CTL Engineering, Inc.
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January 17, 2020

E.P. Ferris & Associates, Inc.
880 King Avenue
Columbus, Ohio 43212

Attention: Mr. John L. Ubbing, P.E.
Bridge Engineer

Reference: Roadway Exploration – Draft
PIK-CR9-5.29
Latham, Ohio
CTL Project No. 19050131COL

Dear Mr. Ubbing:

CTL Engineering, Inc. has completed the Roadway Exploration report for the above referenced project. A pdf copy of the draft report is being submitted.

A Structure Foundation Exploration report for the bridge is being submitted separately.

Thank you for the opportunity to work with you on this project. If you have any questions or need further information, please feel free to contact our office.

Respectfully Submitted

CTL ENGINEERING, INC.

Joe Grani, P.E.
Project Engineer

Roadway Exploration – Draft

PIK-CR9-5.29
Latham, Ohio
CTL Project No. 19050131COL

PREPARED FOR:

E.P. FERRIS & ASSOCIATES, INC
880 KING AVENUE
COLUMBUS, OHIO 43212

PREPARED BY:

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January 17, 2020

TABLE OF CONTENTS

I. EXECUTIVE SUMMARY

The project involves the realignment of a section of County Road 9 (CR 9) in Pike County, Ohio. As a part of the project, a new bridge will be constructed.

Five (5) test borings identified as B-001-0-19 through B-005-0-19 were drilled at the site. Borings B-003-0-19 and B-004-0-19 were drilled in the vicinity of the proposed bridge abutments. The remaining borings were drilled in the vicinity of the proposed roadway. Additionally, one (1) pavement core, identified as X-006-0-19 was performed near the northern end of the project.

Results of the GB1 subgrade analysis indicates that unstable soils are expected in the roadway subgrade near the south end of the project in the vicinity of boring B-001-0-19. Refer to the Subgrade Considerations section of this report for additional information. The pavement may be designed using a CBR value of 6.0.

II. INTRODUCTION

The project involves the realignment of a section of County Road 9 (CR 9) in Pike County, Ohio. As a part of the project, a new bridge will also be constructed. The proposed bridge will be a single-span, composite prestressed box beam with reinforced concrete deck on semi-integral abutments.

The project begins at station 180+90 and ends at Station 198+62, for a total project length of 1,772 feet. The maximum embankment fill will be about 6 feet in height, and will be in the vicinity of the proposed bridge rear abutment and new bridge approach embankment west of the creek. Minor cut is planned in isolated locations for this project.

This report is a Draft Roadway Exploration report. A Structure Foundation Exploration report for the bridge is being submitted separately.

III. GEOLOGY AND OBSERVATIONS OF THE PROJECT

According to the Ohio Department of Natural Resources (ODNR), Glacial Map of Ohio, the project site is located in the unglaciated portion of Ohio.

According to the ODNR, *Physiographic Regions of Ohio*, the site lies on the Shawnee-Mississippian Plateau. According to the Bedrock Geologic Map of Ohio (2006), the bedrock below the site consists of Silurian age dolomite with minor limestone and shale from Pebbles Dolomite of the Lilley and Bisher Formations.

According to the ODNR's Underground Mines website, no deep mines have been mapped within the limits of the project. However, a limestone quarry is located about 1.5 miles west of the site.

According to web based mapping from United States Department of Agriculture, Natural Resources Conservation Service, the near-surface soils at the site consist primarily of Haymond silt loam, (Ha). According to the *Soil Survey of Pike County, Ohio*, the Ha soils exhibit moderately high to high permeability.

According to the Ohio Karst Areas map prepared by the ODNR, the project site lies in an area not known to contain karst features.

The most recent site visit was performed by personnel from CTL Engineering on October 28, 2019. The roadway relocation extends out over existing agricultural fields east and west of the existing creek.

The existing grade in the area of the proposed roadway realignment is relatively flat, except in the area of the creek. Normally consolidated alluvial deposits are common in areas with similar topography.

No major signs of slope instability were noted in the vicinity of the proposed bridge. However, signs of erosion were noted particularly on the creek bank on the eastern side of the creek.

The existing pavement exhibited cracks, particularly near the edge of pavement.

IV. EXPLORATION

Five (5) test borings identified as B-001-0-19 through B-005-0-19 were drilled at the site. Additionally, one (1) pavement core, identified as X-006-0-19 was performed near the northern end of the project.

The borings were performed with a track mounted drill rig utilizing hollow stem augers (HSA) between November 5 and 7, 2019. Standard penetration tests were conducted using a 140-pound automatic hammer, falling 30 inches, to drive 2-inch O.D. split barrel samplers. The energy transfer ratio associated with the automatic SPT hammer is 82.7 percent. The hammer was calibrated on October 18, 2018. Rock coring was performed in borings B-003-0-19 and B-004-0-19 using a double tube core barrel with a diamond bit.

Soil samples obtained were preserved in glass jars, visually classified in the field and laboratory, and tested for natural moisture content. Representative soil samples were subjected to laboratory testing including grain size distribution and Atterberg limits.

Representative samples of the recovered bedrock were subjected to compressive strength testing.

Stations, offsets and ground surface elevations at the test boring locations were provided by personnel from E.P. Ferris & Associates, Inc.

V. FINDINGS

Boring B-001-0-19 was drilled through the existing roadway pavement. This boring exhibited a pavement composition consisting of 2 inches of asphalt over 8 inches of granular base. The asphalt in pavement core X-006-0-19 measured 7 inches in thickness. The remaining borings exhibited 8 to 10 inches of topsoil at the surface.

Below the surface cover, all borings except B-003-0-19 exhibited layers of silt and clay (A-6a) or silty clay (A-6b) to depths ranging from 7.5 feet to 13.5 feet below existing grade. These soils exhibited standard penetration N_{60} values ranging from 6 to 17 blows per foot (bpf), with natural moisture content values ranging from 17 to 34 percent. Boring B-001-0-19 was terminated in these deposits.

The borings then encountered layers of gravel and/or stone fragments with sand and silt (A-2-4), gravel and/or stone fragments with sand, silt, and clay (A-2-6), or coarse and fine sand (A-3a) with interbedded layers of silt (A-4b), and silt and clay (A-6a). These deposits exhibited N_{60} values ranging from 0 bpf (weight of hammer) to 50 blows for 1 inch of penetration, with natural moisture content values ranging from 10 to 66 percent. Borings B-002-0-19 and B-005-0-19 were terminated in these deposits.

Beneath the soil overburden, borings B-003-0-19 and B-004-0-19 exhibited limestone bedrock. The bedrock exhibited Rock Quality Designation (RQD) values ranging from 0 to 76 percent, and core recovery values ranging from 64 to 100 percent.

Groundwater was encountered in borings B-002-0-19 through B-005-0-19 at depths ranging from 3.5 feet to 10.6 feet. These groundwater depths correspond to elevations ranging from 606.4 to 609.9.

VI. ANALYSES AND RECOMMENDATIONS

Based on the subsurface data obtained from the field and laboratory testing, the following recommendations are provided for the proposed roadway.

A. Subgrade Considerations

A subgrade analysis was performed utilizing the subsurface information from the drilled borings along with ODOT Geotechnical Bulletin 1 (GB1) guidelines. A copy of the GB1 spreadsheet is appended to this report under Appendix D.

The natural moisture content values of the near surface (subgrade) samples ranged from 10 to 32 percent, averaging 22 percent. Optimum Moisture Content (OMC) values for the subgrade samples were estimated using procedures outlined in ODOT's GB1. The estimated OMC values ranged from 8 to 18 percent, averaging 14 percent. These soils exhibited an average PI value of 14.

Group Index values for the subgrade samples ranged from 9 to 10, averaging 10. This average Group Index value corresponds to an estimated California Bearing Ratio (CBR) value of 6. It is recommended that the pavement be designed using a CBR value of 6.

Anticipated areas of subgrade stabilization, along with the estimated average excavate/replace depth, are summarized in Table 1.

Table 1. Anticipated Areas of Stabilization

Station		Test Boring No.	Estimated Average Excavate/Replace Depth (inches)
From	To		
Begin Project	186+35	B-001-0-19	12

The above excavate/replace information should only be used as an estimate. The actual depths and limits of excavate/replace should be determined by the Engineer in the field based upon proofrolling. The depths are measured from the proposed pavement subgrade level.

As an alternative to excavate/replace, the subgrades could be stabilized using chemical stabilization. Based on guidelines from GB1, 14 inches of cement stabilization would be appropriate for this site.

Subsequent to subgrade stabilization, or in areas where excavate/replace is not required, the underlying soils may exhibit unstable conditions. In such an event, a bridge lift may be placed as outlined in Item 203.05 of the ODOT Construction and Material Specifications, to provide a stable surface for placing additional fill.

B. Embankment Settlement

From the plan and profile sheets provided by E.P. Ferris & Associates, Inc., it is understood that embankment fill will be placed in the vicinity of the proposed bridge approach embankments to raise the existing grade. The maximum fill height will be approximately 6 feet in the area of the Rear Abutment.

A settlement analysis was performed in the area of maximum fill (near bridge Rear Abutment) using soil data from boring B-003-0-19. It is estimated that the underlying soils will settle 1.0 to 1.5 inches as a result of the fill placement. Results of the settlement analysis are provided in Appendix E.

It is estimated that about 90 percent of the settlement will occur in about 1 week. No settlement monitoring or waiting period is needed for the new embankments prior to pavement installation. Refer to the Structure Foundation Exploration report for a discussion on waiting period at the Rear Abutment of the bridge.

C. Global Stability

Slope stability analyses were performed in the area of maximum fill using the Slide computer program. This program is based on two-dimensional limit equilibrium methods in which the calculation of the factor of safety against instability of a slope is performed by the method of slices. The method used was the Morgenstern-Price method for surfaces of a circular shape.

The soil parameters used in the analysis are based on the subsurface conditions encountered in the borings and estimated parameters for the embankment soils.

Results of the stability analysis are submitted in graphical format in Appendix F of this report.

The graphs presents the geometry of the slope (2H:1V); the modeled soil strata and their corresponding parameters; and the most critical failure surface along with the minimum factor of safety. Factor of safety is defined as the ratio of forces resisting movement (generally the shear strength value along the assumed failure surface) to forces acting on the slope, generally gravity and applied vehicular loads. Results of the global stability analyses are summarized in Table 2.

Table 2. Global Stability at Area of Maximum Fill

Case	Computed Factor of Safety	Minimum Acceptable Factor of Safety
Effective Stress	1.7	1.3
Total Stress	3.9	1.3

Results of the global stability analyses indicate that slope stability will not be of concern in the area of the maximum embankment fill, since the computed factor of safety values are greater than the minimum acceptable factor of safety values.

D. General Construction and Earthwork

1. Site preparation and earthwork should be performed in accordance with the ODOT Construction and Material Specifications, and applicable Geotechnical Bulletins.

2. Permanent embankment side slopes should be constructed at a slope rate of 2:1 Horizontal to Vertical (H:V) or flatter. All slopes should be seeded and vegetation growth permitted to limit sloughing and slope failure.

3. Temporary excavations in excess of 4 feet in depth should be sloped or shored according to OSHA requirements.

4. Excavations in the soils at this site could be accomplished using standard equipment.

VII. 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 Engineering should be notified so that our recommendations can modified, if required.

VIII. TESTING AND OBSERVATION

During the design process, it is recommended that CTL Engineering 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 Engineering is not responsible for independent conclusions, opinions and recommendations made by others based on the data and recommendations provided in this report.

IX. CLOSING

The report was prepared by CTL Engineering, Inc. (Consultant) solely for the use of the 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.

Sastry Malladi, P.E
Project Engineer

Joe Grani, P.E.
Project Engineer

APPENDIX A
SOIL PROFILE

PROJECT DESCRIPTION

THE PROJECT INVOLVES THE REALIGNMENT OF A SECTION OF COUNTY ROAD 9 (CR 9) IN PIKE COUNTY, OHIO. AS A PART OF THE PROJECT, A NEW BRIDGE WILL BE CONSTRUCTED.

HISTORIC RECORDS

HISTORIC GEOTECHNICAL RECORDS WERE SEARCHED FOR ON THE ODOT TIMS WEBSITE. HOWEVER, NO HISTORIC BORINGS WERE FOUND FOR THE EXISTING STRUCTURES.

GEOLOGY

ACCORDING TO THE OHIO DEPARTMENT OF NATURAL RESOURCES (ODNR), GLACIAL MAP OF OHIO, THE PROJECT SITE IS LOCATED IN THE UNGLACIATED PORTION OF OHIO.

ACCORDING TO THE ODNR, PHYSIOGRAPHIC REGIONS OF OHIO, THE SITE LIES ON THE SHAWNEE-MISSISSIPPIAN SECTION AND ALLEGHENY PLATEAUS REGION OF OHIO. ACCORDING TO BEDROCK GEOLOGIC MAP OF OHIO (2006), THE BEDROCK BELOW THE SITE CONSISTS OF SILURIAN AGE DOLOMITE WITH MINOR LIMESTONE AND SHALE FROM PEBBLES DOLOMITE FROM THE LILLEY AND BISHER FORMATIONS.

RECONNAISSANCE

THE MOST RECENT SITE VISIT WAS PERFORMED BY PERSONNEL FROM CTL ENGINEERING ON OCTOBER 28, 2019. THE ROADWAY RELOCATION EXTENDS OUT OVER EXISTING AGRICULTURAL FIELDS EAST AND WEST OF THE EXISTING CREEK.

THE EXISTING GRADE IN THE AREA OF THE PROPOSED ROADWAY REALIGNMENT IS RELATIVELY FLAT, EXCEPT IN THE AREA OF THE CREEK. NORMALLY CONSOLIDATED ALLUVIAL DEPOSITS ARE COMMON IN AREAS WITH SIMILAR TOPOGRAPHY.

NO MAJOR SIGNS OF SLOPE INSTABILITY WERE NOTED IN THE VICINITY OF THE PROPOSED BRIDGE. HOWEVER, SIGNS OF EROSION WERE NOTED PARTICULARLY ON THE CREEK BANK ON THE EASTERN SIDE OF THE CREEK.

THE EXISTING PAVEMENT EXHIBITED CRACKS, PARTICULARLY NEAR THE EDGE OF PAVEMENT.

SUBSURFACE EXPLORATION

FIVE (5) TEST BORINGS IDENTIFIED AS B-001-0-19 THROUGH B-005-0-19 WERE DRILLED AT THE SITE. ADDITIONALLY, ONE (1) PAVEMENT CORE, IDENTIFIED AS X-006-0-19 WAS PERFORMED NEAR THE NORTHERN END OF THE PROJECT.

THE BORINGS WERE PERFORMED WITH A TRACK MOUNTED DRILL RIG UTILIZING HOLLOW STEM AUGERS (HSA) BETWEEN NOVEMBER 5 AND 7, 2019. STANDARD PENETRATION TESTS WERE CONDUCTED USING A 140-POUND AUTOMATIC HAMMER, FALLING 30 INCHES, TO DRIVE 2-INCH O.D. SPLIT BARREL SAMPLERS. THE ENERGY TRANSFER RATIO ASSOCIATED WITH THE AUTOMATIC SPT HAMMER IS 82.7 PERCENT. THE HAMMER WAS CALIBRATED ON OCTOBER 18, 2018. ROCK CORING WAS PERFORMED IN BORINGS B-003-0-19 AND B-004-0-19 USING A DOUBLE TUBE CORE BARREL WITH A DIAMOND BIT.

EXPLORATION FINIDNGS

BORINGS GENERALLY EXHIBITED COARSE AND FINE SAND (A-3a), GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT (A-2-4), GRAVEL AND/OR STONE FRAGMENTS WITH SAND, SILT AND CLAY (A-2-6), SILT (A-4b), SILT AND CLAY (A-6a), OR SILTY CLAY (A-6b) OR CLAY (A-7-6) TO THE DRILL DEPTHS OF B-001-0-19, B-002-0-19, B-005-0-19 AND TO DEPTHS RANGING FROM 20.0 TO 23.0 FEET IN BORINGS B-003-0-19 AND B-004-0-19.

BELOW THE SOIL OVERBURDEN, BORINGS B-003-0-19 AND B-004-0-19 EXHIBITED LIMESTONE BEDROCK. THE BEDROCK WAS SAMPLED USING ROCK CORING TECHNIQUES.

GROUNDWATER WAS ENCOUNTERED DURING DRILLING IN BORINGS B-002-0-19, B-003-0-19 AND B-004-0-19 AT DEPTHS RANGING FROM 3.5 TO 10.6 FEET BELOW EXISTING GRADE. THESE DEPTHS CORRESPOND TO ELEVATIONS RANGING FROM 606.4 TO 609.9.

AT DRILLING COMPLETION, GROUNDWATER LEVELS WERE MEASURED IN BORINGS B-002-0-19 AND B-005-0-19 AT DEPTHS RANGING FROM 7.0 TO 8.4 FEET BELOW GRADE. THESE DEPTHS CORRESPOND TO ELEVATION 608.6.

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 JULY 2018.

LEGEND

DESCRIPTION	ODOT CLASS	CLASSIFIED MECH./VISUAL	
GRAVEL AND/OR STONE FRAGMENTS W/SAND AND SILT	A-2-4	0	9
GRAVEL AND/OR STONE FRAGMENTS W/SAND, SILT & CLAY	A-2-6	0	5
COARSE AND FINE SAND	A-3a	0	1
SILT	A-4b	2	2
SILT AND CLAY	A-6a	3	9
SILTY CLAY	A-6b	1	2
	TOTAL	6	28
LIMESTONE	VISUAL		

PAVEMENT OR BASE =X= APPROXIMATE THICKNESS

SOD AND TOPSOIL =X= APPROXIMATE THICKNESS

EXPLORATION LOCATION - PLAN VIEW

EXPLORATION LOCATION - PLAN VIEW - PAVEMENT CORE

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

WC INDICATES WATER CONTENT IN PERCENT.

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

● **INDICATES A PLASTIC MATERIAL WITH A MOISTURE CONTENT EQUAL TO OR GREATER THAN THE LIQUID LIMIT MINUS 3.**

⊖ **INDICATES A NON-PLASTIC MATERIAL WITH A MOISTURE CONTENT GREATER THAN 25% OR GREATER THAN 19% WITH A WET APPEARANCE.**

X/Y/D" NUMBER OF BLOWS FOR STANDARD PENETRATION TEST (SPT): X= NUMBER OF BLOWS FOR 6 INCHES (UNCORRECTED). Y/D"= NUMBER OF BLOWS (UNCORRECTED) FOR D" OF PENETRATION AT REFUSAL.

SS INDICATES A SPLIT-SPOON SAMPLE.

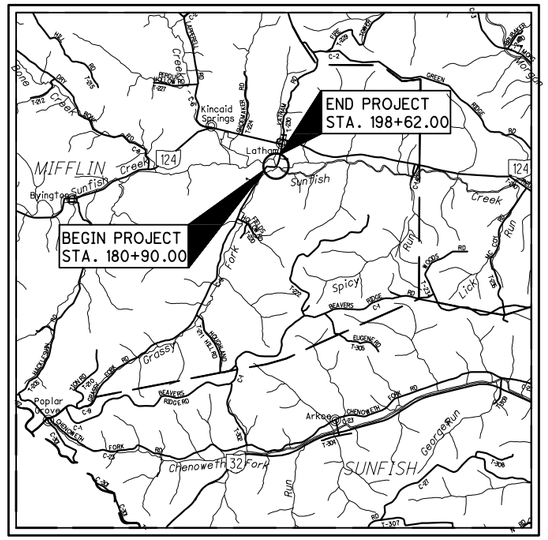
NP INDICATES A NON-PLASTIC SAMPLE.

W- INDICATES FREE WATER ELEVATION.

▼ INDICATES AT COMPLETION WATER ELEVATION.

AVAILABLE INFORMATION

ALL AVAILABLE INFORMATION AND BEDROCK INFORMATION THAT CAN BE CONVINIENTLY SHOWN ON THE SOIL PROFILE SHEETS HAS BEEN REPORTED. ADDITIONAL SUBSURFACE EXPLORATIONS MAY HAVE BEEN MADE TO STUDY SOME SPECIAL ASPECT OF THE PROJECT. COPIES OF THIS DATA, IF ANY, MAY BE INSPECTED IN THE DISTRICT DEPUTY DIRECTOR'S OFFICE, THE OFFICE OF GEOTECHNICAL ENGINEERING AT 1980 WEST BROAD STREET.



LOCATION MAP

SCALE IN MILES

0 1 2 3 4

N

PARTICLE SIZE DEFINITIONS

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

RECON. - CTL ENGINEERING INC.,10/28/2019
DRILLING - CTL ENGINEERING INC., 11/5-11/7/2019
DRAWN - NKS 01/16/2020
REVIEWED - SM 01/17/2020

CTL ENGINEERING, INC.
2860 FISHER ROAD
COLUMBUS, OHIO 43204
PHONE:1(614)276-8123

PID NO. NA

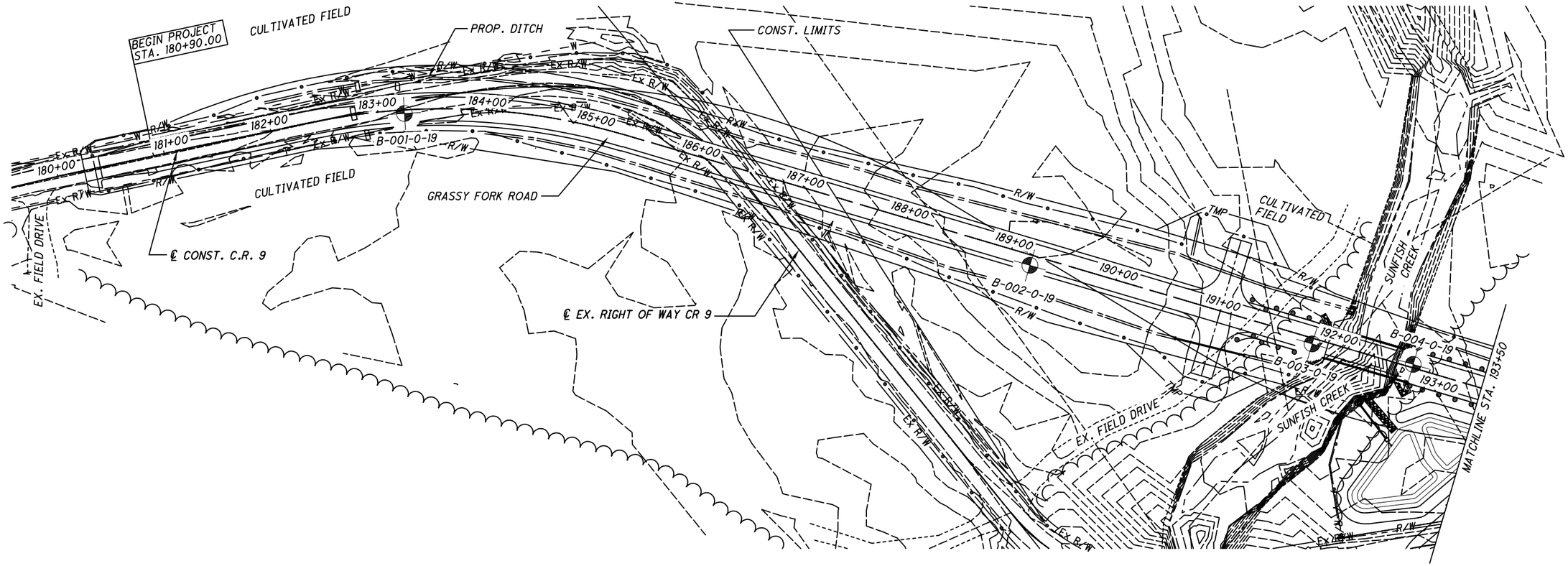
SOIL PROFILE

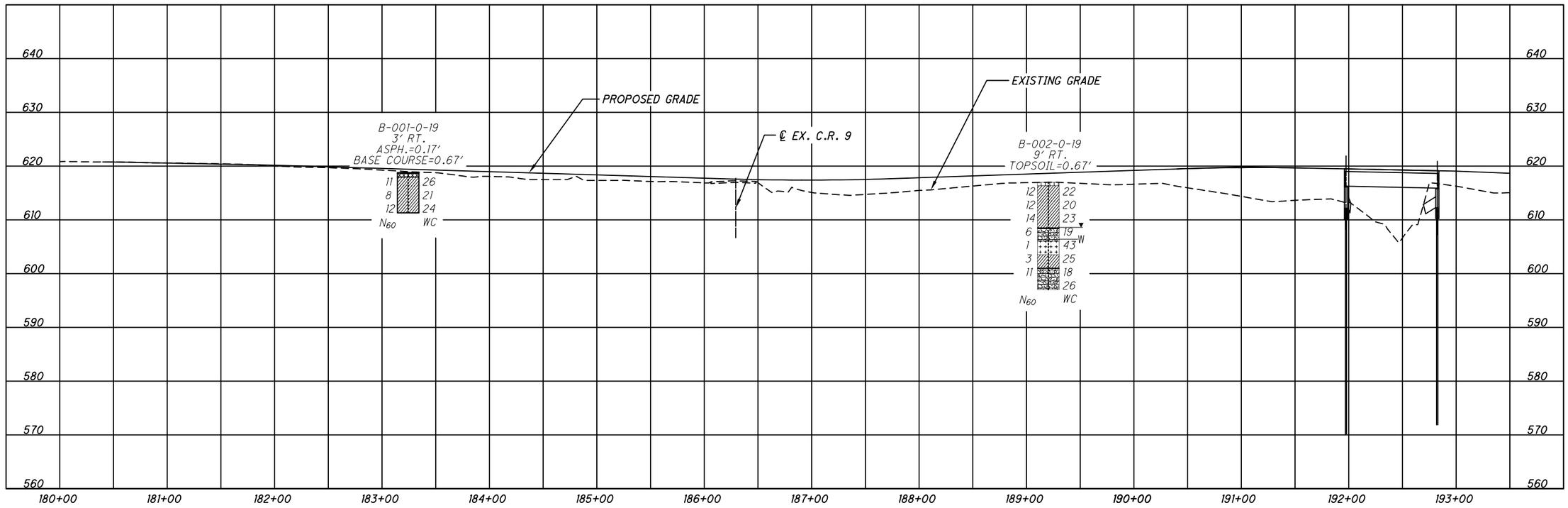
PIK-CR 9-5.29
OVER SUNFISH CEEK

SUMMARY OF SOIL TEST DATA

EXPLORATION NO., STATION & OFFSET	FROM	TO	SAMPLE ID	N60	% REC	HP tsf	% GR	% CS	% FS	% SILT	% CLAY	LL	PL	PI	% WC	ODOT CLASS (GI)	ppm SO_4
B-001-0-19	01.00	02.50	SS-1	11	100	1.75	1	1	4	62	32	35	22	13	26	A-6a (9)	-
STA. 183+514 ; 3′ RT.	03.50	05.00	SS-2	8	39	1	-	-	-	-	-	-	-	-	21	A-6a (VISUAL)	-
LATITUDE = 399265.888	06.00	07.50	SS-3	12	100	1.25	-	-	-	-	-	-	-	-	24	A-6a (VISUAL)	-
LONGITUDE = 1755390.661																	
B-002-0-19	01.00	02.50	SS-1	12	100	2	0	0	1	68	31	35	21	14	22	A-6a (10)	-
STA. 189+20 ; 9′ RT.	03.50	05.00	SS-2	12	100	4.5	-	-	-	-	-	-	-	-	20	A-6a (VISUAL)	-
LATITUDE = 399594.300	06.00	07.50	SS-3	14	100	2.5	-	-	-	-	-	-	-	-	23	A-6a (VISUAL)	-
LONGITUDE = 1755882.456	08.50	10.00	SS-4	6	67	-	-	-	-	-	-	-	-	-	19	A-2-6 (VISUAL)	-
	11.00	12.50	SS-5	1	100	0.5	3	6	5	69	17	38	29	9	43	A-4b (8)	-
	13.50	15.00	SS-6	3	100	-	-	-	-	-	-	-	-	-	25	A-6a (VISUAL)	-
	16.00	17.50	SS-7	11	39	-	-	-	-	-	-	-	-	-	18	A-2-6 (VISUAL)	-
	18.50	19.16	SS-8	8/50/2″	100	-	-	-	-	-	-	-	-	-	26	A-2-6 (VISUAL)	-
B-005-0-19	01.00	02.50	SS-1	14	100	4.5	0	0	2	65	33	36	23	13	23	A-6a (9)	-
STA. 194+50 ; 1′ RT.	03.50	05.00	SS-2	12	100	2.5	-	-	-	-	-	-	-	-	25	A-6a (VISUAL)	-
LATITUDE = 399882.588	06.00	07.50	SS-3	12	100	2.25	-	-	-	-	-	-	-	-	23	A-6a (VISUAL)	-
LONGITUDE = 1756326.058	08.50	10.00	SS-4	6	100	0.25	-	-	-	-	-	-	-	-	34	A-6a (VISUAL)	-
	11.00	12.50	SS-5	10	44	0.25	-	-	-	-	-	-	-	-	31	A-6a (VISUAL)	-
	13.50	15.00	SS-6	14	67	-	-	-	-	-	-	-	-	-	18	A-2-6 (VISUAL)	-

2/8	**PIK-CR 9-5.29** **OVER SUNFISH CREEK**	**SOIL PROFILE** **SUMMERY OF SOIL TEST DATA**	DRAWN N.K.S CHECKED SM



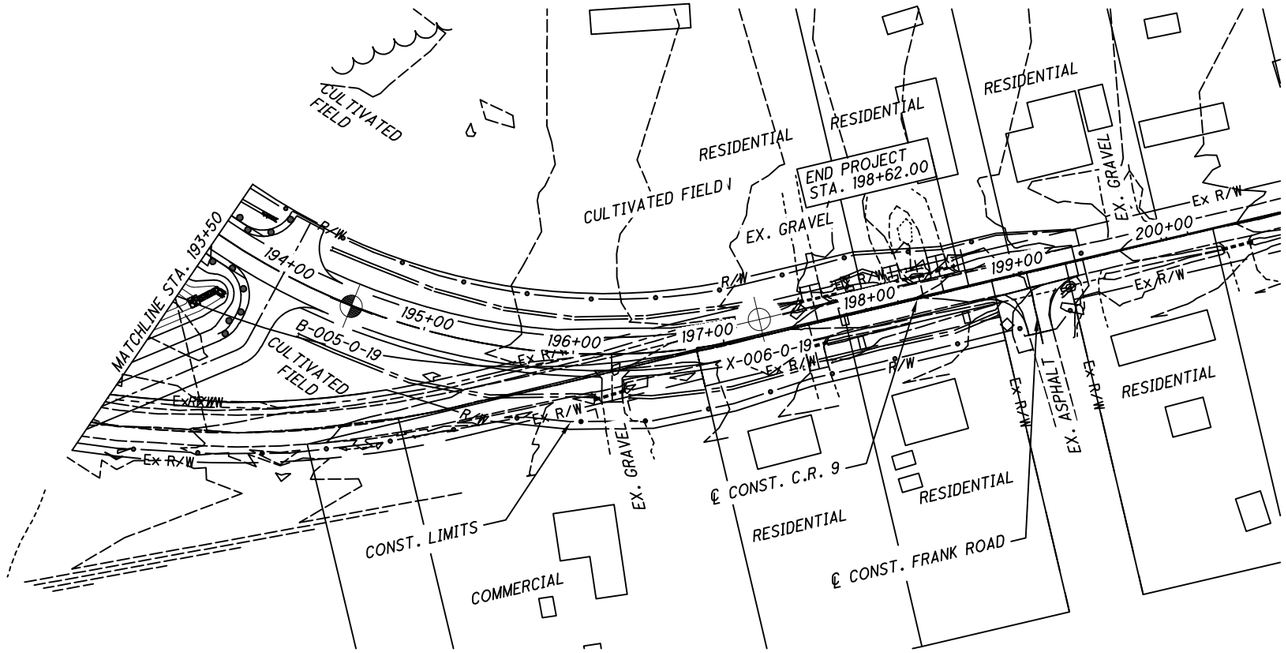


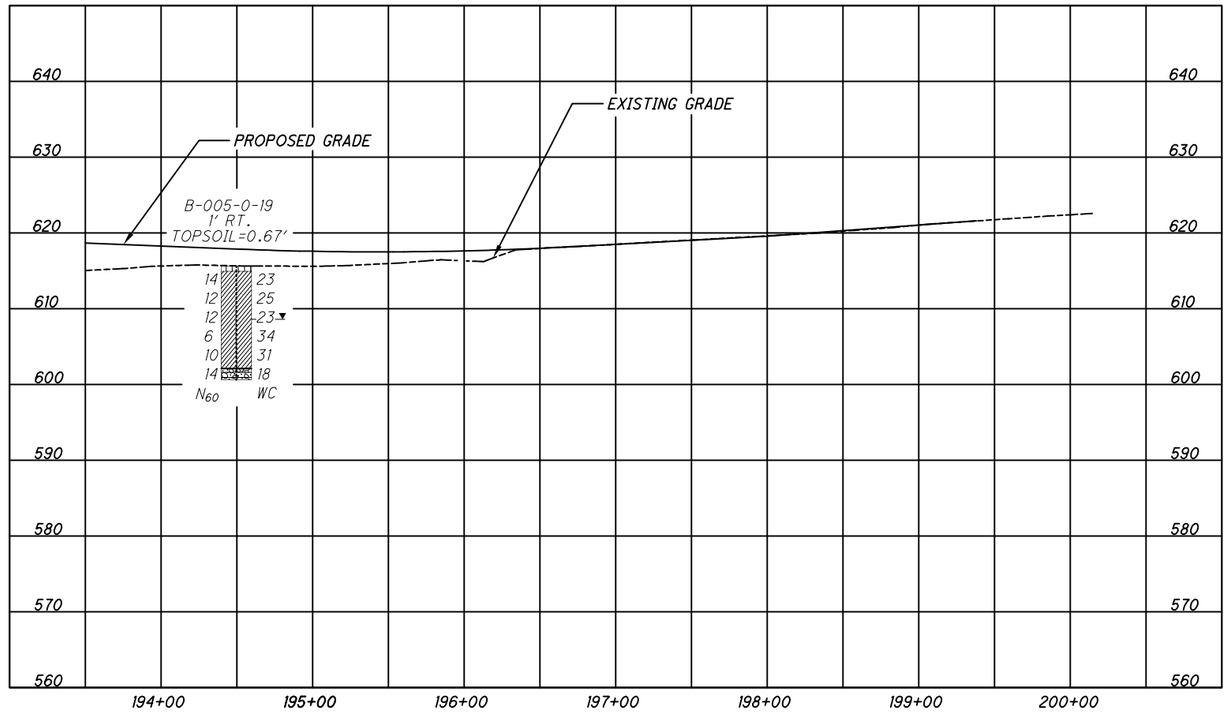
HORIZONTAL SCALE IN FEET
0 25 50 100

DRAWN N.K.S
CHECKED SM

SOIL PROFILE
STA. 180+00.00 TO STA. 193+50.00

PIK-CR 9-5.29
OVER SUNFISH CREEK



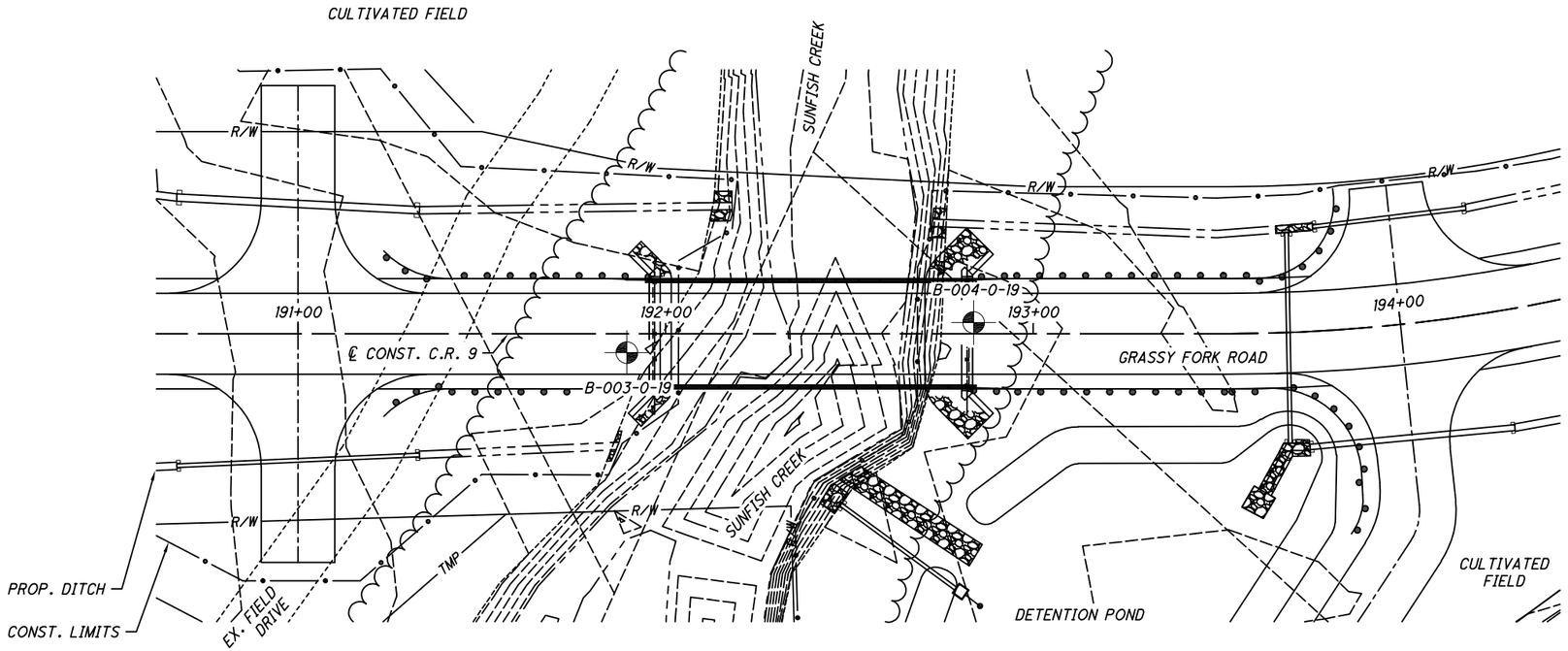


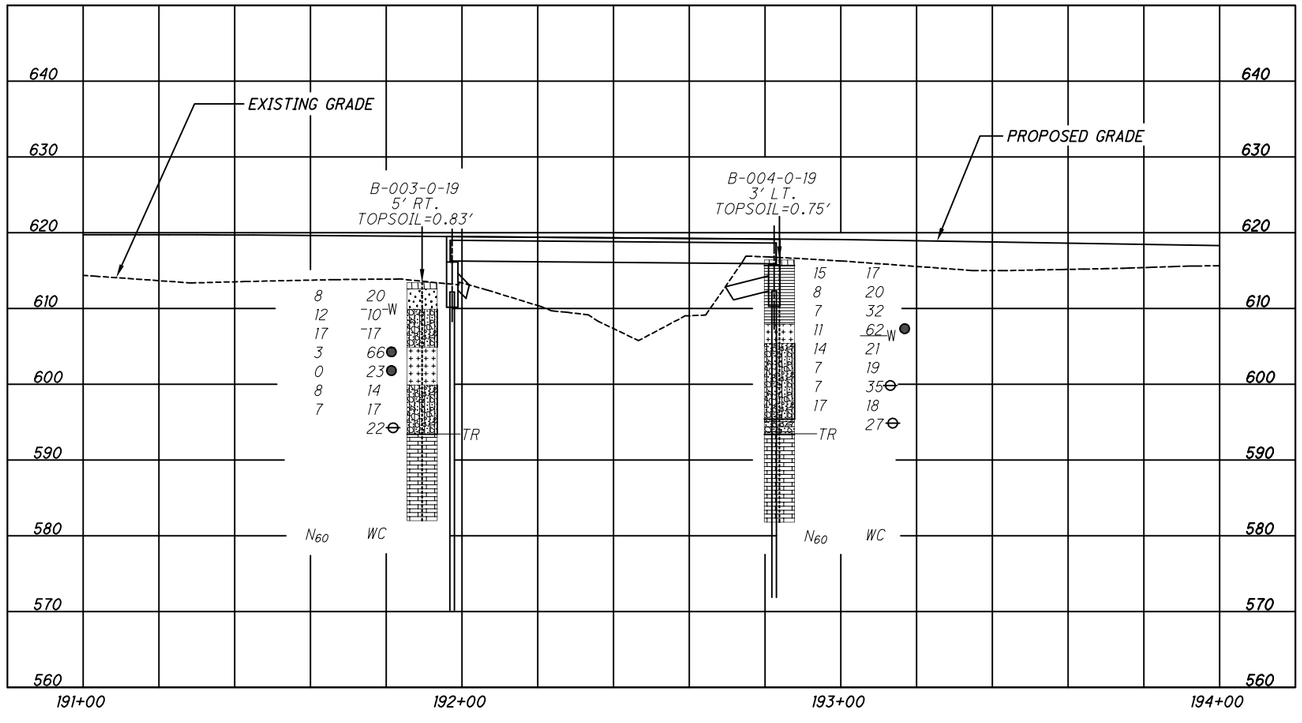
HORIZONTAL SCALE IN FEET
0 25 50 100

DRAWN N.K.S
CHECKED SM

SOIL PROFILE
STA. 193+50.00 TO STA. 200+00.00

PIK-CR 9-5.29
OVER SUNFISH CREEK





HORIZONTAL SCALE IN FEET
0 10 20 40

DRAWN N.K.S
CHECKED SM

STRUCTURE FOUNDATION EXPLORATION
BRIDGE OVER SUNFISH CREEK

PIK-CR 9-5.29
OVER SUNFISH CREEK

PROJECT: PIK-CR9-5.29	DRILLING FIRM / OPERATOR: CTL / TOM	DRILL RIG: B-57 #513	STATION / OFFSET: 191+89, 5' RT.	EXPLORATION ID B-003-0-19
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: CTL / TOM	HAMMER: CME AUTOMATIC	ALIGNMENT: PROPOSED C.R.9	
PID: SFN:	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 10/18/18	ELEVATION: 613.4 (MSL) EOB: 31.4 ft.	PAGE 1 OF 1
START: 11/7/19 END: 11/7/19	SAMPLING METHOD: SPT	ENERGY RATIO (%): 82.7	COORD: 399736.3269 N, 1756111.1814 E	

MATERIAL DESCRIPTION AND NOTES	ELEV. 613.4	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
Topsoil (10")	612.6																	
LOOSE, BROWN, **COARSE AND FINE SAND**, SOME SILT, LITTLE GRAVEL, TRACE CLAY, DAMP	609.9	W 609.9	2 3 3	8	100	SS-1	-	-	-	-	-	-	-	-	-	20	A-3a (V)	
MEDIUM DENSE, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, WET @6.0'; MOIST	604.9		3 5 4	12	33	SS-2	-	-	-	-	-	-	-	-	-	10	A-2-4 (V)	
			7 7 5	17	61	SS-3	-	-	-	-	-	-	-	-	-	17	A-2-4 (V)	
SOFT, GRAY, **SILT**, "AND" SAND, TRACE GRAVEL, TRACE CLAY, CONTAINS ORGANICS, WET @11.0'; STIFF, BROWN, LITTLE CLAY, TRACE GRAVEL, TRACE SAND, NO ORGANICS, MOIST	599.9		1 1 1	3	33	SS-4	0.25	-	-	-	-	-	-	-	-	66	A-4b (V)	
			0 0 0	0	100	SS-5	1.50	0	0	5	80	15	23	19	4	23	A-4b (8)	
LOOSE, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, WET			5 3 3	8	67	SS-6	-	-	-	-	-	-	-	-	-	14	A-2-4 (V)	
			4 3 2	7	67	SS-7	-	-	-	-	-	-	-	-	-	17	A-2-4 (V)	
@18.5'; VERY DENSE	593.4		4 50/2"	-	100	SS-8	-	-	-	-	-	-	-	-	-	22	A-2-4 (V)	
LIMESTONE, GRAY, UNWEATHERED, STRONG, VUGGY, DOLOMITIC; RQD 49%, REC 83%.		TR	0		78	NQ-1											CORE	
@25.5'; COMPRESSIVE STRENGTH = 8,330 PSI			76		100	NQ-2											CORE	
	582.0	EOB	54		64	NQ-3											CORE	

NOTES: CAVED AT 16.3'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT.GDT - 1/16/20 22:42 - J:\DEPT5\19 PROJECTS\19050131COL-E.P. FERRIS-PIK-CR9-5.29\REPORTS\LOGS\19050131COL.GPJ

8 / 9	PIK-CR 9-5.29 OVER SUNFISH CREEK	STRUCTURE FOUNDATION EXPLORATION BORING LOG - B-003-0-19	DRAWN N.K.S CHECKED SM

PROJECT: PIK-CR9-5.29	DRILLING FIRM / OPERATOR: CTL / TOM	DRILL RIG: B-57 #513	STATION / OFFSET: 192+84, 3' LT.	EXPLORATION ID B-004-0-19
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: CTL / TOM	HAMMER: CME AUTOMATIC	ALIGNMENT: PROPOSED C.R.9	
PID: SFN:	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 10/18/18	ELEVATION: 616.4 (MSL) EOB: 34.6 ft.	PAGE 1 OF 1
START: 11/6/19 END: 11/6/19	SAMPLING METHOD: SPT	ENERGY RATIO (%): 82.7	COORD: 399791.8248 N, 1756187.9146 E	

MATERIAL DESCRIPTION AND NOTES	ELEV. 616.4	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
Topsoil (9")	615.7																	
HARD, BROWN, **SILTY CLAY**, TRACE SAND, TRACE GRAVEL, DAMP		1	4 5 6	15	78	SS-1	4.50	0	0	2	74	24	39	23	16	17	A-6b (10)	
@3.5'; VERY STIFF, SOME SAND, DAMP		4	3 2 4	8	100	SS-2	3.50	-	-	-	-	-	-	-	-	20	A-6b (V)	
@6.0'; SOFT, TRACE SAND, MOIST		7	2 2 3	7	100	SS-3	0.25	-	-	-	-	-	-	-	-	32	A-6b (V)	
	607.9																	
STIFF, GRAY, **SILT**, LITTLE CLAY, TRACE GRAVEL, TRACE SAND, CONTAINS ORGANICS, WET		W 606.4 10	0 4 4	11	100	SS-4	1.25	-	-	-	-	-	-	-	-	62	A-4b (V)	
	605.4																	
MEDIUM DENSE, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, MOIST		12	4 4 6	14	67	SS-5	-	-	-	-	-	-	-	-	-	21	A-2-4 (V)	
@13.5'; LOOSE		14	3 3 2	7	67	SS-6	-	-	-	-	-	-	-	-	-	19	A-2-4 (V)	
@16.0'; WET		17	3 3 2	7	22	SS-7	-	-	-	-	-	-	-	-	-	35	A-2-4 (V)	
@18.5'; MOIST		19	8 8 4	17	67	SS-8	-	-	-	-	-	-	-	-	-	18	A-2-4 (V)	
	595.4																	
VERY DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, WET		21	50/1"	-	100	SS-9	-	-	-	-	-	-	-	-	-	27	A-2-6 (V)	
	593.4	TR 23																
LIMESTONE, GRAY, UNWEATHERED, STRONG, DOLOMITIC, VUGGY; RQD 69%, REC 94%.		25	61		95	NQ-1											CORE	
@28.3'; COMPRESSIVE STRENGTH = 11,260 PSI		29	78		94	NQ-2											CORE	
		33	63		94	NQ-3											CORE	
	581.8	EOB 34																

NOTES: CAVED AT 13.6'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT.GDT - 1/16/20 22:42 - J:\DEPT5\19 PROJECTS\19050131COL-E.P. FERRIS-PIK-CR9-5.29\REPORTS\LOGS\19050131COL.GPJ

PROJECT NO:	19050131COL
DATE:	1/16/2020

UNIAXIAL COMPRESSIVE STRENGTH OF INTACT ROCK CORE - ASTM D 7012

Method C

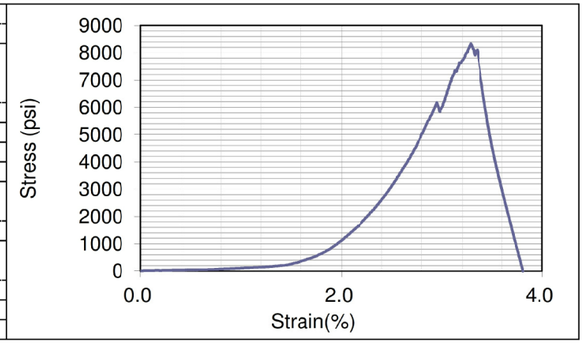
BORING NUMBER	B-003-0-19	TOP DEPTH(FT)	25.5	BOTTOM DEPTH(FT)	25.8
SAMPLE NUMBER	NQ-2	DISTRICT	9	PID NO.	
COUNTY	Pike	ROUTE	CR 9	SECTION	5.29

FORMATION	Peebles Dolomite, Lilley and Bisher Formations, Undivided
DESCRIPTION	Limestone, Gray, Unweathered, Strong, Vuggy, Dolomitic
MOISTURE CONDITION	As Received

MEASUREMENT	LENGTH(INCHES)	DIAMETER(INCHES)
1	4.077	1.955
2	4.075	1.967
3	4.080	1.956
AVERAGE	4.068	1.982

LENGTH/DIAMETER	2.1
CORRECTION FACTOR	1
AREA(IN^2)	3.1
MASS (GRAMS)	544.8
UNIT WEIGHT(LBS/FT^3)	165.3

RATE OF LOADING (in/min)
0.07
COMPRESSIVE STRENGTH (PSI)
8,330
Equip. ID - 68897
NON-CONFORMANCES - None
TIME OF TEST (MINUTES)
1:56
LOADING DIRECTION
PERP. TO BEDDING
TECHNICIAN - MW, KM
TEMPERATURE - Room



BEFORE TESTING

AFTER TESTING

Physical Appearance after Test - Sample sheared through middle portion - No signs of cracking, spalling or shearing at the platen-specimen interface

PROJECT NO:	19050131COL
DATE:	1/16/2020

UNIAXIAL COMPRESSIVE STRENGTH OF INTACT ROCK CORE - ASTM D 7012

Method C

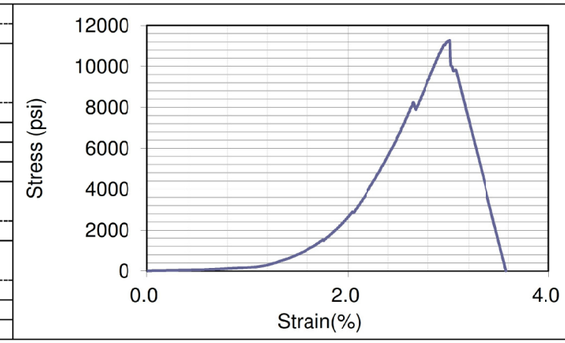
BORING NUMBER	B-004-0-19	TOP DEPTH(FT)	28.3	BOTTOM DEPTH(FT)	28.7
SAMPLE NUMBER	NQ-2	DISTRICT	9	PID NO.	
COUNTY	Pike	ROUTE	CR 9	SECTION	5.29

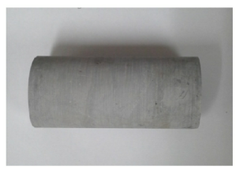
FORMATION	Peebles Dolomite, Lilley and Bisher Formations, Undivided
DESCRIPTION	Limestone, Gray, Unweathered, Strong, Dolomitic, Vuggy
MOISTURE CONDITION	As Received

MEASUREMENT	LENGTH(INCHES)	DIAMETER(INCHES)
1	4.077	1.955
2	4.075	1.967
3	4.080	1.956
AVERAGE	4.075	1.980

LENGTH/DIAMETER	2.1
CORRECTION FACTOR	1
AREA(IN^2)	3.1
MASS (GRAMS)	535.4
UNIT WEIGHT(LBS/FT^3)	162.6

RATE OF LOADING (in/min)
0.09
COMPRESSIVE STRENGTH (PSI)
11,267
Equip. ID - 68897
NON-CONFORMANCES - None
TIME OF TEST (MINUTES)
1:38
LOADING DIRECTION
PERP. TO BEDDING
TECHNICIAN - MW, KM
TEMPERATURE - Room





BEFORE TESTING

AFTER TESTING

Physical Appearance after Test - Sample sheared through middle portion - No signs of cracking, spalling or shearing at the platen-specimen interface

DRAWN N.K.S
CHECKED SM

STRUCTURE FOUNDATION EXPLORATION
COMPRESSIVE STRENGTH TEST RESULT

PIK-CR 9-5.29
OVER SUNFISH CREEK

APPENDIX B
TEST BORING RECORDS

SOIL DESCRIPTION

Descriptors for soil consistency used in this report are based upon the Standard Penetration Test (SPT), ASTM D 1587, with the penetration (N) values corrected to N_{60} , based upon the efficiency of the SPT Hammer used for the soil sampling.

Descriptors for both non-cohesive and cohesive soils are presented below, with the corresponding range of corrected penetration values.

NON-COHESIVE SOIL DESCRIPTION	CORRECTED PENETRATION VALUES BLOWS PER FOOT (BPF)
Very Loose	0 – 4
Loose	5 – 10
Medium Dense	11- 30
Dense	31 – 50
Very Dense	Over 50

COHESIVE SOIL DESCRIPTION	CORRECTED PENETRATION VALUES BLOWS PER FOOT (BPF)
Very Soft	0 – 1
Soft	2 – 4
Medium Stiff	5 – 8
Stiff	9 – 15
Very Stiff	16 –30
Hard	Over 30

Moisture term descriptors for both non-cohesive and cohesive soils are presented below.

NON-COHESIVE SOIL DESCRIPTION	MOISTURE TERMS	COHESIVE SOIL DESCRIPTION
Powdery	Dry	Powdery
Some Moisture	Damp	Below Plastic Limit
Damp to the Touch	Moist	Above Plastic, Below Liquid Limit
Free Water	Wet	Above Liquid Limit

PROJECT: PIK-CR9-5.29	DRILLING FIRM / OPERATOR: CTL / TOM	DRILL RIG: B-57 #513	STATION / OFFSET: 183+51, 3' RT.	EXPLORATION ID B-001-0-19
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: CTL / TOM	HAMMER: CME AUTOMATIC	ALIGNMENT: PROPOSED C.R.9	
PID: SFN:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 10/18/18	ELEVATION: 618.8 (MSL) EOB: 7.5 ft.	PAGE 1 OF 1
START: 11/7/19 END: 11/7/19	SAMPLING METHOD: SPT	ENERGY RATIO (%): 82.7	COORD: 399265.8883 N, 1755390.6606 E	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
Asphalt (2")	618.8																	
Base course (8")	618.7																	
STIFF, BROWN, **SILT AND CLAY**, TRACE SAND, TRACE GRAVEL, MOIST	618.0	1	3 4 4	11	100	SS-1	1.75	1	1	4	62	32	35	22	13	26	A-6a (9)	
		2																
		3																
@3.5'; DAMP		4	7 3 3	8	39	SS-2	1.00	-	-	-	-	-	-	-	-	21	A-6a (V)	
		5																
@6.0'; MOIST		6	3 5 4	12	100	SS-3	1.25	-	-	-	-	-	-	-	-	24	A-6a (V)	
	611.3	7 EOB																

NOTES: CAVED AT 2.0'

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

PROJECT: PIK-CR9-5.29	DRILLING FIRM / OPERATOR: CTL / TOM	DRILL RIG: B-57 #513	STATION / OFFSET: 189+20, 9' RT.	EXPLORATION ID B-002-0-19
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: CTL / TOM	HAMMER: CME AUTOMATIC	ALIGNMENT: PROPOSED C.R.9	
PID: SFN:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 10/18/18	ELEVATION: 617.0 (MSL) EOB: 20.0 ft.	PAGE 1 OF 1
START: 11/6/19 END: 11/6/19	SAMPLING METHOD: SPT	ENERGY RATIO (%): 82.7	COORD: 399594.2996 N, 1755882.4564 E	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
Topsoil (8")	617.0																	
STIFF, BROWN, **SILT AND CLAY**, TRACE SAND, TRACE GRAVEL, MOIST	616.4		5 4 5	12	100	SS-1	2.00	0	0	1	68	31	35	21	14	22	A-6a (10)	
@3.5'; HARD, DAMP			4 4 5	12	100	SS-2	4.50	-	-	-	-	-	-	-	-	20	A-6a (V)	
@6.0'; VERY STIFF, LITTLE SAND, MOIST			4 5 5	14	100	SS-3	2.50	-	-	-	-	-	-	-	-	23	A-6a (V)	
LOOSE, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, WET	608.5	▼	4 2 2	6	67	SS-4	-	-	-	-	-	-	-	-	-	19	A-2-6 (V)	
SOFT, GRAY, **SILT**, LITTLE SAND, LITTLE CLAY, TRACE GRAVEL, CONTAINS ORGANICS, WET	606.0	W 606.4	2 1 0	1	100	SS-5	0.50	3	6	5	69	17	38	29	9	43	A-4b (8)	
SOFT, BROWN, **SILT AND CLAY**, SOME SAND, LITTLE GRAVEL, WET	603.5		0 0 2	3	100	SS-6	-	-	-	-	-	-	-	-	-	25	A-6a (V)	
MEDIUM DENSE, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, WET	601.0		3 4 4	11	39	SS-7	-	-	-	-	-	-	-	-	-	18	A-2-6 (V)	
@18.5'; VERY DENSE, CONTAINS COBBLES	597.0	EOB	8 50/2"	-	100	SS-8	-	-	-	-	-	-	-	-	-	26	A-2-6 (V)	

NOTES: CAVED AT 16.2'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

PROJECT: PIK-CR9-5.29	DRILLING FIRM / OPERATOR: CTL / TOM	DRILL RIG: B-57 #513	STATION / OFFSET: 191+89, 5' RT.
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: CTL / TOM	HAMMER: CME AUTOMATIC	ALIGNMENT: PROPOSED C.R.9
PID: SFN:	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 10/18/18	ELEVATION: 613.4 (MSL) EOB: 31.4 ft.
START: 11/7/19 END: 11/7/19	SAMPLING METHOD: SPT	ENERGY RATIO (%): 82.7	COORD: 399736.3269 N, 1756111.1814 E

EXPLORATION ID B-003-0-19

PAGE 1 OF 2

MATERIAL DESCRIPTION AND NOTES	ELEV. 613.4	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
Topsoil (10")	612.6																	
LOOSE, BROWN, **COARSE AND FINE SAND**, SOME SILT, LITTLE GRAVEL, TRACE CLAY, DAMP	609.9	W 609.9	2 3 3	8	100	SS-1	-	-	-	-	-	-	-	-	-	20	A-3a (V)	
MEDIUM DENSE, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, WET			3 5 4	12	33	SS-2	-	-	-	-	-	-	-	-	-	10	A-2-4 (V)	
@6.0'; MOIST	604.9		7 7 5	17	61	SS-3	-	-	-	-	-	-	-	-	-	17	A-2-4 (V)	
SOFT, GRAY, **SILT**, "AND" SAND, TRACE GRAVEL, TRACE CLAY, CONTAINS ORGANICS, WET			1 1 1	3	33	SS-4	0.25	-	-	-	-	-	-	-	-	66	A-4b (V)	
@11.0'; STIFF, BROWN, LITTLE CLAY, TRACE GRAVEL, TRACE SAND, NO ORGANICS, MOIST	599.9		0 0 0	0	100	SS-5	1.50	0	0	5	80	15	23	19	4	23	A-4b (8)	
LOOSE, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, WET			5 3 3	8	67	SS-6	-	-	-	-	-	-	-	-	-	14	A-2-4 (V)	
			4 3 2	7	67	SS-7	-	-	-	-	-	-	-	-	-	17	A-2-4 (V)	
@18.5'; VERY DENSE	593.4	TR	4 50/2"	-	100	SS-8	-	-	-	-	-	-	-	-	-	22	A-2-4 (V)	
LIMESTONE, GRAY, UNWEATHERED, STRONG, VUGGY, DOLOMITIC; RQD 49%, REC 83%.			0		78	NQ-1											CORE	
@25.5'; COMPRESSIVE STRENGTH = 8,330 PSI			76		100	NQ-2											CORE	
			54		64	NQ-3											CORE	

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 1/16/20 16:01 - J:\DEPT5\19 PROJECTS\19050131COL-E.P. FERRIS-PIK-CR9-5.29\REPORTS\LOGS\19050131COL.GPJ

PID:	SFN:	PROJECT: PIK-CR9-5.29	STATION / OFFSET: 191+89, 5' RT.	START: 11/7/19	END: 11/7/19	PG 2 OF 2	B-003-0-19

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
LIMESTONE, GRAY, UNWEATHERED, STRONG, VUGGY, DOLOMITIC; RQD 49%, REC 83%. *(continued)*	583.4																	
	582.0	EOB 31																

NOTES: CAVED AT 16.3'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

PROJECT: PIK-CR9-5.29	DRILLING FIRM / OPERATOR: CTL / TOM	DRILL RIG: B-57 #513	STATION / OFFSET: 192+84, 3' LT.
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: CTL / TOM	HAMMER: CME AUTOMATIC	ALIGNMENT: PROPOSED C.R.9
PID: SFN:	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 10/18/18	ELEVATION: 616.4 (MSL) EOB: 34.6 ft.
START: 11/6/19 END: 11/6/19	SAMPLING METHOD: SPT	ENERGY RATIO (%): 82.7	COORD: 399791.8248 N, 1756187.9146 E

EXPLORATION ID B-004-0-19

MATERIAL DESCRIPTION AND NOTES	ELEV. 616.4	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
Topsoil (9")	615.7																	
HARD, BROWN, **SILTY CLAY**, TRACE SAND, TRACE GRAVEL, DAMP			4 5 6	15	78	SS-1	4.50	0	0	2	74	24	39	23	16	17	A-6b (10)	
@3.5'; VERY STIFF, SOME SAND, DAMP			3 2 4	8	100	SS-2	3.50	-	-	-	-	-	-	-	-	20	A-6b (V)	
@6.0'; SOFT, TRACE SAND, MOIST			2 2 3	7	100	SS-3	0.25	-	-	-	-	-	-	-	-	32	A-6b (V)	
	607.9																	
STIFF, GRAY, **SILT**, LITTLE CLAY, TRACE GRAVEL, TRACE SAND, CONTAINS ORGANICS, WET		W 606.4	0 4 4	11	100	SS-4	1.25	-	-	-	-	-	-	-	-	62	A-4b (V)	
	605.4																	
MEDIUM DENSE, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, MOIST			4 4 6	14	67	SS-5	-	-	-	-	-	-	-	-	-	21	A-2-4 (V)	
@13.5'; LOOSE			3 3 2	7	67	SS-6	-	-	-	-	-	-	-	-	-	19	A-2-4 (V)	
@16.0'; WET			3 3 2	7	22	SS-7	-	-	-	-	-	-	-	-	-	35	A-2-4 (V)	
@18.5'; MOIST			8 8 4	17	67	SS-8	-	-	-	-	-	-	-	-	-	18	A-2-4 (V)	
	595.4																	
VERY DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, WET			50/1"	-	100	SS-9	-	-	-	-	-	-	-	-	-	27	A-2-6 (V)	
	593.4	TR																
LIMESTONE, GRAY, UNWEATHERED, STRONG, DOLOMITIC, VUGGY; RQD 69%, REC 94%.			61		95	NQ-1											CORE	
@28.3'; COMPRESSIVE STRENGTH = 11,260 PSI			78		94	NQ-2											CORE	

PID:	SFN:	PROJECT: PIK-CR9-5.29	STATION / OFFSET: 192+84, 3' LT.	START: 11/6/19	END: 11/6/19	PG 2 OF 2	B-004-0-19

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
LIMESTONE, GRAY, UNWEATHERED, STRONG, DOLOMITIC, VUGGY; RQD 69%, REC 94%. *(continued)*	586.4	31																
		32																
		33	63		94	NQ-3											CORE	
	581.8	34 EOB																

NOTES: CAVED AT 13.6'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

PROJECT: PIK-CR9-5.29	DRILLING FIRM / OPERATOR: CTL / TOM	DRILL RIG: B-57 #513	STATION / OFFSET: 194+50, 1' RT.	EXPLORATION ID B-005-0-19
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: CTL / TOM	HAMMER: CME AUTOMATIC	ALIGNMENT: PROPOSED C.R.9	
PID: SFN:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 10/18/18	ELEVATION: 615.6 (MSL) EOB: 15.0 ft.	PAGE 1 OF 1
START: 11/5/19 END: 11/6/19	SAMPLING METHOD: SPT	ENERGY RATIO (%): 82.7	COORD: 399882.5875 N, 1756326.0578 E	

MATERIAL DESCRIPTION AND NOTES	ELEV. 615.6	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
Topsoil (8")	615.0																	
HARD, BROWN, **SILT AND CLAY**, TRACE SAND, TRACE GRAVEL, MOIST		1	3 5 5	14	100	SS-1	4.50	0	0	2	65	33	36	23	13	23	A-6a (9)	
		2																
@3.5'; VERY STIFF		3																
		4	3 4 5	12	100	SS-2	2.50	-	-	-	-	-	-	-	-	25	A-6a (V)	
		5																
@6.0'; SOME SAND		6																
		7	3 5 4	12	100	SS-3	2.25	-	-	-	-	-	-	-	-	23	A-6a (V)	
		8																
@8.5'; SOFT, TRACE SAND, WET		9	2 2 2	6	100	SS-4	0.25	-	-	-	-	-	-	-	-	34	A-6a (V)	
		10																
@11.0'; LITTLE SAND, LITTLE GRAVEL		11																
		12	3 4 3	10	44	SS-5	0.25	-	-	-	-	-	-	-	-	31	A-6a (V)	
	602.1	13																
MEDIUM DENSE, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, DAMP		14	4 5 5	14	67	SS-6	-	-	-	-	-	-	-	-	-	18	A-2-6 (V)	
	600.6 EOB	15																

NOTES: CAVED 13.6'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

APPENDIX C
LABORATORY TEST RESULTS

PROJECT NO:	19050131COL
DATE:	1/17/2020

UNIAXIAL COMPRESSIVE STRENGTH OF INTACT ROCK CORE - ASTM D 7012

Method C

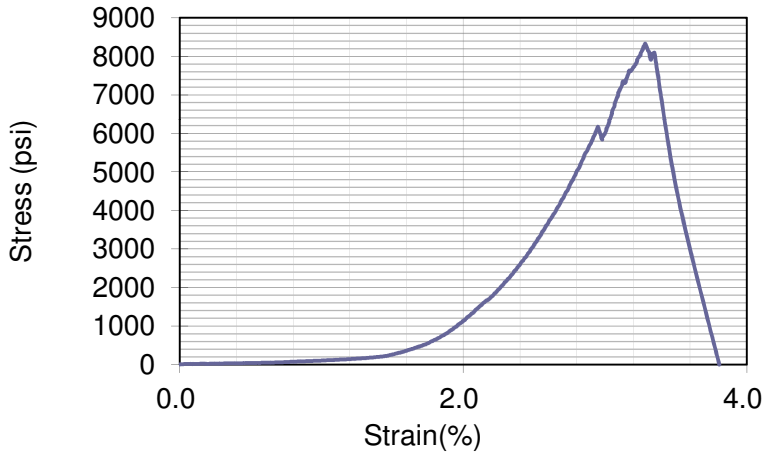
BORING NUMBER	B-003-0-19	TOP DEPTH(FT)	25.5	BOTTOM DEPTH(FT)	25.8
SAMPLE NUMBER	NQ-2	DISTRICT	9	PID NO.	
COUNTY	Pike	ROUTE	CR 9	SECTION	5.29

FORMATION	Peebles Dolomite, Lilley and Bisher Formations, Undivided
DESCRIPTION	Limestone, Gray, Unweathered, Strong, Vuggy, Dolomitic
MOISTURE CONDITION	As Received

MEASUREMENT	LENGTH(INCHES)	DIAMETER(INCHES)
1	4.077	1.955
2	4.075	1.967
3	4.080	1.956
AVERAGE	4.068	1.982

LENGTH/DIAMETER	2.1
CORRECTION FACTOR	1
AREA(IN^2)	3.1
MASS (GRAMS)	544.8
UNIT WEIGHT(LBS/FT^3)	165.3

RATE OF LOADING (in/min)
0.07
COMPRESSIVE STRENGTH (PSI)
8,330
Equip. ID - 68897
NON-CONFORMANCES - None
TIME OF TEST (MINUTES)
1:56
LOADING DIRECTION
PERP. TO BEDDING
TECHNICIAN - MW, KM
TEMPERATURE - Room



BEFORE TESTING

AFTER TESTING

Physical Appearance after Test - Sample sheared through middle portion - No signs of cracking, spalling or shearing at the platen-specimen interface

PROJECT NO:	19050131COL
DATE:	1/17/2020

UNIAXIAL COMPRESSIVE STRENGTH OF INTACT ROCK CORE - ASTM D 7012

Method C

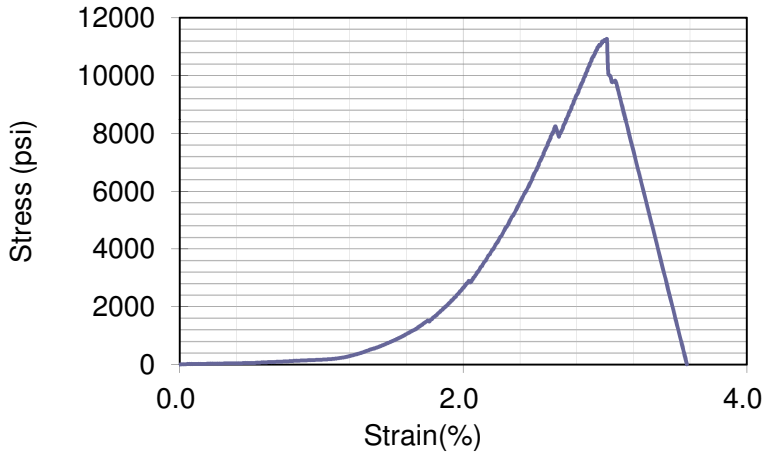
BORING NUMBER	B-004-0-19	TOP DEPTH(FT)	28.3	BOTTOM DEPTH(FT)	28.7
SAMPLE NUMBER	NQ-2	DISTRICT	9	PID NO.	
COUNTY	Pike	ROUTE	CR 9	SECTION	5.29

FORMATION	Peebles Dolomite, Lilley and Bisher Formations, Undivided
DESCRIPTION	Limestone, Gray, Unweathered, Strong, Dolomitic, Vuggy
MOISTURE CONDITION	As Received

MEASUREMENT	LENGTH(INCHES)	DIAMETER(INCHES)
1	4.077	1.955
2	4.075	1.967
3	4.080	1.956
AVERAGE	4.075	1.980

LENGTH/DIAMETER	2.1
CORRECTION FACTOR	1
AREA(IN^2)	3.1
MASS (GRAMS)	535.4
UNIT WEIGHT(LBS/FT^3)	162.6

RATE OF LOADING (in/min)
0.09
COMPRESSIVE STRENGTH (PSI)
11,267
Equip. ID - 68897
NON-CONFORMANCES - None
TIME OF TEST (MINUTES)
1:38
LOADING DIRECTION
PERP. TO BEDDING
TECHNICIAN - MW, KM
TEMPERATURE - Room



BEFORE TESTING

AFTER TESTING

Physical Appearance after Test - Sample sheared through middle portion - No signs of cracking, spalling or shearing at the platen-specimen interface

APPENDIX D
GB1 SPREADSHEETS

GB1 CUT/FILL CALCULATION

BORING NO.	NORTHING	EASTING	BORING SURFACE ELEVATION (FEET)	PROPOSED GRADE (FEET)	PROPOSED PAVEMENT THICKNESS (FEET)	PROPOSED PAVEMENT SUBGRADE (FEET)	CUT/FILL (FEET)
B-001-0-19	399265.8883	1755390.661	618.8	619.3	0.8	618.5	-0.4
B-002-0-19	399594.2996	1755882.456	617.0	618.7	0.8	617.9	0.8
B-003-0-19	399736.3269	1756111.181	613.4	619.5	0.8	618.7	5.3
B-004-0-19	399791.8248	1756187.915	616.4	619.1	0.8	618.3	1.9
B-005-0-19	399882.5875	1756326.058	615.6	617.9	0.8	617.1	1.4

OHIO DEPARTMENT OF TRANSPORTATION

OFFICE OF GEOTECHNICAL ENGINEERING

PLAN SUBGRADES
Geotechnical Bulletin GB1

PIK-CR9-5.29

Road Relocation & New Bridge, 5 Borings

CTL Engineering, Inc.

Prepared By: Joe Grani, P.E.
Date prepared: Tuesday, January 14, 2020

Joe Grani
CTL Engineering, Inc.
2860 Fisher Road
Columbus, OH 43204
614-276-8123
jgrani@ctleng.com

NO. OF BORINGS: 5

#	Boring ID	Alignment	Station	Offset	Dir	Drill Rig	ER	Boring EL.	Proposed Subgrade EL	Cut Fill
1	B-001-0-19	Proposed CR9 CL	183+51	3'	Rt	B-57 Track	83	618.8	618.5	0.3 C
2	B-002-0-19	Proposed CR9 CL	189+20	9'	Rt	B-57 Track	83	617.0	617.9	0.9 F
3	B-003-0-19	Proposed CR9 CL	191+89	5'	Rt	B-57 Track	83	613.4	618.7	5.3 F
4	B-004-0-19	Proposed CR9 CL	192+84	3'	Lt	B-57 Track	83	616.4	618.3	1.9 F
5	B-005-0-19	Proposed CR9 CL	194+50	1'	Rt	B-57 Track	83	615.6	617.1	1.5 F

OHIO DEPARTMENT OF TRANSPORTATION

Subgrade Analysis

V. 14.5 1/18/2019

#	Boring	Sample	Sample Depth		Subgrade Depth		Standard Penetration		HP (tsf)	Physical Characteristics						Moisture		Ohio DOT		Sulfate Content (ppm)	Problem		Excavate and Replace (Item 204)		Recommendation (Enter depth in inches)
			From	To	From	To	N_{60}	N_{60L}		LL	PL	PI	% Silt	% Clay	P200	M_C	M_{OPT}	Class	GI		Unsuitable	Unstable	Unsuitable	Unstable	
1	B	SS-1	1.0	2.5	0.7	2.2	11		1.75	35	22	13	62	32	94	26	17	A-6a	9			HP & Mc		12"	
	001-0	SS-2	3.5	5.0	3.2	4.7	8		1							21	14	A-6a	10						
	19	SS-3	6.0	7.5	5.7	7.2	12		1.25							24	14	A-6a							
								8																	
2	B	SS-1	1.0	2.5	1.9	3.4	12		2	35	21	14	68	31	99	22	16	A-6a	10			N_{60} & Mc			
	002-0	SS-2	3.5	5.0	4.4	5.9	12		4.5							20	14	A-6a	10						
	19	SS-3	6.0	7.5	6.9	8.4	14		2.5							23	14	A-6a							
								12																	
3	B	SS-1	1.0	2.5	6.3	7.8	8									20	8	A-3a							
	003-0	SS-2	3.5	5.0	8.8	10.3	12									10	10	A-2-4							
	19	SS-3	6.0	7.5	11.3	12.8	17									17	10	A-2-4							
4	B	SS-1	1.0	2.5	2.9	4.4	15		4.5	39	23	16	74	24	98	17	18	A-6b	10						
	004-0	SS-2	3.5	5.0	5.4	6.9	8		3.5							20	16	A-6b							
	19	SS-3	6.0	7.5	7.9	9.4	7		0.25							32	16	A-6b							
								8																	
5	B	SS-1	1.0	2.5	2.5	4.0	14		4.5	36	23	13	65	33	98	23	18	A-6a	9						
	005-0	SS-2	3.5	5.0	5.0	6.5	12		2.5							25	14	A-6a	10						
	19	SS-3	6.0	7.5	7.5	9.0	12		2.25							23	14	A-6a							
								12																	

OHIO DEPARTMENT OF TRANSPORTATION

Subgrade Analysis

V. 14.5 1/18/2019

PID:

County-Route-Section: PIK-CR9-5.29
No. of Borings: 5

Geotechnical Consultant: CTL Engineering, Inc.
Prepared By: Joe Grani, P.E.
Date prepared: 1/14/2020

Chemical Stabilization Options		
320	Rubblize & Roll	No
206	Cement Stabilization	Option
	Lime Stabilization	No
206	Depth	14''

Excavate and Replace Stabilization Options	
Global Geotextile Override(N60L):	18''
Override(HP):	24''
Global Geogrid Override(N60L):	12''
Override(HP):	18''

Design CBR	6

% Samples within 6 feet of subgrade			
$N_{60} \leq 5$	0%	HP ≤ 0.5	0%
$N_{60} < 12$	33%	0.5 < HP ≤ 1	11%
$12 \leq N_{60} < 15$	56%	1 < HP ≤ 2	33%
$N_{60} \geq 20$	0%	HP > 2	56%
M+	22%		
Rock	0%		
Unsuitable	0%		

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

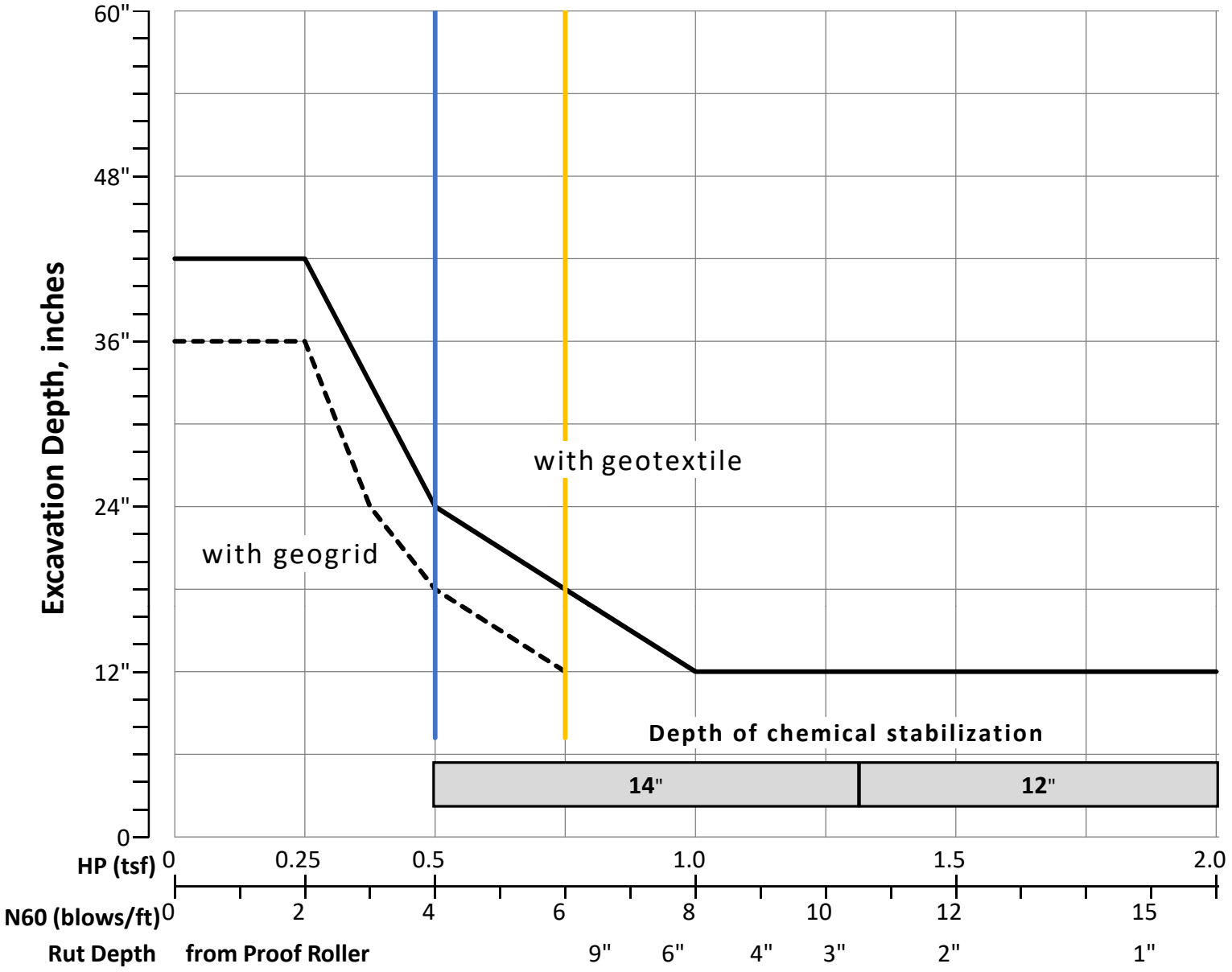
% Proposed Subgrade Surface	
Unstable & Unsuitable	67%
Unstable	67%
Unsuitable	0%

	N_{60}	N_{60L}	HP	LL	PL	PI	Silt	Clay	P 200	M_C	M_{OPT}	GI
Average	12	10	2.54	36	22	14	67	30	97	22	14	10
Maximum	17	12	4.50	39	23	16	74	33	99	32	18	10
Minimum	7	8	0.25	35	21	13	62	24	94	10	8	9

Classification Counts by Sample

ODOT Class	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	2	0	0	0	0	1	0	0	0	9	3	0	0	0	0	15
Percent	0%	0%	0%	13%	0%	0%	0%	0%	7%	0%	0%	0%	60%	20%	0%	0%	0%	0%	100%
% Rock|Granular|Cohesive	0%	20%									80%								100%
Surface Class Count	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	3
Surface Class Percent	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	100%

GB1 Figure B – Subgrade Stabilization



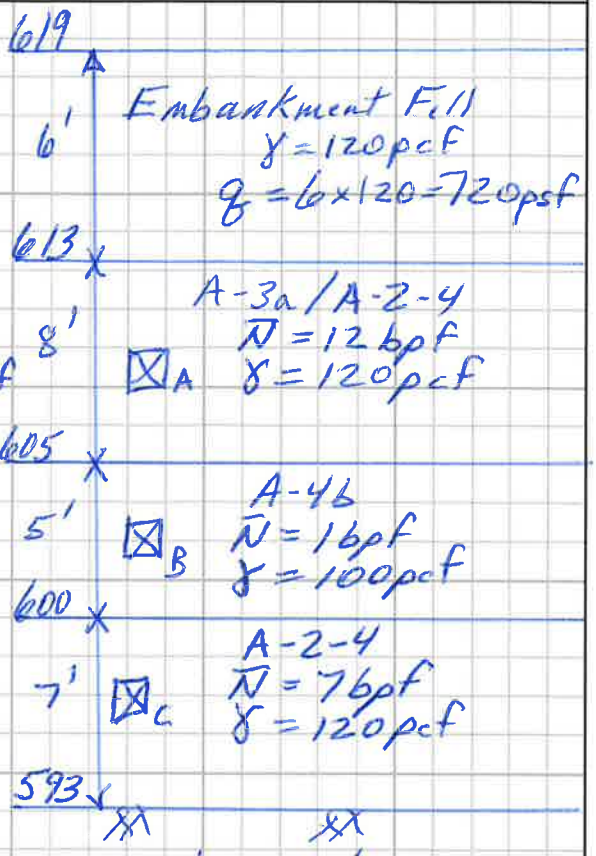
OVERRIDE TABLE

Calculated Average	New Values	Check to Override
2.54	0.50	☑ HP
10.00	6.00	☑ N60L

Average HP
Average N_{60L}

APPENDIX E
SETTLEMENT CALCULATIONS

Settlement @ B-003
Rear Abutment



$p_{oA} = 3 \times 120 + 1(120 - 62.4) = 418$ psf

$p_{oB} = 418 + 4(120 - 62.4) + 2.5(100 - 62.4) = 742$ psf

$p_{oc} = 742 + 2.5(100 - 62.4) + 3.5(120 - 62.4) = 1038$ psf

$BCI_A = 3.2(12) + 30 = 68.4$

$BCI_B = \frac{3.2(1) + 30 + 1.4(1) + 1.2}{2} = 17.9$

$BCI_c = 3.2(7) + 30 = 52.4$

Per DAS Fig. 3.43 & 3.44

$I_A = 1.0$; $I_B = 0.95$; $I_c = 0.85$

$S_A = \frac{1}{BCI_A} H_a \log \frac{p_{oA} + q I_A}{p_{oA}} = \frac{1}{68.4} 8 \times 12 \log \frac{418 + 720(1.0)}{418} = 0.61''$

$S_B = \frac{1}{17.9} 5 \times 12 \log \frac{742 + 720(0.95)}{742} = 0.95''$

$S_C = \frac{1}{52.4} 7 \times 12 \log \frac{1038 + 720(0.85)}{1038} = 0.32''$

$S_{TOTAL} = 1.88'' \times 0.7 = 1.32''$

Say $1.3''$

Layers A&C ⇒ Granular ⇒ Immediate Settlement

Time Rate of Settlement

Layer B (A-4b)

LL = 23
PI = 4

From DAS $C_v \approx 0.0281 (e^{-0.0579 \times LL})$

2 sides Drained

$C_v \approx 7.4 \times 10^{-3}$ cm²/sec

$C_v = 0.69$ ft²/day

Compute time for 90% Consolidation

$$t = \frac{T_v H^2}{C_v}$$

$T_{v_{90}} = 0.848$

$$t = \frac{0.848 (2.5)^2}{0.69} = \underline{8 \text{ days}}$$

Compute time for 60% Consolidation

$T_{v_{60}} = 0.286$

$$t = \frac{0.286 (2.5)^2}{0.69} = 3 \text{ days}$$

APPENDIX F
SLOPE STABILITY ANALYSIS

Soil Parameters

Project: PIK-CR9-5.29
Location: Rear Approach
Boring No.: B-003-0-19
Date: 1/17/20

								Effective Stress		Total Stress		
Layer No.	Top Elev	Bottom Elev	Thickness (feet)	Type	Total Weight (pcf)	N_{60} value (bpf)	Moisture Content (%)	Cohesion (psf)	Friction Angle (degrees)	Cohesion (psf)	Friction Angle (degrees)	Reference
1	619	613	6	Embankment Fill	120							
			Avg	Embankment Fill	120			250	28	2500	0	6
2	613	605	8	A-2-4	120	12 17	10 17					
			Avg	A-2-4	120	15	14	0	30	0	30	5
3	605	600	5	A-4b	100	3 0	66 23					
			Avg	A-4b	100	2	45	100	15	875	0	3,4,7
4	600	593	7	A-2-4	120	8 7	14 17					
			Avg	A-2-4	120	8	16	0	30	0	30	5

Reference Key

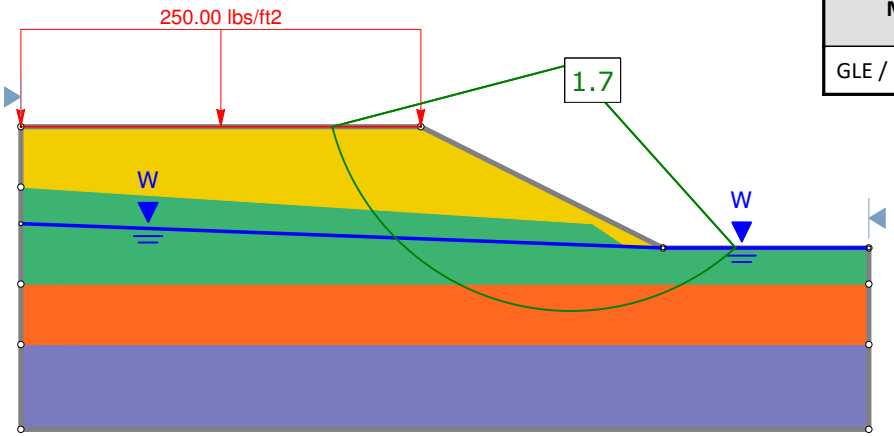
1 Total Stress Cohesion estimated as 12.5% of average N-Value - Bowles "Foundation Analysis and Design"
2 Total Stess Friction Angle estimated to be 0
3 Effective Stress Cohesion estimated to be 10 to 25 percent of Total Stress Cohesion
4 Effective Stress Friction Angle estimated based on soil type
5 Non plastic soils - Friction angle estimated from N-value & soil type
6 ODOT GB2 Table 1
7 Total Stress Cohesion estimated average of hand penetration

Slope Stability Parameters

Project: PIK-CR9-5.29
Location: Rear Approach
Boring No.: B-003-0-19
Date: 1/17/20

						Effective Stress		Total Stress	
Layer No.	Top Elev	Bottom Elev	Thickness (feet)	Type	Total Unit Weight (pcf)	Cohesion (psf)	Friction Angle (degrees)	Cohesion (psf)	Friction Angle (degrees)
1	619	613	6	Embankment Fill	120	250	28	2500	0
2	613	605	8	A-2-4	120	0	30	0	30
3	605	600	5	A-4b	100	100	15	875	0
4	600	593	7	A-2-4	120	0	30	0	30

PIK-CR9-5.29 REAR APPROACH- ES



Method Name	Min FS
GLE / Morgenstern-Price	1.7

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Embankment Fill		120	Mohr-Coulomb	250	28
A-3a/A-2-4		120	Mohr-Coulomb	0	30
A-4b		100	Mohr-Coulomb	100	15
A-2-4		120	Mohr-Coulomb	0	30

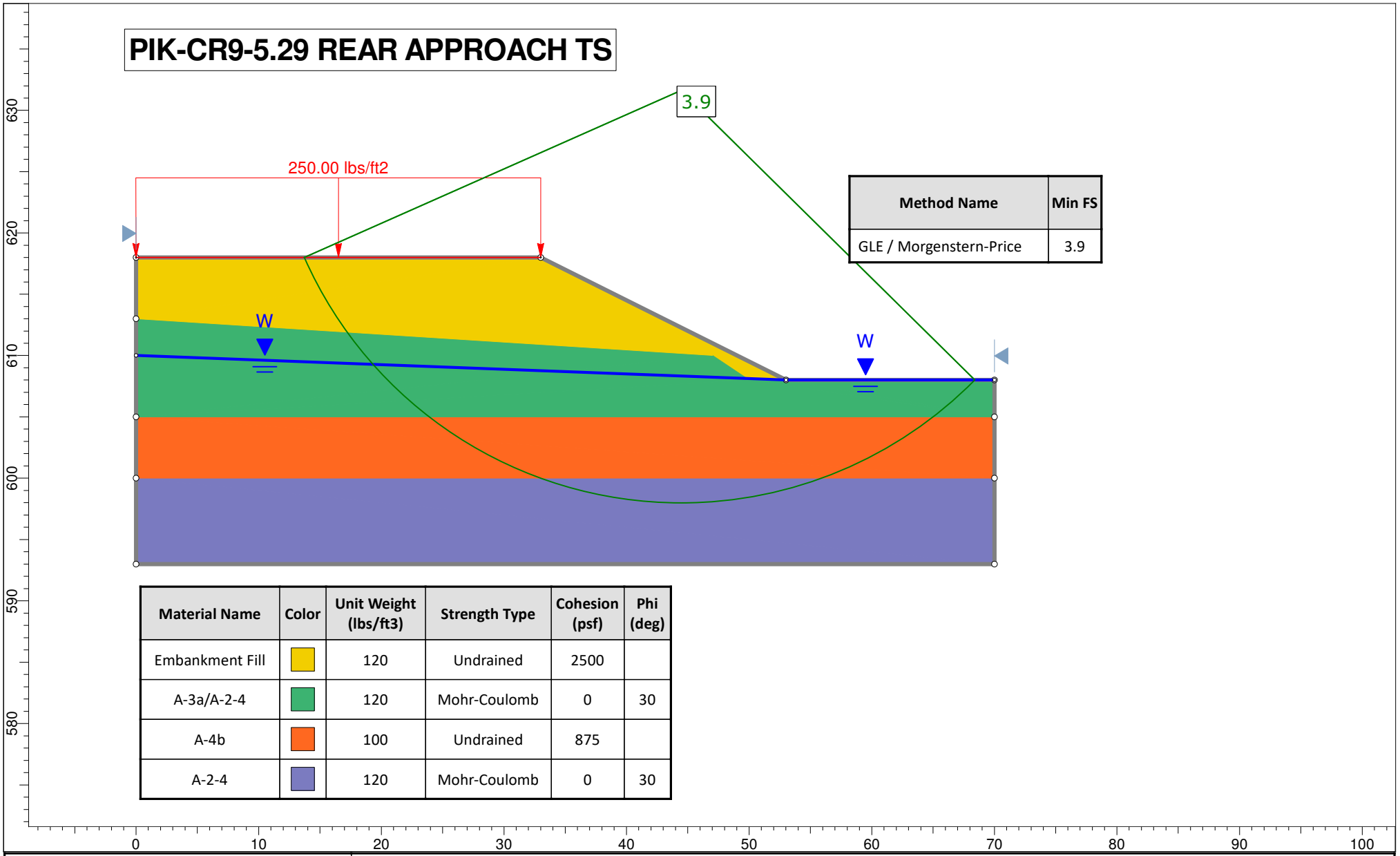
640
620
600
580
-20
0
20
40
60
80
100
120

rocscience

SLIDEINTERPRET 8.026

Project	PIK-CR9-5.29		
Analysis Description	Rear Approach Embankment		
Drawn By	Joe Grani	Scale 1:190	Company CTL Engineering, Inc.
Date	1/14/2020		File Name 20.01.14 Rear Approach ES.slmd

PIK-CR9-5.29 REAR APPROACH TS



Method Name	Min FS
GLE / Morgenstern-Price	3.9

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Embankment Fill		120	Undrained	2500	
A-3a/A-2-4		120	Mohr-Coulomb	0	30
A-4b		100	Undrained	875	
A-2-4		120	Mohr-Coulomb	0	30

rocscience

SLIDEINTERPRET 8.026

Project	PIK-CR9-5.29		
Analysis Description	Rear Approach Embankment		
Drawn By	Joe Grani	*Scale* 1:130	*Company* CTL Engineering, Inc.
Date	1/14/2020		*File Name* 20.01.14 Rear Approach TS.slmd

APPENDIX G
ROCK CORE PHOTOS


EP Ferris
19050131COL
boring S1
11.7.19
RUN | DEPTH | REC | RQD
0.0
2.1
30
19050131COL
E.P. Ferris and Associates, Inc.
PIK-CR9-5.29
B-003-0-19
Box #1 20'-31.4'
TOP
BOTTOM


boring S 2
Box 1 of 1
11 6 19
19050131COL
E.P. Ferris and Associates, Inc.
PIK-CR9-5.29
B-004-0-19
Box #1 23'-34.6'
34.6
TOP
BOTTOM