BACON | FARMER | WORKMAN

ENGINEERING & TESTING, INC.

STRUCTURE GEOTECHNICAL REPORT

Old US 51 over Crooked Creek
FAU Route 8625
Section 29-2BR
Existing Structure No. 061-0007
Proposed Structure No. 061-0092
Marion County, Illinois

Prepared for:
Mr. Brandon Ratermann, P.E., PTOE
Vice President - Transportation
HMG Engineers
9360 Holy Cross Lane
Breese, Illinois 62230

11/25/2024

CHRISTOPHER MATHEWS
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LICENSED
PROFESSIONAL
ENGINEER
STATE OF ILLINOIS

Exp. 11/30/2025

Submittal Date:

November 25, 2024

BACON | FARMER | WORKMAN
ENGINEERING & TESTING, INC.
521 WEST MAIN STREET | SUITE 200 | BELLEVILLE, IL 62220

November 25, 2024

Mr. Brandon Ratermann, P.E., PTOE
Vice President - Transportation
HMG Engineers
9360 Holy Cross Lane
Breese, Illinois 62230

RE: ***Structure Geotechnical Report***
Old US 51 over Crooked Creek
Structure 061-0092
Marion County, Illinois
BFW No: 23030

Dear Mr. Cima:

Bacon Farmer Workman Engineering & Testing, Inc. (BFW), is pleased to present the attached Structure Geotechnical Report for the referenced project. The foundation investigation was conducted in accordance with applicable IDOT and AASHTO Standards.

The attached report includes a review of pertinent project information, descriptions of site and subsurface conditions encountered, and our general recommendations for foundation design and construction of the proposed bridge.

Sincerely,

BACON | FARMER | WORKMAN
ENGINEERING & TESTING, INC.

Shelby N. Livingstone, E.I.T.
Staff Engineer

Christopher L. Mathews, P.E.
Geotechnical Engineer/Project Manager

TABLE OF CONTENTS

1. Project Description and Scope 1
2. Field Exploration 2
2.1 Regional Geology 2
2.2 Subsurface Conditions 2
2.3 Groundwater 3
3. Geotechnical Evaluations 3
3.1 Basis for Recommendations 3
3.2 Seismic Considerations 4
3.2.1 Design Earthquake 4
3.2.2 Seismic Site Classification and Design Parameters 4
3.2.3 Liquefaction Analysis 4
3.3 Abutment Approach Settlement 4
3.4 Bridge Approach Slabs 5
3.5 Bridge Foundations 5
3.5.1 Driven Piles 5
3.5.2 Piles Set in Rock 6
3.5.3 Lateral Pile Response 6
3.6 Slope stability 7
3.7 Scour Considerations 7
4. Construction Considerations 7
5. Limitations 7

APPENDICES

Appendix A – TS&L

Appendix B – Boring Logs

Appendix C – Seismic Site Class Determination

Appendix D – Liquefaction Analysis Output

Appendix E – Pile Design Tables

Appendix F – LPILE Parameters

FIGURES

Figure 1.1. Project Location 1

TABLES

Table 2.1 – Summary of Soil Testing Borings 2
Table 2.2 – Summary of Auger Refusal 3
Table 2.3 – Summary of Groundwater 3
Table 3.1 – Seismic Design Parameters 4
Table 3.2 – Substructure Factored Loads 5
Table 3.3 – Driven H-Pile Capacities..... 6
Table 3.4 – H-Pile Set in Rock Capacities..... 6
Table 3.5 – Scour Elevations 7

1. PROJECT DESCRIPTION AND SCOPE

The purpose of this geotechnical study was to use the provided subsurface information to prepare geotechnical recommendations for the proposed bridge replacement. It should be noted that an SGR was prepared for this site by IDOT dated February 17, 2009.

Plans are for the removal and replacement of an existing 228'-8" three-span wide flange beam structure on Old US 51 over Crooked Creek. This structure is located just north of Central City in Marion County, Illinois. The existing structure (SN 061-0007) was originally built in 1954 as S.B.I. Route 2, section 29-2B. The bridge deck was repaired with resurfacing in 1999 with a 2-inch bituminous overlay. The structure will be replaced using road closure and a detour to maintain traffic.

The new structure will be a two-lane three-span bridge with reinforced concrete decks on 36-inch web girders supported by integral abutments. The planned structure's length is 245'-0", and its width is 34'-10". The structure will be designed according to the 2020 AASHTO LRFD Bridge Design Specifications, 9th Edition. The site location is shown in Figure 1.1. The TS&L provided by Quigg Engineering, Inc (QEI) on May 21, 2024, is attached in Appendix A.

Figure 1.1. Project Location

2. FIELD EXPLORATION

The subsurface exploration was completed by IDOT in November/December 1994 and October/November 2007. Boring logs were provided to BFW in an SGR dated February 17, 2009. Four borings and one rock core were advanced in connection with the 1994 soil exploration. An additional four borings with rock coring were advanced in connection with the 2007 exploration. Based on the information included on the provided borings logs, the borings were advanced using hollow steam augers and SPT samples were collected with a 140-pound auto hammer. Table 2.1 summarizes the boring locations and depths. The boring locations are shown on the provided TS&L in Appendix A. It should be noted that the 1994 borings were not utilized for calculations.

Table 2.1 – Summary of Soil Testing Borings

Boring	Structure	Type	Date of Drilling	Ground Surface Elevation (msl)	Depth (ft)	Station	Offset
1	North Abutment	Boring	11/21/1994	467.28	39.5	1548+57	10.50' LT
2	South Abutment	Boring	11/28/1994	467.27	37.0	1551+04	9.19' LT
3	Pier 1	Boring	12/5/1994	444.41	12.0	1549+37	5.91' LT
4	Pier 2	Boring	12/6/1994	459.47	22.0	1550+27	6.56' LT
5	South Abutment	Rock Core	12/8/1994	467.26	49.0	1551+06	8.89' LT
6	North Abutment	Boring/Rock Core	10/24/2007	468.85	40.5	1548+51	13.50' LT
7	Pier 1	Rock Core	11/9/2007	444.36	49.0	1549+19	12.00' LT
8	Pier 2	Boring/Rock Core	10/31/2007	446.86	50.1	1550+16	11.25' LT
9	South Abutment	Boring/Rock Core	10/18/2007	468.80	43.5	1551+06	12.00' RT

2.1 *REGIONAL GEOLOGY*

According to the Illinois State Geological Survey's map titled *Bedrock Geology of Illinois: Champaign, IL.,* this site is shown to be underlain by Pennsylvanian aged deposits of the Bond formation. The Bond formation is comprised of sandstone, shale, limestone, and coal. The shales are shown to be silty and carbonaceous in places and the limestones are occasionally shaly or argillaceous.

2.2 *SUBSURFACE CONDITIONS*

The surface of borings 1, 2, 6, and 9 consisted of 6 inches to 2 feet of bituminous/PCC pavement and aggregate base course. Borings 7 and 8 consisted of 1 foot of bridge deck with about 21 to 24 feet of suspended augers before encountering the ground surface at elevations 444 to 447.

Layers of clay, silty clay, loam, and silty loam predominated beneath the previously described surface materials, extending to elevations 434 to 451. These cohesive to intermittent materials exhibited SPT "N" values (blow counts) of 0 to 12 blows per foot (bpf) and unconfined compressive strengths of 0 to 3.95 tons per square foot (tsf), indicating a very soft to very stiff consistency.

Weathered shale and limestone were encountered beneath the previously described materials, extending to auger refusal or boring completion depths (elevations 427 to 437). Rock coring was performed in borings 5, 6, 7, 8, and 9 and revealed layers of shale, sandstone, and limestone. A summary of auger refusal elevations is shown below in Table 2.2. It should be noted that the boring logs provided by IDOT show some inconsistencies in the encountered top of rock elevations.

Table 2.2 – Summary of Auger Refusal

Boring	Structure	Depth to Bedrock (ft)	Bedrock Elevation
1	North Abutment	39.5	427.78
2	South Abutment	37.0	430.27
3	Pier 1	12.0	432.41
4	Pier 2	22.0	437.47
5	South Abutment	34.0	433.26
6	North Abutment	32.3	436.35
7	Pier 1	7.5	436.86
8	Pier 2	12.0	434.86
9	South Abutment	35.5	433.30

2.3 *GROUNDWATER*

Groundwater was encountered between elevations 433 and 454 in borings 1, 2, 4, 6, 7, 8, and 9 at the time of drilling activities. It should be noted that the ground water level is dependent upon seasonal and climatic variations and may be present at different depths in the future. Table 2.3 summarizes the groundwater elevations.

Table 2.3 – Summary of Groundwater

Boring	Structure	Elevation of Groundwater (First Encounter)	Elevation of Groundwater (Upon Completion)
1	North Abutment	446.3	447.3
2	South Abutment	438.4	--
3	Pier 1	--	--
4	Pier 2	450.6	454.6
5	South Abutment	--	--
6	North Abutment	444.4	--
7	Pier 1	446.9	--
8	Pier 2	444.4	--
9	South Abutment	433.8	--

3. GEOTECHNICAL EVALUATIONS

Based on the results of the subsurface exploration, current site conditions observed, and laboratory results, and our review of the project plans, the following geotechnical evaluations were performed. The recommendations developed from these evaluations should be used in the design of the bridge structures.

3.1 *BASIS FOR RECOMMENDATIONS*

The following recommendations are based on data from this exploration and the stated project information. In our evaluations, we have utilized both subsurface data provided by IDOT and our experience with similar structures and subsurface conditions. If the structural information is incorrect or changed after our reporting, or if the subsurface conditions encountered during the construction vary from those reported, our recommendations should be reviewed based on the changed conditions.

Experience indicates that the actual subsoil conditions at a site could vary from those generalized based on soil test borings made at specific locations. Therefore, it is essential that a geotechnical engineer be retained to provide soil-engineering services during the site preparation, excavation, and foundation construction phases

of the proposed project. The geotechnical engineer should observe compliance with the design concepts, specifications, and recommendations, and allow design changes in the event subsurface conditions differ from those anticipated prior to the start of construction.

3.2 *SEISMIC CONSIDERATIONS*

3.2.1 Design Earthquake

According to *IDOT Geotechnical Manual*, bridge structures are required to be designed to an earthquake with a 7 percent Probability of Exceedance (PE) over a 75-year exposure period (i.e., a 1,000-year design earthquake). The 1,000-year design earthquake has a Moment Magnitude (Mw) of 4.9 and a Peak Ground Acceleration (PGA) of 0.22g as determined from data provided by the United States Geological Survey (USGS) National Seismic Hazard Mapping Project.

3.2.2 Seismic Site Classification and Design Parameters

The seismic site classification for the site was determined based on the subsurface data collected and the procedures outlined in the draft *IDOT 2024 Seismic Manual*. Specifically, the procedures outlined in Section 3.2 of the manual were utilized to convert N values to shear wave velocity. The weighted averaged shear wave velocity of the upper 100 feet of the seismic soil column at each structure was then calculated. Based on the weighted average shear wave velocity profile in the upper 100 feet of the seismic soil column, Site Class CD should be used for seismic design. Site class calculations are included in Appendix C. Seismic design parameters are presented in Table 3.1.

Table 3.1 – Seismic Design Parameters

Seismic Design Parameters	
Performance Level	Operational
Latitude	38.56
Longitude	-89.13
Site Class	CD
S_{D1}	0.23
SDC	B

3.2.3 Liquefaction Analysis

The liquefaction potential analysis for the site was conducted using field and laboratory data and the techniques outlined in AGMU 10.1. The average seasonal groundwater elevation used in the analysis was estimated from the end of boring conditions and the seasonal weather conditions. Sands located above the groundwater table are not susceptible to liquefaction.

Based on our analyses, the soils at the project site have sufficient strength values to resist liquefaction and/or a plasticity index that make the threat of liquefaction minimal during the design earthquake. While the amount of the seismically induced settlement is dependent on the magnitude and distance from the seismic event, we estimate that the settlements from the design earthquake will be negligible and relatively uniform in nature, so liquefaction mitigation techniques are not required. The liquefaction analysis results are presented in Appendix D.

3.3 *ABUTMENT APPROACH SETTLEMENT*

Based on the provided TS&L prepared by QEI, minimal grade changes will be required. Accordingly, minimal abutment settlement will occur and the effects of downdrag do not be considered in the evaluation of pile capacity.

3.4 *BRIDGE APPROACH SLABS*

The bridge approach slabs should be designed to bear on existing embankment soils or newly placed low plasticity structural fill. In evaluating the bearing resistance of the slabs, we recommend using a modulus of subgrade reaction of 150 pounds per square inch per inch of deflection (pci).

3.5 *BRIDGE FOUNDATIONS*

The bridge foundations must be designed to provide sufficient capacity to resist dead and live loads, including seismic loads. The estimated factored substructure loads provided by QEI are summarized in Table 3.2. Based on information provided by QEI and the depths to bedrock, we recommend utilizing driven piles bearing on rock for foundation support of the abutments and piles set in rock for the piers.

Table 3.2 – Substructure Factored Loads

Substructure Location	Loading Condition	100% of Factored Substructure Load (kips/pile)	120% of Factored Substructure Load (kips/pile)
Abutments Est. 6 Piles	Service	178	214
	Strength-I	266	319
	Extreme Event-I	136	163
Piers Est. 6 Piles	Service	349	419
	Strength-I	514	617
	Extreme Event-I	280	336

3.5.1 Driven Piles

Based on the substructure factored loads and depth to bedrock, driven piles bearing on rock are a suitable option for foundation support of the abutments. The structural capacity of driven piles is dependent upon the cross-sectional area of the pile and the allowable stress of the steel. The pile recommendations in this report assume the H-piles will conform to AASHTO M270 Grade 50 steel with a minimum yield stress of 50 kips per square inch (ksi). The piles should be spaced no closer than three pile diameters, center to center.

To develop capacity, the H-piles will need to bear on bedrock. Based on the refusal depths encountered in the borings, we estimate that the piles will bear at an elevation ranging between 430 and 440 msl. It should be noted that the bedrock conditions were inconsistent, and depths of practical pile refusal may vary between piles. The IDOT Modified Method Excel spreadsheet was used to estimate the pile lengths at various axial geotechnical resistances for driven piles per AGMU Memo 10.2. Per the *IDOT Geotechnical Manual*, a geotechnical resistance factor of 0.55 should be used for driven piles. For H-piles end bearing on rock, the factored resistance available is simply the structural nominal compressive resistance of the pile section factored with the appropriate geotechnical resistance factor. During the seismic event, a Geotechnical Resistance Factor of 1.0 may be used. Geotechnical losses due to liquefaction or settlement do not need to be considered. Table 3.3 summarizes recommended H-Pile capacities at each substructure. Additional pile sizes, lengths, and capacities can be found in Appendix E.

It should be noted that even when utilizing the pile section with the highest capacity included in the IDOT pile design spreadsheet (HP 14 x 117), the maximum factored resistance available was lower than the factored substructure loads based on 6 pile per substructure provided by QEI for the piers. Accordingly, additional piles would likely be required for the piers. It is also understood that a longer pile length than what is drivable may be needed for the support of lateral loads at the pier locations. Therefore, it is recommended that piles set in rock be utilized at the two pier locations, as described in section 3.5.2.

Table 3.3 – Driven H-Pile Capacities

Substructure	Pile Type	Maximum Nominal Required Bearing (kips)	Factored Resistance Available (kips)	Estimated Pile Length (ft)
N. Abutment	HP 12 x 84	663	365	28
N. Abutment	HP 14 x 73	578	318	26
S. Abutment	HP 12 x 84	663	365	31
S. Abutment	HP 14 x 73	578	318	27

3.5.2 Piles Set in Rock

Based on the substructure factored loads and depth to bedrock at the location of the piers, it is recommended that steel H-piles set in bedrock be utilized for foundation support of the two piers. The structural capacity of piles is dependent upon the cross-sectional area of the pile and the allowable stress of the steel. The pile recommendations in this report assume the H-piles will conform to AASHTO M270 Grade 50 steel with a minimum yield stress of 50 kips per square inch (ksi). The piles should be spaced no closer than three pile diameters, center to center.

To develop capacity, the H-piles will need to bear on bedrock. Based on information provided by QEI, we anticipate pre-coring of the piles and creation of a rock socket will be required to meet the pier requirements. The portion of the pre-cored hole through soil should be backfilled with granular bentonite with unconfined compressive strength of 1.0 tons per square foot. The portion of the pre-cored hole considered as part of the rock socket should be backfilled with concrete. The rock socket may be designed for a factored unit tip resistance of 600 kips per square foot (ksf) and factored unit side resistance of 25 ksf. The factored resistances were developed based on strength limit state factors of 0.50 and 0.55 for tip and side resistances, respectively. We recommend a minimum rock socket depth of 5 feet into competent rock. However, deeper rock sockets may be required based on results of the LPILE analysis. Recommended soil parameters for lateral analysis are discussed in Section 3.5.3 of this report.

Section 6.13.2.3.5 of the *IDOT Geotechnical Manual* indicates a Geotechnical Resistance Factor (ϕ_G) of 0.70 should be used for H-piles set in rock. Additionally, the nominal capacity of piles set in rock is taken to be 100% of the pile section's yield strength. During the seismic event, a Geotechnical Resistance Factor of 1.0 may be used. Geotechnical losses due to liquefaction or settlement do not need to be considered. Table 3.4 summarizes the H-Pile capacities for multiple pile sizes.

Table 3.4 – H-Pile Set in Rock Capacities

Pile Type	Structural Nominal Compressive Resistance (kips)	Factored Compressive Resistance, Static (ϕ_G= 0.70, kips)	Factored Compressive Resistance, Seismic (ϕ_G = 1.0, kips)
HP 12x53	775	542	775
HP 12x84	1,230	861	1,230
HP 14x73	1,070	749	1,070
HP 14x89	1,305	914	1,305
HP 14x102	1,305	1050	1,305

3.5.3 Lateral Pile Response

The lateral response can be developed by modeling the soil/shaft interaction with the computer program LPILE. Discrete elements are used in LPILE to represent the shaft and non-linear soil using springs. The non-linear soil springs are commonly referred to as P-Y curves. A summary of the approximate soil modulus

parameters (k) for the LPILE analyses (Reference: LPILE User's Manual, Ensoft, Inc., 2019) can be found in Appendix F.

3.6 *SLOPE STABILITY*

Based on the information shown on the provided TS&L, 2H:1V benched end slopes with riprap armoring will be utilized for the abutments. Based on minimal grade changes and slope heights, a slope stability analysis was not performed for the project.

3.7 *SCOUR CONSIDERATIONS*

We understand that scour protection will be provided at the bridge abutments via Class A5 stone riprap. Design scour elevation, as provided by QEI, is included in Table 3.5.

Table 3.5 – Scour Elevations

Event / Limit State	Design Scour Elevations (ft)				Item 113
	N. Abut.	Pier 1	Pier 2	S. Abut.	
Q100	459.5	433.3	433.1	458.7	5
Q200	459.5	433.5	433.3	458.7	
Design	459.5	433.3	433.1	458.7	
Check	459.5	433.5	433.3	458.7	

4. CONSTRUCTION CONSIDERATIONS

We anticipate that cofferdams will be utilized to construct the piers for the bridge. Based on the TS&L, there will be greater than six feet of difference between the base of the encasement and the estimated water surface elevation; accordingly, a Type II cofferdam will be required.

All work performed for the proposed project should conform to the requirements in the *IDOT Standard Specifications for Road and Bridge Construction* and any pertinent special provisions or policies. Any deviation from the requirements in the manuals above should be approved by the design engineer.

5. LIMITATIONS

This report has been prepared for the exclusive use of HMG Engineers and its subconsultants for the project and the Illinois Department of Transportation. The recommendations provided in the report are specific to the project described herein and are based on the information obtained from the soil boring locations provided by IDOT within the project limits. The analyses have been performed and the recommendations provided in this report are based on subsurface conditions determined at the location of the borings. The report may not reflect all variations that may occur between boring locations or at some other time, the nature and extent of which may not become evident until during the time of construction. If variations in subsurface conditions become evident after submission of this report, it will be necessary to evaluate their nature and review the recommendations provided herein considering the new conditions.

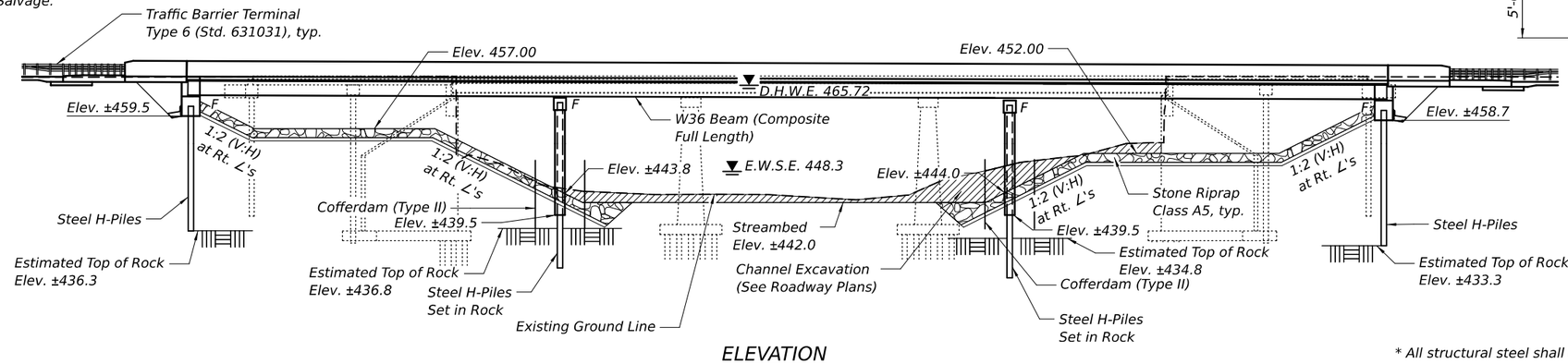
Appendix A

TS&L

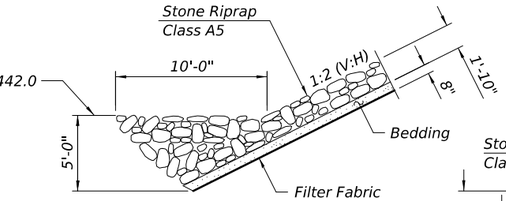
Benchmark: RR spike in power pole. Sta. 1551+90.49, Offset 26.57' Rt., Elev. 467.01.

Existing Structure: SN 061-0007 was originally built in 1954 as SBI Route 2, Section 29-2B. The bridge is 145'-8" bk.-to-bk. abutments and 35'-8" out-to-out of deck. The superstructure consists of 3 spans of wide flange beams on closed abutments and solid wall piers. The bridge has a bituminous overlay in place. The structure will be replaced using road closure and a detour to maintain traffic.

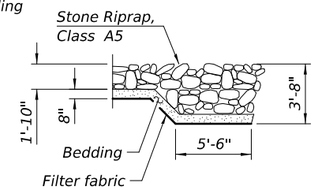
No Salvage.



ELEVATION



SECTION A-A



SECTION B-B

* All structural steel shall be galvanized.

SEISMIC DATA

2023 AASHTO Seismic Hazard
Seismic Design Category (SDC) = B
Design Spectral Acceleration at 1.0 sec. (SD1) = 0.27g
Soil Site Class = D
Performance Level = Operational
Latitude = 38.56° N
Longitude = 89.13° W

LOADING HL-93

Allow 50#/sq. ft. for future wearing surface.

DESIGN SPECIFICATIONS

2020 AASHTO LRFD Bridge Design Specifications, 9th Edition

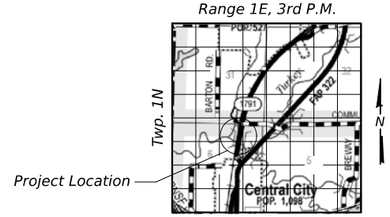
DESIGN STRESSES

FIELD UNITS

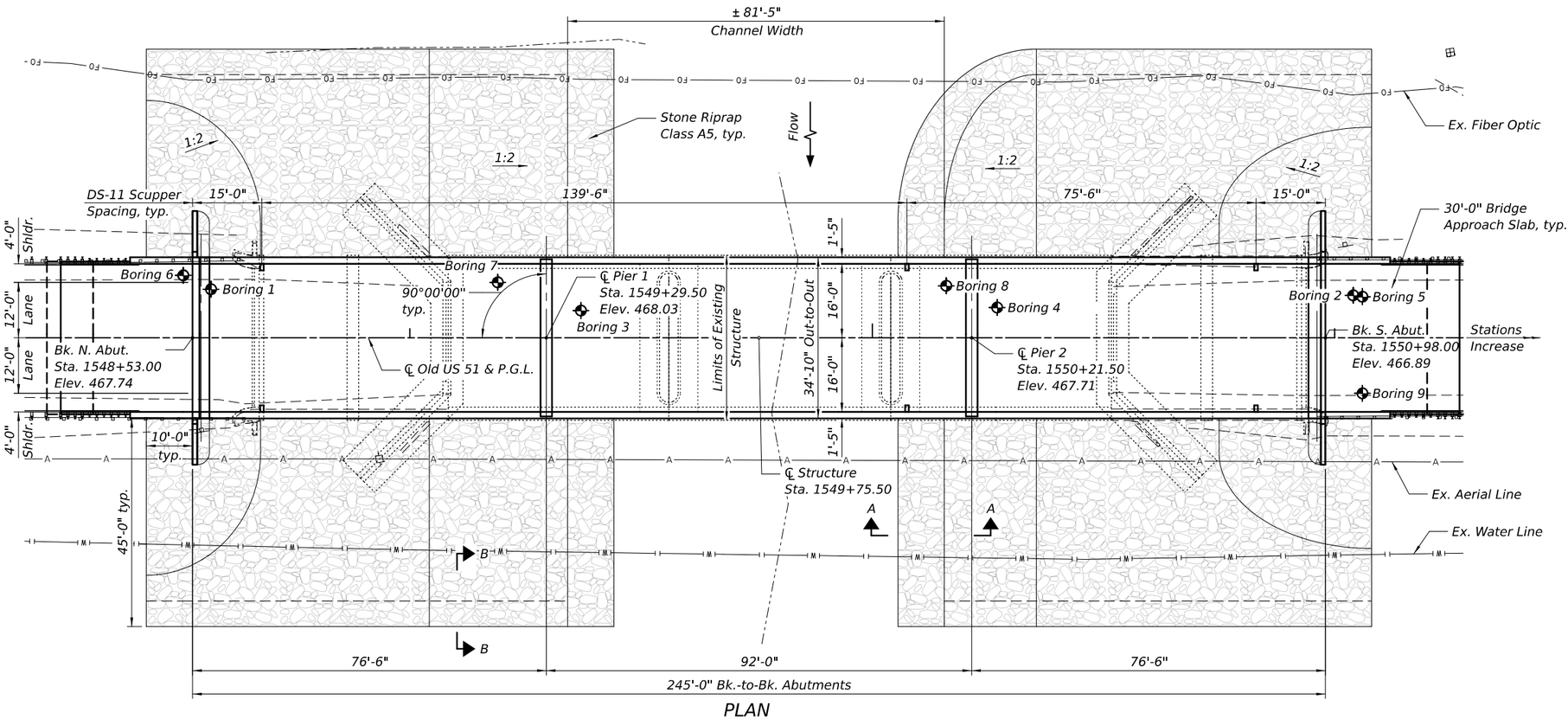
f 'c = 4,000 psi (Superstructure)
f 'c = 3,500 psi (Substructure)
fy = 60,000 psi (Reinforcement)
*fy = 50,000 psi (M270 Grade 50)**

HIGHWAY CLASSIFICATION

F.A.U. Route. 8625 - Old U.S. Route 51
Functional Class: Major Collector
ADT: 1,450 (2022); 1,515 (2046)
ADTT: 58 (2022); 61 (2046)
DHV: 145 (Two-Way)
Design Speed: 55 m.p.h.
Posted Speed: 55 m.p.h.
Two-Way Traffic
Directional Distribution: 50:50



LOCATION SKETCH



PLAN

GENERAL PLAN & ELEVATION
OLD U.S. ROUTE 51 OVER CROOKED CREEK
F.A.U. ROUTE 8625 - SECTION 29-2BR
MARION COUNTY
STATION 1549+75.50
STRUCTURE NO. 061-0092

QUIGG ENGINEERING INC

USER NAME = JCray	DESIGNED - RPW	REVISED -	
0610092-76A37-TSL-001.dgn	CHECKED - ZLD	REVISED -	
PLOT SCALE = 28.333 ' / in.	DRAWN - JDC	REVISED -	
PLOT DATE =	CHECKED - MDC	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET 1 OF 2 SHEETS

F.A.U. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
8625	29-2BR	MARION		
		CONTRACT NO. 76A37		
		ILLINOIS	FED. AID PROJECT	

MODEL: Default
FILE NAME: S:\2021\21L031 - PTB 199-32 D8 - HMG - Various Ph I-II\WO10-OUS-51 TSL Plan\CADD\CADD Sheets\0610092-76A37-TSL-001.dgn
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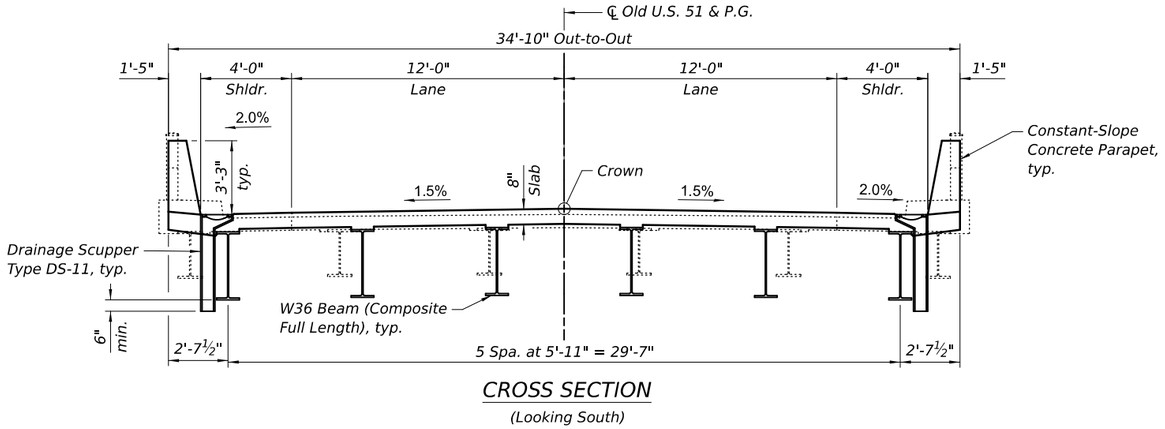
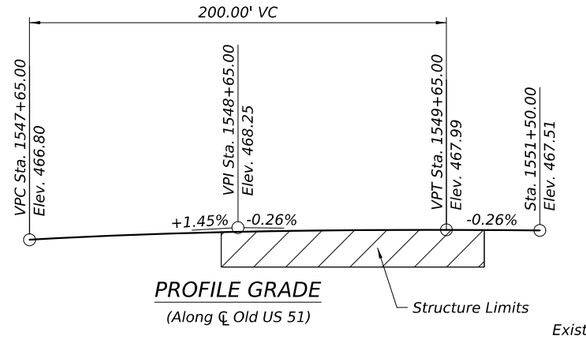


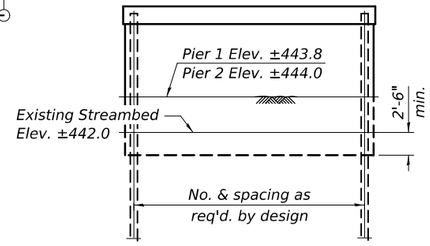
CROSS SECTION

(Looking South)



PROFILE GRADE

(Along ℄ Old US 51)



PIER SKETCH

DESIGN SCOUR ELEVATION TABLE

Event / Limit State	Design Scour Elevations (ft.)				Item 113
	N. Abut.	Pier 1	Pier 2	S. Abut.	
Q100	459.5	433.3	433.1	458.7	5
Q200	459.5	433.5	433.3	458.7	
Design	459.5	433.3	433.1	458.7	
Check	459.5	433.5	433.3	458.7	

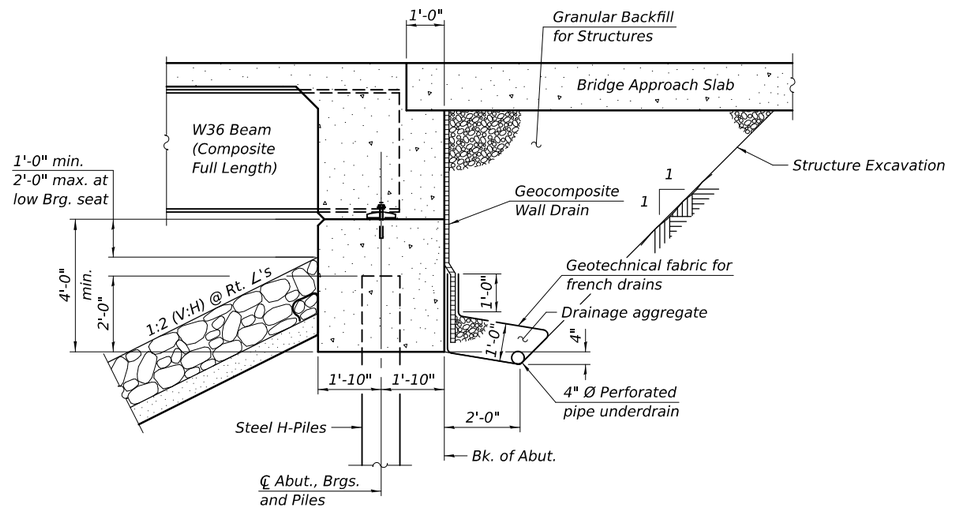
WATERWAY INFORMATION

Drainage Area = 146.4 sq. mi.

Existing Overtopping Elev. = 463.97 @ Sta.
Proposed Overtopping Elev. = 463.97 @ Sta.

Flood	Freq. Yr.	Q C.F.S.	Opening Ft² Exist.	Opening Ft² Prop.	Nat. H.W.E.	Head - Ft. Exist.	Head - Ft. Prop.	Headwater El. Exist.	Headwater El. Prop.
Ten-Year	10	13,975	1,875	2,154	461.06	0.35	0.21	461.41	461.27
Design	50	22,316	2,356	2,772	465.72	1.23	0.91	466.95	466.63
Base	100	26,195	2,356	2,772	467.40	1.80	0.70	469.20	468.10
Scour Check	200	28,784	2,356	2,772	468.57	0.97	0.97	469.54	469.54
Max. Calc.	500	35,909	2,356	2,772	470.95	1.21	1.22	472.16	472.17

10-Year Velocity through Existing Structure = 7.5 fps
10-Year Velocity through Proposed Structure = 6.5 fps



SECTION THRU INTEGRAL ABUTMENT

DETAILS
OLD U.S. ROUTE 51 OVER CROOKED CREEK
F.A.U. ROUTE 8625 - SECTION 29-2BR
MARION COUNTY
STATION 1549+75.50
STRUCTURE NO. 061-0092

MODEL: Default
FILE NAME: S:\2021\21IL031 - PTB 199-32 D8 - HMG - Various Ph I\WO10-OUS-51 TSL Plan\CADD\CADD Sheets\0610092-76A37-TSL-002.dgn
5/30/2024 2:41:21 PM

QUIGG ENGINEERING INC

USER NAME = JCray	DESIGNED - RPW	REVISED -	
0610092-76A37-TSL-002.dgn	CHECKED - ZLD	REVISED -	
PLOT SCALE = 6.667 ' / in.	DRAWN - JDC	REVISED -	
PLOT DATE =	CHECKED - MDC	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET 2 OF 2 SHEETS

F.A.U. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
8625	29-2BR	MARION		
		CONTRACT NO. 76A37		
	ILLINOIS	FED. AID PROJECT		

Appendix B

Boring Logs

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

SOIL BORING LOG

Date 11/21/94

ROUTE FAS 1791 DESCRIPTION Old US 51 over Crooked Creek LOGGED BY D. Lux

SECTION 29-2BR LOCATION NE 1/4, SEC. 6, TWP. 1N, RNG. 1E, 3 PM

COUNTY Marion DRILLING METHOD Hollow Stem Auger HAMMER TYPE 140# Automatic

STRUCT. NO. 061-0007 (E) / 061-0092 (P)
Station 1549+80

BORING NO. 1 N. Abut
Station 1548+57
Offset 10.50ft LT
Ground Surface Elev. 467.28 ft

Surface Water Elev. ____ ft
Stream Bed Elev. ____ ft

Groundwater Elev.:
First Encounter 446.3 ft
Upon Completion 447.3 ft
After ____ Hrs. ____ ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				Existing Bituminous and PCC Pavement, Aggregate Base Course
465.28				
				Brown Marbled Gray CLAY
	30	1.98 S	16	
462.78				
-5				Gray Marbled Brown CLAY
	8	0.94 S	21	
459.28				
	7	1.15 S	20	CLAY
457.78				
-10				Gray Silty LOAM
	3	0.31 B	26	
454.28				
	7	0.31 S	27	Gray CLAY
-15				
451.78				
	3	0.31 E	23	Silty LOAM
450.28				
				Dark Brown Marbled Gray and Brown Silty CLAY to CLAY
-20				
				Dark Brown Marbled Gray and Brown Silty CLAY to CLAY *(continued)*
	0	0.10 B	29	
	0	0.10 B	28	
-25				
441.28				
	13	0.63 S	28	Sandy CLAY
440.28				
				Gray Marbled Brown Silty LOAM
	3	0.10 B	27	
437.78				
-30				Gray Silty LOAM
435.78	40	0.31 S	21	
				Badly Weathered Gray Sandy CLAY to SHALE
433.78				
	4.5"/100		5	Badly Weathered Gray SANDSTONE
-35				
	0.625"/100		8	
427.78				
-40				END OF BORING

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

SOIL BORING LOG

Date 11/21/94

ROUTE FAS 1791 DESCRIPTION Old US 51 over Crooked Creek LOGGED BY D. Lux

SECTION 29-2BR LOCATION NE 1/4, SEC. 6, TWP. 1N, RNG. 1E, 3 PM

COUNTY Marion DRILLING METHOD Hollow Stem Auger HAMMER TYPE 140# Automatic

STRUCT. NO. 061-0007 (E) / 061-0092 (P)
Station 1549+80

BORING NO. 1 N. Abut
Station 1548+57
Offset 10.50ft LT
Ground Surface Elev. 467.28 ft

Surface Water Elev. _____ ft
Stream Bed Elev. _____ ft

Groundwater Elev.:
First Encounter 446.3 ft
Upon Completion 447.3 ft
After _____ Hrs. _____ ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
-45			
-50			
-55			
-60			

NOTE: Value is "N" Column is the TOTAL Blow Count for the Sample

Assumed Elevation at Center of Existing Bridge = 100.0 ft

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

SOIL BORING LOG

Date 11/28/94

ROUTE FAS 1791 DESCRIPTION Old US 51 over Crooked Creek LOGGED BY D. Lux

SECTION 29-2BR LOCATION NE 1/4, SEC. 6, TWP. 1N, RNG. 1E, 3 PM

COUNTY Marion DRILLING METHOD Hollow Stem Auger HAMMER TYPE 140# Automatic

STRUCT. NO. 061-0007 (E) / 061-0092 (P)
Station 1549+80

BORING NO. 2 S. Abut
Station 1551+04
Offset 9.19ft LT
Ground Surface Elev. 467.27 ft

Surface Water Elev. ____ ft
Stream Bed Elev. ____ ft

Groundwater Elev.:
First Encounter 438.4 ft
Upon Completion Cave In ft
After ____ Hrs. ____ ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
465.27				Existing Bituminous and PCC Pavement, Aggregate Base Course
				Gray Marbled Brown CLAY
	6	0.21 B	24	
-5				
	18		17	
459.27				
	3	0.31 S	22	Gray Silty LOAM
-10				
456.77				
	8	0.73 S	22	Gray Silty LOAM
455.27				
				Gray Silty LOAM
-15				
	3	0.31 S	25	
450.27				
				Gray Silty LOAM
	0	0.10 B	24	
-20				

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				Gray Silty LOAM *(continued)*
	0	0.00 B	24	
-25				
	3	0.63 S	28	
440.27				
438.77				Dark Gray Silty LOAM
	11		18	Gray Mix of Very Badly Weathered Clay-SHALE, Sandy LOAM to SAND
-30				
436.27				
	9.5"/100		11	Very Badly Weathered Gray Clay-SHALE
	8 25"/100	2.5 S	5	
-35				
	0.5"/100		1	
430.27				
				END OF BORING
				NOTE: Value is "N" Column is the TOTAL Blow Count for the Sample
-40				

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

SOIL BORING LOG

Date 11/28/94

ROUTE FAS 1791 DESCRIPTION Old US 51 over Crooked Creek LOGGED BY D. Lux

SECTION 29-2BR LOCATION NE 1/4, SEC. 6, TWP. 1N, RNG. 1E, 3 PM

COUNTY Marion DRILLING METHOD Hollow Stem Auger HAMMER TYPE 140# Automatic

STRUCT. NO. 061-0007 (E) / 061-0092 (P)
Station 1549+80

BORING NO. 2 S. Abut
Station 1551+04
Offset 9.19ft LT
Ground Surface Elev. 467.27 ft

Surface Water Elev. ____ ft
Stream Bed Elev. ____ ft

Groundwater Elev.:
First Encounter 438.4 ft
Upon Completion Cave In ft
After ____ Hrs. ____ ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Assumed Elevation at Center of Existing Bridge = 100.0 ft			
-45			
-50			
-55			
-60			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

SOIL BORING LOG

Date 12/5/94

ROUTE FAS 1791 DESCRIPTION Old US 51 over Crooked Creek LOGGED BY D. Lux

SECTION 29-2BR LOCATION NE 1/4, SEC. 6, TWP. 1N, RNG. 1E, 3 PM

COUNTY Marion DRILLING METHOD Hollow Stem Auger HAMMER TYPE 140# Automatic

STRUCT. NO. 061-0007 (E) / 061-0092 (P)
Station 1549+80

BORING NO. 3 Pier 3
Station 1549+37
Offset 5.91ft LT
Ground Surface Elev. 444.41 ft

Surface Water Elev. ____ ft
Stream Bed Elev. ____ ft

Groundwater Elev.:
First Encounter ____ ft
Upon Completion ____ ft
After ____ Hrs. ____ ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	
Gray Silty LOAM				
	3	0.10 E	25	
-5				
438.91				
Gray CLAY	3	0.10 S	43	
435.41	9	25"/100	1.25 S	7
Very Badly Weathered Gray SANDSTONE				
-10				
	0.375"/100			2
432.41				
END OF BORING				
NOTE: Value is "N" Column is the TOTAL Blow Count for the Sample				
-15				
Assumed Elevation at Center of Existing Bridge = 100.0 ft				
-20				

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

SOIL BORING LOG

Date 12/6/94

ROUTE FAS 1791 DESCRIPTION Old US 51 over Crooked Creek LOGGED BY D.Lux

SECTION 29-2BR LOCATION NE 1/4, SEC. 6, TWP. 1N, RNG. 1E, 3 PM

COUNTY Marion DRILLING METHOD Hollow Stem Auger HAMMER TYPE 140# Automatic

STRUCT. NO. 061-0007 (E) / 061-0092 (P)
Station 1549+80

BORING NO. 4 Pier 2
Station 1550+27
Offset 6.56ft LT
Ground Surface Elev. 459.47 ft

Surface Water Elev. ____ ft
Stream Bed Elev. ____ ft

Groundwater Elev.:
First Encounter 450.6 ft
Upon Completion 454.6 ft
After ____ Hrs. ____ ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
457.47				Brown Marbled Red and Gray CLAY
	12	1.78 S	18	
454.97				Gray CLAY
	9	0.52 S	21	
-5				Gray with Brown Streaks CLAY
	6	0.21 S	24	
451.47				
	3		35	Very Badly Weathered Gray Clay SHALE
-10				
	2		27	
445.97				
	51	3.86 S	17	Very Badly Weathered Gray Clay SHALE
-15				
443.47				
	3.875"/100	0.67 S	7	Weathered Gray Clay SHALE
	0.25"/100		7	
-20				

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				Weathered Gray Clay SHALE *(continued)*
	0.25"/100		8	
437.47				
				END OF BORING
				NOTE: Value is "N" Column is the TOTAL Blow Count for the Sample
-25				
				Assumed Elevation at Center of Existing Bridge = 100.0 ft
-30				
-35				
-40				

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

SOIL BORING LOG

Date 12/8/94

ROUTE FAS 1791 DESCRIPTION Old US 51 over Crooked Creek LOGGED BY D. Lux

SECTION 29-2BR LOCATION NE 1/4, SEC. 6, TWP. 1N, RNG. 1E, 3 PM

COUNTY Marion DRILLING METHOD Hollow Stem Auger HAMMER TYPE 140# Automatic

STRUCT. NO. 061-0007 (E) / 061-0092 (P)
Station 1549+80

BORING NO. 5 S. Abut
Station 1551+06
Offset 8.89ft LT
Ground Surface Elev. 467.26 ft

Surface Water Elev. ____ ft
Stream Bed Elev. ____ ft

Groundwater Elev.:
First Encounter ____ ft
Upon Completion ____ ft
After ____ Hrs. ____ ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				Cored through Bituminous and Concrete Pavement, Augered without Sampling to 34 feet
-5				
-10				
-15				
-20				
-25				Cored through Bituminous and Concrete Pavement, Augered without Sampling to 34 feet *(continued)*
-30				
433.26				Borehole continued with rock coring.
-35				
-40				

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

ROCK CORE LOG

Date 12/8/94

ROUTE FAS 1791 DESCRIPTION Old US 51 over Crooked Creek LOGGED BY D. Lux

SECTION 29-2BR LOCATION NE 1/4, SEC. 6, TWP. 1N, RNG. 1E, 3 PM

COUNTY Marion CORING METHOD

STRUCT. NO. 061-0007 (E) / 061-0092 (P)
Station 1549+80

BORING NO. 5 S. Abut
Station 1551+06
Offset 8.89ft LT
Ground Surface Elev. 467.26 ft

CORING BARREL TYPE & SIZE NX
Core Diameter 2 in
Top of Rock Elev. 433.26 ft
Begin Core Elev. 433.26 ft

DEPTH (ft)	CORE (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
433.26	1	78	15		
Gray Badly Weathered Clay SHALE (top 11.5") Gray Weathered SANDSTONE with 1/4 - 1/2" Weathered Clay Shale Partings (remainder)					
-35					
428.26	2	81	15		153.36
Gray Weathered SANDSTONE with 1/4 - 3/4" Clay-Shale Partings					
-40					
	2	81	15		136.44
423.26	3	25	0		
Gray Weathered SANDSTONE with 1-1.5" Gray Clay-Shale Partings					
-45					
418.26					
END OF BORING AND ROCK CORE					
-50					
Assumed Elevation at Center of Existing Bridge = 100.0 ft					
NOTE: Core Catcher twisted upon completion - probable reason for poor recovery and no RQD samples in Run #3					

Color pictures of the cores No
Cores will be stored for examination until
The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D-2938)

BBS, form 138 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

SOIL BORING LOG

Date 10/24/07

ROUTE FAS 1791 DESCRIPTION Old US 51 over Crooked Creek LOGGED BY E. Stewart

SECTION 29-2BR LOCATION NE 1/4, SEC. 6, TWP. 1N, RNG. 1E, 3 PM

COUNTY Marion DRILLING METHOD Hollow Stem Auger HAMMER TYPE 140# Automatic

STRUCT. NO. 061-0007 (E) / 061-0092 (P)
Station 1549+80

BORING NO. 6 N. Abut
Station 1548+51
Offset 13.50ft LT
Ground Surface Elev. 468.85 ft

Surface Water Elev. ____ ft
Stream Bed Elev. ____ ft

Groundwater Elev.:
First Encounter 444.4 ft
Upon Completion ____ ft
After ____ Hrs. ____ ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
468.35	2			ROCK
	3	1.14		
	3	B/20		Light Brown Green LOAM
	5			
465.85	7	3.59		
	5	B/20		Silt LOAM A-6(9) See Classification @ 3.5 ft
463.85 -5	2			
	2	0.76		Light Green Speckled LOAM with Sand
	2	S/15		
	3			
	5	1.63		
	4	B/20		
458.85 -10	2			
	2	0.62		Light Gray Silty Clay LOAM
	2	B/20		
	2			
	2	1.01		
	4	B/20		
-15	3			
	3	1.30		
	4	B/20		
	3			
	3	0.59		
	3	B/20		
-20				

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
	1			Light Gray Silty Clay LOAM *(continued)*
	1	0.29		
	1	B/20		
	0			
	3	0.59		
	2	B/20		
-25	1			
	1	0.13		
	1	B/20		
	0			
	0	0.20		
	0	B/20		
-30				
436.85				
436.35	50/4"	3.50		SHALE
		P		Borehole continued with rock coring.
-35				
-40				

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

ROCK CORE LOG

Date 10/24/07

ROUTE FAS 1791 DESCRIPTION Old US 51 over Crooked Creek LOGGED BY E. Stewart

SECTION 29-2BR LOCATION NE 1/4, SEC. 6, TWP. 1N, RNG. 1E, 3 PM

COUNTY Marion CORING METHOD

STRUCT. NO. 061-0007 (E) / 061-0092 (P)
Station 1549+80

CORING BARREL TYPE & SIZE NX
Core Diameter 2 in
Top of Rock Elev. 436.35 ft
Begin Core Elev. 436.35 ft

BORING NO. 6 N. Abut
Station 1548+51
Offset 13.50ft LT
Ground Surface Elev. 468.85 ft

	DEPTH (ft)	CORE (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
436.35						
Gray SANDSTONE			96	42	7.25	
			96	42	3.9	
	-35		96	42	8.38	
			96	42	4.13	
			96	42	5.77	
			96	42	4.58	
			96	42	5.1	
	-40		96	42	5.33	
428.35						
END OF BORING AND ROCK CORE	-45					
	-50					

Color pictures of the cores Yes
Cores will be stored for examination until

The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D-2938)

BBS, form 138 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

SOIL BORING LOG

Date 11/9/07

ROUTE FAS 1791 DESCRIPTION Old US 51 over Crooked Creek LOGGED BY E. Stewart

SECTION 29-2BR LOCATION NE 1/4, SEC. 6, TWP. 1N, RNG. 1E, 3 PM

COUNTY Marion DRILLING METHOD Hollow Stem Auger HAMMER TYPE 140# Automatic

STRUCT. NO. 061-0007 (E) / 061-0092 (P)
Station 1549+80

BORING NO. 7 Pier 1
Station 1549+19
Offset 12.00ft LT
Ground Surface Elev. 468.86 ft

Surface Water Elev. ____ ft
Stream Bed Elev. ____ ft

Groundwater Elev.:
First Encounter 446.9 ft
Upon Completion ____ ft
After ____ Hrs. ____ ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				Bridge Deck
467.86				
				Suspended Augers
-5				
-10				
-15				
-20				
				Suspended Augers *(continued)*
444.36				Ground Surface
-25				See Previous Boring #3
-30				
436.86				Borehole continued with rock coring.
-35				
-40				

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

ROCK CORE LOG

Date 11/9/07

ROUTE FAS 1791 DESCRIPTION Old US 51 over Crooked Creek LOGGED BY E. Stewart

SECTION 29-2BR LOCATION NE 1/4, SEC. 6, TWP. 1N, RNG. 1E, 3 PM

COUNTY Marion CORING METHOD

STRUCT. NO. 061-0007 (E) / 061-0092 (P)
Station 1549+80

CORING BARREL TYPE & SIZE NX
Core Diameter 2 in
Top of Rock Elev. 436.86 ft
Begin Core Elev. 436.86 ft

BORING NO. 7 Pier 1
Station 1549+19
Offset 12.00ft LT
Ground Surface Elev. 468.86 ft

	DEPTH (ft)	CORE (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
Light Gray Thinly Bedded SANDSTONE (Closed Joints < 2") Gray Calcareous Sandy SHALE (Open Joints < 2")	436.86		88	48	5.75	
			88	48	11.73	485.4
Gray Thinly Bedded SANDSTONE Gray Calcareous SHALE (Open Joints < 2")			88	48	8.2	881.8
Gray Thinly Bedded LIMESTONE Gray Calcareous SHALE (Open Joints < 2")	-35		88	48	8.1	
			88	48	7.25	
Limestone and Chert Pebble CONGLOMERATE with Lime Mud Cement Gray Calcareous SHALE (Closed Joints > 2", < 2') Gray Thinly Bedded Calcareous SANDSTONE (Open Joints > 2", < 2')			88	48	6.32	391.4
			88	48	6.28	649.1
Gray to Dark Gray Calcareous SHALE (Open Joints < 2")			88	48	4.7	
Gray Thinly Bedded LIMESTONE (Open Joints < 2")	-40		88	48	5.37	
Dark Gray Thinly Bedded Calcareous SHALE (Open Joints < 2") Gray Thinly Bedded LIMESTONE with Shale Lenses (Close Joints > 2')			88	48	4.42	
			88	48	5.98	504.5
Dark Gray Thinly Bedded Calcareous SHALE (Open Joints < 2") Gray Thinly Bedded Calcareous SANDSTONE with Shale Lenses (Closed Joints > 2')			88	48	9.85	502.5
			88	48	5.75	513
Gray to Gray-Green Thinly Bedded LIMESTONE	-45		88	48	7.07	552.3
			88	48	3.95	462.8
			88	48	3.28	
			88	48	5.83	
	419.86					
End of Boring and Rock Core	-50					

Color pictures of the cores Yes
Cores will be stored for examination until

The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D-2938)

BBS, form 138 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

SOIL BORING LOG

Date 10/31/07

ROUTE FAS 1791 DESCRIPTION Old US 51 over Crooked Creek LOGGED BY E. Stewart

SECTION 29-2BR LOCATION NE 1/4, SEC. 6, TWP. 1N, RNG. 1E, 3 PM

COUNTY Marion DRILLING METHOD Hollow Stem Auger HAMMER TYPE 140# Automatic

STRUCT. NO. 061-0007 (E) / 061-0092 (P)
Station 1549+80

BORING NO. 8 Pier 2
Station 1550+16
Offset 11.25ft LT
Ground Surface Elev. 468.86 ft

Surface Water Elev. ____ ft
Stream Bed Elev. ____ ft

Groundwater Elev.:
First Encounter 444.4 ft
Upon Completion ____ ft
After ____ Hrs. ____ ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				Bridge Deck
467.86				
				Suspended Augers
-5				
-10				
-15				
-20				
				Suspended Augers *(continued)*
				Ground Surface
446.86	3			
	3	0.12		Light Gray Silty Clay LOAM
	3	B/0		
444.36				
-25	17			
	2	0.33		Light Gray CLAY
	2	B/20		
441.86				
	0			
	0	0.20		Gray CLAY with Weathered Shale
	0	B/20		
-30				
	50/2"			
	-	1.75		
	-	P		
434.86				
				Borehole continued with rock coring.
-35				
-40				

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

ROCK CORE LOG

Date 10/31/07

ROUTE FAS 1791 DESCRIPTION Old US 51 over Crooked Creek LOGGED BY E. Stewart

SECTION 29-2BR LOCATION NE 1/4, SEC. 6, TWP. 1N, RNG. 1E, 3 PM

COUNTY Marion CORING METHOD

STRUCT. NO. 061-0007 (E) / 061-0092 (P)
Station 1549+80

CORING BARREL TYPE & SIZE NX

Core Diameter 2 in
Top of Rock Elev. 434.86 ft
Begin Core Elev. 434.86 ft

BORING NO. 8 Pier 2
Station 1550+16
Offset 11.25ft LT
Ground Surface Elev. 468.86 ft

		DEPTH (ft)	CORE (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
Gray Thinly Bedded Calcareous SANDSTONE (Closed Joints < 2")	434.86						
Gray Thinky Bedded LIMESTONE (Closed Joints < 2", Open Joints > 2')		-35		100	49	4	
				100	49	3.77	
				100	49	2.77	569.9
Greenish Gray Calcareous SANDSTONE				100	49	2.87	393.4
Dark Gray Thinly Bedded SHALE							
Light Gray Thinly Bedded Calcareous SANDSTONE				100	49	8.72	387.9
Gray Thinly Bedded LIMESTONE (Closed Joints > 2", < 2')				100	49	4.17	434.2
Greenish Gray Thinly Bedded SHALE w/ Thin Sandstone Lenses (Closed Joints < 2")		-40		100	49	3.47	375.2
Gray Thinly Bedded LIMESTONE (Closed Joints < 2")				100	49	4.03	
Light Gray Sandy SHALE (Open Joints < 2")				100	49	3	333.4
Gray Thinly Bedded LIMESTONE (Closed Joints > 2", < 2')				100	49	4.43	
Dark Gray SHALE with Sandstone Lenses (Close Joints < 2")				100	49	2.9	257.6
		-45		100	49	3.62	
Gray Calcareous SANDSTONE (Open Joints > 2", < 2')				100	49	3.9	
Dark Gray Calcareous SHALE (Open Joints < 2')				100	49	2.75	338.2
Light Gray SANDSTONE (Open Joints < 2")				100	49	4.12	
Gray Calcareous SHALE (Open Joints < 2")				100	49	3.58	882.5
Gray SANDSTONE with Gray Shale Lenses (Open Joints > 2", < 2')							
Light Gray Very Thinly Bedded SHALE (Open Joints < 2")							
Light Gray Thinly Bedded SANDSTONE (Closed Joints > 2", < 2')							
Gray Calcareous SHALE (Open Joints < 2")	418.78	-50					
END OF BORING AND ROCK CORE							

Color pictures of the cores Yes
Cores will be stored for examination until

The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D-2938)

BBS, form 138 (Rev. 8-99)

Illinois Department of Transportation

Division of Highways
Illinois Department of Transportation

SOIL BORING LOG

Date 10/18/07

ROUTE FAS 1791 DESCRIPTION Old US 51 over Crooked Creek LOGGED BY E. Stewart

SECTION 29-2BR LOCATION NE 1/4, SEC. 6, TWP. 1N, RNG. 1E, 3 PM

COUNTY Marion DRILLING METHOD Hollow Stem Auger HAMMER TYPE 140# Automatic

STRUCT. NO. 061-0007 (E) / 061-0092 (P)
Station 1549+80

BORING NO. 9 S. Abut
Station 1551+06
Offset 12.00ft RT
Ground Surface Elev. 468.80 ft

Surface Water Elev. ____ ft
Stream Bed Elev. ____ ft

Groundwater Elev.:
First Encounter 433.8 ft
Upon Completion ____ ft
After ____ Hrs. ____ ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
468.30				ASPHALT
	2			
	1	1.11		Medium Brown Silty CLAY
	1	B/20		
	4			
	4	1.96		
	4	B/20		
464.30				
-5	1			Light Brown with Red Speckly Sandy LOAM
	1	0.20		
	1	S/0		
461.80				
	0			Light Gray LOAM
	0	0.65		
	0	B/20		
-10	1			
	1	0.43		
	1	B/20		
	3			
	2	0.33		
	1	B/20		
-15	0			
	0	0.20		
	0	B/20		
	0			
	0	0.10		
	0	B/20		
-20	0			
	0	0.13		Light Gray LOAM *(continued)*
	0	B/20		
	1			
	2	0.33		
	2	B/20		
444.30				
-25	10			SHALE
	10	0.46		
	15	S/20		
	30			
	50	2.93		
	-	S/20		
-30				
	20			
	50	3.10		
	-	B/5		
-35	50/2"			
433.30	-			
				Borehole continued with rock coring.
-40				

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

ROCK CORE LOG

Date 10/18/07

ROUTE FAS 1791 DESCRIPTION Old US 51 over Crooked Creek LOGGED BY E. Stewart

SECTION 29-2BR LOCATION NE 1/4, SEC. 6, TWP. 1N, RNG. 1E, 3 PM

COUNTY Marion CORING METHOD

STRUCT. NO. 061-0007 (E) / 061-0092 (P)
Station 1549+80

CORING BARREL TYPE & SIZE NX
Core Diameter 2 in
Top of Rock Elev. 433.30 ft
Begin Core Elev. 433.30 ft

BORING NO. 9 S. Abut
Station 1551+06
Offset 12.00ft RT
Ground Surface Elev. 468.80 ft

DEPTH (ft)	CORE (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
433.30					
Soft Gray Medium SHALE with Minor Rock		96	65	5.98	
		96	65	3.7	
		96	65	3.77	
		96	65	2.42	
-40		96	65	3.05	
		96	65	5.95	
		96	65	4.37	
425.30		96	65	4.5	
END OF BORING AND ROCK CORE					
-45					
-50					
-55					

Color pictures of the cores Yes
Cores will be stored for examination until

The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D-2938)

BBS, form 138 (Rev. 8-99)

Illinois Department of Transportation

Memorandum

To:	Richard Mauch, Veniecy Pearman-Green, Earline Stewart Bill Kramer, Riyad Wahab, Luis Camacho
From:	Kurt Schmuck BMPR Soils Lab
Subject:	Rock Core Compression Testing (2 pages)
Date:	December 19, 2007

NOTE: The District 8 supplied boring log at Sta.1549+19 is identified as "Pier 3". Profile drawings of the structure depict only two piers. This information was confirmed by Bureau of Bridges & Structures. For this report, boring "Pier 3" will be re-named Pier 1. This will be consistent with the direction of increase in stationing on the profile drawings.

The data below represent only the limestone and sandstone layers for each of the two borings. Test results could not be obtained from the shale layers due to the severe fragmentation of the material.

County: Marion
Route: FAS-1791
Section: 29-2BR
Job # :
Contract:
S.N. 061-0007(exist.) 061-0092(prop.)
Date: 12/12/2007

Unconfined Compressive Strength of Intact Rock Cores
ASTM D-2938

All samples trimmed to maintain a length-to-diameter ratio of 2.0 to 2.5. ASTM D-4543

Approximate Stress Rate @ 20 psi/sec.

Boring: Pier 1
Station: 1549+19 12 ft. Lt.

Sample	Depth (ft.)	Dia. (in.)	Area (in2.)	Length (in.)	Weight (grams)	As Tested Moist. %	Unit Weight (lbs / ft3) Wet	Unit Weight (lbs / ft3) Dry	Compressive Strength Data: Load (lbs)	Stress (psi)	Stress (tsf)	Stress (ksf)	Deflec. (in.)
---	---	---	---	---	---	---	---	---	---	---	---	---	---
P1C1	33.4 - 33.8	2.050	3.301	3.952	505.1	0.22	147.5	147.2	22250	6741	485.4	970.7	0.036
P1C2	34.6 - 35.0	2.047	3.291	3.956	544.2	0.21	159.2	158.9	40305	12247	881.8	1763.6	0.035
P1C3	37.0 - 37.5	2.040	3.269	3.959	498.7	0.34	146.8	146.3	17770	5437	391.4	782.9	0.040
P1C4	38.0 - 38.5	2.050	3.301	3.985	511.8	0.18	148.2	148.0	29755	9015	649.1	1298.1	0.038
---	40.5 - 41.0	---	NO RECOVERY			---	---	---	---	---	---	---	---
P1C5	41.9 - 42.3	2.045	3.285	3.942	491.6	0.20	144.6	144.4	23015	7007	504.5	1009.0	0.036
P1C6	43.5 - 43.9	2.053	3.310	3.940	479.3	0.17	140.0	139.8	23105	6980	502.5	1005.1	0.040
P1C7	44.1 - 44.5	2.051	3.304	3.946	486.7	0.15	142.2	142.0	23540	7125	513.0	1026.0	0.040
P1C8	44.7 - 45.1	2.053	3.310	3.909	477.7	0.23	140.6	140.3	25395	7672	552.3	1104.7	0.048
P1C9	45.8 - 46.2	2.048	3.294	3.994	505.4	0.26	146.3	146.0	21175	6428	462.8	925.6	0.041
---	46.4 - 49.0	---	NO RECOVERY			---	---	---	---	---	---	---	---

County: Marion
Route: FAS-1791
Section: 29-2BR
Job # :
Contract:
S.N. 061-0007(exist.) 061-0092(prop.)
Date: 12/12/2007

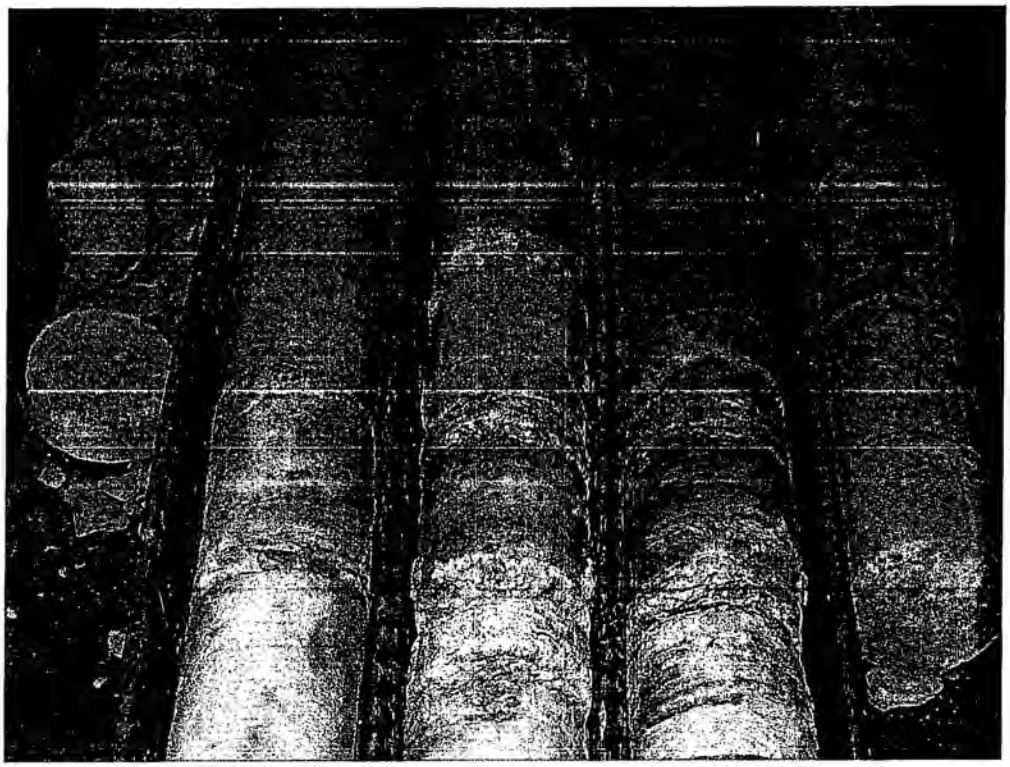
Unconfined Compressive Strength of Intact Rock Cores
ASTM D-2938

All samples trimmed to maintain a length-to-diameter ratio of 2.0 to 2.5. ASTM D-4543

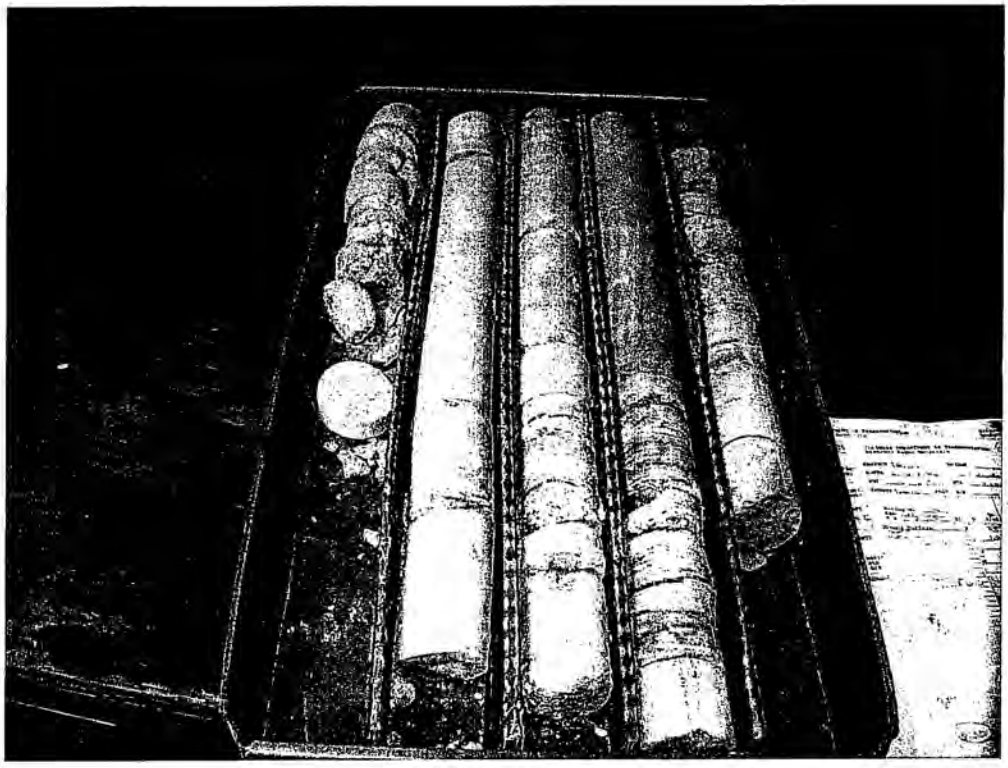
Approximate Stress Rate @ 20 psi/sec.

Boring: Pier 2
Station: 1550+16 11.25 ft. Lt.

Sample	Depth (ft.)	Dia. (in.)	Area (in2.)	Length (in.)	Weight (grams)	As Tested Moist. %	Unit Weight (lbs / ft3) Wet	Unit Weight (lbs / ft3) Dry	Compressive Strength Data: Load (lbs)	Stress (psi)	Stress (tsf)	Stress (ksf)	Deflec. (in.)
---	---	---	---	---	---	---	---	---	---	---	---	---	---
P2C1	36.1 - 36.5	2.048	3.294	4.012	545.4	0.50	157.2	156.4	26075	7915	569.9	1139.8	0.041
P2C2	36.7 - 37.2	2.053	3.310	4.035	516.8	0.29	147.4	147.0	18085	5463	393.4	786.7	0.038
P2C3	38.2 - 38.7	2.054	3.314	4.103	509.3	0.34	142.7	142.2	17850	5387	387.9	775.7	0.040
P2C4	38.7 - 39.1	2.053	3.310	3.957	485.9	0.23	141.3	141.0	19965	6031	434.2	868.5	0.047
P2C5	40.8 - 41.3	2.050	3.301	3.980	525.4	0.48	152.4	151.6	17200	5211	375.2	750.4	0.047
P2C6	42.0 - 42.5	2.053	3.310	4.070	544.8	0.24	154.0	153.7	15330	4631	333.4	666.9	0.030
P2C7	44.3 - 44.8	2.047	3.291	4.002	485.1	0.42	140.3	139.7	11775	3578	257.6	515.2	0.063
P2C8	47.5 - 48.0	2.049	3.297	4.102	500.6	0.24	141.0	140.7	15490	4698	338.2	676.5	0.040
P2C9	49.1 - 49.6	2.046	3.288	3.987	534.8	0.17	155.4	155.2	40300	12258	882.5	1765.1	0.037



North Abutment

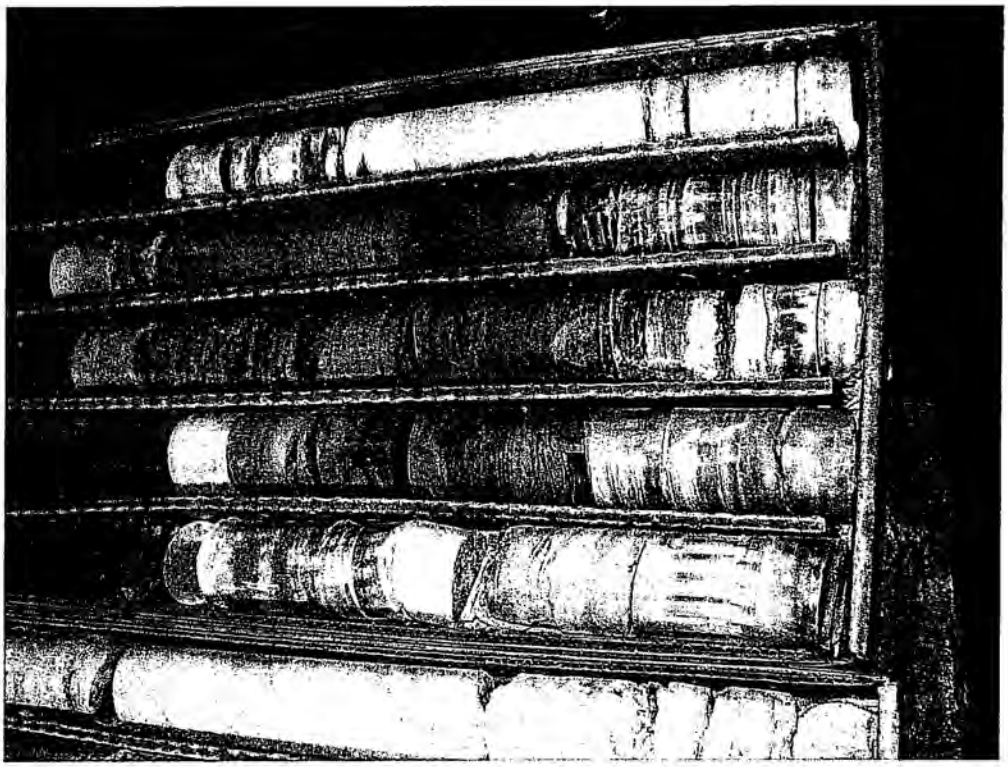


North Abutment 2

South Abutment

Pier 2

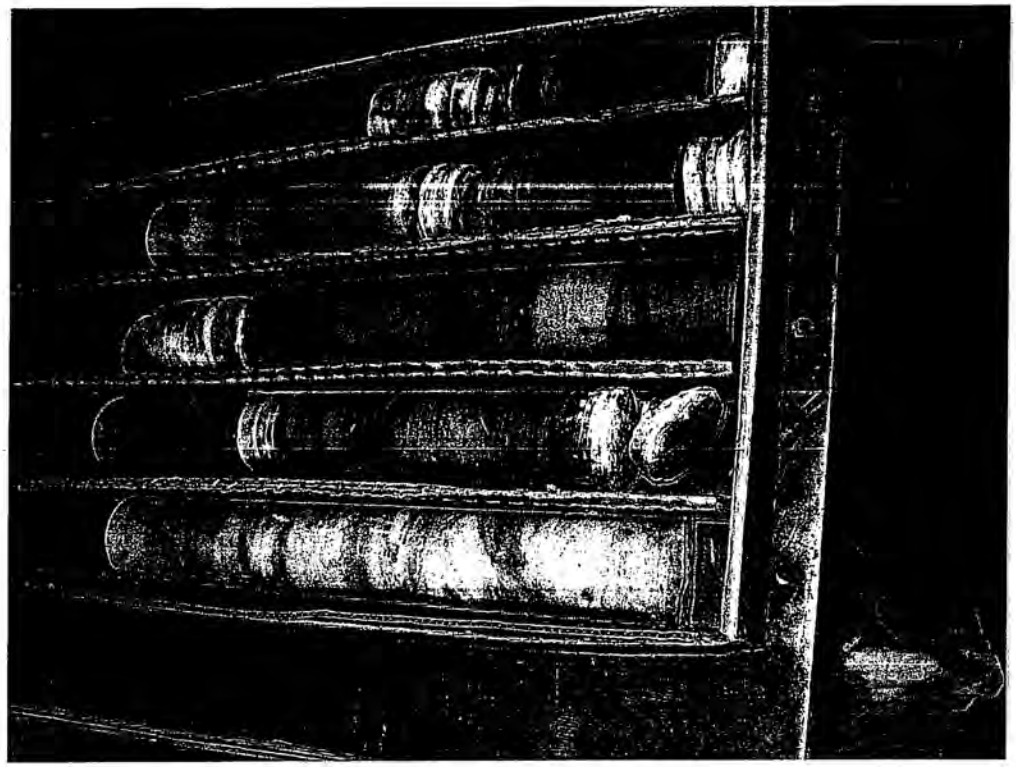
Pier 2A



Pier 2B

Pier 1

Pier 1



Pier 1

Appendix C

Seismic Site Classification

BACON | FARMER | WORKMAN
ENGINEERING & TESTING, INC.

Project:	Old 51 over Crooked Creek
BFW Project No:	23030
Structure:	N. Abut
Boring:	6
Boring El:	468.85
GWT Depth:	24.45
GWT El:	444.4
Base of Substructure El:	459.5
Pile or Shaft Dia.	12
Hammer Efficiency:	80%
Approximate Fixity El.	453.5

$V_{s,100}$ Calculations

Depth	Thickness	Vs,avg	d_i/Vs
17	17	448.39	0.0379137
100	83	2500.00	0.0332

Weighted Average $V_{s,100}$ (ft/sec) =	**1406**
Site Class =	**CD**

Seismic Soil Column Depth (ft)	Bottom of Sample Elevation	Sample Thickness (ft)	Sample Depth (ft)	N	Soil Type	Age (H or P)	N60	Ageing Factor (H)	Ageing Factor (P)	Vertical Effective Stress (psf)	Vertical Effective Stress (kPA)	Vs (m/s)	Vs (ft/s)
	467.35	1.50	1.50	6	Clay	H	8.00	0.88	1.00	187.50	8.98	65.76	215.76
	464.85	2.50	4.00	12	Clay	H	16.00	0.88	1.00	500.00	23.94	101.27	332.25
	462.35	2.50	6.50	3	Clay	H	4.00	0.88	1.00	812.50	38.90	93.45	306.61
	459.85	2.50	9.00	9	Clay	H	12.00	0.88	1.00	1125.00	53.87	125.01	410.13
	457.35	2.50	11.50	4	Clay	H	5.33	0.88	1.00	1437.50	68.83	117.80	386.47
	454.85	2.50	14.00	6	Clay	H	8.00	0.88	1.00	1750.00	83.79	134.40	440.95
1.15	452.35	2.50	16.50	7	Clay	H	9.33	0.88	1.00	2062.50	98.75	145.42	477.09
3.65	449.85	2.50	19.00	6	Clay	H	8.00	0.88	1.00	2375.00	113.72	148.20	486.22
6.15	447.35	2.50	21.50	2	Clay	H	2.67	0.88	1.00	2687.50	128.68	127.91	419.66
8.65	444.85	2.50	24.00	5	Clay	H	6.67	0.88	1.00	3000.00	143.64	154.83	507.97
11.15	442.35	2.50	26.50	2	Clay	H	2.67	0.88	1.00	3156.50	151.13	134.67	441.83
13.65	439.85	2.50	29.00	1	Clay	H	1.33	0.88	1.00	3313.00	158.63	121.57	398.84
17.15	436.35	3.50	32.00	1	Clay	H	1.33	0.88	1.00	3532.10	169.12	124.08	407.10
100.00	353.50	82.85	114.95	3	Bedrock	H	4.00	#N/A	1.00	#N/A	#N/A	762.00	2500.00

BACON | FARMER | WORKMAN
ENGINEERING & TESTING, INC.

Project:	Old 51 over Crooked Creek
BFW Project No:	23030
Structure:	Pier 1
Boring:	3
Boring El:	444.41
GWT Depth:	
GWT El:	
Base of Substructure El:	439.5
Pile or Shaft Dia.	12
Hammer Efficiency:	80%
Approximate Fixity El.	433.5

$V_{s,100}$ Calculations

Depth	Thickness	Vs,avg	d_i/Vs
100	100	2500.00	0.04

Weighted Average $V_{s,100}$ (ft/sec) =	**2500**
Site Class =	**B**

Seismic Soil Column Depth (ft)	Bottom of Sample Elevation	Sample Thickness (ft)	Sample Depth (ft)	N	Soil Type	Age (H or P)	N60	Ageing Factor (H)	Ageing Factor (P)	Vertical Effective Stress (psf)	Vertical Effective Stress (kPA)	Vs (m/s)	Vs (ft/s)
	439.91	4.50	4.50	3	Clay	H	4.00	0.88	1.00	562.50	26.93	83.08	272.57
	437.41	2.50	7.00	3	Clay	H	4.00	0.88	1.00	875.00	41.90	95.70	313.97
	435.41	2.00	9.00	3	Clay	H	4.00	0.88	1.00	1125.00	53.87	103.71	340.26
100.00	333.50	101.91	110.91		Bedrock		0.00	1.00	1.00	#N/A	#N/A	762.00	2500.00

BACON | FARMER | WORKMAN
ENGINEERING & TESTING, INC.

Project:	Old 51 over Crooked Creek
BFW Project No:	23030
Structure:	Pier 2
Boring:	4
Boring El:	459.47
GWT Depth:	8.87
GWT El:	450.6
Base of Substructure El:	439.5
Pile or Shaft Dia.	12
Hammer Efficiency:	80%
Approximate Fixity El.	433.5

$V_{s,100}$ Calculations

Depth	Thickness	Vs,avg	d_i/Vs
100	100	2500.00	0.04

Weighted Average $V_{s,100}$ (ft/sec) =	**2500**
Site Class =	**B**

Seismic Soil Column Depth (ft)	Bottom of Sample Elevation	Sample Thickness (ft)	Sample Depth (ft)	N	Soil Type	Age (H or P)	N60	Ageing Factor (H)	Ageing Factor (P)	Vertical Effective Stress (psf)	Vertical Effective Stress (kPA)	Vs (m/s)	Vs (ft/s)
	457.47	2.00	2.00	12	Clay	H	16.00	0.88	1.00	250.00	11.97	81.12	266.15
	454.97	2.50	4.50	9	Clay	H	12.00	0.88	1.00	562.50	26.93	100.14	328.54
	452.47	2.50	7.00	6	Clay	H	8.00	0.88	1.00	875.00	41.90	107.66	353.23
	449.97	2.50	9.50	3	Clay	H	4.00	0.88	1.00	1031.50	49.39	100.87	330.94
	447.47	2.50	12.00	2	Clay	H	2.67	0.88	1.00	1188.00	56.88	98.51	323.18
	443.47	4.00	14.50	51	Clay	H	68.00	0.88	1.00	1438.40	68.87	181.62	595.85
	440.97	2.50	17.00	50	Bedrock	H	66.67	#N/A	1.00	#N/A	#N/A	762.00	2500.00
	438.47	2.50	19.50	50	Bedrock	H	66.67	#N/A	1.00	#N/A	#N/A	762.00	2500.00
100.00	333.50	104.97	124.47	50	Bedrock	H	66.67	#N/A	1.00	#N/A	#N/A	762.00	2500.00

Project:	Old 51 over Crooked Creek
BFW Project No:	23030
Structure:	S. Abut
Boring:	9
Boring El:	468.85
GWT Depth:	35.05
GWT El:	433.8
Base of Substructure El:	458.7
Pile or Shaft Dia.	12
Hammer Efficiency:	80%
Approximate Fixity El.	452.7

$V_{s,100}$ Calculations

Depth	Thickness	Vs,avg	d_i/Vs
10	10	403.83	0.024763
17	7	752.64	0.0093006
100	83	2500.00	0.0332

Weighted Average $V_{s,100}$ (ft/sec) =	**1487**
Site Class =	**C**

Seismic Soil Column Depth (ft)	Bottom of Sample Elevation	Sample Thickness (ft)	Sample Depth (ft)	N	Soil Type	Age (H or P)	N60	Ageing Factor (H)	Ageing Factor (P)	Vertical Effective Stress (psf)	Vertical Effective Stress (kPA)	Vs (m/s)	Vs (ft/s)
	467.35	1.50	1.50	2	Clay	H	2.67	0.88	1.00	187.50	8.98	54.56	179.01
	465.35	2.00	3.50	8	Clay	H	10.67	0.88	1.00	437.50	20.95	90.57	297.15
	462.85	2.50	6.00	2	Clay	H	2.67	0.88	1.00	750.00	35.91	85.02	278.95
	460.35	2.50	8.50	1	Clay	H	1.33	0.88	1.00	1062.50	50.87	84.48	277.18
	457.85	2.50	11.00	2	Clay	H	2.67	0.88	1.00	1375.00	65.84	103.22	338.66
	455.35	2.50	13.50	3	Clay	H	4.00	0.88	1.00	1687.50	80.80	118.08	387.40
	452.85	2.50	16.00	1	Clay	H	1.33	0.88	1.00	2000.00	95.76	103.44	339.36
2.35	450.35	2.50	18.50	1	Clay	H	1.33	0.88	1.00	2312.50	110.72	108.36	355.50
4.85	447.85	2.50	21.00	1	Clay	H	1.33	0.88	1.00	2625.00	125.69	112.84	370.21
7.35	445.35	2.50	23.50	4	Clay	H	5.33	0.88	1.00	2937.50	140.65	148.06	485.77
9.85	442.85	2.50	26.00	15	Clay	H	20.00	0.88	1.00	3250.00	155.61	191.46	628.16
12.35	440.35	2.50	28.50	50	Clay	H	66.67	0.88	1.00	3562.50	170.57	241.95	793.81
17.35	435.35	5.00	33.50	50	Clay	H	66.67	0.88	1.00	4187.50	200.50	254.80	835.95
100.00	352.70	82.65	116.15		Bedrock	H	0.00	#N/A	1.00	#N/A	#N/A	762.00	2500.00

Appendix D

Liquefaction Analysis

Illinois Department of Transportation

LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ========== 6
ELEVATION OF BORING GROUND SURFACE ========== 468.85 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ========== 24.45 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========== FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.300
EARTHQUAKE MOMENT MAGNITUDE ========== 4.9
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ========== 0.00 FT.
HAMMER EFFICIENCY========== 73 %
BOREHOLE DIAMETER========== 2.5 to 4.5 IN.
SAMPLING METHOD========== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **2.581**

AVG. SHEAR WAVE VELOCITY (top 40')
$\bar{V}^{*}_{s,40'}$ = **333** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 4.9
Source-To-Site Distance, R (km) = 54
Ground Motion Prediction Equations = NMSZ
PGA = **0.022**

	BORING DATA							CONDITIONS DURING DRILLING					CONDITIONS DURING EARTHQUAKE							
ELEV. OF SAMPLE (FT.)	BORING SAMPLE DEPTH (FT.)	SPT N VALUE (BLOWS)	UNCONF. COMPR. STR., Q_u (TSF.)	% FINES < #200 (%)	PLAST. INDEX PI	LIQUID LIMIT LL	MOIST. CONTENT w_c (%)	EFFECTIVE UNIT WT. (KCF.)	VERT. STRESS (KSF.)	CORR. SPT N VALUE $(N_1)_{60}$	EQUIV. CLN. SAND SPT N VALUE $(N_1)_{60cs}$	CRR RESIST. MAG 7.5 $CRR_{7.5}$	EFFECTIVE UNIT WT. (KCF.)	VERT. STRESS (KSF.)	TOTAL VERT. STRESS (KSF.)	OVER-BURDEN CORR. FACT. (Ks)	CORR. RESIST. $CRR_{7.5}$ CRR	SOIL MASS PART. FACTOR (r_d)	EQ INDUCED CSR	FACTOR OF SAFETY * CRR/CSR
468.75	0.1	6	1.14		10	30	20	0.123	0.012	10.257	10.257	0.115	0.061	0.006	0.012	1.500	**0.447**	0.998	**0.394**	**N.L. (2)**
466.35	2.5	12	3.59		5	32	16	0.137	0.341	21.135	21.135	0.230	0.075	0.186	0.342	1.500	**0.891**	0.938	**0.336**	**N.L. (2)**
463.85	5	4	0.76		10	25	21	0.118	0.636	5.888	5.888	0.079	0.056	0.326	0.638	1.470	**0.299**	0.871	**0.332**	**N.L. (2)**
461.35	7.5	9	1.63		10	25	20	0.127	0.954	12.345	12.345	0.134	0.065	0.489	0.957	1.435	**0.498**	0.801	**0.306**	**N.L. (2)**
458.85	10	4	0.62		12	28	26	0.116	1.244	5.372	5.372	0.075	0.054	0.624	1.248	1.281	**0.248**	0.729	**0.284**	**N.L. (2)**
456.35	12.5	6	1.01		10	25	27	0.122	1.549	7.869	7.869	0.095	0.060	0.774	1.554	1.246	**0.305**	0.658	**0.258**	**1.182 (C)**
453.85	15	7	1.3		10	25	23	0.125	1.861	8.859	8.859	0.103	0.063	0.931	1.867	1.203	**0.320**	0.591	**0.231**	**1.385 (C)**
451.35	17.5	6	0.59		10	25	29	0.116	2.151	7.317	7.317	0.090	0.054	1.066	2.158	1.159	**0.270**	0.529	**0.209**	**1.292 (C)**
448.85	20	2	0.29		12	28	28	0.108	2.421	2.350	2.350	0.055	0.046	1.181	2.429	1.124	**0.159**	0.473	**0.190**	**N.L. (2)**
446.35	22.5	5	0.59		10	25	28	0.116	2.711	5.624	5.624	0.077	0.054	1.316	2.720	1.102	**0.218**	0.424	**0.171**	**1.275 (C)**
443.85	25	2	0.13		12	28	28	0.038	2.806	2.231	2.231	0.054	0.038	1.411	2.971	1.085	**0.151**	0.383	**0.157**	**N.L. (2)**
441.35	27.5	1	0.2		12	28	28	0.042	2.911	1.101	1.101	0.049	0.042	1.516	3.232	1.069	**0.137**	0.348	**0.145**	**N.L. (2)**

* FACTOR OF SAFETY DESCRIPTIONS

N.L. (1) = NOT LIQUEFIABLE, ABOVE EQ GROUND WATER ELEVATION
N.L. (2) = NOT LIQUEFIABLE, PI $\geq$ 12 OR w_c/LL $\leq$ 0.85
N.L. (3) = NOT LIQUEFIABLE, $(N_1)_{60} > 25$
(C) = CONTRACTIVE SOIL TYPES
(D) = DILATIVE SOIL TYPES

Illinois Department of Transportation

LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ========== 8
ELEVATION OF BORING GROUND SURFACE ========== 446.86 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ========== 2.46 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========== FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ========== 0.300
EARTHQUAKE MOMENT MAGNITUDE ========== 4.9
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ========== 0.00 FT.
HAMMER EFFICIENCY========== 73 %
BOREHOLE DIAMETER========== 2.5 to 4.5 IN.
SAMPLING METHOD========== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **2.581**

AVG. SHEAR WAVE VELOCITY (top 40')
$\bar{V}^{*}_{s,40'}$ = **228** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 4.9
Source-To-Site Distance, R (km) = 54
Ground Motion Prediction Equations = NMSZ
PGA = **0.022**

	BORING DATA							CONDITIONS DURING DRILLING					CONDITIONS DURING EARTHQUAKE							
ELEV. OF SAMPLE (FT.)	BORING SAMPLE DEPTH (FT.)	SPT N VALUE (BLOWS)	UNCONF. COMPR. STR., Q_u (TSF.)	% FINES < #200 (%)	PLAST. INDEX PI	LIQUID LIMIT LL	MOIST. CONTENT w_c (%)	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	CORR. SPT N VALUE $(N_1)_{60}$	EQUIV. CLN. SAND SPT N VALUE $(N_1)_{60cs}$	CRR RESIST. MAG 7.5 $CRR_{7.5}$	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	TOTAL VERT. STRESS (KSF.)	OVER-BURDEN CORR. FACT. (Ks)	CORR. RESIST. $CRR_{7.5}$ CRR	SOIL MASS PART. FACTOR (r_d)	EQ INDUCED CSR	FACTOR OF SAFETY * CRR/CSR
446.76	0.1	6	0.12		12	26	28	0.099	0.010	10.257	10.257	0.115	0.037	0.004	0.010	1.500	**0.447**	0.995	**0.521**	**N.L. (2)**
444.36	2.5	4	3.59		10	25	28	0.075	0.190	6.826	6.826	0.086	0.075	0.184	0.340	1.500	**0.334**	0.887	**0.320**	**1.044 (D)**
441.86	5	1	0.76		12	26	28	0.056	0.330	1.629	1.629	0.051	0.056	0.324	0.636	1.456	**0.193**	0.776	**0.297**	**N.L. (2)**

* FACTOR OF SAFETY DESCRIPTIONS

N.L. (1) = NOT LIQUEFIABLE, ABOVE EQ GROUND WATER ELEVATION
N.L. (2) = NOT LIQUEFIABLE, PI $\geq$ 12 OR w_c/LL $\leq$ 0.85
N.L. (3) = NOT LIQUEFIABLE, $(N_1)_{60} > 25$
(C) = CONTRACTIVE SOIL TYPES
(D) = DILATIVE SOIL TYPES

Illinois Department of Transportation

LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ========== 9
ELEVATION OF BORING GROUND SURFACE ========== 468.80 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ========== 35.00 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========== FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ========== 0.300
EARTHQUAKE MOMENT MAGNITUDE ========== 4.9
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ========== 0.00 FT.
HAMMER EFFICIENCY========== 73 %
BOREHOLE DIAMETER========== 2.5 to 4.5 IN.
SAMPLING METHOD========== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **2.581**

AVG. SHEAR WAVE VELOCITY (top 40')
$V^*_{s,40'}$ = **221** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 4.9
Source-To-Site Distance, R (km) = 54
Ground Motion Prediction Equations = NMSZ
PGA = **0.022**

	BORING DATA							CONDITIONS DURING DRILLING					CONDITIONS DURING EARTHQUAKE							
ELEV. OF SAMPLE (FT.)	BORING SAMPLE DEPTH (FT.)	SPT N VALUE (BLOWS)	UNCONF. COMPR. STR., Q_u (TSF.)	% FINES < #200 (%)	PLAST. INDEX PI	LIQUID LIMIT LL	MOIST. CONTENT w_c (%)	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	CORR. SPT N VALUE $(N_1)_{60}$	EQUIV. CLN. SAND SPT N VALUE $(N_1)_{60cs}$	CRR RESIST. MAG 7.5 $CRR_{7.5}$	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	TOTAL VERT. STRESS (KSF.)	OVER-BURDEN CORR. FACT. (Ks)	CORR. RESIST. $CRR_{7.5}$ CRR	SOIL MASS PART. FACTOR (r_d)	EQ INDUCED CSR	FACTOR OF SAFETY * CRR/CSR
468.7	0.1	2	1.11		12	26	28	0.123	0.012	3.413	3.413	0.061	0.061	0.006	0.012	1.500	**0.236**	0.995	**0.393**	**N.L. (2)**
466.8	2	8	1.96		10	25	28	0.130	0.259	13.762	13.762	0.148	0.068	0.135	0.260	1.500	**0.572**	0.906	**0.340**	**1.682 (D)**
464.3	4.5	2	0.2		12	26	28	0.104	0.519	3.057	3.057	0.059	0.042	0.240	0.521	1.500	**0.227**	0.791	**0.335**	**N.L. (2)**
461.8	7	1	0.65		12	26	28	0.117	0.812	1.395	1.395	0.050	0.055	0.378	0.815	1.412	**0.184**	0.683	**0.287**	**N.L. (2)**
459.3	9.5	2	0.43		12	26	28	0.112	1.092	2.762	2.762	0.057	0.050	0.503	1.096	1.333	**0.196**	0.584	**0.248**	**N.L. (2)**
456.8	12	3	0.33		10	25	28	0.109	1.364	4.082	4.082	0.065	0.047	0.620	1.369	1.279	**0.216**	0.497	**0.214**	**1.009 (C)**
454.3	14.5	1	0.2		12	26	28	0.104	1.624	1.329	1.329	0.050	0.042	0.725	1.630	1.239	**0.160**	0.421	**0.184**	**N.L. (2)**
451.8	17	1	0.1		12	26	28	0.098	1.869	1.291	1.291	0.050	0.036	0.815	1.876	1.211	**0.156**	0.357	**0.160**	**N.L. (2)**
449.3	19.5	1	0.13		10	25	28	0.100	2.119	1.247	1.247	0.050	0.038	0.910	2.127	1.184	**0.153**	0.303	**0.138**	**1.109 (C)**
446.8	22	4	0.33		10	25	28	0.109	2.392	4.780	4.780	0.070	0.047	1.028	2.401	1.156	**0.210**	0.259	**0.118**	**1.780 (C)**

* FACTOR OF SAFETY DESCRIPTIONS

N.L. (1) = NOT LIQUEFIABLE, ABOVE EQ GROUND WATER ELEVATION
N.L. (2) = NOT LIQUEFIABLE, PI $\geq$ 12 OR w_c/LL $\leq$ 0.85
N.L. (3) = NOT LIQUEFIABLE, $(N_1)_{60} > 25$
(C) = CONTRACTIVE SOIL TYPES
(D) = DILATIVE SOIL TYPES

Appendix E

Pile Design Tables

Pile Design Table for N. Abutment utilizing Boring #6

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 42	293	161	25
Steel HP 10 X 57	439	241	27
Steel HP 12 X 53	411	226	26
Steel HP 12 X 63	482	265	26
Steel HP 12 X 74	581	319	27

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 12 X 84	663	365	28
Steel HP 14 X 73	578	318	26
Steel HP 14 X 89	691	380	27
Steel HP 14 X 102	809	445	28
Steel HP 14 X 117	925	509	29
Precast 14"x 14"	139	76	18

Pile Design Table for S. Abutment utilizing Boring #9

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 42	328	180	26
Steel HP 10 X 57	441	242	29
Steel HP 12 X 53	414	228	26
Steel HP 12 X 63	494	272	28
Steel HP 12 X 74	577	317	29

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 12 X 84	663	365	31
Steel HP 14 X 73	578	318	27
Steel HP 14 X 89	703	386	29
Steel HP 14 X 102	802	441	31
Steel HP 14 X 117	927	510	33
Precast 14"x 14"	117	64	17

Appendix F

LPILE Parameters

LPILE Parameters

North Abutment (Boring B-6)

Material Type	Bottom Elevation of Layer	Unit Weight (pcf)	Cohesion (psf)	E_{50}	Friction Angle (°)	*k* Value (pci)	Rock Unconfined Compressive Strength (pci)
Stiff Clay	458.85	110	1,000	0.010	-	-	-
Soft Clay	436.85	57	500	0.020	-	-	-
Strong Rock	--	150	-	-	-	-	4,000

Pier 1 (Borings B-3 and B-7)

Material Type	Bottom Elevation of Layer	Unit Weight (pcf)	Cohesion (psf)	E_{50}	Friction Angle (°)	*k* Value (pci)	Rock Unconfined Compressive Strength (pci)
Soft Clay	436.86	57	500	0.020	-	-	-
Strong Rock	--	150	-	-	-	-	4,000

Pier 2 (Boring B-8)

Material Type	Bottom Elevation of Layer	Unit Weight (pcf)	Cohesion (psf)	E_{50}	Friction Angle (°)	*k* Value (pci)	Rock Unconfined Compressive Strength (pci)
Soft Clay	434.86	57	500	0.020	-	-	-
Strong Rock	--	150	-	-	-	-	4,000

South Abutment (Boring B-9)

Material Type	Bottom Elevation of Layer	Unit Weight (pcf)	Cohesion (psf)	E_{50}	Friction Angle (°)	*k* Value (pci)	Rock Unconfined Compressive Strength (pci)
Soft Clay	444.30	57	500	0.020	-	-	-
Cemented Soil	433.30	68	500	-	12	1,000	-
Strong Rock	425.30	150	-	-	-	-	4,000