Bridge Report
I-275 Bridge over Elm Street
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 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
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 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 bridge replacement project. 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 3:41 PM

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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 discussion of the exploration findings and our conclusions and recommendations specific to the bridge. Please see our abutment retaining wall report for recommendations regarding the abutment retaining walls.

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, 2 and 3 are planned to be used to support the new bridge superstructure dead, live, and wind loads with the longitudinal loads (braking and temperature) assumed to be resisted by the abutment retaining walls through the integral end bents. 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 loads are essentially the same or less, we believe reuse of the existing bridge foundations is appropriate assuming the existing foundations meet current TDOT standard design criteria. 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 spread 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 encountered, such as backfill for the existing foundations, will need to be excavated/removed to expose the underlying hard residual soils for foundation support.

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 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 spread foundations installed 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 middle bent of the existing bridge (Bent 2) located along the center of Elm Street will be maintained and incorporated into the new bridge design as well. A new pier wall will be constructed along existing Bent 2. The existing substructure is assumed to carry all the superstructure dead, live, wind and braking loads. New shallow spread foundations installed between the existing foundations are assumed to only carry the precast cap and pier wall loads. Bent 2 of the existing bridge is supported on shallow spread footings. 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 2.28 to 3.25 and 3.47 to 4.06 kips per square foot (ksf), respectively.

We understand that the new shallow spread 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 and Site Conditions

3.1 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 AASHTO and/or 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, 8 of which pertain to the bridge (B-01-B-08) and are discussed herein. 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 marked by a member 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. However, 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.

After augering and prior to coring, we measured the groundwater level, if present. The borings were backfilled with grout.

The approximate boring locations are depicted on the Foundation Data 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 Foundation Data Sheets. A summary of the boring locations is presented in Table 4-1.

Table 4-1 Locations of Bridge Borings

Boring Number	I-275 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

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 Test Boring Summary

Boring Number Station, Offset	Ground Surface Elevation, Boring Depth	Origin	General Description	SPT N - Value or 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+	

Boring Number Station, Offset	Ground Surface Elevation, Boring Depth	Origin	General Description	SPT N - Value or REC/RQD Range	Surface Material
		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	
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	

Table 5-2 – Rock Core Summary

Boring No. Station No. Offset	Depth / Elev.(ft) Top of Rock Core Termination	Core Run Intervals (feet)	RQD (%)	REC. (%)	Rock Description
I-275 B-01 Sta. 55+39 75 RT	21.4 / 880.6 50.1 / 851.9	RUN 1: 21.4 to 25.1 RUN 2: 25.1 to 30.1 RUN 3: 30.1 to 35.1 RUN 4: 35.1 to 40.1 **RUN 5**: 40.1 to 35.1 **RUN 6**: 45.1 to 50.1	84 76 84 96 68 96	95 94 98 100 94 96	**21.4'-21.9':** CALCAREOUS SHALE, gray, bedded, continuous, good quality, 75° to 80° bedding angle, slightly weathered to fresh, medium **21.9'-22.1':** SOIL SEAM **22.10'-26.1':** CALCAREOUS SHALE, gray, bedded, continuous, good quality, 75° to 80° bedding angle, slightly weathered to fresh, medium **26.1'-26.2':** SOIL SEAM **26.2'-27.2':** CALCAREOUS SHALE, gray, bedded, continuous, good quality, 75° to 80° bedding angle, slightly weathered to fresh, medium **27.2'-27.4':** SOIL SEAM **27.4'-30.7':** CALCAREOUS SHALE, gray, bedded, continuous, good quality, 75° to 80° bedding angle, slightly weathered to fresh, medium **30.7'-30.8':** SOIL SEAM **30.8'-50.1':** CALCAREOUS SHALE, gray, bedded, continuous, fair quality to excellent quality, 80° to 85° bedding angle, moderately weathered to fresh, medium
I-275 B-02 Sta. 55+04 75 RT	7.6 / 894.4 37.8 / 864.2	RUN 1: 7.6 to 9.8 RUN 2: 9.8 to 14.8 RUN 3: 14.8 to 19.8 RUN 4: 19.8 to 24.8 RUN 5: 24.8 to 29.8 RUN 6: 29.8 to 34.8 RUN 7 34.8 to 37.8	95 82 40 40 84 90 67	95 92 98 100 98 94 100	**7.6'-12.5':**CALCAREOUS SHALE, gray with tan, bedded, continuous, excellent quality to good quality 80° to 85° bedding angle, slightly weathered to fresh, medium **12.5'-12.9':** SOIL SEAM **12.9'-14.8':** CALCAREOUS SHALE, gray with tan, bedded, continuous, good quality, 80° to 85° bedding angle, slightly weathered to fresh, medium **14.8'-14.9':** SOIL SEAM **14.9'-29.8':** CALCAREOUS SHALE, gray with tan, bedded, continuous, poor quality to good quality, 80° to 85° bedding, slightly weathered to fresh, medium **29.8'-37.8':** CALCAREOUS SHALE, gray with tan, bedded, continuous, excellent quality to fair 70° to 85° bedding, slightly weathered to fresh, medium
I-275 B-03 Sta. 55+41 20 LT	13.7 / 888.3 32.8 / 869.2	RUN 1: 13.7 to 14.8 RUN 2: 14.8 to 19.8 RUN 3: 19.8 to 24.8 RUN 4: 24.8 to 29.8 RUN 5: 29.8 to 32.8	64 72 96 92 100	82 100 100 100 100	**13.7'-16.2':** CALCAREOUS SHALE, gray with tan, bedded, fairly continuous to continuous, fair quality to excellent quality, 75° to 80° bedding angle, moderately weathered to fresh, medium **16.2'-28.8':** CALCAREOUS SHALE, gray, bedded, continuous, excellent quality,

Boring No. Station No. Offset	Depth / Elev.(ft) Top of Rock Core Termination	Core Run Intervals (feet)	RQD (%)	REC. (%)	Rock Description
					75° to 80° bedding angle, slightly weathered to fresh, medium **28.8'-29.8':** CALCAREOUS SHALE, gray with tan, bedded, continuous, fair quality, 75° to 80° bedding angle, slightly weathered to fresh, medium **29.8'-32.8':** CALCAREOUS SHALE, gray, bedded, continuous, excellent quality, 75° to 80° bedding angle, slightly weathered to fresh, medium
I-275 B-04 Sta. 55+05 12 RT	15.4 / 886.6 33.3 / 868.7	RUN 1: 15.4 to 20 RUN 2: 20 to 25 RUN 3: 25 to 30 RUN 4: 30 to 33.3	70 98 100 100	100 100 100 100	**15.4'-17':** CALCAREOUS SHALE, gray with tan, bedded, incompetent, poor quality, 70° to 80° bedding angle, moderately weathered to fresh, medium**17-33.3':** CALCAREOUS SHALE, gray with tan, bedded, continuous, excellent quality, 75° to 80° bedding angle, slightly weathered to fresh, medium
I-275 B-05 Sta. 55+40 22 LT	14.4 / 888.6 39.8 / 863.2	RUN 1: 14.4 to 14.8 RUN 2: 14.8 to 19.8 RUN 3: 19.8 to 24.8 RUN 4: 24.8 to 29.8 RUN 5: 29.8 to 34.8 RUN 6: 34.8 to 39.8	0 70 56 90 84 96	75 96 90 100 100 100	**14.4'-16.3':** CALCAREOUS SHALE, gray with tan, bedded, incompetent to continuous, very poor quality to fair quality, 75° to 80° bedding angle, moderately weathered to fresh, medium **16.3'-16.9':** SOIL SEAM **16.9'-17.7':** CALCAREOUS SHALE, gray with tan, bedded, continuous, fair quality, 75° to 80° bedding angle, slightly weathered to fresh, medium **17.7'-18.1':** SOIL SEAM **18.1'-21.9':** CALCAREOUS SHALE, gray with tan, bedded, continuous, fair quality, 75° to 80° bedding angle, slightly weathered to fresh, medium **21.9'-22.8':** SOIL SEAM **22.8'-39.8':** CALCAREOUS SHALE, gray with tan, bedded, continuous, fair quality to excellent qulaity, 75° to 80° bedding angle, slightly weathered, medium
I-275 B-06 Sta. 55+06 22 LT	17.6 / 885.4 39.6 / 863.4	RUN 1: 17.6 to 19.6 RUN 2: 19.6 to 24.6 RUN 3: 24.6 to 29.6 RUN 4: 29.6 to 34.6 RUN 5: 34.6 to 39.6	40 100 100 100 100	90 100 100 100 100	**17.6'-23.5:** CALCAREOUS SHALE, gray, bedded, continuous, poor quality to excellent, 75° to 80° bedding angle, moderately weathered to fresh, medium **23.5'-23.6':** SOIL SEAM **23.6'-39.6:** CALCAREOUS SHALE, gray with tan, bedded, continuous, excellent quality, 75° to 80° bedding angle, fresh, medium
I-275 B-07 Sta. 55+39 75 LT	24.4 / 879.6 49.5 / 854.5	RUN 1: 24.4 to 29.5 RUN 2: 29.5 to 34.5	67 60	90 88	**24.4'-25.1':** CALCAREOUS SHALE, gray with tan, bedded, fairly continuous, fair quality, 75° to 80° bedding angle, slightly weathered to fresh, medium

Boring No. Station No. Offset	Depth / Elev.(ft) Top of Rock Core Termination	Core Run Intervals (feet)	RQD (%)	REC. (%)	Rock Description
		RUN 3: 34.5 to 39.5 RUN 4: 39.5 to 44.5 RUN 5: 44.5 to 49.5	68 96 100	96 100 100	**25.1'-25.3':** SOIL SEAM **25.3'-25.7':** CALCAREOUS SHALE, gray with tan, bedded, fairly continuous, fair quality, 75° to 80° bedding angle, slightly weathered to fresh, medium **25.7'-25.8':** SOIL SEAM **25.8'-26.6':** CALCAREOUS SHALE, gray with tan, bedded, fairly continuous, fair quality, 75° to 80° bedding angle, slightly weathered to fresh, medium **26.6'-26.7':** Soil Seam **26.7'-27':** CALCAREOUS SHALE, gray with tan, bedded, fairly continuous, fair quality, 75° to 80° bedding angle, slightly weathered to fresh, medium **27'-27.1':** SOIL SEAM **27.1'-32.1:** CALCAREOUS SHALE, gray with tan, bedded, fairly continuous, fair quality, 75° to 80° bedding angle, slightly weathered to fresh, medium **32.1'-32.4':** SOIL SEAM **32.4'-33.2':** CALCAREOUS SHALE, gray with tan, bedded, fairly continuous, fair quality, 75° to 80° bedding angle, slightly weathered to fresh, medium **33.2'-33.5':** SOIL SEAM **33.5'-35.5':** CALCAREOUS SHALE, gray with tan, bedded, fairly continuous, fair quality, 75° to 80° bedding angle, slightly weathered to fresh, medium **35.5'-35.7':** SOIL SEAM **35.7'-49.5':** CALCAREOUS SHALE, gray with tan, bedded, continuous, fair quality to excellent quality, 80° to 85° bedding angle, slightly weathered to fresh, medium
I-275 B-08 Sta. 55+04 76 LT	12.4 / 891.7 39.7 / 864.3	RUN 1: 12.3 to 14.7 RUN 2: 14.7 to 19.7 RUN 3: 19.7 to 24.7 RUN 4: 24.7 to 29.7 RUN 5: 29.7 to 34.7 RUN 6: 34.7 to 39.7	63 62 76 84 88 90	100 98 92 98 100 90	**12.3'-34.7':** CALCAREOUS SHALE, gray with tan, bedded, fairly continuous to continuous, fair quality to good quality, 75° to 85° bedding angle, slightly weathered to fresh, medium **34.7'-39.7':** CALCAREOUS SHALE, gray with tan, bedded, continuous, excellent quality, 75° to 80° bedding angle, slightly weathered to fresh, medium (could not retrieve last 0.5 feet of run)

5.2 Groundwater

Groundwater was not encountered in the test borings at the time of prior to coring. 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. The laboratory test results, and a brief description of the laboratory test procedures are presented in Appendix III.

7.0 Bridge Foundation Recommendations and Considerations

7.1 Foundations

The existing foundations for Bents 1, 2 and 3 are planned to be used to support the new bridge superstructure dead, live, and wind loads with the longitudinal loads (braking and temperature) assumed to be resisted by the retaining walls through the integral end bents. The existing foundations are a combination of shallow footings bearing on bedrock and driven 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 foundations loads are essentially the same or less, we believe reuse of the existing bridge foundations is appropriate assuming the existing foundations are assessed as structurally sound and meet current TDOT standard design criteria.

New foundations for the project will be constructed adjacent to the existing foundations and are assumed to only carry the precast cap and retaining wall or pier wall loads for the new bridge. As stated above, longitudinal loads (braking and temperature) are assumed to be resisted by the retaining walls through the integral end bents. 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.

Shallow foundations bearing on residual soils and weathered rock with SPT N-values of 30 bpf and greater may be designed using a nominal (ultimate) bearing resistance of 11.5 kips per square foot (ksf). Using the geotechnical strength bearing resistance factor of 0.45 (AASHTO LRFD Bridge Design Specifications, 9th Ed., 2020 (AASHTO LRFD 2020)), gives a factored geotechnical strength bearing resistance of 5 ksf. To resist lateral forces, we recommend a nominal (ultimate) friction coefficient between the hard clays, silts and weathered rock bearing surface and foundation concrete of 0.50. We recommend using a sliding resistance factor for the geotechnical strength limit state of 0.85 (similar to the factor used for cast-in-place concrete on clay). 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

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 site conditions encountered. Exposure to weather often reduces foundation support capabilities, thus necessitating remedial measures (undercutting and replacement of softened subgrades) prior to concrete placement. A thin (e.g. 2- to 3-inch thick) mud-mat of lean concrete may be used to protect the exposed foundation subgrades if the opened excavations cannot be backfilled with concrete the same day they are opened. The foundation excavation depth should account for the added mud mat thickness. Foundation bearing areas should be level or suitably benched, and free of loose soil, water, and debris.

7.2 Seismic Considerations

Based on the drilling data, we recommend Seismic Site Class C for the proposed bridge (reference Table 3.10.3.1-1 – Site Class Definitions, AASHTO 2020). From Article 3.10 AASHTO 2020 and the USGS website we obtained the following peak ground acceleration (PGA), short- and long-period spectral accelerations (S_S and S_1, respectively) and five-percent-damped-design response spectrum accelerations (A_S, S_{DS}, and S_{D1}, respectively) for the site:

- PGA = 0.157 g
- S_s = 0.281 g
- S_1 = 0.07 g
- A_S = 0.188 g
- S_{DS} = 0.338 g
- S_{D1} = 0.118 g

With an SD1 value of 0.118, the bridge is assigned to Seismic Zone 1 (AASHTO 2020, Article 3.10.6). Given the bridge is assigned to Seismic Zone 1, a liquefaction assessment is typically not required because the sustained ground acceleration is usually not large enough or does not act over a long enough period of time for liquefaction

to occur (AASHTO 2020, Article C10.5.4.2). Further, the overburden consists of clay soils and weathered rock which are considered not susceptible to liquefaction.

7.3 Excavation

The borings refused at depths ranging from approximately 8 to 24 feet below the existing ground surface. However, hard residual soils and very dense weathered rock with SPT N-values of greater than 50 bpf were encountered within depths of 3 to 8 feet. These hard soils and very dense weathered rock will be more difficult to excavate and may require ripping with a large trackhoe or the use of pneumatic and/or hydraulic hammers to facilitate excavation.

7.4 Ground Water Considerations

We expect groundwater levels will be within the bedrock mass. However, water/groundwater conditions can vary seasonally and be affected by recent rainfall conditions, construction activity and/or other site-specific factors such as water levels adjacent creeks and ponds. During periods of heavy rain, perched groundwater conditions may occur at this site. If perched groundwater is encountered, the contractor should provide adequate dewatering to maintain the groundwater level below the bottom of excavations. Water seeping into shallow excavations can typically be controlled by pumping from sumps. Water from the pumps should be discharged beyond the construction boundaries to limit its effect on construction activities.

8.0 Limitations of Report

This report has been prepared in accordance with generally accepted geotechnical engineering practice for specific application to this project. The conclusions and recommendations contained in this report are based on applicable standards of our practice in this geographic area at the time this report was prepared. No other warranty, expressed or implied, is made. S&ME is not responsible for the conclusions, opinions, or recommendations of others based on this data.

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 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 of the planned bridge or elevations of the tops of the planned foundations, 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 retain us and give us the opportunity to review the final 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

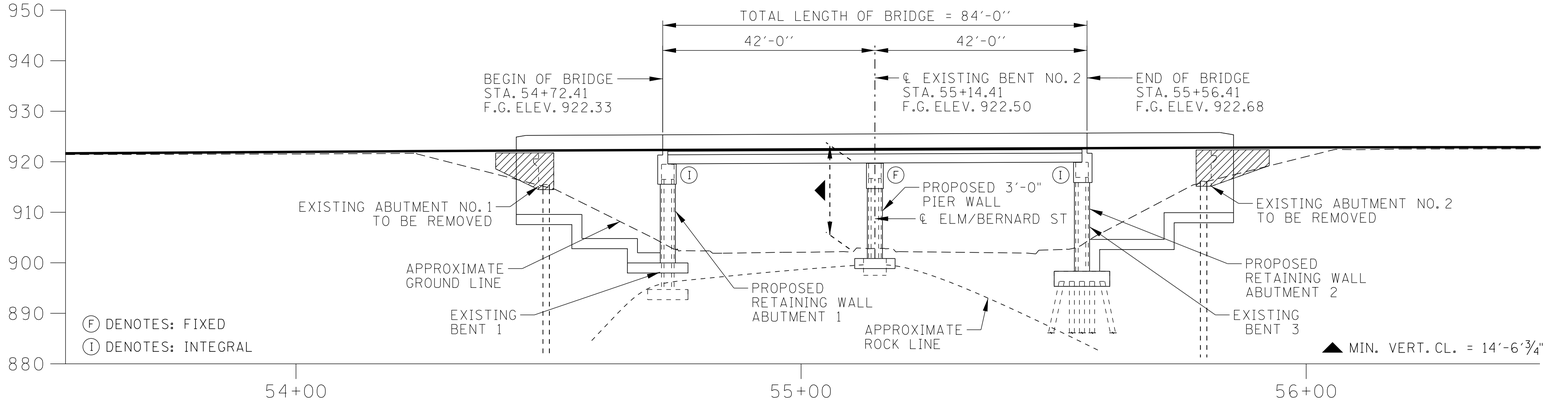
Foundation Data Sheets

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

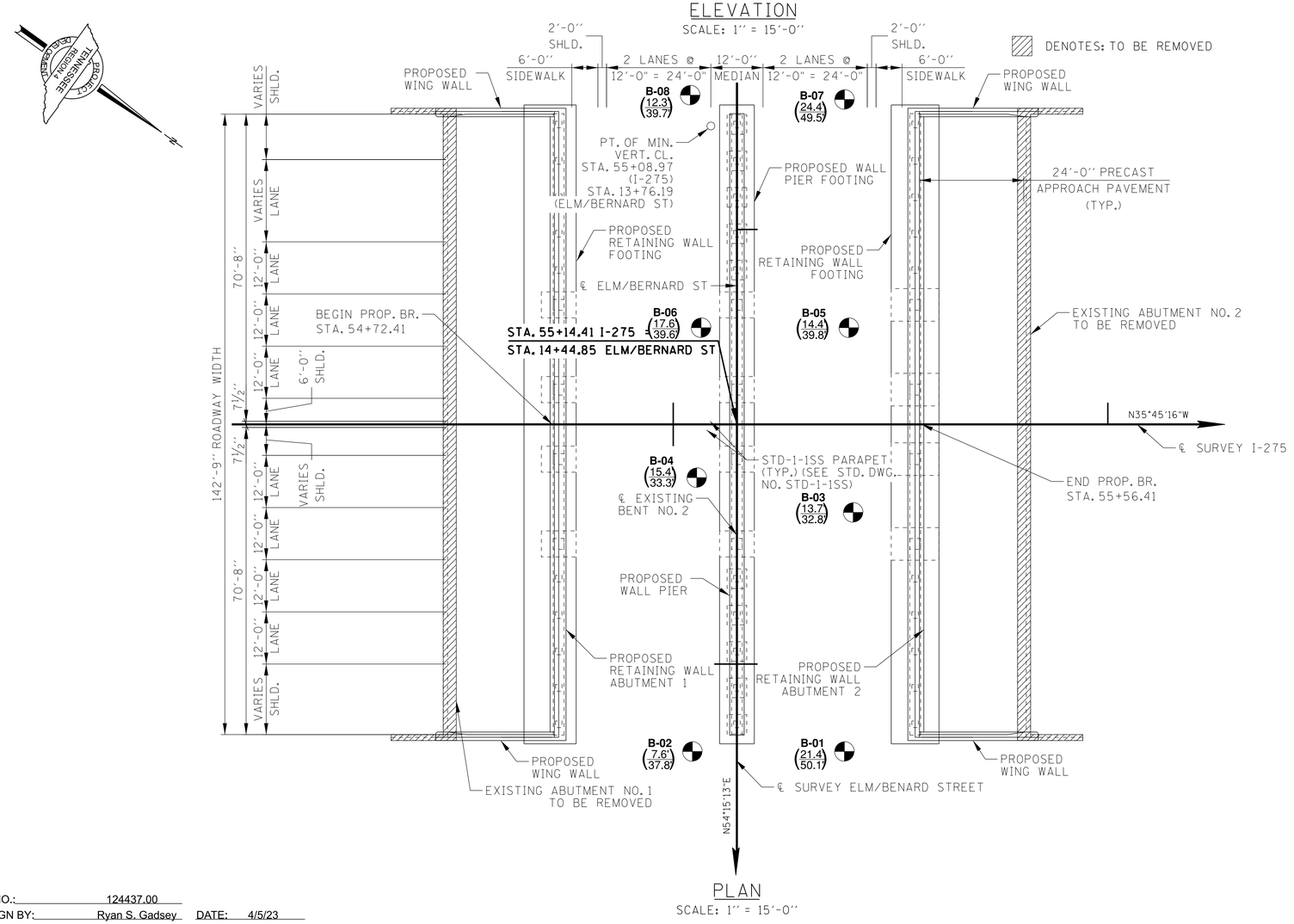
PROJECT NO.	YEAR	SHEET NO.
BR-I-275-3(136)	2023	1 OF 3

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

NOTES:
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.

LEGEND: BORING LOCATIONS

- B-152 (24.5) (70.3) - BORING I.D. - DEPTH TO REFUSAL (ABOVE LINE) - 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
BRIDGE
I-275 OVER ELM/BERNARD STREET
STA. 55+14.41
BRIDGE ID. NO. 47I02750003
KNOX COUNTY
2023

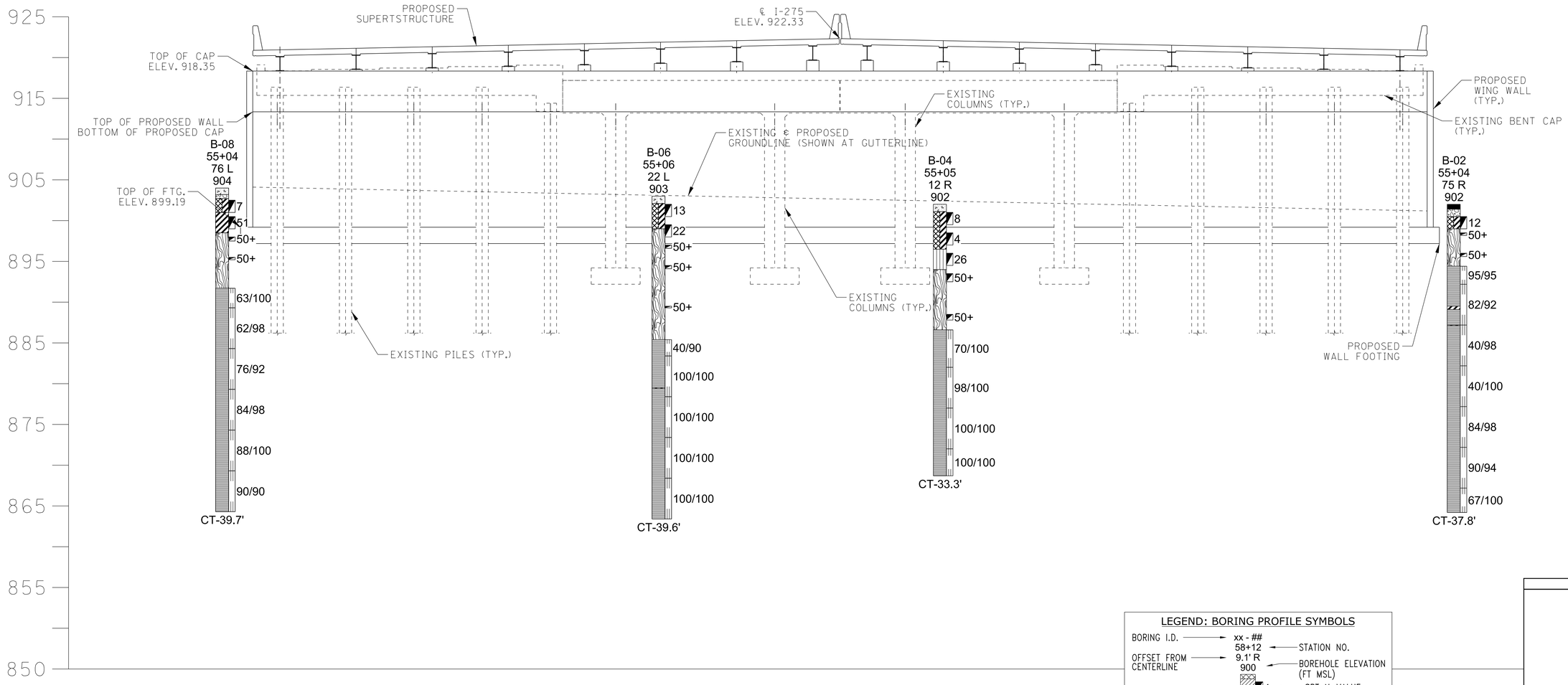
PIN NO.: 124437.00
DESIGN BY: Ryan S. Gadsey DATE: 4/5/23
DRAWN BY: Ryan S. Gadsey DATE: 4/5/23
SUPERVISED BY: B. Evan Graves DATE: 4/5/23
CHECKED BY: Carter D. Bearden DATE: 4/5/23

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

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

REVISIONS

NO.	DATE	BY	BRIEF DESCRIPTION



BENT 1/ABUTMENT 1 TYPICAL SECTION

(LOOKING FORWARD ON SURVEY)

NOTE: ALL ELEVATIONS PROVIDED ARE APPROXIMATE.

LEGEND: BORING PROFILE SYMBOLS

SEALED BY

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

STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

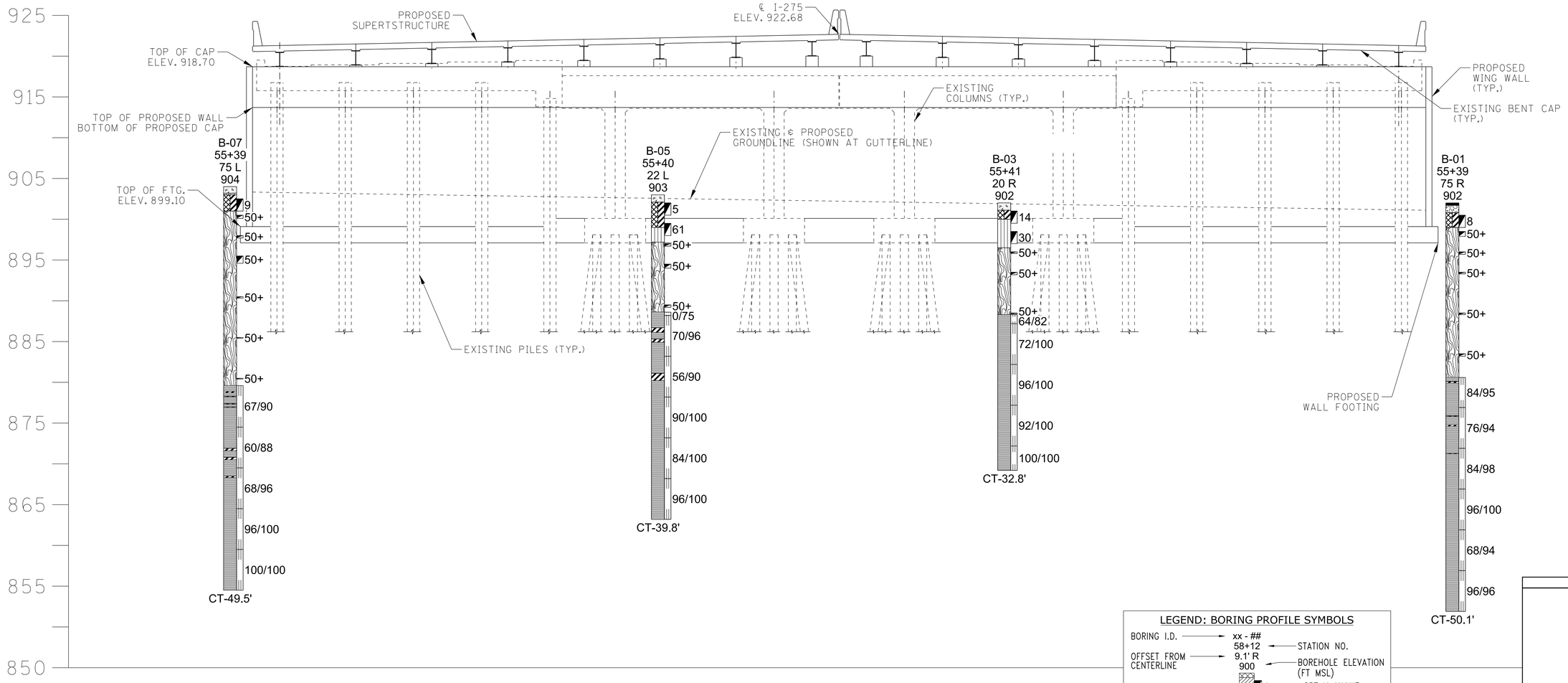
GEOTECHNICAL ABUTMENT PROFILE
BRIDGE - ABUTMENT 1
I-275 OVER ELM/BERNARD STREET
STA. 55+14.41
BRIDGE ID. NO. 47I02750003
KNOX COUNTY
2023

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

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

REVISIONS

NO.	DATE	BY	BRIEF DESCRIPTION

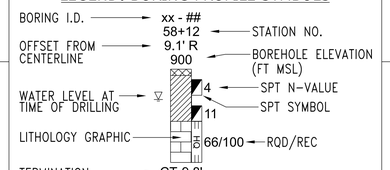


BENT 3/ABUTMENT 2 TYPICAL SECTION

(LOOKING FORWARD ON SURVEY)

NOTE: ALL ELEVATIONS PROVIDED ARE APPROXIMATE.

LEGEND: BORING PROFILE SYMBOLS



- 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
BRIDGE - 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.

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.
Medium 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.

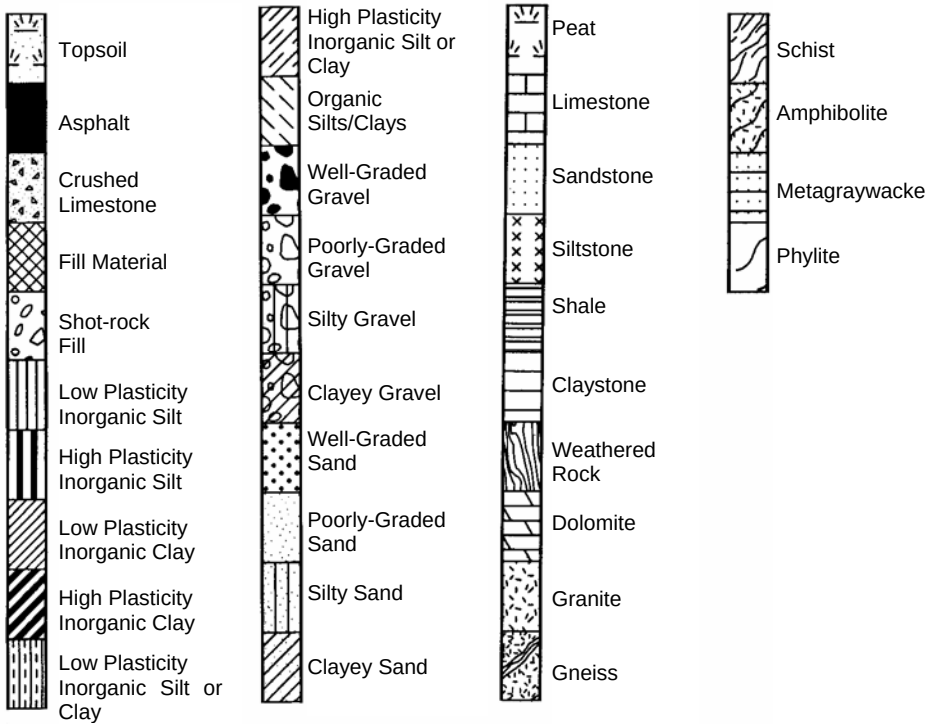
$$\text{RQD} = \frac{\text{Sum of 4 in. and longer Rock Pieces Recovered}}{\text{Length of Core Run}} \times 100 = \frac{43\ \text{RQD}}{\text{NQ}}$$

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

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

SYMBOLS

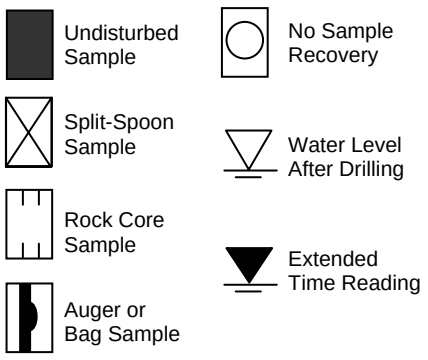
KEY TO MATERIAL TYPES



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						8	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'								(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+)**
										(REC:0.2)
	890.0	12'								
			WEATHERED ROCK, sampled as shale fragments, few silt, very dense, gray with tan brown, dry						>>	50/2" **(50+)**
										(REC:0.2)
	885.0	17'								
			WEATHERED ROCK, sampled as shale fragments, few clayey silt, very dense, tan brown, dry						>>	50/4" **(50+)**
										(REC:0.3)
			Auger refusal at 21.4 feet, began NQ coring							
	880.6	21.4'								
	880.1	21.9'	CALCAREOUS SHALE, gray, bedded, continuous, good quality, 75° to 80° bedding angle, slightly weathered to fresh, medium	Bedrock						
	879.9	22.1'								
			Soil seam							
	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							
	874.8	27.2'								
	874.6	27.4'								
			Soil seam							
	871.3	30.7'	CALCAREOUS SHALE, gray, bedded, continuous, good quality, 75° to 80°							
	871.2	30.8'								

RUN 1 (NQ)
RUN - 3.7' - Depth from 21.4' to 25.1'
RQD - 84%
REC - 95%

25.1' / 876.9' msl

RUN 2 (NQ)
RUN - 5.0' - Depth from 25.1' to 30.1'
RQD - 76%
REC - 94%

30.1' / 871.9' msl

BORING RECORD S&ME - SPLIT LITHOLOGY 22430250.GPJ 2016.GDT 4/10/23

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					
			Soil seam					
		40	CALCAREOUS SHALE, gray, bedded, continuous, fair quality to excellent quality, 80° to 85° bedding angle, moderately weathered to fresh, medium*(Continued)*					
		45						
	851.9	50	*Coring terminated at 50.1 feet*					
		55						
		60						

RUN 3 (NQ)
RUN - 5.0' - Depth from 30.1' to 35.1'
RQD - 84%
REC - 98%*(Continued)*

35.1' / 866.9' msl

RUN 4 (NQ)
RUN - 5.0' - Depth from 35.1' to 40.1'
RQD - 96%
REC - 100%

40.1' / 861.9' msl

RUN 5 (NQ)
RUN - 5.0' - Depth from 40.1' to 45.1'
RQD - 68%
REC - 94%

45.1' / 856.9' msl

RUN 6 (NQ)
RUN - 5.0' - Depth from 45.1' to 50.1'
RQD - 96%
REC - 96%

50.1' / 851.9' msl

BORING RECORD S&ME - SPLIT LITHOLOGY 22430250.GPJ 2016.GDT 4/10/23

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	Fill					
	899.0	3'	FAT CLAY, (CH), little shale fragments, stiff, purple with red brown, moist	Residuum					12 — 3 - 2 - 10 **(12)**
			WEATHERED ROCK, sampled as shale fragments, very dense, tan brown, dry						>> (REC:0.9) 50/4" **(50+)**
		5							(REC:0.2)
									>> 50/5" **(50+)**
	894.4	7.6'	*Auger refusal at 7.6 feet, began NQ coring*	Bedrock					(REC:0.3)
			CALCAREOUS SHALE, gray with tan, continuous, excellent quality to good quality, 80° to 85° bedding angle, slightly weathered to fresh, medium						**RUN 1** (NQ) RUN - 2.2' - Depth from 7.6' to 9.8' RQD - 95% REC - 95% 9.8' / 892.2' msl
		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						**RUN 2** (NQ) RUN - 5.0' - Depth from 9.8' to 14.8' RQD - 82% REC - 92% 14.8' / 887.2' msl
	887.2	14.8'							
	887.1	14.9'	Soil seam						**RUN 3** (NQ) RUN - 5.0' - Depth from 14.8' to 19.8' RQD - 40% REC - 98%
		15							
			CALCAREOUS SHALE, gray with tan, continuous, poor quality to good quality, 80° to 85° bedding angle, slightly weathered to fresh, medium						19.8' / 882.2' msl **RUN 4** (NQ) RUN - 5.0' - Depth from 19.8' to 24.8' RQD - 40% REC - 100%
		20							
									24.8' / 877.2' msl **RUN 5** (NQ) RUN - 5.0' - Depth from 24.8' to 29.8' RQD - 84% REC - 98%
		25							
	872.2	30	29.8'						29.8' / 872.2' msl

BORING RECORD S&ME - SPLIT LITHOLOGY 22430250.GPJ 2016.GDT 4/10/23

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	
		35	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		*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 4/10/23

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						
	900.0	2'	FAT CLAY, (CH), trace sand, stiff, tan brown with, slightly moist	Residuum					14 30	6 - 2 - 12 **(14)** (REC:1.3)
		5								36 - 18 - 12 **(30)** (REC:0.8)
	896.5	5.5'	GRAVELLY SILT, (ML), stiff to very stiff, tan brown, dry, Shale fragments							50/2" **(50+)** (REC:0.2)
			WEATHERED ROCK, sampled as shale fragments, very dense, tan brown, dry, Shale fragments							50/3" **(50+)** (REC:0.2)
		10								
	888.3	13.7'	*Auger refusal at 13.7 feet, began NQ coring*	Bedrock						50/1" **(50+)** (REC:0.1)
		15	CALCAREOUS SHALE, gray with tan, bedded, fairly continuous to continuous, fair quality to excellent, 75° to 80° bedding angle, moderately 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
	885.8	16.2'	CALCAREOUS SHALE, gray, bedded, continuous, excellent 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 - 72% REC - 100% — 19.8' / 882.2' msl
		20								**RUN 3** (NQ) RUN - 5.0' - Depth from 19.8' to 24.8' RQD - 96% REC - 100% — 24.8' / 877.2' msl
		25								**RUN 4** (NQ) RUN - 5.0' - Depth from 24.8' to 29.8' RQD - 92% REC - 100%
	873.2	28.8'								
	872.2	30	CALCAREOUS SHALE, gray with tan, bedded, continuous, fair quality, 75° to 80° bedding angle, slightly weathered to fresh, medium							29.8' / 872.2' msl

BORING RECORD S&ME - SPLIT LITHOLOGY 22430250.GPJ 2016.GDT 4/10/23

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 4/10/23

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					7 - 4 - 4 **(8)** (REC:0.5)
	899.0	3'	FAT CLAY, (CH), trace sand, soft, brown with red brown, slightly moist						2 - 2 - 2 **(4)** (REC:0.8)
	896.5	5.5'	GRAVELLY SILT, (ML), very stiff, tan brown, dry, Shale fragments	Residuum					29 - 12 - 14 **(26)** (REC:0.6)
	894.0	8'	WEATHERED ROCK, sampled as shale fragments, very dense, tan brown, dry, Shale fragments						28 - 50 **(50+)** (REC:0.8)
	886.6	15.4'	*Auger refusal at 15.4 feet, began NQ coring*	Bedrock					>> 36 - 50/2" **(50+)** (REC:0.6)
	885.0	17'	CALCAREOUS SHALE, gray with tan, bedded, continuous, 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						

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 4/10/23

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*		
			RUN 4 (NQ) RUN - 3.3' - Depth from 30' to 33.3' RQD - 100% REC - 100%*(Continued)*		
			33.3' / 868.7' msl		

35
40
45
50
55
60

BORING RECORD S&ME - SPLIT LITHOLOGY 22430250.GPJ 2016.GDT 4/10/23

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					6 — 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)
									>> 50/5" **(50+)** (REC:0.4)
									>> 50/4" **(50+)** (REC:0.3)
	888.6	14.4'	*Auger refusal at 14.4 feet, began NQ coring*	Bedrock					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'	Soil seam						
	885.3	17.7'	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%
	884.9	18.1'	Soil seam						19.8' / 883.2' msl
	881.1	21.9'	CALCAREOUS SHALE, gray with tan, bedded, continuous, fair quality, 75° to 80° bedding angle, slightly weathered to fresh, medium						**RUN 3** (NQ) RUN - 5.0' - Depth from 19.8' to 24.8' RQD - 56% REC - 90%
	880.2	22.8'	Soil seam						24.8' / 878.2' msl
			CALCAREOUS SHALE, gray with tan, bedded, continuous, fair quality, 75° to 80° bedding angle, slightly weathered to fresh, medium						**RUN 4** (NQ) RUN - 5.0' - Depth from 24.8' to 29.8' RQD - 90% REC - 100%
			Soil seam						29.8' / 873.2' msl
			CALCAREOUS SHALE, gray with tan, bedded, continuous, fair quality to excellent quality, 75° to 80° bedding angle, slightly weathered to fresh, medium						

BORING RECORD S&ME - SPLIT LITHOLOGY 22430250.GPJ 2016.GDT 4/10/23

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 4/10/23

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								
	902.1	0.9'	Concrete, 11 inches 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'	Soil seam							
	879.4	23.6'								
		25	CALCAREOUS SHALE, gray, bedded, continuous, excellent quality, 75° to 80° bedding angle, fresh, medium							
		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 4/10/23

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	
			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

BORING RECORD S&ME - SPLIT LITHOLOGY 22430250.GPJ 2016.GDT 4/10/23

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) 0 10 20 30 40 50 60 70 80 90 100	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					9	2 - 3 - 6 **(9)**
		5	WEATHERED ROCK, sampled as shale fragments, very dense, tan brown, dry							*(REC:0.8)*
										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+)**
		15								*(REC:0.2)*
	887.0	17'	WEATHERED ROCK, sampled as shale fragments, few silt, very dense, gray with tan brown, dry							50/1" **(50+)**
		20								*(REC:0.1)*
	882.0	22'	WEATHERED ROCK, sampled as shale fragments, few silt, very dense, gray brown, dry							
	879.6	24.4'	*Auger refusal at 24.4 feet, began NQ coring*	Bedrock						50/1" **(50+)**
	878.9	25.1'								*(REC:0.1)*
	878.7	25.3'								
	878.3	25.7'	CALCAREOUS SHALE, gray, bedded, fairly continuous, fair quality, 75° to 80° bedding angle, slightly weathered to fresh, medium							
	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 4/10/23

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 4/10/23

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					3 - 4 - 3 **(7)**
									(REC:0.8)
		5	FAT CLAY, (CH), little shale fragments, hard, purple with red brown, moist						2 - 9 - 42 **(51)**
	898.5	5.5'	WEATHERED ROCK, sampled as shale fragments, very dense, tan brown, dry						*(REC:1.1)*
									>> 50/4" **(50+)**
									(REC:0.3)
		10							>> 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						
		15							
		20							
		25							
		30							

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 4/10/23

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

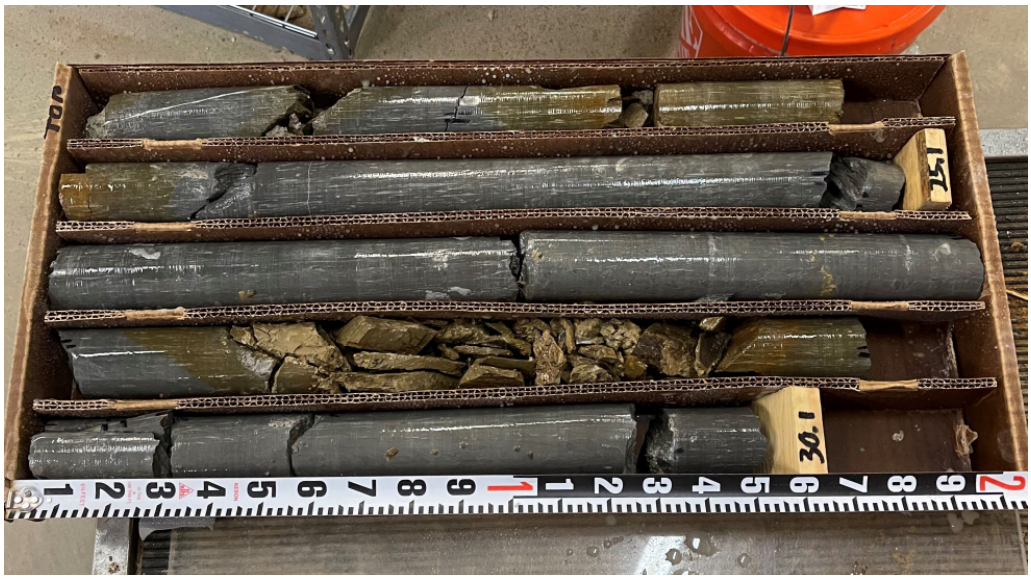
Remarks:

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 4/10/23

Borehole ID: B-08

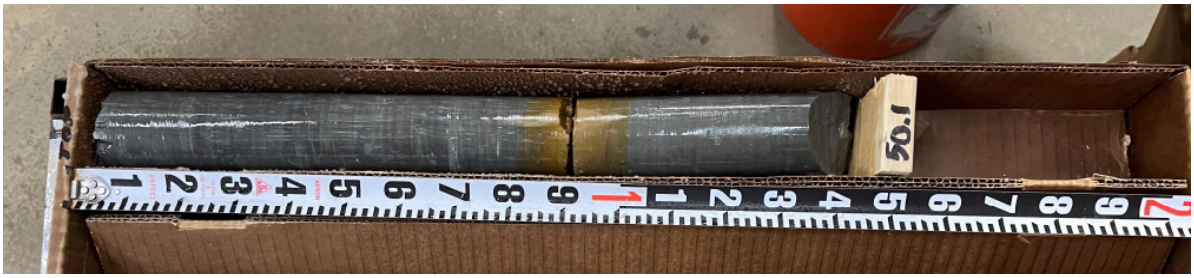
Logged by: Joshua Baines



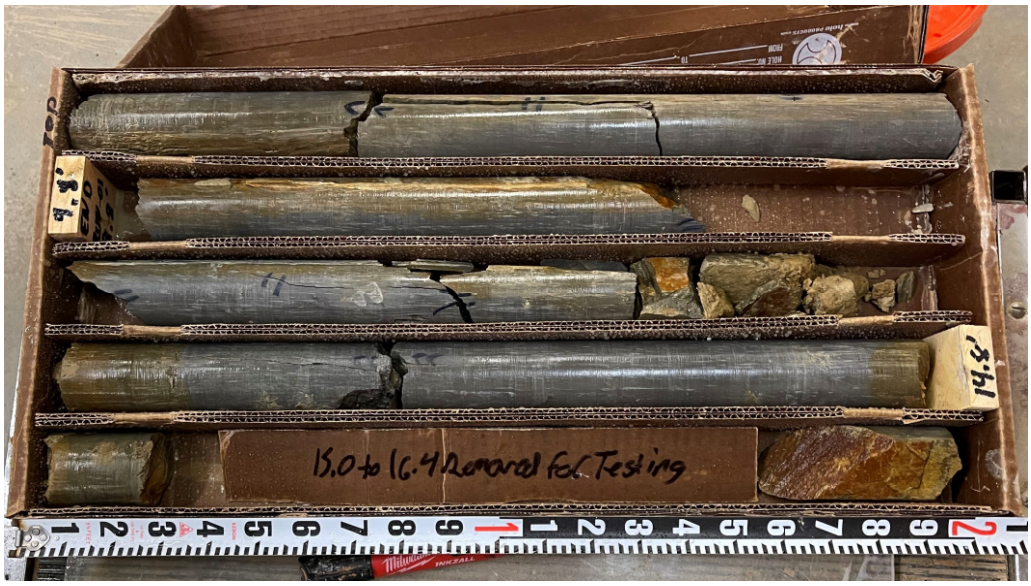
BORING B-01, I-275, STATION 55+39, 75 FEET RIGHT: BOX 1 OF 4				
RUN	**DEPTH (FT)**	**RQD (%)**	**RECOVERY (%)**	**ROCK DESCRIPTION**
1	21.4-25.1	84	95	CALCAREOUS SHALE, gray, continuous, good quality, 75 to 80 degree bedding, slight weathering to fresh, medium hard
2	25.1-30.1	76	94	

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	

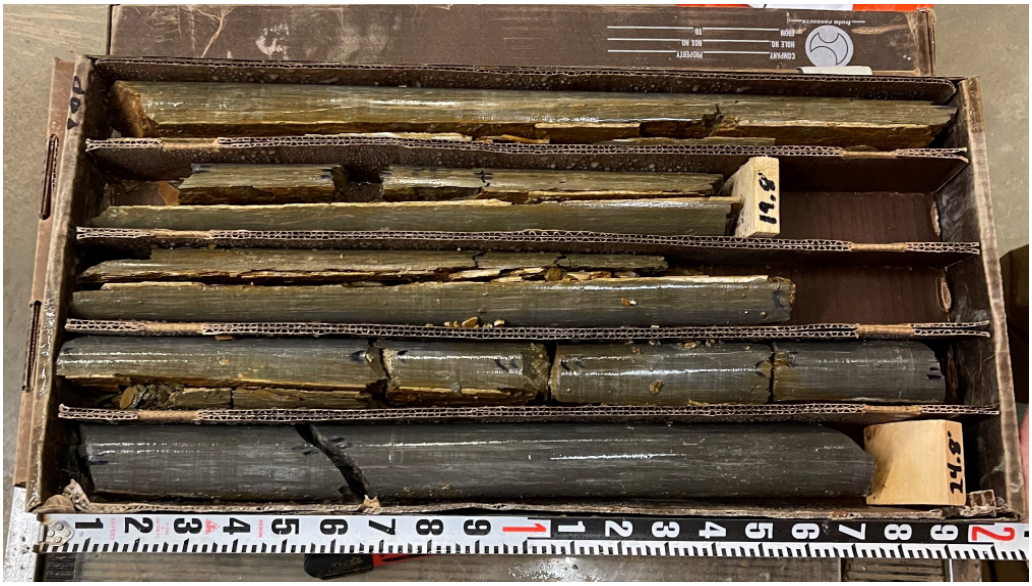
BORING B-01, I-275, STATION 55+39, 75 FEET RIGHT: BOX 3 OF 4				
RUN	**DEPTH (FT)**	**RQD (%)**	**RECOVERY (%)**	**ROCK DESCRIPTION**
4 (cont'd)	35.1-40.1	96	100	CALCAREOUS SHALE, gray, continuous, fair to excellent quality, 80 to 85 degree bedding, slight weathering to fresh, medium hard
5	40.1-45.1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

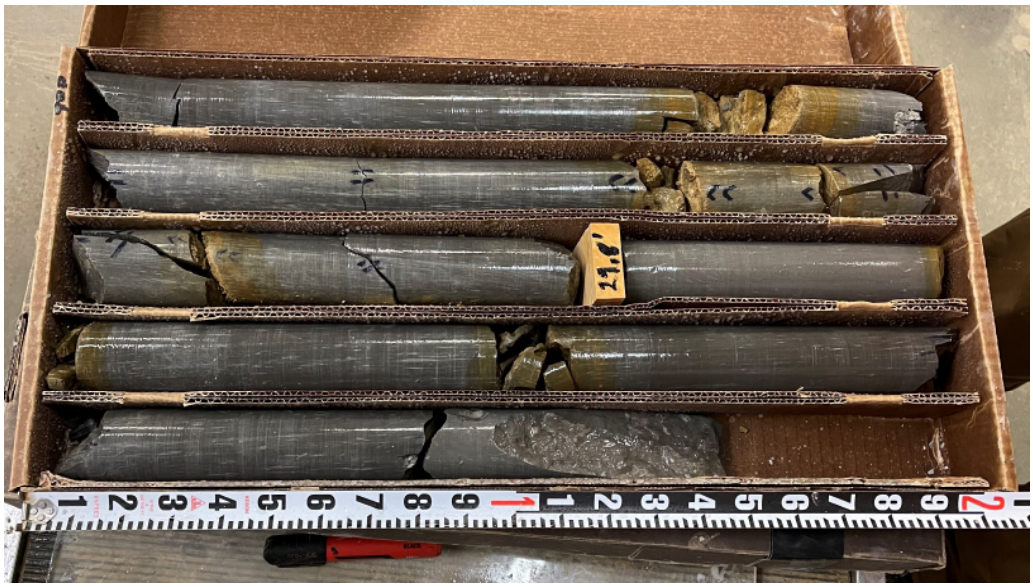


BORING B-02, I-275, STATION 55+04, 75 FEET RIGHT: BOX 1 OF 4				
RUN	**DEPTH (FT)**	**RQD (%)**	**RECOVERY (%)**	**ROCK DESCRIPTION**
1	7.6-9.8	95	95	CALCAREOUS SHALE, gray with tan, continuous, excellent to good quality, 80 to 85 degree bedding, slight weathering to fresh, medium hard
2	9.8-14.8	82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

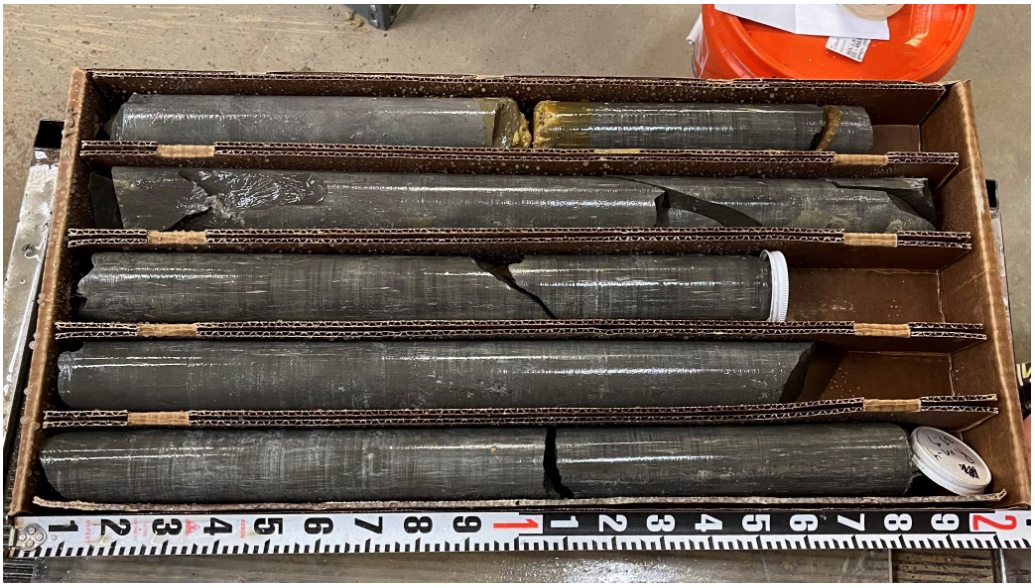
SEE TEST BORING RECORDS FOR FULL DESCRIPTION OF ROCK CORE

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

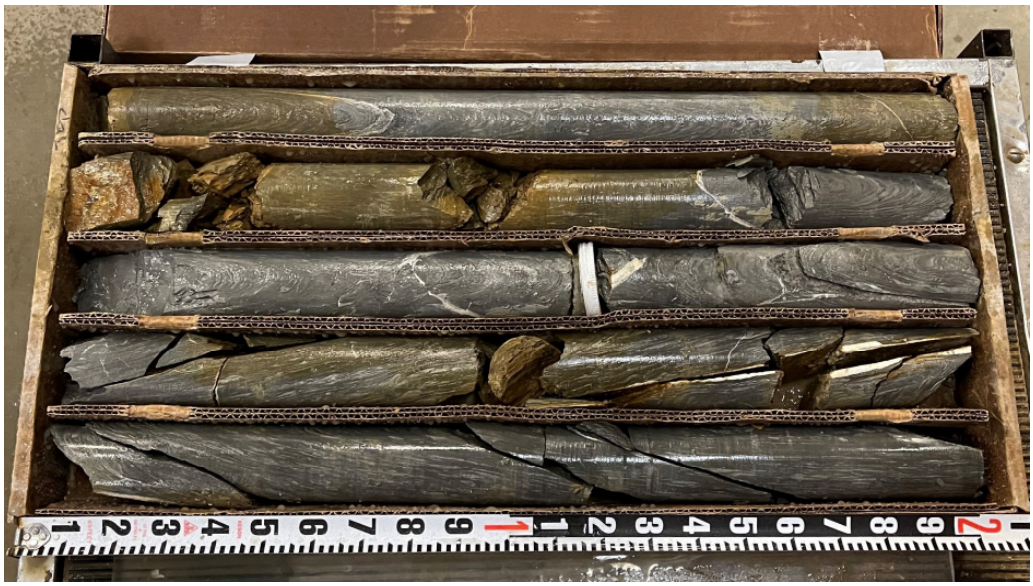
BORING B-03, I-275, STATION 55+41, 20 FEET RIGHT: BOX 2 OF 2				
RUN	**DEPTH (FT)**	**RQD (%)**	**RECOVERY (%)**	**ROCK DESCRIPTION**
3 (cont'd)	19.8-24.8	96	100	CALCAREOUS SHALE, gray with tan, continuous, fair to excellent quality, 75 to 80 degree bedding, slight weathering to fresh, medium hard
4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

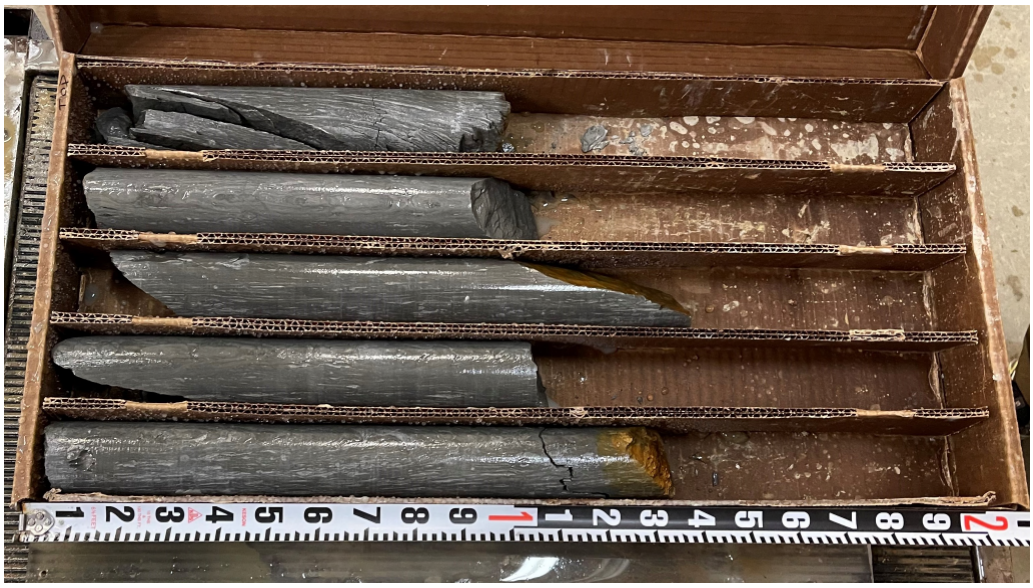


BORING B-04, I-275, STATION 55+05, 12 FEET RIGHT: BOX 2 OF 2				
RUN	**DEPTH (FT)**	**RQD (%)**	**RECOVERY (%)**	**ROCK DESCRIPTION**
3	25-30	100	100	CALCAREOUS SHALE, gray, continuous, excellent quality, 75 to 80 degree bedding, slight weathering to fresh, medium hard
4	30-33.3	100	100	

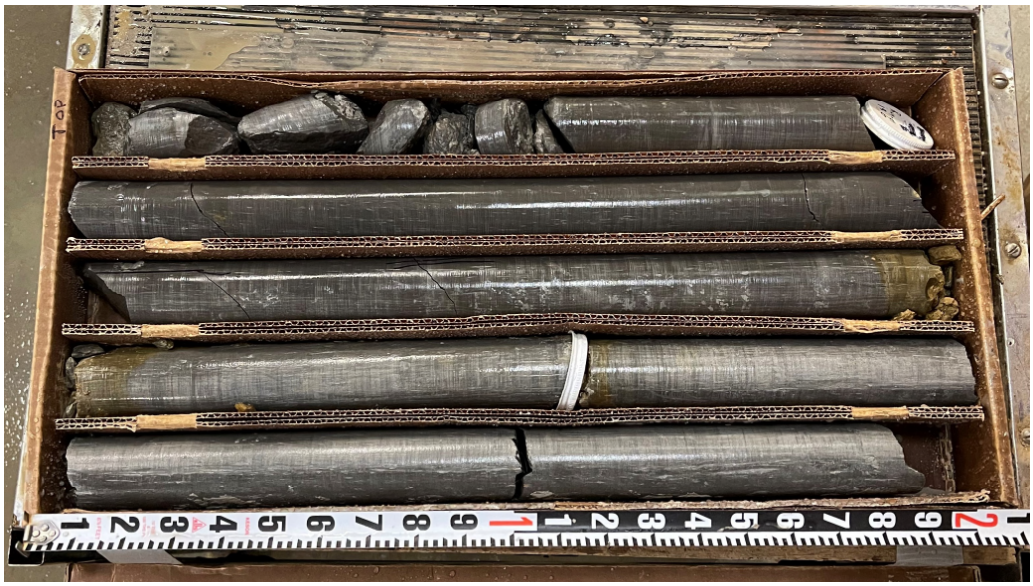
BORING B-05, I-275, STATION 55+40, 22 FEET LEFT: BOX 1 OF 3				
RUN	**DEPTH (FT)**	**RQD (%)**	**RECOVERY (%)**	**ROCK DESCRIPTION**
1	14.4-14.8	0	75	CALCAREOUS SHALE, gray with tan, incompetent to continuous, very poor to fair quality, 75 to 80 degree bedding, moderate weathering to fresh, medium hard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



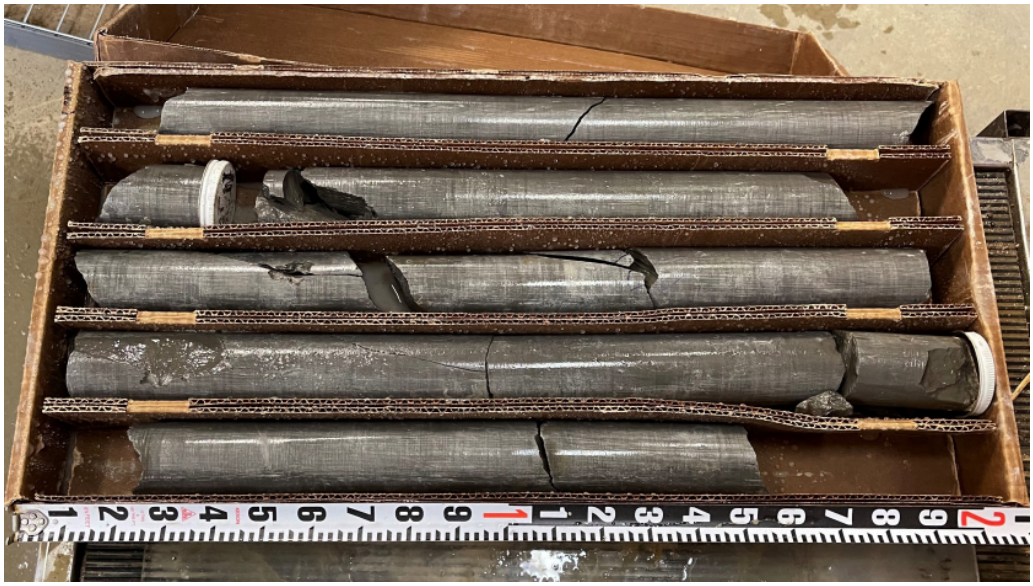
BORING B-05, I-275, STATION 55+40, 22 FEET LEFT: BOX 2 OF 3				
RUN	**DEPTH (FT)**	**RQD (%)**	**RECOVERY (%)**	**ROCK DESCRIPTION**
4	24.8-29.8	90	100	CALCAREOUS SHALE, gray with tan, continuous, poor quality, 80 to 85 degree bedding, slight weathering to fresh, medium hard
5	29.8-34.8	84	100	



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	



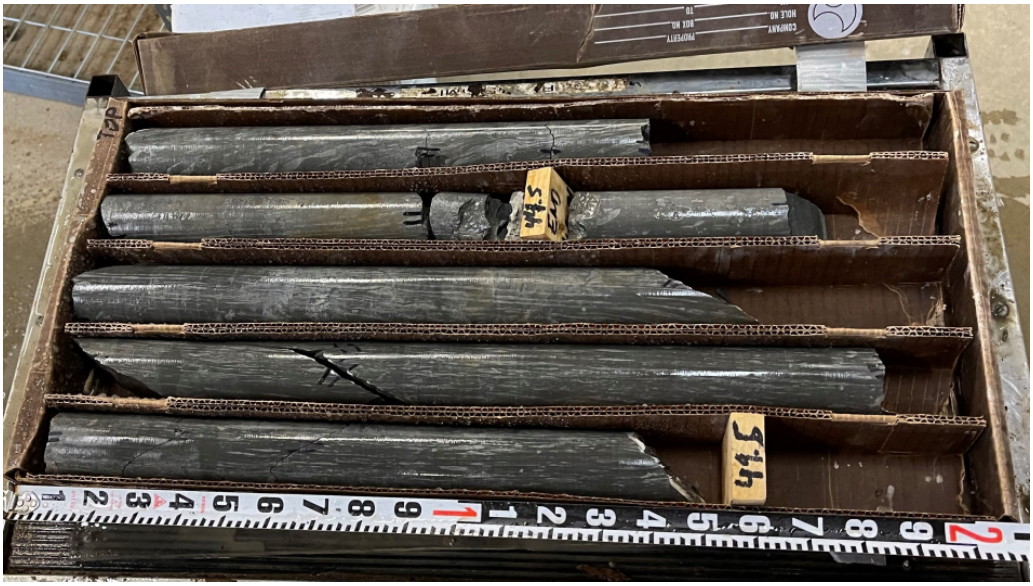
BORING B-06, I-275, STATION 55+06, 22 FEET LEFT: BOX 2 OF 3				
RUN	**DEPTH (FT)**	**RQD (%)**	**RECOVERY (%)**	**ROCK DESCRIPTION**
3 (cont'd)	24.6-29.6	100	100	CALCAREOUS SHALE, gray, continuous, excellent quality, 75 to 80 degree bedding, fresh, medium hard
4	29.6-34.6	100	100	
5	34.6-39.6	100	100	

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

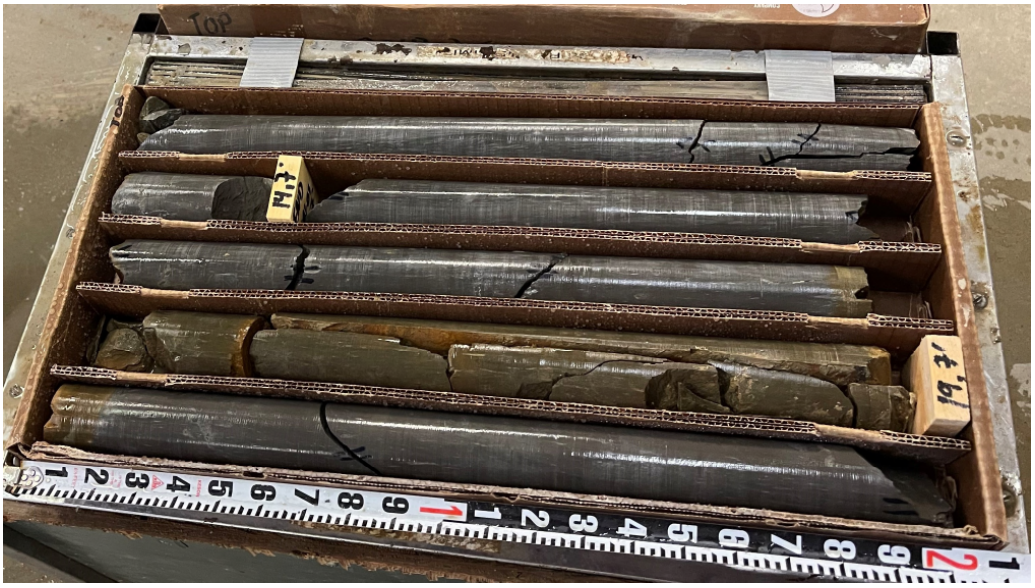
BORING B-07, I-275, STATION 55+39, 75 FEET LEFT: BOX 1 OF 3				
RUN	**DEPTH (FT)**	**RQD (%)**	**RECOVERY (%)**	**ROCK DESCRIPTION**
1	24.4-29.5	67	90	CALCAREOUS SHALE, gray, continuous to fairly continuous, fair quality, 75 to 80 degree bedding, slightly weathering to fresh, medium hard
2	29.5-34.5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

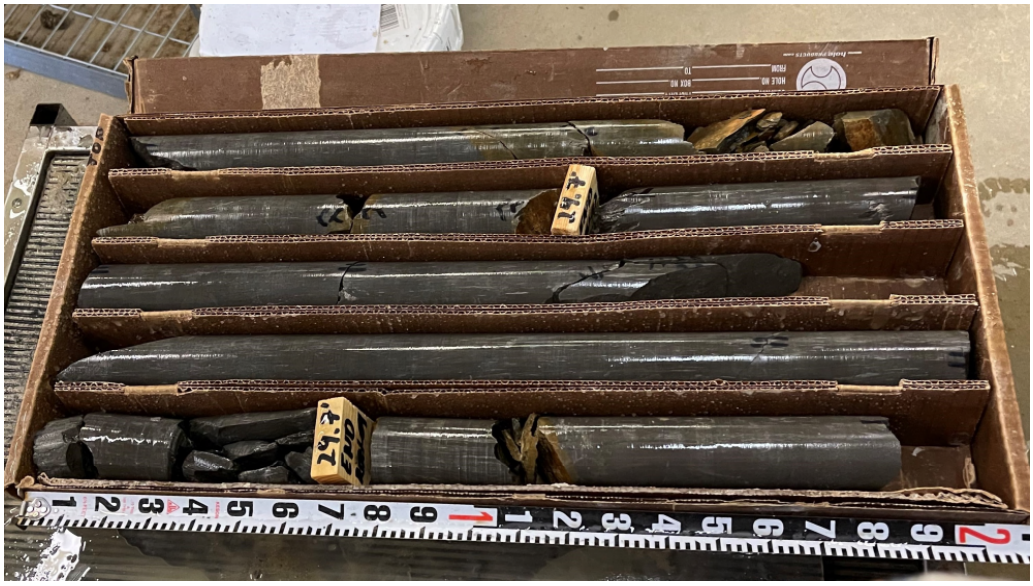
SEE TEST BORING RECORDS FOR FULL DESCRIPTION OF ROCK CORE



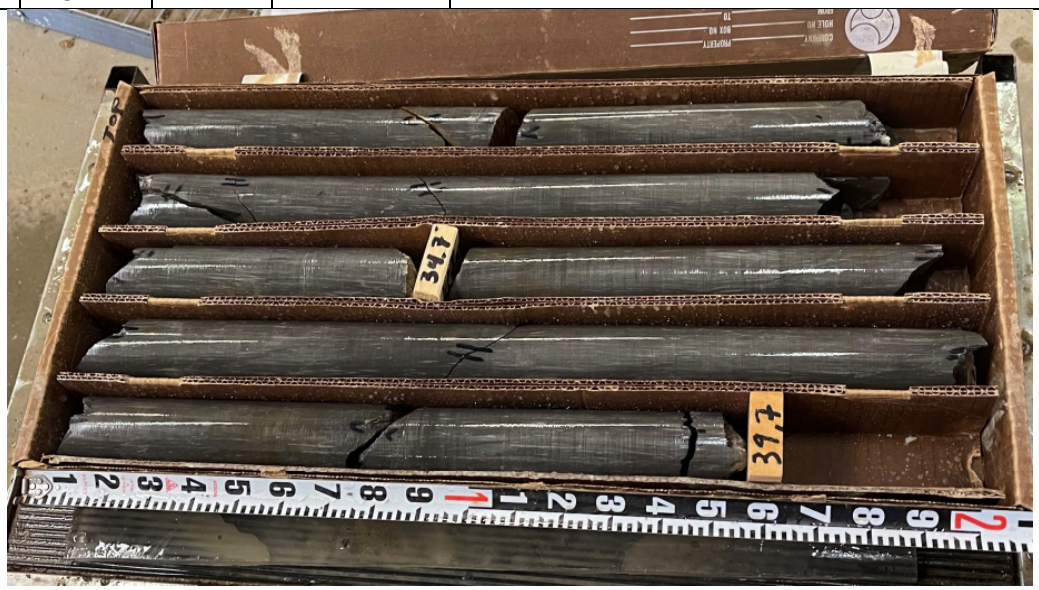
BORING B-07, I-275, STATION 55+39, 75 FEET LEFT: BOX 3 OF 3				
RUN	**DEPTH (FT)**	**RQD (%)**	**RECOVERY (%)**	**ROCK DESCRIPTION**
4 (cont'd)	39.5-44.5	96	100	CALCAREOUS SHALE, gray, continuous, excellent quality, 80 to 85 degree bedding, slightly weathering to fresh, medium hard
5	44.5-49.5	100	100	



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.

UNIAXIAL COMPRESSIVE STRENGTH OF ROCK
ASTM D7012, Method C

A rock core specimen is cut to length and the ends are machined flat. The specimen is placed in a loading frame (with no confining). The axial load on the specimen is then increased and measured until the peak load and failure are obtained. The test results are provided on the Uniaxial Compressive Strength of Rock Test Reports and/or presented on the laboratory test results summary.

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

LIQUID LIMIT, PLASTIC LIMIT, & PLASTIC INDEX

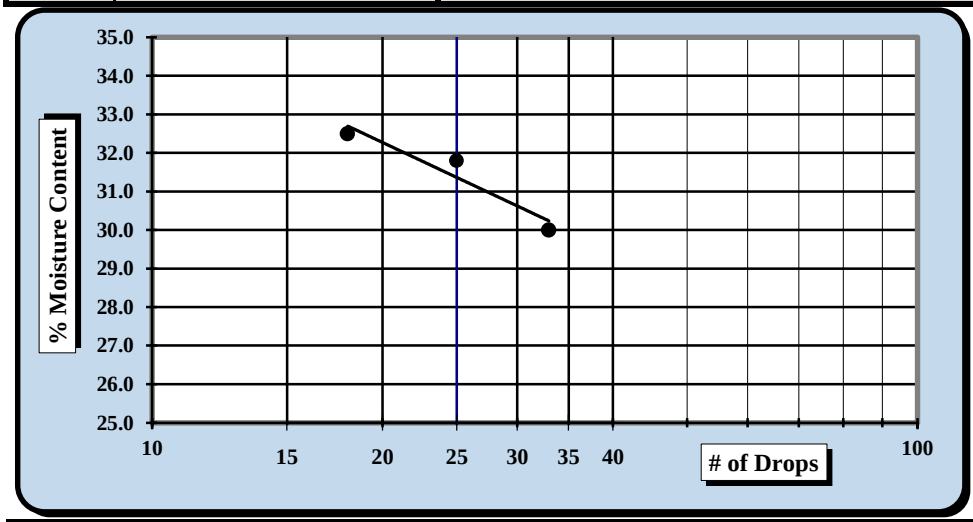
Quality Assurance ASTM D4318 ☐ AASHTO T 89 ☒ AASHTO T 90 ☒

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*

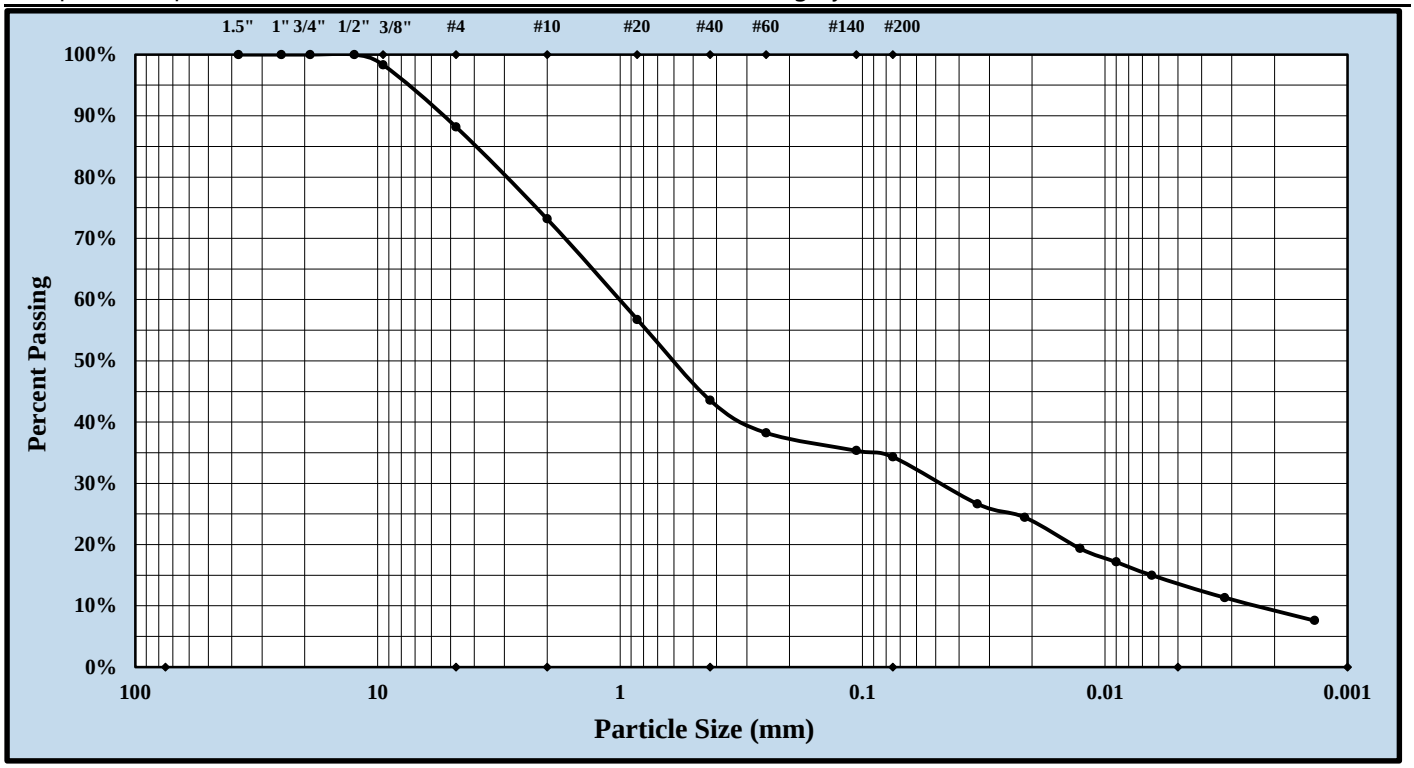
Form No. TR-D422-3
Revision No. 2
Revision Date: 08/29/17

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-43-D7012C-02
Revision No. : 0
Revision Date: 08/22/18

UNCONFINED COMPRESSION
(ASTM D7012 Method C)

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

Project Name: I-275 Over Elm Street
Project Number: 22430250

Report Date: February 17, 2023
Reviewed By: Victoria Igoe

Boring No.	Sample No.	Depth (ft)	Dimensions, in.		Shape (See Key)	Area (in^2)	Unit Weight (lbs/ft^3)	Loading Rate (psi/sec)	Maximum Load (lbs)	Strength (psi)	Moisture (%)
			Length	Diameter							
B-02	Run-03	18.98-19.35	4.66	1.98	A	3.08	160.3	58	13,792	4,478	0.8
B-03	Run-02	15.18-15.55	4.45	1.98	A	3.08	157.4	57	12,390	4,023	1.4
B-04	Run-01	17.86-18.22	4.55	1.98	A	3.08	166.9	66	18,518	6,012	0.9
B-07	Run-01	26.70-27.07	4.18	1.97	A	3.05	163.5	57	12,150	3,984	0.9

NOTES: Effective (as received) unit weight as determined by RTH 109-93.
Loading rates were selected to target reaching failure between 2 and 15 minutes. Cores did not meet strength to satisfy this time window for failure
Test results for specimens not meeting the requirements of ASTM D4543-19 may differ from a test specimen that meets the requirements of ASTM D4543.

SHAPE KEY

ASTM D4543-19 Standard Practice for Preparing Rock Core as Cylindrical Test Specimens and Verifying Conformance to Dimensional and Shape Tolerance Section 1.2 - "Rock is a complex engineering material that can vary greatly as a function of lithology, stress history, weathering, moisture content and chemistry, and other natural geologic processes. As such, it is not always possible to obtain or prepare rock core specimens that satisfy the desirable tolerances given in this practice. Most commonly, this situation presents itself with weaker, more porous, and poorly cemented rock types and rock types containing significant or weak (or both) structural features. For rock types which are difficult to prepare, all reasonable efforts shall be made to prepare a specimen in accordance with this practice and for the intended test procedure. However, when it has been determined by trial and error that this is not possible, prepare the rock specimen to the closest tolerances practicable and consider this to be the best effort and report it as such and if allowable or necessary for the intended test, capping the ends of the specimen as discussed in this practice is permitted."

A Test specimen measurements met the desired shape tolerances of ASTM D4543-19 (side straightness, end flatness & parallelism, and end perpendicularity to axis)

B Test specimen measurements met the desired shape tolerances of ASTM D4543-19 for end flatness & parallelism, and end perpendicularity to axis. Specimen did not meet the desired tolerance for side straightness. Specimen prepared to closest tolerances practicable.

C Test specimen measurements met the desired shape tolerances of ASTM D4543-19 for end flatness & parallelism. Specimen did not meet the desired tolerances for side straightness and end perpendicularity to axis. Specimen prepared to closest tolerances practicable.

D Test specimen measurements met the desired shape tolerances of ASTM D4543-19 for end flatness. Specimen did not meet the desired tolerances for side straightness, parallelism and end perpendicularity to axis. Specimen prepared to closest tolerances practicable.

E Test specimen measurements met the desired shape tolerances of ASTM D4543-19 for end flatness and end perpendicularity to axis. Specimen did not meet the desired tolerance for side

PREPARING ROCK CORE AS CYLINDRICAL TEST SPECIMENS AND VERIFYING CONFORMANCE TO DIMENSIONAL AND SHAPE TOLERANCES (ASTM D4543)

1413 Topside Road, Louisville, TN 37777

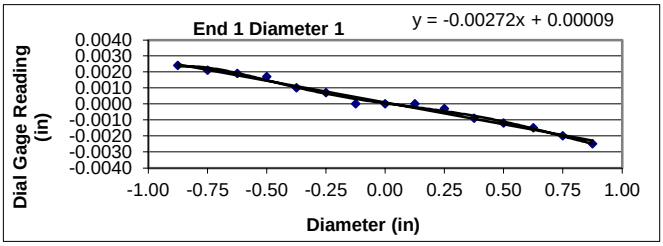
Project:	I-275 Over Elm Street	**Diameter (in):**	1.98	**Date:**	2/16/2023
Project No.:	22430250	**Length (in):**	4.66	**Tested by:**	Ryan Skinner
Boring Id:	B-02	**Unit Weight (pcf):**	160.3	**Reviewed by:**	Victoria Igoe
Sample No.:	Run-03	**Moisture Content (%):**	0.8		
Depth (ft):	18.98-19.35				

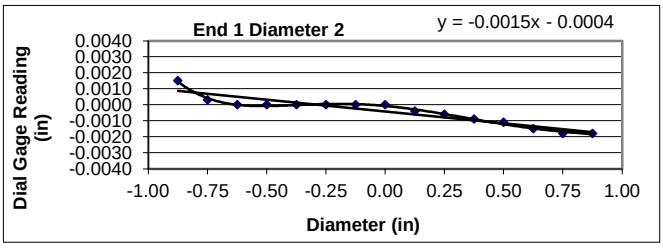
Deviation From Straightness (Procedure S1)

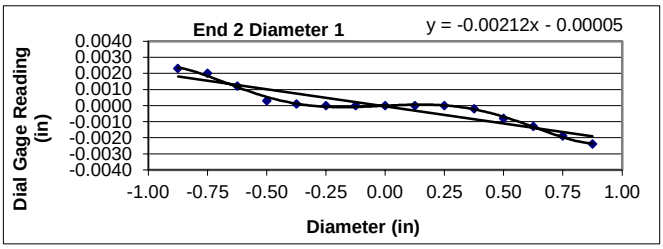
Is the maximum gap ≤ 0.02 in.? **YES** Straightness Tolerance Met? **YES**

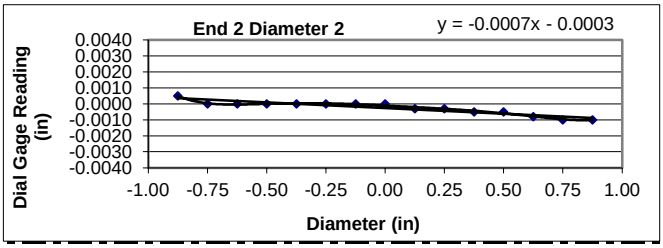
End Flatness and Parallelism Readings (Procedure FP1)

Position	End 1	End 1(90)	End 2	End 2(90)
- 7/8	0.0024	0.0015	0.0023	0.0005
- 6/8	0.0021	0.0003	0.0020	0.0000
- 5/8	0.0019	0.0000	0.0012	0.0000
- 4/8	0.0017	0.0000	0.0003	0.0000
- 3/8	0.0010	0.0000	0.0001	0.0000
- 2/8	0.0007	0.0000	0.0000	0.0000
- 1/8	0.0000	0.0000	0.0000	0.0000
0	0.0000	0.0000	0.0000	0.0000
1/8	0.0000	-0.0004	0.0000	-0.0003
2/8	-0.0003	-0.0006	0.0000	-0.0003
3/8	-0.0009	-0.0009	-0.0002	-0.0005
4/8	-0.0012	-0.0011	-0.0008	-0.0005
5/8	-0.0015	-0.0015	-0.0013	-0.0008
6/8	-0.0020	-0.0018	-0.0019	-0.0010
7/8	-0.0025	-0.0018	-0.0024	-0.0010









Flatness is met when the difference at any point between a smooth curve drawn through points and a visual best fit line is ≤ 0.001 in.

Flatness Tolerance Met? **YES**

Parallelism is met when the angular difference between best fit lines on opposing ends is ≤ 0.25°.

Parrallelism Diameter 1

End 1:	Slope of Best Fit Line:	-0.00272
	Angle of Best Fit Line:	-0.15584
End 2:	Slope of Best Fit Line:	-0.00212
	Angle of Best Fit Line:	-0.12130
	Max Angular Difference:	**-0.03**

Parrallelism Diameter 2

End 1:	Slope of Best Fit Line:	-0.00148
	Angle of Best Fit Line:	-0.08496
End 2:	Slope of Best Fit Line:	-0.00071
	Angle of Best Fit Line:	-0.04076
	Max Angular Difference:	**-0.04**

Parallelism Tolerance Met? **YES**

Perpendicularity (Procedure P1) is met when the difference between max and min readings along each line divided by the diameter is ≤ 0.0043.

	Difference b/w max & min	Divide by Diameter	Meets Tolerance
End 1 Diam 1	0.0049	0.0025	**YES**
End 1 Diam 2	0.0033	0.0017	**YES**
End 2 Diam 1	0.0047	0.0024	**YES**
End 2 Diam 2	0.0015	0.0008	**YES**

Perpendicularity Tolerance Met? **YES**

PREPARING ROCK CORE AS CYLINDRICAL TEST SPECIMENS AND VERIFYING CONFORMANCE TO DIMENSIONAL AND SHAPE TOLERANCES (ASTM D4543)

1413 Topside Road, Louisville, TN 37777

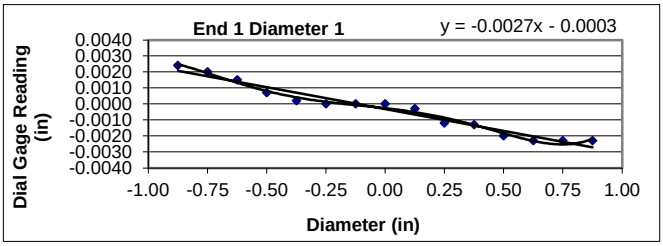
Project:	I-275 Over Elm Street	**Diameter (in):**	1.98	**Date:**	2/16/2023
Project No.:	22430250	**Length (in):**	4.45	**Tested by:**	Ryan Skinner
Boring Id:	B-03	**Unit Weight (pcf):**	157.4	**Reviewed by:**	Victoria Igoe
Sample No.:	Run-02	**Moisture Content (%):**	1.4		
Depth (ft):	15.18-15.55				

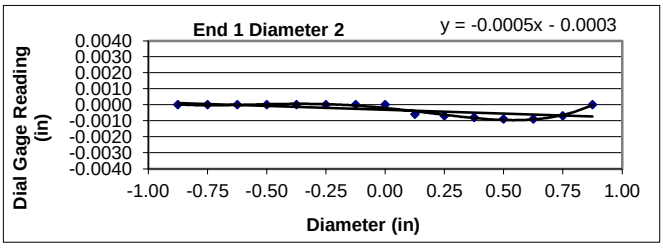
Deviation From Straightness (Procedure S1)

Is the maximum gap ≤ 0.02 in.? **YES** Straightness Tolerance Met? **YES**

End Flatness and Parallelism Readings (Procedure FP1)

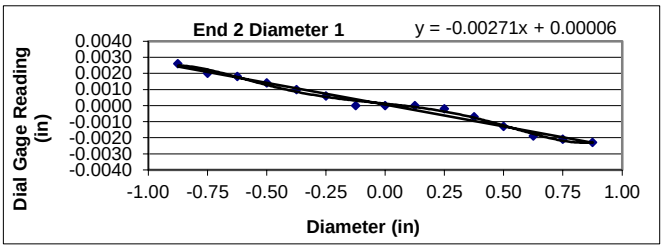
Position	End 1	End 1(90)	End 2	End 2(90)
- 7/8	0.0024	0.0000	0.0026	0.0017
- 6/8	0.0020	0.0000	0.0020	0.0012
- 5/8	0.0015	0.0000	0.0018	0.0010
- 4/8	0.0007	0.0000	0.0014	0.0006
- 3/8	0.0002	0.0000	0.0010	0.0004
- 2/8	0.0000	0.0000	0.0006	0.0000
- 1/8	0.0000	0.0000	0.0000	0.0000
0	0.0000	0.0000	0.0000	0.0000
1/8	-0.0003	-0.0006	0.0000	-0.0006
2/8	-0.0012	-0.0007	-0.0002	-0.0007
3/8	-0.0013	-0.0008	-0.0007	-0.0009
4/8	-0.0020	-0.0009	-0.0013	-0.0012
5/8	-0.0023	-0.0009	-0.0019	-0.0014
6/8	-0.0023	-0.0007	-0.0021	-0.0016
7/8	-0.0023	0.0000	-0.0023	-0.0018

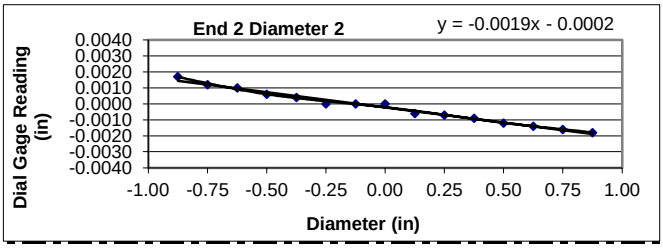




Flatness is met when the difference at any point between a smooth curve drawn through points and a visual best fit line is ≤ 0.001 in.

Flatness Tolerance Met? **YES**





Parallelism is met when the angular difference between best fit lines on opposing ends is ≤ 0.25°.

Parrallelism Diameter 1

End 1:	Slope of Best Fit Line:	-0.00273
	Angle of Best Fit Line:	-0.15666
End 2:	Slope of Best Fit Line:	-0.00271
	Angle of Best Fit Line:	-0.15535
	Max Angular Difference:	**0.00**

Parrallelism Diameter 2

End 1:	Slope of Best Fit Line:	-0.00048
	Angle of Best Fit Line:	-0.02734
End 2:	Slope of Best Fit Line:	-0.00190
	Angle of Best Fit Line:	-0.10870
	Max Angular Difference:	**0.08**

Parallelism Tolerance Met? **YES**

Perpendicularity (Procedure P1) is met when the difference between max and min readings along each line divided by the diameter is ≤ 0.0043.

	Difference b/w max & min	Divide by Diameter	Meets Tolerance
End 1 Diam 1	0.0047	0.0024	**YES**
End 1 Diam 2	0.0009	0.0005	**YES**
End 2 Diam 1	0.0049	0.0025	**YES**
End 2 Diam 2	0.0035	0.0018	**YES**

Perpendicularity Tolerance Met? **YES**

PREPARING ROCK CORE AS CYLINDRICAL TEST SPECIMENS AND VERIFYING CONFORMANCE TO DIMENSIONAL AND SHAPE TOLERANCES (ASTM D4543)

1413 Topside Road, Louisville, TN 37777

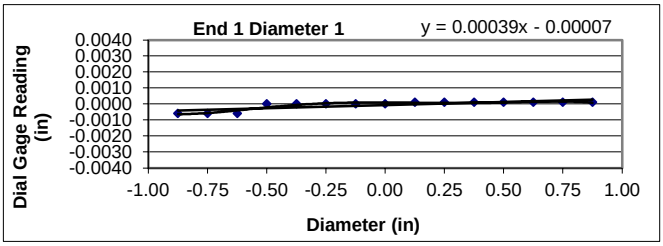
Project:	I-275 Over Elm Street	**Diameter (in):**	1.98	**Date:**	2/16/2023
Project No.:	22430250	**Length (in):**	4.55	**Tested by:**	Ryan Skinner
Boring Id:	B-04	**Unit Weight (pcf):**	166.9	**Reviewed by:**	Victoria Igoe
Sample No.:	Run-01	**Moisture Content (%):**	0.9		
Depth (ft):	17.86-18.22				

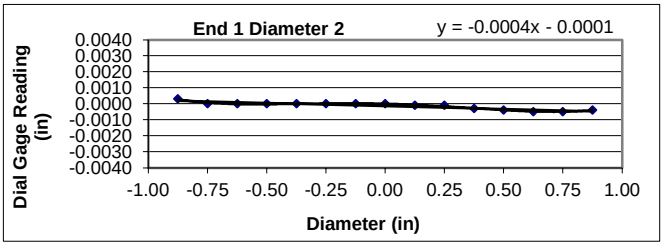
Deviation From Straightness (Procedure S1)

Is the maximum gap ≤ 0.02 in.? **YES** Straightness Tolerance Met? **YES**

End Flatness and Parallelism Readings (Procedure FP1)

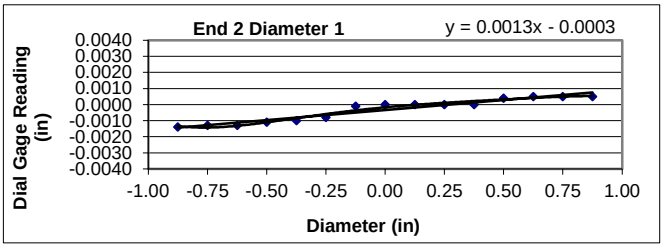
Position	End 1	End 1(90)	End 2	End 2(90)
- 7/8	-0.0006	0.0003	-0.0014	0.0016
- 6/8	-0.0006	0.0000	-0.0013	0.0010
- 5/8	-0.0006	0.0000	-0.0013	0.0002
- 4/8	0.0000	0.0000	-0.0011	0.0002
- 3/8	0.0000	0.0000	-0.0010	0.0000
- 2/8	0.0000	0.0000	-0.0008	0.0000
- 1/8	0.0000	0.0000	-0.0001	0.0000
0	0.0000	0.0000	0.0000	0.0000
1/8	0.0001	-0.0001	0.0000	0.0000
2/8	0.0001	-0.0001	0.0000	-0.0004
3/8	0.0001	-0.0003	0.0000	-0.0006
4/8	0.0001	-0.0004	0.0004	-0.0007
5/8	0.0001	-0.0005	0.0005	-0.0007
6/8	0.0001	-0.0005	0.0005	-0.0007
7/8	0.0001	-0.0004	0.0005	-0.0012

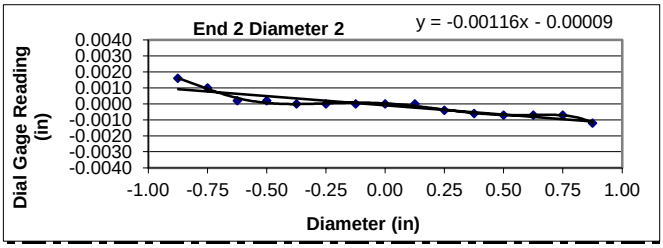




Flatness is met when the difference at any point between a smooth curve drawn through points and a visual best fit line is ≤ 0.001 in.

Flatness Tolerance Met? **YES**





Parallelism is met when the angular difference between best fit lines on opposing ends is ≤ 0.25°.

Parrallelism Diameter 1

End 1:	Slope of Best Fit Line:	0.00039
	Angle of Best Fit Line:	0.02226
End 2:	Slope of Best Fit Line:	0.00125
	Angle of Best Fit Line:	0.07170
	Max Angular Difference:	**-0.05**

Parrallelism Diameter 2

End 1:	Slope of Best Fit Line:	-0.00038
	Angle of Best Fit Line:	-0.02161
End 2:	Slope of Best Fit Line:	-0.00116
	Angle of Best Fit Line:	-0.06630
	Max Angular Difference:	**0.04**

Parallelism Tolerance Met? **YES**

Perpendicularity (Procedure P1) is met when the difference between max and min readings along each line divided by the diameter is ≤ 0.0043.

	Difference b/w max & min	Divide by Diameter	Meets Tolerance
End 1 Diam 1	0.0007	0.0004	**YES**
End 1 Diam 2	0.0008	0.0004	**YES**
End 2 Diam 1	0.0019	0.0010	**YES**
End 2 Diam 2	0.0028	0.0014	**YES**

Perpendicularity Tolerance Met? **YES**

PREPARING ROCK CORE AS CYLINDRICAL TEST SPECIMENS AND VERIFYING CONFORMANCE TO DIMENSIONAL AND SHAPE TOLERANCES (ASTM D4543)

1413 Topside Road, Louisville, TN 37777

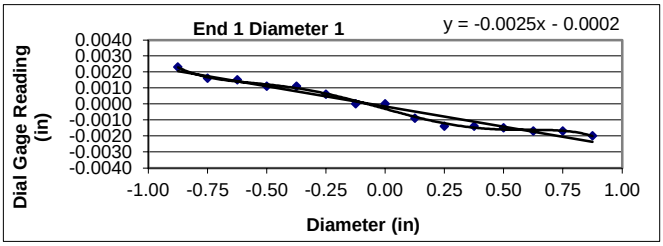
Project:	I-275 Over Elm Street	**Diameter (in):**	1.97	**Date:**	2/16/2023
Project No.:	22430250	**Length (in):**	4.18	**Tested by:**	Ryan Skinner
Boring Id:	B-07	**Unit Weight (pcf):**	163.5	**Reviewed by:**	Victoria Igoe
Sample No.:	Run-01	**Moisture Content (%):**	0.9		
Depth (ft):	26.70-27.07				

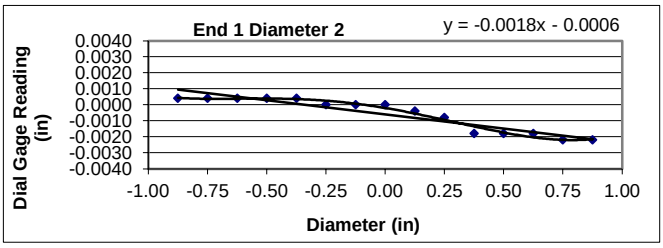
Deviation From Straightness (Procedure S1)

Is the maximum gap ≤ 0.02 in.? **YES** Straightness Tolerance Met? **YES**

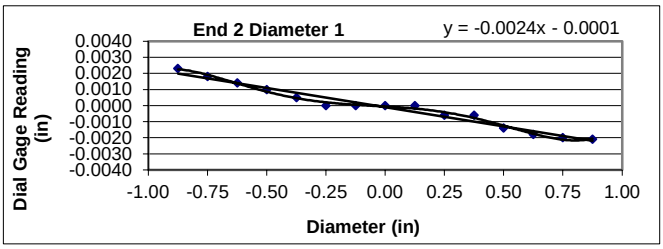
End Flatness and Parallelism Readings (Procedure FP1)

Position	End 1	End 1(90)	End 2	End 2(90)
- 7/8	0.0023	0.0004	0.0023	-0.0005
- 6/8	0.0016	0.0004	0.0018	-0.0005
- 5/8	0.0015	0.0004	0.0014	-0.0005
- 4/8	0.0011	0.0004	0.0010	-0.0005
- 3/8	0.0011	0.0004	0.0005	-0.0005
- 2/8	0.0006	0.0000	0.0000	-0.0001
- 1/8	0.0000	0.0000	0.0000	0.0000
0	0.0000	0.0000	0.0000	0.0000
1/8	-0.0009	-0.0004	0.0000	-0.0009
2/8	-0.0014	-0.0008	-0.0006	-0.0009
3/8	-0.0014	-0.0018	-0.0006	-0.0010
4/8	-0.0015	-0.0018	-0.0014	-0.0010
5/8	-0.0017	-0.0018	-0.0018	-0.0010
6/8	-0.0017	-0.0022	-0.0020	-0.0010
7/8	-0.0020	-0.0022	-0.0021	-0.0016

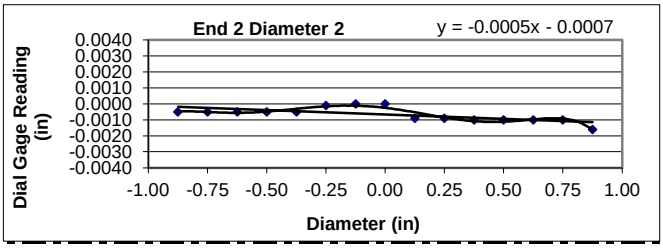




Flatness is met when the difference at any point between a smooth curve drawn through points and a visual best fit line is ≤ 0.001 in.



Flatness Tolerance Met? **YES**



Parallelism is met when the angular difference between best fit lines on opposing ends is ≤ 0.25°.

Parrallelism Diameter 1

End 1:	Slope of Best Fit Line:	-0.00253
	Angle of Best Fit Line:	-0.14520
End 2:	Slope of Best Fit Line:	-0.00239
	Angle of Best Fit Line:	-0.13702
	Max Angular Difference:	**-0.01**

Parrallelism Diameter 2

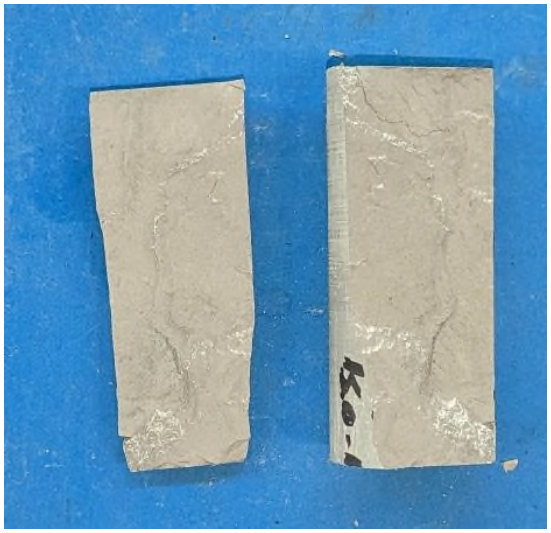
End 1:	Slope of Best Fit Line:	-0.00178
	Angle of Best Fit Line:	-0.10182
End 2:	Slope of Best Fit Line:	-0.00055
	Angle of Best Fit Line:	-0.03143
	Max Angular Difference:	**-0.07**

Parallelism Tolerance Met? **YES**

Perpendicularity (Procedure P1) is met when the difference between max and min readings along each line divided by the diameter is ≤ 0.0043.

	Difference b/w max & min	Divide by Diameter	Meets Tolerance
End 1 Diam 1	0.0043	0.0022	**YES**
End 1 Diam 2	0.0026	0.0013	**YES**
End 2 Diam 1	0.0044	0.0022	**YES**
End 2 Diam 2	0.0016	0.0008	**YES**

Perpendicularity Tolerance Met? **YES**



Date: 02/16/2023

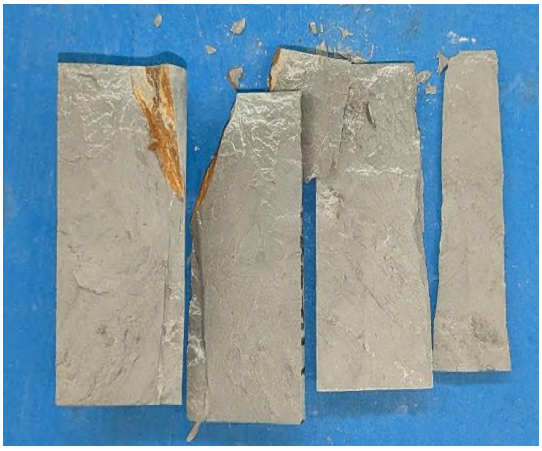
Photographer: Ryan Skinner

1	**Location / Orientation**	B-02, Run-03 (18.98' – 19.35')
	Remarks	Unconfined Compressive Strength of Rock Core Specimen Before/After (ASTM D7012 Method C)

Date: 02/16/2023

Photographer: Ryan Skinner

2	**Location / Orientation**	B-03, Run-02 (15.18' – 15.55')
	Remarks	Unconfined Compressive Strength of Rock Core Specimen Before/After (ASTM D7012 Method C)



Date: 02/16/2023

Photographer: Ryan Skinner

3	**Location / Orientation**	B-04, Run-01 (17.86' – 18.22')
	Remarks	Unconfined Compressive Strength of Rock Core Specimen Before/After (ASTM D7012 Method C)

Date: 02/16/2023

Photographer: Ryan Skinner

4	**Location / Orientation**	B-07, Run-01 26.70' – 27.07')
	Remarks	Unconfined Compressive Strength of Rock Core Specimen Before/After (ASTM D7012 Method C)

Appendix IV

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.