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AN EMPLOYEE OWNED COMPANY



Consulting Engineers • Testing • Inspection Services • Analytical Laboratories

Established 1927

July 11, 2025

BG Engineering Group, LLC
5960 Wilcox Place, Suite C
Dublin, OH 43016

Attention: Greg Boyer P.E.
Principal

Reference: Structure Foundation Exploration Report- Final Report
HIG-73-0.26 Bridge Replacement
PID No. 105111
Highland County, Ohio
CTL Project No. 24050039COL

Dear Mr. Boyer:

CTL Engineering, Inc. (CTL) has completed the geotechnical exploration report for the above referenced project. We are providing an electronic version (PDF file) of the Final Report via email.

Thank you for the opportunity to be of service to you on this project. If you have any questions, please contact me at our office.

Respectfully Submitted,

CTL Engineering, Inc.

A handwritten signature in black ink that reads "Sastry M.V.S." with a horizontal line underneath.

Sastry Malladi, P. E.
Project Engineer

STRUCTURE FOUNDATION EXPLORATION- FINAL REPORT

**HIG-73-0.26 BRIDGE REPLACEMENT
PID No. 105111
HIGHLAND COUNTY, OHIO
CTL PROJECT NO. 24050039COL**

PREPARED FOR:

**BG ENGINEERING GROUP, LLC
5960 WILCOX PLACE, SUITE C
DUBLIN, OH 43016**

PREPARED BY:

**CTL ENGINEERING, INC.
2860 FISHER ROAD
COLUMBUS, OHIO 43204**

July 11, 2025



TABLE OF CONTENTS

	<u>PAGE</u>
I. <u>EXECUTIVE SUMMARY</u>	1
II. <u>INTRODUCTION</u>	1
III. <u>GEOLOGY AND OBSERVATIONS OF THE PROJECT</u>	1
IV. <u>EXPLORATION</u>	2
IV. <u>FINDINGS</u>	3
V. <u>ANALYSES AND RECOMMENDATIONS</u>	4
A. Bridge - Scour Data	4
B. Bridge – Foundation Support	5
C. Lateral Parameters	6
D. Subgrade Considerations – Bridge Approach & Shoulder Widening	6
VI. <u>CHANGED CONDITIONS</u>	7
VII. <u>TESTING AND OBSERVATION</u>	7
VIII. <u>CLOSING</u>	7

APPENDIX A GEOTECHNICAL PROFILE - BRIDGE

APPENDIX B TEST BORING RECORDS

APPENDIX C LABORATORY TEST RESULTS

APPENDIX D DRILLED SHAFT DESIGN CALCULATIONS

APPENDIX E LPILE PARAMETERS

APPENDIX F SUBGRADE ANALYSIS

APPENDIX G ROCK CORE PHOTOS



I. EXECUTIVE SUMMARY

The project, designated as HIG-73-0.26, involves the replacement of existing two-span bridge with a single-span, steel-rolled beam bridge, with composite reinforced concrete deck on converted semi-integral abutments on drilled shafts. As part of the project, a new eight (8) foot wide shoulder will be constructed on the east side of the bridge/bridge approach area, and a new four (4) foot wide shoulder will be constructed on the west side of the bridge/bridge approach area.

Two (2) dual purpose (roadway/structure) test borings (Type A/E1) were performed for this project. Beneath the surface cover, the test borings exhibited soils described as A-1-b, A-4a, A-6a or A-7-6 soils extending down to the top of rock. Beneath the soil overburden, the borings encountered augerable sandstone bedrock at a depth of 8.5 feet below existing grade. This depth corresponds to elevations ranging from 1109.5 to 1111.3 feet. Rock coring was performed below the augerable rock layer. The recovered rock from coring operations was described as sandstone or dolomite.

Groundwater was encountered in boring B-002-0-24 at a depth of 10.0 feet below existing grade which corresponds to an elevation of 1108 feet.

Based upon the soil and rock information obtained from the test borings, it is CTL's opinion that the proposed bridge can be supported onto drilled shafts socketed into the underlying bedrock. Please refer to the Analyses and Recommendations section for additional information.

II. INTRODUCTION

The project, designated as HIG-73-0.26, involves the replacement of existing two-span bridge with a single-span, steel-rolled beam bridge, with composite reinforced concrete deck on converted semi-integral abutments on drilled shafts. As part of the project, a new eight (8) foot wide shoulder will be constructed on the east side of the bridge/bridge approach area, and a new four (4) foot wide shoulder will be constructed on the west side of the bridge/bridge approach area.

This is a Final Structure Foundation Exploration Report.

III. GEOLOGY AND OBSERVATIONS OF THE PROJECT

According to the Ohio Department of Natural Resources (ODNR) Physiographic Regions of Ohio, the site lies in the glaciated portion of Ohio, within the Southern Ohio Loamy Till Plain.

According to the Bedrock Geologic Map of Ohio (2006), the underlying bedrock within the project area is mapped as Silurian age Estill shale and minor dolomite interbedded.



According to the ODNR website, no mapped deep mines are located within the project area. According to ODNR's karst interactive map website, there are no mapped karst features within the project area. However, there are several karst – field verified and suspect features mapped about 3 miles south of the proposed structure.

According to the USDA Soil Survey Map, the primary surficial soil type at the site consisted of Algiers silt loam (Ag). These Ag soils are somewhat poorly drained, and exhibit moderately high to high hydraulic conductivity (0.6 to 2.0 in/hr.).

A site reconnaissance was performed by CTL personnel on January 24, 2024. The existing HIG-73-0.26 (SFN: 3601536) two-lane bridge was constructed in 1946, with a total length of 50 feet and a bridge deck width of 31 feet. It is a two-span, continuous concrete slab bridge supported on spread footings at both abutments and middle pier. East Fork Little Miami River flows below the structure. During the site reconnaissance, deterioration of the concrete bridge deck, as well as the guardrail concrete posts were observed. Additionally, corrosion of the steel rails between the guardrail concrete posts were observed. Overhead utilities are located on both sides of SR 73. Some erosion was noted on the stream banks.

The surrounding land use of the project area was noted being wooded, agricultural or residential.

IV. **EXPLORATION**

Two (2) multi-purpose (roadway/structure) test borings (Type A/E1) were performed for this project. The location, depth and surface elevations of the borings are summarized in Table 1. The boring locations are included in the Geotechnical Profile sheets included in Appendix A, and on the boring logs included in Appendix B.

Table 1: Boring Locations, Depths and Elevations

Boring No.	Station	Offset	Boring Elevation (ft)	Depth (ft)
B-001-0-24	222+87	17' Rt	1119.8	25.1
B-002-0-24	223+73	5' Lt	1118.0	20.1

The borings were performed on July 18 and July 19, 2024. The borings were performed with a track mounted drill rig utilizing 3.25-inch inside diameter (I.D) hollow stem augers (HSA). Standard Penetration Tests (SPTs) were conducted using a 140-pound automatic hammer, falling 30 inches, to drive 2-inch outside diameter (O.D) split barrel samplers. Rock coring was performed in the borings using an NQ size core barrel with a diamond bit. The hammer system used was calibrated on November 4, 2022. The energy transfer ratio associated with the automatic SPT hammer was 79.3 percent.

The recovered split spoon samples obtained during the drilling operations were preserved in glass jars, visually classified in the field, and laboratory, and tested for moisture



content. Representative samples were subjected to additional laboratory testing including Atterberg Limits, grain size distribution and hand penetrometer.

The recovered rock from the coring operations was visually described, and the Rock Quality Designation (RQD) and core recovery values were determined. Representative samples of the recovered rock were subjected to compressive strength testing.

The survey information at the test boring locations was provided by BG Engineering Group, LLC.

Historic geotechnical records were searched on the ODOT TIMS website. No historic structure boring data was available for the existing structure.

IV. FINDINGS

Boring B-001-0-24 exhibited 8 inches of topsoil at the surface, and boring B-002-0-24 exhibited 6 inches of asphalt over 6 inches of gravel at the surface.

Beneath the surface cover, the test borings exhibited layers of gravel and/or stone fragments with sand (A-1-b), sandy silt (A-4a), silt and clay (A-6a), or clay (A-7-6) soils extending down to a depth of 8.5 feet below existing grade. These soils exhibited standard penetration (SPT) N_{60} values ranging from 11 to 37 blows per foot (bpf), with natural moisture content values ranging from 6 to 27 percent. The near surface soils encountered to a depth of 5.5 feet were further identified as fill materials.

Beneath the soil overburden, the borings encountered augerable bedrock described as sandstone at a depth of 8.5 feet below existing grade, and elevations ranging from 1109.5 to 1111.3 feet. The augerable bedrock layer exhibited SPT N_{60} values ranging from 50 blows for 1-inch penetration to 50 blows for 5 inches of penetration.

Rock coring was performed in the borings below the augerable rock layers. The recovered rock was described as sandstone or dolomite. The rock cores exhibited rock quality designation (RQD) values ranging from 22 to 85 percent, with core recovery values ranging from 76 to 99 percent.

Unconfined Compressive Strength (UCS) testing was performed on selected bedrock core samples representative of the bedrock units. Results of the testing are provided in Appendix C, are summarized in Table 2.



Table 2. Rock Test Results

Boring ID	Sample Elevation (Feet)	Sample Depth (Feet)	Q _u (psi)	Lithology
B-001-0-24	1107.4	12.4	5,370	Dolomite
	1100.2	19.6	5,130	Dolomite
B-002-0-24	1107.0	11.0	3,670	Dolomite
	1106.1	11.9	2,830	Dolomite

Q_u= Unconfined compressive strength test, ASTM D7012

Groundwater was encountered in boring B-002-0-24 at a depth of 10.0 feet below existing grade which corresponds to an elevation of 1108 feet.

V. ANALYSES AND RECOMMENDATIONS

A. Bridge - Scour Data

For the purpose of scour analysis, the mean particle grain size (D₅₀), critical shear stress (τ_c) and erosion category (EC) of the creek bed materials were determined according to ODOT Geotechnical Design Manual (GDM) Section 1302. The scour data for the proposed structures are shown in Table 3.

Table 3. Scour Data

Boring	Sample No.	Elevation MSL (feet)	D ₅₀ (mm)	τ_c (psf)	D _{50, equiv} (mm)	Erosion Category (EC)
B-001-0-24 Rear Abutment	SS-3	1115.8 to 1114.3	0.2995	0.0063	0.2995	1.6
	SS-4	1114.3 to 1112.8	0.0140	0.6958	33.3096	3.4
	SS-5	1112.8 to 1111.3	0.0591	0.2394	11.4621	2.9
	SS-6, 7 and NQ-1	1111.3 to 1107.7	N/A	0.7659	36.662	3.761
	NQ-1/NQ-2	1107.7 to 1094.7	N/A	191.795	9181.0	3.761
B-002-0-24 Forward Abutment	SS-3	1114.0 to 1112.5	0.0114	0.4943	23.6605	3.8
	SS-4	1112.5 to 1111.0	1.0017	0.0209	1.0017	2.2
	SS-5	1111.0 to 1109.5	0.1036	0.1322	6.3279	3.1
	SS-6 & 7	1109.5 to 1107.9	N/A	1.7829	85.345	3.761
	NQ-1/NQ-2	1107.9 to 1097.9	N/A	142.453	6819.2	3.761



B. Bridge – Foundation Support

Based upon the soil and rock information obtained from the borings, it is CTL's opinion that the proposed bridge can be supported onto drilled shaft foundations socketed into the underlying bedrock. The drilled shaft foundations may be proportioned using a nominal unit tip resistance value not exceeding those provided in the Table 4. The socket length should be determined by the structural engineer.

Table 4: Nominal Unit Tip Resistance

Location	Bottom of Foundation Elevation* (feet)	Boring No.	Top of Bedrock Elevation	Nominal Unit Tip Resistance, q_p (ksf)
Rear Abutment	1108.8	B-001-0-24	1111.3	923.4
Forward Abutment	1107.6	B-002-0-24	1107.9	509.4

* From Stage 2 plans

Based on the bedrock data as well as input from District personnel, it is CTL's opinion that the bedrock encountered at this site is considered as non-scour resistant.

Per ODOT BDM 305.4.1.1, the shaft sockets should extend a minimum of 10 feet below the controlling scour elevation into the bedrock.

The socket tip should extend at least 1.5 times the socket diameter into the bedrock per ODOT BDM 305.4.2 (AASHTO LRFD 10.8.3.5.4c).

Per ODOT GDM 1306.4.2, the drilled shafts should be designed for tip resistance or side resistance, but not both. If both tip and side resistance are used, then each value should be modified according to deflection and mobilization of resistance in accordance with ODOT GDM 1306.3.2. Unfactored unit side resistance values are provided in Table 5.

Table 5. Unfactored Unit Side Resistance

Location	Bottom of Foundation Elevation* (feet)	Boring No.	Elevation (feet)	Nominal Unit Side Resistance, q_p (ksf)
Rear Abutment	1108.8	B-001-0-24	1108.8 to 1098.8	34.9
Forward Abutment	1107.6	B-002-0-24	1107.6 to 1097.6	29.4

* From Stage 2 plans

Per ODOT BDM 305.4.1.1, the shaft resistance should be neglected within the soils or non-scour resistant bedrock within the scour zone.



Side resistance within the soil overburden and upper portion of the rock socket should be neglected as outlined in ODOT BDM section 305.4.2.

The resistance factors in Table 6 should be used for Shaft Side Resistance. The resistance factors were obtained from AASHTO Table 10.5.5.2.4-1.

The drilled shaft tip and side resistance calculations are provided in Appendix D.

Table 6. Resistance Factors for Shaft Side Resistance

Material Type	Resistance Factors	
	Compressive	Uplift
Rock	0.55	0.40

C. Lateral Parameters

Please refer to Appendix E for the Lpile parameters which can be utilized while performing lateral pile analysis.

D. Subgrade Considerations – Bridge Approach & Shoulder Widening

A subgrade analysis was performed utilizing the subsurface information from the B-001-0-24 and B-002-0-24 and ODOT Geotechnical Design Manual (GDM) Section 600. A copy of the Subgrade Analysis spreadsheet is provided in Appendix F. A proposed pavement thickness of 1.0 feet was assumed for estimating cut/fill in the Subgrade Analysis spreadsheet.

Based on the requirements outlined in the GDM Section 600, no subgrade issues are expected within the underlying soils, therefore, provided the underlying soils are stable during the proofrolling operations, no subgrade stabilization is needed within the bridge approach areas.

The natural moisture content values of the near surface soil samples ranged from 10 to 27 percent, averaging 20 percent. The estimated optimum moisture content (OMC) value was 16 percent. On average, the natural moisture content values were 4 percent higher than the optimum moisture content values.

Group Index values were calculated for the samples tested in the upper 5.5 feet of the proposed subgrade. Group Index values ranged from 1 to 19, averaging 11. This average Group Index value corresponds to an estimated California Bearing Ratio (CBR) value of 6.0 percent. The pavements for this project may be designed using a CBR value of 6.0.



VI. CHANGED CONDITIONS

The evaluations, conclusions, and recommendations in this report are based on our interpretation of the field and laboratory data obtained during the exploration, our understanding of the project and our experience with similar sites and subsurface conditions using generally accepted geotechnical engineering practices. Although individual test borings are representative of the subsurface conditions at the boring locations on the dates drilled, they are not necessarily representative of the subsurface conditions between boring locations or subsurface conditions during other seasons of the year.

In the event that changes in the project are proposed, additional information becomes available, or if it is apparent that subsurface conditions are different from those provided in this report, CTL should be notified so that our recommendations can be modified, if required.

VII. TESTING AND OBSERVATION

During the design process, it is recommended that CTL work with the project designers to confirm that the geotechnical recommendations are properly incorporated into the final plans and specifications, and to assist with establishing criteria for the construction observation and testing.

CTL is not responsible for independent conclusions, opinions and recommendations made by others based on the data and recommendations provided in this report. It is recommended that CTL be retained to provide construction quality control services on this project. If CTL is not retained for these services, CTL shall assume no responsibility for compliance with the design concepts or recommendations provided.

VIII. CLOSING

The report was prepared by CTL Engineering, Inc. (Consultant) solely for the use of Client in accordance with an executed contract. The Client's use of or reliance on this report is limited by the terms and conditions of the contract and by the qualifications and limitations stated in the report. It is also acknowledged that the Client's use of and reliance of this report is limited for reasons which include: actual site conditions that may change with time; hidden conditions, not discoverable within the scope of the assessment, may exist at the site; and the scope of the investigation may have been limited by time, budget and other constraints imposed by the Client.

Neither the report, nor its contents, conclusions or recommendations, are intended for the use of any party other than the Client. Consultant and the Client assume no liability for any reliance placed on this report by such party. The rights of the Client under contract may not be assigned to any person or entity, without the consent of the Consultant which consent shall not be unreasonably withheld. This geotechnical report does not address the environmental conditions of the site. The Consultant is not responsible for consequences



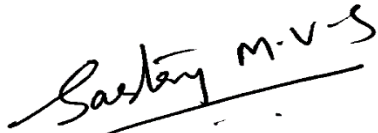
or conditions arising from facts that were concealed, withheld, or not fully disclosed at the time the assessment was conducted.

To the fullest extent permitted by law, the Consultant and Client agree to indemnify and hold each other, and their officers and employees harmless from and against claims, damages, losses and expenses arising out of unknown or concealed conditions. Furthermore, neither the Consultant nor its employees shall be liable to the Owner in an amount in excess of the available professional liability insurance coverage of the Consultant. In addition, Client and Consultant agree neither shall be liable for any special, indirect or consequential damages of any kind or nature.

The Consultant's services have been provided consistent with its professional standard of care. No other warranties are made, either expressed or implied.

Respectfully Submitted,

CTL ENGINEERING, INC.

A handwritten signature in black ink, appearing to read "Sastry M.V.S", written over a horizontal line.

Sastry Malladi, P.E.
Project Engineer

A handwritten signature in black ink, appearing to read "Joe Grani", written in a cursive style.

Joe Grani, P.E.
Project Engineer



APPENDIX A

GEOTECHNICAL PROFILE - BRIDGE



PROJECT DESCRIPTION

THE PROJECT, DESIGNATED AS HIG- 73-0.26, INVOLVES THE REPLACEMENT OF EXISTING TWO-SPAN BRIDGE WITH A SINGLE-SPAN, STEEL-ROLLED BEAM BRIDGE, WITH COMPOSITE REINFORCED CONCRETE DECK ON CONVERTED SEMI-INTEGRAL ABUTMENTS ON DRILLED SHAFTS.

HISTORIC RECORDS

HISTORIC GEOTECHNICAL RECORDS WERE SEARCHED ON THE ODOT TIMS WEBSITE. NO HISTORIC STRUCTURE BORING DATA WAS AVAILABLE FOR THE EXISTING STRUCTURE.

GEOLOGY

ACCORDING TO THE OHIO DEPARTMENT OF NATURAL RESOURCES (ODNR) PHYSIOGRAPHIC REGIONS OF OHIO, THE SITE LIES IN THE GLACIATED PORTION OF OHIO, WITHIN THE SOUTHERN OHIO LOAMY TILL PLAIN.

ACCORDING TO THE BEDROCK GEOLOGIC MAP OF OHIO (2006), THE UNDERLYING BEDROCK WITHIN THE PROJECT AREA IS MAPPED AS SILURIAN AGE ESTILL SHALE AND MINOR DOLOMITE INTERBEDDED.

ACCORDING TO THE ODNR WEBSITE, NO MAPPED DEEP MINES ARE LOCATED WITHIN THE PROJECT AREA. ACCORDING TO ODNR'S KARST INTERACTIVE MAP WEBSITE, THERE ARE NO MAPPED KARST FEATURES WITHIN THE PROJECT AREA. HOWEVER, THERE ARE SEVERAL KARST - FIELD VERIFIED AND SUSPECT FEATURES MAPPED ABOUT 3 MILES SOUTH OF THE PROPOSED STRUCTURE.

RECONNAISSANCE

A SITE RECONNAISSANCE WAS PERFORMED BY CTL PERSONNEL ON JANUARY 24, 2024. THE EXISTING HIG-73-0.30 (SFN: 3601536) TWO-LANE BRIDGE WAS CONSTRUCTED IN 1946, WITH A TOTAL LENGTH OF 50 FEET AND A BRIDGE DECK WIDTH OF 31 FEET. IT IS A TWO-SPAN, CONTINUOUS CONCRETE SLAB BRIDGE SUPPORTED ON SPREAD FOOTINGS AT BOTH ABUTMENTS AND MIDDLE PIER. EAST FORK LITTLE MIAMI RIVER FLOWS BELOW THE STRUCTURE. DURING THE SITE RECONNAISSANCE, DETERIORATION OF THE CONCRETE BRIDGE DECK, AS WELL AS THE GUARDRAIL CONCRETE POSTS WERE OBSERVED. ADDITIONALLY, CORROSION OF THE STEEL RAILS BETWEEN THE GUARDRAIL CONCRETE POSTS WERE OBSERVED. OVERHEAD UTILITIES ARE LOCATED ON BOTH SIDES OF SR 73. SOME EROSION WAS NOTED ON THE STREAM BANKS.

SUBSURFACE EXPLORATION

TWO (2) MULTI- PURPOSE (ROADWAY/STRUCTURE) TEST BORINGS (TYPE A/E1) WERE PERFORMED FOR THIS PROJECT.

THE BORINGS WERE PERFORMED ON JULY 18 AND JULY 19, 2024. THE BORINGS WERE PERFORMED WITH A TRACK MOUNTED DRILL RIG UTILIZING 3.25-INCH INSIDE DIAMETER (I.D) HOLLOW STEM AUGERS (HSA). STANDARD PENETRATION TESTS (SPT'S) WERE CONDUCTED USING A 140- POUND AUTOMATIC HAMMER, FALLING 30 INCHES, TO DRIVE 2-INCH OUTSIDE DIAMETER (O.D) SPLIT BARREL SAMPLERS. ROCK CORING WAS PERFORMED IN THE BORINGS USING AN NQ SIZE CORE BARREL WITH A DIAMOND BIT. THE HAMMER SYSTEM USED WAS CALIBRATED ON NOVEMBER 4, 2022. THE ENERGY TRANSFER RATIO ASSOCIATED WITH THE AUTOMATIC SPT HAMMER WAS 79.3 PERCENT.

EXPLORATION FINDINGS

BENEATH THE SURFACE COVER, THE TEST BORINGS EXHIBITED SOILS DESCRIBED AS A-1-b, A- 4a, A- 6a OR A- 7- 6 SOILS EXTENDING DOWN TO TOP OF ROCK. BENEATH THE SOIL OVERBURDEN, THE BORINGS ENCOUNTERED AUGERABLE SANDSTONE BEDROCK AT A DEPTH OF 8.5 FEET BELOW EXISTING GRADE. THIS DEPTH CORRESPONDS TO ELEVATIONS RANGING FROM 1109.5 TO 1111.3 FEET. ROCK CORING WAS PERFORMED BELOW AUGERABLE ROCK LAYER. THE RECOVERED ROCK FROM CORING OPERATIONS WAS DESCRIBED AS SANDSTONE OR DOLOMITE.

GROUND WATER WAS ENCOUNTERED IN BORING B-002-0-24 AT A DEPTH OF 10.0 FEET BELOW EXISTING GRADE WHICH CORRESPONDS TO AN ELEVATION OF 1108 FEET.

SPECIFICATIONS

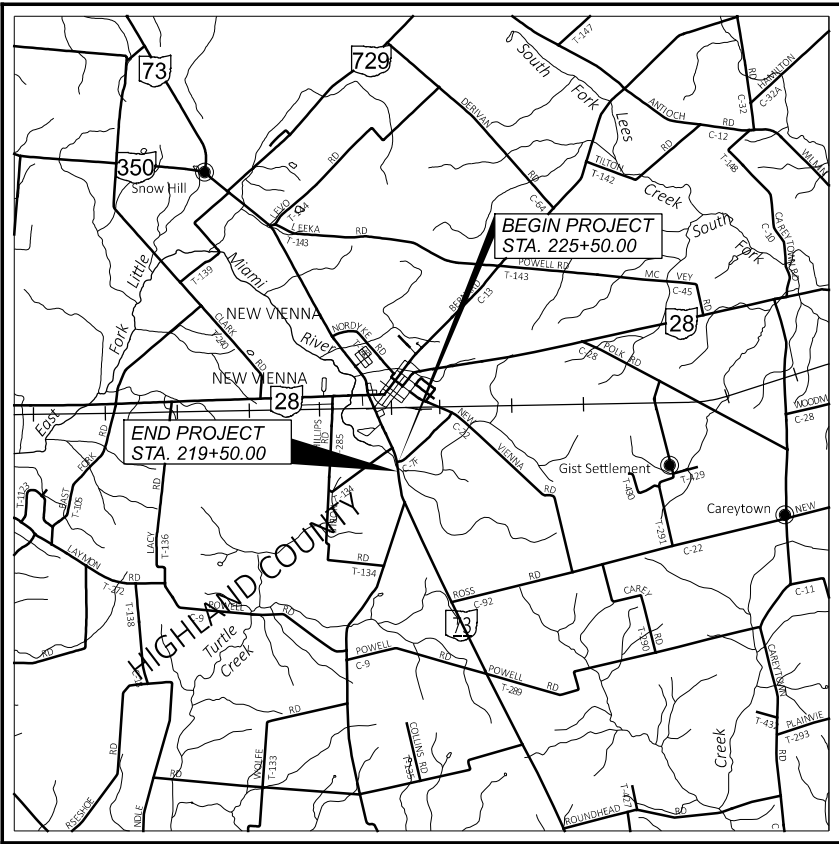
THIS GEOTECHNICAL EXPLORATION WAS PERFORMED IN ACCORDANCE WITH THE STATE OF OHIO, DEPARTMENT OF TRANSPORTATION, OFFICE OF GEOTECHNICAL ENGINEERING, SPECIFICATIONS FOR GEOTECHNICAL EXPLORATIONS, DATED JANUARY 19, 2024

AVAILABLE INFORMATION

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

LEGEND

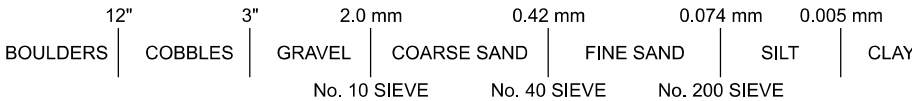
DESCRIPTION	ODOT CLASS	CLASSIFIED MECH./VISUAL	
GRAVEL AND/OR STONE FRAGMENTS WITH SAND	A-1-b (0)	1	0
SANDY SILT	A-4a (2)	2	0
SILT AND CLAY	A-6a (5)	3	0
CLAY	A-7-6 (15)	4	0
	TOTAL	10	0
SANDSTONE	VISUAL		
DOLOMITE	VISUAL		
PAVEMENT OR BASE = X = APPROXIMATE THICKNESS	VISUAL		
SOD AND TOPSOIL = X = APPROXIMATE THICKNESS	VISUAL		
BORING LOCATION - PLAN VIEW			
DRIVE SAMPLE AND/OR TEST BORING PLOTTED TO VERTICAL SCALE ONLY. HORIZONTAL BAR INDICATES A CHANGE IN STRATIGRAPHY.			
WC	INDICATES WATER CONTENT IN PERCENT.		
N ₆₀	INDICATES STANDARD PENETRATION RESISTANCE NORMALIZED TO 60% DRILL ROD ENERGY RATIO.		
W	INDICATES FREE WATER ELEVATION.		
TR	INDICATES TOP OF ROCK.		
SS	INDICATES A SPLIT-SPOON SAMPLE.		
NP	INDICATES A NON-PLASTIC SAMPLE.		



LOCATION MAP
SCALE IN MILES



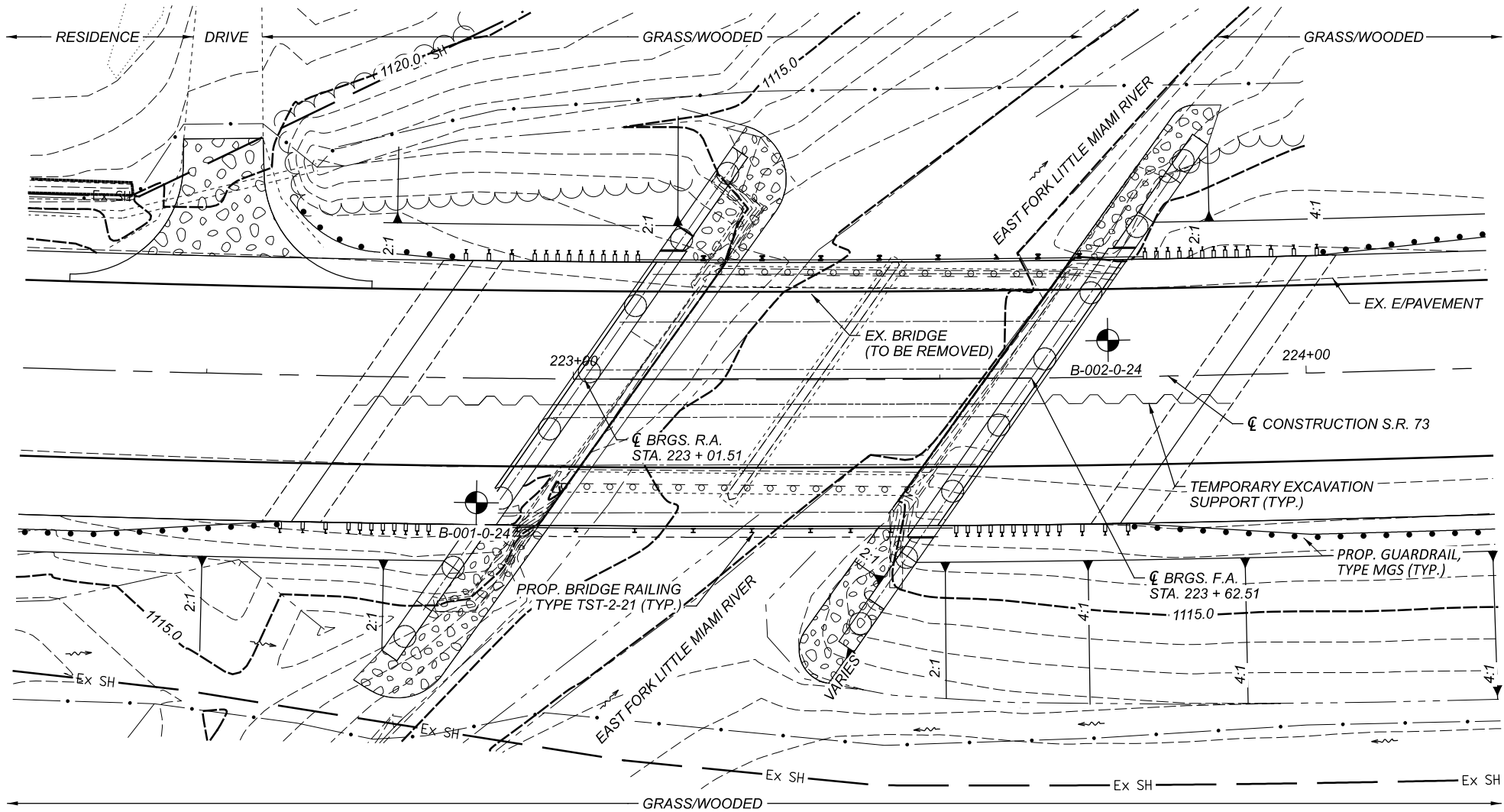
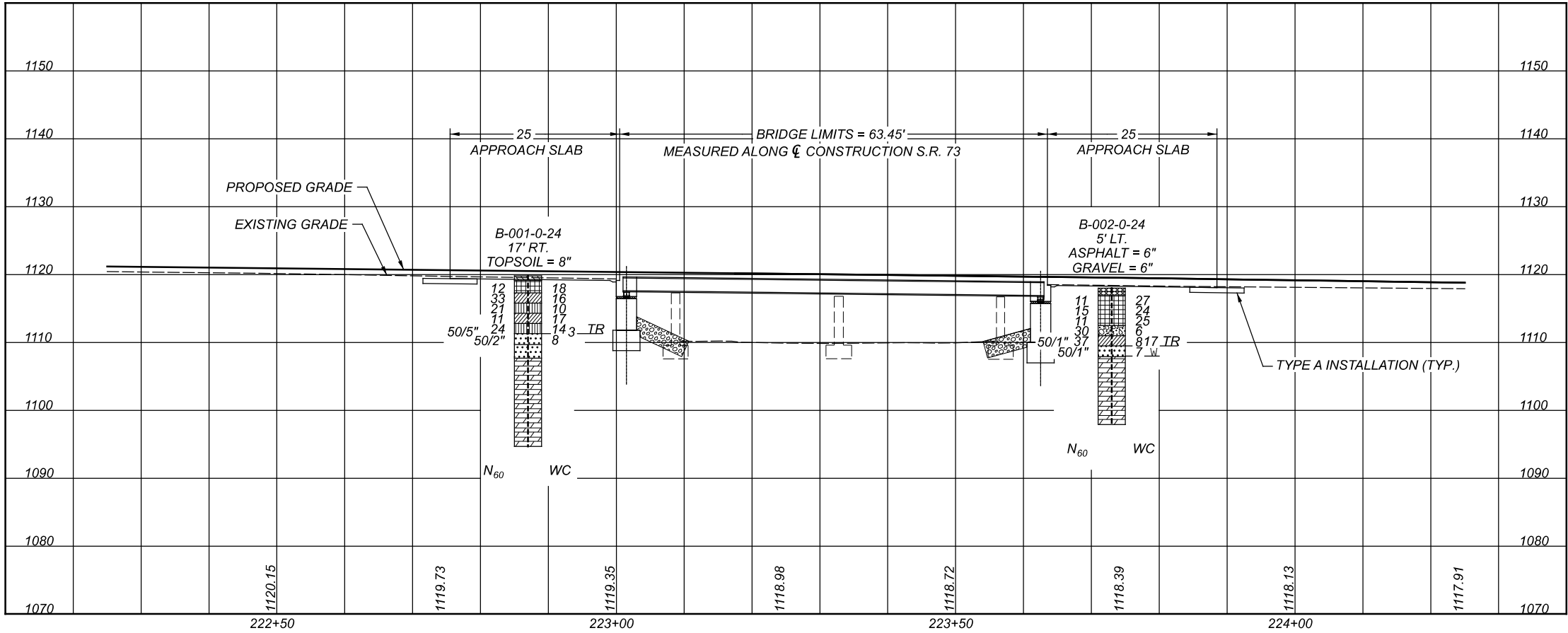
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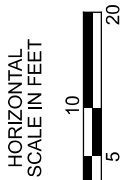
RECON. - CC 01/29/2024
DRILLING - CTL 07/18 - 07/19/2024
DRAWN - N.K.S 10/06/2024
REVIEWED - SM/JG 10/06/2024

BEDROCK TEST SUMMARY				
BORING ID	SAMPLE ELEVATION (FEET)	SAMPLE DEPTH (FEET)	Qu (PSI)	LITHOLOGY
B-001-0-24	1107.4	12.4	5,370	DOLOMITE
	1100.2	19.6	5,130	DOLOMITE
B-002-0-24	1107.0	11.0	3,670	DOLOMITE
	1106.1	11.9	2,830	DOLOMITE

BRIDGE SCOUR ANALYSIS						
TEST BORING	SAMPLE NO.	ELEVATION (FEET)	D ₅₀ (mm)	T _c (PSF)	D ₅₀ equi. (mm)	EROSION CATEGORY (EC)
B-001-0-24 (REAR ABUTMENT)	SS-3	1115.8 - 1114.3	0.2995	0.0063	0.2995	1.6
	SS-4	1114.3 - 1112.8	0.0140	0.6958	33.3096	3.4
	SS-5	1112.8 - 1111.3	0.0591	0.2394	11.4621	2.9
	SS-6,7 and NQ-1	1111.3 - 1107.7	N/A	0.7659	36.662	3.761
	NQ-1/NQ-2	1107.7 - 1094.7	N/A	191.795	9181.0	3.761
B-002-0-24 (FORWARD ABUTMENT)	SS-3	1114.0 - 1112.5	0.0114	0.4943	23.6605	3.8
	SS-4	1112.5 - 1111.0	1.0017	0.0209	1.0017	2.2
	SS-5	1111.0 - 1109.5	0.1036	0.1322	6.3279	3.1
	SS-6 & 7	1109.5 - 1107.9	N/A	1.7829	85.345	3.761
	NQ-1/NQ-2	1107.9 - 1097.9	N/A	142.453	6819.2	3.761



GEOTECHNICAL PROFILE - BRIDGE
BRIDGE NO. HIG-73-0.26
S.R. 73 EAST FORK LITTLE MIAMI RIVER



DESIGN AGENCY



DESIGNER

N.K.S

REVIEWER

SM 10-06-24

PROJECT ID

105111

SUBSET TOTAL

2 5

SHEET TOTAL

P.54 57

HIG-73-0.26

MODEL: Sheet PAPERSIZE: 17x11 (in.) DATE: 06-10-2024 TIME: 20:53:32 USER: hp
D:\Drop Box\CTL 2024\October\Dept 05\COL\Sostry\24050039COL_ODOT\Mod_06.10.24\05111ZL001.dgn

PROJECT: HIG-73-0-26			DRILLING FIRM / OPERATOR:			CTL / TM			DRILL RIG: CME 55 #393			STATION / OFFSET: 222+87, 17' RT.			EXPLORATION HOLE																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
TYPE: BRIDGE			SAMPLING FIRM / LOGGER:			CTL / TM			HAMMER: CME AUTOMATIC			ALIGNMENT: S.R. 73			B-001+0-24																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
PID: 105111 SFN: 3601536			DRILLING METHOD: 3.25" HSA / NQ2			SPT / NQ2			CALIBRATION DATE: 11/4/22			ELEVATION: 1119.8 (MSL) EOB: 25.1 ft.			PAGE 1 OF 1																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
START: 7/19/24 END: 7/19/24			SAMPLING METHOD:			SPT / NQ2			ENERGY RATIO (%): 79.3			LAT / LONG: 39.315006, -83.689531																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
MATERIAL DESCRIPTION AND NOTES			ELEV.			DEPTHS			SPT/ RQD			N ₆₀			REC SAMPLE ID			HP (tsf)			GR			CS			FS			SI			CL			LL			PL			PI			WC			ODOT CLASS (GI)			HOLE SEALED																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
TOPSOIL (6")			1119.8			1			4			12			SS-1			4.25			2			4			8			44			42			47			22			25			18			A-7-6 (15)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
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HARD, BROWN, SILT AND CLAY, SOME GRAVEL, SOME SAND, MOIST (FILL)			1115.8			3			10			6			21			SS-3			4.00			34			13			13			26			14			23			16			7			10			A-4a (1)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
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VERY STIFF, BROWN, SANDY SILT, SOME GRAVEL, LITTLE CLAY, CONTAINS BRICK FRAGMENTS, DAMP (FILL)			1112.8			5			4			3			24			SS-5			4.00			15			12			21			35			17			25			16			9			14			A-4a (3)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
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SANDSTONE, BROWN, HIGHLY WEATHERED, WEAK.			1109.7			7			50/5"			-			SS-7			-			-			-			-			-			-			-			-			-			-			8			Rock (V)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
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DOLOMITE, BROWN TO GRAY, MODERATELY WEATHERED, MODERATELY STRONG; RQD 62%, REC 100%. @12.4'; COMPRESSIVE STRENGTH (Qu) = 5,370 psi			1107.7			12			22			98			NQ2-2			-			-			-			-			-			-			-			-			-			-			-			CORE																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
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@19.6'; COMPRESSIVE STRENGTH (Qu) = 5,130 psi			1094.7			14			85			99			NQ2-3			-			-			-			-			-			-			-			-			-			-			-			CORE																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
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NOTES: CAVED AT 10'
ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH GROUT



B-001-0-24



Run #:	Depth	Recovery (in)	RQD (in)
NQ2-1	10.1'	45.5/60	13/60
NQ2-2	15.1'	59/60	32/60

DESIGN AGENCY	
	
2860 FISHER ROAD COLUMBUS, OHIO 43204 PHONE: (614) 276-5123 FAX: (614) 276-6377	
DESIGNER	
N.K.S	
REVIEWER	
SM 10-06-24	
PROJECT ID	
105111	
SUBSET	TOTAL
3	5
SHEET	TOTAL
P.55	57

GEOTECHNICAL PROFILE - BRIDGE
BORING LOG AND ROCK CORE PHOTO FOR B-001-0-24



B-001-0-24



Run #:	Depth	Recovery (in)	RQD (in)
NQ2-3	20.1'	59.5/60	51/60
HIG-73-0.26 BRIDGE REPLACEMENT			
		99%	85%

HIG-73-0.26

MODEL: Sheet PAPERSIZE: 17x11 (in.) DATE: 06-10-2024 TIME: 20:55:35 USER: hp
D:\Drop Box\CTL 2024\October\Dept 05\COL Sastry\24050039COL_ODOT Mod_06.10.24\05111ZL003.dgn

PROJECT: HIG-73-0.26			DRILLING FIRM / OPERATOR: _____				CTL / TM					
TYPE: BRIDGE			SAMPLING FIRM / LOGGER: _____				CTL / TM					
PID: 105111 SFN: 3601536			DRILLING METHOD: 3.25" HSA / NQ2									
START: 7/18/24 END: 7/18/24			SAMPLING METHOD: _____				SPT / NQ2					
MATERIAL DESCRIPTION AND NOTES							ELEV.		DEPTHS			
<div>ASPHALT (6")</div> <div>GRAVEL (6")</div> <div>VERY STIFF, BROWN, CLAY, "AND" SILT, TRACE SAND, MOIST (FILL) @2.5"; HARD, LITTLE SAND, TRACE GRAVEL</div> <div>@4.0'; VERY STIFF, CONTAINS WOOD PIECES</div> <div>MEDIUM DENSE, BROWN, GRAVEL AND/OR STONE FRAGMENTS WITH SAND, LITTLE SILT, TRACE CLAY, DAMP</div> <div>VERY STIFF, BROWN, SILT AND CLAY, SOME SAND, LITTLE GRAVEL, DAMP</div> <div>SANDSTONE, BROWN, HIGHLY WEATHERED, WEAK.</div> <div>DOLOMITE, BROWN AND GRAY, MODERATELY WEATHERED, MODERATELY STRONG; RQD 62%, REC 96%.</div> <div>@11.0': COMPRESSIVE STRENGTH (Qu)= 3,670 psi</div> <div>@11.9': COMPRESSIVE STRENGTH (Qu) = 2,830 psi</div>							1118.0					
							1117.5					
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PROJECT: HIG-73-0.26		DRILLING FIRM / OPERATOR: _____				CTL / TM						
TYPE: BRIDGE		SAMPLING FIRM / LOGGER: _____				CTL / TM						
PID: 105111 SFN: 3601536		DRILLING METHOD: 3.25" HSA / NQ2										
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PROJECT: HIG-73-0.26		DRILLING FIRM / OPERATOR: _____				CTL / TM						
TYPE: BRIDGE		SAMPLING FIRM / LOGGER: _____				CTL / TM						
PID: 105111 SFN: 3601536		DRILLING METHOD: 3.25" HSA / NQ2										
START: 7/18/24 END: 7/18/24		SAMPLING METHOD: _____				SPT / NQ2						
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PROJECT: HIG-73-0.26		DRILLING FIRM / OPERATOR: _____				CTL / TM						
TYPE: BRIDGE		SAMPLING FIRM / LOGGER: _____				CTL / TM						
PID: 105111 SFN: 3601536		DRILLING METHOD: 3.25" HSA / NQ2										
START: 7/18/24 END: 7/18/24		SAMPLING METHOD: _____				SPT / NQ2						
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PROJECT: HIG-73-0.26		DRILLING FIRM / OPERATOR: _____				CTL / TM						
TYPE: BRIDGE		SAMPLING FIRM / LOGGER: _____				CTL / TM						
PID: 105111 SFN: 3601536		DRILLING METHOD: 3.25" HSA / NQ2										
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TYPE: BRIDGE		SAMPLING FIRM / LOGGER: _____				CTL / TM						
PID: 105111 SFN: 3601536		DRILLING METHOD: 3.25" HSA / NQ2										
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1097.9		FOR										

PROJECT: HIG-73-0.26		DRILLING FIRM / OPERATOR: _____				CTL / TM						
TYPE: BRIDGE		SAMPLING FIRM / LOGGER: _____				CTL / TM						
PID: 105111 SFN: 3601536		DRILLING METHOD: 3.25" HSA / NQ2										
START: 7/18/24 END: 7/18/24		SAMPLING METHOD: _____				SPT / NQ2						
MATERIAL DESCRIPTION AND NOTES							ELEV.		DEPTHS			
<div>ASPHALT (6")</div> <div>GRAVEL (6")</div> <div>VERY STIFF, BROWN, CLAY, "AND" SILT, TRACE SAND, MOIST (FILL) @2.5"; HARD, LITTLE SAND, TRACE GRAVEL</div> <div>@4.0'; VERY STIFF, CONTAINS WOOD PIECES</div> <div>MEDIUM DENSE, BROWN, GRAVEL AND/OR STONE FRAGMENTS WITH SAND, LITTLE SILT, TRACE CLAY, DAMP</div> <div>VERY STIFF, BROWN, SILT AND CLAY, SOME SAND, LITTLE GRAVEL, DAMP</div> <div>SANDSTONE, BROWN, HIGHLY WEATHERED, WEAK.</div> <div>DOLOMITE, BROWN AND GRAY, MODERATELY WEATHERED, MODERATELY STRONG; RQD 62%, REC 96%.</div> <div>@11.0': COMPRESSIVE STRENGTH (Qu)= 3,670 psi</div> <div>@11.9': COMPRESSIVE STRENGTH (Qu) = 2,830 psi</div>							1118.0					
							1117.5					
							1117.0		1			
									2			
									3			
									5			
									4			
									5			
									6			
									1			
							1112.5		2			
									6			
									9			
									6			
							1111.0		14			
									9			
							1109.5		2			
									2			
									26			
									30/1'			
		9										
1107.9		10										
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		11										
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		13										
		14										
		15										
		16										
		17										
		18										
		19										
		20										
1097.9		FOR										

PROJECT: HIG-73-0.26		DRILLING FIRM / OPERATOR: _____				CTL / TM						
TYPE: BRIDGE		SAMPLING FIRM / LOGGER: _____				CTL / TM						
PID: 105111 SFN: 3601536		DRILLING METHOD: 3.25" HSA / NQ2										
START: 7/18/24 END: 7/18/24		SAMPLING METHOD: _____				SPT / NQ2						
MATERIAL DESCRIPTION AND NOTES							ELEV.		DEPTHS			
<div>ASPHALT (6")</div> <div>GRAVEL (6")</div> <div>VERY STIFF, BROWN, CLAY, "AND" SILT, TRACE SAND, MOIST (FILL) @2.5"; HARD, LITTLE SAND, TRACE GRAVEL</div> <div>@4.0'; VERY STIFF, CONTAINS WOOD PIECES</div> <div>MEDIUM DENSE, BROWN, GRAVEL AND/OR STONE FRAGMENTS WITH SAND, LITTLE SILT, TRACE CLAY, DAMP</div> <div>VERY STIFF, BROWN, SILT AND CLAY, SOME SAND, LITTLE GRAVEL, DAMP</div> <div>SANDSTONE, BROWN, HIGHLY WEATHERED, WEAK.</div> <div>DOLOMITE, BROWN AND GRAY, MODERATELY WEATHERED, MODERATELY STRONG; RQD 62%, REC 96%.</div> <div>@11.0': COMPRESSIVE STRENGTH (Qu)= 3,670 psi</div> <div>@11.9': COMPRESSIVE STRENGTH (Qu) = 2,830 psi</div>							1118.0					
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1097.9		FOR										

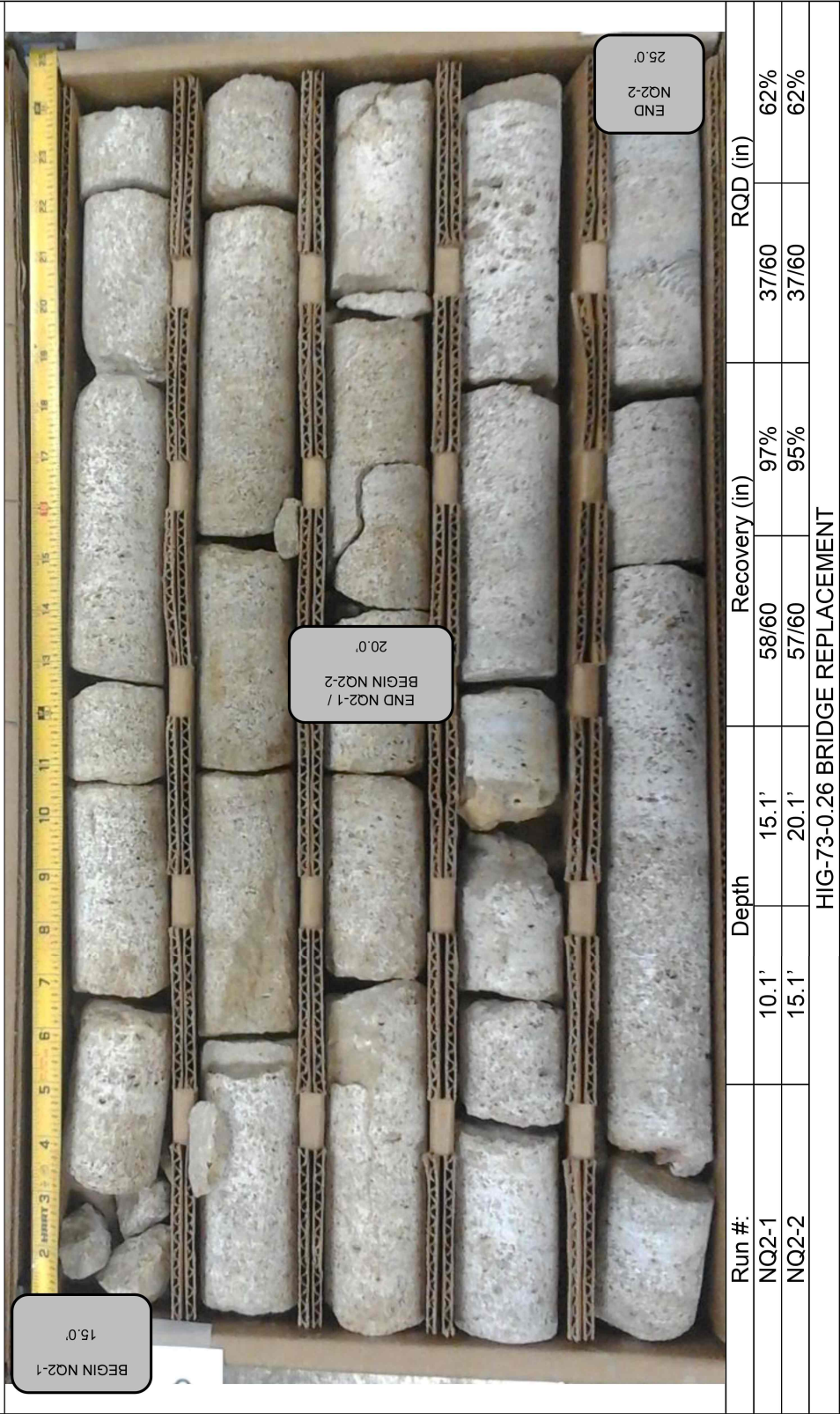
PROJECT: HIG-73-0.26		DRILLING FIRM / OPERATOR: _____				CTL / TM						
TYPE: BRIDGE		SAMPLING FIRM / LOGGER: _____				CTL / TM						
PID: 105111 SFN: 3601536		DRILLING METHOD: 3.25" HSA / NQ2										
START: 7/18/24 END: 7/18/24		SAMPLING METHOD: _____				SPT / NQ2						
MATERIAL DESCRIPTION AND NOTES							ELEV.		DEPTHS			
<div>ASPHALT (6")</div> <div>GRAVEL (6")</div> <div>VERY STIFF, BROWN, CLAY, "AND" SILT, TRACE SAND, MOIST (FILL) @2.5"; HARD, LITTLE SAND, TRACE GRAVEL</div> <div>@4.0'; VERY STIFF, CONTAINS WOOD PIECES</div> <div>MEDIUM DENSE, BROWN, GRAVEL AND/OR STONE FRAGMENTS WITH SAND, LITTLE SILT, TRACE CLAY, DAMP</div> <div>VERY STIFF, BROWN, SILT AND CLAY, SOME SAND, LITTLE GRAVEL, DAMP</div> <div>SANDSTONE, BROWN, HIGHLY WEATHERED, WEAK.</div> <div>DOLOMITE, BROWN AND GRAY, MODERATELY WEATHERED, MODERATELY STRONG; RQD 62%, REC 96%.</div> <div>@11.0': COMPRESSIVE STRENGTH (Qu)= 3,670 psi</div> <div>@11.9': COMPRESSIVE STRENGTH (Qu) = 2,830 psi</div>							1118.0					
							1117.5					
							1117.0		1			
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							1111.0		14			
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							1109.5		2			
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									26			
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1107.9		10										
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		19										
		20										
1097.9		FOR										


PROJECT: HIG-73-0.26		DRILLING FIRM / OPERATOR: _____				CTL / TM						
TYPE: BRIDGE		SAMPLING FIRM / LOGGER: _____				CTL / TM						
PID: 105111 SFN: 3601536		DRILLING METHOD: 3.25" HSA / NQ2										
START: 7/18/24 END: 7/18/24		SAMPLING METHOD: _____				SPT / NQ2						
MATERIAL DESCRIPTION AND NOTES							ELEV.		DEPTHS			
<div>ASPHALT (6")</div> <div>GRAVEL (6")</div> <div>VERY STIFF, BROWN, CLAY, "AND" SILT, TRACE SAND, MOIST (FILL) @2.5"; HARD, LITTLE SAND, TRACE GRAVEL</div> <div>@4.0'; VERY STIFF, CONTAINS WOOD PIECES</div> <div>MEDIUM DENSE, BROWN, GRAVEL AND/OR STONE FRAGMENTS WITH SAND, LITTLE SILT, TRACE CLAY, DAMP</div> <div>VERY STIFF, BROWN, SILT AND CLAY, SOME SAND, LITTLE GRAVEL, DAMP</div> <div>SANDSTONE, BROWN, HIGHLY WEATHERED, WEAK.</div> <div>DOLOMITE, BROWN AND GRAY, MODERATELY WEATHERED, MODERATELY STRONG; RQD 62%, REC 96%.</div> <div>@11.0': COMPRESSIVE STRENGTH (Qu)= 3,670 psi</div> <div>@11.9': COMPRESSIVE STRENGTH (Qu) = 2,830 psi</div>							1118.0					
							1117.5					
							1117.0		1			
									2			
									3			
									5			
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									6			
									1			
							1112.5					

NOTES: CAVED AT 9'
ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED ASPHALT PATCH; BACKFILLED WITH GROUT



B-002-0-24



DESIGN AGENCY	
	
2860 FISHER ROAD COLUMBUS, OHIO 43204 PHONE: (614) 276-1123 FAX: (614) 276-6377	
DESIGNER	
N.K.S	
REVIEWER	
SM 10-06-24	
PROJECT ID	
105111	
SUBSET	TOTAL
5	5
SHEET	TOTAL
P.57	57

GEOTECHNICAL PROFILE - BRIDGE
BORING LOG AND ROCK CORE PHOTO FOR B-002-0-24

APPENDIX B

TEST BORING RECORDS



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

1) STRENGTH OF SOIL:

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

2) COLOR :

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

3) PRIMARY COMPONENT

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

Cohesive (fine grained) Soils - Consistency

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

4) COMPONENT MODIFIERS:

Description	Percentage By Weight
Trace	0% - 10%
Little	$>10\%$ - 20%
Some	$>20\%$ - 35%
“And”	$>35\%$

5) Soil Organic Content

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

6) Relative Visual Moisture

Description	Criteria	
	Cohesive Soil	Non-cohesive Soils
Dry	Powdery; Cannot be rolled; Water content well below the plastic limit	No moisture present
Damp	Leaves very little moisture when pressed between fingers; Crumbles at or before rolled to $\frac{1}{8}$ ”; Water content below plastic limit	Internal moisture, but no to little surface moisture
Moist	Leaves small amounts of moisture when pressed between fingers; Rolled to $\frac{1}{8}$ ” or smaller before crumbling; Water content above plastic limit to -3% of the liquid limit	Free water on surface, moist (shiny) appearance
Wet	Very mushy; Rolled multiple times to $\frac{1}{8}$ ” or smaller before crumbles; Near or above the liquid limit	Voids filled with free water, can be poured from split spoon.

APPENDIX A.2 – ODOT Quick Reference Guide for Rock Description

1: ROCK TYPE: Common rock types are: Claystone; Coal; Dolomite; Limestone; Sandstone; Siltstone; & Shale.

2: COLOR: To be determined when rock is wet. When using the GSA Color charts use only Name, not code.

3: WEATHERING

Description	Field Parameter
Unweathered	No evidence of any chemical or mechanical alternation of the rock mass. Mineral crystals have a bright appearance with no discoloration. Fractures show little or no staining on surfaces.
Slightly weathered	Slight discoloration of the rock surface with minor alterations along discontinuities. Less than 10% of the rock volume presents alteration.
Moderately weathered	Portions of the rock mass are discolored as evident by a dull appearance. Surfaces may have a pitted appearance with weathering “halos” evident. Isolated zones of varying rock strengths due to alteration may be present. 10 to 15% of the rock volume presents alterations.
Highly weathered	Entire rock mass appears discolored and dull. Some pockets of slightly too moderately weathered rock may be present and some areas of severely weathered materials may be present.
Severely weathered	Majority of the rock mass reduced to a soil-like state with relic rock structure discernable. Zones of more resistant rock may be present, but the material can generally be molded and crumbled by hand pressures.

5: RELATIVE STRENGTH

Description	Field Parameter
Very Weak	Core can be carved with a knife and scratched by fingernail. Can be excavated readily with a point of a pick. Pieces 1 inch or more in thickness can be broken by finger pressure.
Weak	Core can be grooved or gouged readily by a knife or pick. Can be excavated in small fragments by moderate blows of a pick point. Small, thin pieces can be broken by finger pressure.
Slightly Strong	Core can be grooved or gouged 0.05 inch deep by firm pressure of a knife or pick point. Can be excavated in small chips to pieces about 1-inch maximum size by hard blows of the point of a geologist’s pick.
Moderately Strong	Core can be scratched with a knife or pick. Grooves or gouges to ¼” deep can be excavated by hand blows of a geologist’s pick. Requires moderate hammer blows to detach hand specimen.
Strong	Core can be scratched with a knife or pick only with difficulty. Requires hard hammer blows to detach hand specimen. Sharp and resistant edges are present on hand specimen.
Very Strong	Core cannot be scratched by a knife or sharp pick. Breaking of hand specimens requires hard repeated blows of the geologist hammer.
Extremely strong	Core cannot be scratched by a knife or sharp pick. Chipping of hand specimens requires hard repeated blows of the geologist hammer.

7: DESCRIPTORS

Arenaceous – sandy
Calcareous - contains calcium carbonate
Conglomeritic - contains rounded to subrounded gravel
Ferriferous – contains iron
Friable – easily broken down
Siliceous – contains silica

Argillaceous - clayey
Carbonaceous - contains carbon
Crystalline – contains crystalline structure
Fissile – thin planner partings
Micaceous – contains mica
Stylolitic – contain stylotites (suture like structure)

4: TEXTURE

Component		Grain Diameter
Boulder		>12”
Cobble		3”-12”
Gravel		0.08”-3”
Sand	Coarse	0.02”-0.08”
	Medium	0.01”-0.02”
	Fine	0.005”-0.01”
	Very Fine	0.003”-0.005”

6: BEDDING

Description	Thickness
Very Thick	>36”
Thick	18” – 36”
Medium	10” – 18”
Thin	2” – 10”
Very Thin	0.4” – 2”
Laminated	0.1” – 0.4”
Thinly Laminated	<0.1”

Brecciated – contains angular to subangular gravel
Cherty- contains chert fragments
Dolomitic- contains calcium/magnesium carbonate
Fossiliferous – contains fossils
Pyritic – contains pyrite
Vuggy – contains openings

[illegible]

NOTES: CAVED AT 10'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH GROUT

[illegible]

NOTES: CAVED AT 9'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED ASPHALT PATCH; BACKFILLED WITH GROUT

APPENDIX C

LABORATORY TEST RESULTS



PROJECT NO:	24050039COL
DATE:	10/3/2024

UNIAXIAL COMPRESSIVE STRENGTH OF INTACT ROCK CORE - ASTM D 7012



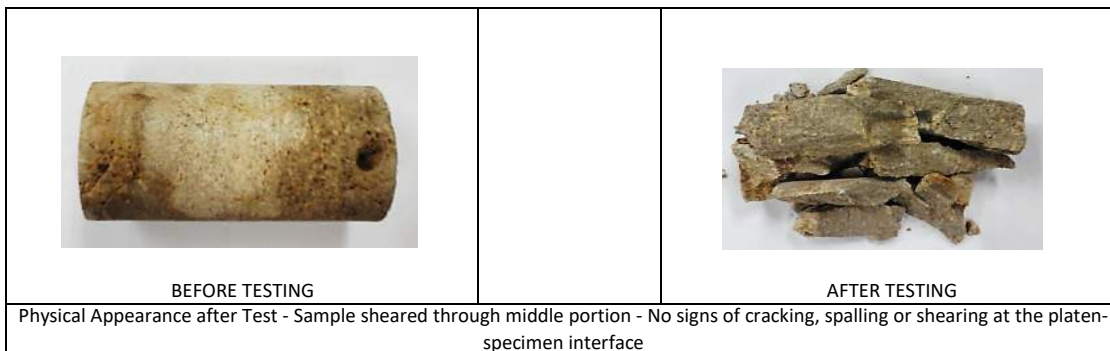
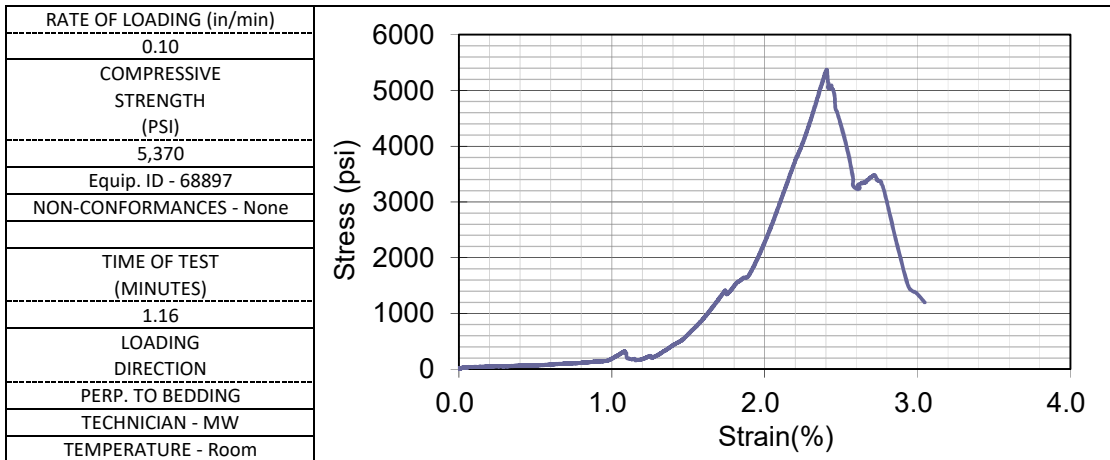
Method C

BORING NUMBER	B-001-0-24	TOP DEPTH(FT)	12.4	BOTTOM DEPTH(FT)	12.8
SAMPLE NUMBER	NQ2-1	DISTRICT	9	PID NO.	105111
COUNTY	HIG	ROUTE	SR 73	SECTION	0.26

FORMATION	Silurian
DESCRIPTION	Dolomite, Brown, Moderately Weathered, Moderately Strong
MOISTURE CONDITION	As Received

MEASUREMENT	LENGTH(INCHES)	DIAMETER(INCHES)
1	4.001	1.982
2	4.005	1.992
3	4.004	1.984
AVERAGE	4.003	1.986

LENGTH/DIAMETER	2.0
CORRECTION FACTOR	1
AREA(IN ²)	3.1
MASS (GRAMS)	512.5
UNIT WEIGHT(LBS/FT ³)	157.4



- ≤ Prepared in accordance with ASTM D 4543: **Yes; see report**
- ≤ Received sample preserved in accordance with SGE: **Yes**
- ≤ Sampled preserved after preparation: **N; Tested immediately after preparation.**

PROJECT NO:	24050039COL
DATE:	10/3/2024

UNIAXIAL COMPRESSIVE STRENGTH OF INTACT ROCK CORE - ASTM D 7012



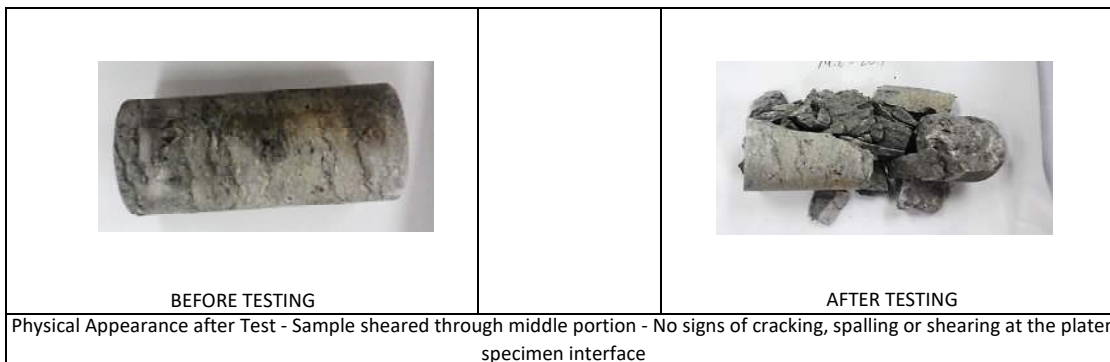
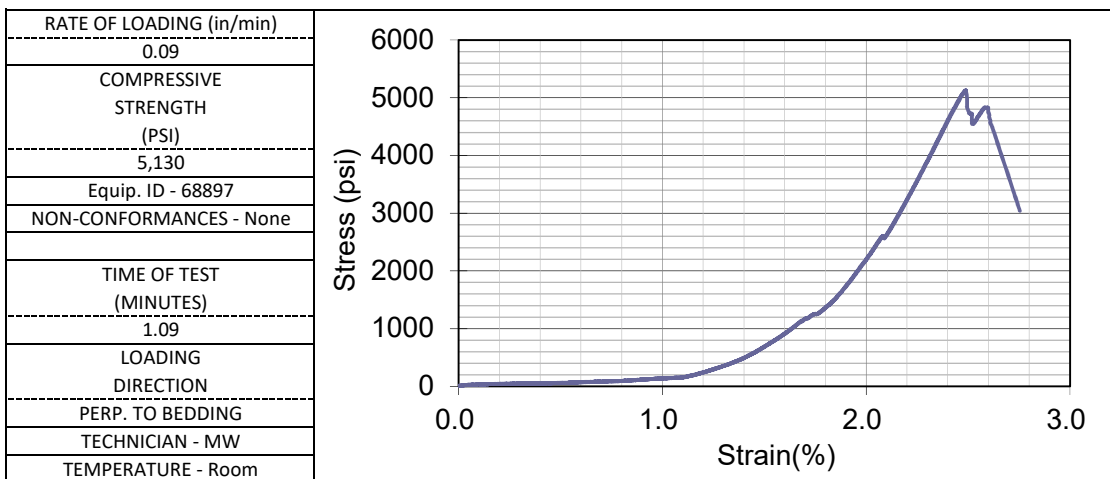
Method C

BORING NUMBER	B-001-0-24	TOP DEPTH(FT)	19.6	BOTTOM DEPTH(FT)	20.1
SAMPLE NUMBER	NQ2-2	DISTRICT	9	PID NO.	105111
COUNTY	HIG	ROUTE	SR 73	SECTION	0.26

FORMATION	Silurian
DESCRIPTION	Dolomite, Gray, Moderately Weathered, Moderately Strong
MOISTURE CONDITION	As Received

MEASUREMENT	LENGTH(INCHES)	DIAMETER(INCHES)
1	4.013	1.979
2	4.007	1.981
3	4.008	1.987
AVERAGE	4.009	1.982

LENGTH/DIAMETER	2.0
CORRECTION FACTOR	1
AREA(IN ²)	3.1
MASS (GRAMS)	529.7
UNIT WEIGHT(LBS/FT ³)	163.1



- ≤ Prepared in accordance with ASTM D 4543: **Yes; see report**
- ≤ Received sample preserved in accordance with SGE: **Yes**
- ≤ Sampled preserved after preparation: **N; Tested immediately after preparation.**

PROJECT NO:	24050039COL
DATE:	10/3/2024

UNIAXIAL COMPRESSIVE STRENGTH OF INTACT ROCK CORE - ASTM D 7012



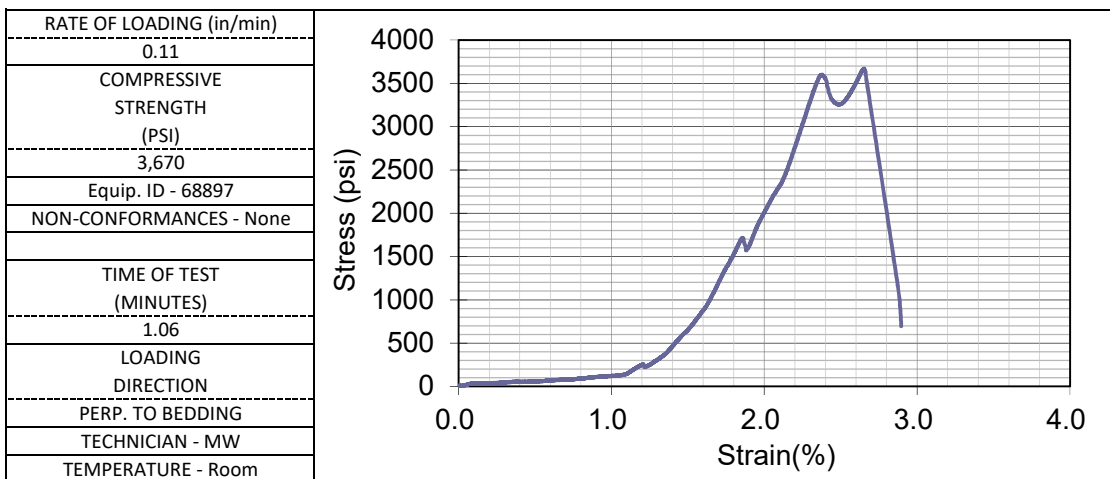
Method C

BORING NUMBER	B-002-0-24	TOP DEPTH(FT)	11.0	BOTTOM DEPTH(FT)	11.5
SAMPLE NUMBER	NQ2-1	DISTRICT	9	PID NO.	105111
COUNTY	HIG	ROUTE	SR 73	SECTION	0.26

FORMATION	Silurian
DESCRIPTION	Dolomite, Brown, Moderately Weathered, Moderately Strong
MOISTURE CONDITION	As Received

MEASUREMENT	LENGTH(INCHES)	DIAMETER(INCHES)
1	4.035	1.983
2	4.029	1.979
3	4.036	1.976
AVERAGE	4.033	1.979

LENGTH/DIAMETER	2.0
CORRECTION FACTOR	1
AREA(IN ²)	3.1
MASS (GRAMS)	487.1
UNIT WEIGHT(LBS/FT ³)	149.5



- ≤ Prepared in accordance with ASTM D 4543: **Yes; see report**
- ≤ Received sample preserved in accordance with SGE: **Yes**
- ≤ Sampled preserved after preparation: **N; Tested immediately after preparation.**

PROJECT NO:	24050039COL
DATE:	10/3/2024

UNIAXIAL COMPRESSIVE STRENGTH OF INTACT ROCK CORE - ASTM D 7012



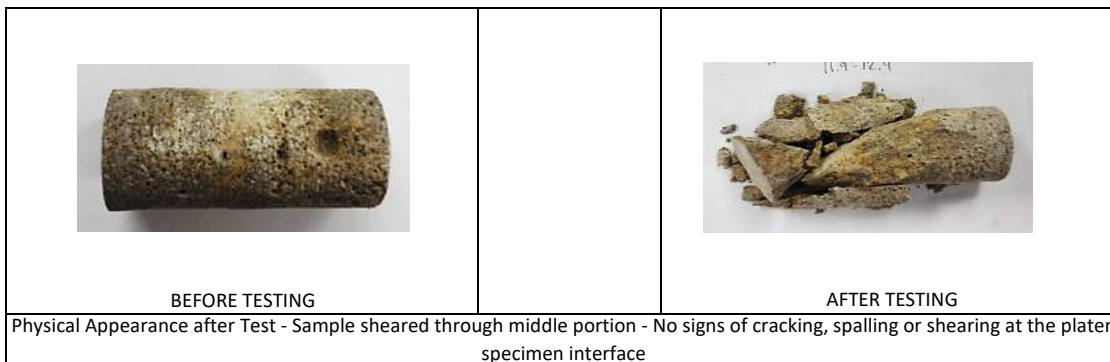
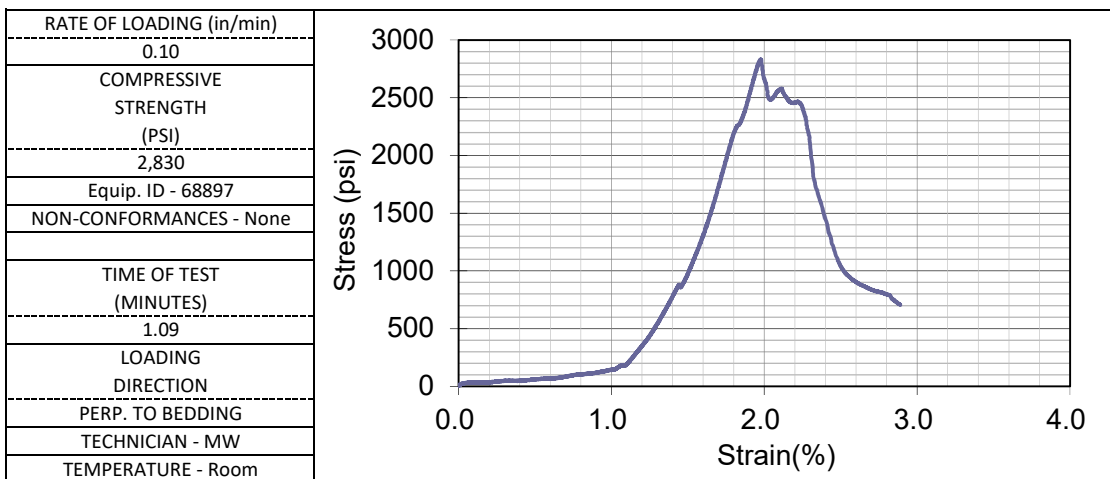
Method C

BORING NUMBER	B-002-0-24	TOP DEPTH(FT)	11.9	BOTTOM DEPTH(FT)	12.4
SAMPLE NUMBER	NQ2-1	DISTRICT	9	PID NO.	105111
COUNTY	HIG	ROUTE	SR 73	SECTION	0.26

FORMATION	Silurian
DESCRIPTION	Sandstone, Brown, Moderately Weathered, Slightly Strong
MOISTURE CONDITION	As Received

MEASUREMENT	LENGTH(INCHES)	DIAMETER(INCHES)
1	4.004	1.979
2	4.008	1.981
3	4.011	1.986
AVERAGE	4.008	1.982

LENGTH/DIAMETER	2.0
CORRECTION FACTOR	1
AREA(IN ²)	3.1
MASS (GRAMS)	479.0
UNIT WEIGHT(LBS/FT ³)	147.6



- ≤ Prepared in accordance with ASTM D 4543: **Yes; see report**
- ≤ Received sample preserved in accordance with SGE: **Yes**
- ≤ Sampled preserved after preparation: **N; Tested immediately after preparation.**

APPENDIX D

DRILLED SHAFT CALCULATIONS



Drilled Shaft - Side Resistance in Rock

HIG-73-0.26

Rear Abutment

Boring No B-001-0-24
 Proposed Bottom of Foundation 1108.8 feet (From Stage 2 Plans)
 Top of Coreable Rock Elevation 1109.7 feet (From Boring)

LRFD Side Resistance

Top Elev.	Material	q_u (ksf)	P_a (ksf)	C	f'_c (ksf)	q_s (ksf)	$q_{s,max}$ (ksf)	Check	Compressive		Uplift	
									Resistance Factor	Factored Side Resistance (ksf)	Resistance Factor	Factored Side Resistance (ksf)
1108.8	Rock	773.3	2.12	1.00	576	40.5	34.9	No Good	0.55	22.3	0.4	16.2

* Side Friction within upper several feet of rock should be neglected per ODOT BDM section 305.4.2- To be determined by the structural engineer

** Side Resistance should be neglected within the scour zone - To be determined by the Structural Engineer

Notes

P_a (ksf)= Atmospheric Pressure	
C = regression Coefficient	(C=1 for corable rock and for augerable rock lowerbound value per AASHTO TABLE 10.8.3.5.4b-1)
f'_c (ksi)= Concrete Compressive Strength	(4.0 ksi as per ODOT BDM Section C304.2.1)
$q_s = C P_a (q_u / P_a)^{0.5}$	(AASHTO Equation 10.8.3.5.4b-1)
$q_{s,max} = P_a (f'_c / P_a)^{0.5}$	
Resistance Factor= 0.55 Compressive	(AASHTO TABLE 10.5.5.2.4-1)
0.40 Uplift	(AASHTO TABLE 10.5.5.2.4-1)
q_u (ksf)= 773.3 ksf	Compressive Strength of dolomite (psi)= 5,370
	B-001-0-24, Compressive Strength Test Result, NQ2-1

Drilled Shaft - Tip Resistance

HIG-73-0.26

Rear Abutment

Boring No B-001-0-24

Unconfined Compressive Strength, q_u ⁽¹⁾ (psi)	Unconfined Compressive Strength, q_u (ksf)	Nominal Unit Tip Resistance, q_p ⁽²⁾ (ksf)	Resistance Factor, Tip Resistance ⁽³⁾	Factored Unit Tip Resistance, q_p (ksf)
5,130	738.7	1846.8	0.50	923.4

Reference Key

- (1) Compressive Strength Test Result, NQ2-2
- (2) AASHTO 10.8.3.5.4c-1
- (3) AASHTO Table 10.5.5.2.4-1

Drilled Shaft - Side Resistance in Rock

HIG-73-0.26

Rear Abutment

Boring No B-002-0-24
 Proposed Bottom of Foundation 1107.6 feet (From Stage 2 Plans)
 Top of Coreable Rock Elevation 1107.9 feet (From Boring)

LRFD Side Resistance

Top Elev.	Material	q_u (ksf)	P_a (ksf)	C	f'_c (ksf)	q_s (ksf)	$q_{s,max}$ (ksf)	Check	Compressive		Uplift	
									Resistance Factor	Factored Side Resistance (ksf)	Resistance Factor	Factored Side Resistance (ksf)
1107.6	Rock	407.5	2.12	1.00	576	29.4	34.9	OK	0.55	16.2	0.4	11.8

* Side Friction within upper several feet of rock should be neglected per ODOT BDM section 305.4.2- To be determined by the structural engineer

** Side Resistance should be neglected within the scour zone - To be determined by the Structural Engineer

Notes

P_a (ksf)= Atmospheric Pressure

C = regression Coefficient

f'_c (ksi)= Concrete Compressive Strength

$q_s = C P_a (q_u / P_a)^{0.5}$

$q_{s,max} = P_a (f'_c / P_a)^{0.5}$

Resistance Factor= 0.55 Compressive

0.40 Uplift

q_u (ksf)= 407.5 ksf

(C=1 for corable rock and for augerable rock lowerbound value per AASHTO TABLE 10.8.3.5.4b-1)

(4.0 ksi as per ODOT BDM Section C304.2.1)

(AASHTO Equation 10.8.3.5.4b-1)

(AASHTO TABLE 10.5.5.2.4-1)

(AASHTO TABLE 10.5.5.2.4-1)

Compressive Strength of dolomite (psi)= 2,830

B-002-0-24, Compressive Strength Test Result, NQ2-1

Drilled Shaft - Tip Resistance

HIG-73-0.26

Rear Abutment

Boring No B-002-0-24

Unconfined Compressive Strength, q_u ⁽¹⁾ (psi)	Unconfined Compressive Strength, q_u (ksf)	Nominal Unit Tip Resistance, q_p ⁽²⁾ (ksf)	Resistance Factor, Tip Resistance ⁽³⁾	Factored Unit Tip Resistance, q_p (ksf)
2,830	407.5	1018.8	0.50	509.4

Reference Key

- (1) Compressive Strength Test Result, NQ2-1
- (2) AASHTO 10.8.3.5.4c-1
- (3) AASHTO Table 10.5.5.2.4-1

APPENDIX E

LPILE PARAMETERS



L-PILE Soil and Rock Parameters

HIG-73-0.26

Boring No

Bottom of Foundation Elevation	1108.8	feet	(From Stage 2 Plans)
Top of Coreable Rock Elevation	1109.7	feet	(From Boring)

B-001-0-24

Below the Bottom of Foundation

Use Rock Type-	Weak Rock (Reese)		
Effective Unit Weight =	157.4	pcf	B-001-0-24, Compressive Strength Test Result, NQ2-1
Strain Factor K_{rm} =	0.00005		From L-pile
Compressive Strength q_u =	5370	psi	B-001-0-24, Compressive Strength Test Result, NQ2-1
Initial Rock Modulus =	480000	psi	GDM Table 400-6, Moderately Strong to Strong
RQD =	22%		Boring B-001-0-24, RQD of NQ2-1

Boring No

Bottom of Foundation Elevation	1107.6	feet	(From Stage 2 Plans)
Top of Coreable Rock Elevation	1107.9	feet	(From Boring)

B-002-0-24

Below the Bottom of Foundation

Use Rock Type-	Weak Rock (Reese)		
Effective Unit Weight =	147.6	pcf	B-002-0-24, Compressive Strength Test Result, NQ2-1
Strain Factor K_{rm} =	0.00005		From L-pile
Compressive Strength q_u =	2830	psi	B-002-0-24, Compressive Strength Test Result, NQ2-1
Initial Rock Modulus =	250000	psi	GDM Table 400-6, very weak rock
RQD =	62%		B-002-0-24, NQ-2-1

APPENDIX F

SUBGRADE ANALYSIS





OHIO DEPARTMENT OF TRANSPORTATION

OFFICE OF GEOTECHNICAL ENGINEERING

PLAN SUBGRADES

Geotechnical Design Manual Section 600

Instructions: Enter data in the shaded cells only.

(Enter state route number, project description, county, consultant's name, prepared by name, and date prepared. This information will be transferred to all other sheets. The date prepared must be entered in the appropriate cell on this sheet to remove these instructions prior to printing.)

HIG-73-0.26

105111

Bridge Replacement

CTL Engineering Inc.

Prepared By: Sastry Malladi, P.E
Date prepared: Thursday, October 3, 2024

Sastry Malladi, P.E
2860 Fisher Road
Columbus, Ohio

614-276-8123
smalladi@ctleng.com

NO. OF BORINGS: **2**



#	Boring ID	Alignment	Station	Offset	Dir	Drill Rig	ER	Boring EL.	Proposed Subgrade EL	Cut Fill
1	B-001-0-24	SR 73	222+87	17	Right	CME 55#393	79	1119.8	1119.8	0.0
2	B-002-0-24	SR 73	223+73	5	Left	CME 55#393	79	1118.0	1118.2	0.2 F

[illegible]

PID: 105111

County-Route-Section: HIG-73-0.26

No. of Borings: 2

Geotechnical Consultant: CTL Engineering Inc.

Prepared By: Sastry Malladi, P.E

Date prepared: 10/3/2024

Chemical Stabilization Options		
320	Rubblize & Roll	No
206	Cement Stabilization	No
	Lime Stabilization	Option
206	Depth	12"

Excavate and Replace Stabilization Options	
Global Geotextile Average(N60L): Average(HP):	12" 0"
Global Geogrid Average(N60L): Average(HP):	0" 0"

Design CBR	6
---------------	---

% Samples within 3 feet of subgrade			
N ₆₀ ≤ 5	0%	HP ≤ 0.5	0%
N ₆₀ < 12	17%	0.5 < HP ≤ 1	0%
12 ≤ N ₆₀ < 15	17%	1 < HP ≤ 2	0%
N ₆₀ ≥ 20	17%	HP > 2	67%
M+	17%		
Rock	0%		
Unsuitable Soil	0%		

Excavate and Replace at Surface	
Average	
Maximum	0"
Minimum	0"

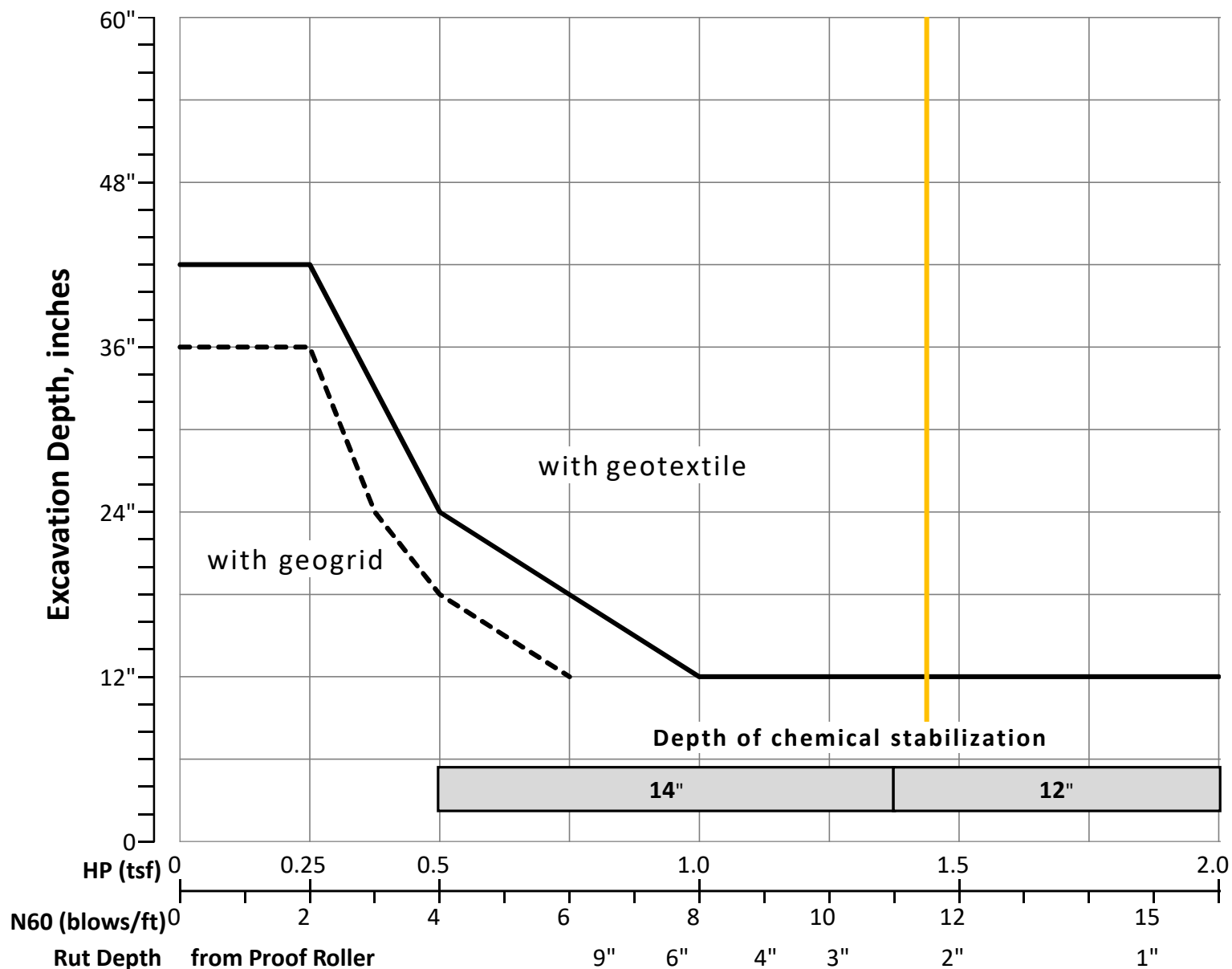
% Proposed Subgrade Surface	
Unstable & Unsuitable	25%
Unstable	25%
Unsuitable (Soil & Rock)	0%

	N ₆₀	N _{60L}	HP	LL	PL	PI	Silt	Clay	P 200	M _C	M _{OPT}	GI
Average	17	12	3.79	40	19	21	41	32	73	20	16	11
Maximum	33	12	4.25	54	22	34	50	44	94	27	19	19
Minimum	11	11	3.00	23	16	7	26	14	40	10	11	1

Classification Counts by Sample																				
ODOT Class	UCF	Rock	A-1-a	A-1-b	A-2-4	A-2-5	A-2-6	A-2-7	A-3	A-3a	A-4a	A-4b	A-5	A-6a	A-6b	A-7-5	A-7-6	A-8a	A-8b	Totals
Count	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	4	0	0	6
Percent	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	17%	0%	0%	17%	0%	0%	67%	0%	0%	100%
% Rock Granular Cohesive	0%	0%	17%									83%								100%
Surface Class Count	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3	0	0	4
Surface Class Percent	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	25%	0%	0%	75%	0%	0%	100%



Fig. 600-1 – Subgrade Stabilization



OVERRIDE TABLE

Calculated Average	New Values	Check to Override
3.79	0.50	<input type="checkbox"/> HP
11.50	6.00	<input type="checkbox"/> N60L

Average HP

Average N_{60L}



APPENDIX G

ROCK CORE PHOTOS



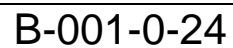


B-001-0-24



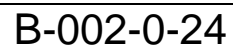
Run #:	Depth		Recovery (in)		RQD (in)	
NQ2-1	10.1'	15.1'	45.5/60	76%	13/60	22%
NQ2-2	15.1'	20.1'	59/60	98%	32/60	53%

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END NQ2-3
25.1'

Run #:	Depth		Recovery (in)		RQD (in)	
NQ2-3	20.1'	25.1'	59.5/60	99%	51/60	85%
HIG-73-0.26 BRIDGE REPLACEMENT						



Run #:	Depth		Recovery (in)		RQD (in)	
NQ2-1	10.1'	15.1'	58/60	97%	37/60	62%
NQ2-2	15.1'	20.1'	57/60	95%	37/60	62%

HIG-73-0.26 BRIDGE REPLACEMENT