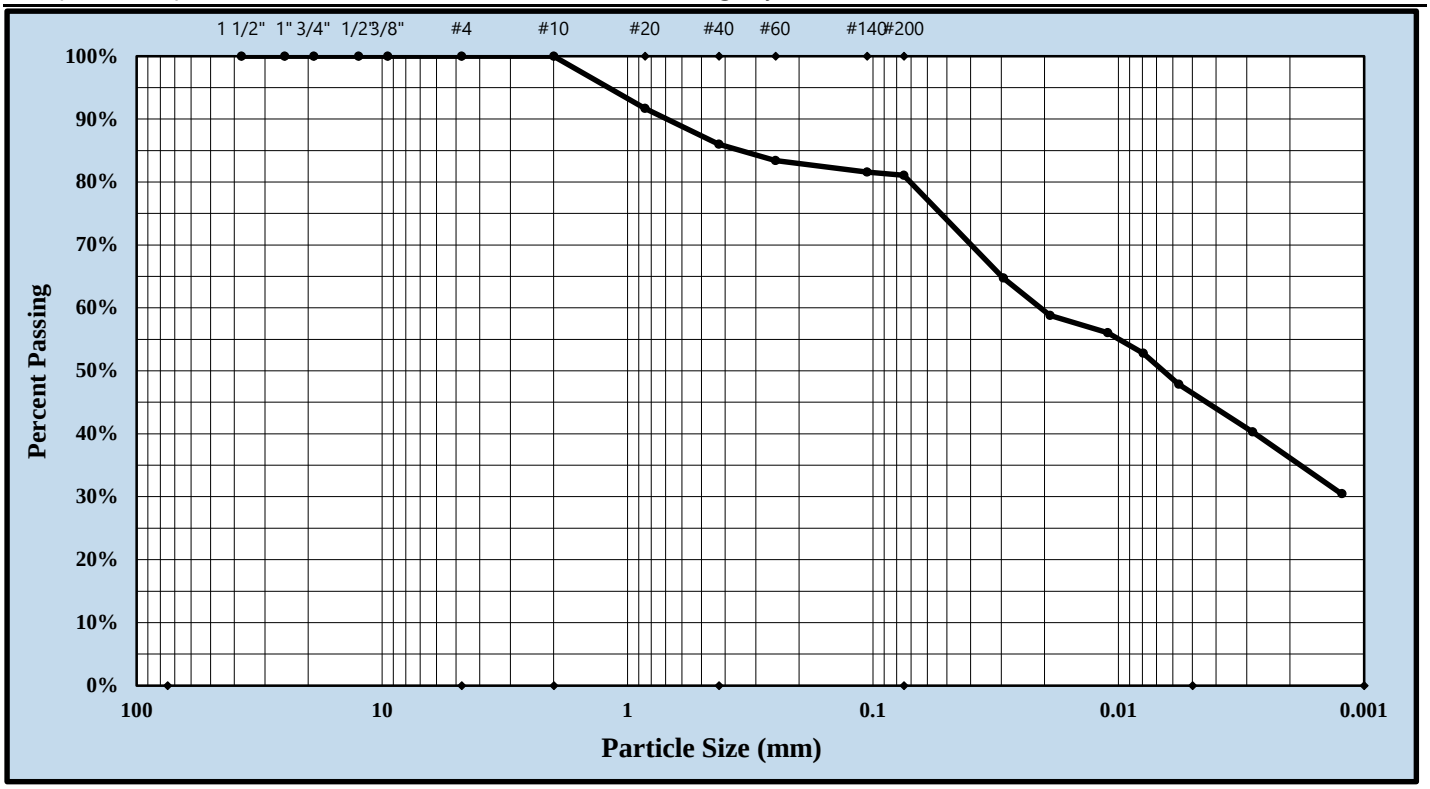
Form No. TR-D422-2
Revision No. 2LEXdAASHTO
Revision Date: 01/30/23

PARTICLE SIZE ANALYSIS OF SOIL

AASHTO T88

S&ME, Inc. - Lexington: 2020 Liberty Road, Suite 105, Lexington, KY 40505

Project #:	22430250	Report Date:	1/26/23
Project Name:	I-275 Bridge over Elm Street	Test Date(s):	1/23/23
Client Name:	HDR Engineering, Inc.		
Client Address:	2517 Sir Barton Way, Suite 400, Lexington, KY		
Type:	UD	Sample Date:	01/16/23
Location:	B-11	Depth (ft.):	20.0 - 22.0
Sample Description:	FAT CLAY WITH SAND (CH) (A-7-6), light yellow brown		



AASHTO M145 PARTICLE SIZES			
Gravel	< 75 mm and > 2.00 mm (#10)	Silt Size	< 0.075 and > 0.005 mm
Coarse Sand	< 2.00 mm and >0.425 mm (#40)	Clay Size	< 0.005 mm
Fine Sand	< 0.425 mm and > 0.075 mm (#200)		

Nom. Maximum Particle Size:	#10	Gravel:	0.0%	Silt Size:	34.6%
Silt & Clay (% Passing #200):	81.1%	Total Sand:	18.9%	Clay Size:	46.5%
Assumed Relative Density:	2.750	Moisture Content:	36.9%		
Liquid Limit:	55	Plastic Limit:	28	Plastic Index:	27
Coarse Sand:	14.0%			Fine Sand:	4.9%

Description of Sand and Gravel	Rounded ☐	Angular ☒	Hard & Durable ☒	Soft ☐	Weathered & Friable ☐		
Mechanical Stirring Apparatus A	Dispersion Period:	1 min.	Dispersing Agent:	Sodium Hexametaphosphate:	40 g./ Liter		

References / Comments / Deviations:

Jacob Folsom	Jacob Folsom	Lab Services Manager	2/13/2023
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D4318-T89-90
Revision No. 1 LEXb
Revision Date: 05/16/22

LIQUID LIMIT, PLASTIC LIMIT, & PLASTIC INDEX

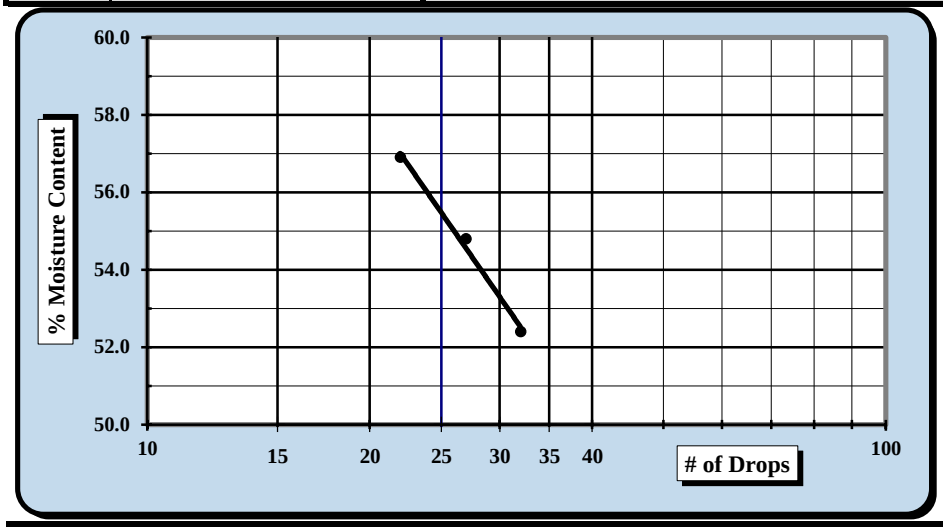
ASTM D 4318 ☒ AASHTO T 89 ☐ AASHTO T 90 ☐

S&ME, Inc. - Lexington: 2020 Liberty Road, Suite 105, Lexington, KY 40505

Project #:	22430250	Report Date:	04/13/23
Project Name:	I-275 Bridge over Elm Street	Test Date(s)	01/23/23
Client Name:	HDR Engineering, Inc.		
Client Address:	2517 Sir Barton Way, STE 400, Lexington, KY		
		Sample Date:	01/26/23
Location:	B-11	Depth (ft):	20.0 - 22.0
Sample Description:	FAT CLAY WITH SAND (CH) (A-7-6), light yellow brown		

Type and Specification	*S&ME ID #*	*Cal Date:*	*Type and Specification*	*S&ME ID #*	*Cal Date:*
Balance (0.01 g)	32707	01/19/22	Grooving tool	2022.12.22A	12/22/22
LL Apparatus	33653	01/04/23			
Oven (brown)	24438	10/25/22			

		Liquid Limit						Plastic Limit		
A	Tare Weight	16.86	16.45	15.18				15.97	16.33	
B	Wet Soil Weight + A	25.99	24.78	23.18				22.43	22.58	
C	Dry Soil Weight + A	22.85	21.83	20.28				21.03	21.22	
D	Water Weight (B-C)	3.14	2.95	2.90				1.40	1.36	
E	Dry Soil Weight (C-A)	5.99	5.38	5.10				5.06	4.89	
F	% Moisture (D/E)*100	52.4%	54.8%	56.9%				27.7%	27.8%	
N	# OF DROPS	32	27	22				*Moisture Contents determined by ASTM D 2216*		
LL	LL = **F** * FACTOR									
Ave.	*Average*							**27.8%**		



One Point Liquid Limit			
N	**Factor**	**N**	**Factor**
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.99	29	1.018
24	0.995	30	1.022
25	1.000		

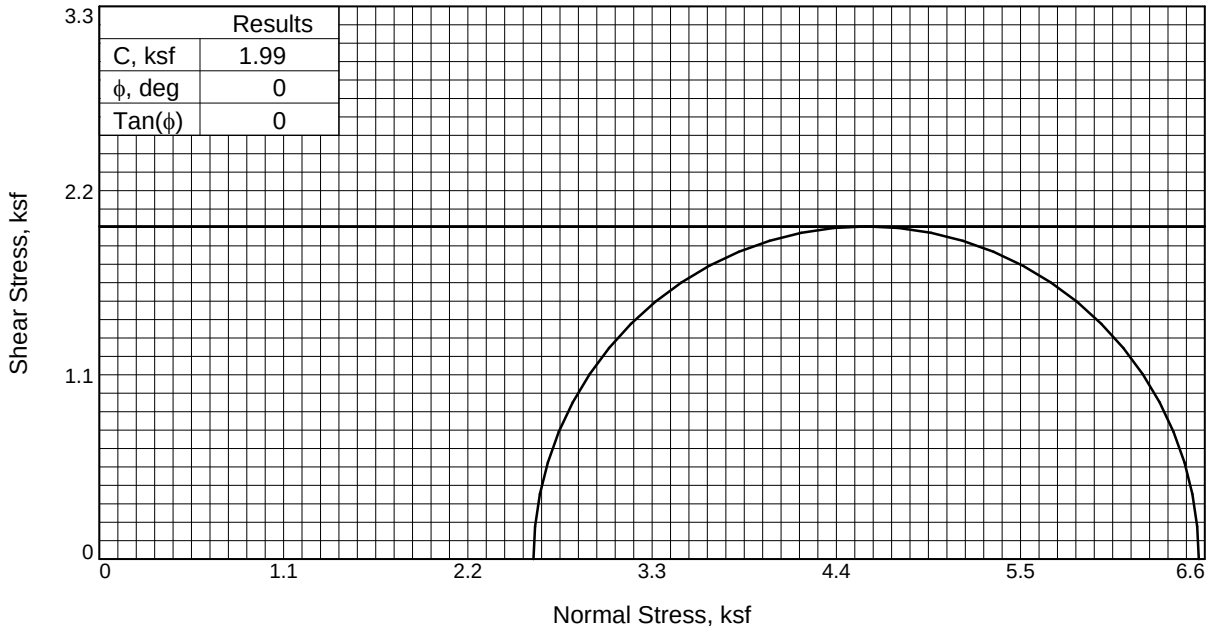
NP, Non-Plastic	☐
Liquid Limit	**55**
Plastic Limit	**28**
Plastic Index	**27**
Group Symbol	**CH***
Multipoint Method	☒
One-point Method	☐

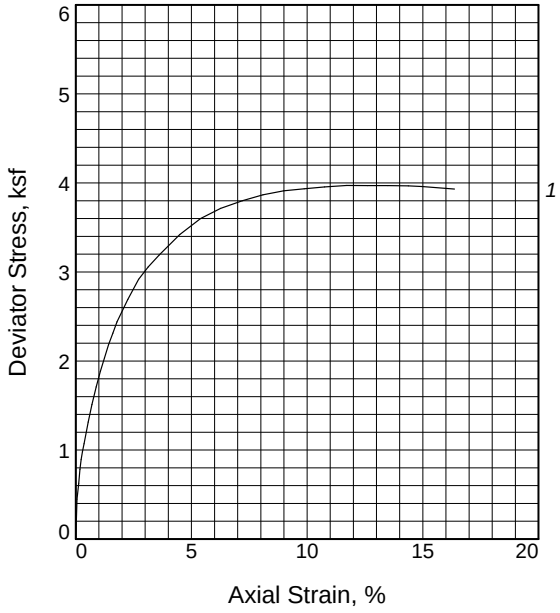
Wet Preparation ☐ Dry Preparation ☒ Air Dried ☒ *Est. the % retained on the #40 Sieve:* 20%

Notes / Deviations / References: *Classification listed here applies only to portion passing No. 40 sieve.

A. Harrod/JL Supervising	1/20/2023	Jacob Folsom	4/13/2023
Technician Name	*Date*	*Technical Responsibility*	*Date*

C & phi are not test results but an interpretation of the test results. The designer is responsible for interpreting test data as provided by S&ME.





Sample No.		1
Initial	Water Content, %	32.6
	Dry Density, pcf	90.4
	Saturation, %	99.7
	Void Ratio	0.8992
	Diameter, in.	2.862
	Height, in.	5.559
At Test	Water Content, %	32.7
	Dry Density, pcf	90.4
	Saturation, %	99.9
	Void Ratio	0.8992
	Diameter, in.	2.862
	Height, in.	5.559
Strain rate, %/min.		0.50
Back Pressure, psi		0.00
Cell Pressure, psi		18.00
Fail. Stress, ksf		3.97
Strain, %		11.7
Ult. Stress, ksf		3.96
Strain, %		15.0
σ_1 Failure, ksf		6.56
σ_3 Failure, ksf		2.59

Type of Test:
Unconsolidated Undrained

Sample Type: Intact

Description: FAT CLAY WITH SAND (CH) (A-7-6), light yellow brown

LL= 55 **PL=** 28 **PI=** 27

Assumed Specific Gravity= 2.750

Remarks: Failure criterion is peak deviator stress.

Client: HDR Engineering, Inc.

Project: I-275 Bridge over Elm Street

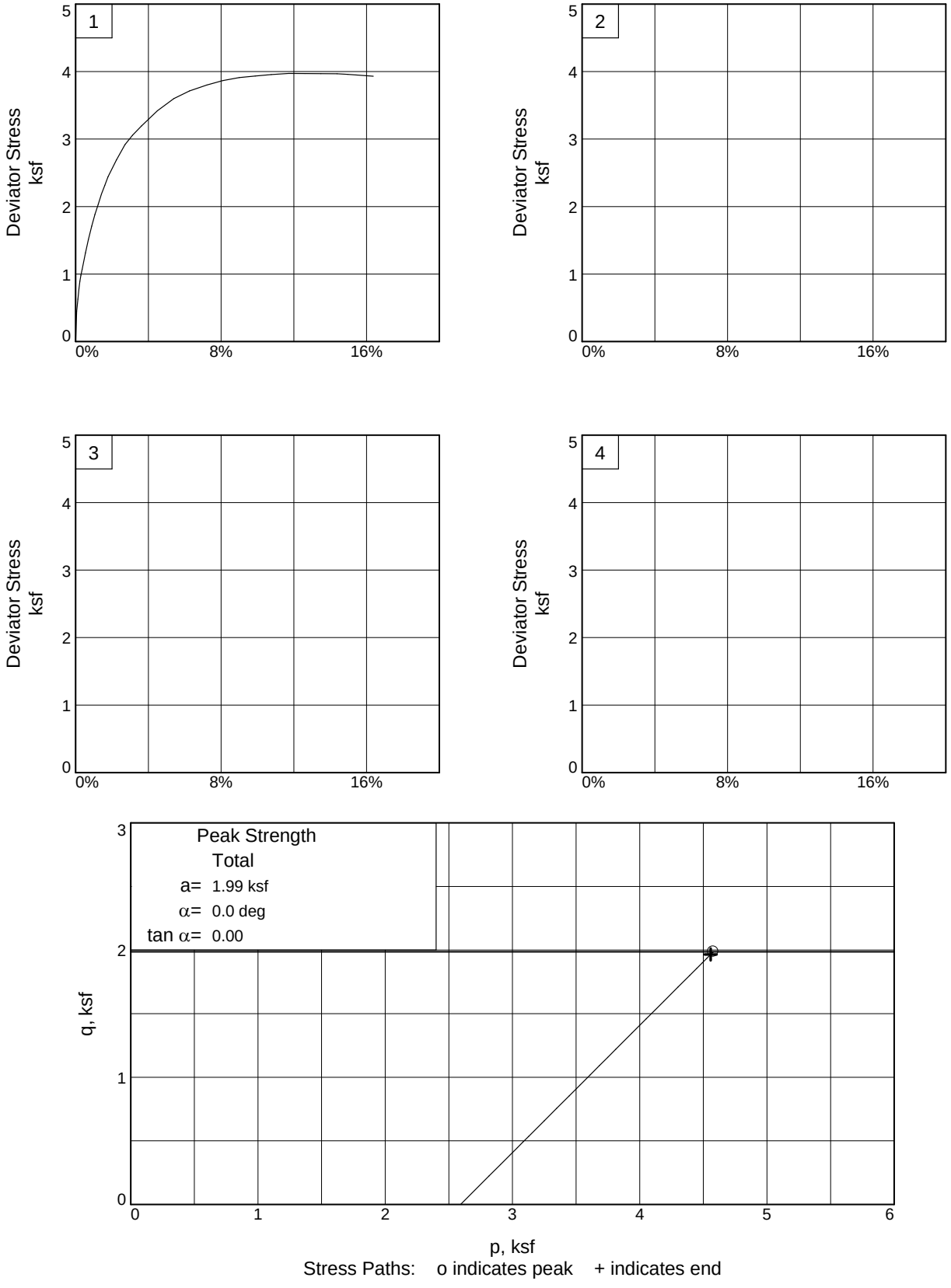
Source of Sample: B-11 **Depth:** 20.0 - 22.0 ft.

Proj. No.: 22430250 **Date Sampled:** 01/16/2023

TRIAXIAL SHEAR TEST REPORT
S&ME, Inc.
Lexington, Kentucky

Tested By: J. LaMothe **Checked By:** J. Folsom 01/31/2023

C & phi are not test results but an interpretation of the test results. The designer is responsible for interpreting test data as provided by S&ME.



Client: HDR Engineering, Inc.
Project: I-275 Bridge over Elm Street
Source of Sample: B-11 **Depth:** 20.0 - 22.0 ft.
Project No.: 22430250 **Figure** 2 of 2

S&ME, Inc.

Tested By: J. LaMothe **Checked By:** J. Folsom 01/31/2023

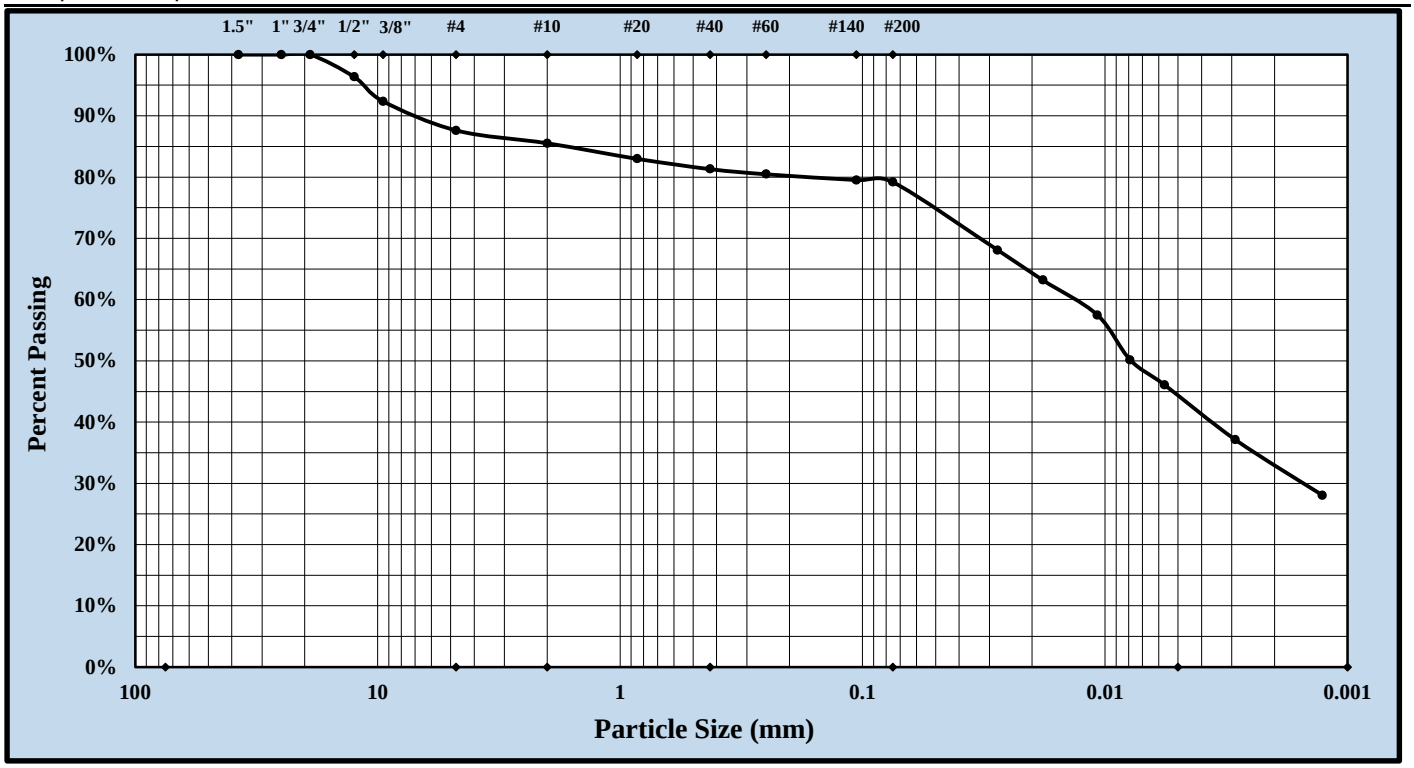
Form No. TR-D422-3
Revision No. 2
Revision Date: 08/29/17

PARTICLE SIZE ANALYSIS OF SOIL

Log No. 43-3763 *AASHTO T 88*

S&ME, Inc. - Knoxville: 1413 Topside Road, Louisville, TN 37777

S&ME Project #:	22430250	Report Date:	2/10/2023
Project Name:	I-275 Over Elm Street	Test Date(s):	1/31/2023
Client Name:	HDR		
Address:	120 Brentwood Commons Way, Suite 525, Brentwood, TN		
Sample ID:	B-11	Sample #: SS-08	Sample Date: 12/19/22
Location:	Boreholes	Depth:	28.50 ft
Sample Description:	FAT CLAY WITH GRAVEL (CH), brown		**A-7-6**



		Fine Sand	< 0.425 mm and > 0.075 mm (#200)
Gravel	< 75 mm and > 2.00 mm (#10)	Silt	< 0.075 and > 0.002 mm
Coarse Sand	< 2.00 mm and > 0.425 mm (#40)	Clay	< 0.002 mm

Maximum Particle Size:	3/4 in	Gravel:	14.5%	Silt	46.4%
Silt & Clay (% Passing #200):	79.2%	Total Sand:	6.3%	Clay	32.8%
Assumed Specific Gravity	2.650	Moisture Content	70.9%		
Liquid Limit	69	Plastic Limit	31	Plastic Index	38
Coarse Sand:	4.2%			Fine Sand:	2.1%

Description of Sand and Gravel: Rounded ☐ Angular ☒ Hard & Durable ☒ Soft ☐ Weathered & Friable ☐

Mechanical Stirring Apparatus A | Dispersion Period: 1 min. | Dispersing Agent: Sodium Hexametaphosphate: 40 g./ Liter

References / Comments / Deviations: AASHTO T 88, T 89, T 90, M 145

Victoria Igoe	Victoria Igoe	Associate Project Manager	2/10/2023
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-D4318-T89-90
Revision No. 1
Revision Date: 7/26/17

LIQUID LIMIT, PLASTIC LIMIT, & PLASTIC INDEX

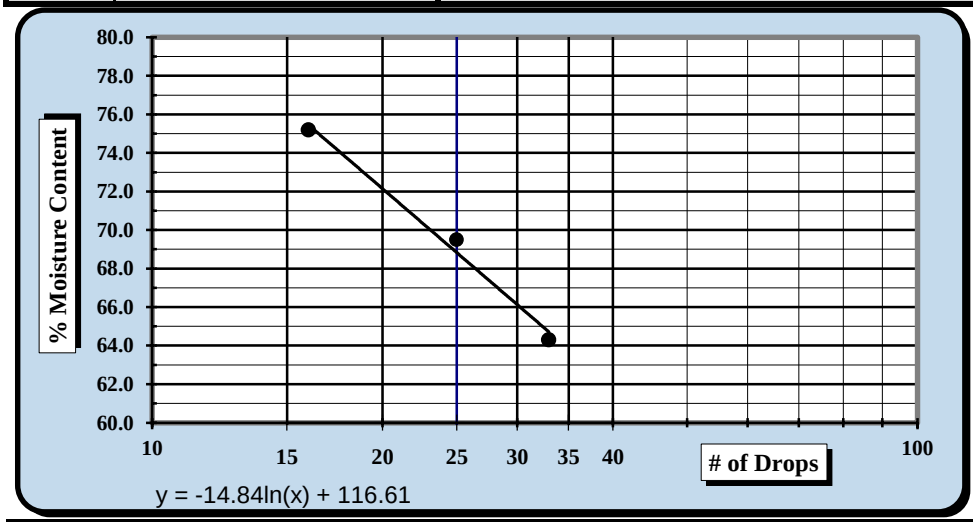
Quality Assurance ASTM D4318 ☐ AASHTO T 89 ☒ AASHTO T 90 ☒

S&ME, Inc. - Knoxville: 1413 Topside Road, Louisville, TN 37777

Project #:	22430250	Report Date:	2/10/2023
Project Name:	I-275 Over Elm Street	Test Date(s)	1/28/2022
Client Name:	HDR		
Client Address:	120 Brentwood Commons Way, Suite 525, Brentwood, TN		
Boring #:	B-11	Sample #: SS-08	Sample Date: 12/19/2022
Log #:	43-3763		Depth: 28.50 ft
Description:	FAT CLAY WITH GRAVEL (CH), brown		

Type and Specification	*S&ME ID #*	*Cal Date:*	*Type and Specification*	*S&ME ID #*	*Cal Date:*
Balance (0.01 g)	18435	2/18/2022	Grooving tool	16015	8/15/2022
LL Apparatus	18414	8/10/2022	No. 40 Sieve	31697	9/16/2022
Oven	12872	7/21/2022			

Pan #		Liquid Limit						Plastic Limit		
	Tare #:	9	A3	A5				B5		
A	Tare Weight	15.36	15.83	15.74				15.87		
B	Wet Soil Weight + A	29.29	31.76	32.86				23.36		
C	Dry Soil Weight + A	23.84	25.23	25.51				21.57		
D	Water Weight (B-C)	5.45	6.53	7.35				1.79		
E	Dry Soil Weight (C-A)	8.48	9.40	9.77				5.70		
F	% Moisture (D/E)*100	64.3%	69.5%	75.2%				31.4%		
N	# OF DROPS	33	25	16				*Moisture Contents determined by AASHTO T 265*		
LL	LL = **F** * FACTOR									
Ave.	*Average*							**31.4%**		



One Point Liquid Limit

N	Factor	N	Factor
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.99	29	1.018
24	0.995	30	1.022
25	1.000		

NP, Non-Plastic ☐

Liquid Limit	**69**
Plastic Limit	**31**
Plastic Index	**38**
Group Symbol	**CH**

Multipoint Method ☑
One-point Method ☐

Wet Preparation ☐ Dry Preparation ☑ Air Dried ☑

Notes / Deviations / References: **Group symbol is for minus No. 40 portion only.**

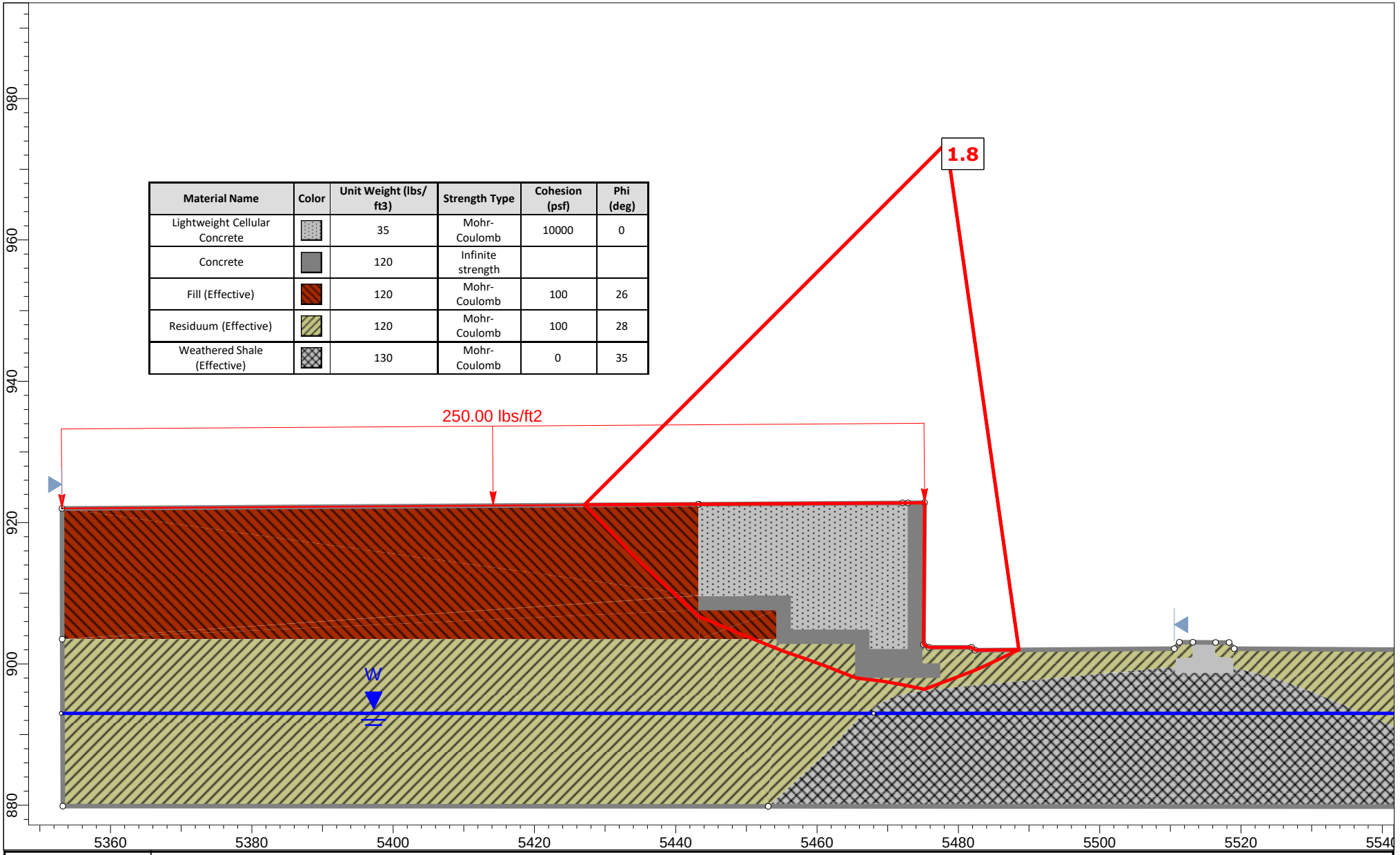
AASHTO T90: Determining the Plastic Limit & Plastic Index of Soils *AASHTO T89: Determining the Liquid Limit of Soils*

Kim Gonzalez	1/29/2023	Lindsey Deskins	2/10/2023
Technician Name	*Date*	*Technical Responsibility*	*Date*

Appendix IV

Global Stability Analysis

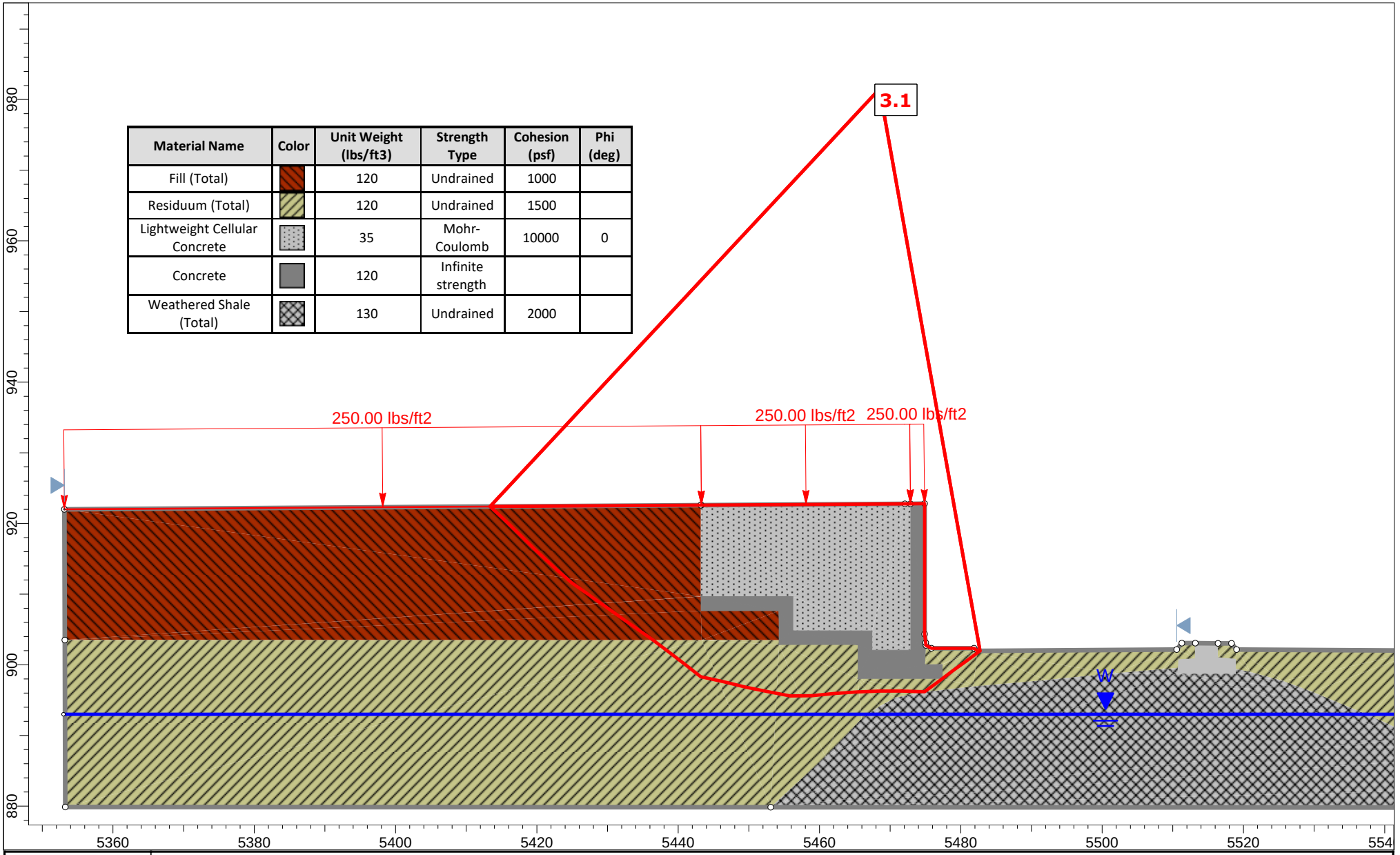
Material Name	Color	Unit Weight (lbs/ ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Lightweight Cellular Concrete		35	Mohr-Coulomb	10000	0
Concrete		120	Infinite strength		
Fill (Effective)		120	Mohr-Coulomb	100	26
Residuum (Effective)		120	Mohr-Coulomb	100	28
Weathered Shale (Effective)		130	Mohr-Coulomb	0	35



Project: I-275 Bridge over Elm Street			
Analysis: Abutment 1 Retaining Wall		Description: Cast-In-Place Wall	
Drawn By: J. Baines	Project Number: 22430250	Company: S&ME	Figure: 1
Location: Station 54+72.41 - Effective Stress	File Name: I-275 Walls.slmd	Date: 5/31/2023	

SLIDEINTERPRET 9.027

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Fill (Total)		120	Undrained	1000	
Residuum (Total)		120	Undrained	1500	
Lightweight Cellular Concrete		35	Mohr-Coulomb	10000	0
Concrete		120	Infinite strength		
Weathered Shale (Total)		130	Undrained	2000	

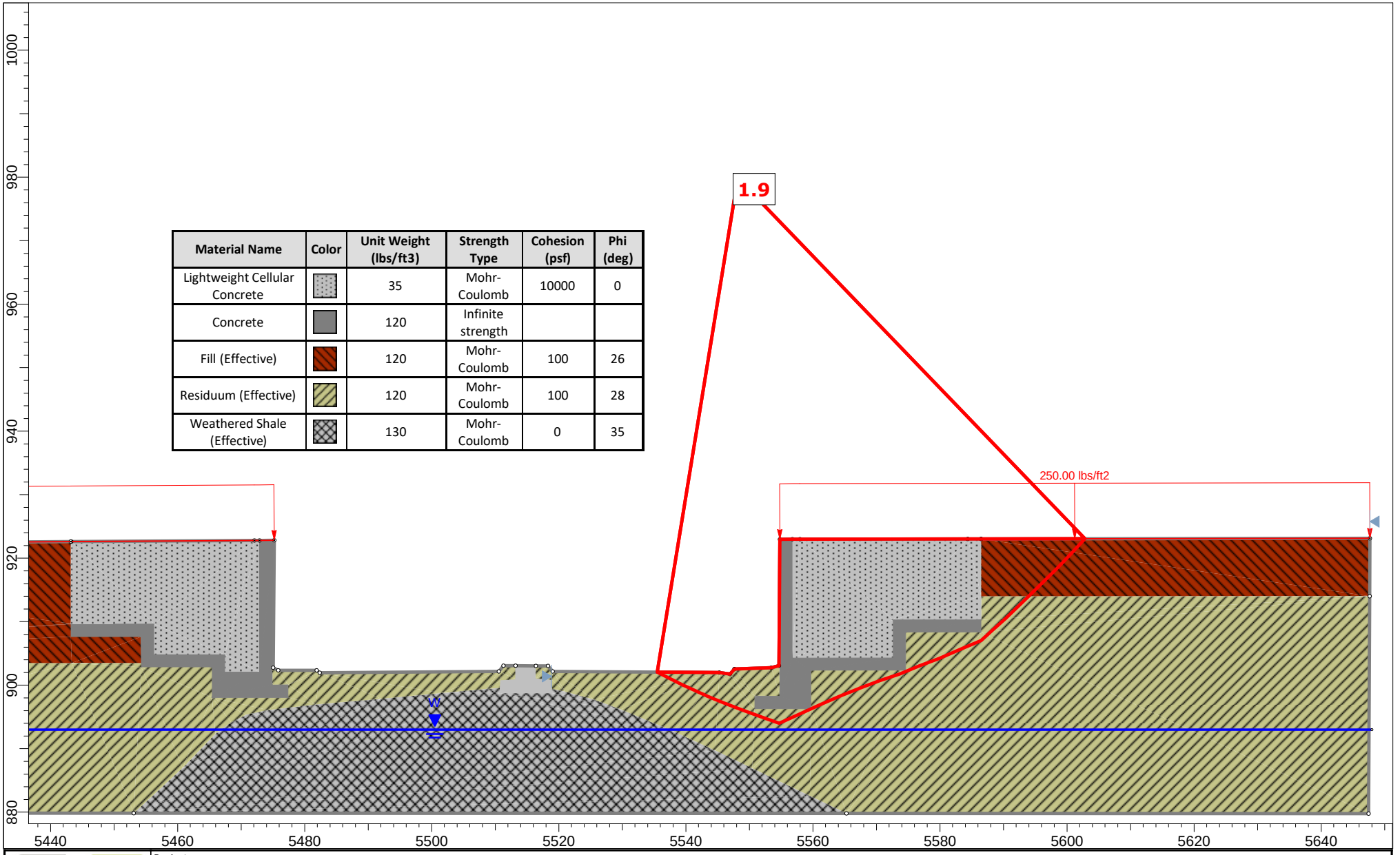


Project	I-275 Bridge over Elm Street			
Analysis	Abutment 1 Retaining Wall		Description	Cast-In-Place Wall
Drawn By	J. Baines	Project Number	22430250	Company S&ME
Location	Station 54+72.41 - Total Stress	File Name	I-275 Walls.slmd	Date 5/31/2023

Figure 2

SLIDEINTERPRET 9.027

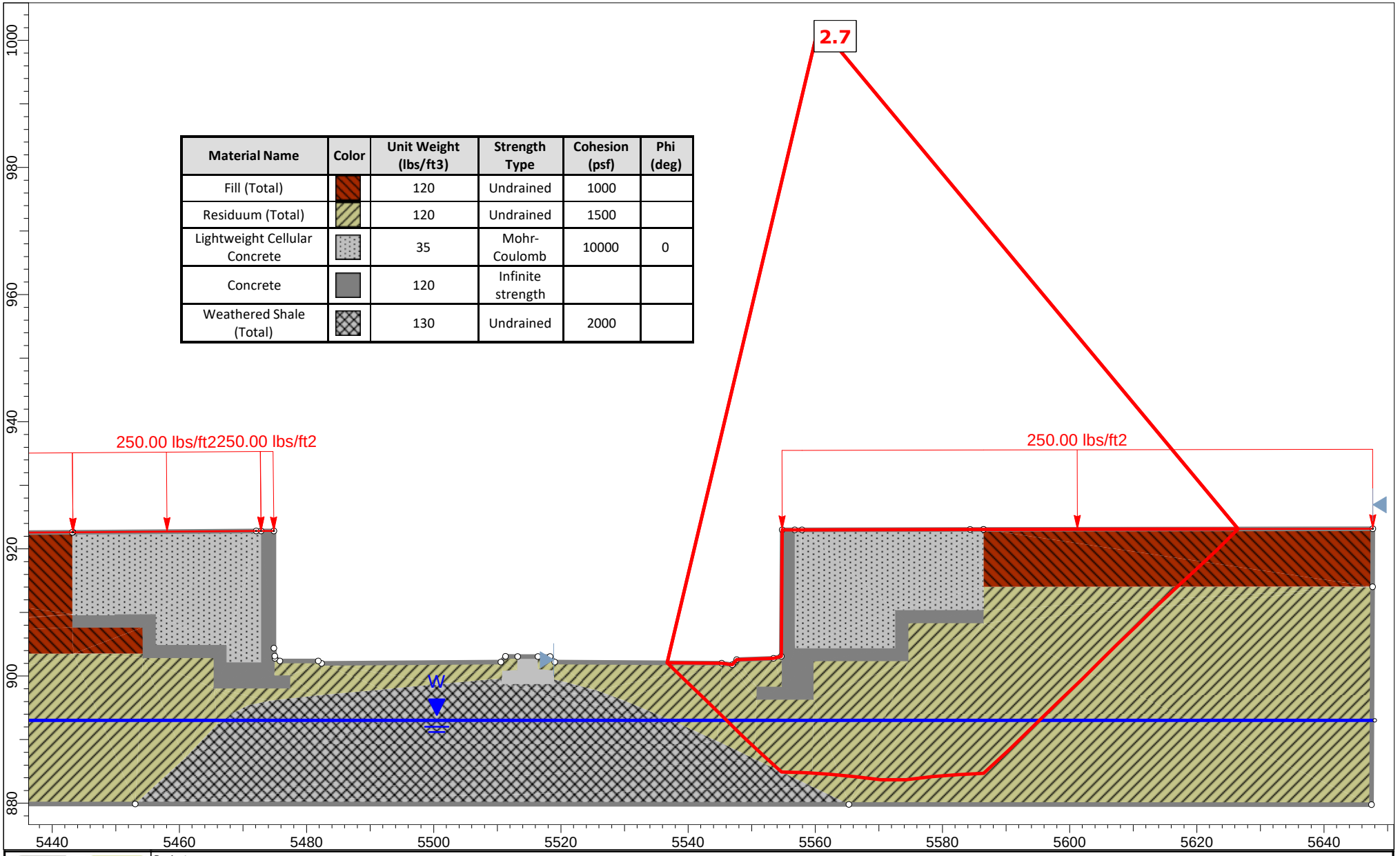
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Lightweight Cellular Concrete		35	Mohr-Coulomb	10000	0
Concrete		120	Infinite strength		
Fill (Effective)		120	Mohr-Coulomb	100	26
Residuum (Effective)		120	Mohr-Coulomb	100	28
Weathered Shale (Effective)		130	Mohr-Coulomb	0	35



Project	I-275 Bridge over Elm Street				
Analysis	Abutment 2 Retaining Wall			Description	Cast-In-Place Wall
Drawn By	J. Baines	Project Number	22430250	Company	S&ME
Location	Station 55+56.41 - Effective Stress	File Name	I-275 Walls.slmd	Date	5/31/2023
					Figure 3

SLIDEINTERPRET 9.027

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Fill (Total)		120	Undrained	1000	
Residuum (Total)		120	Undrained	1500	
Lightweight Cellular Concrete		35	Mohr-Coulomb	10000	0
Concrete		120	Infinite strength		
Weathered Shale (Total)		130	Undrained	2000	



Project: I-275 Bridge over Elm Street			
Analysis: Abutment 2 Retaining Wall		Description: Cast-In-Place Wall	
Drawn By: J. Baines	Project Number: 22430250	Company: S&ME	Figure: 4
Location: Station 55+56.41 - Total Stress	File Name: I-275 Walls.slmd	Date: 5/31/2023	

SLIDEINTERPRET 9.027

Appendix V

Important Information about Your Geotechnical Engineering Report

Important Information About Your Geotechnical Engineering Report

Variations in subsurface conditions can be a principal cause of construction delays, cost overruns and claims. The following information is provided to assist you in understanding and managing the risk of these variations.

Geotechnical Findings Are Professional Opinions

Geotechnical engineers cannot specify material properties as other design engineers do. Geotechnical material properties have a far broader range on a given site than any manufactured construction material, and some geotechnical material properties may change over time because of exposure to air and water, or human activity.

Site exploration identifies subsurface conditions at the time of exploration and only at the points where subsurface tests are performed or samples obtained. Geotechnical engineers review field and laboratory data and then apply their judgment to render professional opinions about site subsurface conditions. Their recommendations rely upon these professional opinions. Variations in the vertical and lateral extent of subsurface materials may be encountered during construction that significantly impact construction schedules, methods and material volumes. While higher levels of subsurface exploration can mitigate the risk of encountering unanticipated subsurface conditions, no level of subsurface exploration can eliminate this risk.

Scope of Geotechnical Services

Professional geotechnical engineering judgment is required to develop a geotechnical exploration scope to obtain information necessary to support design and construction. A number of unique project factors are considered in developing the scope of geotechnical services, such as the exploration objective; the location, type, size and weight of the proposed structure; proposed site grades and improvements; the construction schedule and sequence; and the site geology.

Geotechnical engineers apply their experience with construction methods, subsurface conditions and exploration methods to develop the exploration scope. The scope of each exploration is unique based on available project and site information. Incomplete project information or constraints on the scope of exploration increases the risk of variations in subsurface conditions not being identified and addressed in the geotechnical report.

Services Are Performed for Specific Projects

Because the scope of each geotechnical exploration is unique, each geotechnical report is unique. Subsurface conditions are explored and recommendations are made for a specific project. Subsurface information and recommendations may not be adequate for other uses. Changes in a proposed structure location, foundation loads, grades, schedule, etc. may require additional geotechnical exploration, analyses, and consultation. The geotechnical engineer should be consulted to determine if additional services are required in response to changes in proposed construction, location, loads, grades, schedule, etc.

Geo-Environmental Issues

The equipment, techniques, and personnel used to perform a geo-environmental study differ significantly from those used for a geotechnical exploration. Indications of environmental contamination may be encountered incidental to performance of a geotechnical exploration but go unrecognized. Determination of the presence, type or extent of environmental contamination is beyond the scope of a geotechnical exploration.

Geotechnical Recommendations Are Not Final

Recommendations are developed based on the geotechnical engineer's understanding of the proposed construction and professional opinion of site subsurface conditions. Observations and tests must be performed during construction to confirm subsurface conditions exposed by construction excavations are consistent with those assumed in development of recommendations. It is advisable to retain the geotechnical engineer that performed the exploration and developed the geotechnical recommendations to conduct tests and observations during construction. This may reduce the risk that variations in subsurface conditions will not be addressed as recommended in the geotechnical report.