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Structure Geotechnical Report

F.A.S. 960 (US Route 45)
Section 38B-1
Johnson County
Job No. D-99-009-08
Contract No. 78029
PTB No. 148-035
F.A.S. 960 (US Route 45) Over Little Cache Creek
Proposed S.N. 044-0060
Existing S.N. 044-0004

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Table of Contents

Tables and Figures

1. Project Description

Introduction

The proposed project will replace the bridge (SN 044-0004) carrying US Route 45 over Little Cache Creek in Johnson County. The project is located on US Rte. 45 approximately 0.1 miles south of the intersection of IL Rte. 146 and US Rte. 45 in Vienna, IL. The subsurface exploration was conducted by District Nine Geotechnical Unit in October 2008. Figure 1 shows the structure location and boring location plan.

Scope

The scope of work will include reviewing available subsurface information for the project area, performing necessary engineering analyses, and formulating recommendations presented in this report.

2. Existing Structure

The existing structure over Little Cache Creek (S.N. 044-0004) was rebuilt in 1981. The single span pony truss was removed and the existing reinforced concrete closed abutments were rebuilt. Two new solid wall encased pile bent piers were added to accommodate a new widened three-span 11-in precast prestressed concrete (PPC) deck beam superstructure. The existing structure is skewed at 36.17-degrees. The total structure length is 89-ft 4-in from back-to-back of abutments along the centerline of the road. The existing deck width is 34-ft 8-in and is overlain with a bituminous concrete surface course. In spans 1 through 3, the existing superstructure consists of eight (8) 11-in by 52-in PPC deck beams. The spans are 30-ft 6-in at the north end, 28-ft 4-in at the center, and 30-ft 6-in at the south end. Both abutments are founded on H-piles driven to original footing (structure constructed in 1924).The existing piers are pile bent piers with a solid concrete encasement wall around the piles. Both piers are founded on a single row of seven steel HP 8x36 piles driven to refusal at approximate El 340.

Portions of the substructure are to be abandoned in-place. The abandoned pier footings and piles are located within the middle span of the proposed structure. The abandoned abutment footings and piles are located between the proposed abutments and piers. The location of abandoned existing structure relative to the proposed structure is shown in Figure 1.

3. Proposed Structure

The proposed structure will be a three-span bridge with a 36-ft wide cast-in-place concrete deck. The substructure will consist of integral abutments and bent-type piers. Span lengths will be 31-ft 9-in at the north end, 37-ft 9-in at the center, and 31-ft 9-in at the south end. The new piers are located between the existing piers and the abandoned abutments. The north and south abutments are located within the existing approach embankments.

The proposed structure is expected to have factored abutment and pier vertical subsurface reactions of approximately 690 and 1320 kips, respectively.

At the center of the bridge the elevation will be increased to 368.85. The approaches will require a maximum of 6-in raise in the existing roadway. The roadway will be overlayed. No new fill will be required in front of the new abutments. The slopes from the piers to the abutments will require an estimated 2-ft 6-in of excavation to maintain a slope of 1.0V:2.0H.

4. Site Investigation

The bridge is located in Little Cache Creek watershed. The ground is relatively flat except for the creek channel. At the bridge site, the creek channel is approximately 90 feet wide with flow from northeast to southwest. The existing approaches are approximately 1.3 feet above the 100-year event and 13.5 feet above the creek bed. Figure 1 is a site plan showing the existing topography and the proposed bridge.

IDOT District 9 provided logs of two borings drilled in January and March of 1980. These borings were drilled prior to design of the existing bridge. One boring with Standard Penetration Test sampling was drilled at each side of the creek to bedrock.

IDOT District 9 drilled two borings (1-S and 2-S) in October 2008. These borings were drilled through the bridge approaches to depths of 53 to 55 feet below grade. Rock core samples were taken at boring, 1-S and 2-S to a depth of 10-ft and 5-ft respectively for each boring. Boring locations are shown in Figure 1.

5. Generalized Subsurface Conditions

Subsurface Materials

The subsurface profile at the bridge site consists of alluvial and residual soils overlying bedrock. The native soil profile consists of layers of grey silt loam, black to brown silty clay loam, brown mottled grey silty clay to silty clay loam, and grey clay. Some sand seams were found in Boring 2-S at approximate depths 21-ft, 28-ft, and 40-ft. Consistency of the upper silt loam to silty clay layers is very soft to medium stiff with a range of unconfined strengths 0.1-tsf to 0.9-tsf. The silty clay to clay layer immediately above bedrock in boring 1-S has a consistency of medium stiff to stiff with unconfined strength ranging between 0.4-tsf to 1.9-tsf with an average of 1.2-tsf. Hard limestone bedrock was encountered in both borings 1-S and 2-S with elevations ranging between El 323.1 and El 319.3, respectively. Shallow sandstone was encountered in boring 1-S(1980) at El 343.8. Boring 2-S (1980) was terminated at El 322.8 berfore encountering bedrock.

A subsurface data profile is shown in Figure 2. Boring logs are included in Appendix A.

Groundwater Levels

Groundwater levels were encountered during drilling in both borings (1-S and 2-S). Water levels were noted at El 330.6 and El 347.8 in boring 1-S and boring 2-S, respectively. Groundwater elevations in borings 1-S (1980) and 2-S (1980) were noted at El 346.3 and 348.8, respectively.

Groundwater rises when the water in Little Cache Creek rises. Construction of Piers 1 and 2 may be influenced by the water levels in the creek.

6. Geotechnical Evaluations

Seismicity

The bridge is located in the New Madrid Seismic Zone and could be subjected to severe seismic loadings. The subsurface profile to a depth of 100 feet consists of approximately 45 feet of very soft to stiff clays over limestone bedrock. This profile is indicative of Site Class D. Seismic design parameters for a 1,000-year return period earthquake are listed in Table 1. Based on these seismic parameters, the bridge should be assigned to Seismic Performance Zone 3.

Table 1 Seismic Design Parameters

PGA =	0.60	F_{pga} =	1.00	A_S =	0.60
S_S =	1.10	F_a =	1.06	S_{DS} =	1.17
S_1 =	0.27	F_v =	1.86	S_{D1} =	0.50

A liquefaction potential analysis was completed based on information from the two most recent borings 1-S and 2-S. The borings encountered fine-grained soils that are not considered to be liquefaction-susceptible.

Slope Stability

The proposed approaches are to be built near the same elevation of the existing approaches. Factor of safety for static slope stability analysis for the abutments is 2.4 based on SPT soil parameters. The minimum permissible required is 1.5 as per IDOT, Geotechnical Manual. The global stability during seismic event for the existing embankment was performed using the PGA from Table 1. The seismic factor of safety determined is 0.9 which is less than the minimum permissible value of 1.0. Seismic slope stability deformation was then determined using Newmark procedure. The estimated deformation is approximately 2 inches which is less than the maximum 6 inches acceptable as per IDOT, Geotechnical Manual.

Settlement

Primary consolidation has been completed by the existing structure as it has been in place for many of years. The proposed structure is within the limits of the existing structure and minimal settlement is expected at the proposed structure abutments and piers.

Scour

This bridge will be subject to scour from Little Cache Creek. According to the Hydraulic Report, the total predicted scour for the bridge at the pier locations for the 100-year and 50-year storm is 34.09-ft and 34.15-ft, respectively. The 50-year storm results generate the critical or deepest estimated scour. In view of this, the design for scour is based on 50-year storm. The abutments may be designed assuming no scour, because they will be armored with riprap. A design scour depth reduction is appropriate for the soil conditions found at this bridge. Estimated scour depths after reduction due to subsurface conditions based on borings 1-S and 2-S are 24.2-ft and 26.0-ft, respectively. Cumulative reductions based on borings 1-S and 2-S of 29% and 24%, respectively were calculated as per the criteria in the IDOT Bridge Manual. Estimated scour depths after reduction were used as design levels. Design scour elevations to be used for bridge design are shown in Table 2.

Table 2 Design Scour Elevations

	North Abutment	North Pier	South Pier	South Abutment
50-year	362.6	329.1	327.3	362.6

Scour will cause a slight loss of axial resistance and a significant loss of lateral resistance at the piers. If design for the full scour depth, at the piers, results in extraordinary costs for the pier foundations, scour countermeasures may be considered. The piers are located at the bottom of the creek bank, outside the usual limits for abutment riprap armor.

Mining Activity

The Illinois State Geological Survey Directory of Coal Mines does not list any mines in the immediate vicinity of the site.

7. Design Recommendations

Driven Piles

The proposed integral abutments and the proposed piers should be supported by H-piles driven to maximum nominal required bearing on bedrock. Higher bearing elevations are not recommended due to the potential for large geotechnical losses from scour. The bottom elevation of the pile cap at the North and South Abutments is approximately El 362.6. The geotechnical pile capacity for the piers is generated assuming pile cut off elevation of approximately El 365.5. List of design values for several H-Pile sections are given in Table 3 and 4. The estimated pile lengths in Table 3 were set based on a maximum penetration of 2.5-ft into bedrock. We recommend using pile points/shoes in order to achieve penetration of 2.5-ft into bedrock during pile driving. Test piles are not required at this site because the top of bedrock elevations are consistent. The embedment of the piles at the piers might not provide the required lateral resistance. If that is the case, we recommend setting the piles in rock and the parameters given in Table 4 should be used. Estimated pile lengths presented in the tables below include the minimum embedment in the pile caps at the abutments and piers. It should also be noted that there can be possible interference during pile driving due to the existing piles and foundations. The WSDOT dynamic formula shall be used for the determination of Nominal Driven Bearing in the field according to Guide Bridge Special Provision 68. An improved resistance factor of 0.55 shall be used to determine the factored resistance available.

Table 3 Pile Design Parameters

Location	**Pile Type**	**Factored Resistance Available, R_F (kips)**	*** Factored Geotechnical Losses, R_{Sdd} (kips)**	**Nominal Required Bearing, R_N (kips)**	**Estimated Pile Length (ft)**
North Abutment	HP 10x42	185	0	335	42.0
	HP 12x63	274	0	497	42.5
	HP 14x89	387	0	705	43.0
Pier 1	HP 10x42	99	85(Scour)	335	44.5
	HP 12x63	169	104(Scour)	497	45.0
	HP 14x89	264	124(Scour)	705	45.5
Pier 2	HP 10x42	112	72(Scour)	335	46.5
	HP 12x63	186	87(Scour)	497	47.5
	HP 14x89	284	104(Scour)	705	48.0
South Abutment	HP 10x42	184	0	335	46.5
	HP 12x63	274	0	497	47.0
	HP 14x89	387	0	705	47.5

* (Nominal Scour) x (0.55 Geotechnical Resistance Factor) x (1.04 Bias Factor Ratio)

$R_F=R_N*(0.55)-R_{Sdd}$

Table 4 Pile Design Parameters - Piles Socketed into Bedrock

Location	**Pile Type**	**Factored Tip Resistance Available, R_F (kips)***	**Minimum Pile Socket Depth into Rock (ft)**	**Estimated Pile Length (ft)**
Pier 1	HP 10x42	185	2.5	46.0
	HP 12x63	274	3.0	46.5
	HP 14x89	388	3.5	47.0
Pier 2	HP 10x42	185	2.5	48.0
	HP 12x63	274	3.0	48.5
	HP 14x89	388	3.5	49.0

*R_F developed from end bearing on rock (structural capacity controls), all capacity due to skin friction in rock socket and soil overburden is neglected.

Nominal required bearing of piles given in Table 3 should be used for extreme event limit state designs.

The structure designer should evaluate lateral resistance of driven piles based on both soil and structure properties. The parameters presented in Table 3 and 4 are the factored resistance available per pile, however, the lateral loading may govern the pile design. Soil parameters for generating P-y curves with the LPILE computer program are given in Table 5. Lateral analysis should consider strength limits and service limit loads on the piles to determine the desired pile section and length. The P-multipliers in AASHTO Table 10.7.2.4-1 should be used in the analyses.

Table 5 LPILE Parameters

Location	**Bottom Elevation (ft)**	**Soil Type**	**Soil Parameters**			
North Abutment	358.0	stiff clay w/water	c=5.1 psi	k=100 pci	γ'=0.029 pci	ε_{50}=0.01
	344.5	soft clay	c=3.3 psi	k=30 pci	γ'=0.029 pci	ε_{50}=0.02
	338.0	stiff clay w/water	c=9.2 psi	k=200 pci	γ'=0.030 pci	ε_{50}=0.007
	335.5	soft clay	c=2.8 psi	k=30 pci	γ'=0.029 pci	ε_{50}=0.02
	328.0	stiff clay w/ water	c=7.6 psi	k=200 pci	γ'=0.032 pci	ε_{50}=0.007
	323.0	stiff clay w/ water	c=13.2 psi	k=200 pci	γ'=0.034 pci	ε_{50}=0.007
		strong rock	q_u=1350 psi		γ'=0.086 pci	
Pier 1	344.5	soft clay	c=3.3 psi	k=30 pci	γ'=0.029 pci	ε_{50}=0.02
	338.0	stiff clay w/water	c=9.2 psi	k=200 pci	γ'=0.030 pci	ε_{50}=0.007
	335.5	soft clay	c=2.8 psi	k=30 pci	γ'=0.029 pci	ε_{50}=0.02
	328.0	stiff clay w/ water	c=7.6 psi	k=200 pci	γ'=0.032 pci	ε_{50}=0.007
	323.0	stiff clay w/ water	c=13.2 psi	k=200 pci	γ'=0.034 pci	ε_{50}=0.007
		strong rock	q_u=1350 psi		γ'=0.086 pci	
Pier 2	352.5	soft clay	c=1.0 psi	k=30 pci	γ'=0.025 pci	ε_{50}=0.02
	350.0	stiff clay w/water	c=12.5 psi	k=200 pci	γ'=0.033 pci	ε_{50}=0.007
	345.0	stiff clay w/water	c=3.8 psi	k=100 pci	γ'=0.030 pci	ε_{50}=0.01
	340.0	stiff clay w/water	c=6.9 psi	k=100 pci	γ'=0.029 pci	ε_{50}=0.01
	335.0	soft clay	c=3.1 psi	k=30 pci	γ'=0.025 pci	ε_{50}=0.02
	330.0	stiff clay w/water	c=4.9 psi	k=100 pci	γ'=0.025 pci	ε_{50}=0.01
	323.0	soft clay	c=2.4 psi	k=30 pci	γ'=0.025 pci	ε_{50}=0.02
	319.0	medium dense gravel and sand	ϕ=33°	k=60 pci	γ'=0.038 pci	
		strong rock	q_u=1350 psi		γ'=0.086 pci	
South Abutment	362.5	stiff clay w/water	c=6.3 psi	k=100 pci	γ'=0.030 pci	ε_{50}=0.01
	352.5	soft clay	c=1.0 psi	k=30 pci	γ'=0.025 pci	ε_{50}=0.02
	350.0	stiff clay w/water	c=12.5 psi	k=200 pci	γ'=0.033 pci	ε_{50}=0.007
	345.0	stiff clay w/water	c=3.8 psi	k=100 pci	γ'=0.030 pci	ε_{50}=0.01
	340.0	stiff clay w/water	c=6.9 psi	k=100 pci	γ'=0.029 pci	ε_{50}=0.01
	335.0	soft clay	c=3.1 psi	k=30 pci	γ'=0.025 pci	ε_{50}=0.02
	330.0	stiff clay w/water	c=4.9 psi	k=100 pci	γ'=0.025 pci	ε_{50}=0.01
	323.0	soft clay	c=2.4 psi	k=30 pci	γ'=0.025 pci	ε_{50}=0.02
	319.0	medium dense gravel and sand	ϕ=33°	k=60 pci	γ'=0.038 pci	
		strong rock	q_u=1350 psi		γ'=0.086 pci	

Spread Footings

Spread footing foundations are not feasible due to the relatively soft soils found at the site and the anticipated deep scour at the piers.

Drilled Shafts

Drilled shafts could be used at all substructure units; however, they would probably be more costly than driven piles due to the depth of bedrock.

Roadway Approaches

The approach footing support should be according to the current IDOT standard. The approach footing will be bearing on soft clay loam (A-4) on the existing approach. The in-situ subgrade material, soft clay loam, will not provide the maximum service bearing resistance of 2,000 psf required for design. We recommend removal of at least 12 inches of the in-situ material and replace with compacted granular subbase material Type B on geotextile fabric as per IDOT Standard Specifications section 210.

8. Construction Considerations

Temporary Construction Support

The construction sequence likely will require temporary sheet piling along the stage line to retain backfill behind the existing abutments. The maximum excavation line at the North Abutment is approximately EL 361 and at the South Abutment El 361. The existing embankment and subsoils at the North Abutment will provide sufficient embedment for cantilever sheet piling. Structural design of the temporary sheet piling can be completed using the procedure in the IDOT Bridge Manual and the charts in Design Guide 3.13.1 – Temporary Sheet Piling Design. To determine the embedment depth from Design Guide 3.13.1 at the North Abutment an average undrained shear strength value of 0.6 tsf was determined from boring 1-S (2008). The existing embankment and subsoils at the South Abutment will not provide sufficient embedment for the cantilever sheet piling based on weak undrained shear strengths discovered in boring 2-S (2008). Structural design of the temporary sheet piling can not be completed using the procedure in the IDOT Bridge Manual and the charts in Design Guide 3.13.1 – Temporary Sheet Piling Design. We recommend the design of the soil retention system at the South Abutment should be as per GBSP No.44 – Temporary Soil Retention System.

Setting Piles in Rock

The installation of the foundation piles at Pier 1 and Pier 2 shall conform to the guidance specified in IDOT GBSP No.56 Setting Piles in Rock. Minimum pile embedment depths to reach maximum axial pile capacity were given in Table 4. Lateral loads may control the embedment depth of the piles, hence, we recommend lateral analysis should be performed using LPILE or GROUP to determine the design embedment.

Existing Foundations

There can be possible interference during pile driving due to the existing piles and foundations. The Contractor driving or installing the piles should take precautions to avoid any obstructions.

Cofferdam

The most recent borings indicate the water surface elevation in the creek to be El 354.4 at the time of drilling (October 2008) whereas the streambed is at El 353.9. The water surface elevation in the creek varies depending on the time of the year. Estimated Water Surface Elevation (EWSE) provided on TS&L plans is El 356.5. The tip elevations for the socketted piles are anticipated to vary from El 315.5 to 320.5. The height of the water between the anticipated bottom of the underwater structure excavation (approximate El 351) and the EWSE is 5.5 feet. Cofferdams will be required to complete the installation and setting of piles in rock at the pier locations depending on time of construction. Cofferdam Type 1 is recommended as per IDOT Memorandum ABD 11.2. Placement of the concrete in the rock socket may be achieved by use of tremie if it is underwater as per Article 503.08 of the IDOT Standard Specifications.

We have been pleased to provide this information. Please contact us if you have any questions regarding this report.

Sincerely,

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Reviewed by

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Figure 1 Boring Location Plan

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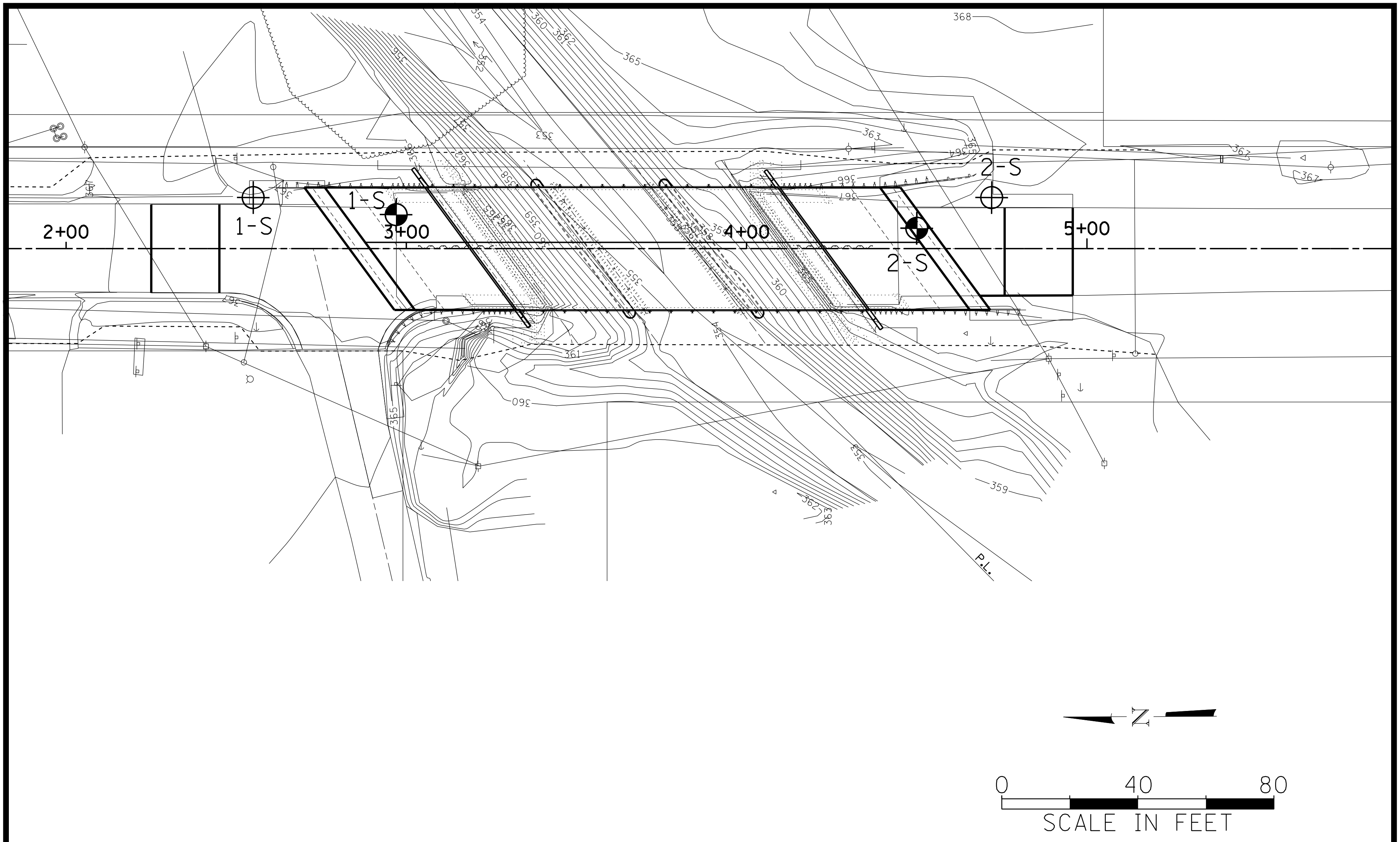

LEGEND

- BORING LOCATION (2008)
- BORING LOCATION (1980)

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BORING LOCATION PLAN

FAS ROUTE 960 (US 45)
OVER LITTLE CACHE CREEK
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

08H0131

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Figure 2 Subsurface Data Profile

1-S (1980)
Sta. 2+55, 15' LT

	N	Qu	w%	
366.3				Medium very moist brown Silty Clay Loam A-4 with coarse Gravel mixed
363.8	3	0.7B	25	Medium very moist brown mottled grey & black Silty Clay to Silty Clay Loam A-4 to A-6
361.3	1	0.2B	36	Very soft very moist to wet grey Silty Clay A-6
358.8	1	0.2B	21	Very soft wet grey Silty Clay A-6
356.3	1	0.1B	27	Very soft wet grey Clay Loam A-4
353.3	2	0.8B	37	Medium very moist grey organic Silty Clay Loam A-4 with rotten wood mixed
	4	0.6S	48	Medium very moist grey Clay Loam A-4 & Gravel
348.8				
348.3	55	-	-	Very dense moist grey broken weathered Sandstone
346.3 ▽	52	-	-	Very dense moist brown mottled grey weathered Sandstone with Clay Shale layers
343.8	100	-	-	Hard moist brown Sandstone Cored 23.0 to 25.0 feet, 71% Recovery
341.3				Bottom of hole = 25.0 feet

1-S (2008)
Sta. 2+97, 10' LT

	N	Qu	w%	
367.6				Asphalt
366.1	5	0.7S	23	Medium, moist to very moist, grey, Silt Loam A-4
363.1	2	0.6B	25	Medium, moist to very moist, grey, Silty Clay Loam A-4
	3	0.9B	24	
358.1	1	0.4B	30	Soft to medium, very moist, grey, Silty Clay to Silty Clay Loam A-6
	3	0.5B	30	
	4	0.6B	27	
	3	0.4B	33	
348.1	2	0.5B	22	Soft to medium, very moist, grey, Silty Clay Loam A-4 with Sand and rotten wood layers
344.6	4	1.6B	29	Stiff, moist, grey, Clay A7-6
	5	1.3B	30	
	3	1.1B	29	
338.1	2	0.4B	37	Soft, very moist, grey, Clay A7-6
335.6	2	1.1B	26	Stiff, moist, grey, Silty Clay A-6
	6	1.1B	25	
330.6 ▽	8	1.1B	14	Stiff, moist, grey, Silty Clay A-6 with broken Sandstone gravel
328.1	10	1.9B	16	Stiff, moist, grey, Clay A7-6
323.1	100/2"			Hard, dry, grey, highly laminated, Limestone Cored 44.7 to 49.7 feet 90% Recovery; 25% RQD Cored 49.7 to 54.7 feet 70% Recovery; 30% RQD
312.6				Bottom of hole = 55.0 feet To convert "N" values to "N60" multiply by 1.25

2-S (2008)
Sta. 4+50, 6' RT

	N	Qu	w%	
367.3				Asphalt and Concrete
365.8	8	0.9S	22	Medium, moist to very moist, grey, Silt Loam A-4
362.8	2	0.2B	38	Very soft, very moist, grey and black, Silty Clay Loam A-4
	WH	0.1B	35	
	3	0.2B	29	
355.3	WH	0.1B	27	Very soft, very moist, grey, Silt Loam A-4
352.8	7	1.8S	24	Stiff, moist, brown, Silty Clay Loam A-6
350.3	6	0.6S	26	Medium, very moist, brown mottled grey, Silty Clay to Silty Clay Loam A-6
347.8 ▽	2	0.5B	26	Soft to medium, very moist, grey, Silt Loam A-4 with Sand seams
345.3	3	1.2B	31	Stiff, moist, grey, Clay A7-6
342.8	2	0.8B	31	Medium, very moist, grey, Clay A7-6
340.3	WH	0.5B	25	Soft to medium, very moist, grey, Silty Clay Loam A-6 with Sand seams
337.8	WH	0.4B	32	Soft, very moist, grey, Silty Clay A-6
335.3	1	0.8B	30	Medium, very moist, grey, Silty Clay Loam A-6
	3	0.6B	34	
330.3	1	0.3B	25	Soft, very moist, grey, Silty Clay Loam A-6 with Sand seams
	2	0.4B	28	
322.8	17			Medium, moist, grey, broken Limestone Gravel with Sand
319.3				Hard, dry, grey, Limestone Cored 48.0 to 53.0 feet 100% Recovery; 75% RQD
314.3				Bottom of hole = 53.0 feet To convert "N" values to "N60" multiply by 1.25

2-S (1980)
Sta. 4+72, 15' RT

	N	Qu	w%	
367.8				Medium moist black Cinders
366.8				Medium moist to very moist grey Silty Clay Loam to Silt Loam A-4
362.8	2	0.2B	31	Very soft very moist grey Silty Clay Loam to Silt Loam A-4
360.3	3	0.8B	26	Medium very moist brown streaked grey Silty Clay Loam A-4 to A-6
357.8	9	1.7S	25	Stiff moist to very moist brown mottled grey Silt Loam A-4
	8	1.5S	22	
	7	1.2S	23	
350.3				
348.8 ▽	3	0.4S	32	Soft very moist organic grey Clay Loam A-4
347.8	2	0.5B	29	Medium very moist grey Clay Loam A-4
345.3	7	1.6B	28	Stiff very moist grey Clay A-7-6
342.8	4	1.0B	31	Stiff very moist grey Silty Clay to Clay A-6
340.3	3	0.8B	28	Medium very moist grey Clay Loam A-4
337.8	4	1.4B	26	Stiff moist to very moist grey Silty Clay Loam A-4
335.3	2	0.8B	35	Medium very moist grey Silty Clay Loam A-4
332.8	22	-	-	Medium wet grey fine grained Sand
	10	-	-	
328.8	4	0.7B	29	Medium wet grey fine grained Sand
	3	0.5B	26	
322.8				Bottom of hole = 45.0 feet

Notes:
1. All boring elevations have been adjusted to current vertical datum.
2. Borings 1-S (2008) and 2-S (2008) were drilled October 27 to 29, 2008. Water surface in creek was Elev. 354.4 during drilling.
3. Borings 1-S (1980) and 2-S (1980) were drilled in January and March, 1980.

SUBSURFACE DATA PROFILE
STRUCTURE NO. 044-0060

SHEET NO. 1	F.A.S RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
	960	38B-1	JOHNSON	_	
1 SHEET			CONTRACT NO. 78029		
	FED. ROAD DIST. NO. _	ILLINOIS	FED. AID PROJECT		

Appendix

Appendix A - Geotechnical Data

The following data is attached to this report for use by the structure designer:

- 2008 IDOT District 9 Boring Logs
- 1980 Existing Structure No. 044-0004 Boring Logs

ILLINOIS DEPARTMENT OF TRANSPORTATION
District Nine Materials

Bridge Foundation
Boring Log
Sheet 1 **of** 2

FAS 960 (US 45) Over Little Cache Creek

Route AS 960 (US 45) **Structure Number:** 044-0004 **Date:** 10/29/2008

Section 38B & C **Bored By:** Rich Moberly

County: Johnson **Location:** 0.2 miles South of IL 146 **Checked By:** Rob Graeff

Boring No 1-S
Station 2+97
Offset 10' Lt CL
Ground Surface 367.6 **Ft**

	DEPTH	BLOWS	Qu tsf	W%
Asphalt				
366.1				
Medium, moist to very moist, grey, Silt Loam A-4		1		
		3	0.7S	23
		2		
363.1				
Medium, moist to very moist, grey, Silty Clay Loam A-4	5.0	1		
		1	0.6B	25
		1		
		1		
		1	0.9B	24
		2		
358.1				
Soft to medium, very moist, grey, Silty Clay to Silty Clay Loam A-6	10.0	1		
		WH	0.4B	30
		1		
		1		
		1	0.5B	30
		2		
	15.0	1		
		2	0.6B	27
		2		
		1		
		1	0.4B	33
		2		
348.1				
Soft to medium, very moist, grey, Silty Clay Loam A-4 with Sand and rotten wood layers	20.0	1		
		1	0.5B	22
		1		
		1		
344.6		1		
Stiff, moist, grey, Clay A7-6		3	1.6B	29
	25.0	1		

Surf Wat Elev: 354.4
Ground Water Elevation
when Drilling 330.6
At Completion
At: **Hrs:**

	DEPTH	BLOWS	Qu tsf	W%
Stiff, moist, grey, Clay A7-6		2	1.3B	30
		3		
		1		
		1	1.1B	29
		2		
338.1				
Soft, very moist, grey, Clay A7-6	30.0	WH		
		1	0.4B	37
		1		
335.6				
Stiff, moist, grey, Silty Clay A-6		WH		
		1	1.1B	26
		1		
	35.0	1		
		3	1.1B	25
		3		
330.6				
Stiff, moist, grey, Silty Clay A-6 with broken Sandstone gravel		1		
		3	1.1B	14
		5		
328.1				
Stiff, moist, grey, Clay A7-6	40.0	1		
		5	1.9B	16
		5		
323.1				
Hard, dry, grey, highly laminated, Limestone	45.0	100/2"		
Cored 44.7 to 49.7 feet 90% Rec; 25% RQD				
	50.0			

N-Std Pentr Test: 2" OD Sampler,140# Hammer, 30" Fall (Type Fail. B-Bulge S-Shear E-Estimated P-Penetrometer)

Sheet 2 of 2

Route US 960 (US 45)
Date: 10/29/2008
Section: 38B & C
County: Johnson

Boring No: 1-S
Station: 2+97
Offset: 10' Lt CL
Ground Surface: 367.6 **Ft**

	DEPTH	BLOWS	Qu tsf	W%		DEPTH	BLOWS	Qu tsf	W%
Hard, dry, grey, highly laminated, Limestone Cored 49.7 to 54.7 feet 70% Rec; 30% RQD 312.6	55.0					80.0			
Bottom of hole = 54.7 feet Free water observed at 37.0 feet Elevation referenced to BM @ NW corner of structure; Elevation = 366.3 feet To convert "N" values to "N60" multiply by 1.25	60.0					85.0			
	65.0					90.0			
	70.0					95.0			
	75.0					100.0			

N-Std Pentr Test: 2" OD Sampler,140# Hammer, 30" Fall (Type Fail. B-Bulge S-Shear E-Estimated P-Penetrometer)

ILLINOIS DEPARTMENT OF TRANSPORTATION
District Nine Materials

Bridge Foundation
Boring Log

FAS 9[illegible] (US 45) Over Little Cache Creek

Sheet 1 **of** 2

Route AS 960 (US 45) **Structure Number:** 044-0004 **Date:** 10/27/2008

Section 38B & C **Bored By:** Rich Moberly

County: Johnson **Location:** 0.2 miles South of IL 146 **Checked By:** Rob Graeff

Boring No 2-S
Station 4+50
Offset 6' Rt CL
Ground Surface 367.3 Ft

Surf Wat Elev: 354.4
Ground Water Elevation
when Drilling 347.8
At Completion
At: **Hrs:**

	DEPTH	BLOWS	Qu tsf	W%
Asphalt and Concrete				
365.8				
Medium, moist to very moist, grey, Silt Loam A-4		1		
		4	0.9S	22
		4		
362.8				
Very soft, very moist, grey and black, Silty Clay Loam A-4	5.0	1		
		1	0.2B	38
		1		
		WH		
		WH	0.1B	35
		WH		
	10.0	WH		
		2	0.2B	29
		1		
355.3				
Very soft, very moist, brown, Silt Loam A-4		WH		
		WH	0.1B	27
		WH		
352.8				
Stiff, moist, brown, Silty Clay Loam A-6	15.0	1		
		3	1.8S	24
		4		
350.3				
Medium, very moist, brown mottled grey, Silty Clay to Silty Clay Loam A-6		1		
		2	0.6S	26
		4		
347.8				
Soft to Medium, very moist, grey, Silt Loam A-4 with Sand seams	20.0	WH		
		1	0.5B	26
		1		
345.3				
Stiff, moist, grey, Clay A7-6		WH		
		1	1.2B	31
		2		
342.8				
	25.0	WH		

	DEPTH	BLOWS	Qu tsf	W%
Medium, very moist, grey, Clay A7-6		1	0.8B	31
		1		
340.3				
Soft to medium, very moist, grey, Silty Clay Loam A-6 with Sand seams		WH		
		WH	0.5B	25
		WH		
337.8				
Soft, very moist, grey, Silty Clay A-6	30.0	WH		
		WH	0.4B	32
		WH		
335.3				
Medium, very moist, grey, Silty Clay Loam A-6		WH		
		WH	0.8B	30
		1		
	35.0	WH		
		1	0.6B	34
		2		
330.3				
Soft, very moist, grey, Silty Clay Loam A-6 with Sand seams		WH		
		WH	0.3B	25
		1		
	40.0	WH		
		1	0.4B	28
		1		
322.8				
Medium, moist, grey, broken Limestone Gravel with Sand	45.0	6		
		8		
		9		
319.3				
Cored 48.0 to 53.0 feet 100% Rec; 75% RQD Hard, dry, grey, Limestone				
	50.0			

N-Std Pentr Test: 2" OD Sampler,
140# Hammer, 30" Fall (Type Fail. B-Bulge S-Shear E-Estimated P-Penetrometer)

Sheet 2 of 2

Route AS 960 (US 45)

Date: 10/27/2008

Section: 38B & C

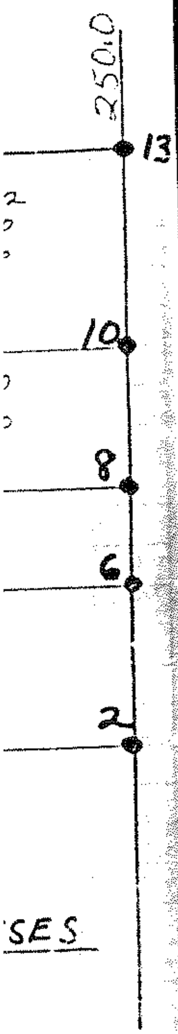
County: Johnson

Boring No: 2-S Station: 4+50 Offset: 6' Rt CL Ground Surface: 367.3 Ft	DEPTH	BLOWS	Qu tsf	W%		DEPTH	BLOWS	Qu tsf	W%
Cored 48.0 to 53.0 feet 100% Rec; 75% RQD Hard, dry, grey, Limestone 314.3									
Bottom of hole = 53.0 feet	55.0					80.0			
Free water observed at 19.5 feet Elevation referenced to BM @ NW corner of structure; Elev. = 366.3 feet To convert "N" values to "N60" multiply by 1.25	60.0					85.0			
	65.0					90.0			
	70.0					95.0			
	75.0					100.0			

N-Std Pentr Test: 2" OD Sampler,
140# Hammer, 30" Fall (Type Fail. B-Bulge S-Shear E-Estimated P-Penetrometer)

of 2
Date 5-8-80
Date

S)



SES

= 1.7692

1.4648

Illinois Department of Transportation

Bridge Found
Boring Log

Sh. 1 of

PROJECT -
BRIDGE CARRYING F.A.S. 960 (ILL. 45) OVER LITTLE CACHE CREEK
Date JANUARY 1980
ROUTE F.A.S. 960 (ILL.45)
Bored By JOEL CONGIARDO
SEC. 35BC-BR
STA. 2+71 (inc. to South)
Checked By GARY L. PULLEY
COUNTY JOHNSON

Boring No. 1-S
Station 2+55
Offset 15' LT. CL

Surface Water El. NONE
Groundwater El. at Completion 362.5
After - Hours -

		Elevation	N	Qu t/s.f.	w (%)
Ground Surface	366.5	0			
MEDIUM VERY MOIST BROWN SILTY CLAY LOAM A-4 WITH COARSE GRAVEL MIXED	364.0				
MEDIUM VERY MOIST BROWN MOTTLED GREY & BLACK SILTY CLAY TO SILTY CLAY LOAM A-4 TO A-6	361.5	-5	3	0.7B	25
VERY SOFT VERY MOIST TO WET GREY SILTY CLAY A-6	359.0		1	0.2B	36
VERY SOFT WET GREY SILTY CLAY A-6	356.5	-10	1	0.2B	21
VERY SOFT WET GREY CLAY LOAM A-4	353.5		1	0.1B	27
MEDIUM VERY MOIST GREY ORGANIC SILTY CLAY LOAM A-4 WITH ROTTEN WOOD MIXED		-15	2	0.8B	37
	349.0		4	0.6S	48
MEDIUM VERY MOIST GREY CLAY LOAM A-4 & GRAVEL	348.5		55	-	-
VERY DENSE MOIST GREY BROKEN WEATHERED SANDSTONE	346.5	-20			
VERY DENSE MOIST BROWN MOTTLED GREY WEATHERED SANDSTONE W/CLAY SHALE LAYERS	344.0		52	-	-

		Elevation	N	Qu t/s.f.	
HARD MOIST BROWN SANDSTONE	341.5	-25	100	BLOWS CORED 71%	RE

BOTTOM OF HOLE = 25.0'.

DURING DRILLING OPERATIONS IT APPEARED THAT FREE WATER WAS ENCOUNTERED AT 20.0'.

DURING CORING OPERATIONS H_2O WAS USED FROM -22.7' TO 25.0'.

STRUCTURE LOCATION:
Close to Mid. E. Ln.,
SE 1/4, SECTION 5, T13S, R3E, 3RD P.M., JOHNSON COUNTY, ILLINOIS.

-30
-35
-40
-45

N-Standard Penetration Test- Blows per foot to drive 2" O.D. Split Spoon Sampler 12" with 140 No. hammer falling 30".

Qu-Unconfined Compressive Strength - t/sf

w - Water Content - percentage of oven dry weight-%.

Type failure:
B - Bulge Failure
S - Shear Failure
E - Estimated Value
P - Penetrometer

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SN 044-0040

Illinois Department of Transportation

Bridge Foundation Boring Log

Sh. 1 of 2 Sh

PROJECT - BRIDGE CARRYING F.A.S. 960 (ILL.45) Date MARCH, 1980
ROUTE F.A.S. 960 OVER LITTLE CACHE CREEK Bored By JOEL CONGIARDO
SEC. 36BC-BR STA. 3+71 Checked By GARY L. PULLEY
COUNTY JOHNSON

Boring No. 2-S
Station 4+72
Offset 15' RT. CL

Surface Water El. NONE
Groundwater El. at Completion 360.0
After - Hours -

	Elevation	N	Qu t/s.f.	w (%)
Ground Surface 368.0	0			
MED. MOIST BLACK CINDERS 367.0				
MEDIUM MOIST TO VERY MOIST GREY SILTY CLAY LOAM TO SILT LOAM A-4 363.0	-5			
VERY SOFT VERY MOIST GREY SILTY CLAY LOAM TO SILT LOAM A-4 360.5		2	0.2P	31
MEDIUM VERY MOIST BROWN STREAKED GREY SILTY CLAY LOAM A-4 TO A-6 358.0	-10	3	0.8B	26
STIFF MOIST TO VERY MOIST BROWN MOTTLED GREY SILT LOAM A-4 350.5	-15	9 8 7	1.7S 1.5S 1.2S	25 22 23
SOFT VERY MOIST ORGANIC GREY CLAY LOAM A-4 348.0	-20	3	0.4S	32
MEDIUM VERY MOIST GREY CLAY LOAM A-4 345.5		2	0.5B	29

	Elevation	N	Qu t/s.f.	w (%)
STIFF VERY MOIST GREY CLAY A-7-6 343.0	-25	7	1.6P	28
STIFF VERY MOIST GREY SILTY CLAY TO CLAY A-6 340.5		4	1.0B	31
MEDIUM VERY MOIST GREY CLAY LOAM A-4 338.0	-30	3	0.8B	28
STIFF MOIST TO VERY MOIST GREY SILTY CLAY LOAM A-4 335.5		4	1.4B	26
MEDIUM VERY MOIST GREY SILTY CLAY LOAM A-4 333.0	-35	2	0.8B	35
MEDIUM WET GREY FINE GRAINED SAND 329.0		22 10	- -	- -
MEDIUM WET GREY FINE GRAINED SAND 323.0	-40 -45	4 3	0.7B 0.5B	29 26

N-Standard Penetration Test- Blows per foot to drive 2" O.D. Split Spoon Sampler 12" with 140 No. hammer falling 30".

Qu-Unconfined Compressive Strength - t/sf

w - Water Content - percentage of oven dry weight-%

Type failure:
B - Bulge Failure
S - Shear Failure
E - Estimated Value
P - Penetrometer

[illegible] (Rev. 4-78)