

January 10, 2024

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

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

Reference: Structure Foundation Exploration – Final
PIK-CR9-5.29
Latham, Ohio
CTL Project No. 19050131COL

Dear Mr. Ubbing:

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

A Roadway Exploration report was 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

STRUCTURE FOUNDATION EXPLORATION - FINAL

**PIK-CR9-5.29
LATHAM, OHIO
CTL PROJECT NO. 19050131COL**

PREPARED FOR:

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

PREPARED BY:

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JANUARY 10, 2024



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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. The proposed bridge will be a single-span, composite prestressed box beam with reinforced concrete deck on semi-integral abutments.

The maximum embankment fill will be about 6 feet in height, and will be in the vicinity of the proposed bridge rear abutment.

Two (2) test borings identified as B-003-0-19 and B-004-0-19 were drilled in the vicinity of the proposed bridge abutments.

The proposed bridge abutments may be supported onto steel H-piles set into pre-bored holes into underlying bedrock. Please refer to the *Analyses and Recommendations* section for additional information.

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 maximum embankment fill will be about 6 feet in height, and will be in the vicinity of the proposed bridge rear abutment.

This report is a Final Structure Foundation Exploration report. A Roadway Exploration report was 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

Two (2) test borings identified as B-003-0-19 and B-004-0-19 were drilled in the vicinity of the proposed bridge abutments.

The borings were performed with a track mounted drill rig utilizing hollow stem augers (HSA) on November 6 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**

The borings exhibited 9 to 10 inches of topsoil at the surface.

Below the topsoil, boring B-004-0-19 exhibited a layer of silty clay (A-6b) to a depth of 8.5 feet below existing grade. These soils exhibited standard penetration N_{60} values ranging from 7 to 15 blows per foot (bpf), with natural moisture content values ranging from 17 to 32 percent.

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). The granular deposits exhibited N_{60} values ranging from 7 bpf to 50 blows for 1 inch of penetration, with natural moisture content values ranging from 14 to 35 percent. The silt layers exhibited N_{60} values ranging from 0 bpf (weight of hammer) to 11 bpf, with natural moisture content values ranging from 23 to 66 percent.

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-003-0-19 and B-004-0-19 at depths of 3.5 feet and 10.0 feet, respectively. These groundwater depths correspond to elevations ranging from 606.4 to 609.9.

VI. **ANALYSES AND RECOMMENDATIONS**

Based on the soil and rock data obtained from the field and laboratory testing, the following recommendations are provided for the proposed structures.

A. **Creek Bed Material**

For the purpose of scour analysis, the D_{50} and type of creek bed materials encountered are shown in Table 1.

Table 1. D₅₀ Values

Boring No.	Sample No.	Elevation (feet)	D ₅₀ (mm)	Soil Type
B-003-0-19	SS-5	Above 599.9	0.01	A-4b
*	*	Below 599.9	1.344 to 2.516	A-2-4

* Historic data from bridge in same river valley PIK-124-1015 (May 1992)

It is CTL’s opinion that the bedrock below elevation 590.4 at the Rear Abutment (boring B-003-0-19), and at or below elevation 589.6 at the Forward Abutment (boring B-004-0-19) is scour resistant.

B. Foundation Support

It is understood that scour has been estimated to extend down to the top of the scour resistant bedrock. Per ODOT Geotechnical Design Manual (GDM) Section 1304.6, if the design flood scour reaches the top of rock, do not use driven piles. However, piles set in prebored holes into the bedrock may be used. The piles must penetrate 10 feet below the maximum estimated scour depth.

The bottom of the pre-bored holes should extend down to elevation 580.4 at the Rear Abutment (boring B-003-0-19), and at or below elevation 579.6 at the Forward Abutment (boring B-004-0-19).

Preboring should be performed as outlined in Item 507.11 of the ODOT CMS. According to Item 507.11 for steel H-Piles, the predrilled hole should be between 6 inches less and 2 inches more than the pile’s diagonal dimension.

According to ODOT GDM Section 1305, the piles should be set in the prebored holes without driving the piles. The prebored holes should be backfilled with Class QC Misc. concrete up to the bottom of the pile cap elevation.

According to ODOT GDM Section 1305.1, since the piles are not driven, they are not subject to driving stresses or potential driving damage. Therefore, structural resistance factor of $\phi_c = 0.95$ should be used.

Temporary casing can be provided through the soil overburden to prevent the soil from caving into the prebored hole.

The estimated pile tip elevations and pile lengths are provided in Table 2. The estimated pile length included a 2-foot penetration into the pile cap, and was rounded up to the nearest 5-foot segment length.



Table 2. Estimated Pile Lengths

Location/ Boring No.	Bottom of Pile Cap Elevation	Estimated Pile Tip Elevation (feet)	Estimated Pile Length (feet)	Order Length (feet)
Rear Abutment B-003-0-19	609.91	580.4	35	40
Forward Abutment B-004-0-19	609.50	579.6	35	40

The total factored load for any single pile shall not exceed the factored structural resistance (P_r) values provided in Table 3.

Table 3. Factored Structural Resistance

Pile Size	P_r (Kips)
HP 10x42	580
HP 12x53	730
HP 14x73	1010

C. Negative Skin Friction (Downdrag Force)

According to the ODOT Bridge Design Manual (BDM), the amount of relative settlement between soil and pile that is necessary to mobilize negative shaft resistance is about 0.4 inch. Since the settlement of the soils below the proposed pile cap is in excess of 0.4 inch, if the piles are installed prior to approach embankment fill placement, then downdrag forces should be included in the design.

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.

Settlement analyses were performed in the area of Rear Abutment using soil data from boring B-003-0-19, and at the Forward Abutment using soil data from boring B-004-0-19. It is estimated that the underlying soils at the Rear Abutment will settle about 1.0 to 1.5 inches as a result of the fill placement. At the Forward Abutment, less than 0.4 inch of settlement is expected. Results of the settlement analyses are appended to this report.

It is estimated that about 90 percent of the settlement will occur in about 1 week. Because settlements will occur relatively quickly, it is recommended that the fill



for the Rear Approach embankment is placed and that the fill be allowed to settle for 1 week prior to pile installation.

If the 1-week waiting period at the rear abutment is not included in the construction schedule, then downdrag force should be included in the pile design for the Rear Abutment. The estimated downdrag forces on the HP 10x42 piles at the proposed Rear Abutment is provided in Table 4. Since the estimated settlement at the Forward Abutment is less than 0.4 inch, the downdrag at the Forward Abutment can be neglected. Downdrag calculations are appended to this report in Appendix D.

Table 4. Downdrag Force

Location	Pile Type	Unfactored Downdrag Force (Kips)	Factored Downdrag Force (Kips)
Rear Abutment	HP 10x42	18	25

The factored downdrag force was computed using a load factor of 1.4. This load factor was obtained from AASHTO Table 3.4.1-2 *Load Factors for Permanent Loads*.

D. General Construction and Earthwork

1. Site preparation and earthwork should be performed in accordance with the ODOT Construction and Material Specifications.
2. Embankment side slopes should be seeded and vegetation growth permitted to limit erosion, sloughing and slope failure.
3. Temporary excavations in excess of 4 feet in depth should be sloped or shored according to OSHA requirements.

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 be 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



Client: E.P. Ferris & Associates, Inc.

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not be assigned to any person or entity, without the consent of the Consultant which consent shall not be unreasonably withheld.

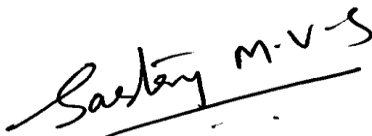
This geotechnical report does not address the environmental conditions of the site. The Consultant is not responsible for consequences or conditions arising from facts that were concealed, withheld, or not fully disclosed at the time the assessment was conducted.

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

**STRUCTURE FOUNDATION EXPLORATION
SHEETS**

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 TMS 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 FINDINGS

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

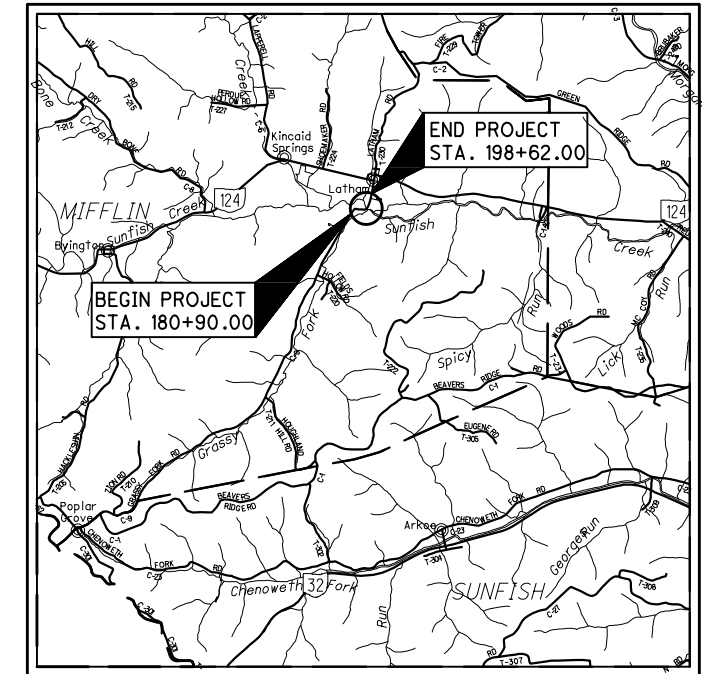
THIS GEOTECHNICAL EXPLORATION WAS PERFORMED IN ACCORDANCE WITH THE STATE OF OHIO, DEPARTMENT OF TRANSPORTATION, OFFICE OF GEOTECHNICAL ENGINEERING, SPECIFICATIONS FOR GEOTECHNICAL EXPLORATIONS, DATED JULY 2018.

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.			

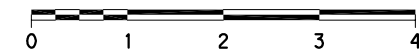
AVAILABLE INFORMATION

ALL AVAILABLE INFORMATION AND BEDROCK INFORMATION THAT CAN BE CONVENIENTLY 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.

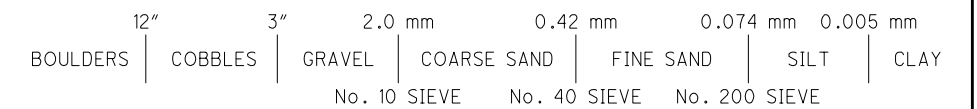


LOCATION MAP

SCALE IN MILES



PARTICLE SIZE DEFINITIONS



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



SUMMARY OF SOIL TEST DATA

EXPLORATION NO., STATION & OFFSET	FROM	TO	SAMPLE ID	N ₆₀	% 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				SAME AS SS-1					21	A-6a (VISUAL)	-
LATITUDE = 39.093819	06.00-07.50		SS-3	12	100	1.25				SAME AS SS-1					24	A-6a (VISUAL)	-
LONGITUDE = -83.250881																	
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				SAME AS SS-1					20	A-6a (VISUAL)	-
LATITUDE = 39.094653	06.00-07.50		SS-3	14	100	2.5				SAME AS SS-1					23	A-6a (VISUAL)	-
LONGITUDE = -83.249561	08.50-10.00		SS-4	6	67	-				BROWN, GRAVEL AND/OR STONE FRAGMENTS WITH SAND, SILT, AND CLAY					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	-				BROWN, SILT AND CLAY					25	A-6a (VISUAL)	-
	16.00-17.50		SS-7	11	39	-				BROWN, GRAVEL AND/OR STONE FRAGMENTS WITH SAND, SILT, AND CLAY					18	A-2-6 (VISUAL)	-
	18.50-19.16		SS-8	8/50/2"100	-	-				SAME AS SS-7					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				SAME AS SS-1					25	A-6a (VISUAL)	-
LATITUDE = 39.095492	06.00-07.50		SS-3	12	100	2.25				SAME AS SS-1					23	A-6a (VISUAL)	-
LONGITUDE = -83.247503	08.50-10.00		SS-4	6	100	0.25				SAME AS SS-1					34	A-6a (VISUAL)	-
	11.00-12.50		SS-5	10	44	0.25				SAME AS SS-1					31	A-6a (VISUAL)	-
	13.50-15.00		SS-6	14	67	-				BROWN, GRAVEL AND/OR STONE FRAGMENTS WITH SAND, SILT, AND CLAY					18	A-2-6 (VISUAL)	-



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PIK-CR 9-5.29
OVER SUNFISH CREEK

SOIL PROFILE
SUMMARY OF SOIL TEST DATA

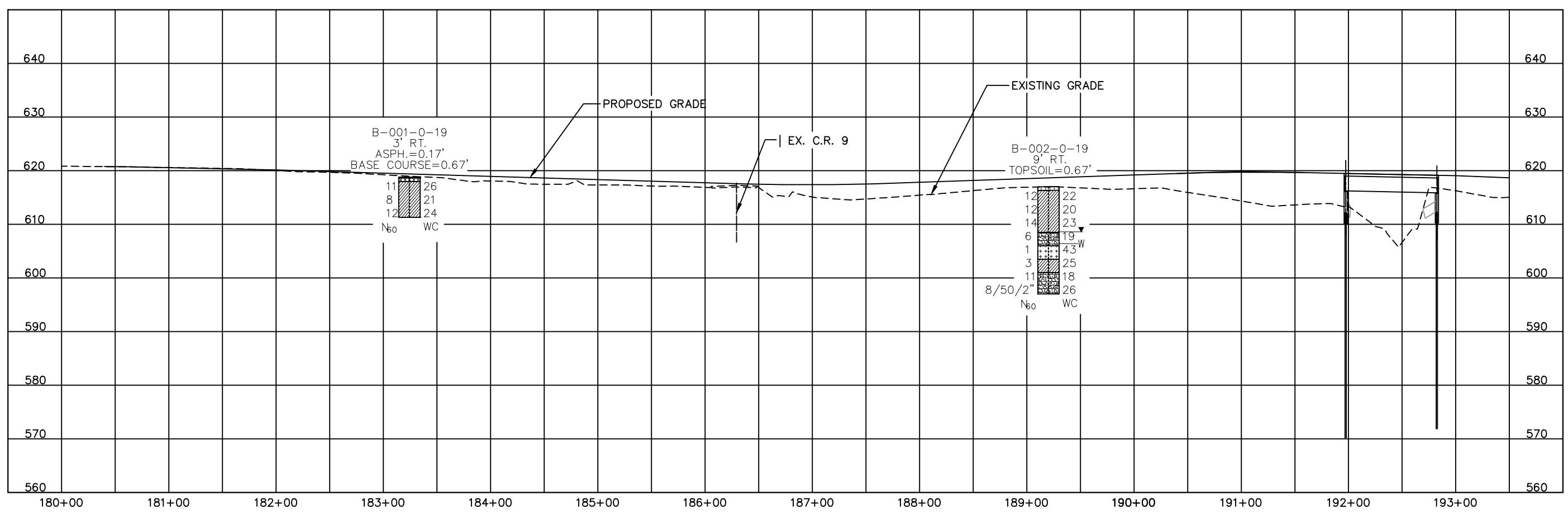
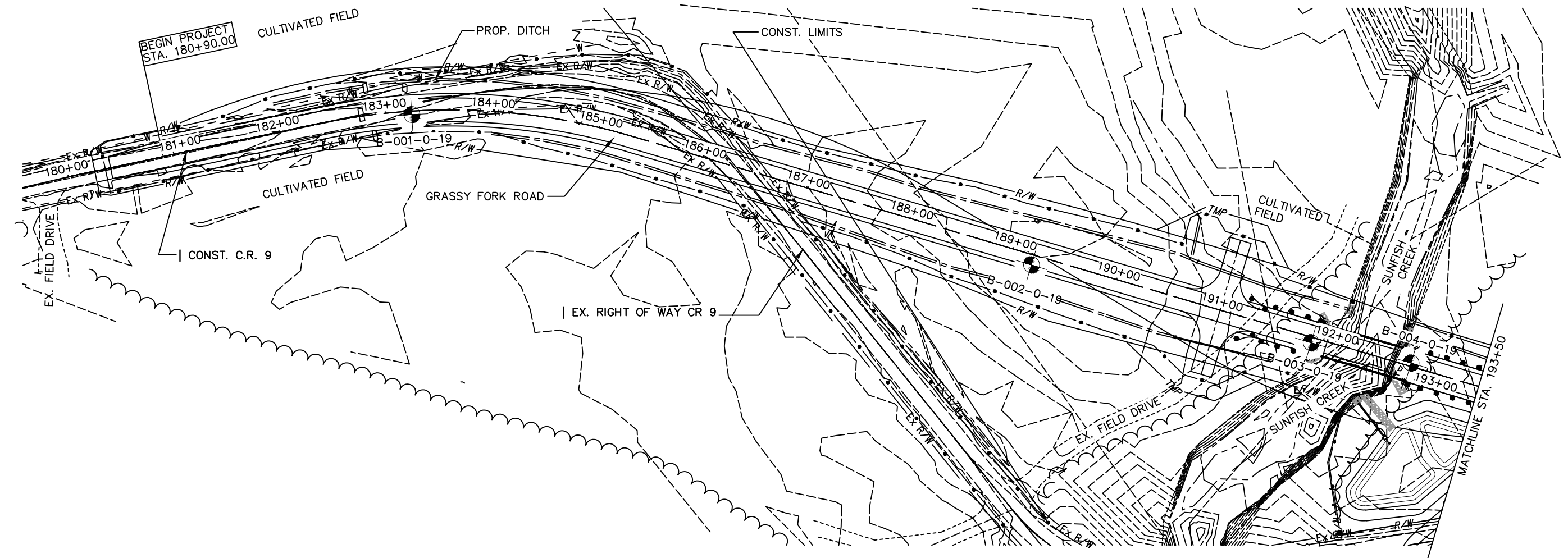
DRAWN
N.K.S
CHECKED
SM

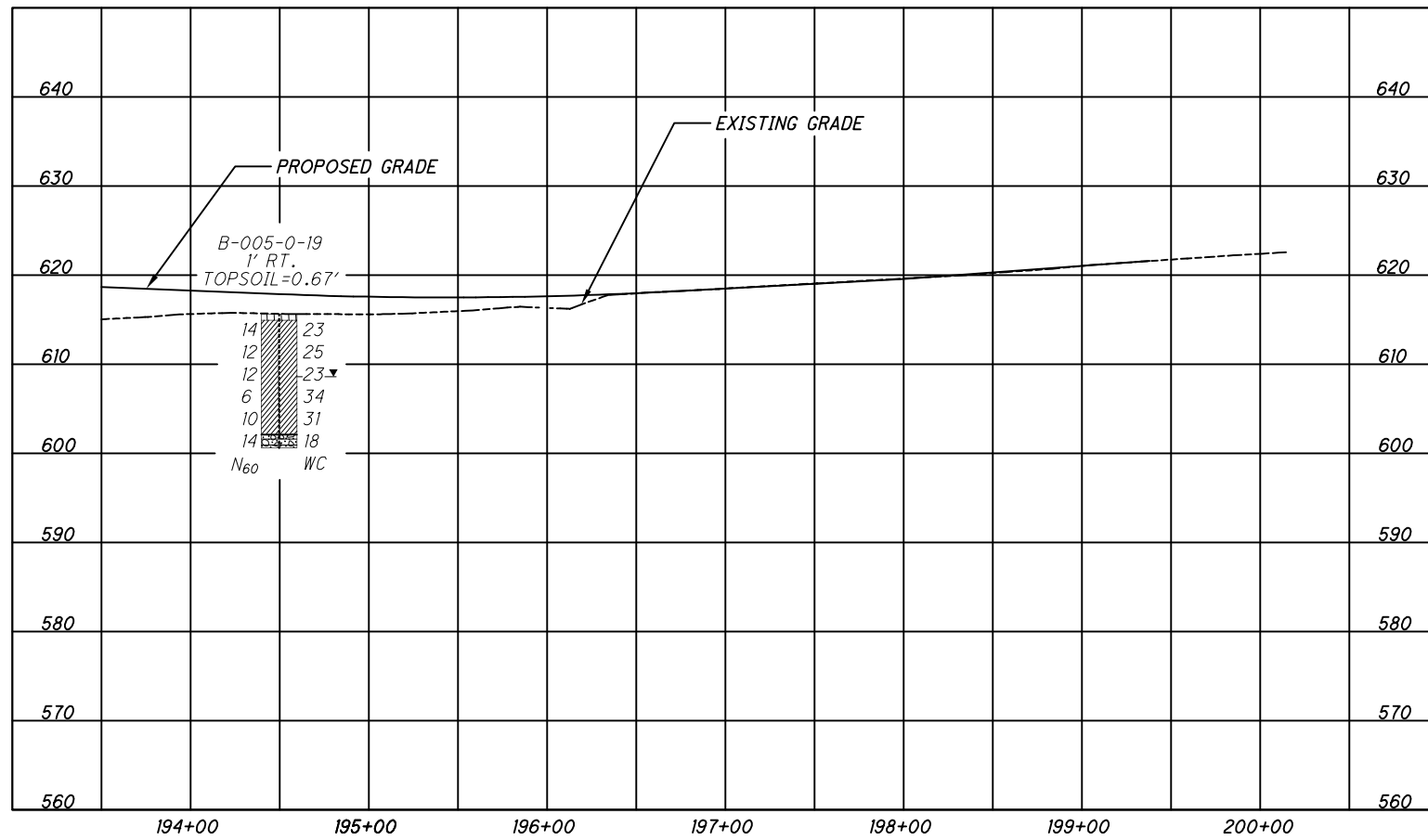
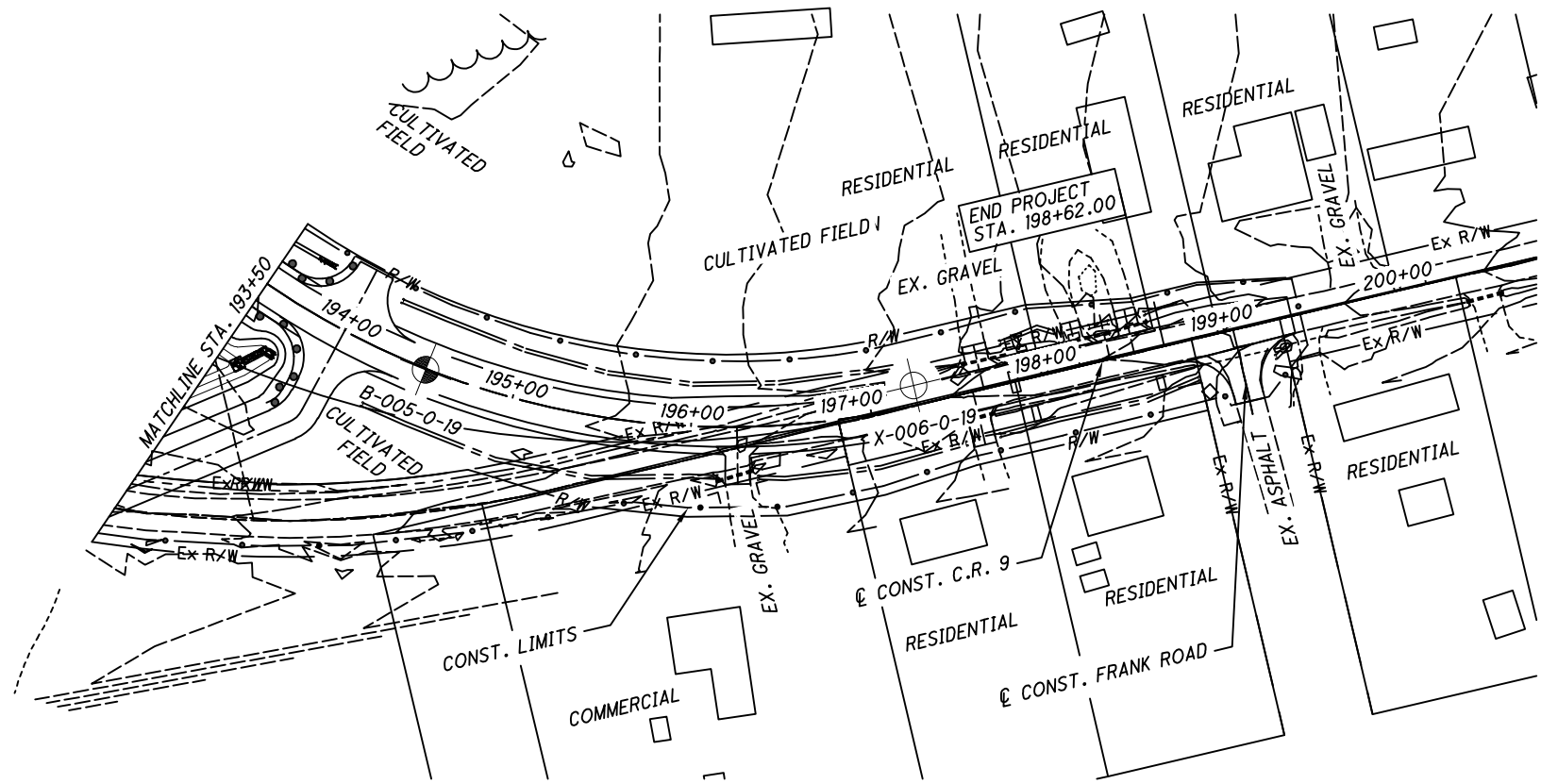


DRAWN N.L.K./S
CHECKED SM

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

PIK-CR 9-5.29
OVER SUNFISH CREEK



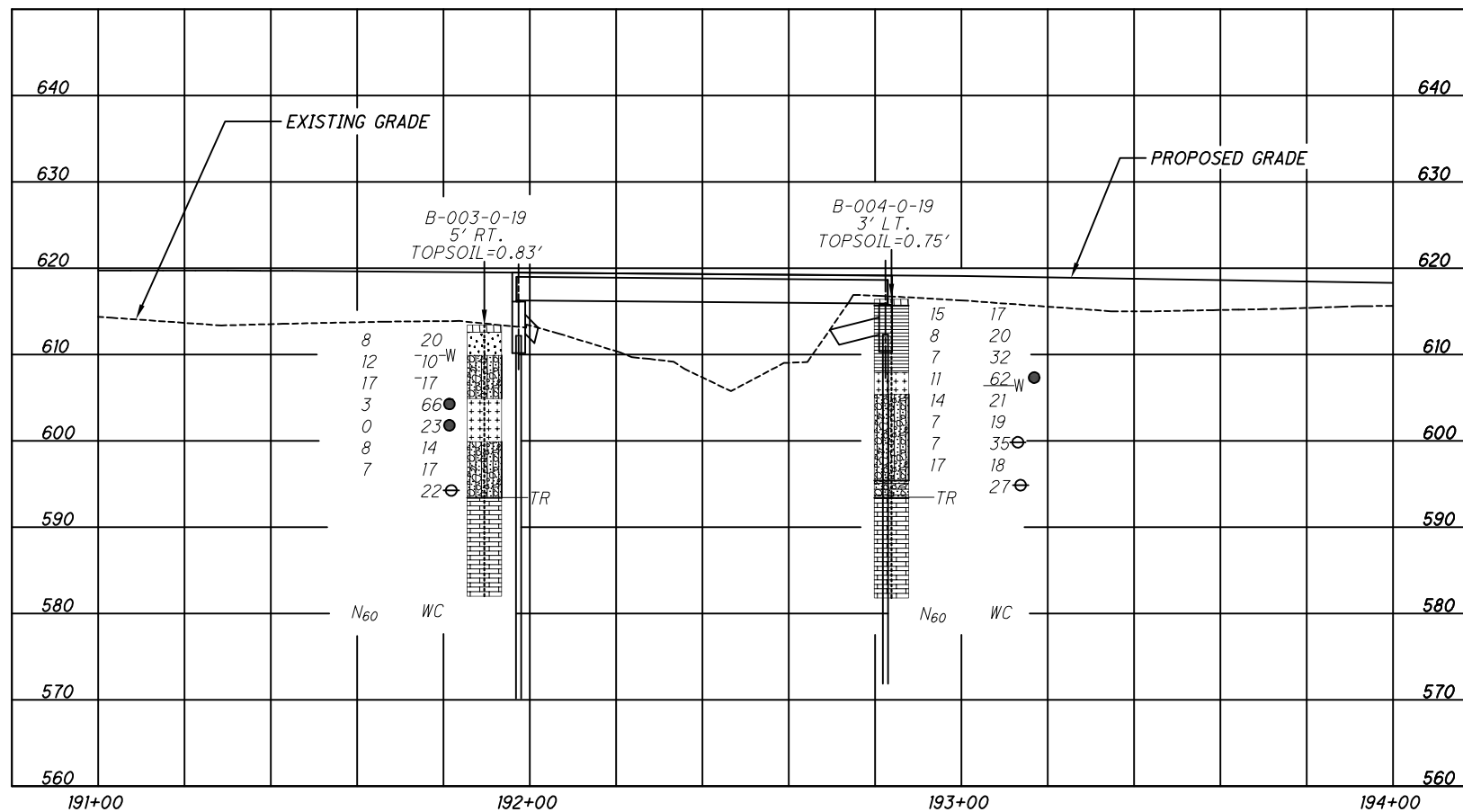
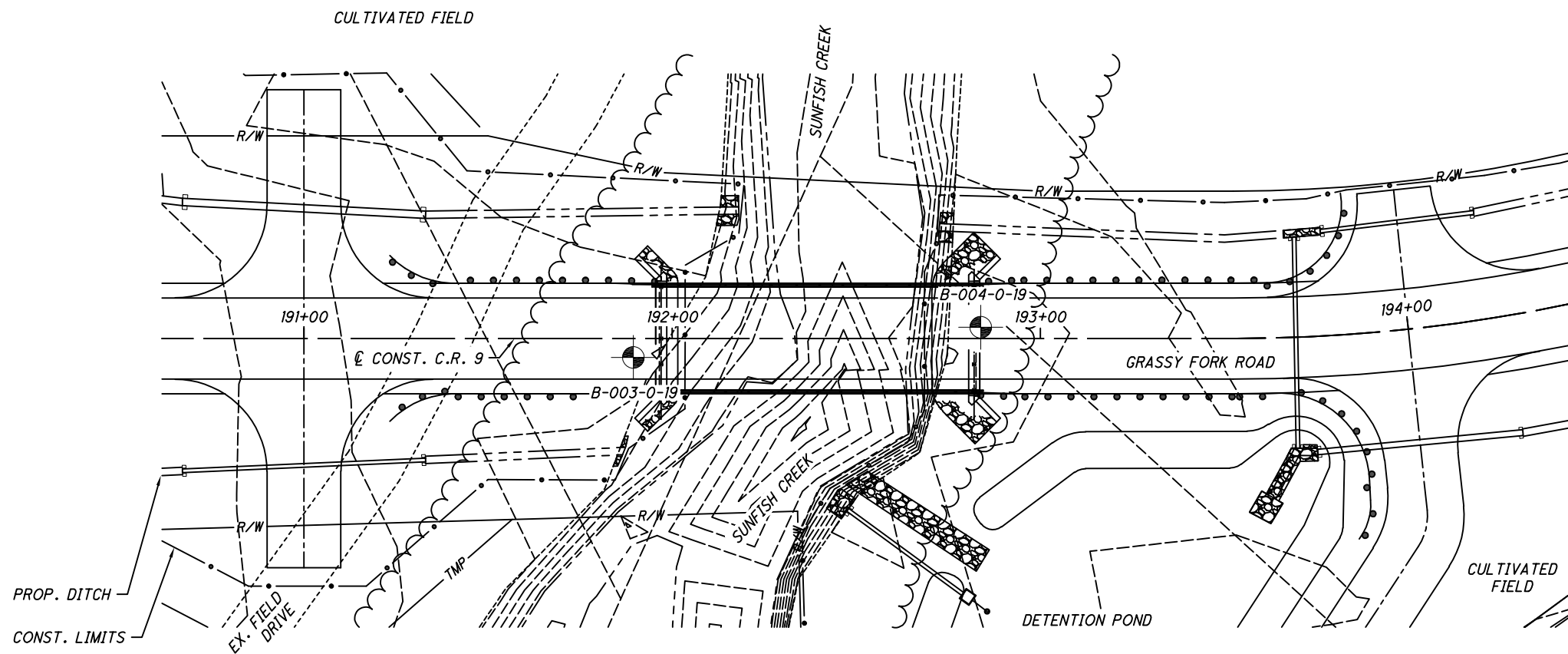


DRAWN: N.K.S.
CHECKED: SM

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

PIK-CR 9-5.29
OVER SUNFISH CREEK







 DRAWN: N.K.S.
 CHECKED: SM

STRUCTURE FOUNDATION EXPLORATION
BRIDGE OVER SUNFISH CREEK

PIK-CR 9-5.29
OVER SUNFISH CREEK

5 / 8


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	LAT / LONG: 39.094950, -83.248350	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG				WC	ODOT CLASS (GI)	BACK FILL
								GR	CS	FS	SI	CL	LL	PL	PI				
Topsoil (10")	613.4																		
LOOSE, BROWN, COARSE AND FINE SAND, SOME SILT, LITTLE GRAVEL, TRACE CLAY, DAMP	609.9	1-3	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	609.9	4-5	3 5	12	33	SS-2	-	-	-	-	-	-	-	-	-	10	A-2-4 (V)		
@6.0'; MOIST		6-7	7 7	17	61	SS-3	-	-	-	-	-	-	-	-	-	17	A-2-4 (V)		
SOFT, GRAY, SILT, "AND" SAND, TRACE GRAVEL, TRACE CLAY, CONTAINS ORGANICS, WET	604.9	8-10	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		11-12	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	599.9	13-15	5 3	8	67	SS-6	-	-	-	-	-	-	-	-	-	14	A-2-4 (V)		
@18.5'; VERY DENSE		16-17	4 3	7	67	SS-7	-	-	-	-	-	-	-	-	-	17	A-2-4 (V)		
LIMESTONE, GRAY, UNWEATHERED, STRONG, VUGGY, DOLOMITIC; RQD 49%, REC 83%.	593.4	19-20	4 50/2"	-	100	SS-8	-	-	-	-	-	-	-	-	-	22	A-2-4 (V)		
@25.5'; COMPRESSIVE STRENGTH = 8,330 PSI	582.0	21-22	0		78	NQ-1											CORE		
		23-24																CORE	
		25-26	76		100	NQ-2												CORE	
		27-28																	
		29-30	54		64	NQ-3												CORE	
		31																	

NOTES: CAVED AT 16.3'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT GDT - 2/23/22 10:38 - J:\DEPT\5\2013-2020 PROJECT\19050131\COL-E.P. FERRIS-PIK-CR9-5.29\REPORTS\LOGS\19050131\COL.GPJ

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	LAT / LONG: 39.095067, -83.248075	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (G)	BACK FILL
								GR	CS	FS	SI	CL	LL	PL	PI			
Topsoil (9")	615.7																	
HARD, BROWN, SILTY CLAY, TRACE SAND, TRACE GRAVEL, DAMP		1	4	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																
		4	3	8	100	SS-2	3.50	-	-	-	-	-	-	-	-	20	A-6b (V)	
@6.0'; SOFT, TRACE SAND, MOIST		5																
		6	2	7	100	SS-3	0.25	-	-	-	-	-	-	-	-	32	A-6b (V)	
		7	2	3														
STIFF, GRAY, SILT, LITTLE CLAY, TRACE GRAVEL, TRACE SAND, CONTAINS ORGANICS, WET	607.9	8																
		9	0	4	11	100	SS-4	1.25	-	-	-	-	-	-	-	62	A-4b (V)	
		10																
MEDIUM DENSE, BROWN, GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT, TRACE CLAY, MOIST	605.4	11	4	4	14	67	SS-5	-	-	-	-	-	-	-	-	21	A-2-4 (V)	
@13.5'; LOOSE		12																
		13																
@16.0'; WET		14	3	3	7	67	SS-6	-	-	-	-	-	-	-	-	19	A-2-4 (V)	
		15																
@18.5'; MOIST		16																
		17	3	3	7	22	SS-7	-	-	-	-	-	-	-	-	35	A-2-4 (V)	
		18																
		19	8	8	17	67	SS-8	-	-	-	-	-	-	-	-	18	A-2-4 (V)	
		20																
VERY DENSE, BROWN, GRAVEL AND STONE FRAGMENTS WITH SAND, SILT, AND CLAY, WET	595.4	21	60/1"	-	100	SS-9	-	-	-	-	-	-	-	-	-	27	A-2-6 (V)	
		22																
LIMESTONE, GRAY, UNWEATHERED, STRONG, DOLOMITIC, VUGGY; RQD 69%, REC 94%.	593.4	23																
		24																
@28.3'; COMPRESSIVE STRENGTH = 11,260 PSI		25	61		95	NQ-1											CORE	
		26																
		27																
		28																
		29	78		94	NQ-2											CORE	
		30																
		31																
		32																
		33	63		94	NQ-3											CORE	
		34																
	581.8																	

NOTES: CAVED AT 13.6'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT GDT - 2/23/22 10:38 - J:\DEPT\2013-2020 PROJECT\19050131\COL-E.P. FERRIS-PIK-CR9-5.29\REPORTS\LOGS\19050131\COL.GPJ

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

**UNIAXIAL COMPRESSIVE STRENGTH OF
INTACT ROCK CORE - ASTM D 7012**

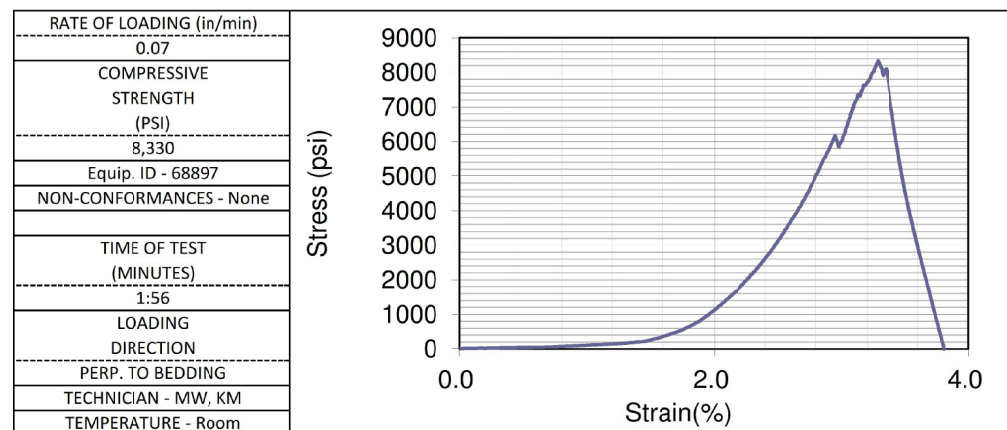


Method C

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)	LENGTH/DIAMETER	2.1
1	4.077	1.955	CORRECTION FACTOR	1
2	4.075	1.967	AREA(IN ²)	3.1
3	4.080	1.956	MASS (GRAMS)	544.8
AVERAGE	4.068	1.982	UNIT WEIGHT(LBS/FT ³)	165.3



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

**UNIAXIAL COMPRESSIVE STRENGTH OF
INTACT ROCK CORE - ASTM D 7012**

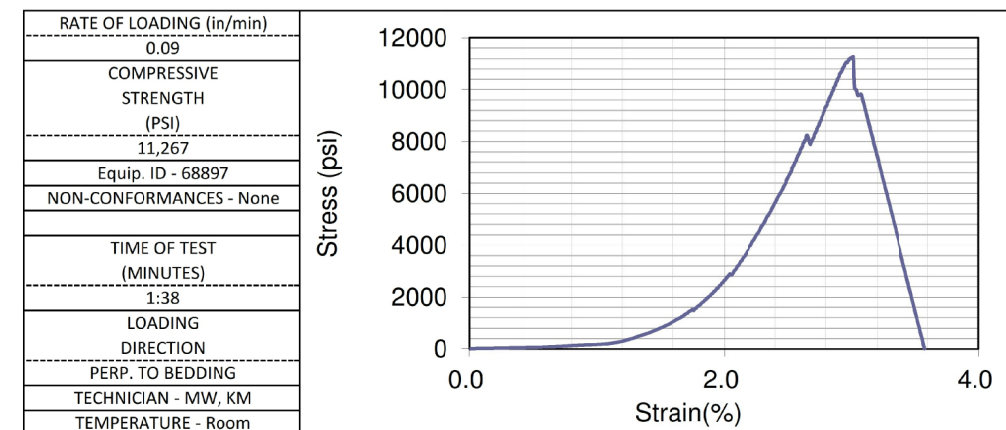


Method C

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)	LENGTH/DIAMETER	2.1
1	4.077	1.955	CORRECTION FACTOR	1
2	4.075	1.967	AREA(IN ²)	3.1
3	4.080	1.956	MASS (GRAMS)	535.4
AVERAGE	4.075	1.980	UNIT WEIGHT(LBS/FT ³)	162.6



APPENDIX B

TEST BORING RECORDS

STANDARD ODOT LOG W/ SULFATES (8.5 X 11) - OH DOT.GDT. - 1/17/20 14:53 - J:\DEPT\19 PROJECTS\1905013\COL-E.P. FERRIS-PIK-CR9-5.29\REPORTS\LOGS\1905013\COL.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. 583.4	DEPTHS	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			ODOT CLASS (GI)	SO4 ppm	BACK FILL
									GR	CS	FS	SI	CL	LL	PL	PI			
LIMESTONE, GRAY, UNWEATHERED, STRONG, VUGGY, DOLOMITIC; RQD 49%, REC 83%. (continued)		582.0	31																
		EOB																	
<p>NOTES: CAVED AT 16.3'</p> <p>ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS</p>																			

STANDARD ODOT LOG W/ SULFATES (8.5 X 11) - OH DOT.GDT - 1/17/20 14:53 - J:\DEPT\19 PROJECTS\1905013\COL-E.P. FERRIS-PIK-CR9-5.29\REPORTS\LOGS\1905013\COL.GPJ

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. 586.4	DEPTHS	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	SO4 ppm	BACK FILL	
										GR	CS	FS	SI	CL	LL	PL	PI					
LIMESTONE , GRAY, UNWEATHERED, STRONG, DOLOMITIC, VUGGY; RQD 69%, REC 94%. <i>(continued)</i>			581.8	31																		
				32																		
				33	63	94	NQ-3															
				34																		
				EOB																		
NOTES: CAVED AT 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**



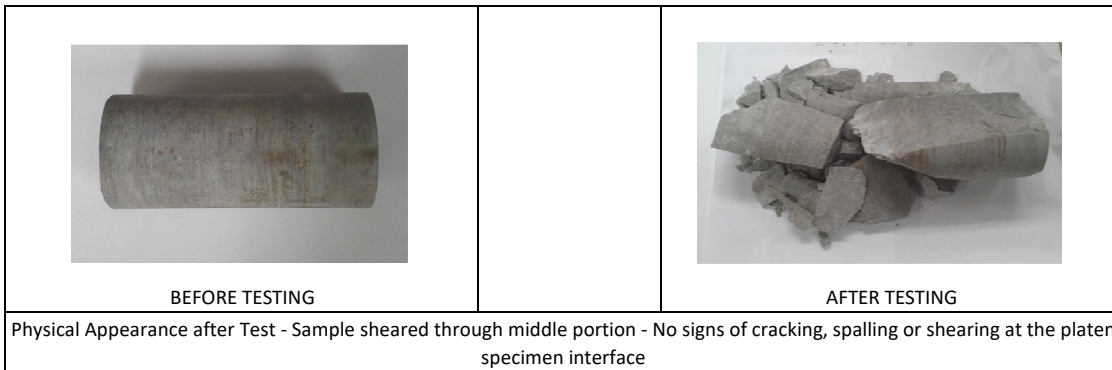
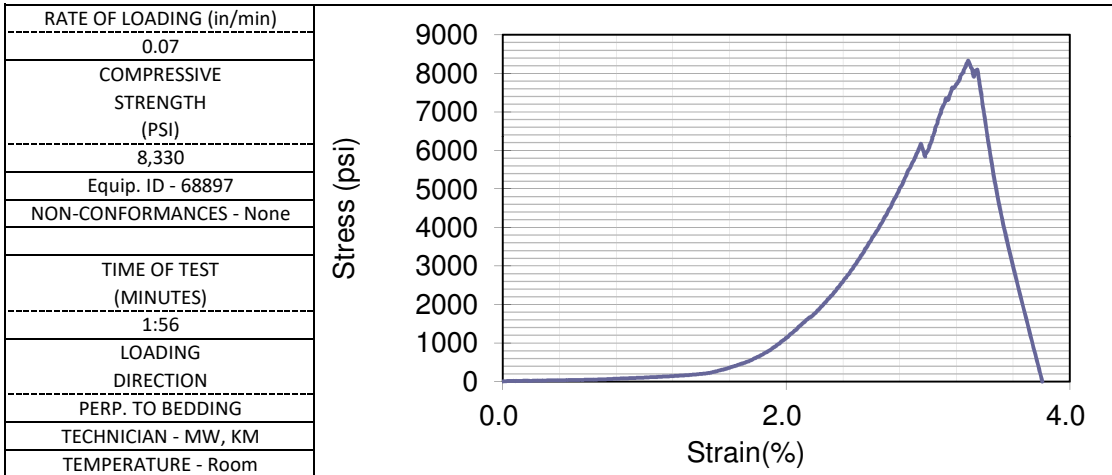
Method C

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



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

**UNIAXIAL COMPRESSIVE STRENGTH OF
INTACT ROCK CORE - ASTM D 7012**



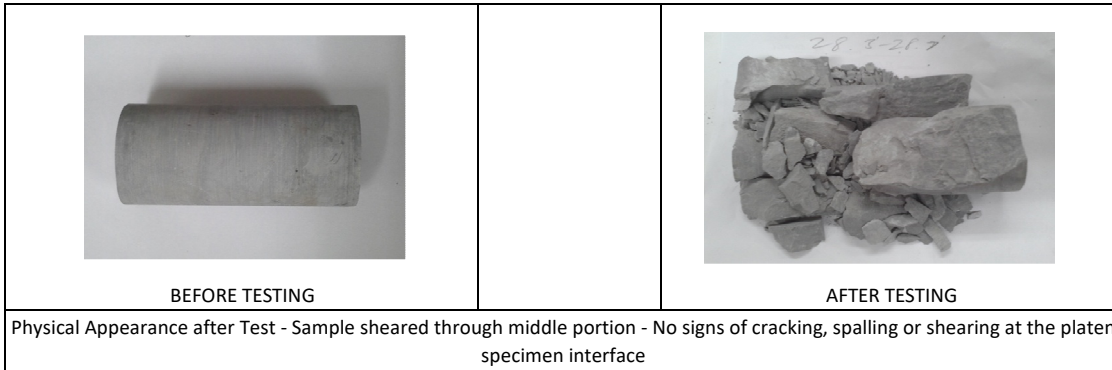
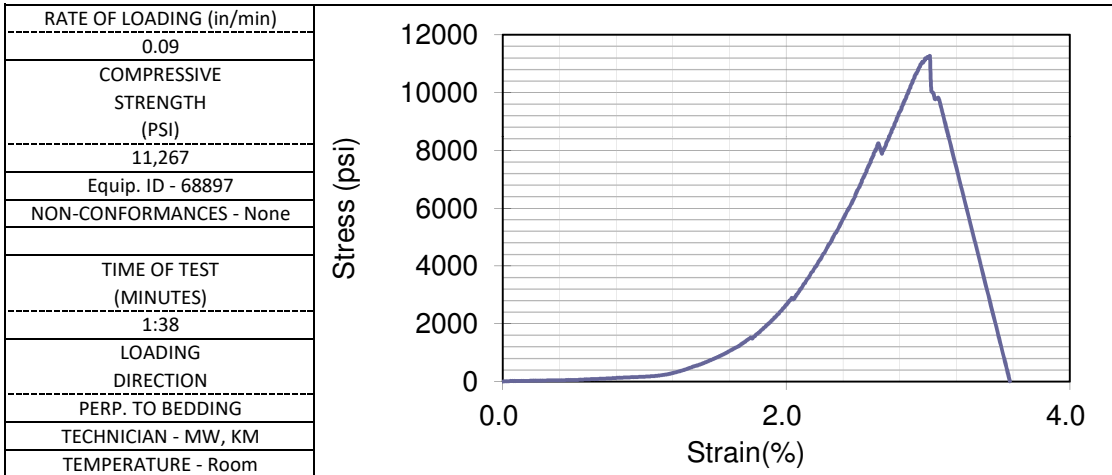
Method C

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



APPENDIX D

SETTLEMENT CALCULATIONS



Settlement @ B-003
Rear Abutment

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

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

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

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

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

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

Per DAS Fig. 3.43 & 3.44

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

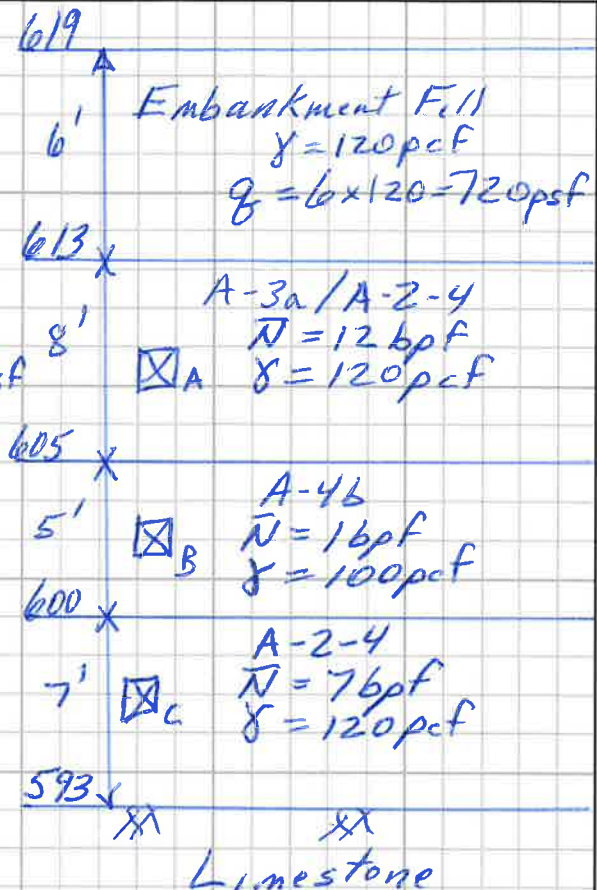
$$S_A = \frac{1}{BCI_A} H_a \log \frac{p_{oA} + q I_A}{p_{oA}} = \frac{1}{68.4} 8 \times 12 \log \frac{418 + 720(1.0)}{418} = 0.61''$$

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

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

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

Say 1.3''





Layers A&C \Rightarrow Granular \Rightarrow Immediate Settlement

Time Rate of Settlement

Layer B (A-46)

$$\frac{L}{PI} = \frac{23}{4}$$

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

2 sides Drained

$$C_v \approx 7.4 \times 10^{-3} \text{ cm}^2/\text{sec}$$

$$C_v = 0.69 \text{ ft}^2/\text{day}$$

Compute time for 90% Consolidation

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

$$T_{v90} = 0.848$$

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

Compute time for 60% Consolidation

$$T_{v60} = 0.286$$

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



Settlement @ B-004
 Forward Abutment

$$p_{0A} = \frac{8.5}{2} (120) = 510 \text{ psf}$$

$$p_{0B} = 8.5(120) + \frac{2.5}{2}(100) = 1145 \text{ psf}$$

$$p_{0C} = 1145 + \frac{2.5}{2}(100 - 62.4) = 1552 \text{ psf}$$

$$BCI_A = 3.2(10) + 30 = 62.0$$

$$BCI_B = \frac{3.2(11) + 30 + 1.4(11) + 1.2}{2} = 40.9$$

$$BCI_C = 3.2(11) + 30 = 65.2$$

Per DAS Fig 3.43 & 3.44

$$I_A = 1.0 ; I_B = 0.94 ; I_C = 0.83$$

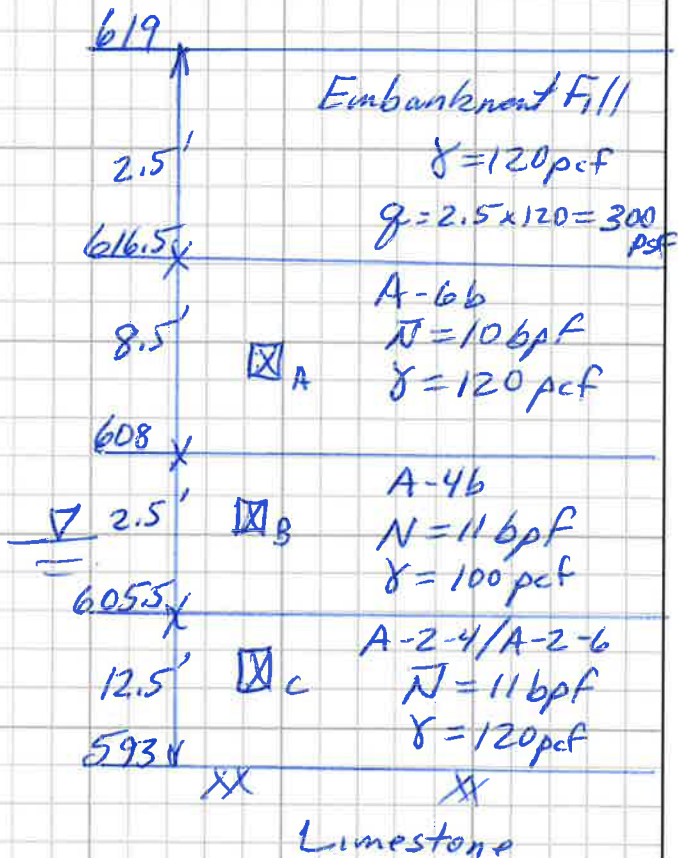
$$S_A = \frac{1}{62.0} 8.5 \times 12 \log \frac{510 + 300(1.0)}{510} = 0.33''$$

$$S_B = \frac{1}{40.9} 2.5 \times 12 \log \frac{1145 + 300(0.94)}{1145} = 0.07''$$

$$S_C = \frac{1}{65.2} 12.5 \times 12 \log \frac{1552 + 300(0.83)}{1552} = 0.15''$$

$$S_{TOTAL} = \underline{0.55} \times 0.7 = \underline{0.39''}$$

Say 0.39'' OK



APPENDIX E

DOWNDRAG CALCULATIONS

Soil Parameters

Project: PIK-CR9-5.29
 Location: Rear Abutment
 Boring No.: B-003-0-19
 Date: 1/17/20
 Bottom of the pile cap= 609.91 feet

Layer No.	Top Elev	Bottom Elev	Thickness (feet)	Type	Total Weight (pcf)	N ₆₀ value (bpf)	Moisture Content (%)	Total Stress		Reference
								Cohesion (psf)	Friction Angle (degrees)	
1	609.9	605	4.91	A-2-4	120	12	10	0	30	3
2	605	600	5	A-4b	100	3	66	875	0	1,2
3	600	593	7	A-2-4	120	8	14	0	30	3
			Avg	A-2-4	120	8	16			

Reference Key

- 1 Total Stress Cohesion estimated from average hand penetration values
- 2 Total Stress Friction Angle estimated to be 0
- 3 Non plastic soils - Friction angle estimated from N-value & soil type

Downdrag Calculation

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

Top Elev	Bottom Elev	Net Settlement (in)	
613	605	0.61	
605	600	0.95	
600	593	0.32	
Total=		1.88	in
Settlement=		1.32	in 70% of Total

Measuring from bottom of pile, 0.4 inch settlement occurs at and below elevation = 600.6 feet

Compute Skin Friction using the Ultimate data from RS pile Analysis

From RS pile Results

HP 10x42

Unfactored Downdrag Load	18 Kips	
Load Factor for Downdrag (AASHTO 3.4.1-2)	1.4	
Factored Downdrag Load	25.2 Kips	Say 25 Kips

Project: PIK-CR9-5.29
Location: Rear Abutment
Boring No.: B-003-0-19
Date: 1/17/2020

Bottom of the pile
 cap= 609.91 feet
 Pile Type= HP 10x42

Ultimate

Capacity (Total)

<u>(kips)</u>	<u>Depth (feet)</u>	<u>Elevation</u>
0.001793505	0.01	609.9
0.070186476	0.3382	609.5718
0.159433227	0.6764	609.2336
0.267740251	1.0146	608.8954
0.39510755	1.3528	608.5572
0.541535123	1.691	608.219
0.70702297	2.0292	607.8808
0.891571091	2.3674	607.5426
1.095179486	2.7056	607.2044
1.317848156	3.0438	606.8662
1.559577099	3.382	606.528
1.820366317	3.7202	606.1898
2.100215809	4.0584	605.8516
2.399125576	4.3966	605.5134
2.717095616	4.7348	605.1752
2.879342995	4.9	605.01
2.676955232	4.92	604.99
3.841646501	5.2482	604.6618
5.006337771	5.5864	604.3236
6.17102904	5.9246	603.9854
7.335720309	6.2628	603.6472
8.500411578	6.601	603.309
9.665102848	6.9392	602.9708
10.82979412	7.2774	602.6326
11.99448539	7.6156	602.2944
13.15917666	7.9538	601.9562
14.32386792	8.292	601.618
15.51166841	8.6302	601.2798
16.71533063	8.9684	600.9416
17.92513786	9.3066	600.6034
19.14109012	9.6448	600.2652
20.06269506	9.9	600.01
20.54559435	9.92	599.99
21.05153345	10.2482	599.6618
21.5916666	10.5864	599.3236
22.15086003	10.9246	598.9854
22.72911373	11.2628	598.6472
23.32642771	11.601	598.309
23.94280196	11.9392	597.9708
24.57823648	12.2774	597.6326
25.23273128	12.6156	597.2944
25.90628635	12.9538	596.9562
26.5989017	13.292	596.618
27.31057732	13.6302	596.2798
28.04131321	13.9684	595.9416
28.79110938	14.3066	595.6034
29.55996582	14.6448	595.2652
30.34788254	14.983	594.927
31.15485953	15.3212	594.5888
31.9808968	15.6594	594.2506
32.82599433	15.9976	593.9124
33.69015215	16.3358	593.5742
34.57337024	16.674	593.236
35.17419924	16.9	593.01

APPENDIX F

ROCK CORE PHOTOS

EP Ferris
19050131COL
Boring S 1
11.7.19

RUN | DEPTH | REC | RSD

0.0

2.1

3.0

19050131COL
E.P. Ferris and Associates, Inc.
PIK-CR9-5.29
B-003-0-19
Box #1 20'-31.4'

TOP

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

BOTTOM

10
43

19050131COL
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'

6

1

3

34.6

TOP

BOTTOM

