Structure Geotechnical Report

(In-House)

IL 1 over Embarras River Overflow

Bridge Replacement

Proposed Structure Number:	051-0075
Existing Structure Number:	051-0005
Route:	FAP 332 (IL 1)
Section:	16BR
County:	Lawrence
Project Number:	P-97-025-06
Contract:	74164

Prepared For:	Planning Unit Derek G. Verhulst
Prepared By:	Foundations and Geotechnical Unit Lindsey N. Jones, PE Lindsey.Jones@illinois.gov
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Report Date:	June 12, 2018
Revised Date:	September 26, 2018

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Appendix

1.0 Scope of Work

It is proposed that the existing 19 span 819'-1 ½" long structure (051-0005) be removed and replaced by a 12 span structure. The existing abutments appear to be supported by a combination of precast concrete piles and spread footing. The existing piers appear to be supported by pile supported footings.

The proposed structure will be designed with the 2017 AASHTO LRFD code. The estimated factored substructure loads were estimated by the Designer and are as follows:

	S. Abut.	Pier 1	Pier 2	Pier 3	Pier 4	Pier 5
Estimated Factored Substructure Loads (kips)	217	776	935	994	979	983

	Pier 6	Pier 7	Pier 8	Pier 9	Pier 10	N. Abut.
Estimated Factored Substructure Loads (kips)	983	979	994	935	776	217

2.0 Subsurface Data

Twelve (12) borings were taken for subsurface exploration. Bedrock consists of sandstone and is located approximately 105 ft. below ground surface (approximately elevation 312). Four (4) rock cores were taken.

Artesian conditions were recorded in Boring 6 from elevation 326.37 to 336.37.

The tables below provide the borings that were used to evaluate each substructure and the estimated top of rock elevation:

	S. Abut.	Pier 1	Pier 2	Pier 3	Pier 4	Pier 5
Representative Boring	B-1	B-2	B-3	B-4	B-5	B-6
Estimated Top of Rock	313.24	312.29	313.31	313.18	313.27	311.37
Rock Core Available?	No	Yes	No	No	Yes	No

	Pier 6	Pier 7	Pier 8	Pier 9	Pier 10	N. Abut.
Representative Boring	B-7	B-8	B-9	B-10	B-11	B-12
Estimated Top of Rock	313.03	317.23	319.94	321.48	317.07	316.45
Rock Core Available?	Yes	No	No	No	Yes	No

See Appendix A for the Boring Location Plan and Boring Logs.

3.0 Geotechnical Analyses

3.1 Settlement

Existing side and end slopes for both abutments are 2 Horizontal to 1 Vertical (2H:1V). The proposed side and end slopes for both abutments will be 2H:1V.

The proposed abutments will be located behind the existing abutments. The roadway profile is being raised slightly. This will result in the grade at each abutment being raised by approximately 1 ft. Settlement is not a concern at the abutments.

3.2 Scour

A follow-up Memorandum to the Hydraulic Report was issued by the Hydraulic Unit on October 10, 2017 indicating that 7 ft of raw scour referenced from a flowline elevation of 412.5 should be used at every pier due to anticipated future migration of the channel. Therefore, the following raw scour depths will be used in the scour calculation:

Location	Raw/Unadjusted Scour Depths (ft.)	
	Q100	Q200
Piers 1-10	7.00	7.00

Once the raw scour depths are adjusted for the soil type present, then the adjusted scour depths are subtracted from elevation 412.5. The following table shows the bottom of substructure elevations, the existing streambed elevation, and the streambed elevation used in the scour calculation:

Substructure	Substructure Type	Bottom of Substructure Elev. (ft).	Existing Streambed Elev. (ft)	Streambed Elev. For Scour Calc. (ft)
Pier 1	Pile Bent	410.0	416.5	412.5
Pier 2	Pile Bent	410.0	416.5	412.5
Pier 3	Pile Bent	410.0	415.5	412.5
Pier 4	Pile Bent	410.0	415.5	412.5
Pier 5	Footing w/ Piles	408.5	415.5	412.5
Pier 6	Footing w/ Piles	408.5	416.5	412.5
Pier 7	Pile Bent	410.0	417.0	412.5
Pier 8	Pile Bent	410.0	417.0	412.5
Pier 9	Pile Bent	410.0	417.0	412.5
Pier 10	Pile Bent	410.0	416.5	412.5

The design scour elevations were calculated using the recommended scour reductions from the 2012 Bridge Manual (Section 2.3.6.3.2).

If the abutments are protected in accordance with the Bridge Manual and all ten piers are the substructure type described in the table above, then the following is the recommended Design Scour Elevation Table:

Event/Limit State	Design Scour Elevations (ft.)						Item 113
	S. Abut.	Pier 1	Pier 2	Pier 3	Pier 4	Pier 5	
Q100	423.8*	408.6	409.0	409.0	409.0	409.0	5
Q200	423.8*	408.6	409.0	409.0	409.0	409.0	
Design	423.8*	408.6	409.0	409.0	409.0	409.0	
Check	423.8*	408.6	409.0	409.0	409.0	409.0	
	Pier 6	Pier 7	Pier 8	Pier 9	Pier 10	N. Abut.	
Q100	408.5	408.3	408.1	407.2	405.5	424.5*	
Q200	408.5	408.3	408.1	407.2	405.5	424.5*	
Design	408.5	408.3	408.1	407.2	405.5	424.5*	
Check	408.5	408.3	408.1	407.2	405.5	424.5*	

*For the scour table on the Final Plans, all abutment scour elevation should be updated to match the bottom of abutment elevation shown on the Final Plans.

3.3 Seismic

The latitude and longitude coordinates for the site are 38.74521, -87.68395. The LRFD seismic data for the structure site is as follows:

Seismic Performance Zone (SPZ) = 3
Design Spectral Acceleration at 1.0 sec. (SD1) = 0.328g
Design Spectral Acceleration at 0.2 sec. (SDS) = 0.748g
Soil Site Class = E

Illinois Route 1 within Lawrence County is a Secondary Emergency Route.

3.4 Liquefaction

Atterberg Limit Tests were not on all of the boring logs, therefore Liquefaction Analysis input values were estimated based on the available Atterberg Limit Test results and the soil descriptions on the boring logs. Two (2) seismic events were evaluated: R = 215 km M = 7.7; and R = 10 km M = 5.3, where R equals distance to the source and M equals the magnitude of the event. The controlling event for liquefaction was R = 215 km and M = 7.7. Liquefiable layers for this event are located between the elevations listed below for each substructure:

Substructure	S. Abut.	Pier 1	Pier 2	Pier 3	Pier 4	Pier 5
Elev. of Top of Liquefiable Layer	403.74	404.79	406.31	401.68	402.27	405.67
Elev. of Bottom of Liquefiable Layer	401.24	367.29	366.61	366.68	364.47	355.87

Substructure	Pier 6	Pier 7	Pier 8	Pier 9	Pier 10	N. Abut.
Elev. of Top of Liquefiable Layer	407.03	404.73	404.94	407.48	405.07	409.15
Elev. of Bottom of Liquefiable Layer	367.03	367.23	367.44	367.48	367.57	371.65

See Appendix B for the Liquefaction Analysis spreadsheets. The deepest liquefiable layer is located approximately 60 ft below the finished grade. Having the foundation founded in or on rock will be beneficial should a seismic event occur.

Ground improvement could be implemented to reduce liquefaction at this site if it is determined to be more cost effective than increasing the foundation size to withstand the lateral forces (see Section 4.0 for further discussion). Ground improvement that involves vibration should only be selected with caution unless a detour can be used during construction or the effects of vibration on the existing foundation during staging is determined. There are some thick beds of granular material at the site, so vibration could cause the granular layers to consolidate and the structure to settle. If necessary, ground improvement options will be determined at the Final Design phase.

3.5 Global Stability

The global stability of the site was evaluated for both static and seismic conditions. The static slope stability Factor of Safety (FOS) for both abutments was above the required FOS of 1.5 (see Appendix C for analyses).

Substructure	Static Slope Stability FOS
South Abutment	2.71
North Abutment	3.17

The horizontal seismic coefficient used to evaluate the seismic slope stability was calculated based on the Federal Highway Administration (FHWA) Reference Manual titled “LRFD Seismic Analysis and Design of Transportation Geotechnical Features and Structural Foundations” (FHWA Publication No. FHWA-NHI-11-032). The resulting horizontal seismic coefficient for both abutments was as follows for each event (See Appendix D for calculations):

Seismic Event	Horizontal Seismic Coefficient (both Abutments)
R = 215; M = 7.7	0.116
R = 10; M = 5.3	0.190

The event that resulted in the largest horizontal seismic coefficient was used in the seismic slope stability analysis.

The seismic slope stability analysis took into consideration the liquefiable layers. The liquefiable layers (as identified in the Liquefaction Analysis) were assigned reduced cohesion and friction angles. The FHWA-NHI-11-032 Manual states:

> *“Saturated soils which liquefy typically possess some "residual" shear strength even when in the liquefied state. In initially loose soils, this residual strength may be very small and of little consequence. In denser soils (particularly in dense granular soils which tend to dilate or expand in volume), this residual strength can be high enough to render the impact of liquefaction relatively insignificant. For medium dense soils, the residual shear strength can be the most important*

factor in determining whether or not remediation is necessary" (Page 4-39).

Based on the above statement, the soil parameters for liquefiable granular layers were modified as follows:

Soil Description	Adjusted Friction Angle (ϕ) for Liquefied State
Loose Granular	ϕ*0.10
Medium Granular	ϕ*0.15
Dense Granular	ϕ*0.20

The soil parameters for liquefiable cohesive layers were modified based on the Factor of Safety of the material from the Liquefaction Analysis spreadsheets. The modifications were as follows:

FOS from Liquefaction Spreadsheet	Adjusted Cohesion for Liquefied State
0.000 to 0.800	c*0.10
0.801 to 0.950	c*0.15
0.951 to 0.999	c*0.20

The short-term and liquefied state soil parameters were used for the seismic slope stability analysis and the resulting Factors of Safety were (see Appendix E for analyses):

Substructure	Seismic Slope Stability FOS
South Abutment	1.13
North Abutment	1.03

Per the 2015 IDOT Geotechnical Manual, a seismic slope stability factor of safety (FOS) of 1.0 is acceptable (GM Section 6.12.4.1). Both abutments meet the required minimum FOS.

4.0 Foundation Recommendations

Due to the length of the structure the use of integral abutments is not allowed (per All Bridge Designers Memorandum 12.3). Therefore, foundation types are not limited by the abutment type and all foundation types were considered. It appears the existing approach slabs are supported by wooden piles. The location of the proposed abutments should be closely compared to the existing plans to determine if existing foundation and proposed foundation will conflict.

Due to the liquefiable soil present at the site, spread footing foundation should not be used "unless ground improvement techniques are employed to mitigate liquefaction" (AGMU 10.1). The soil at the site is not particularly conducive to spread footing foundation, so spread footing foundation was not considered further.

Metal Shell piles were considered for the site. Due to the liquefiable layers present, 12" Metal Shell pile sizes and 14" Metal Shell piles with 0.25" wall are not feasible. There is

little-to-no resistance available from these pile sizes after the reduction for liquefaction and subsequent downdrag. 14" Metal Shell piles with 0.312" wall and 16" metal shell piles have some resistance available after the liquefaction and downdrag reductions are made, however the piles will likely undergo substantial settlement if a seismic event occurs. Metal Shell piles are only feasible if ground improvement is used to eliminate the liquefaction threat.

Scour was not considered as a reduction in the Strength Limit State design of the foundation at the abutments, however scour was taken into consideration at the piers. Liquefaction and downdrag were taken into consideration at all substructures for the Extreme Limit State.

H-piles, drilled shafts, or large diameter pipe piles are recommended for the site.

4.1 Driven H-Piles

The feasibility of H-Piles is largely dependent on the ability of the piles to perform during a seismic event. Lateral loads were requested from the Planning Unit Designer, however the Designer recommended that the lateral loads be provided by the Design Unit. The feasibility of H-piles will have to be verified during the Final Design phase of the structure. The analysis will need to take into consideration the lateral loads at all substructures.

If H-piles are found to be feasible, then the pile tables provided in Appendix F can be used. Both Strength Limit State and Extreme Limit State pile tables are provided for each of the substructures. It is recommended that all piles be driven to refusal. Pile shoes are recommended as it is anticipated that piles will terminate in sandstone.

4.2 Drilled Shafts

Drilled Shafts are feasible and a viable option for the site if H-Piles are not feasible due to lateral concerns. Temporary or permanent casing would be necessary for Drilled Shaft construction due to the presence of granular and weak cohesive layers at the site. It should be noted that artesian conditions were documented in Boring 6, which could complicate the construction of Drilled Shafts. Additional information for Drilled Shaft design will be provided during the Final Design phase if it is needed.

4.3 Large Diameter Pipe Piles

Large Diameter Pipe Piles are another feasible and viable option for the site if H-Piles are not able to withstand the lateral forces. Additional information for Large Diameter Pipe Piles will be provided during the Final Design phase if it is needed.

4.4 Test Piles

One test pile at every other substructure is recommended, for a total of 6 test piles during the first stage of construction. Test piles are recommended at Pier 1, Pier 3, Pier 5, Pier 7, Pier 9, and the North Abutment

4.5 Lateral Analysis

Lateral stability of the structure during a seismic event given the thickness of the liquefiable layers is a major concern for the site.

Soil parameters for both the Strength Limit State and Extreme Limit State lateral analysis will be determined during the Final Design phase. The Extreme Limit State parameters should take into account the reduced strength of the liquefiable layers during a seismic event.

Ground improvement could be implemented to reduce liquefaction at this site if it is determined to be more cost effective than increasing the foundation size to withstand the lateral forces (see Section 3.4 for ground improvement discussion).

5.0 Construction Considerations

5.1 Temporary Retention

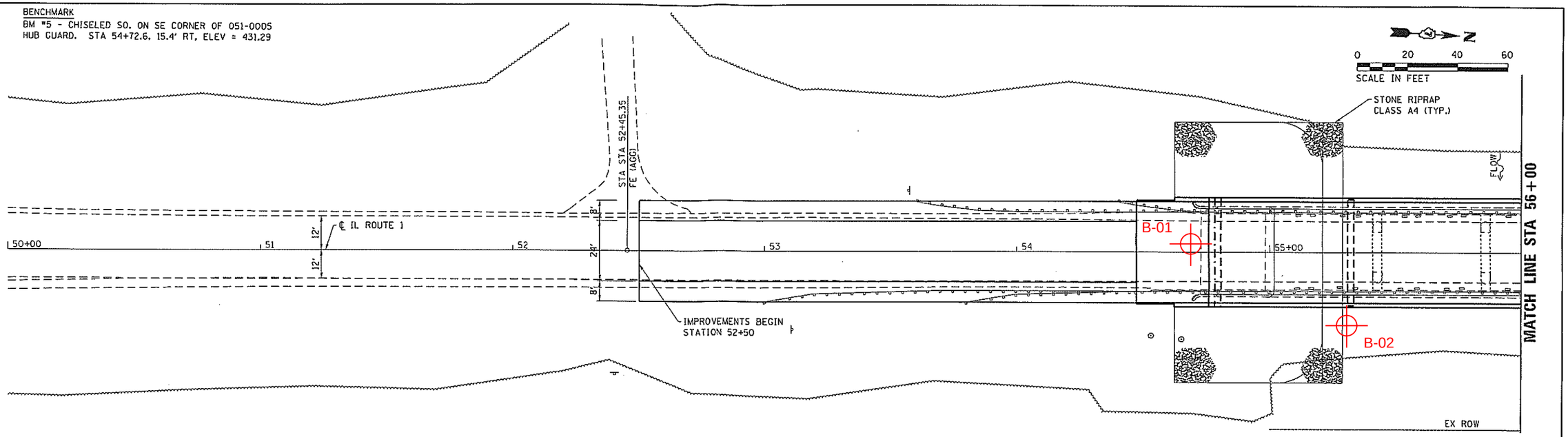
Staged construction is proposed for the structure. The new abutments are proposed to be set behind the existing abutments and the profile grade raised slightly. Sloped excavation will likely not be feasible. Temporary Soil Retention System is recommended at both abutments.

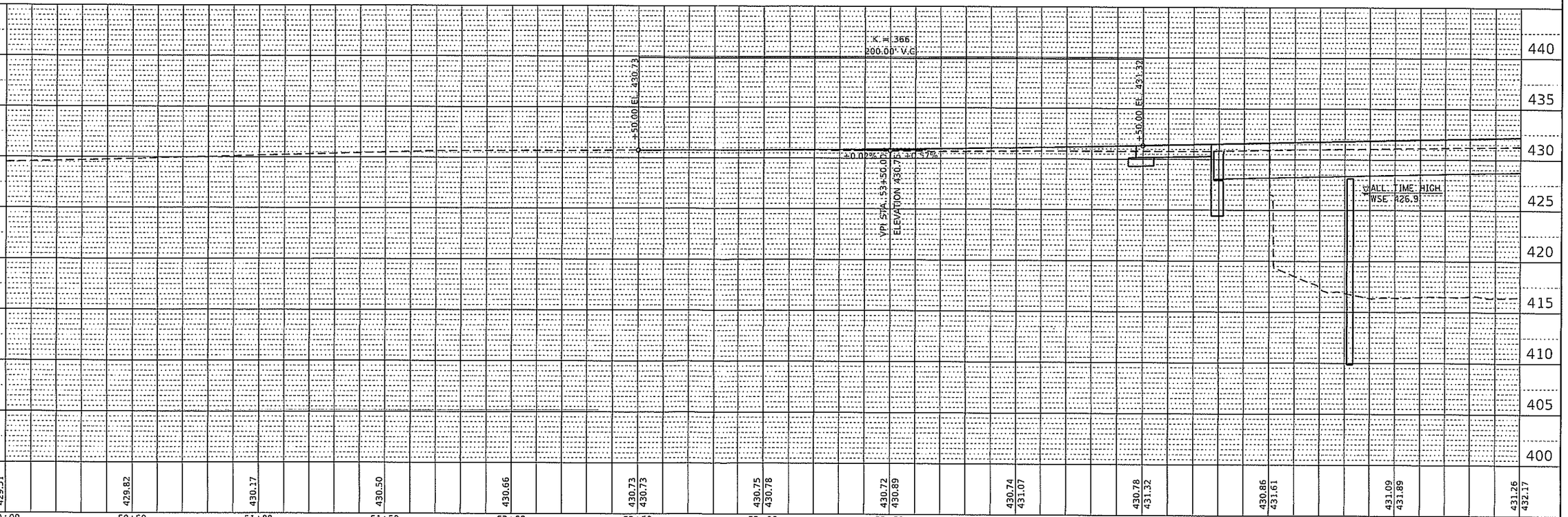
5.2 Cofferdam and Seal Coat

The Estimated Water Surface Elevation (EWSE) is 414.8 ft. The channel is located between proposed Piers 3 and 4. All of the proposed piers lie outside of the channel and the EWSE is below the existing groundline at every pier. Cofferdams do not appear necessary for the construction of the piers.

Appendix A

BENCHMARK
BM #5 - CHISELED SQ. ON SE CORNER OF 051-0005 HUB GUARD. STA 54+72.6, 15.4' RT, ELEV = 431.29





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PLOT DATE = 12/14/2017	DATE - 06/22/17	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

F.A.P. ROUTE 332 (IL 1) PLAN AND PROFILE
PROPOSED SN 051-0075

SCALE: | SHEET 1 OF 3 SHEETS | STA. 50+00 | TO STA. 56+00

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
332	(16BR-1,BR-2)B-1	LAWRENCE		
		CONTRACT NO. 74164		
	ILLINOIS	FED. AID PROJECT		

PLAN	SURVEYED	DATE
NOTE BOOK	PLOTTED	BY
NO.	ALIGNMENT CHECKED	
	RT. OF WAY CHECKED	
	LOCO TAE TIME	

PROFILE	SURVEYED	DATE
NOTE BOOK	PLOTTED	BY
NO.	GRADES CHECKED	
	B.M. NOTED	
	STRUCTURE NUMBERS CHKD	

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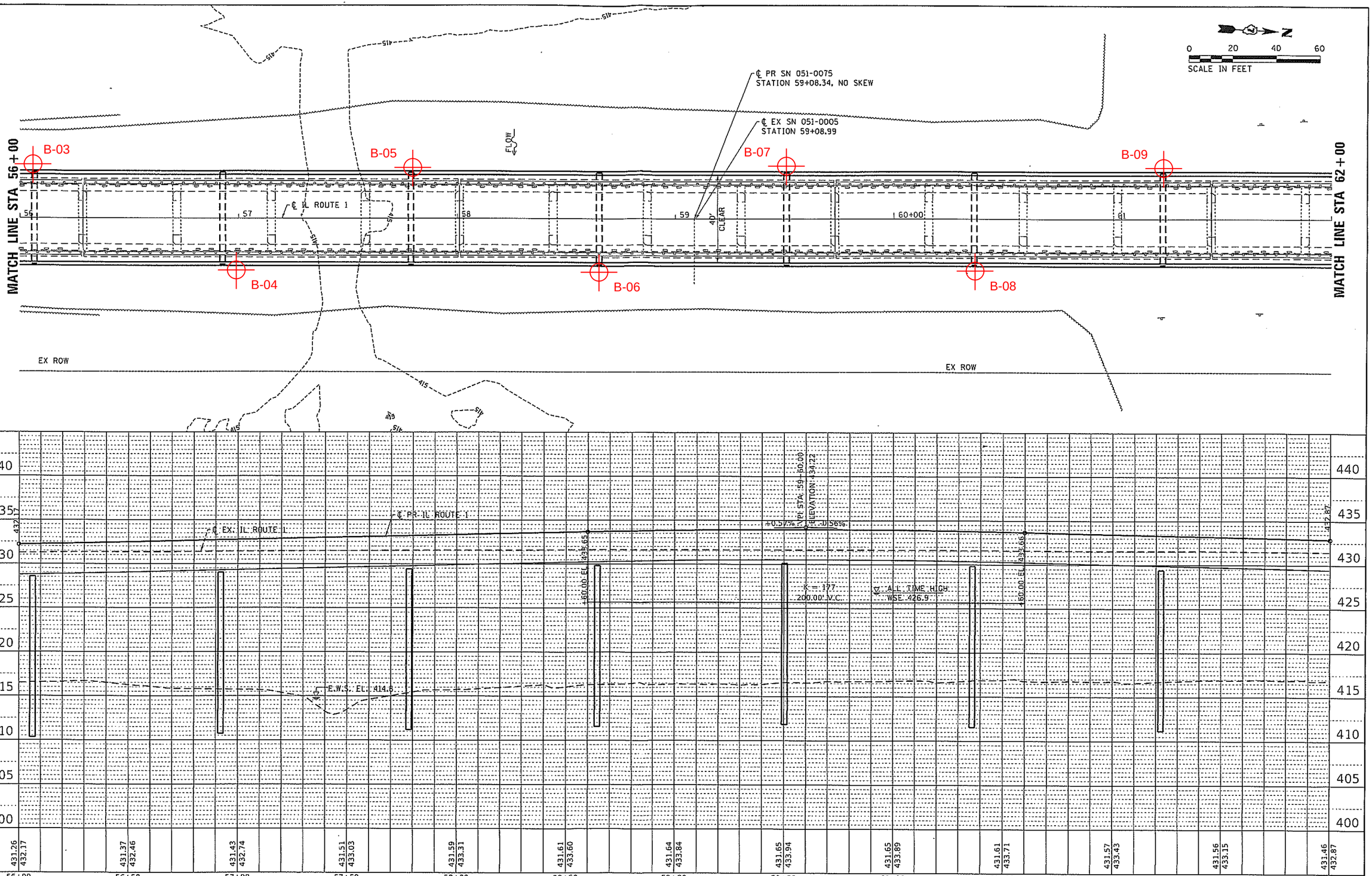

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PLOT DATE = 12/14/2017	DATE - 06/22/17	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

F.A.P. ROUTE 332 (IL 1) PLAN AND PROFILE
PROPOSED SN 051-0075

SCALE: | SHEET 2 OF 3 SHEETS | STA. 56+00 | TO STA. 62+00

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
332	(16BR-1,BR-2)B-1	LAWRENCE		
		CONTRACT NO. 74164		
	ILLINOIS	FED. AID PROJECT		

BENCHMARKS
BM #7 - CHISELED SQ. ON NE CORNER OF 051-0005 HUB GUARD. STA 63+18.3, 15.9' RT, ELEV = 431.55
L2 - RR SPIKE IN POWER POLE. STA 66+88.7, 70.1' LT, ELEV = 416.7

STONE RIPRAP CLASS A4, (TYP.)

FLOW

B-11

B-12

B-10

MATCH LINE STA. 62+00

STA 64+73.00 BK
STA 57+11.10 AH

IMPROVEMENTS END STATION 60+00

℄ IL ROUTE 1

62 63 64 58 59 60+00

12' 12' 8' 24'

EXISTING SLOPE WALL CONC

EX ROW

0 20 40 60
SCALE IN FEET

N

PLAN
SURVEYED
PLOTTED
CROSS CHECKED
RT. OF WAY CHECKED
CADD FILE NAME
NOTE BOOK
NO.
DATE
BY

PROFILE
SURVEYED
PLOTTED
CROSS CHECKED
B.M. NOTED
STRUCTURE NOTATIONS CHKD
NOTE BOOK
NO.
DATE
BY

440 435 430 425 420 415 410 405 400

432.87

℄ PR IL ROUTE

EQUATION
BK 64+73.00
AH 57+11.10

℄ EX IL ROUTE 1

-0.56%

429.71

2. ALL TIME HIGH WSE 426.9

431.46 432.87 | 431.39 432.59 | 431.26 432.31 | 431.16 432.03 | 431.05 431.75 | 430.99 431.46 | 430.78 431.12 | 430.55 430.83 | 430.29 430.55 | 430.07 430.27 | 429.85 429.99 | 429.71 429.71

62+00 62+50 63+00 63+50 64+00 64+50 57+50 58+00 58+50 59+00 59+50 60+00

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PLOT DATE = 12/14/2017	DATE - 06/22/17	REVISED -		

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
332	(16BR-1,BR-2)B-1	LAWRENCE		
		CONTRACT NO. 74164		
	ILLINOIS FED. AID PROJECT			

Illinois Department of Transportation

Division of Highways
IDOT

SOIL BORING LOG

Date 9/29/17

ROUTE FAP 332 (IL 1) **DESCRIPTION** Embarras River Overflow **LOGGED BY** E. Sandschafer

SECTION (16BR-1,BR-2)B-1 **LOCATION** W 1/2, **SEC.** 30, **TWP.** 4 N, **RNG.** 11 W, 3 **PM**

COUNTY Lawrence **DRILLING METHOD** Hollow stem auger & split spoon **HAMMER TYPE** Auto 140#

STRUCT. NO. 051-0075
Station 62+80

BORING NO. 1 (S Abut)
Station 54+64
Offset 8.0ft Lt (West)
Ground Surface Elev. 430.74 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter 403.7 ft
Upon Completion Washed ft
After 72 **Hrs.** 406.2 ft

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Description
				6" asphalt on 13" concrete pavement.
				429.14 Estimated, CLAY LOAM, embankment.
				No samples.
				426.24 Stiff, damp, brown, CLAY LOAM, embankment.
-5	2			
	3	1.24	25	
	4	B		
	3			
	4	1.57	24	
	5	B		
-10	2			
	3	1.48	24	
	5	B		
				418.74 Medium, damp, gray, SILTY CLAY, embankment.
	2			
	2	0.62	29	
	2	B		
-15	1			
	1	0.62	27	
	2	B		
				413.74 Stiff, damp, brown, CLAY.
	1			
	3	1.40	25	
	4	B		
				411.24 Stiff, damp, brown, SILTY CLAY.
-20	3			
				Stiff, damp, brown, SILTY CLAY. *(continued)*
	4	1.81	24	
	5	B		
				408.74 Very stiff, damp, brown, CLAY.
	2			
	3	2.06	22	
	4	B		
				▼406.24 Soft, very damp, brown, SILTY LOAM.
-25	2			
	1	0.33	25	
	3	B		
				▽ 403.74 Loose, wet, brown, fine grained, SAND. *6% passing #200 sieve.*
	3			
	1		26	
	2			
				401.24 Very soft, very damp, gray, SANDY LOAM.
-30	2			
	3	0.18	21	
	3	S		
				396.24 Medium to dense, wet, brown, fine grained, SAND. *4% passing #200 sieve.*
-35	5			
	10		23	
	20			
				391.24 Very soft, very damp, gray, SILT.
-40	2			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
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)

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Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 9/29/17

ROUTE FAP 332 (IL 1) DESCRIPTION Embarras River Overflow LOGGED BY E. Sandschafer

SECTION (16BR-1,BR-2)B-1 LOCATION W 1/2, SEC. 30, TWP. 4 N, RNG. 11 W, 3 PM

COUNTY Lawrence DRILLING METHOD Hollow stem auger & split spoon HAMMER TYPE Auto 140#

STRUCT. NO. 051-0075
Station 62+80

BORING NO. 1 (S Abut)
Station 54+64
Offset 8.0ft Lt (West)
Ground Surface Elev. 430.74 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
▽ First Encounter 403.7 ft
▽ Upon Completion Washed ft
▼ After 72 Hrs. 406.2 ft

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Description
	7	0.21	27	Very soft, very damp, gray, SILTY CLAY. *(continued)*
	6	B		
386.24				
-45	4			Stiff, damp, gray, SILTY CLAY.
	5	2.06	28	
	6	B		
-50	4			
	5	1.65	28	
	6	B		
-55				
370.74 -60	1			
	3	0.62	28	Medium, damp, gray, SILTY CLAY.
	4	B		
-65				
361.24				
-70	14			Dence, wet, gray, fine grained, SAND. *10% passing #200 sieve.*
	17		22	
	21			
-75				
351.24				
-80	6			Stiff, damp, gray, SILTY CLAY.

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
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File Name S:\NEW GEOTECHNICAL\GINTDATA\PROJECTS\LAWRENCE CO (051)\051-0075 SOIL ROCK 2017.GPJ Data Template D6TEMPLT.GDT Date Printed 10/16/17
Latitude W 87 deg 41 min 02.592 sec Longitude N 38 deg 44 min 38.950 sec Datum Job Number

Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

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ROUTE FAP 332 (IL 1) DESCRIPTION Embarras River Overflow LOGGED BY E. Sandschafer

SECTION (16BR-1,BR-2)B-1 LOCATION W 1/2, SEC. 30, TWP. 4 N, RNG. 11 W, 3 PM

COUNTY Lawrence DRILLING METHOD Hollow stem auger & split spoon HAMMER TYPE Auto 140#

STRUCT. NO. 051-0075
Station 62+80

BORING NO. 1 (S Abut)
Station 54+64
Offset 8.0ft Lt (West)
Ground Surface Elev. 430.74 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
▽ First Encounter 403.7 ft
▽ Upon Completion Washed ft
▽ After 72 Hrs. 406.2 ft

	DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)
Stiff, damp, gray, SILTY CLAY. *(continued)*		7	1.90	34
		9	S	
	-85			
	-90	5		
		7	2.06	24
		8	B	
	-95			
	331.24			
Very stiff, damp, gray, LOAM.	-100	6		
Very stiff, damp, gray, LOAM. *(continued)*		6	2.68	20
		10	B	
	-105			
	321.24			
Very dense, wet, gray, fine grained, SAND. *9% passing #200 sieve.*	-110	46		
		39		14
		30		
Benchmarks: BM 5 Chiseled square on hubguard on SE corner of existing structure Sta 54+73 Rt 15.4' = 431.29' BM 7 Chiseled square on hubguard on NE corner of existing structure Sta 63+18 Rt 15.9' = 431.55'	-115			
	313.24			
Very dense, moist, gray, SANDSTONE.	313.14	50/1"		16
Extent of exploration.		50/0"		
		50/0"		
	-120			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
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)

File Name S:\NEW GEOTECHNICAL\GINTDATA\PROJECTS\LAWRENCE CO (051)\051-0075 SOIL ROCK 2017.GPJ Data Template D6TEMPLT.GDT Date Printed 10/16/17
Latitude W 87 deg 41 min 02.592 sec Longitude N 38 deg 44 min 38.950 sec Datum Job Number

Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 9/11/17

ROUTE FAP 332 (IL 1) **DESCRIPTION** Embarras River Overflow **LOGGED BY** E. Sandschafer

SECTION (16BR-1,BR-2)B-1 **LOCATION** W 1/2, **SEC.** 30, **TWP.** 4 N, **RNG.** 11 W, 3 **PM**

COUNTY Lawrence **DRILLING METHOD** Hollow stem auger & split spoon **HAMMER TYPE** Auto 140#

STRUCT. NO. 051-0075
Station 62+80

BORING NO. 2
Station 55+37
Offset 24.0ft Rt (East)
Ground Surface Elev. 416.79 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
▽ **First Encounter** 402.3 ft
▽ **Upon Completion** Washed ft
▽ **After** 24 **Hrs.** 407.3 ft

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Description
				Riprap and broken concrete on CLAY.
				No samples.
412.29				
-5	5			Hard, damp, brown mottled gray, CLAY.
	5	4.5	19	
	5	PP		
409.79				
	5			Medium, damp, brown, CLAY w/ Silt.
	4	0.74	25	
	6	B		
▽				
-10	3			
	3	0.74	25	
	4	B		
404.79				
	3			Medium, damp, brown marbled gray, SILTY LOAM.
	2	0.54	24	
	4	B		
▽				
401.79 -15	3			
	3		26	Loose, wet, gray, fine grained, SAND. *8% passing #200 sieve.*
	4			
	0			
	1		28	*3% passing #200 sieve.*
	5			
396.79 -20	5			
				No recovery on this trip, estimated SAND.
	12			
	16			
	2			Loose, wet, gray fine grained,
	4		22	SAND w/ 1/2" Sandy Loam
	6			partings. *7% passing #200 sieve.*
-25	3			
	3		21	*9% passing #200 sieve.*
	4			
389.79				
	2			Gray, SANDY LOAM.
388.79				
	3	1.11	25	Stiff, damp, gray, CLAY.
	4	B		
387.29				
-30	8			Wet, gray, fine grained, SAND. *4% passing #200 sieve.*
386.29	6	1.07	29	
	4	B		Stiff, damp, gray, CLAY.
382.29				
-35	4			Stiff, damp, gray, SILTY CLAY.
	4	1.24	26	
	5	B		
-40	5			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
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Latitude W 87 deg 41 min 01.952 sec Longitude N 38 deg 44 min 39.586 sec Datum Job Number

Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 9/11/17

ROUTE FAP 332 (IL 1) **DESCRIPTION** Embarras River Overflow **LOGGED BY** E. Sandschafer

SECTION (16BR-1,BR-2)B-1 **LOCATION** W 1/2, **SEC.** 30, **TWP.** 4 N, **RNG.** 11 W, 3 **PM**

COUNTY Lawrence **DRILLING METHOD** Hollow stem auger & split spoon **HAMMER TYPE** Auto 140#

STRUCT. NO. 051-0075
Station 62+80

BORING NO. 2
Station 55+37
Offset 24.0ft Rt (East)
Ground Surface Elev. 416.79 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
▽ **First Encounter** 402.3 ft
▽ **Upon Completion** Washed ft
▼ **After** 24 **Hrs.** 407.3 ft

	DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)
Stiff, damp, gray, SILTY CLAY. *(continued)*		5 7	1.73 B	27
	371.79 -45	2		
Very soft, damp, gray, SILTY LOAM.		2 3	0.12 B	28
	367.29 -50	12		
Medium, wet, gray, fine grained, SAND. *4% passing #200 sieve.*		12 14		20
	-55			
	356.79 -60	8		
Dense, wet, gray, fine grained, SAND. *5% passing #200 sieve.*		16 19		19
	-65			
	347.29 -70	5		
Very stiff, damp, gray, LOAM.		6 9	2.27 B	26
	-75			
	337.29 -80	7		
Stiff, damp, gray, SILTY CLAY.				

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
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Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 9/11/17

ROUTE FAP 332 (IL 1) DESCRIPTION Embarras River Overflow LOGGED BY E. Sandschafer

SECTION (16BR-1,BR-2)B-1 LOCATION W 1/2, SEC. 30, TWP. 4 N, RNG. 11 W, 3 PM

COUNTY Lawrence DRILLING METHOD Hollow stem auger & split spoon HAMMER TYPE Auto 140#

STRUCT. NO. 051-0075
Station 62+80

BORING NO. 2
Station 55+37
Offset 24.0ft Rt (East)
Ground Surface Elev. 416.79 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
▽ First Encounter 402.3 ft
▽ Upon Completion Washed ft
▽ After 24 Hrs. 407.3 ft

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Description
	8	1.81	22	Stiff, damp, gray, SILTY CLAY. *(continued)*
	9	B		
-85				
327.29				
-90	15			Medium, damp, gray, SANDY LOAM.
	15	0.65	19	
	17	B		
-95				
317.29				
-100	50/3"		11	
	50/2"			Very dense, very damp, gray, fine grained, SAND w/ small Gravel and Sandstone fragments. *(continued)*
	50/1"			
312.29				
312.19				Hard, moist, gray, SANDSTONE.
-105	50/1"		13	
311.79	50/0"			Borehole continued with rock coring.
	50/0"			
-110				
-115				
-120				

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
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Division of Highways
IDOT

ROCK CORE LOG

Date 9/11/17

ROUTE FAP 332 (IL 1) **DESCRIPTION** Embarras River Overflow **LOGGED BY** E. Sandschafer

SECTION (16BR-1,BR-2)B-1 **LOCATION** W 1/2, SEC. 30, TWP. 4 N, RNG. 11 W, 3 PM

COUNTY Lawrence **CORING METHOD** Rotary, surf set diamond bit

STRUCT. NO. 051-0075
Station 62+80

BORING NO. 2
Station 55+37
Offset 24.0ft Rt (East)
Ground Surface Elev. 416.79 ft

CORING BARREL TYPE & SIZE NW, conv dbl bbl, split inner
Core Diameter 2.06 in
Top of Rock Elev. 312.29 ft
Begin Core Elev. 311.79 ft

	DEPTH (ft)	CORE (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
Soft, gray, SANDSTONE, scratches easily. *Rock core B2C1 from 105.0' to 105.5' depth = 229.4 tsf*	311.79	B2C1	87	23	1.7	
	306.79 -110					
Soft, gray, SANDSTONE, scratches easily. *No recovery from 111.7' to 115.0' depth.*		B2C2	34	0	2.2	
	301.79 -115					
Extent of exploration. Benchmarks: BM 5 Chiseled square on hubguard on SE corner of existing structure Sta 54+73 Rt 15.4' = 431.29' BM 7 Chiseled square on hubguard on NE corner of existing structure Sta 63+18 Rt 15.9' = 431.55'	-120					
	-125					

Color pictures of the cores Available on request
Cores will be stored for examination until 09/11/22
The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D-2938)
RQD is the ratio of the total length of sound core specimens >4" to total length of core run

BBS, form 138 (Rev. 8-99)

ROCK CORE 051-0075 SOIL ROCK 2017.GPJ D6TEMPLT.GDT 10/16/17

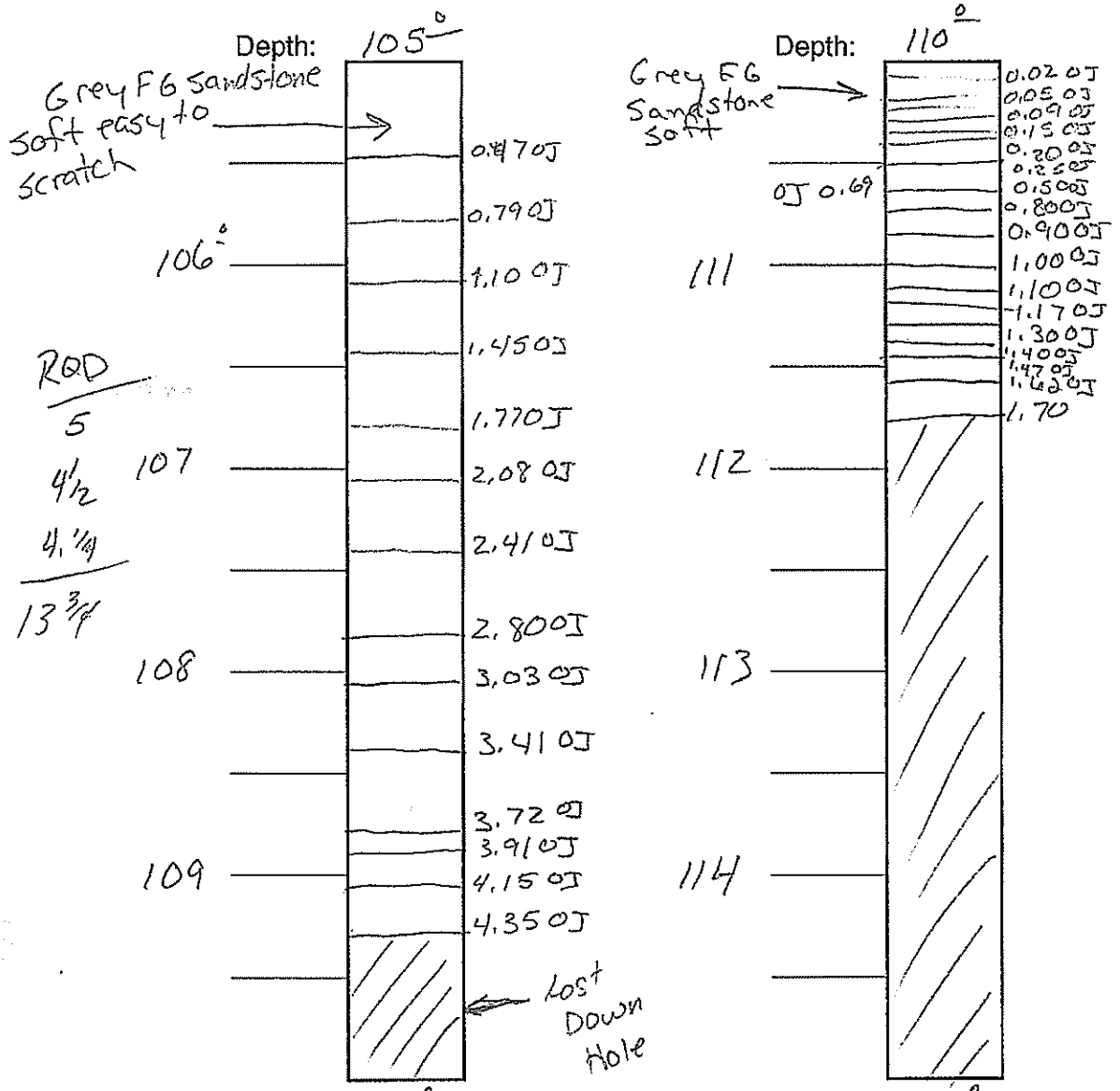
Field Rock Core Log

Date: 9-11-17

Structure # : 051-0005 (0075) Boring # : B2

Rock Core # : C1

Rock Core # : C2



Core Time: 8:37

Recovery: 87.4

RQD: 23%

Core Time: 10:50

Recovery: 34%

RQD: 0%

Logged By: Eric Sandschafer

Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 9/14/17

ROUTE FAP 332 (IL 1) DESCRIPTION Embarras River Overflow LOGGED BY E. Sandschafer

SECTION (16BR-1,BR-2)B-1 LOCATION W 1/2, SEC. 30, TWP. 4 N, RNG. 11 W, 3 PM

COUNTY Lawrence DRILLING METHOD Hollow stem auger & split spoon HAMMER TYPE Auto 140#

STRUCT. NO. 051-0075
Station 62+80

BORING NO. 3
Station 56+10
Offset 24.5ft Lt (West)
Ground Surface Elev. 416.31 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
▽ First Encounter 395.5 ft
▽ Upon Completion Washed ft
▼ After 24 Hrs. 404.3 ft

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Description
				Riprap and broken concrete on CLAY.
				No samples.
411.81				
-5	5			Stiff, damp, brown, CLAY.
	5	1.90	23	
	5	B		
	4			
	5	2.47	23	
	6	B		
406.31 -10	3			
	3	0.16	26	Very soft, very damp, brown, SILTY LOAM.
	3	B		
▼404.31				
	2			Medium, damp, brown mottled gray, SILTY CLAY.
	2	0.82	25	
	3	B		
401.81				
-15	2			Very stiff, damp, brown marbled gray, CLAY.
	3	2.27	32	
	4	B		
399.31				
	1			Soft, very damp, gray, SILT.
	1	0.29	38	
	1	B		
-20	6			

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Description
	11	0.16	35	Soft, very damp, gray, SILT.
	12	B		*(continued)* ▽ 395.51
				Loose to medium, wet, gray, fine grained, SAND.
	7			
	5		22	*6% passing #200 sieve.*
	5			
-25	10			
	15		22	
	19			
	3			
	4		21	*9% passing #200 sieve.*
	5			
386.81				
-30	3			Stiff, damp, gray, SILTY CLAY.
	4	1.65	29	
	5	B		
-35	4			
	5	1.65	27	
	6	B		
376.31 -40	4			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
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Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 9/14/17

ROUTE FAP 332 (IL 1) DESCRIPTION Embarras River Overflow LOGGED BY E. Sandschafer

SECTION (16BR-1,BR-2)B-1 LOCATION W 1/2, SEC. 30, TWP. 4 N, RNG. 11 W, 3 PM

COUNTY Lawrence DRILLING METHOD Hollow stem auger & split spoon HAMMER TYPE Auto 140#

STRUCT. NO. 051-0075
Station 62+80

BORING NO. 3
Station 56+10
Offset 24.5ft Lt (West)
Ground Surface Elev. 416.31 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
▽ First Encounter 395.5 ft
▼ Upon Completion Washed ft
▼ After 24 Hrs. 404.3 ft

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Description
	6	1.65	26	Stiff, damp, gray, SILTY CLAY.
	6	B		
-45	2			
	3	1.24	25	
	4	B		
366.61				
-50	7			Medium, wet, gray, fine grained, SAND. *6% passing #200 sieve.*
	9		21	
	14			
-55				
356.31				
-60	21			

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Description
	24		12	Dense, wet, gray, fine grained, SAND w/ Sandstone fragments. *8% passing #200 sieve.*
	25			
-65				
346.81				
-70	8			Soft to medium, damp, gray, CLAY LOAM.
	8	0.5	22	
	9	PP		
-75				
336.81				
-80	6			Very stiff, damp, gray, LOAM.

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
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SOIL BORING LOG

Date 9/14/17

ROUTE FAP 332 (IL 1) DESCRIPTION Embarras River Overflow LOGGED BY E. Sandschafer

SECTION (16BR-1,BR-2)B-1 LOCATION W 1/2, SEC. 30, TWP. 4 N, RNG. 11 W, 3 PM

COUNTY Lawrence DRILLING METHOD Hollow stem auger & split spoon HAMMER TYPE Auto 140#

STRUCT. NO. 051-0075
Station 62+80

BORING NO. 3
Station 56+10
Offset 24.5ft Lt (West)
Ground Surface Elev. 416.31 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
▽ First Encounter 395.5 ft
▽ Upon Completion Washed ft
▼ After 24 Hrs. 404.3 ft

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Description
	6	2.47	21	Very stiff, damp, gray, LOAM. *(continued)*
	10	B		
-85				
-90	20			
326.01				
	25	0.62	21	Gray, wet, fine grained, SAND. *11% passing #200 sieve.*
	21	B		
-95				
316.81				
-100	14			
	30	0.23	22	Very soft, wet, gray, SANDY LOAM. *(continued)*
	18	S		
313.31				
				Very dense, moist, gray, SANDSTONE.
311.71				
-105	*		11	Extent of exploration.
-110				
-115				
-120				

* 50/1", 50/0", 50/0"

Benchmarks:
BM 5 Chiseled square on hubguard on SE corner of existing structure Sta 54+73 Rt 15.4' = 431.29'
BM 7 Chiseled square on hubguard on NE corner of existing structure Sta 63+18 Rt 15.9' = 431.55'

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
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SOIL BORING LOG

Date 9/5/17

ROUTE FAP 332 (IL 1) **DESCRIPTION** Embarras River Overflow **LOGGED BY** E. Sandschafer

SECTION (16BR-1,BR-2)B-1 **LOCATION** W 1/2, **SEC.** 30, **TWP.** 4 N, **RNG.** 11 W, 3 PM

COUNTY Lawrence **DRILLING METHOD** Hollow stem auger & split spoon **HAMMER TYPE** Auto 140#

STRUCT. NO. 051-0075
Station 62+80

BORING NO. 4
Station 56+94
Offset 23.0ft Rt (East)
Ground Surface Elev. 416.18 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
▽ **First Encounter** 396.7 ft
▽ **Upon Completion** Washed ft
▼ **After** 216 **Hrs.** 407.2 ft

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Description
				Riprap and broken concrete on CLAY.
				No samples.
411.68				
-5	7			Hard, damp, brown, CLAY.
	8	4.5	18	
	10	PP		
	4			
	5	1.98	25	
	6	B		
-10	3			▼
	4	2.06	28	
	5	B		
404.18				
	3			Stiff, damp, gray mottled brown, SILTY CLAY.
	4	1.32	26	
	4	B		
401.68				
-15	2			Very soft, damp, gray, SILT.
	2	0.21	31	
	2	B		
	1			
	1	0.21	31	LL = 26.3
	1	B		PL = 16.3
				PI = 10.0
▽ 396.68				
-20	2			
				Medium to loose, wet, gray, fine grained, SAND. *7% passing #200 sieve.*
	9		22	
	12			
	2			
				6% passing #200 sieve.
	4		20	
	6			
-25	5			
				12% passing #200 sieve.
	4		21	
	7			
	6			
				7% passing #200 sieve. *(continued)*
	8		14	
	7			
386.68				
-30	3			Very soft, damp, gray, fine grained, SANDY LOAM.
	4	0.09	18	
	7	S		
381.68				
-35	4			Very stiff, damp, brown to gray, SILTY CLAY.
	5	2.27	25	
	7	B		
-40	3			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
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Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 9/5/17

ROUTE FAP 332 (IL 1) DESCRIPTION Embarras River Overflow LOGGED BY E. Sandschafer

SECTION (16BR-1,BR-2)B-1 LOCATION W 1/2, SEC. 30, TWP. 4 N, RNG. 11 W, 3 PM

COUNTY Lawrence DRILLING METHOD Hollow stem auger & split spoon HAMMER TYPE Auto 140#

STRUCT. NO. 051-0075
Station 62+80

BORING NO. 4
Station 56+94
Offset 23.0ft Rt (East)
Ground Surface Elev. 416.18 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
▽ First Encounter 396.7 ft
▽ Upon Completion Washed ft
▼ After 216 Hrs. 407.2 ft

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Description
	3 5	2.27 B	25	Very stiff, damp, brown to gray, SILTY CLAY. *(continued)*
371.68				
-45	1 2 4	0.25 B	27	Very soft, damp, gray, SILTY LOAM. LL = 27.3 PL = 22.4 PI = 4.9
366.68				
-50	9 13 12		23	Medium, wet, gray, fine grained, SAND. *4% passing #200 sieve.*
-55				
356.18				
-60	17			
-65	21 16		17	Medium, wet, gray, fine grained, SAND. *5% passing #200 sieve.*
346.68				
-70	6 7 9	1.90 B	20	Stiff, damp, gray, SILTY CLAY.
-75				
336.68				
-80	6			Stiff, damp, gray, SANDY LOAM.

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
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)

File Name S:\NEW GEOTECHNICAL\GINTDATA\PROJECTS\LAWRENCE CO (051)\051-0075 SOIL ROCK 2017.GPJ Data Template D6TEMPLT.GDT Date Printed 10/16/17
Latitude W 87 deg 41 min 02.163 sec Longitude N 38 deg 40 min 40.860 sec Datum Job Number

Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 9/5/17

ROUTE FAP 332 (IL 1) DESCRIPTION Embarras River Overflow LOGGED BY E. Sandschafer

SECTION (16BR-1,BR-2)B-1 LOCATION W 1/2, SEC. 30, TWP. 4 N, RNG. 11 W, 3 PM

COUNTY Lawrence DRILLING METHOD Hollow stem auger & split spoon HAMMER TYPE Auto 140#

STRUCT. NO. 051-0075
Station 62+80

BORING NO. 4
Station 56+94
Offset 23.0ft Rt (East)
Ground Surface Elev. 416.18 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
▽ First Encounter 396.7 ft
▽ Upon Completion Washed ft
▽ After 216 Hrs. 407.2 ft

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Description
	8	1.11	22	Stiff, damp, gray, SANDY LOAM. *(continued)*
	10	B		
-85				
326.68				
-90	35			Very dense, wet, dark gray, fine grained, SAND. *5% passing #200 sieve.*
	28		17	
	36			
-95				
316.18 -100	18			

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Description
	31		15	Very dense, wet, dark gray, fine grained, SAND. *8% passing #200 sieve.*
	32			
313.18				
				Very dense, moist, gray, estimated SANDSTONE. *Low recovery, chips/pieces of Sandstone.*
311.48 -105	50/1"			Extent of exploration.
	50/1"			
	50/0"			
-110				Benchmarks: BM 5 Chiseled square on hubguard on SE corner of existing structure Sta 54+73 Rt 15.4' = 431.29' BM 7 Chiseled square on hubguard on NE corner of existing structure Sta 63+18 Rt 15.9' = 431.55'
-115				
-120				

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
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Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 9/7/17

ROUTE FAP 332 (IL 1) DESCRIPTION Embarras River Overflow LOGGED BY E. Sandschafer

SECTION (16BR-1,BR-2)B-1 LOCATION W 1/2, SEC. 30, TWP. 4 N, RNG. 11 W, 3 PM

COUNTY Lawrence DRILLING METHOD Hollow stem auger & split spoon HAMMER TYPE Auto 140#

STRUCT. NO. 051-0075
Station 62+80

BORING NO. 5
Station 57+75
Offset 25.0ft Lt (West)
Ground Surface Elev. 415.27 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
▽ First Encounter 400.8 ft
▽ Upon Completion Washed ft
▼ After 24 Hrs. 400.8 ft

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Description
				Riprap and broken concrete on CLAY.
				No samples.
410.77				
-5	5			Hard, damp, gray mottled brown, CLAY.
	6	+4.5	19	
	7	PP		
	4			
	4	1.90	24	
	5	B		
-10	4			
	4	1.90	22	
	6	B		
	1			
402.27				
	2	0.12	23	Very soft, very damp, gray, SILTY LOAM.
	3	B		
▽ ▼ 400.77				
-15	8			Medium, wet, gray, fine grained, SAND. *5% passing #200 sieve.*
	7		20	
	6			
	6			
	9		21	*6% passing #200 sieve.*
	10			
395.27				
-20	6			
	5		23	Loose, wet, gray, fine grained, SAND. *5% passing #200 sieve.*
	5			
393.27				
	1			Very soft, very damp, gray, SANDY LOAM.
	2	0.21	21	
	2	B		
-25	3			
	4	0.12	21	
	5	BS		
388.27				
	3			Medium, wet, gray, fine grained, SAND. *9% passing #200 sieve.*
	6		19	
	8			
-30	5			
	5		19	
	4			
384.47				
				Stiff, damp, gray, CLAY w/ Silt.
-35	5			
	6	2.06	27	
	7	B		
-40	4			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
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Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 9/7/17

ROUTE FAP 332 (IL 1) DESCRIPTION Embarras River Overflow LOGGED BY E. Sandschafer

SECTION (16BR-1,BR-2)B-1 LOCATION W 1/2, SEC. 30, TWP. 4 N, RNG. 11 W, 3 PM

COUNTY Lawrence DRILLING METHOD Hollow stem auger & split spoon HAMMER TYPE Auto 140#

STRUCT. NO. 051-0075
Station 62+80

BORING NO. 5
Station 57+75
Offset 25.0ft Lt (West)
Ground Surface Elev. 415.27 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
▽ First Encounter 400.8 ft
▽ Upon Completion Washed ft
▽ After 24 Hrs. 400.8 ft

	DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)
Stiff, damp, gray, CLAY w/ Silt. *(continued)*		5 6	1.81 B	29
370.77				
Soft, damp, gray, LOAM.	-45	2 2 3	0.33 B	27
365.77				
Medium, wet, gray, fine grained, SAND. *4% passing #200 sieve.*	-50	7 7 7		21
364.47				
Gray, CLAY w/ Silt.	-55			
355.77				
	-60	19		
Very dense, wet, gray, fine grained, SAND. *5% passing #200 sieve.* *(continued)*		25 26		18
345.77				
Medium, damp, gray, LOAM.	-65			
	-70	7 8 9	0.82 B	23
335.77				
	-75			
	-80	10		

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
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Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 9/7/17

ROUTE FAP 332 (IL 1) DESCRIPTION Embarras River Overflow LOGGED BY E. Sandschafer

SECTION (16BR-1,BR-2)B-1 LOCATION W 1/2, SEC. 30, TWP. 4 N, RNG. 11 W, 3 PM

COUNTY Lawrence DRILLING METHOD Hollow stem auger & split spoon HAMMER TYPE Auto 140#

STRUCT. NO. 051-0075
Station 62+80

BORING NO. 5
Station 57+75
Offset 25.0ft Lt (West)
Ground Surface Elev. 415.27 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
▽ First Encounter 400.8 ft
▽ Upon Completion Washed ft
▼ After 24 Hrs. 400.8 ft

	DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)
Medium, damp, gray, SILTY LOAM w/ fine grained, Sand. *(continued)*		11 17	0.62 B	21
	-85			
	325.77			
Very dense, wet, brown, fine grained, SAND. *10% passing #200 sieve.*	-90			15
	-95			
	-100	50/1"		13
Very dense, wet, brown, fine grained, SAND. *10% passing #200 sieve. (continued)*		50/1" 50/1"		
	313.27			
Hard, moist, gray, SANDSTONE.				
	310.67			
	310.27 -105	50/1"		12
Borehole continued with rock coring.		50/0" 50/0"		
	-110			
	-115			
	-120			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
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Illinois Department of Transportation
Division of Highways
IDOT

ROCK CORE LOG

Date 9/7/17

ROUTE FAP 332 (IL 1) **DESCRIPTION** Embarras River Overflow **LOGGED BY** E. Sandschafer

SECTION (16BR-1,BR-2)B-1 **LOCATION** W 1/2, **SEC.** 30, **TWP.** 4 N, **RNG.** 11 W, 3 **PM**

COUNTY Lawrence **CORING METHOD** Rotary, surf set diamond bit

STRUCT. NO. 051-0075
Station 62+80

BORING NO. 5
Station 57+75
Offset 25.0ft Lt (West)
Ground Surface Elev. 415.27 ft

CORING BARREL TYPE & SIZE NW, conv dbl bbl, split inner
Core Diameter 2.06 in
Top of Rock Elev. 313.27 ft
Begin Core Elev. 310.27 ft

	DEPTH (ft)	CORE (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
Soft, gray, SANDSTONE, scratches easily. 310.27		B5C1	59	18	1.1	
Rock core B5C1 from 107.11' to 107.60' depth = 277.6 tsf.						
No recovery from 107.95' to 110.00' depth.						
305.27	-110					
Soft, gray, SANDSTONE, scratches easily.		B5C2	55	8	1.1	
Rock core B5C2 from 111.65' to 112.05' depth = 244.9tsf.						
No recovery from 112.75' to 115.00' depth.						
300.27	-115					
Extent of exploration.						
Benchmarks: BM 5 Chiseled square on hubguard on SE corner of existing structure Sta 54+73 Rt 15.4' = 431.29' BM 7 Chiseled square on hubguard on NE corner of existing structure Sta 63+18 Rt 15.9' = 431.55'						
	-120					
	-125					

Color pictures of the cores Available on request
Cores will be stored for examination until 09/07/22
The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D-2938)
RQD is the ratio of the total length of sound core specimens >4" to total length of core run

BBS, form 138 (Rev. 8-99)

ROCK CORE 051-0075 SOIL ROCK 2017.GPJ D6TEMPLT.GDT 10/16/17

Field Rock Core Log

Date: 9-7-17

Structure # : 051-0005(007S) Boring # : B 5

Rock Core # : C 1

Depth: 105'

Grey FG SANDSTONE
Soft v easy - 0 scratch

0.250J
0.530J
0.81 0J
106
1.00 0J
1.340J
1.67 0J
107
2.110J
B5C1
2.60 0J
severe weathering
2.75 0J
2.84 0J
2.95 0J
108
LOST DOWN Hole?
109

RQD
5.125
5.875
11.0
÷
60
0.183

Depth: 110.2'
Core Time: 5:42
Recovery: 59.1%
RQD: 18.3%

Rock Core # : C2

Depth: 110'

Grey FG SANDSTONE
Soft

High Weathering
0.20 0J
0.36 0J
0.45 0J
0.65 0J
0.85 0J
0.95 0J
111
1.27 0J
1.55 0J
1.65 0J
CORE TO Test
B5C2
112
2.05 0J
2.21 0J
2.31 0J
2.62 0J
2.75
113
LOST DOWN HOLE
114

RQD
4.75
÷
60
0.0791

Note:
14' of sand in augers. Quit.

Depth: 115'
Core Time: 5:21
Recovery: 58%
RQD: 7.9%

Logged By: Eric Sandschafer

Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 9/1/17

ROUTE FAP 332 (IL 1) DESCRIPTION Embarras River Overflow LOGGED BY E. Sandschafer

SECTION (16BR-1,BR-2)B-1 LOCATION W 1/2, SEC. 30, TWP. 4 N, RNG. 11 W, 3 PM

COUNTY Lawrence DRILLING METHOD Hollow stem auger & split spoon HAMMER TYPE Auto 140#

STRUCT. NO. 051-0075
Station 62+80

BORING NO. 6
Station 58+66
Offset 24.0ft Rt (East)
Ground Surface Elev. 415.87 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
▽ First Encounter 401.4 ft
▽ Upon Completion Washed ft
▼ After 312 Hrs. 406.9 ft

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Description
				Riprap and broken concrete on SILTY CLAY.
				No samples.
411.37				
-5	4			Very stiff, damp, brown mottled gray, SILTY CLAY.
	4	2.68	20	
	4	B		
408.87				
	3			Very soft, damp, gray, SILTY LOAM.
	3	0.40	30	
	4	B		
▼ 406.37				
-10	2			Very soft, very damp, brown, SANDY LOAM.
405.67				
	3	0.04	25	Brown, fine grained, SAND.
	4	B		
403.87				
	2			Very soft, damp, brown, SANDY LOAM.
	2	0.16	24	
	2	B		
▽ 401.37				
-15	3			Medium, wet, brown, fine grained, SAND. *5% passing #200 sieve.*
	5		25	
	7			
	6			
	6		18	*8% passing #200 sieve.*
	8			
395.87				
-20	6			
	6		25	Medium to loose, wet, gray, fine grained, SAND. *4% passing #200 sieve.*
	7			
	1			
	3		19	*12% passing #200 sieve.*
	5			
-25	6			
	5		22	*5% passing #200 sieve.*
	3			
	4			
	4		20	*9% passing #200 sieve.*
	5			
-30	2			
	3		18	*11% passing #200 sieve.*
	5			
381.37				
-35	4			Stiff, damp, brownish gray, SILTY CLAY.
	5	1.65	27	
	7	B		
375.87				
-40	6			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
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Latitude W 87 deg 41 min 02.649 sec Longitude N 38 deg 44 min 43.075 sec Datum Job Number

Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 9/1/17

ROUTE FAP 332 (IL 1) DESCRIPTION Embarras River Overflow LOGGED BY E. Sandschafer

SECTION (16BR-1,BR-2)B-1 LOCATION W 1/2, SEC. 30, TWP. 4 N, RNG. 11 W, 3 PM

COUNTY Lawrence DRILLING METHOD Hollow stem auger & split spoon HAMMER TYPE Auto 140#

STRUCT. NO. 051-0075
Station 62+80

BORING NO. 6
Station 58+66
Offset 24.0ft Rt (East)
Ground Surface Elev. 415.87 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
▽ First Encounter 401.4 ft
▽ Upon Completion Washed ft
▼ After 312 Hrs. 406.9 ft

	DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)
Gray, SANDY LOAM. 375.37		6	1.40	28
Stiff, damp, gray, SILTY CLAY.		3	B	
370.87	-45	1		
Gray, SILT. 370.37		3	1.07	30
Gray, SILTY CLAY.		3	B	
365.87	-50	6		
Medium, wet, gray, fine grained, SAND. *5% passing #200 sieve.*		6		26
		5		
	-55			
355.87	-60	8		
Medium, wet, gray, fine grained, SAND. *3% passing #200 sieve.*		13		20
		15		
	-65			
346.37				
Stiff, damp, gray, LOAM.	-70	6		
		7	1.90	23
		9	B	
	-75			
336.37				
	-80	7		

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
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Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 9/1/17

ROUTE FAP 332 (IL 1) DESCRIPTION Embarras River Overflow LOGGED BY E. Sandschafer

SECTION (16BR-1,BR-2)B-1 LOCATION W 1/2, SEC. 30, TWP. 4 N, RNG. 11 W, 3 PM

COUNTY Lawrence DRILLING METHOD Hollow stem auger & split spoon HAMMER TYPE Auto 140#

STRUCT. NO. 051-0075
Station 62+80

BORING NO. 6
Station 58+66
Offset 24.0ft Rt (East)
Ground Surface Elev. 415.87 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
▽ First Encounter 401.4 ft
▽ Upon Completion Washed ft
▽ After 312 Hrs. 406.9 ft

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Description
	9 11	2.47 B	24	Very stiff, damp, gray, SILTY LOAM w/ very fine Sand. Artesian condition. *(continued)*
-85				
326.37				
-90	50/3"			Very dense, wet, gray, fine grained, SAND. *8% passing #200 sieve.*
	50/3" 50/4"		19	
				Hard drilling at 94' depth.
-95				
315.87 -100	50/4"			
	50/5" 48		15	Very dense, wet, gray, fine grained, SAND. *10% passing #200 sieve.*
311.37				
311.27 -105	50/1" 50/0" 50/0"		14	Very dense, moist, gray, SANDSTONE. Low recovery, chips/pieces of Sandstone.
				Extent of exploration.
				Benchmarks: BM 5 Chiseled square on hubguard on SE corner of existing structure Sta 54+73 Rt 15.4' = 431.29' BM 7 Chiseled square on hubguard on NE corner of existing structure Sta 63+18 Rt 15.9' = 431.55'
-110				
-115				
-120				

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
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Division of Highways
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SOIL BORING LOG

Date 9/6/17

ROUTE FAP 332 (IL 1) **DESCRIPTION** Embarras River Overflow **LOGGED BY** E. Sandschafer

SECTION (16BR-1,BR-2)B-1 **LOCATION** W 1/2, **SEC.** 30, **TWP.** 4 N, **RNG.** 11 W, 3 **PM**

COUNTY Lawrence **DRILLING METHOD** Hollow stem auger & split spoon **HAMMER TYPE** Auto 140#

STRUCT. NO. 051-0075
Station 62+80

BORING NO. 7
Station 59+52
Offset 30.0ft Lt (West)
Ground Surface Elev. 416.53 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
▽ **First Encounter** 404.5 ft
▽ **Upon Completion** Washed ft
▽ **After** 192 **Hrs.** 407.0 ft

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)
Riprap and broken concrete on CLAY.				*Low recovery this trip, large piece of wood in sampler.*	1 2		
No samples.				Loose to medium, wet, gray, fine grained, SAND. *6% passing #200 sieve.*	2 4 6		22
412.03							
Stiff, damp, brown, CLAY. -5	6 5 5	2.0 PP	17	-25	5 7 5		23
5% passing #200 sieve.							
409.53							
Soft, damp, brown, CLAY LOAM.	4 4 4	0.33 B	19	*33% passing #200 sieve.*	4 6 10		13
▽407.03							
Very soft, damp, brown, SANDY LOAM. -10	3 1 1	0.16 B	22	-30	3 3 4		19
7% passing #200 sieve.							
▽ 404.53							
Loose to medium, wet, brown to gray, fine grained, SAND. *7% passing #200 sieve.*	2 3 3		25				
				382.03			
-15	3			Very stiff, damp, gray, CLAY w/ Silt. -35	3		
4% passing #200 sieve.	4 7		24		5 6	2.05 B	25
	6						
4% passing #200 sieve.	8 9		23				
396.53 -20	1			376.53 -40	5		

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
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Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 9/6/17

ROUTE FAP 332 (IL 1) DESCRIPTION Embarras River Overflow LOGGED BY E. Sandschafer

SECTION (16BR-1,BR-2)B-1 LOCATION W 1/2, SEC. 30, TWP. 4 N, RNG. 11 W, 3 PM

COUNTY Lawrence DRILLING METHOD Hollow stem auger & split spoon HAMMER TYPE Auto 140#

STRUCT. NO. 051-0075
Station 62+80

BORING NO. 7
Station 59+52
Offset 30.0ft Lt (West)
Ground Surface Elev. 416.53 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
▽ First Encounter 404.5 ft
▽ Upon Completion Washed ft
▼ After 192 Hrs. 407.0 ft

	DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)
Gray, SANDY LOAM w/ Silt. 376.03		5	1.81	26
		5	B	
Stiff, damp, brownish gray, SILTY CLAY. 372.03				
Soft, damp, gray, SILT to SILTY LOAM	-45	1		
		2	0.41	29
		2	B	
367.03				
Medium to dense, wet, gray, fine grained, SAND. *10% passing #200 sieve.*	-50	9		
		12		27
		13		
	-55			
356.53	-60	13		
Medium to dense, wet, gray, fine grained, SAND. *4% passing #200 sieve.*		18		15
		18		
	-65			
347.03				
Very stiff, damp, gray, LOAM.	-70	7		
		9	2.47	25
		11	B	
	-75			
336.53	-80	6		

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
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)

File Name S:\NEW GEOTECHNICAL\GINTDATA\PROJECTS\LAWRENCE CO (051)\051-0075 SOIL ROCK 2017.GPJ Data Template D6TEMPLT.GDT Date Printed 10/16/17
Latitude W 87 deg 41 min 02.606 sec Longitude N 38 deg 44 min 43.945 sec Datum Job Number

Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 9/6/17

ROUTE FAP 332 (IL 1) **DESCRIPTION** Embarras River Overflow **LOGGED BY** E. Sandschafer

SECTION (16BR-1,BR-2)B-1 **LOCATION** W 1/2, SEC. 30, TWP. 4 N, RNG. 11 W, 3 PM

COUNTY Lawrence **DRILLING METHOD** Hollow stem auger & split spoon **HAMMER TYPE** Auto 140#

STRUCT. NO. 051-0075
Station 62+80

BORING NO. 7
Station 59+52
Offset 30.0ft Lt (West)
Ground Surface Elev. 416.53 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
▽ **First Encounter** 404.5 ft
▽ **Upon Completion** Washed ft
▼ **After** 192 **Hrs.** 407.0 ft

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Description
	8	1.40	24	Stiff, damp, gray, LOAM.
	12	B		
-85				
327.03				
-90	32			Dense, wet, gray, fine grained, SAND. *12% passing #200 sieve.*
	27		16	
	34			
-95				
316.53 -100	15			
	34		15	Dense, wet, gray, fine grained, SAND. *(#11)% passing #200 sieve.*
	37			
313.03				Hard, moist, gray, SANDSTONE.
311.93				
311.53 -105	50/1"		12	Borehole continued with rock coring.
	50/0"			
	50/0"			
-110				
-115				
-120				

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
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Illinois Department of Transportation
Division of Highways
IDOT

ROCK CORE LOG

Date 9/6/17

ROUTE FAP 332 (IL 1) DESCRIPTION Embarras River Overflow LOGGED BY E. Sandschafer

SECTION (16BR-1,BR-2)B-1 LOCATION W 1/2, SEC. 30, TWP. 4 N, RNG. 11 W, 3 PM

COUNTY Lawrence CORING METHOD Rotary, surf set diamond bit

STRUCT. NO. 051-0075
Station 62+80

BORING NO. 7
Station 59+52
Offset 30.0ft Lt (West)
Ground Surface Elev. 416.53 ft

CORING BARREL TYPE & SIZE NW, conv dbl bbl, split inner
Core Diameter 2.06 in
Top of Rock Elev. 313.03 ft
Begin Core Elev. 405.53 ft

	DEPTH (ft)	CORE (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
Gray, fine grained, SANDSTONE w/ thin, black, partings.	311.53	B7C1	74	25	1.7	
Rock core B7C1 from 107.50' to 108.00' depth = 198.4 tsf.						
No recovery from 108.65' to 110.00' depth.	306.53 -110					
Gray, fine grained, SANDSTONE, scratches easily.						
No recovery from 112.60' to 115.00' depth.	301.53 -115					
Extent of exploration.						
Benchmarks: BM 5 Chiseled square on hubguard on SE corner of existing structure Sta 54+73 Rt 15.4' = 431.29' BM 7 Chiseled square on hubguard on NE corner of existing structure Sta 63+18 Rt 15.9' = 431.55'	-120					
	-125					

Color pictures of the cores Available on request
Cores will be stored for examination until 09/06/22
The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D-2938)
RQD is the ratio of the total length of sound core specimens >4" to total length of core run

BBS, form 138 (Rev. 8-99)

ROCK CORE 051-0075 SOIL ROCK 2017.GPJ D8TEMPLT.GDT 10/16/17

Field Rock Core Log

Date: 9-6-17

Structure # : 051-0005(0075) Boring # : B7

Rock Core # : 1

Depth: 105'

Grey FG Sandstone w/some thin blackish partings

RQD 15"

106

107

108

109

110'

0.19 OJ
0.44 OJ
0.55 OJ
0.70 OJ
0.81 OJ
1.08 OJ
1.14 OJ
1.34 OJ
1.53 OJ
1.82 OJ
B7c1
CORE TO TEST
3.08 OJ
3.20 OJ
3.33 OJ
3.49 OJ
3.62 OJ
3.65 OJ

Depth: 110'

Core Time: 8:29

Recovery: 74%

RQD: 25%

Rock Core # : 2

Depth: 110'

Grey FG Sandstone easy to scratch

111

112

113

114

115'

0.09 OJ
0.24 OJ
0.42 OJ
0.53 OJ
0.70 OJ
0.89 OJ
1.10 OJ
1.17 OJ
1.24 OJ
1.32 OJ
1.60 OJ
1.68 OJ
1.87 OJ
1.97 OJ
2.07 OJ
2.15 OJ
2.25 OJ
2.34 OJ
2.43 OJ
2.50 OJ
2.60 OJ

NO RECOVERY

Depth: 115'

Core Time: 8:20

Recovery: 53%

RQD: 0%

Logged By: Eric Sandschafer

Illinois Department of Transportation

Division of Highways
IDOT

SOIL BORING LOG

Date 8/31/17

ROUTE FAP 332 (IL 1) DESCRIPTION Embarras River Overflow LOGGED BY E. Sandschafer

SECTION (16BR-1,BR-2)B-1 LOCATION W 1/2, SEC. 30, TWP. 4 N, RNG. 11 W, 3 PM

COUNTY Lawrence DRILLING METHOD Hollow stem auger & split spoon HAMMER TYPE Auto 140#

STRUCT. NO. 051-0075
Station 62+80

BORING NO. 8
Station 60+38
Offset 27.0ft Rt (East)
Ground Surface Elev. 416.73 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
▽ First Encounter 404.7 ft
▽ Upon Completion Washed ft
▽ After 336 Hrs. 407.2 ft

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Description
				Riprap and broken concrete on SILTY CLAY LOAM.
				No samples.
412.23				
-5	3			Very stiff, damp, brown, SILTY CLAY LOAM.
	4	3.30	19	
	5	S		
409.73				
	5			Very soft, very damp, brown, SANDY LOAM.
	6	0.21	22	
	3	B		
-10	3			
	3	0.08	23	
	4	B		
▽ 404.73				
	1			Loose, wet, brown to gray, fine grained, SAND. *3% passing #200 sieve.*
	1		26	
	2			
-15	2			
	2		25	*5% passing #200 sieve.*
	3			
	2			
	2		19	*6% passing #200 sieve.*
	4			
396.73 -20	4			

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Description
	5		21	Medium to loose, wet, gray, fine grained, SAND. *5% passing #200 sieve.*
	6			
	2			
	3		17	*4% passing #200 sieve.*
	4			
-25	3			
	8		22	*5% passing #200 sieve.*
	11			
	4			
	7		20	*1% passing #200 sieve.*
	10			
-30	5			
	5		21	*2% passing #200 sieve.*
	9			
382.23				
-35	1			Medium, damp, gray, SILTY CLAY.
	2	0.82	30	
	2	B		
376.73 -40	3			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
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Latitude W 87 deg 41 min 01.895 sec Longitude N 38 deg 44 min 44.390 sec Datum Job Number

Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 8/31/17

ROUTE FAP 332 (IL 1) DESCRIPTION Embarras River Overflow LOGGED BY E. Sandschafer

SECTION (16BR-1,BR-2)B-1 LOCATION W 1/2, SEC. 30, TWP. 4 N, RNG. 11 W, 3 PM

COUNTY Lawrence DRILLING METHOD Hollow stem auger & split spoon HAMMER TYPE Auto 140#

STRUCT. NO. 051-0075
Station 62+80

BORING NO. 8
Station 60+38
Offset 27.0ft Rt (East)
Ground Surface Elev. 416.73 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
▽ First Encounter 404.7 ft
▽ Upon Completion Washed ft
▼ After 336 Hrs. 407.2 ft

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Description
	4 6	0.66 B	25	Medium, damp, gray, SILTY CLAY.
371.73 -45	3			
	3 3	0.21 B	31	Very soft, damp, gray, SILTY CLAY LOAM. LL = 27.4 PL = 23.6 PI = 3.8
367.23 -50	9			Very soft, very damp, gray, SANDY LOAM.
	9 10	0.16 B	21	
-55				
357.23 -60	4			
356.03 -65	8 14	0.49 B	27	Medium, damp, gray, SILTY LOAM. *(continued)*
				Gray, fine grained, SAND.
347.23 -70	7			Stiff, damp, gray, SILTY CLAY.
	9 10	1.81 BS	31	
-75				
337.23 -80	6			Stiff, damp, gray, SILTY LOAM.

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
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Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 8/31/17

ROUTE FAP 332 (IL 1) DESCRIPTION Embarras River Overflow LOGGED BY E. Sandschafer

SECTION (16BR-1,BR-2)B-1 LOCATION W 1/2, SEC. 30, TWP. 4 N, RNG. 11 W, 3 PM

COUNTY Lawrence DRILLING METHOD Hollow stem auger & split spoon HAMMER TYPE Auto 140#

STRUCT. NO. 051-0075
Station 62+80

BORING NO. 8
Station 60+38
Offset 27.0ft Rt (East)
Ground Surface Elev. 416.73 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
▽ First Encounter 404.7 ft
▽ Upon Completion Washed ft
▼ After 336 Hrs. 407.2 ft

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Material Description
	9	1.11	24	Stiff, damp, gray, SILTY LOAM. *(continued)*
	17	B		
-85				
327.23				
-90	50			Very dense, wet, gray, fine grained, SAND. *7% passing #200 sieve.*
	50/4"		18	
	42			
-95				
				* Very dense, moist, gray, SANDSTONE. Low recovery, only fragments of Sandstone recovered.
				** 50/0", 50/1", 50/1"
317.23				
~~317.03~~ -100	**		2	*

Extent of exploration.

Benchmarks:
BM 5 Chiseled square on hubguard on SE corner of existing structure Sta 54+73 Rt 15.4' = 431.29'
BM 7 Chiseled square on hubguard on NE corner of existing structure Sta 63+18 Rt 15.9' = 431.55'

-105
-110
-115
-120

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
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Illinois Department of Transportation

Division of Highways
IDOT

SOIL BORING LOG

Date 8/30/17

ROUTE FAP 332 (IL 1) DESCRIPTION Embarras River Overflow LOGGED BY E. Sandschafer

SECTION (16BR-1,BR-2)B-1 LOCATION W 1/2, SEC. 30, TWP. 4 N, RNG. 11 W, 3 PM

COUNTY Lawrence DRILLING METHOD Hollow stem auger & split spoon HAMMER TYPE Auto 140#

STRUCT. NO. 051-0075
Station 62+80

BORING NO. 9
Station 61+15
Offset 26.0ft Lt (West)
Ground Surface Elev. 416.94 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
▽ First Encounter 404.9 ft
▽ Upon Completion Washed ft
▽ After 360 Hrs. 407.4 ft

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Description
				Riprap and broken concrete on CLAY.
				No samples.
412.44				
-5	4			Stiff, damp, brown, CLAY.
	4	1.90	24	
	4	B		
409.94				
	4			Medium to very soft, damp, brown, SANDY LOAM.
	4	0.44	16	
	4	S		
-10	4			
	4	0.04	21	
	3	B		
▽ 404.94				
	4			Loose, wet, brown, fine grained, SAND. *4% passing #200 sieve.*
	4		24	
	4			
-15	2			
	3		26	*5% passing #200 sieve.*
	4			
	6			
	7		22	*4% passing #200 sieve.*
	11			
396.94 -20	7			

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Description
	6		21	Medium, wet, brown, fine grained, SAND. *5% passing #200 sieve.*
	7			
	6			
	9		16	*7% passing #200 sieve.*
	11			
392.44				
-25	6			Very soft, very damp, gray, SILTY LOAM.
	9	0.2	28	
	11	PP		
389.94				
	5			Medium, wet, gray, fine grained, SAND. *2% passing #200 sieve.*
	8		20	
	11			
-30	5			
	7		19	*3% passing #200 sieve.*
	11			
382.44				
-35	0			Medium, damp, gray, SILTY CLAY.
	1	0.87	30	
	1	B		
377.44				
-40	3			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
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Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 8/30/17

ROUTE FAP 332 (IL 1) DESCRIPTION Embarras River Overflow LOGGED BY E. Sandschafer

SECTION (16BR-1,BR-2)B-1 LOCATION W 1/2, SEC. 30, TWP. 4 N, RNG. 11 W, 3 PM

COUNTY Lawrence DRILLING METHOD Hollow stem auger & split spoon HAMMER TYPE Auto 140#

STRUCT. NO. 051-0075
Station 62+80

BORING NO. 9
Station 61+15
Offset 26.0ft Lt (West)
Ground Surface Elev. 416.94 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
▽ First Encounter 404.9 ft
▽ Upon Completion Washed ft
▼ After 360 Hrs. 407.4 ft

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Description
	4 6	0.21 B	36	Very soft, damp, gray, SILT.
				LL = 40.9 PL = 35.8 PI = 5.1 *(continued)*
372.44				
-45	2			Medium, damp, gray, SILTY CLAY.
	2 2	0.82 B	29	
367.44				
-50	6			Soft, very damp, gray, fine, SANDY LOAM.
	8 10	0.21 B	22	
-55				
357.44				
-60	11			
	13 13		19	Medium, wet, gray, fine grained, SAND. *2% passing #200 sieve.* *(continued)*
-65				
347.44				
-70	6			Very stiff, damp, gray, SILTY LOAM.
	8 10	2.89 B	21	
-75				
337.44				
-80	7			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
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Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 8/30/17

ROUTE FAP 332 (IL 1) DESCRIPTION Embarras River Overflow LOGGED BY E. Sandschafer

SECTION (16BR-1,BR-2)B-1 LOCATION W 1/2, SEC. 30, TWP. 4 N, RNG. 11 W, 3 PM

COUNTY Lawrence DRILLING METHOD Hollow stem auger & split spoon HAMMER TYPE Auto 140#

STRUCT. NO. 051-0075
Station 62+80

BORING NO. 9
Station 61+15
Offset 26.0ft Lt (West)
Ground Surface Elev. 416.94 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
▽ First Encounter 404.9 ft
▽ Upon Completion Washed ft
▼ After 360 Hrs. 407.4 ft

	DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)
Very dense, damp, gray, SANDY LOAM w/ Sand. *(continued)*		11 17	2.47 B	23
	-85			
	-90	26 29 37		16
	-95			
319.94 Very dense, moist, gray, SANDSTONE.				
* 50/1", 50/1", 50/0" 317.34				
Extent of exploration.	-100	*		12

Benchmarks:
BM 5 Chiseled square on hubguard on SE corner of existing structure Sta 54+73 Rt 15.4' = 431.29'
BM 7 Chiseled square on hubguard on NE corner of existing structure Sta 63+18 Rt 15.9' = 431.55'

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)
-105			
-110			
-115			
-120			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
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Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 8/29/17

ROUTE FAP 332 (IL 1) **DESCRIPTION** Embarras River Overflow **LOGGED BY** E. Sandschafer

SECTION (16BR-1,BR-2)B-1 **LOCATION** W 1/2, **SEC.** 30, **TWP.** 4 N, **RNG.** 11 W, 3 **PM**

COUNTY Lawrence **DRILLING METHOD** Hollow stem auger & split spoon **HAMMER TYPE** Auto 140#

STRUCT. NO. 051-0075
Station 62+80

BORING NO. 10
Station 62+02
Offset 27.5ft Rt (East)
Ground Surface Elev. 416.98 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
▽ **First Encounter** 405.0 ft
▽ **Upon Completion** Washed ft
▼ **After** 384 **Hrs.** 407.5 ft

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Description
				Riprap and broken concrete on CLAY.
				No samples.
412.48				
-5	4			Medium, damp, brown, CLAY.
	3	0.82	17	
	4	B		
409.98				
	3			Medium, damp, brown, LOAM.
	3	0.62	21	
	3	B		
▼407.48				
-10	2			Very soft, very damp, gray, SANDY LOAM.
	2	0.16	23	
	2	B		
▽ 404.98				
	2			Loose, wet, brown, fine grained, SAND. *7% passing #200 sieve.*
	3		24	
	4			
-15	3			
	3		30	*4% passing #200 sieve.*
	4			
	3			
	4		22	*3% passing #200 sieve.*
	5			
396.98 -20	3			
	6		28	Medium, wet, gray, fine grained, SAND w/ wood pieces. *5% passing #200 sieve.*
	7			
394.98				
	1			Very soft, wet, gray, SANDY LOAM.
	1	0.21	18	
	3	B		
392.48				
-25	4			Medium to loose, wet, gray, SAND.
	6		22	*6% passing #200 sieve.*
	5			
	3			
	4		27	With wood pieces. *2% passing #200 sieve.*
	4			
-30	8			
	9		19	*2% passing #200 sieve.*
	11			
382.48				
-35	1			Soft, damp, gray, SILTY CLAY.
	2	0.41	35	
	3	B		
				LL = 38.3 PL = 32.9 PI = 5.4
377.48				
-40	1			Stiff, damp, gray, SILTY CLAY.

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
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)

File Name S:\NEW GEOTECHNICAL\GINTDATA\PROJECTS\LAWRENCE CO (051)\051-0075 SOIL ROCK 2017.GPJ Data Template D6TEMPLT.GDT Date Printed 10/16/17
Latitude W 87 deg 41 min 02.329 sec Longitude N 38 deg 44 min 46.934 sec Datum Job Number

Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 8/29/17

ROUTE FAP 332 (IL 1) **DESCRIPTION** Embarras River Overflow **LOGGED BY** E. Sandschafer

SECTION (16BR-1,BR-2)B-1 **LOCATION** W 1/2, **SEC.** 30, **TWP.** 4 N, **RNG.** 11 W, 3 **PM**

COUNTY Lawrence **DRILLING METHOD** Hollow stem auger & split spoon **HAMMER TYPE** Auto 140#

STRUCT. NO. 051-0075
Station 62+80

BORING NO. 10
Station 62+02
Offset 27.5ft Rt (East)
Ground Surface Elev. 416.98 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
▽ **First Encounter** 405.0 ft
▽ **Upon Completion** Washed ft
▼ **After** 384 **Hrs.** 407.5 ft

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Description
	2 3	1.32 B	30	Stiff, damp, gray, SILTY CLAY. *(continued)*
372.48				
-45	2 2 3	0.49 B	27	Soft, damp, gray, SILTY LOAM.
367.48				
-50	7 5 6	2.47 B	26	Very stiff, damp, gray, LOAM. *5" Gray, Sandy Loam lense.*
-55				
357.48				
-60	13			

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Description
	19 21		20	Dense, wet, gray, fine grained, SAND. *4% passing #200 sieve.* *(continued)*
-65				
347.48				
-70	4 5 6	2.47 B	25	Very stiff, damp, gray, SILTY CLAY LOAM.
-75				
337.48				
-80	7			Gray, SANDY LOAM.

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
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)

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Division of Highways
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SOIL BORING LOG

Date 8/29/17

ROUTE FAP 332 (IL 1) DESCRIPTION Embarras River Overflow LOGGED BY E. Sandschafer

SECTION (16BR-1,BR-2)B-1 LOCATION W 1/2, SEC. 30, TWP. 4 N, RNG. 11 W, 3 PM

COUNTY Lawrence DRILLING METHOD Hollow stem auger & split spoon HAMMER TYPE Auto 140#

STRUCT. NO. 051-0075
Station 62+80

BORING NO. 10
Station 62+02
Offset 27.5ft Rt (East)
Ground Surface Elev. 416.98 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
▽ First Encounter 405.0 ft
▽ Upon Completion Washed ft
▼ After 384 Hrs. 407.5 ft

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Description
336.78	11	1.11	24	Gray, SANDY CLAY LOAM.
	10	B		
-85				
327.48				
-90	25			Very dense, damp, gray, SANDY LOAM.
	27		21	
	27			
-95	19			
321.48	28		11	
	50/3"			Very dense, moist, gray, SANDSTONE.
* 50/1", 50/1", 50/0" 317.28				
-100	*		13	

Extent of Exploration.

Benchmarks:
BM 5 Chiseled square on hubguard on SE corner of existing structure Sta 54+73 Rt 15.4' = 431.29'
BM 7 Chiseled square on hubguard on NE corner of existing structure Sta 63+18 Rt 15.9' = 431.55'

-105 -110 -115 -120

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
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Division of Highways
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SOIL BORING LOG

Date 8/28/17

ROUTE FAP 332 (IL 1) **DESCRIPTION** Embarras River Overflow **LOGGED BY** E. Sandschafer

SECTION (16BR-1,BR-2)B-1 **LOCATION** W 1/2, SEC. 30, TWP. 4 N, RNG. 11 W, 3 PM

COUNTY Lawrence **DRILLING METHOD** Hollow stem auger & split spoon **HAMMER TYPE** Auto 140#

STRUCT. NO. 051-0075
Station 62+80

BORING NO. 11
Station 62+74
Offset 30.0ft Lt (West)
Ground Surface Elev. 417.07 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
▽ **First Encounter** 406.6 ft
▽ **Upon Completion** Washed ft
▼ **After** 408 **Hrs.** 407.6 ft

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Description
				Riprap and broken concrete on SILTY CLAY.
				No samples.
				412.57
-5	5			Hard, damp, brown, SILTY CLAY.
	6	+4.5	25	
	5	PP		
				410.07
	3			Soft, damp, brown, SANDY LOAM.
	5	0.41	19	
	6	B		
-10	5			▼
	7			*No recovery this trip.* ▽ 406.57
	7			Medium to loose, wet, gray, fine grained, SAND.
	2			
	3	0.33	25	*3% passing #200 sieve.*
	4	B		
-15	4			
	5		22	*4% passing #200 sieve.*
	6			
	7			
	5		22	*3% passing #200 sieve.*
	4			
	3			397.07
-20				

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Description
	6		18	Medium to loose, wet, gray, fine grained, SAND. *6% passing #200 sieve.*
	9			
				395.07
	4			Very soft, very damp, gray, fine grained, SANDY LOAM.
	8	0.22	22	
	11	S		
-25	1			
	2	0.17	24	
	6	S		
	4			
	2	0.22	20	
	5	S		
				387.57
-30	5			Medium, wet, gray, fine grained, SAND. *5% passing #200 sieve.*
	9		18	
	11			
				382.57
-35	3			Soft, damp, gray, SILT.
	3	0.49	33	
	4	B		
				LL = 42.1 PL = 32.9 PI = 9.2
				377.57
-40	2			Stiff, damp, gray, SILTY CLAY.

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
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Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 8/28/17

ROUTE FAP 332 (IL 1) **DESCRIPTION** Embarras River Overflow **LOGGED BY** E. Sandschafer

SECTION (16BR-1,BR-2)B-1 **LOCATION** W 1/2, **SEC.** 30, **TWP.** 4 N, **RNG.** 11 W, 3 **PM**

COUNTY Lawrence **DRILLING METHOD** Hollow stem auger & split spoon **HAMMER TYPE** Auto 140#

STRUCT. NO. 051-0075
Station 62+80

BORING NO. 11
Station 62+74
Offset 30.0ft Lt (West)
Ground Surface Elev. 417.07 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter 406.6 ft
Upon Completion Washed ft
After 408 **Hrs.** 407.6 ft

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Description
	2	1.32	31	Stiff, damp, gray, SILTY CLAY. *(continued)*
	3	B		
372.57				
-45	2			Medium, damp, gray, SILTY LOAM.
	2	0.91	27	
	3	B		
367.57				
-50	5			Medium, damp, gray, SILTY CLAY.
366.57	11	0.62	27	
	19	B		Gray, SILTY CLAY w/ SAND partings.
-55				
357.57				
-60	14			

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Description
	20		18	Dense, wet, gray, fine grained, SAND. *5% passing #200 sieve.* *(continued)*
	22			
-65				
347.57				
-70	7			Stiff, damp, gray, SILTY CLAY.
	8	1.54	28	
	9	S		
-75				
337.57				
-80	6			Very stiff, damp, gray, LOAM

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
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Illinois Department of Transportation
Division of Highways
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SOIL BORING LOG

Date 8/28/17

ROUTE FAP 332 (IL 1) DESCRIPTION Embarras River Overflow LOGGED BY E. Sandschafer

SECTION (16BR-1,BR-2)B-1 LOCATION W 1/2, SEC. 30, TWP. 4 N, RNG. 11 W, 3 PM

COUNTY Lawrence DRILLING METHOD Hollow stem auger & split spoon HAMMER TYPE Auto 140#

STRUCT. NO. 051-0075
Station 62+80

BORING NO. 11
Station 62+74
Offset 30.0ft Lt (West)
Ground Surface Elev. 417.07 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
▽ First Encounter 406.6 ft
▽ Upon Completion Washed ft
▼ After 408 Hrs. 407.6 ft

	DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)
Very stiff, damp, gray, LOAM *(continued)*		8 11	2.68 B	23
	-85			
327.57				
Stiff, damp, gray, SILTY CLAY.	-90	13		
326.77		21 23	1.24 B	25
Gray, SILTY CLAY w/ SANDY LOAM partings.				
	-95			
* Very dense, moist, gray, SANDY CLAY SHALE. ** 50/1", 50/0", 50/0"				
317.57				
* 317.07	-100	**		12

Borehole continued with rock coring.

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
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Illinois Department of Transportation
Division of Highways
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ROCK CORE LOG

Date 8/28/17

ROUTE FAP 332 (IL 1) DESCRIPTION Embarras River Overflow LOGGED BY E. Sandschafer

SECTION (16BR-1,BR-2)B-1 LOCATION W 1/2, SEC. 30, TWP. 4 N, RNG. 11 W, 3 PM

COUNTY Lawrence CORING METHOD Rotary, surf set diamond bit

STRUCT. NO. 051-0075
Station 62+80

CORING BARREL TYPE & SIZE NW, conv dbl bbl, split inner

Core Diameter 2.06 in
Top of Rock Elev. 317.57 ft
Begin Core Elev. 317.07 ft

BORING NO. 11
Station 62+74
Offset 30.0ft Lt (West)
Ground Surface Elev. 417.07 ft

	DEPTH (ft)	CORE (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
Gray, SANDSTONE, easily scratched. *Silty Clay Shale 1" layer.* *Rock Core B11C1 at depth 102.0' to 102.6' = 233.0 tsf Qu.*	317.07	B11C1	93	86	1.4	
	312.07 -105					
Gray, SANDSTONE, easily scratched. *Rock Core B11C2 at depth 108.4' to 109.3' = 240.0 tsf Qu.*		B11C2	92	69	1.1	
	307.07 -110					
Extent of exploration. Benchmarks: BM 5 Chiseled square on hubguard on SE corner of existing structure Sta 54+73 Rt 15.4' = 431.29' BM 7 Chiseled square on hubguard on NE corner of existing structure Sta 63+18 Rt 15.9' = 431.55'	-115					
	-120					

Color pictures of the cores Available on request
Cores will be stored for examination until 08/28/22
The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D-2938)
RQD is the ratio of the total length of sound core specimens >4" to total length of core run

BBS, form 138 (Rev. 8-99)

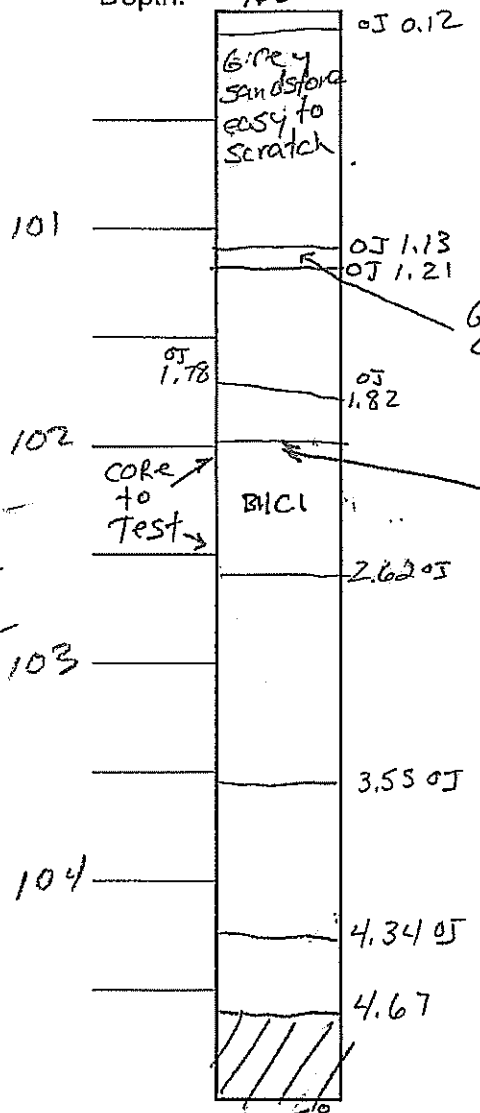
Field Rock Core Log

Date: 8-28-17

Structure # : 051-0005/0075 Boring # : B11

Rock Core # : 1

Depth: 100'



Depth: 105'

Core Time: 6:52

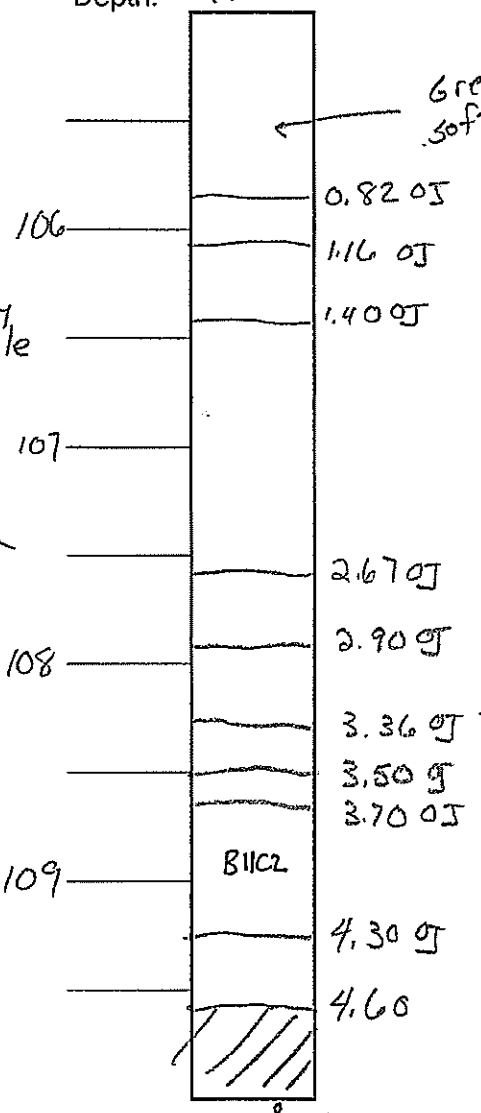
Recovery: 93.4%

RQD: 86.25%

RQD
11.75
6.75
9.75
10.25
9.25
4.00

Rock Core # : 2

Depth: 105'



Depth: 110'

Core Time: 5:29

Recovery: 92%

RQD: 69.2%

RQD
9.75
4.00
15.00
5.50
7.25

Logged By: Eric Sandschafer

Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 9/28/17

ROUTE FAP 332 (IL 1) **DESCRIPTION** Embarras River Overflow **LOGGED BY** E. Sandschafer

SECTION (16BR-1,BR-2)B-1 **LOCATION** W 1/2, SEC. 30, TWP. 4 N, RNG. 11 W, 3 PM

COUNTY Lawrence **DRILLING METHOD** Hollow stem auger & split spoon **HAMMER TYPE** Auto 140#

STRUCT. NO. 051-0075
Station 62+80

BORING NO. 12 (N Abut)
Station 63+40
Offset 8.0ft Rt (East)
Ground Surface Elev. 431.15 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
▽ **First Encounter** 404.2 ft
▽ **Upon Completion** Washed ft
▼ **After** 96 **Hrs.** 407.2 ft

DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)	Description
				3" asphalt on 13" concrete pavement. *18" sleeper slab directly beneath concrete pavement.*
428.35				
				Estimated, CLAY, embankment.
426.65				No samples.
-5	3			Very stiff, damp, gray, CLAY, embankment.
	4	2.89	20	
	5	B		
424.15				
	3			Very stiff, damp, gray, SANDY CLAY LOAM, embankment.
	5	2.84	19	
	7	S		
421.65				
-10	5			Very stiff, damp, gray, SILTY CLAY LOAM, embankment.
	7	3.09	18	
	10	BS		
419.15				
	4			Stiff, damp, gray, LOAM, embankment. Broken concrete pieces and strong creosote odor in samples.
	6	2.47	17	
	10	B		
-15	6			
	8	1.5	19	
	7	PP		
414.15				
	3			Very stiff, damp, gray, CLAY, embankment.
	3	2.2	26	
	3	PP		
411.65				
-20	3			
409.15				
	4	1.2	22	Stiff, damp, brown, CLAY LOAM. *Low recovery, piece of concrete in sampler shoe. (continued)*
	5	PP		
	2			Medium, damp, brown marlbed gray, SILTY CLAY LOAM.
	3	0.74	21	
	3	B		
▼ 406.65				
-25	2			Very soft, wet, brown, SILTY LOAM.
	2	0.1	22	
	3	PP		
▽ 404.15				
	3			Medium, wet, brown fine grained, SAND. *5% passing #200 sieve.*
	5		23	
	8			
-30	5			
	7		24	*4% passing #200 sieve.*
	9			
-35	7			
	15			*No recovery on this trip.*
	17			
391.15 -40	3			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
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Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 9/28/17

ROUTE FAP 332 (IL 1) DESCRIPTION Embarras River Overflow LOGGED BY E. Sandschafer

SECTION (16BR-1,BR-2)B-1 LOCATION W 1/2, SEC. 30, TWP. 4 N, RNG. 11 W, 3 PM

COUNTY Lawrence DRILLING METHOD Hollow stem auger & split spoon HAMMER TYPE Auto 140#

STRUCT. NO. 051-0075
Station 62+80

BORING NO. 12 (N Abut)
Station 63+40
Offset 8.0ft Rt (East)
Ground Surface Elev. 431.15 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
▽ First Encounter 404.2 ft
▽ Upon Completion Washed ft
▼ After 96 Hrs. 407.2 ft

	DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)
Medium, wet, brown, fine grained, SAND. *9% passing #200 sieve.*		5 6		20
2% passing #200 sieve. 386.15	-45	7		
Stiff, damp, gray, CLAY w/ Silt.		5 4	1.65 B	31
381.65				
Very soft, very damp, gray, SILT.	-50	1		
		2 2	0.16 B	37
	-55			
371.65				
Soft, damp, gray, LOAM.	-60	3		
Soft, damp, gray, LOAM. 370.65 *(continued)*		7 8	0.41 B	25
Gray, SANDY LOAM.				
	-65			
361.65				
Dense, wet, gray, fine grained, SAND. *7% passing #200 sieve.*	-70	9		
		15 16		22
	-75			
351.65				
Very stiff, damp, gray, CLAY.	-80	5		

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
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SECTION (16BR-1,BR-2)B-1 LOCATION W 1/2, SEC. 30, TWP. 4 N, RNG. 11 W, 3 PM

COUNTY Lawrence DRILLING METHOD Hollow stem auger & split spoon HAMMER TYPE Auto 140#

STRUCT. NO. 051-0075
Station 62+80

BORING NO. 12 (N Abut)
Station 63+40
Offset 8.0ft Rt (East)
Ground Surface Elev. 431.15 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
▽ First Encounter 404.2 ft
▽ Upon Completion Washed ft
▼ After 96 Hrs. 407.2 ft

	DEPTH (ft)	BLOWS /6"	UCS Qu (tsf)	MOIST (%)
Very stiff, damp, gray, CLAY. *(continued)*		8 10	2.89 B	18
	-85			
	341.65			
Very stiff, damp, gray, LOAM.	-90	10 12 17	2.68 BS	22
	-95			
	331.65			
	-100	25		
Medium, damp, gray, SANDY LOAM. *(continued)*		31 37	0.62 B	17
	-105			
	321.65			
Very dense, damp, gray, SANDY LOAM TILL.	-110	50/5" 37 30		13
	317.45			
Hard, damp, gray, SILTY CLAY SHALE.	316.45			
Extent of exploration.	-115	50/1" 50/1" 50/1"		7
Benchmarks: BM 5 Chiseled square on hubguard on SE corner of existing structure Sta 54+73 Rt 15.4' = 431.29' BM 7 Chiseled square on hubguard on NE corner of existing structure Sta 63+18 Rt 15.9' = 431.55'	-120			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
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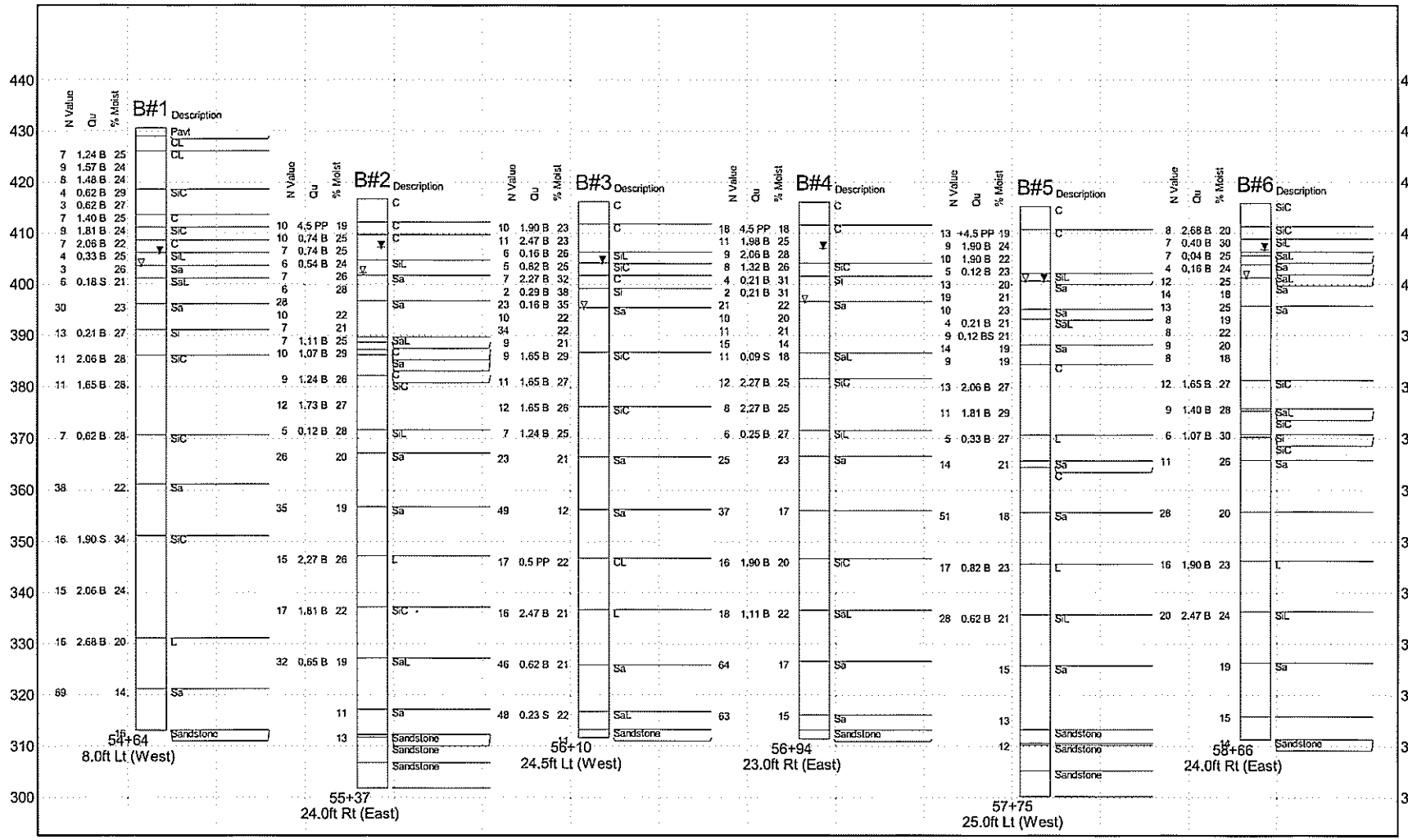
Structure Number 051-0075 Embarras River Overflow
Located in the W 1/2 of Section 30, Township 4 N, Range 11 W of the 3 P.M.



NOT TO HORIZONTAL SCALE

Illinois Department of Transportation
Division of Highways
IDOT

VARIATIONS IN SUBSURFACE CONDITIONS MAY EXIST BETWEEN BORINGS

Groundwater
▽ First Encounter
▽ Completion
▼ after (refer to log) hours

Abbreviations
WOH - Sampler Advanced by Weight of Hammer, WOP - Weight of Pipe
B.S. - Before Sealing

SUBSURFACE DATA PROFILE

Route: FAP 332 (IL 1)

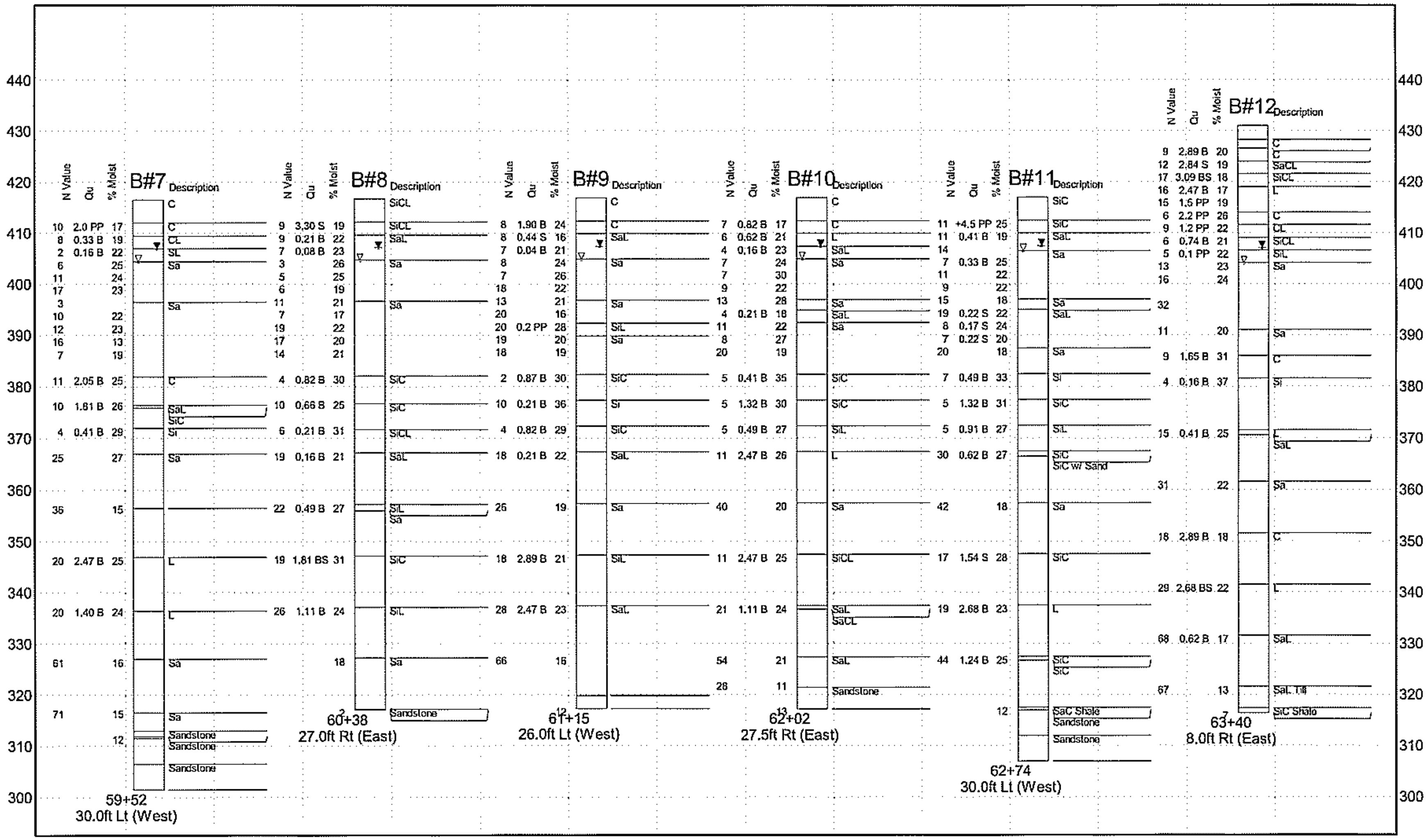
Section: (16BR-1,BR-2)B-1

County: Lawrence

TEST FENCE 2 051-0075 SOIL ROCK 2017.GPJ D6TEMPLT.GDT 10/16/17

TEST FENCE 2 051-0075 SOIL ROCK 2017.GPJ D6TEMPLT.GDT 10/16/17

Structure Number 051-0075 Embarras River Overflow
Located in the W 1/2 of Section 30, Township 4 N, Range 11 W of the 3 P.M.



NOT TO HORIZONTAL SCALE

VARIATIONS IN SUBSURFACE CONDITIONS MAY EXIST BETWEEN BORINGS

Illinois Department of Transportation
Division of Highways
IDOT

Groundwater
▽ First Encounter
▽ Completion
▼ after (refer to log) hours

Abbreviations
WOH - Sampler Advanced by Weight of Hammer, WOP - Weight of Pipe
B.S. - Before Seating

SUBSURFACE DATA PROFILE

Route: FAP 332 (IL 1)

Section: (16BR-1,BR-2)B-1

County: Lawrence

TEST FENCE 2 051-0075 SOIL ROCK 2017.GPJ D6TEMPLT.GDT 10/16/17

TEST FENCE 2 051-0075 SOIL ROCK 2017.GPJ D6TEMPLT.GDT 10/16/17

Appendix B

Illinois Department of Transportation

LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ==========B-01 S Abut
ELEVATION OF BORING GROUND SURFACE ========== 430.74 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ========== 27.04 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========== 14.24 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.191
EARTHQUAKE MOMENT MAGNITUDE ========== 7.7
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ========== 0.00 FT.
HAMMER EFFICIENCY========== 73 %
BOREHOLE DIAMETER========== 8 IN.
SAMPLING METHOD==========Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **0.948**

AVG. SHEAR WAVE VELOCITY (top 40')
$\bar{V}_{s,40'}$ = **448** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.7
Source-To-Site Distance, R (km) = 215.3
Ground Motion Prediction Equations = NMSZ
PGA = **0.076**

	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
424.74	6	7	1.24	36	11	12	25	0.124	0.744	11.462	18.754	0.200	0.124	0.744	0.744	1.349	**0.256**	0.947	**0.118**	**N.L. (1)**
422.24	8.5	9	1.57	36	11	12	24	0.127	1.062	14.203	22.043	0.243	0.127	1.062	1.062	1.236	**0.284**	0.919	**0.114**	**N.L. (1)**
418.74	12	8	1.48	36	11	12	24	0.126	1.503	12.091	19.509	0.209	0.126	1.503	1.503	1.105	**0.219**	0.874	**0.109**	**N.L. (1)**
416.24	14.5	4	0.62	36	11	12	29	0.116	1.793	5.875	12.050	0.132	0.054	1.638	1.654	1.065	**0.133**	0.838	**0.105**	**1.267 (C)**
413.74	17	3	0.62	36	11	12	27	0.116	2.083	4.250	10.100	0.114	0.054	1.773	1.945	1.042	**0.113**	0.801	**0.109**	**1.037 (C)**
411.24	19.5	7	1.4	75	12	12	25	0.125	2.395	9.478	16.373	0.174	0.063	1.930	2.258	1.026	**0.169**	0.764	**0.111**	**N.L. (2)**
408.74	22	9	1.81	36	11	12	24	0.129	2.718	11.602	18.922	0.202	0.067	2.098	2.582	1.003	**0.193**	0.727	**0.111**	**1.739 (D)**
406.24	24.5	7	2.06	75	12	12	22	0.130	3.043	8.584	15.301	0.163	0.068	2.268	2.908	0.982	**0.152**	0.692	**0.110**	**N.L. (2)**
403.74	27	4	0.33	36	10	12	25	0.109	3.315	4.711	10.654	0.119	0.047	2.385	3.181	0.973	**0.110**	0.660	**0.109**	**1.009 (C)**
401.24	29.5	3		6			26	0.051	3.443	3.477	3.523	0.062	0.051	2.513	3.465	0.967	**0.057**	0.632	**0.108**	**0.528 (C)**
396.24	34.5	6	0.18	36	10	12	21	0.041	3.648	6.778	13.134	0.142	0.041	2.718	3.982	0.940	**0.126**	0.587	**0.107**	**1.178 (C)**
391.24	39.5	30		4			23	0.071	4.003	35.592	35.592	-0.369	0.071	3.073	4.649	0.865	**-0.303**	0.555	**0.104**	**N.L. (3)**
386.24	44.5	13	0.21	75	10	12	27	0.042	4.213	13.621	21.345	0.233	0.042	3.283	5.171	0.876	**0.193**	0.534	**0.104**	**1.856 (D)**
381.24	49.5	11	2.06	36	11	12	28	0.068	4.553	11.026	18.232	0.194	0.068	3.623	5.823	0.859	**0.158**	0.521	**0.104**	**1.519 (C)**
370.74	60	11	1.65	36	11	12	28	0.065	5.235	10.117	17.141	0.182	0.065	4.305	7.160	0.822	**0.142**	0.507	**0.105**	**1.352 (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

Illinois Department of Transportation

LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ========== B-2 Pier 1
ELEVATION OF BORING GROUND SURFACE ========== 416.79 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ========== 14.49 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========== 0.00 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ========== 0.191
EARTHQUAKE MOMENT MAGNITUDE ========== 7.7
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ========== 0.00 FT.
HAMMER EFFICIENCY========== 73 %
BOREHOLE DIAMETER========== 8 IN.
SAMPLING METHOD========== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **0.948**

AVG. SHEAR WAVE VELOCITY (top 40')
$\bar{V}_{s,40'}$ = **512** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.7
Source-To-Site Distance, R (km) = 215.3
Ground Motion Prediction Equations = NMSZ
PGA = **0.076**

	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
409.79	7	10	4.5	75	12	12	19	0.140	0.980	15.727	23.872	0.271	0.078	0.546	0.983	1.500	**0.386**	0.962	**0.215**	**N.L. (2)**
407.29	9.5	10	0.74	75	12	12	25	0.118	1.275	15.422	23.506	0.265	0.056	0.686	1.279	1.428	**0.359**	0.943	**0.218**	**N.L. (2)**
404.79	12	7	0.74	75	12	12	25	0.118	1.570	10.406	17.487	0.186	0.056	0.826	1.575	1.300	**0.229**	0.921	**0.218**	**N.L. (2)**
401.79	15	6	0.54	36	10	12	24	0.052	1.726	9.008	15.810	0.168	0.052	0.982	1.918	1.229	**0.196**	0.891	**0.216**	**0.907 (C)**
399.79	17	7		8			26	0.058	1.842	10.460	10.890	0.121	0.058	1.098	2.159	1.169	**0.134**	0.868	**0.212**	**0.632 (D)**
396.79	20	6		3			28	0.057	2.013	8.833	8.833	0.103	0.057	1.269	2.517	1.122	**0.110**	0.832	**0.205**	**0.537 (C)**
394.79	22	28		7			22	0.070	2.153	46.976	47.496	0.273	0.070	1.409	2.782	1.178	**0.305**	0.806	**0.198**	**N.L. (3)**
392.79	24	10		7			22	0.061	2.275	14.192	14.433	0.154	0.061	1.531	3.029	1.088	**0.159**	0.781	**0.192**	**0.828 (D)**
389.79	27	7		9			21	0.058	2.449	9.675	10.396	0.117	0.058	1.705	3.390	1.052	**0.116**	0.743	**0.183**	**0.634 (C)**
387.29	29.5	7	1.11	36	10	12	25	0.060	2.599	9.444	16.333	0.174	0.060	1.855	3.696	1.037	**0.171**	0.713	**0.177**	**0.966 (C)**
386.29	30.5	10		4			25	0.061	2.660	13.358	13.358	0.144	0.061	1.916	3.819	1.026	**0.140**	0.702	**0.174**	**0.805 (D)**
382.29	34.5	10	1.07	75	12	12	29	0.060	2.900	12.848	20.417	0.221	0.060	2.156	4.309	0.995	**0.208**	0.662	**0.164**	**N.L. (2)**
376.79	40	9	1.24	36	11	12	26	0.062	3.241	10.957	18.149	0.193	0.062	2.497	4.993	0.955	**0.175**	0.620	**0.154**	**1.136 (C)**
371.79	45	12	1.73	36	11	12	27	0.066	3.571	13.899	21.679	0.237	0.066	2.827	5.635	0.916	**0.206**	0.594	**0.147**	**1.401 (D)**
367.29	49.5	5	0.12	36	10	12	28	0.037	3.738	5.662	11.795	0.129	0.037	2.994	6.082	0.920	**0.113**	0.578	**0.146**	**0.774 (C)**
357.29	59.5	26		4			20	0.069	4.428	28.473	28.473	0.387	0.069	3.684	7.396	0.826	**0.303**	0.560	**0.140**	**N.L. (3)**
347.29	69.5	35		5			19	0.072	5.148	35.907	35.907	-0.263	0.072	4.404	8.740	0.750	**-0.187**	0.543	**0.134**	**N.L. (3)**

* 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 ==========: B-3 Pier 2
ELEVATION OF BORING GROUND SURFACE ==========: 416.31 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ==========: 20.81 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ==========: 0.00 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) =====: 0.191
EARTHQUAKE MOMENT MAGNITUDE ==========: 7.7
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ==========: 0.00 FT.
HAMMER EFFICIENCY==========: 73 %
BOREHOLE DIAMETER==========: 8 IN.
SAMPLING METHOD==========: Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **0.948**

AVG. SHEAR WAVE VELOCITY (top 40')
$V^{*}_{s,40'}$ = **519** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.7
Source-To-Site Distance, R (km) = 215.3
Ground Motion Prediction Equations = NMSZ
PGA = **0.076**

	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
410.31	6	10	1.9	75	12	12	23	0.129	0.774	16.824	25.189	0.296	0.067	0.402	0.776	1.500	**0.421**	0.971	**0.233**	**N.L. (2)**
406.31	10	11	2.47	75	12	12	23	0.132	1.302	17.240	25.688	0.306	0.070	0.682	1.306	1.453	**0.422**	0.942	**0.224**	**N.L. (2)**
404.31	12	6	0.16	36	10	12	26	0.102	1.506	9.060	15.873	0.169	0.040	0.762	1.511	1.316	**0.211**	0.925	**0.228**	**0.925 (D)**
401.81	14.5	5	0.82	36	11	12	25	0.119	1.804	7.325	13.790	0.148	0.057	0.905	1.809	1.243	**0.175**	0.901	**0.224**	**0.781 (C)**
399.31	17	7	2.27	75	12	12	32	0.131	2.131	9.813	16.776	0.178	0.069	1.077	2.138	1.204	**0.204**	0.874	**0.216**	**N.L. (2)**
397.41	18.9	2	0.29	75	10	12	38	0.108	2.336	2.729	8.275	0.098	0.046	1.164	2.344	1.141	**0.106**	0.852	**0.213**	**0.498 (C)**
395.51	20.8	23	0.16	10	12	75	35	0.102	2.530	33.650	35.247	-0.546	0.040	1.240	2.538	1.232	**-0.638**	0.829	**0.211**	**N.L. (2)**
391.81	24.5	10		6			22	0.061	2.756	12.927	13.017	0.141	0.061	1.466	2.995	1.097	**0.146**	0.782	**0.199**	**0.734 (D)**
389.31	27	34		9			22	0.072	2.936	50.190	51.600	0.321	0.072	1.646	3.331	1.107	**0.336**	0.751	**0.189**	**N.L. (3)**
386.81	29.5	9		9			21	0.060	3.086	11.093	11.838	0.130	0.060	1.796	3.637	1.041	**0.128**	0.722	**0.182**	**0.703 (D)**
381.81	34.5	9	1.65	36	11	12	29	0.065	3.411	10.571	17.685	0.188	0.065	2.121	4.274	1.000	**0.179**	0.670	**0.168**	**1.065 (C)**
376.31	40	11	1.65	36	11	12	27	0.065	3.768	12.274	19.728	0.212	0.065	2.479	4.975	0.955	**0.192**	0.627	**0.156**	**1.231 (D)**
371.81	44.5	12	1.65	36	11	12	26	0.065	4.061	12.862	20.434	0.221	0.065	2.771	5.548	0.924	**0.193**	0.603	**0.150**	**1.287 (D)**
366.61	49.7	7	1.24	36	11	12	25	0.062	4.383	7.190	13.627	0.147	0.062	3.094	6.195	0.908	**0.126**	0.584	**0.145**	**0.869 (C)**
356.31	60	23		6			21	0.068	5.084	22.372	22.506	0.249	0.068	3.794	7.538	0.835	**0.198**	0.565	**0.139**	**1.424 (D)**
346.81	69.5	49		8			12	0.075	5.796	48.724	49.638	0.299	0.075	4.506	8.843	0.740	**0.210**	0.548	**0.134**	**N.L. (3)**

* 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 ==========B-4 Pier 3
ELEVATION OF BORING GROUND SURFACE ========== 416.18 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ========== 19.48 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========== 0.00 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.191
EARTHQUAKE MOMENT MAGNITUDE ========== 7.7
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ========== 0.00 FT.
HAMMER EFFICIENCY========== 73 %
BOREHOLE DIAMETER========== 8 IN.
SAMPLING METHOD==========Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **0.948**

AVG. SHEAR WAVE VELOCITY (top 40')
$V^{*}_{s,40'}$ = **534** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.7
Source-To-Site Distance, R (km) = 215.3
Ground Motion Prediction Equations = NMSZ
PGA = **0.076**

	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
410.18	6	18	4.5	75	12	12	18	0.140	0.840	32.492	43.990	0.221	0.078	0.468	0.842	1.500	**0.314**	0.975	**0.218**	**N.L. (2)**
407.68	8.5	11	1.98	75	12	12	25	0.130	1.165	17.205	25.647	0.305	0.068	0.638	1.168	1.485	**0.430**	0.960	**0.218**	**N.L. (2)**
404.18	12	9	2.06	75	12	12	28	0.130	1.620	13.228	20.874	0.227	0.068	0.876	1.625	1.303	**0.280**	0.934	**0.215**	**N.L. (2)**
401.68	14.5	8	1.32	36	11	12	26	0.125	1.933	11.382	18.659	0.199	0.063	1.034	1.938	1.228	**0.232**	0.912	**0.213**	**1.089 (D)**
399.18	17	4	0.21	75	10	26.3	31	0.105	2.195	5.532	11.638	0.128	0.043	1.141	2.202	1.162	**0.141**	0.888	**0.213**	**0.662 (C)**
396.68	19.5	2	0.21	75	10	26.3	31	0.042	2.300	2.761	8.313	0.099	0.042	1.246	2.463	1.125	**0.105**	0.860	**0.211**	**0.498 (C)**
394.18	22	21		7			22	0.068	2.470	30.869	31.252	0.591	0.068	1.416	2.789	1.158	**0.649**	0.831	**0.203**	**N.L. (3)**
391.68	24.5	10		6			20	0.061	2.623	13.260	13.352	0.144	0.061	1.569	3.097	1.079	**0.147**	0.801	**0.196**	**0.750 (D)**
389.18	27	11		12			21	0.062	2.778	14.265	16.269	0.173	0.062	1.724	3.408	1.058	**0.174**	0.771	**0.189**	**0.921 (D)**
386.68	29.5	15		7			14	0.065	2.940	19.454	19.740	0.212	0.065	1.886	3.727	1.035	**0.208**	0.742	**0.182**	**1.143 (D)**
381.68	34.5	11	0.09	36	10	12	18	0.034	3.110	13.608	21.329	0.233	0.034	2.056	4.209	1.009	**0.223**	0.689	**0.175**	**1.274 (D)**
376.68	39.5	12	2.27	36	11	12	25	0.069	3.455	14.080	21.896	0.241	0.069	2.401	4.866	0.963	**0.220**	0.648	**0.163**	**1.350 (D)**
371.68	44.5	8	2.27	36	11	30	25	0.069	3.800	8.927	15.712	0.167	0.069	2.746	5.523	0.933	**0.148**	0.619	**0.155**	**N.L. (2)**
366.68	49.5	6	0.25	36	4.9	27.3	27	0.044	4.020	6.502	12.803	0.139	0.044	2.966	6.055	0.920	**0.121**	0.599	**0.152**	**0.796 (C)**
356.18	60	25		4			23	0.069	4.745	25.879	25.879	0.310	0.069	3.691	7.435	0.832	**0.245**	0.578	**0.145**	**N.L. (3)**
346.68	69.5	37		5			17	0.073	5.438	36.697	36.697	-0.104	0.073	4.384	8.721	0.749	**-0.074**	0.561	**0.139**	**N.L. (3)**

* 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

LIQUEFACTION ANALYSIS

Illinois Department of Transportation

REFERENCE BORING NUMBER ========== B-5 Pier 4
ELEVATION OF BORING GROUND SURFACE ========== 415.27 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ========== 14.47 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========== 0.00 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ========== 0.191
EARTHQUAKE MOMENT MAGNITUDE ========== 7.7
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ========== 0.00 FT.
HAMMER EFFICIENCY========== 73 %
BOREHOLE DIAMETER========== 8 IN.
SAMPLING METHOD========== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **0.948**

AVG. SHEAR WAVE VELOCITY (top 40')
$\bar{V}_{s,40'}$ = **565** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.7
Source-To-Site Distance, R (km) = 215.3
Ground Motion Prediction Equations = NMSZ
PGA = **0.076**

	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
408.77	6.5	13	4.5	75	12	12	19	0.140	0.910	21.655	30.985	0.557	0.078	0.507	0.913	1.500	**0.792**	0.979	**0.219**	**N.L. (2)**
405.77	9.5	9	1.9	75	12	12	24	0.129	1.297	13.642	21.370	0.233	0.067	0.708	1.301	1.394	**0.308**	0.964	**0.220**	**N.L. (2)**
402.27	13	10	1.9	75	12	12	22	0.129	1.749	14.620	22.544	0.250	0.067	0.943	1.754	1.286	**0.305**	0.943	**0.218**	**N.L. (2)**
400.77	14.5	5	0.12	36	10	12	23	0.037	1.804	7.324	13.789	0.148	0.037	0.998	1.903	1.212	**0.170**	0.932	**0.221**	**0.769 (C)**
398.27	17	13		5			20	0.063	1.962	19.505	19.505	0.209	0.063	1.156	2.216	1.193	**0.237**	0.912	**0.217**	**1.092 (D)**
395.27	20	19		6			21	0.067	2.163	29.257	29.424	0.432	0.067	1.357	2.605	1.171	**0.479**	0.884	**0.211**	**N.L. (3)**
393.27	22	10		5			23	0.061	2.285	14.047	14.047	0.151	0.061	1.479	2.851	1.097	**0.157**	0.863	**0.207**	**0.758 (D)**
390.77	24.5	4	0.21	36	10	12	21	0.042	2.390	5.555	11.666	0.128	0.042	1.584	3.112	1.073	**0.130**	0.836	**0.204**	**0.637 (C)**
388.27	27	9	0.12	36	10	12	21	0.037	2.482	12.357	19.829	0.213	0.037	1.676	3.361	1.071	**0.217**	0.808	**0.201**	**1.080 (D)**
386.27	29	14		9			19	0.064	2.610	19.286	20.171	0.218	0.064	1.804	3.614	1.049	**0.216**	0.786	**0.196**	**1.102 (D)**
384.47	30.8	9		5			19	0.060	2.718	11.896	11.896	0.130	0.060	1.912	3.834	1.025	**0.127**	0.766	**0.191**	**0.665 (D)**
377.62	37.65	13	2.06	75	12	12	27	0.068	3.184	16.025	24.229	0.277	0.068	2.378	4.727	0.964	**0.254**	0.700	**0.173**	**N.L. (2)**
370.77	44.5	11	1.81	75	12	12	29	0.066	3.636	12.600	20.120	0.217	0.066	2.830	5.607	0.918	**0.189**	0.653	**0.161**	**N.L. (2)**
365.77	49.5	5	0.33	4	10	12	27	0.047	3.871	5.544	5.544	0.076	0.047	3.065	6.154	0.928	**0.067**	0.631	**0.157**	**0.427 (C)**
364.47	50.8	14		4			21	0.064	3.954	15.349	15.349	0.164	0.064	3.148	6.318	0.901	**0.140**	0.626	**0.156**	**0.897 (D)**
355.77	59.5	11	1	75	12	12	18	0.059	4.467	11.223	18.468	0.197	0.059	3.661	7.374	0.856	**0.160**	0.607	**0.152**	**N.L. (2)**
345.77	69.5	51		5			18	0.076	5.227	55.533	55.533	0.360	0.076	4.421	8.758	0.745	**0.254**	0.587	**0.144**	**N.L. (3)**

* 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 ==========B-6 Pier 5
ELEVATION OF BORING GROUND SURFACE ========== 415.87 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ========== 14.47 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========== 0.00 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.191
EARTHQUAKE MOMENT MAGNITUDE ========== 7.7
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ========== 0.00 FT.
HAMMER EFFICIENCY========== 73 %
BOREHOLE DIAMETER========== 8 IN.
SAMPLING METHOD==========Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **0.948**

AVG. SHEAR WAVE VELOCITY (top 40')
$\bar{V}_{s,40'}$ = **510** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.7
Source-To-Site Distance, R (km) = 215.3
Ground Motion Prediction Equations = NMSZ
PGA = **0.076**

	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
408.87	7	8	2.68	36	11	12	20	0.133	0.931	12.477	19.973	0.215	0.071	0.497	0.934	1.500	**0.306**	0.962	**0.224**	**1.366** (D)
406.37	9.5	7	0.4	36	10	12	30	0.111	1.209	10.770	17.924	0.191	0.049	0.620	1.212	1.413	**0.256**	0.943	**0.229**	**1.118** (D)
405.67	10.2	7	0.04	36	10	12	25	0.089	1.271	10.789	17.947	0.191	0.027	0.638	1.275	1.401	**0.254**	0.937	**0.232**	**1.095** (D)
403.87	12	6		4			25	0.113	1.474	9.132	9.132	0.106	0.051	0.730	1.479	1.272	**0.127**	0.920	**0.232**	**0.547** (D)
401.37	14.5	4	0.16	36	10	12	24	0.040	1.574	6.186	12.424	0.135	0.040	0.830	1.735	1.260	**0.161**	0.895	**0.232**	**0.694** (C)
398.87	17	12		5			25	0.063	1.732	18.910	18.910	0.202	0.063	0.988	2.049	1.245	**0.239**	0.866	**0.223**	**1.072** (D)
395.87	20	14		8			18	0.064	1.924	21.905	22.480	0.249	0.064	1.180	2.428	1.199	**0.283**	0.830	**0.212**	**1.335** (D)
393.87	22	13		4			25	0.063	2.050	19.752	19.752	0.212	0.063	1.306	2.679	1.152	**0.232**	0.804	**0.205**	**1.132** (D)
391.37	24.5	8		12			19	0.059	2.197	11.560	13.478	0.145	0.059	1.453	2.982	1.100	**0.151**	0.772	**0.197**	**0.766** (D)
388.87	27	8		5			22	0.059	2.345	11.293	11.293	0.125	0.059	1.601	3.286	1.070	**0.126**	0.741	**0.189**	**0.667** (D)
386.37	29.5	9		9			20	0.060	2.495	12.394	13.161	0.142	0.060	1.751	3.592	1.049	**0.141**	0.711	**0.181**	**0.779** (D)
381.37	34.5	8		11			18	0.059	2.790	10.491	11.977	0.131	0.059	2.046	4.199	1.009	**0.125**	0.660	**0.168**	**0.744** (C)
375.87	40	12	1.65	36	11	12	27	0.065	3.147	14.851	22.821	0.254	0.065	2.403	4.899	0.962	**0.232**	0.618	**0.156**	**1.487** (D)
370.87	45	9	1.4	36	11	12	28	0.063	3.462	10.613	17.736	0.189	0.063	2.718	5.526	0.933	**0.167**	0.592	**0.149**	**1.121** (C)
365.87	50	6	1.07	36	11	12	30	0.060	3.762	6.771	13.125	0.142	0.060	3.018	6.138	0.915	**0.123**	0.575	**0.145**	**0.848** (C)
355.87	60	11		5			26	0.062	4.382	11.363	11.363	0.125	0.062	3.638	7.382	0.878	**0.104**	0.558	**0.141**	**0.738** (C)
346.37	69.5	28		3			20	0.070	5.047	28.140	28.140	0.375	0.070	4.303	8.640	0.783	**0.278**	0.541	**0.135**	**N.L. (3)**

* 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

LIQUEFACTION ANALYSIS

Illinois Department of Transportation

REFERENCE BORING NUMBER ==========B-7 Pier 6
ELEVATION OF BORING GROUND SURFACE ========== 416.53 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ========== 12.03 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========== 0.00 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.191
EARTHQUAKE MOMENT MAGNITUDE ========== 7.7
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ========== 0.00 FT.
HAMMER EFFICIENCY========== 73 %
BOREHOLE DIAMETER========== 8 IN.
SAMPLING METHOD==========Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **0.948**

AVG. SHEAR WAVE VELOCITY (top 40')
$V^{*}_{s,40'}$ = **485** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.7
Source-To-Site Distance, R (km) = 215.3
Ground Motion Prediction Equations = NMSZ
PGA = **0.076**

	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
409.53	7	10	2	75	12	12	17	0.130	0.910	16.083	24.300	0.279	0.068	0.476	0.913	1.500	**0.396**	0.953	**0.227**	**N.L. (2)**
407.03	9.5	8	0.33	36	11	12	19	0.109	1.183	12.396	19.875	0.214	0.047	0.594	1.186	1.453	**0.295**	0.930	**0.231**	**1.277 (D)**
404.53	12	2	0.16	36	10	12	22	0.102	1.438	3.072	8.687	0.102	0.040	0.694	1.442	1.283	**0.124**	0.903	**0.233**	**0.532 (C)**
402.03	14.5	6		7			25	0.057	1.580	9.266	9.466	0.108	0.057	0.836	1.741	1.237	**0.127**	0.874	**0.226**	**0.562 (D)**
399.53	17	11		4			24	0.062	1.735	17.153	17.153	0.182	0.062	0.991	2.052	1.234	**0.213**	0.842	**0.216**	**0.986 (D)**
397.03	19.5	17		4			23	0.066	1.900	27.404	27.404	0.350	0.066	1.156	2.373	1.229	**0.408**	0.808	**0.206**	**N.L. (3)**
394.53	22	3		4			22	0.051	2.028	4.451	4.451	0.068	0.051	1.284	2.656	1.106	**0.071**	0.774	**0.199**	**0.357 (C)**
392.03	24.5	10		6			22	0.061	2.180	14.502	14.600	0.156	0.061	1.436	2.965	1.107	**0.164**	0.740	**0.190**	**0.863 (D)**
389.53	27	12		5			23	0.063	2.338	17.190	17.190	0.183	0.063	1.594	3.278	1.082	**0.188**	0.708	**0.181**	**1.039 (D)**
387.03	29.5	16		3			13	0.065	2.500	22.969	22.969	0.256	0.065	1.756	3.597	1.061	**0.258**	0.679	**0.173**	**1.491 (D)**
382.03	34.5	7		7			19	0.058	2.790	9.179	9.377	0.108	0.058	2.046	4.199	1.008	**0.103**	0.629	**0.160**	**0.644 (C)**
376.03	40.5	11	2.05	75	12	12	25	0.068	3.198	13.500	21.201	0.231	0.068	2.454	4.981	0.957	**0.210**	0.588	**0.148**	**N.L. (2)**
372.03	44.5	10	1.81	36	11	12	26	0.066	3.462	11.787	19.144	0.205	0.066	2.718	5.495	0.931	**0.181**	0.569	**0.143**	**1.266 (C)**
367.03	49.5	4	0.41	36	10	12	29	0.049	3.707	4.552	10.462	0.117	0.049	2.963	6.052	0.925	**0.103**	0.553	**0.140**	**0.736 (C)**
356.53	60	25		10			27	0.069	4.432	27.208	28.666	0.395	0.069	3.688	7.432	0.825	**0.309**	0.537	**0.134**	**N.L. (3)**
347.03	69.5	36		4			15	0.073	5.125	37.246	37.246	-0.037	0.073	4.381	8.718	0.748	**-0.026**	0.522	**0.129**	**N.L. (3)**

* 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

LIQUEFACTION ANALYSIS

Illinois Department of Transportation

REFERENCE BORING NUMBER ==========: B-8 Pier 7
ELEVATION OF BORING GROUND SURFACE ==========: 416.73 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ==========: 12.03 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ==========: 0.00 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) =====: 0.191
EARTHQUAKE MOMENT MAGNITUDE ==========: 7.7
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ==========: 0.00 FT.
HAMMER EFFICIENCY==========: 73 %
BOREHOLE DIAMETER==========: 8 IN.
SAMPLING METHOD==========: Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **0.948**

AVG. SHEAR WAVE VELOCITY (top 40')
$\bar{V}_{s,40'}$ = **481** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.7
Source-To-Site Distance, R (km) = 215.3
Ground Motion Prediction Equations = NMSZ
PGA = **0.076**

	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
409.73	7	9	3.3	36	11	12	19	0.136	0.952	14.113	21.935	0.241	0.074	0.518	0.955	1.500	**0.343**	0.951	**0.218**	**1.573** (D)
407.23	9.5	9	0.21	36	10	12	22	0.105	1.215	13.972	21.766	0.239	0.043	0.626	1.218	1.451	**0.328**	0.927	**0.224**	**1.464** (D)
404.73	12	7	0.08	36	10	12	23	0.096	1.455	10.707	17.848	0.190	0.034	0.711	1.459	1.359	**0.245**	0.900	**0.230**	**1.065** (D)
402.73	14	3		3			26	0.051	1.557	4.627	4.627	0.069	0.051	0.813	1.686	1.211	**0.080**	0.876	**0.226**	**0.354** (C)
400.23	16.5	5		5			25	0.055	1.694	7.694	7.694	0.093	0.055	0.950	1.980	1.190	**0.105**	0.844	**0.218**	**0.482** (C)
397.73	19	6		6			19	0.057	1.837	9.127	9.200	0.106	0.057	1.093	2.278	1.162	**0.117**	0.810	**0.210**	**0.557** (C)
395.23	21.5	11		5			21	0.062	1.992	16.605	16.605	0.177	0.062	1.248	2.589	1.156	**0.194**	0.776	**0.200**	**0.970** (D)
392.73	24	7		4			17	0.058	2.137	10.228	10.228	0.115	0.058	1.393	2.890	1.103	**0.120**	0.742	**0.191**	**0.628** (C)
390.23	26.5	19		5			22	0.067	2.304	29.044	29.044	0.412	0.067	1.560	3.214	1.114	**0.435**	0.709	**0.181**	**N.L. (3)**
387.73	29	17		1			20	0.066	2.469	24.750	24.750	0.287	0.066	1.725	3.535	1.069	**0.291**	0.679	**0.173**	**1.682** (D)
382.23	34.5	14		2			21	0.064	2.821	18.612	18.612	0.199	0.064	2.077	4.230	1.006	**0.190**	0.624	**0.158**	**1.203** (D)
376.73	40	4	0.82	36	11	12	30	0.057	3.135	4.961	10.953	0.122	0.057	2.391	4.887	0.972	**0.112**	0.586	**0.149**	**0.752** (C)
371.73	45	10	0.66	36	11	12	25	0.054	3.405	11.907	19.288	0.207	0.054	2.661	5.469	0.936	**0.184**	0.563	**0.144**	**1.278** (D)
367.23	49.5	6	0.21	36	3.8	27.4	31	0.042	3.594	6.954	13.345	0.144	0.042	2.850	5.938	0.928	**0.127**	0.549	**0.142**	**0.894** (C)
357.23	59.5	19	0.16	36	10	12	21	0.040	3.994	21.463	30.756	0.531	0.040	3.250	6.962	0.857	**0.432**	0.534	**0.142**	**3.042** (D)
356.03	60.7	22	0.49	36	10	12	27	0.051	4.055	25.061	35.073	-0.676	0.051	3.311	7.098	0.841	**-0.540**	0.533	**0.142**	**N.L. (3)**
347.23	69.5	19		3			31	0.067	4.644	19.326	19.326	0.207	0.067	3.900	8.237	0.838	**0.165**	0.518	**0.136**	**1.213** (D)

* 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 ==========B-9 Pier 8
ELEVATION OF BORING GROUND SURFACE ========== 416.94 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ========== 12.04 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========== 0.00 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.191
EARTHQUAKE MOMENT MAGNITUDE ========== 7.7
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ========== 0.00 FT.
HAMMER EFFICIENCY========== 73 %
BOREHOLE DIAMETER========== 8 IN.
SAMPLING METHOD==========Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **0.948**

AVG. SHEAR WAVE VELOCITY (top 40')
$\bar{V}_{s,40'}$ = **501** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.7
Source-To-Site Distance, R (km) = 215.3
Ground Motion Prediction Equations = NMSZ
PGA = **0.076**

	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
409.94	7	8	1.9	75	12	12	24	0.129	0.903	12.588	20.106	0.217	0.067	0.469	0.906	1.500	**0.308**	0.959	**0.230**	**N.L. (2)**
407.44	9.5	8	0.44	36	10	12	16	0.112	1.183	12.394	19.873	0.214	0.050	0.594	1.187	1.452	**0.294**	0.938	**0.233**	**1.262 (D)**
404.94	12	7	0.04	36	10	12	21	0.089	1.406	10.840	18.007	0.192	0.027	0.662	1.410	1.388	**0.253**	0.914	**0.242**	**1.045 (D)**
402.94	14	8		4			24	0.059	1.524	12.439	12.439	0.135	0.059	0.780	1.653	1.280	**0.164**	0.893	**0.235**	**0.698 (D)**
400.44	16.5	7		5			26	0.058	1.669	10.837	10.837	0.121	0.058	0.925	1.954	1.217	**0.139**	0.864	**0.227**	**0.612 (D)**
397.94	19	18		4			22	0.066	1.834	29.688	29.688	0.447	0.066	1.090	2.275	1.266	**0.537**	0.833	**0.216**	**N.L. (3)**
395.44	21.5	13		5			21	0.063	1.991	19.989	19.989	0.215	0.063	1.247	2.589	1.169	**0.239**	0.800	**0.206**	**1.160 (D)**
392.44	24.5	20		7			16	0.067	2.192	31.482	31.870	0.701	0.067	1.448	2.977	1.151	**0.765**	0.761	**0.194**	**N.L. (3)**
389.94	27	20	0.2	36	10	12	28	0.042	2.297	30.912	42.095	0.184	0.042	1.553	3.238	1.133	**0.197**	0.729	**0.189**	**N.L. (3)**
387.44	29.5	19		2			20	0.067	2.465	28.163	28.163	0.375	0.067	1.721	3.561	1.075	**0.383**	0.699	**0.180**	**N.L. (3)**
382.44	34.5	18		3			19	0.066	2.795	24.810	24.810	0.288	0.066	2.051	4.203	1.011	**0.276**	0.649	**0.165**	**1.673 (D)**
377.44	39.5	2	0.87	36	11	12	30	0.058	3.085	2.501	8.001	0.096	0.058	2.341	4.805	0.979	**0.089**	0.611	**0.156**	**0.571 (C)**
372.44	44.5	10	0.21	75	5.1	40.9	36	0.042	3.295	12.125	19.550	0.210	0.042	2.551	5.327	0.948	**0.189**	0.585	**0.152**	**1.243 (D)**
367.44	49.5	4	0.82	36	11	12	29	0.057	3.580	4.647	10.576	0.118	0.057	2.836	5.924	0.934	**0.105**	0.568	**0.147**	**0.714 (C)**
357.44	59.5	18	0.21	36	10	12	22	0.042	4.000	20.185	29.222	0.421	0.042	3.256	6.968	0.860	**0.344**	0.550	**0.146**	**2.356 (D)**
347.44	69.5	26		2			19	0.069	4.690	27.319	27.319	0.348	0.069	3.946	8.282	0.810	**0.267**	0.534	**0.139**	**N.L. (3)**

* 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

LIQUEFACTION ANALYSIS

Illinois Department of Transportation

REFERENCE BORING NUMBER ========== B-10 Pier 9
ELEVATION OF BORING GROUND SURFACE ========== 416.98 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ========== 9.48 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) ========== 0.191
EARTHQUAKE MOMENT MAGNITUDE ========== 7.7
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ========== 0.00 FT.
HAMMER EFFICIENCY========== 73 %
BOREHOLE DIAMETER========== 8 IN.
SAMPLING METHOD========== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **0.948**

AVG. SHEAR WAVE VELOCITY (top 40')
$\bar{V}_{s,40'}$ = **470** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.7
Source-To-Site Distance, R (km) = 215.3
Ground Motion Prediction Equations = NMSZ
PGA = **0.076**

	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
409.98	7	7	0.82	75	12	12	17	0.119	0.833	11.160	18.392	0.196	0.057	0.399	0.836	1.500	**0.279**	0.947	**0.246**	**N.L. (2)**
407.48	9.5	6	0.62	36	10	12	21	0.054	0.968	9.863	16.836	0.179	0.054	0.534	1.127	1.460	**0.248**	0.921	**0.241**	**1.029 (D)**
404.98	12	4	0.16	36	10	12	23	0.040	1.068	6.773	13.127	0.142	0.040	0.634	1.383	1.354	**0.182**	0.892	**0.242**	**0.752 (C)**
402.48	14.5	7		7			24	0.058	1.213	11.867	12.088	0.132	0.058	0.779	1.684	1.277	**0.160**	0.860	**0.231**	**0.693 (D)**
399.98	17	7		4			30	0.058	1.358	11.757	11.757	0.129	0.058	0.924	1.985	1.223	**0.150**	0.826	**0.220**	**0.682 (D)**
396.98	20	9		3			22	0.060	1.538	14.830	14.830	0.158	0.060	1.104	2.352	1.186	**0.178**	0.784	**0.207**	**0.860 (D)**
394.98	22	13		5			28	0.063	1.664	21.793	21.793	0.239	0.063	1.230	2.603	1.181	**0.268**	0.755	**0.199**	**1.347 (D)**
392.48	24.5	4	0.21	36	10	12	18	0.042	1.769	6.354	12.625	0.137	0.042	1.335	2.864	1.121	**0.146**	0.721	**0.192**	**0.760 (C)**
389.98	27	11		6			22	0.062	1.924	17.219	17.329	0.184	0.062	1.490	3.175	1.103	**0.193**	0.689	**0.182**	**1.060 (D)**
387.48	29.5	8		2			27	0.059	2.072	12.027	12.027	0.131	0.059	1.638	3.478	1.065	**0.133**	0.660	**0.174**	**0.764 (D)**
382.48	34.5	20		2			19	0.067	2.407	30.528	30.528	0.510	0.067	1.973	4.125	1.026	**0.496**	0.612	**0.159**	**N.L. (3)**
377.48	39.5	5	0.41	36	5.4	38.3	35	0.049	2.652	6.774	13.129	0.142	0.049	2.218	4.682	0.989	**0.133**	0.578	**0.151**	**0.881 (C)**
372.48	44.5	5	1.32	36	11	12	30	0.062	2.962	6.429	12.715	0.138	0.062	2.528	5.304	0.957	**0.125**	0.555	**0.145**	**0.862 (C)**
367.48	49.5	5	0.49	36	10	12	27	0.051	3.217	6.174	12.409	0.135	0.051	2.783	5.871	0.935	**0.120**	0.540	**0.141**	**0.851 (C)**
357.48	59.5	11	2.47	36	10	12	26	0.070	3.917	12.181	19.617	0.211	0.070	3.483	7.195	0.865	**0.173**	0.525	**0.135**	**1.281 (C)**
347.48	69.5	40		4			20	0.074	4.657	45.529	45.529	0.246	0.074	4.223	8.559	0.759	**0.177**	0.510	**0.128**	**N.L. (3)**

* 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 ==========: B-11 Pier 10
ELEVATION OF BORING GROUND SURFACE ==========: 417.07 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ==========: 9.47 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ==========: 0.00 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) =====: 0.191
EARTHQUAKE MOMENT MAGNITUDE ==========: 7.7
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ==========: 0.00 FT.
HAMMER EFFICIENCY==========: 73 %
BOREHOLE DIAMETER==========: 8 IN.
SAMPLING METHOD==========: Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **0.948**

AVG. SHEAR WAVE VELOCITY (top 40')
$\bar{V}_{s,40'}$ = **567** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.7
Source-To-Site Distance, R (km) = 215.3
Ground Motion Prediction Equations = NMSZ
PGA = **0.076**

	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
410.07	7	11	4.5	36	11	12	25	0.140	0.980	17.501	26.002	0.313	0.078	0.546	0.983	1.500	**0.445**	0.977	**0.218**	**2.041** (D)
406.57	10.5	11	0.41	36	10	12	19	0.049	1.152	18.251	26.902	0.336	0.049	0.718	1.373	1.441	**0.459**	0.959	**0.228**	**2.013** (D)
405.07	12	14		3			25	0.064	1.248	24.065	24.065	0.275	0.064	0.814	1.562	1.358	**0.354**	0.950	**0.227**	**1.559** (D)
402.57	14.5	7		3			25	0.058	1.393	11.326	11.326	0.125	0.058	0.959	1.863	1.210	**0.143**	0.933	**0.225**	**0.636** (D)
400.07	17	11		4			22	0.062	1.548	18.027	18.027	0.192	0.062	1.114	2.174	1.199	**0.218**	0.913	**0.221**	**0.986** (D)
397.57	19.5	9		3			22	0.060	1.698	14.189	14.189	0.152	0.060	1.264	2.480	1.143	**0.165**	0.890	**0.217**	**0.760** (D)
395.07	22	15		6			18	0.065	1.860	24.337	24.481	0.282	0.065	1.426	2.799	1.136	**0.304**	0.865	**0.211**	**1.441** (D)
392.57	24.5	19	0.22	36	10	12	22	0.043	1.968	31.382	42.658	0.196	0.043	1.534	3.062	1.138	**0.211**	0.839	**0.208**	**N.L. (3)**
390.07	27	8	0.17	36	10	12	24	0.040	2.068	11.972	19.366	0.208	0.040	1.634	3.318	1.079	**0.212**	0.811	**0.205**	**1.034** (D)
387.57	29.5	7	0.22	36	10	12	20	0.043	2.175	10.293	17.351	0.185	0.043	1.741	3.582	1.056	**0.185**	0.783	**0.200**	**0.925** (C)
382.57	34.5	20		5			18	0.067	2.510	29.806	29.806	0.455	0.067	2.076	4.229	1.007	**0.434**	0.731	**0.185**	**N.L. (3)**
377.57	39.5	7	0.49	75	9.2	42.1	33	0.051	2.765	9.281	16.137	0.172	0.051	2.331	4.796	0.975	**0.159**	0.688	**0.176**	**N.L. (2)**
372.57	44.5	5	1.32	36	11	12	31	0.062	3.075	6.299	12.559	0.136	0.062	2.641	5.418	0.947	**0.122**	0.655	**0.167**	**0.731** (C)
367.57	49.5	5	0.91	36	10	12	27	0.058	3.365	6.019	12.223	0.133	0.058	2.931	6.020	0.924	**0.117**	0.633	**0.161**	**0.727** (C)
357.57	59.5	30	0.62	36	11	12	27	0.054	3.905	36.817	49.181	0.294	0.054	3.471	7.184	0.821	**0.229**	0.609	**0.157**	**N.L. (3)**
347.57	69.5	42		5			18	0.074	4.645	48.391	48.391	0.284	0.074	4.211	8.548	0.760	**0.205**	0.588	**0.148**	**N.L. (3)**

* 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

LIQUEFACTION ANALYSIS

Illinois Department of Transportation

REFERENCE BORING NUMBER ========== B-12 N Abutment
ELEVATION OF BORING GROUND SURFACE ========== 431.15 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ========== 26.95 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========== 14.65 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ========== 0.191
EARTHQUAKE MOMENT MAGNITUDE ========== 7.7
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ========== 0.00 FT.
HAMMER EFFICIENCY========== 73 %
BOREHOLE DIAMETER========== 8 IN.
SAMPLING METHOD========== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **0.948**

AVG. SHEAR WAVE VELOCITY (top 40')
$\bar{V}_{s,40'}$ = **590** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.7
Source-To-Site Distance, R (km) = 215.3
Ground Motion Prediction Equations = NMSZ
PGA = **0.076**

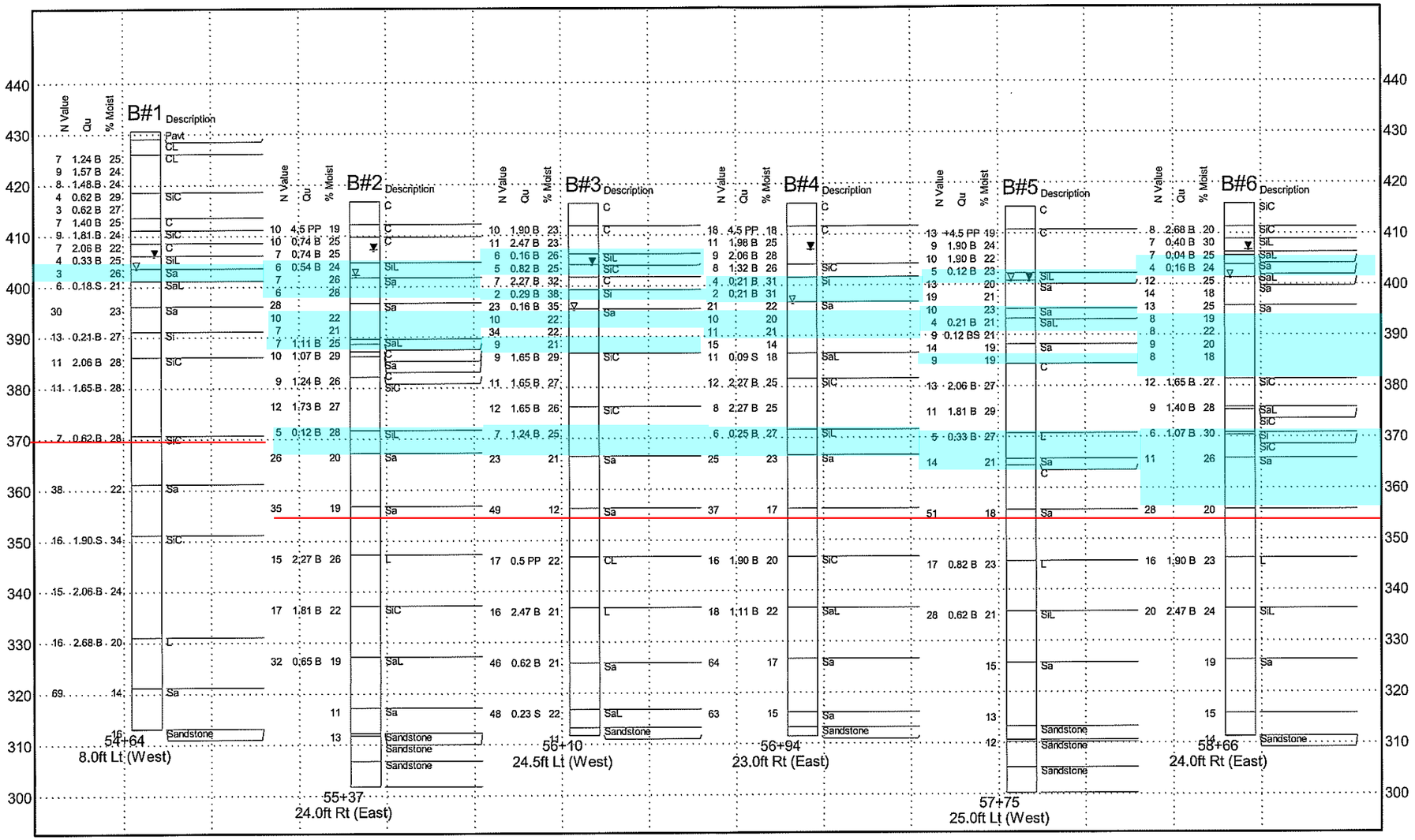
	BORING DATA							CONDITIONS DURING DRILLING					CONDITIONS DURING EARTHQUAKE							
ELEV. OF SAMPLE (FT.)	BORING SAMPLE DEPTH (FT.)	SPT N VALUE (BLOWS)	UNCONF. COMPR. STR., Q_u (TSF.)	% FINES < #200 (%)	PLAST. INDEX PI	LIQUID LIMIT LL	MOIST. CONTENT w_c (%)	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. 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
424.15	7	9	2.89	75	12	12	20	0.134	0.938	14.175	22.010	0.242	0.134	0.938	0.938	1.284	**0.295**	0.982	**0.122**	**N.L. (1)**
421.65	9.5	12	2.84	36	10	12	19	0.134	1.273	18.920	27.704	0.360	0.134	1.273	1.273	1.191	**0.406**	0.972	**0.121**	**N.L. (1)**
419.15	12	17	3.09	36	10	12	18	0.135	1.611	27.093	37.511	-0.012	0.135	1.611	1.611	1.116	**-0.012**	0.960	**0.119**	**N.L. (1)**
416.65	14.5	16	2.47	36	10	12	17	0.132	1.941	24.096	33.915	11.981	0.132	1.941	1.941	1.034	**11.751**	0.945	**0.117**	**N.L. (1)**
414.15	17	15	1.5	36	10	12	19	0.126	2.256	21.335	30.602	0.516	0.064	2.101	2.247	1.003	**0.491**	0.928	**0.123**	**3.992 (D)**
411.65	19.5	6	2.2	75	12	12	26	0.131	2.583	7.826	14.391	0.154	0.069	2.273	2.576	0.982	**0.143**	0.909	**0.128**	**N.L. (2)**
409.15	22	9	1.2	36	10	12	22	0.124	2.893	11.227	18.473	0.197	0.062	2.428	2.887	0.962	**0.180**	0.887	**0.131**	**1.374 (C)**
406.65	24.5	6	0.74	36	10	12	21	0.118	3.188	7.171	13.606	0.146	0.056	2.568	3.183	0.952	**0.132**	0.863	**0.133**	**0.992 (C)**
404.15	27	5	0.1	36	10	12	22	0.035	3.276	5.929	12.115	0.132	0.035	2.656	3.426	0.946	**0.119**	0.837	**0.134**	**0.888 (C)**
401.65	29.5	13		5			23	0.063	3.433	15.111	15.111	0.161	0.063	2.813	3.740	0.928	**0.142**	0.811	**0.134**	**1.060 (D)**
396.65	34.5	16		4			24	0.065	3.758	18.055	18.055	0.192	0.065	3.138	4.377	0.895	**0.163**	0.760	**0.132**	**1.235 (D)**
391.65	39.5	32		4			22	0.071	4.113	37.656	37.656	0.001	0.071	3.493	5.044	0.819	**0.001**	0.716	**0.128**	**N.L. (3)**
386.15	45	11		9			20	0.062	4.454	11.133	11.879	0.130	0.062	3.834	5.728	0.866	**0.107**	0.679	**0.126**	**0.849 (C)**
381.65	49.5	9	1.65	75	12	12	31	0.065	4.747	8.781	15.538	0.166	0.065	4.127	6.301	0.838	**0.131**	0.657	**0.125**	**N.L. (2)**
371.65	59.5	4	0.16	75	10	12	37	0.040	5.147	3.721	9.465	0.108	0.040	4.527	7.325	0.841	**0.086**	0.631	**0.127**	**0.677 (C)**
361.65	69.5	15	0.41	36	10	12	25	0.049	5.637	13.129	20.755	0.225	0.049	5.017	8.439	0.773	**0.165**	0.609	**0.127**	**1.299 (C)**
351.65	79.5	31		7			22	0.071	6.347	26.444	26.790	0.333	0.071	5.727	9.773	0.716	**0.226**	0.595	**0.126**	**N.L. (3)**

* 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

Structure Number 051-0075 Embarras River Overflow
Located in the W 1/2 of Section 30, Township 4 N, Range 11 W of the 3 P.M.

Liquefied Layers



NOT TO HORIZONTAL SCALE

Illinois Department of Transportation
Division of Highways
IDOT

VARIATIONS IN SUBSURFACE CONDITIONS MAY EXIST BETWEEN BORINGS

Groundwater
▽ First Encounter
▼ Completion
▼ after (refer to log) hours

Abbreviations
WOH - Sampler Advanced by Weight of Hammer, WOP - Weight of Pipe
B.S. - Before Seating

SUBSURFACE DATA PROFILE

Route: FAP 332 (IL 1)

Section: (16BR-1,BR-2)B-1

County: Lawrence

TEST FENCE 2 051-0075 SOIL ROCK 2017.GPJ D6TEMPLT.GDT 10/16/17

TEST FENCE 2 051-0075 SOIL ROCK 2017.GPJ D6TEMPLT.GDT 10/16/17

Structure Number 051-0075 Embarras River Overflow
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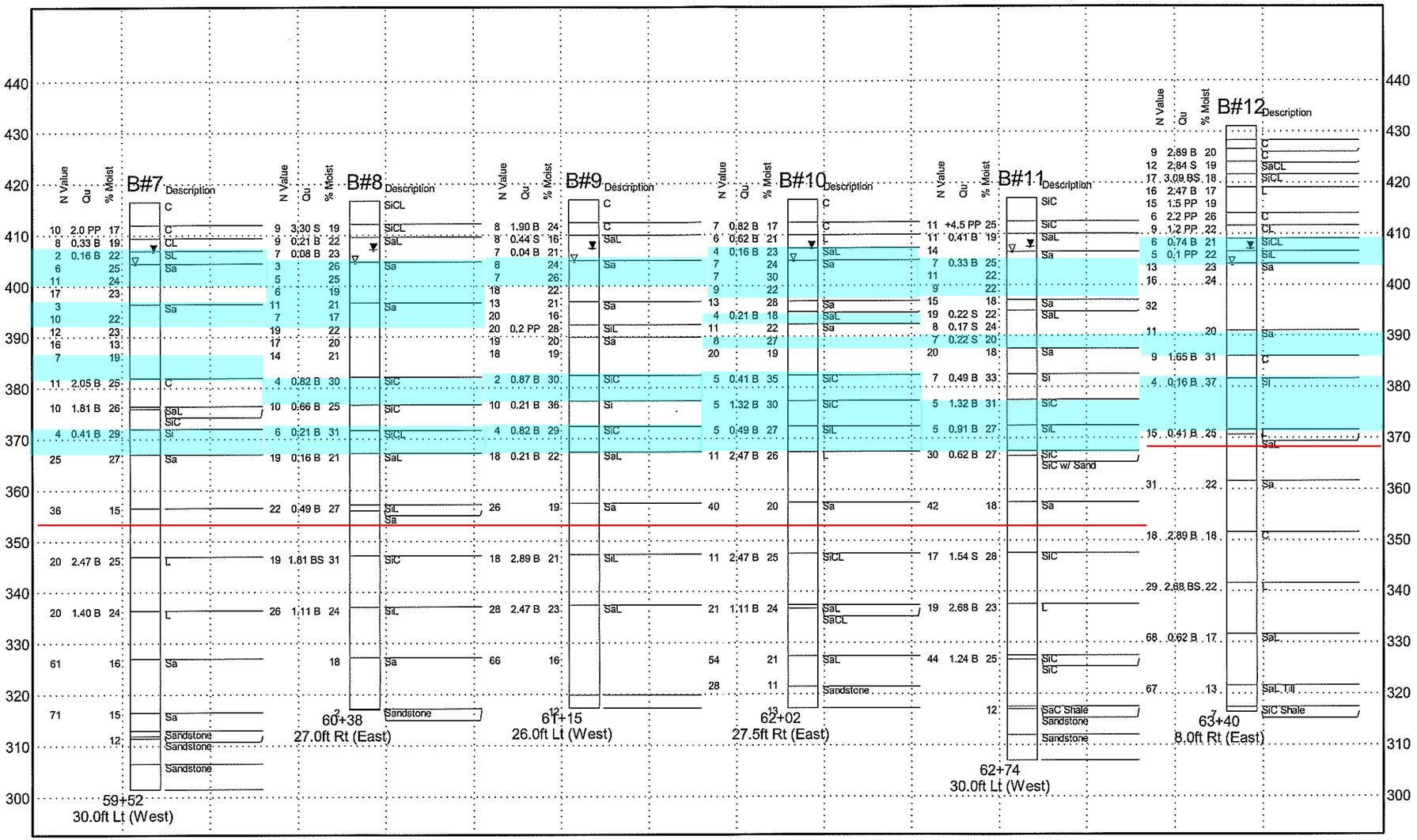
Liquefied Layers



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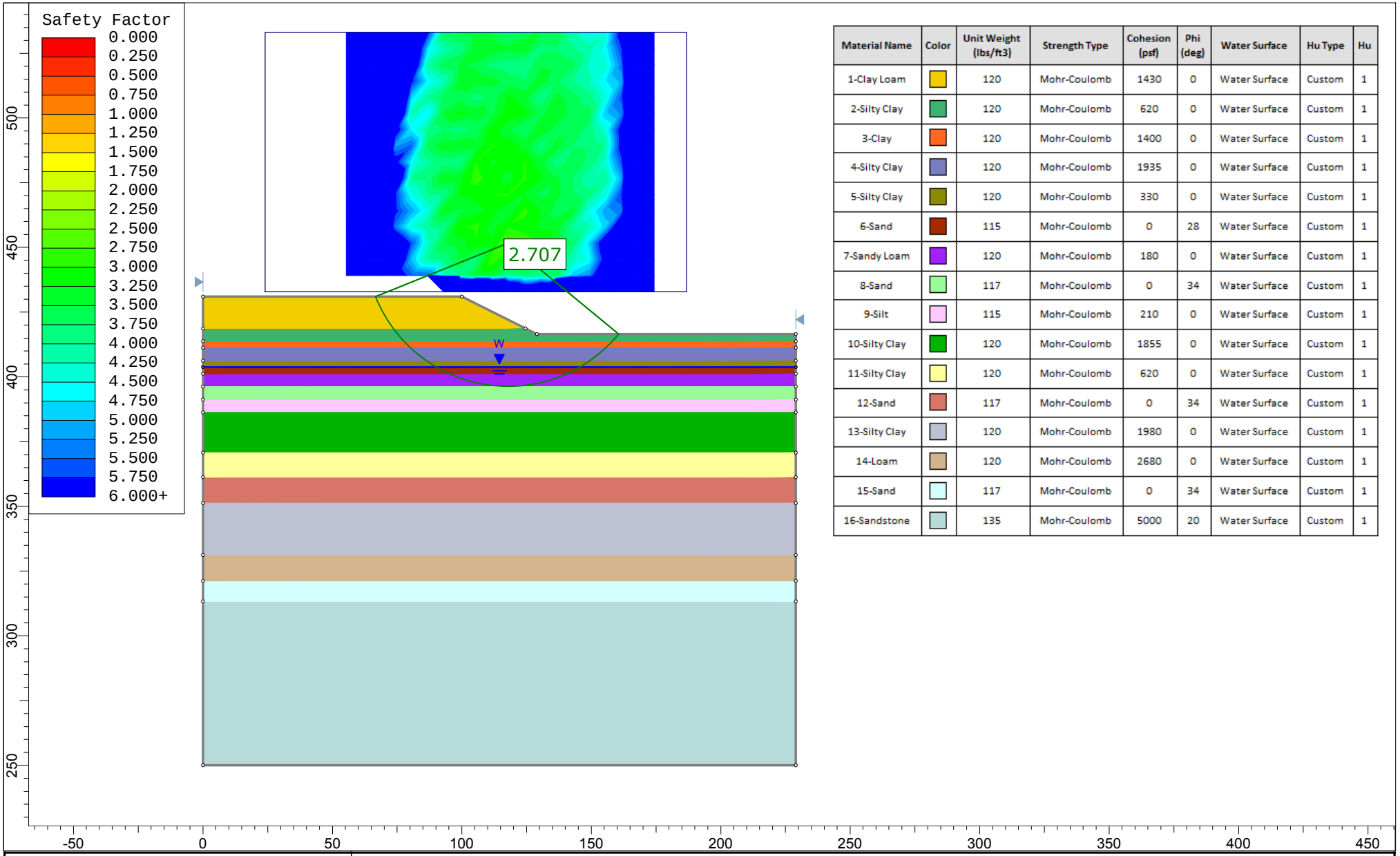
TEST FENCE 2 051-0075 SOIL ROCK 2017.GPJ D6TEMPLT.GDT 10/16/17

TEST FENCE 2 051-0075 SOIL ROCK 2017.GPJ D6TEMPLT.GDT 10/16/17

Appendix C



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
1-Clay Loam		120	Mohr-Coulomb	1430	0	Water Surface	Custom	1
2-Silty Clay		120	Mohr-Coulomb	620	0	Water Surface	Custom	1
3-Clay		120	Mohr-Coulomb	1400	0	Water Surface	Custom	1
4-Silty Clay		120	Mohr-Coulomb	1935	0	Water Surface	Custom	1
5-Silty Clay		120	Mohr-Coulomb	330	0	Water Surface	Custom	1
6-Sand		115	Mohr-Coulomb	0	28	Water Surface	Custom	1
7-Sandy Loam		120	Mohr-Coulomb	180	0	Water Surface	Custom	1
8-Sand		117	Mohr-Coulomb	0	34	Water Surface	Custom	1
9-Silt		115	Mohr-Coulomb	210	0	Water Surface	Custom	1
10-Silty Clay		120	Mohr-Coulomb	1855	0	Water Surface	Custom	1
11-Silty Clay		120	Mohr-Coulomb	620	0	Water Surface	Custom	1
12-Sand		117	Mohr-Coulomb	0	34	Water Surface	Custom	1
13-Silty Clay		120	Mohr-Coulomb	1980	0	Water Surface	Custom	1
14-Loam		120	Mohr-Coulomb	2680	0	Water Surface	Custom	1
15-Sand		117	Mohr-Coulomb	0	34	Water Surface	Custom	1
16-Sandstone		135	Mohr-Coulomb	5000	20	Water Surface	Custom	1

rocscience

SLIDEINTERPRET 7.021

Project	SN 051-0075 Slope Stability Analysis		
Analysis Description	South Abutment - Static		
Drawn By	LNJ	*Scale* 1:615	*Company* BBS Foundations & Geotechnical Unit
Date	5/31/2018, 10:45:54 AM		*File Name* SAbut B-01_Static Slope_051-0075.slim

Slide Analysis Information

SN 051-0075 Slope Stability Analysis

Project Summary

File Name:	SAbut B-01_Static Slope_051-0075.slim
Slide Modeler Version:	7.021
Project Title:	SN 051-0075 Slope Stability Analysis
Analysis:	South Abutment - Static
Author:	LNJ
Company:	BBS Foundations & Geotechnical Unit
Date Created:	5/31/2018, 10:45:54 AM

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Failure Direction:	Left to Right
Data Output:	Standard
Maximum Material Properties:	20
Maximum Support Properties:	20

Analysis Options

Slices Type:	Vertical

Analysis Methods Used
Bishop simplified
Janbu simplified

Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius Increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Invalid Surfaces
Minimum Elevation: Not Defined
Minimum Depth: Not Defined
Minimum Area: Not Defined
Minimum Weight: Not Defined

Seismic

Advanced seismic analysis: No
Staged pseudostatic analysis: No

Material Properties

Property	1-Clay Loam	2-Silty Clay	3-Clay	4-Silty Clay	5-Silty Clay	6-Sand	7-Sandy Loam	8-Sand
Color								
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	120	120	120	120	120	115	120	117
Cohesion [psf]	1430	620	1400	1935	330	0	180	0
Friction Angle [deg]	0	0	0	0	0	28	0	34
Water Surface	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table
Hu Value	1	1	1	1	1	1	1	1

Property	9-Silt	10-Silty Clay	11-Silty Clay	12-Sand	13-Silty Clay	14-Loam	15-Sand	16-Sandstone
Color								
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	115	120	120	117	120	120	117	135
Cohesion [psf]	210	1855	620	0	1980	2680	0	5000
Friction Angle [deg]	0	0	0	34	0	0	34	20
Water Surface	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table
Hu Value	1	1	1	1	1	1	1	1

Global Minimums

Method: bishop simplified

FS	2.707450
Center:	117.924, 451.643
Radius:	55.287
Left Slip Surface Endpoint:	66.635, 431.000
Right Slip Surface Endpoint:	160.604, 416.500
Resisting Moment:	5.12835e+006 lb-ft
Driving Moment:	1.89416e+006 lb-ft
Total Slice Area:	1833.66 ft2
Surface Horizontal Width:	93.9691 ft
Surface Average Height:	19.5134 ft

Method: janbu simplified

FS	2.882850
Center:	117.924, 451.643
Radius:	55.287
Left Slip Surface Endpoint:	66.635, 431.000
Right Slip Surface Endpoint:	160.604, 416.500
Resisting Horizontal Force:	68190.7 lb
Driving Horizontal Force:	23654 lb
Total Slice Area:	1833.66 ft2
Surface Horizontal Width:	93.9691 ft
Surface Average Height:	19.5134 ft

Valid / Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces: 2839
Number of Invalid Surfaces: 2210

Error Codes:

Error Code -107 reported for 140 surfaces
Error Code -108 reported for 1892 surfaces
Error Code -112 reported for 178 surfaces

Method: janbu simplified

Number of Valid Surfaces: 2669
Number of Invalid Surfaces: 2380

Error Codes:

Error Code -107 reported for 140 surfaces
Error Code -108 reported for 2062 surfaces
Error Code -112 reported for 178 surfaces

Error Codes

The following errors were encountered during the computation:

-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (bishop simplified) - Safety Factor: 2.70745

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	1.7146	394.318	-65.8994	1-Clay Loam	1430	0	528.172	1430	-950.32	0	-950.32	230.388	230.388
2	1.7146	1118.16	-61.8402	1-Clay Loam	1430	0	528.172	1430	-334.214	0	-334.214	652.483	652.483
3	1.7146	1732.93	-58.2678	1-Clay Loam	1430	0	528.172	1430	156.876	0	156.876	1010.99	1010.99
4	1.7146	2270.35	-55.0281	1-Clay Loam	1430	0	528.172	1430	569.292	0	569.292	1324.39	1324.39
5	2.09042	3407.77	-51.7288	2-Silty Clay	620	0	228.998	620	1340.02	0	1340.02	1630.28	1630.28
6	2.09042	4034.89	-48.3496	2-Silty Clay	620	0	228.998	620	1672.8	0	1672.8	1930.27	1930.27
7	2.51019	5575.64	-44.8835	3-Clay	1400	0	517.092	1400	1706.39	0	1706.39	2221.38	2221.38
8	2.06406	5121.38	-41.6167	4-Silty Clay	1935	0	714.695	1935	1846.53	0	1846.53	2481.44	2481.44
9	2.06406	5554.09	-38.8132	4-Silty Clay	1935	0	714.695	1935	2116.16	0	2116.16	2691.06	2691.06
10	2.06406	5946.22	-36.1164	4-Silty Clay	1935	0	714.695	1935	2359.54	0	2359.54	2881.02	2881.02
11	1.97181	6013.42	-33.566	5-Silty Clay	330	0	121.886	330	2968.85	0	2968.85	3049.73	3049.73
12	1.97181	6309.19	-31.1458	5-Silty Clay	330	0	121.886	330	3126.07	0	3126.07	3199.73	3199.73
13	1.62792	5409.69	-28.9876	6-Sand	0	28	583.604	1580.08	2999.84	28.1396	2971.7	3323.17	3295.03
14	1.62792	5572.01	-27.0758	6-Sand	0	28	596.203	1614.19	3118.1	82.2433	3035.86	3422.88	3340.63
15	1.62792	5721.6	-25.1961	6-Sand	0	28	608.122	1646.46	3228.65	132.104	3096.55	3514.76	3382.66
16	1.81757	6553.3	-23.2388	7-Sandy Loam	180	0	66.4832	180	3576.99	180.351	3396.64	3605.54	3425.19
17	1.81757	6715.31	-21.2035	7-Sandy Loam	180	0	66.4832	180	3668.88	226.701	3442.18	3694.67	3467.97
18	1.81757	6848.27	-19.196	7-Sandy Loam	180	0	66.4832	180	3744.68	268.444	3476.24	3767.83	3499.38
19	1.81757	6820.89	-17.2127	7-Sandy Loam	180	0	66.4832	180	3732.16	305.755	3426.4	3752.76	3447
20	1.81757	6738.12	-15.2505	7-Sandy Loam	180	0	66.4832	180	3689.1	338.784	3350.31	3707.22	3368.44
21	1.81757	6640.83	-13.3064	7-Sandy Loam	180	0	66.4832	180	3637.96	367.657	3270.31	3653.69	3286.03
22	1.81757	6529.38	-11.3778	7-Sandy Loam	180	0	66.4832	180	3579	392.481	3186.51	3592.37	3199.89
23	1.81757	6404.09	-9.46228	7-Sandy Loam	180	0	66.4832	180	3512.35	413.343	3099.01	3523.44	3110.09
24	1.81757	6265.21	-7.55735	7-Sandy Loam	180	0	66.4832	180	3438.21	430.318	3007.89	3447.03	3016.71
25	1.81757	6112.94	-5.66079	7-Sandy Loam	180	0	66.4832	180	3356.66	443.463	2913.19	3363.25	2919.78
26	1.81757	5947.44	-3.77044	7-Sandy Loam	180	0	66.4832	180	3267.81	452.821	2814.99	3272.19	2819.37
27	1.81757	5768.8	-1.8842	7-Sandy Loam	180	0	66.4832	180	3171.72	458.424	2713.3	3173.91	2715.49
28	1.81757	5577.11	0	7-Sandy Loam	180	0	66.4832	180	3068.44	460.289	2608.15	3068.44	2608.15
29	1.81757	5372.38	1.8842	7-Sandy Loam	180	0	66.4832	180	2957.99	458.424	2499.56	2955.8	2497.38
30	1.81757	5154.58	3.77044	7-Sandy Loam	180	0	66.4832	180	2840.35	452.821	2387.53	2835.97	2383.15
31	1.81757	4923.66	5.66079	7-Sandy Loam	180	0	66.4832	180	2715.51	443.463	2272.05	2708.92	2265.46

32	1.81757	4679.5	7.55735	7-Sandy Loam	180	0	66.4832	180	2583.41	430.318	2153.09	2574.59	2144.27
33	1.81757	4421.95	9.46228	7-Sandy Loam	180	0	66.4832	180	2443.97	413.343	2030.63	2432.89	2019.55
34	1.81757	4167.16	11.3778	7-Sandy Loam	180	0	66.4832	180	2306.08	392.481	1913.6	2292.7	1900.22
35	1.81757	4045.43	13.3064	7-Sandy Loam	180	0	66.4832	180	2241.45	367.657	1873.8	2225.73	1858.07
36	1.81757	3944.51	15.2505	7-Sandy Loam	180	0	66.4832	180	2188.33	338.784	1849.55	2170.2	1831.42
37	1.81757	3829.06	17.2127	7-Sandy Loam	180	0	66.4832	180	2127.28	305.755	1821.53	2106.68	1800.93
38	1.81757	3698.64	19.196	7-Sandy Loam	180	0	66.4832	180	2058.08	268.444	1789.63	2034.93	1766.49
39	1.81757	3552.74	21.2035	7-Sandy Loam	180	0	66.4832	180	1980.44	226.701	1753.74	1954.65	1727.95
40	1.81757	3390.73	23.2388	7-Sandy Loam	180	0	66.4832	180	1894.06	180.351	1713.71	1865.52	1685.17
41	1.62792	2889.01	25.1961	6-Sand	0	28	355.404	962.239	1941.81	132.104	1809.71	1774.6	1642.5
42	1.62792	2739.42	27.0758	6-Sand	0	28	349.387	945.947	1861.31	82.2433	1779.07	1682.71	1600.47
43	1.62792	2577.1	28.9876	6-Sand	0	28	342.634	927.664	1772.82	28.1396	1744.68	1582.99	1554.85
44	1.97181	2878.25	31.1458	5-Silty Clay	330	0	121.886	330	1533.34	0	1533.34	1459.68	1459.68
45	1.97181	2582.48	33.566	5-Silty Clay	330	0	121.886	330	1390.55	0	1390.55	1309.68	1309.68
46	2.06406	2354.76	36.1164	4-Silty Clay	1935	0	714.695	1935	1662.13	0	1662.13	1140.65	1140.65
47	2.06406	1962.62	38.8132	4-Silty Clay	1935	0	714.695	1935	1525.55	0	1525.55	950.653	950.653
48	2.06406	1529.92	41.6167	4-Silty Clay	1935	0	714.695	1935	1375.91	0	1375.91	740.998	740.998
49	2.51019	1207.9	44.8835	3-Clay	1400	0	517.092	1400	996.012	0	996.012	481.02	481.02
50	2.43107	402.585	48.6257	2-Silty Clay	620	0	228.998	620	425.492	0	425.492	165.51	165.51

Global Minimum Query (janbu simplified) - Safety Factor: 2.88285

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	1.7146	394.318	-65.8994	1-Clay Loam	1430	0	496.037	1430	-878.747	0	-878.747	230.124	230.124
2	1.7146	1118.16	-61.8402	1-Clay Loam	1430	0	496.037	1430	-274.402	0	-274.402	652.262	652.262
3	1.7146	1732.93	-58.2678	1-Clay Loam	1430	0	496.037	1430	208.651	0	208.651	1010.79	1010.79
4	1.7146	2270.35	-55.0281	1-Clay Loam	1430	0	496.037	1430	615.067	0	615.067	1324.22	1324.22
5	2.09042	3407.77	-51.7288	2-Silty Clay	620	0	215.065	620	1357.62	0	1357.62	1630.22	1630.22
6	2.09042	4034.89	-48.3496	2-Silty Clay	620	0	215.065	620	1688.41	0	1688.41	1930.21	1930.21
7	2.51019	5575.64	-44.8835	3-Clay	1400	0	485.631	1400	1737.61	0	1737.61	2221.26	2221.26
8	2.06406	5121.38	-41.6167	4-Silty Clay	1935	0	671.211	1935	1885.02	0	1885.02	2481.3	2481.3
9	2.06406	5554.09	-38.8132	4-Silty Clay	1935	0	671.211	1935	2151.01	0	2151.01	2690.93	2690.93
10	2.06406	5946.22	-36.1164	4-Silty Clay	1935	0	671.211	1935	2391.15	0	2391.15	2880.9	2880.9
11	1.97181	6013.42	-33.566	5-Silty Clay	330	0	114.47	330	2973.76	0	2973.76	3049.71	3049.71
12	1.97181	6309.19	-31.1458	5-Silty Clay	330	0	114.47	330	3130.53	0	3130.53	3199.71	3199.71
13	1.62792	5409.69	-28.9876	6-Sand	0	28	551.378	1589.54	3017.62	28.1396	2989.49	3323.1	3294.96
14	1.62792	5572.01	-27.0758	6-Sand	0	28	563.044	1623.17	3134.99	82.2433	3052.74	3422.81	3340.57

15	1.62792	5721.6	-25.1961	6-Sand	0	28	574.067	1654.95	3244.61	132.104	3112.51	3514.7	3382.59
16	1.81757	6553.3	-23.2388	7-Sandy Loam	180	0	62.4382	180	3578.72	180.351	3398.37	3605.53	3425.18
17	1.81757	6715.31	-21.2035	7-Sandy Loam	180	0	62.4382	180	3670.44	226.701	3443.74	3694.67	3467.96
18	1.81757	6848.27	-19.196	7-Sandy Loam	180	0	62.4382	180	3746.08	268.444	3477.64	3767.82	3499.38
19	1.81757	6820.89	-17.2127	7-Sandy Loam	180	0	62.4382	180	3733.41	305.755	3427.66	3752.75	3447
20	1.81757	6738.12	-15.2505	7-Sandy Loam	180	0	62.4382	180	3690.19	338.784	3351.41	3707.22	3368.43
21	1.81757	6640.83	-13.3064	7-Sandy Loam	180	0	62.4382	180	3638.92	367.657	3271.26	3653.68	3286.03
22	1.81757	6529.38	-11.3778	7-Sandy Loam	180	0	62.4382	180	3579.8	392.481	3187.32	3592.37	3199.89
23	1.81757	6404.09	-9.46228	7-Sandy Loam	180	0	62.4382	180	3513.03	413.343	3099.68	3523.43	3110.09
24	1.81757	6265.21	-7.55735	7-Sandy Loam	180	0	62.4382	180	3438.74	430.318	3008.42	3447.02	3016.71
25	1.81757	6112.94	-5.66079	7-Sandy Loam	180	0	62.4382	180	3357.06	443.463	2913.59	3363.25	2919.78
26	1.81757	5947.44	-3.77044	7-Sandy Loam	180	0	62.4382	180	3268.07	452.821	2815.25	3272.19	2819.37
27	1.81757	5768.8	-1.8842	7-Sandy Loam	180	0	62.4382	180	3171.86	458.424	2713.43	3173.91	2715.49
28	1.81757	5577.11	0	7-Sandy Loam	180	0	62.4382	180	3068.44	460.289	2608.15	3068.44	2608.15
29	1.81757	5372.38	1.8842	7-Sandy Loam	180	0	62.4382	180	2957.86	458.424	2499.43	2955.8	2497.38
30	1.81757	5154.58	3.77044	7-Sandy Loam	180	0	62.4382	180	2840.09	452.821	2387.27	2835.97	2383.15
31	1.81757	4923.66	5.66079	7-Sandy Loam	180	0	62.4382	180	2715.11	443.463	2271.65	2708.92	2265.46
32	1.81757	4679.5	7.55735	7-Sandy Loam	180	0	62.4382	180	2582.87	430.318	2152.56	2574.59	2144.27
33	1.81757	4421.95	9.46228	7-Sandy Loam	180	0	62.4382	180	2443.3	413.343	2029.95	2432.89	2019.55
34	1.81757	4167.16	11.3778	7-Sandy Loam	180	0	62.4382	180	2305.27	392.481	1912.79	2292.7	1900.22
35	1.81757	4045.43	13.3064	7-Sandy Loam	180	0	62.4382	180	2240.5	367.657	1872.84	2225.73	1858.08
36	1.81757	3944.51	15.2505	7-Sandy Loam	180	0	62.4382	180	2187.23	338.784	1848.45	2170.21	1831.42
37	1.81757	3829.06	17.2127	7-Sandy Loam	180	0	62.4382	180	2126.03	305.755	1820.27	2106.69	1800.93
38	1.81757	3698.64	19.196	7-Sandy Loam	180	0	62.4382	180	2056.67	268.444	1788.23	2034.94	1766.49
39	1.81757	3552.74	21.2035	7-Sandy Loam	180	0	62.4382	180	1978.89	226.701	1752.18	1954.66	1727.96
40	1.81757	3390.73	23.2388	7-Sandy Loam	180	0	62.4382	180	1892.34	180.351	1711.98	1865.52	1685.17
41	1.62792	2889.01	25.1961	6-Sand	0	28	331.734	956.338	1930.71	132.104	1798.61	1774.64	1642.53
42	1.62792	2739.42	27.0758	6-Sand	0	28	325.925	939.592	1849.36	82.2433	1767.11	1682.75	1600.5
43	1.62792	2577.1	28.9876	6-Sand	0	28	319.423	920.849	1760	28.1396	1731.86	1583.04	1554.9
44	1.97181	2878.25	31.1458	5-Silty Clay	330	0	114.47	330	1528.87	0	1528.87	1459.69	1459.69
45	1.97181	2582.48	33.566	5-Silty Clay	330	0	114.47	330	1385.65	0	1385.65	1309.69	1309.69
46	2.06406	2354.76	36.1164	4-Silty Clay	1935	0	671.211	1935	1630.52	0	1630.52	1140.77	1140.77
47	2.06406	1962.62	38.8132	4-Silty Clay	1935	0	671.211	1935	1490.71	0	1490.71	950.784	950.784
48	2.06406	1529.92	41.6167	4-Silty Clay	1935	0	671.211	1935	1337.42	0	1337.42	741.14	741.14
49	2.51019	1207.9	44.8835	3-Clay	1400	0	485.631	1400	964.794	0	964.794	481.135	481.135

50	2.43107	402.585	48.6257	2-Silty Clay	620	0	215.065	620	409.73	0	409.73	165.567	165.567

Interslice Data

Global Minimum Query (bishop simplified) - Safety Factor: 2.70745

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	66.6352	431	0	0	0
2	68.3498	427.167	-4547.8	0	0
3	70.0644	423.964	-6523.62	0	0
4	71.779	421.191	-6993.94	0	0
5	73.4936	418.74	-6503.74	0	0
6	75.584	416.09	-3431.66	0	0
7	77.6744	413.74	21.4367	0	0
8	80.1846	411.24	2989.86	0	0
9	82.2487	409.406	4901.06	0	0
10	84.3127	407.746	6939.92	0	0
11	86.3768	406.24	9018.83	0	0
12	88.3486	404.932	12663	0	0
13	90.3204	403.74	16147.8	0	0
14	91.9483	402.838	17903.7	0	0
15	93.5763	402.006	19528.3	0	0
16	95.2042	401.24	21011.5	0	0
17	97.0217	400.46	23682.4	0	0
18	98.8393	399.754	26148.6	0	0
19	100.657	399.122	28397.4	0	0
20	102.474	398.559	30378.1	0	0
21	104.292	398.063	32085.4	0	0
22	106.11	397.633	33528.5	0	0
23	107.927	397.267	34716.7	0	0
24	109.745	396.964	35659.9	0	0
25	111.562	396.723	36368.2	0	0
26	113.38	396.543	36852.2	0	0
27	115.197	396.423	37122.8	0	0
28	117.015	396.364	37191.6	0	0
29	118.833	396.364	37070.8	0	0
30	120.65	396.423	36773.2	0	0
31	122.468	396.543	36312.2	0	0
32	124.285	396.723	35702.1	0	0
33	126.103	396.964	34958.4	0	0
34	127.92	397.267	34097.2	0	0
35	129.738	397.633	33133	0	0
36	131.556	398.063	32048.7	0	0
37	133.373	398.559	30843.5	0	0
38	135.191	399.122	29524.8	0	0
39	137.008	399.754	28101.7	0	0
40	138.826	400.46	26584.4	0	0
41	140.643	401.24	24985.4	0	0
42	142.271	402.006	22919.8	0	0
43	143.899	402.838	20802.2	0	0
44	145.527	403.74	18645.7	0	0
45	147.499	404.932	16578.3	0	0
46	149.471	406.24	14518.7	0	0
47	151.535	407.746	10540.8	0	0
48	153.599	409.406	6533.23	0	0
49	155.663	411.24	2535.67	0	0
50	158.173	413.74	-1251.9	0	0
51	160.604	416.5	0	0	0

Global Minimum Query (janbu simplified) - Safety Factor: 2.88285

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	66.6352	431	0	0	0
2	68.3498	427.167	-4218.57	0	0
3	70.0644	423.964	-5947.9	0	0
4	71.779	421.191	-6219.77	0	0
5	73.4936	418.74	-5562.47	0	0
6	75.584	416.09	-2414.76	0	0
7	77.6744	413.74	1104.05	0	0
8	80.1846	411.24	4229.2	0	0
9	82.2487	409.406	6300.4	0	0
10	84.3127	407.746	8486.54	0	0
11	86.3768	406.24	10702.5	0	0
12	88.3486	404.932	14367.6	0	0
13	90.3204	403.74	17872.3	0	0
14	91.9483	402.838	19696.5	0	0
15	93.5763	402.006	21388.9	0	0
16	95.2042	401.24	22939.5	0	0
17	97.0217	400.46	25619.2	0	0
18	98.8393	399.754	28093.8	0	0
19	100.657	399.122	30350.8	0	0
20	102.474	398.559	32339.6	0	0
21	104.292	398.063	34054.7	0	0
22	106.11	397.633	35505.5	0	0
23	107.927	397.267	36701.4	0	0
24	109.745	396.964	37652.1	0	0
25	111.562	396.723	38367.8	0	0
26	113.38	396.543	38859.2	0	0
27	115.197	396.423	39137.2	0	0
28	117.015	396.364	39213.4	0	0
29	118.833	396.364	39099.9	0	0
30	120.65	396.423	38809.6	0	0
31	122.468	396.543	38355.9	0	0
32	124.285	396.723	37753.3	0	0
33	126.103	396.964	37017	0	0
34	127.92	397.267	36163.4	0	0
35	129.738	397.633	35206.7	0	0
36	131.556	398.063	34130.1	0	0
37	133.373	398.559	32932.8	0	0
38	135.191	399.122	31622.2	0	0
39	137.008	399.754	30207.3	0	0
40	138.826	400.46	28698.4	0	0
41	140.643	401.24	27108.1	0	0
42	142.271	402.006	25089.4	0	0
43	143.899	402.838	23019.8	0	0
44	145.527	403.74	20912.5	0	0
45	147.499	404.932	18865	0	0
46	149.471	406.24	16826.4	0	0
47	151.535	407.746	12985.5	0	0
48	153.599	409.406	9125.24	0	0
49	155.663	411.24	5287.68	0	0
50	158.173	413.74	1656.83	0	0
51	160.604	416.5	0	0	0

List Of Coordinates

Water Table

X	Y
0	403.74
229	403.74

External Boundary

X	Y
0	431
0	418.74
0	413.74
0	411.24
0	406.24
0	403.74
0	401.24
0	396.24
0	391.24
0	386.24
0	370.74
0	361.24
0	351.24
0	331.24
0	321.24
0	313.24
0	250
229	250
229	313.24
229	321.24
229	331.24
229	351.24
229	361.24
229	370.74
229	386.24
229	391.24
229	396.24
229	401.24
229	403.74
229	406.24
229	411.24
229	413.74
229	416.5
129	416.5
124.52	418.74
100	431

Material Boundary

X	Y
0	418.74
124.52	418.74

Material Boundary

X	Y
0	413.74
229	413.74

Material Boundary

X	Y
0	411.24
229	411.24

Material Boundary

X	Y
0	406.24
229	406.24

Material Boundary

X	Y
0	401.24
229	401.24

Material Boundary

X	Y
0	396.24
229	396.24

Material Boundary

X	Y
0	391.24
229	391.24

Material Boundary

X	Y
0	386.24
229	386.24

Material Boundary

X	Y
0	370.74
229	370.74

Material Boundary

X	Y
0	361.24
229	361.24

Material Boundary

X	Y
0	351.24
229	351.24

Material Boundary

X	Y
0	331.24
229	331.24

Material Boundary

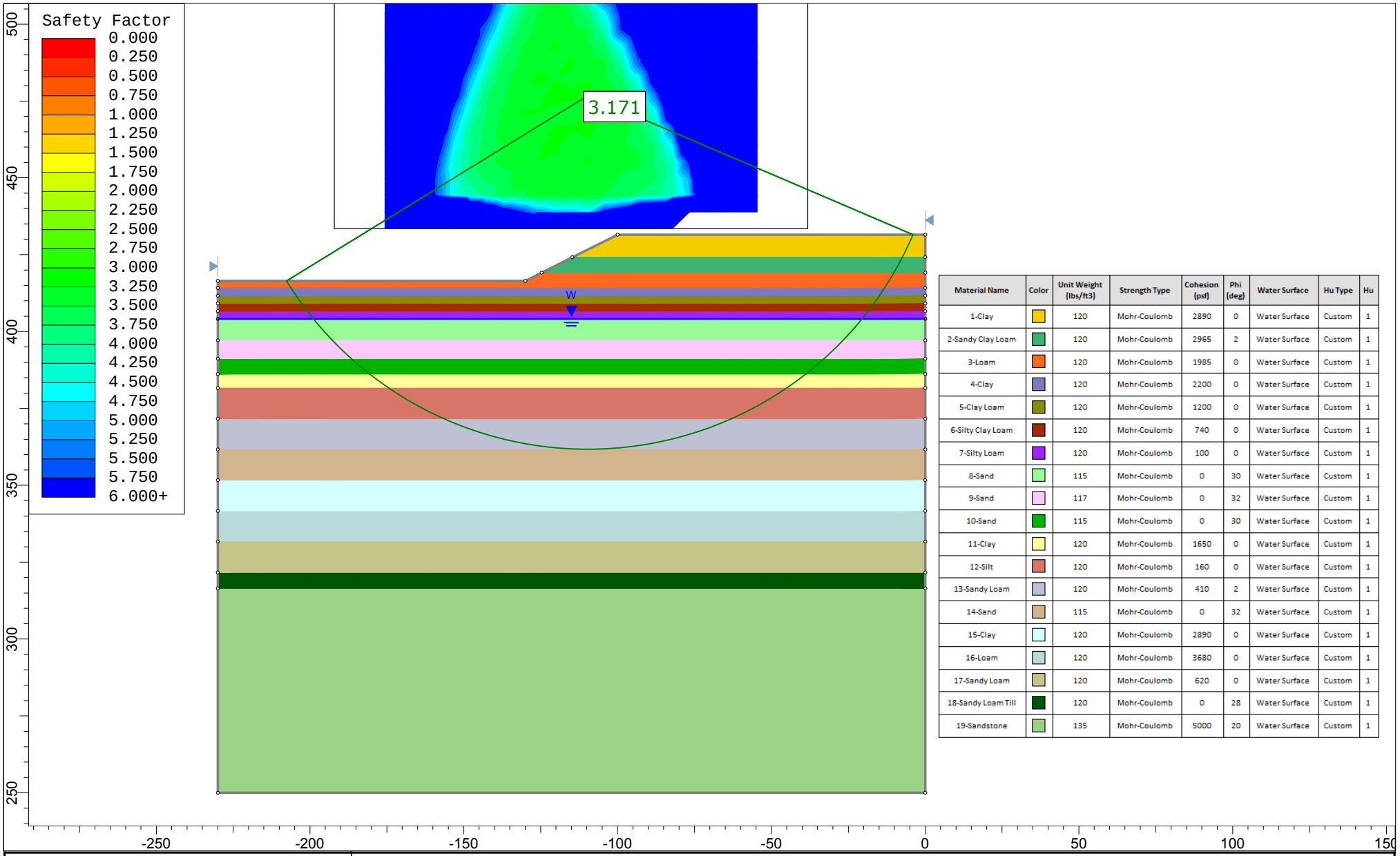
X	Y
0	321.24
229	321.24

Material Boundary

X	Y
0	313.24
229	313.24

Material Boundary

X	Y
0	403.74
229	403.74



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
1-Clay		120	Mohr-Coulomb	2890	0	Water Surface	Custom	1
2-Sandy Clay Loam		120	Mohr-Coulomb	2965	2	Water Surface	Custom	1
3-Loam		120	Mohr-Coulomb	1985	0	Water Surface	Custom	1
4-Clay		120	Mohr-Coulomb	2200	0	Water Surface	Custom	1
5-Clay Loam		120	Mohr-Coulomb	1200	0	Water Surface	Custom	1
6-Silty Clay Loam		120	Mohr-Coulomb	740	0	Water Surface	Custom	1
7-Silty Loam		120	Mohr-Coulomb	100	0	Water Surface	Custom	1
8-Sand		115	Mohr-Coulomb	0	30	Water Surface	Custom	1
9-Sand		117	Mohr-Coulomb	0	32	Water Surface	Custom	1
10-Sand		115	Mohr-Coulomb	0	30	Water Surface	Custom	1
11-Clay		120	Mohr-Coulomb	1650	0	Water Surface	Custom	1
12-Silt		120	Mohr-Coulomb	160	0	Water Surface	Custom	1
13-Sandy Loam		120	Mohr-Coulomb	410	2	Water Surface	Custom	1
14-Sand		115	Mohr-Coulomb	0	32	Water Surface	Custom	1
15-Clay		120	Mohr-Coulomb	2890	0	Water Surface	Custom	1
16-Loam		120	Mohr-Coulomb	3680	0	Water Surface	Custom	1
17-Sandy Loam		120	Mohr-Coulomb	620	0	Water Surface	Custom	1
18-Sandy Loam Till		120	Mohr-Coulomb	0	28	Water Surface	Custom	1
19-Sandstone		135	Mohr-Coulomb	5000	20	Water Surface	Custom	1

rocscience

SLIDEINTERPRET 7.021

Project	SN 051-0075 Slope Stability Analysis			
Analysis Description	North Abutment - Static			
Drawn By	LNJ	*Scale*	1:517	*Company* BBS Foundations & Geotechnical Unit
Date	5/31/2018, 10:45:54 AM			*File Name* NAbut B-12_Static Slope_051-0075.slim

Slide Analysis Information

SN 051-0075 Slope Stability Analysis

Project Summary

File Name:	NAbut B-12_Static Slope_051-0075.slim
Last saved with Slide version:	7.021
Project Title:	SN 051-0075 Slope Stability Analysis
Analysis:	North Abutment - Static
Author:	LNJ
Company:	BBS Foundations & Geotechnical Unit
Date Created:	5/31/2018, 10:45:54 AM

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Failure Direction:	Right to Left
Data Output:	Standard
Maximum Material Properties:	20
Maximum Support Properties:	20

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
	Janbu simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Grid Search
Radius Increment:	10
Composite Surfaces:	Disabled
Reverse Curvature:	Invalid Surfaces
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Material Properties

Property	1-Clay	2-Sandy Clay Loam	3-Loam	4-Clay	5-Clay Loam	6-Silty Clay Loam	7-Silty Loam	8-Sand
Color								
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	120	120	120	120	120	120	120	115
Cohesion [psf]	2890	2965	1985	2200	1200	740	100	0
Friction Angle [deg]	0	2	0	0	0	0	0	30
Water Surface	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table
Hu Value	1	1	1	1	1	1	1	1

Property	9-Sand	10-Sand	11-Clay	12-Silt	13-Sandy Loam	14-Sand	15-Clay	16-Loam
Color								
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	117	115	120	120	120	115	120	120
Cohesion [psf]	0	0	1650	160	410	0	2890	3680
Friction Angle [deg]	32	30	0	0	2	32	0	0
Water Surface	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table
Hu Value	1	1	1	1	1	1	1	1

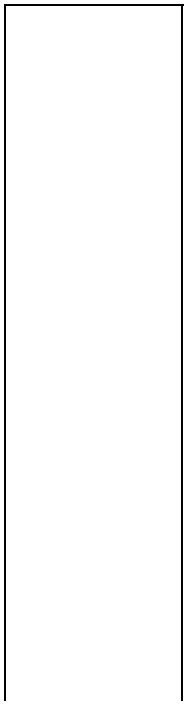
Property	17-Sandy Loam	18-Sandy Loam Till	19-Sandstone
Color			
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	120	120	135
Cohesion [psf]	620	0	5000
Friction Angle [deg]	0	28	20
Water Surface	Water Table	Water Table	Water Table
Hu Value	1	1	1

List Of Coordinates

Water Table

X	Y
-230	404.15
0	404.15

External Boundary



X	Y
-100	431.5
-114.7	424.15
-124.7	419.15
-130	416.5
-230	416.5
-230	414.15
-230	411.65
-230	409.15
-230	406.65
-230	404.15
-230	397.15
-230	391.15
-230	386.15
-230	381.65
-230	371.65
-230	361.65
-230	351.65
-230	341.65
-230	331.65
-230	321.65
-230	316.45
-230	250
0	250
0	316.45
0	321.65
0	331.65
0	341.65
0	351.65
0	361.65
0	371.65
0	381.65
0	386.15
0	391.15
0	397.15
0	404.15
0	406.65
0	409.15
0	411.65
0	414.15
0	419.15
0	424.15
0	431.5

Material Boundary

X	Y
-114.7	424.15
0	424.15

Material Boundary

X	Y
-124.7	419.15
0	419.15

Material Boundary

X	Y
-230	414.15
0	414.15

Material Boundary

X	Y
-230	411.65
0	411.65

Material Boundary

X	Y
-230	409.15
0	409.15

Material Boundary

X	Y
-230	406.65
0	406.65

Material Boundary

X	Y
-230	404.15
0	404.15

Material Boundary

X	Y
-230	397.15
0	397.15

Material Boundary

X	Y
-230	391.15
0	391.15

Material Boundary

X	Y
-230	386.15
0	386.15

Material Boundary

X	Y
-230	381.65
0	381.65

Material Boundary

X	Y
-230	371.65
0	371.65

Material Boundary

X	Y
-230	361.65
0	361.65

Material Boundary

X	Y
-230	351.65
0	351.65

Material Boundary

X	Y
-230	341.65
0	341.65

Material Boundary

X	Y
-230	331.65
0	331.65

Material Boundary

X	Y
-230	321.65
0	321.65

Material Boundary

X	Y
-230	316.45
0	316.45

Appendix D

INPUT PARAMETERS: R=10; M=5.3

LOCATION	South Abut.	
EMBANKMENT HEIGHT (H)	15	FT
PEAK HORIZONTAL GROUND ACCELERATION (PGA)	0.357	DIM
SEISMIC SITE CLASSIFICATION	E	
SITE FACTOR AT ZERO PERIOD ON ACCELERATION SPECTRUM (F_{pga})	1.029	DIM
AASHTO SPECTRAL ACCELERATION AT 1.0 SEC. FOR SITE CLASS B (S_1)	0.336	DIM
AASHTO SITE FACTOR FOR 1.0 SEC. SPECTRAL ACCELERATION (F_V)	2.656	DIM

STEP 1: PSEUDO-STATIC SLOPE STABILITY ANALYSIS:

MAXIMUM POSSIBLE SEISMIC COEFFICIENT (k_{max}) = 0.367353 DIM

$k_{max} = F_{pga} * PGA$ == 1.029*0.357 ====== 0.36735 [EQ. 6-1 FHWA-NHI-11-032]

PEAK AVERAGE SEISMIC COEFFICIENT (k_{av}) = 0.379 DIM

$k_{av} = \alpha * k_{max}$ ====== 1.032*0.367353 === 0.379 [EQ. 6-2 FHWA-NHI-11-032]

SLOPE & HEIGHT ADJUSTMENT FACTORS

$\alpha = 1+0.01*H*(0.5*\beta-1)$ ===== 1+0.01*15*(0.5*2.43-1) ====== 1.032 [EQ. 6-3 FHWA-NHI-11-032]

NOTE: EQUATION IS APPLICABLE FOR H <= 100 FT.
FOR SITE CLASS A & B EQUATION 6-3 SHOULD BE MULTIPLIED BY 1.2.
$\alpha = 1.2*[1+0.01*H*(0.5*\beta-1)]$

$\beta = (F_v*S_1)/k_{max}$ ==== (2.656*0.336)/0.367353 ========== 2.429 [EQ. 6-4 FHWA-NHI-11-032]

HORIZONTAL SEISMIC COEFFICIENT FOR SEISMIC SLOPE STABILITY ANALYSIS (k_h) = **0.19** CONTROL

$k_h = 0.5*\alpha*F_{pga}*PGA = 0.5*\alpha*k_{max} = 0.5*k_{av}$ ====== 0.5*0.379 ======== 0.19 [EQ. 6-5 FHWA-NHI-11-032]

NOTE: THIS k_h VALUE IS FOR A FACTOR OF SAFETY (FOS) OF 1.1 AND ASSUMES THE SLOPE CAN ACCOMMODATE 1-2 INCHES OF PERMANENT DISPLACEMENT.

VERTICAL SEISMIC COEFFICIENT FOR SEISMIC SLOPE STABILITY ANALYSIS (k_v) = **0**

NOTE: VERTICAL ACCELERATION IS NORMALLY SET EQUAL TO ZERO [FHWA-NHI-11-032 PAGE 6-6].

RUN THE SEISMIC SLOPE STABILITY ANALYSIS WITH THE k_h AND k_v SHOWN ABOVE. IF THE FACTOR OF SAFETY (FOS) IS GREATER THAN OR EQUAL TO 1.1 THEN THE SLOPE IS STABLE UNDER SEISMIC CONDITIONS.
IF THE FOS < 1.1 THEN CONTINUE BELOW.

STEP 2: DISPLACEMENT-BASED SEISMIC SLOPE STABILITY:

USING THE SAME STABILITY MODEL AS ABOVE, REDUCE THE HORIZONTAL SEISMIC LOAD/COEFFICIENT (k_h) UNTIL THE FOS INCREASES TO 1.0 [PAGE 6-10 FROM FHWA-NHI-11-032]. THE COEFFICIENT AT WHICH THE FOS = 1.0 IS KNOWN AS THE YIELD ACCELERATION COEFFICIENT. RECORD THIS COEFFICIENT BELOW.

YIELD ACCELERATION SEISMIC COEFFICIENT (k_y)		DIM
MAXIMUM POSSIBLE SEISMIC COEFFICIENT (k_{max})		DIM (SEE ABOVE)
PEAK AVERAGE SEISMIC COEFFICIENT (k_{av})		DIM (SEE ABOVE)
SLOPE & HEIGHT ADJUSTMENT FACTORS		
α ======	DIM (SEE ABOVE)	
β ======	DIM (SEE ABOVE)	
AASHTO SPECTRAL ACCELERATION AT 1.0 SEC. FOR SITE CLASS B (S_1)		DIM (SEE ABOVE)
AASHTO SITE FACTOR FOR 1.0 SEC. SPECTRAL ACCELERATION (F_V)		DIM (SEE ABOVE)
PEAK GROUND VELOCITY (PGV)		
$PGV = 38*F_V*S_1$ ========	[EQ. 6-9 FHWA-NHI-11-032]	

ESTIMATED HORIZONTAL DISPLACEMENT (d) = INCH

FOR SITES IN SITE CLASS A & B: [EQ. 6-8 FHWA-NHI-11-032]

$\log(d) = -1.31 -0.93*\log(k_y/k_{max}) +4.52*\log(1-(k_y/k_{max})) -0.46*\log(k_{max}) +1.12*\log(PGV)$

FOR ALL OTHER SITE CLASSES: [EQ. 6-7 FHWA-NHI-11-032]

$\log(d) = -1.51 -0.74*\log(k_y/k_{max}) +3.27*\log(1-(k_y/k_{max})) -0.80*\log(k_{max}) +1.59*\log(PGV)$

INCH

INPUT PARAMETERS: R=10; M=5.3

LOCATION	North Abut.	
EMBANKMENT HEIGHT (H)	16	FT
PEAK HORIZONTAL GROUND ACCELERATION (PGA)	0.357	DIM
SEISMIC SITE CLASSIFICATION	E	
SITE FACTOR AT ZERO PERIOD ON ACCELERATION SPECTRUM (F_{pga})	1.029	DIM
AASHTO SPECTRAL ACCELERATION AT 1.0 SEC. FOR SITE CLASS B (S_1)	0.336	DIM
AASHTO SITE FACTOR FOR 1.0 SEC. SPECTRAL ACCELERATION (F_V)	2.656	DIM

STEP 1: PSEUDO-STATIC SLOPE STABILITY ANALYSIS:

MAXIMUM POSSIBLE SEISMIC COEFFICIENT (k_{max}) = 0.367353 DIM

$k_{max} = F_{pga} * PGA$ == 1.029*0.357 ====== 0.36735 [EQ. 6-1 FHWA-NHI-11-032]

PEAK AVERAGE SEISMIC COEFFICIENT (k_{av}) = 0.38 DIM

$k_{av} = \alpha^* k_{max}$ ====== 1.034*0.367353 === 0.38 [EQ. 6-2 FHWA-NHI-11-032]

SLOPE & HEIGHT ADJUSTMENT FACTORS

$\alpha = 1+0.01*H*(0.5*\beta-1)$ ===== 1+0.01*16*(0.5*2.43-1) ====== 1.034 [EQ. 6-3 FHWA-NHI-11-032]

NOTE: EQUATION IS APPLICABLE FOR H <= 100 FT.
FOR SITE CLASS A & B EQUATION 6-3 SHOULD BE MULTIPLIED BY 1.2.
$\alpha = 1.2*[1+0.01*H*(0.5*\beta-1)]$

$\beta = (F_v*S_1)/k_{max}$ ==== (2.656*0.336)/0.367353 ========== 2.429 [EQ. 6-4 FHWA-NHI-11-032]

HORIZONTAL SEISMIC COEFFICIENT FOR SEISMIC SLOPE STABILITY ANALYSIS (k_h) = **0.19** CONTROL

$k_h = 0.5*\alpha*F_{pga}*PGA = 0.5*\alpha*k_{max} = 0.5*k_{av}$ ====== 0.5*0.38 ========= 0.19 [EQ. 6-5 FHWA-NHI-11-032]

NOTE: THIS k_h VALUE IS FOR A FACTOR OF SAFETY (FOS) OF 1.1 AND ASSUMES THE SLOPE CAN ACCOMMODATE 1-2 INCHES OF PERMANENT DISPLACEMENT.

VERTICAL SEISMIC COEFFICIENT FOR SEISMIC SLOPE STABILITY ANALYSIS (k_v) = **0**

NOTE: VERTICAL ACCELERATION IS NORMALLY SET EQUAL TO ZERO [FHWA-NHI-11-032 PAGE 6-6].

RUN THE SEISMIC SLOPE STABILITY ANALYSIS WITH THE k_h AND k_v SHOWN ABOVE. IF THE FACTOR OF SAFETY (FOS) IS GREATER THAN OR EQUAL TO 1.1 THEN THE SLOPE IS STABLE UNDER SEISMIC CONDITIONS.
IF THE FOS < 1.1 THEN CONTINUE BELOW.

STEP 2: DISPLACEMENT-BASED SEISMIC SLOPE STABILITY:

USING THE SAME STABILITY MODEL AS ABOVE, REDUCE THE HORIZONTAL SEISMIC LOAD/COEFFICIENT (k_h) UNTIL THE FOS INCREASES TO 1.0 [PAGE 6-10 FROM FHWA-NHI-11-032]. THE COEFFICIENT AT WHICH THE FOS = 1.0 IS KNOWN AS THE YIELD ACCELERATION COEFFICIENT. RECORD THIS COEFFICIENT BELOW.

YIELD ACCELERATION SEISMIC COEFFICIENT (k_y) = DIM

MAXIMUM POSSIBLE SEISMIC COEFFICIENT (k_{max}) = DIM (SEE ABOVE)

PEAK AVERAGE SEISMIC COEFFICIENT (k_{av}) = DIM (SEE ABOVE)

SLOPE & HEIGHT ADJUSTMENT FACTORS

α ====== DIM (SEE ABOVE)

β ====== DIM (SEE ABOVE)

AASHTO SPECTRAL ACCELERATION AT 1.0 SEC. FOR SITE CLASS B (S_1) = DIM (SEE ABOVE)

AASHTO SITE FACTOR FOR 1.0 SEC. SPECTRAL ACCELERATION (F_V) = DIM (SEE ABOVE)

PEAK GROUND VELOCITY (PGV) =

$PGV = 38*F_V*S_1$ ======== [EQ. 6-9 FHWA-NHI-11-032]

ESTIMATED HORIZONTAL DISPLACEMENT (d) = INCH

FOR SITES IN SITE CLASS A & B: [EQ. 6-8 FHWA-NHI-11-032]

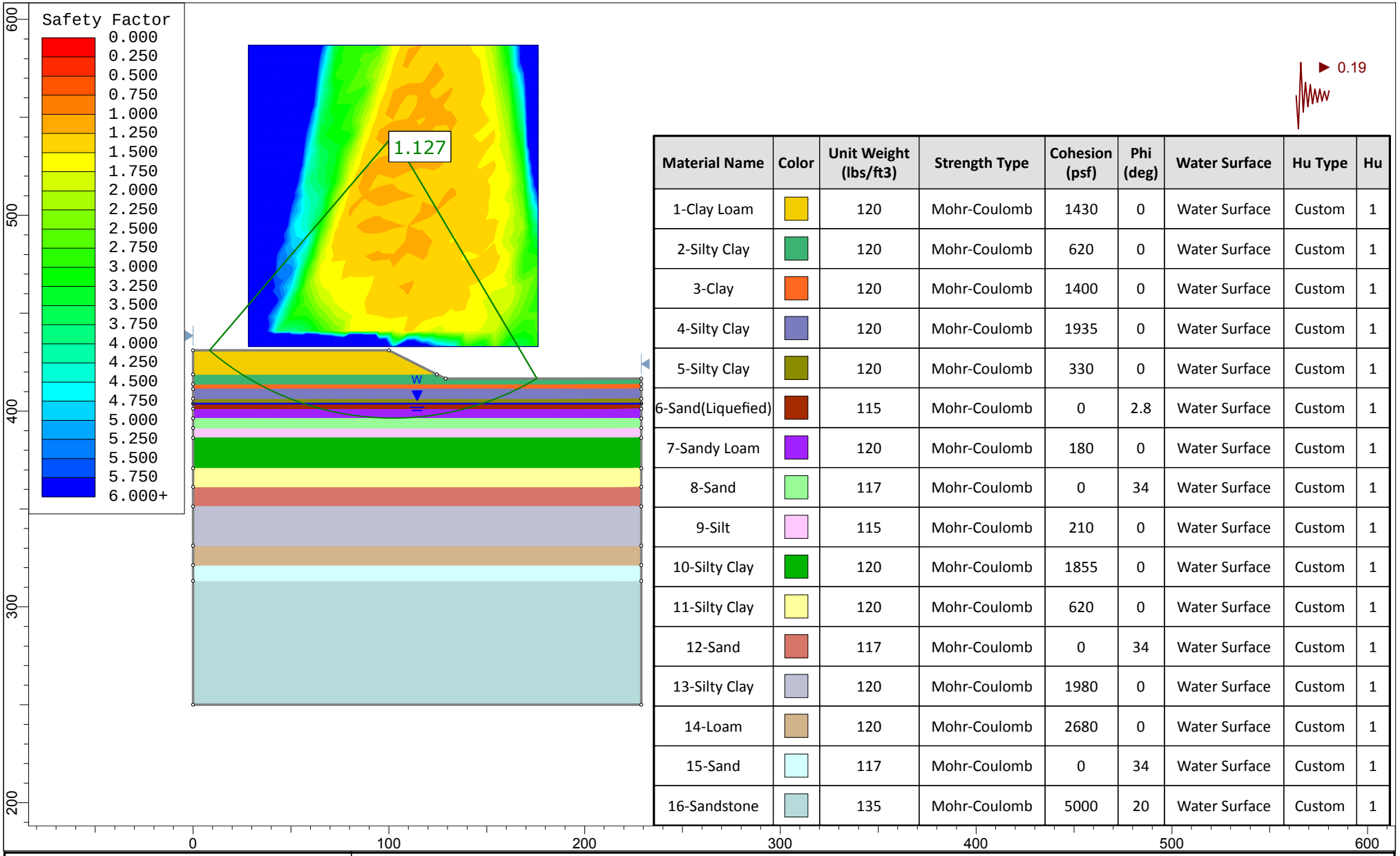
$\log(d) = -1.31 -0.93*\log(k_y/k_{max}) +4.52*\log(1-(k_y/k_{max})) -0.46*\log(k_{max}) +1.12*\log(PGV)$

FOR ALL OTHER SITE CLASSES: [EQ. 6-7 FHWA-NHI-11-032]

$\log(d) = -1.51 -0.74*\log(k_y/k_{max}) +3.27*\log(1-(k_y/k_{max})) -0.80*\log(k_{max}) +1.59*\log(PGV)$

INCH

Appendix E



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
1-Clay Loam		120	Mohr-Coulomb	1430	0	Water Surface	Custom	1
2-Silty Clay		120	Mohr-Coulomb	620	0	Water Surface	Custom	1
3-Clay		120	Mohr-Coulomb	1400	0	Water Surface	Custom	1
4-Silty Clay		120	Mohr-Coulomb	1935	0	Water Surface	Custom	1
5-Silty Clay		120	Mohr-Coulomb	330	0	Water Surface	Custom	1
6-Sand(Liquefied)		115	Mohr-Coulomb	0	2.8	Water Surface	Custom	1
7-Sandy Loam		120	Mohr-Coulomb	180	0	Water Surface	Custom	1
8-Sand		117	Mohr-Coulomb	0	34	Water Surface	Custom	1
9-Silt		115	Mohr-Coulomb	210	0	Water Surface	Custom	1
10-Silty Clay		120	Mohr-Coulomb	1855	0	Water Surface	Custom	1
11-Silty Clay		120	Mohr-Coulomb	620	0	Water Surface	Custom	1
12-Sand		117	Mohr-Coulomb	0	34	Water Surface	Custom	1
13-Silty Clay		120	Mohr-Coulomb	1980	0	Water Surface	Custom	1
14-Loam		120	Mohr-Coulomb	2680	0	Water Surface	Custom	1
15-Sand		117	Mohr-Coulomb	0	34	Water Surface	Custom	1
16-Sandstone		135	Mohr-Coulomb	5000	20	Water Surface	Custom	1

rocscience

SLIDEINTERPRET 7.021

Project	SN 051-0075 Slope Stability Analysis		
Analysis Description	South Abutment - Seismic (R=10; M=5.3)		
Drawn By	LNJ	Scale 1:813	Company BBS Foundations & Geotechnical Unit
Date	5/31/2018, 10:45:54 AM		File Name SAbut B-01_Seismic Slope_051-0075.slim

Slide Analysis Information

SN 051-0075 Slope Stability Analysis

Project Summary

File Name:	SAbut B-01_Seismic Slope_051-0075.slim
Last saved with Slide version:	7.021
Project Title:	SN 051-0075 Slope Stability Analysis
Analysis:	South Abutment - Seismic (R=10; M=5.3)
Author:	LNJ
Company:	BBS Foundations & Geotechnical Unit
Date Created:	5/31/2018, 10:45:54 AM

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Failure Direction:	Left to Right
Data Output:	Standard
Maximum Material Properties:	20
Maximum Support Properties:	20

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
	Janbu simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Grid Search
Radius Increment:	10
Composite Surfaces:	Disabled
Reverse Curvature:	Invalid Surfaces
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Loading

Seismic Load Coefficient (Horizontal): 0.19

Material Properties

Property	1-Clay Loam	2-Silty Clay	3-Clay	4-Silty Clay	5-Silty Clay	6-Sand(Liquefied)	7-Sandy Loam	8-Sand
Color								
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	120	120	120	120	120	115	120	117
Cohesion [psf]	1430	620	1400	1935	330	0	180	0
Friction Angle [deg]	0	0	0	0	0	2.8	0	34
Water Surface	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table
Hu Value	1	1	1	1	1	1	1	1

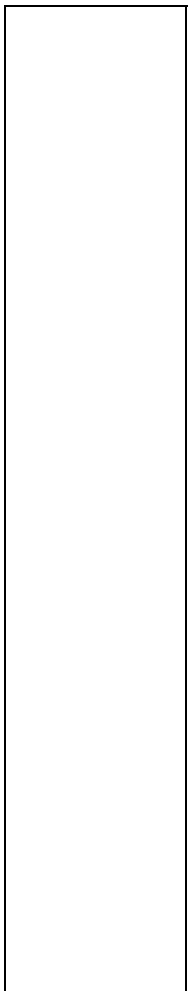
Property	9-Silt	10-Silty Clay	11-Silty Clay	12-Sand	13-Silty Clay	14-Loam	15-Sand	16-Sandstone
Color								
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	115	120	120	117	120	120	117	135
Cohesion [psf]	210	1855	620	0	1980	2680	0	5000
Friction Angle [deg]	0	0	0	34	0	0	34	20
Water Surface	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table
Hu Value	1	1	1	1	1	1	1	1

List Of Coordinates

Water Table

X	Y
0	403.74
229	403.74

External Boundary



X	Y
0	431
0	418.74
0	413.74
0	411.24
0	406.24
0	403.74
0	401.24
0	396.24
0	391.24
0	386.24
0	370.74
0	361.24
0	351.24
0	331.24
0	321.24
0	313.24
0	250
229	250
229	313.24
229	321.24
229	331.24
229	351.24
229	361.24
229	370.74
229	386.24
229	391.24
229	396.24
229	401.24
229	403.74
229	406.24
229	411.24
229	413.74
229	416.5
129	416.5
124.52	418.74
100	431

Material Boundary

X	Y
0	418.74
124.52	418.74

Material Boundary

X	Y
0	413.74
229	413.74

Material Boundary

X	Y
0	411.24
229	411.24

Material Boundary

X	Y
0	406.24
229	406.24

Material Boundary

X	Y
0	401.24
229	401.24

Material Boundary

X	Y
0	396.24
229	396.24

Material Boundary

X	Y
0	391.24
229	391.24

Material Boundary

X	Y
0	386.24
229	386.24

Material Boundary

X	Y
0	370.74
229	370.74

Material Boundary

X	Y
0	361.24
229	361.24

Material Boundary

X	Y
0	351.24
229	351.24

Material Boundary

X	Y
0	331.24
229	331.24

Material Boundary

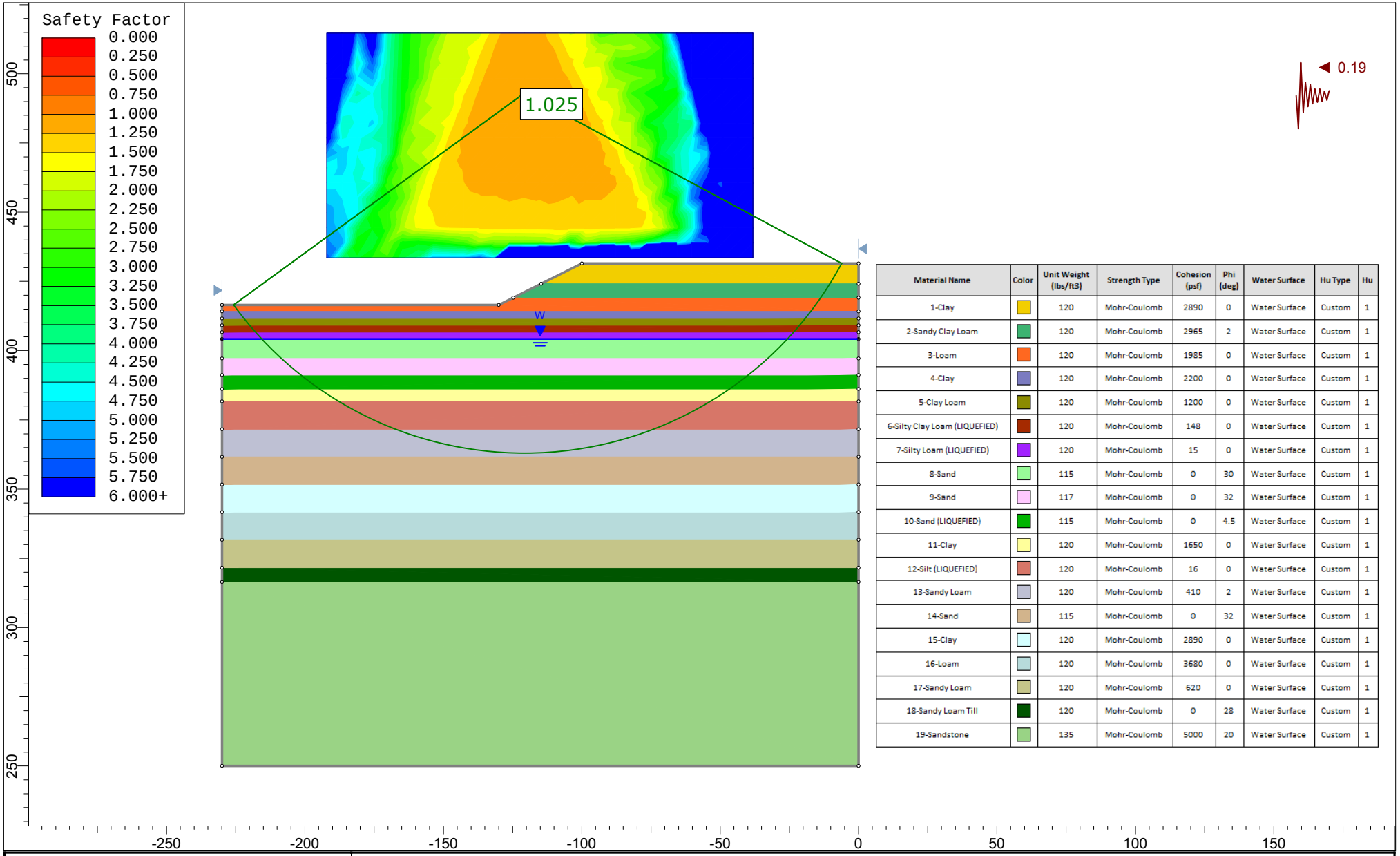
X	Y
0	321.24
229	321.24

Material Boundary

X	Y
0	313.24
229	313.24

Material Boundary

X	Y
0	403.74
229	403.74



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
1-Clay		120	Mohr-Coulomb	2890	0	Water Surface	Custom	1
2-Sandy Clay Loam		120	Mohr-Coulomb	2965	2	Water Surface	Custom	1
3-Loam		120	Mohr-Coulomb	1985	0	Water Surface	Custom	1
4-Clay		120	Mohr-Coulomb	2200	0	Water Surface	Custom	1
5-Clay Loam		120	Mohr-Coulomb	1200	0	Water Surface	Custom	1
6-Silty Clay Loam (LIQUEFIED)		120	Mohr-Coulomb	148	0	Water Surface	Custom	1
7-Silty Loam (LIQUEFIED)		120	Mohr-Coulomb	15	0	Water Surface	Custom	1
8-Sand		115	Mohr-Coulomb	0	30	Water Surface	Custom	1
9-Sand		117	Mohr-Coulomb	0	32	Water Surface	Custom	1
10-Sand (LIQUEFIED)		115	Mohr-Coulomb	0	4.5	Water Surface	Custom	1
11-Clay		120	Mohr-Coulomb	1650	0	Water Surface	Custom	1
12-Silt (LIQUEFIED)		120	Mohr-Coulomb	16	0	Water Surface	Custom	1
13-Sandy Loam		120	Mohr-Coulomb	410	2	Water Surface	Custom	1
14-Sand		115	Mohr-Coulomb	0	32	Water Surface	Custom	1
15-Clay		120	Mohr-Coulomb	2890	0	Water Surface	Custom	1
16-Loam		120	Mohr-Coulomb	3680	0	Water Surface	Custom	1
17-Sandy Loam		120	Mohr-Coulomb	620	0	Water Surface	Custom	1
18-Sandy Loam Till		120	Mohr-Coulomb	0	28	Water Surface	Custom	1
19-Sandstone		135	Mohr-Coulomb	5000	20	Water Surface	Custom	1

Project	SN 051-0075 Slope Stability Analysis		
Analysis Description	North Abutment - Seismic (R=10; M=5.3)		
Drawn By	LNJ	Scale	1:575
Company	BBS Foundations & Geotechnical Unit		
Date	5/31/2018, 10:45:54 AM	File Name	NAbut B-12_Seismic Slope_051-0075.slim

SLIDEINTERPRET 7.021

Slide Analysis Information

SN 051-0075 Slope Stability Analysis

Project Summary

File Name:	NAbut B-12_Seismic Slope_051-0075.slim
Last saved with Slide version:	7.021
Project Title:	SN 051-0075 Slope Stability Analysis
Analysis:	North Abutment - Seismic (R=10; M=5.3)
Author:	LNJ
Company:	BBS Foundations & Geotechnical Unit
Date Created:	5/31/2018, 10:45:54 AM

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Failure Direction:	Right to Left
Data Output:	Standard
Maximum Material Properties:	20
Maximum Support Properties:	20

Analysis Options

Slices Type:	Vertical

Analysis Methods Used
Bishop simplified
Janbu simplified

Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Grid Search
Radius Increment:	10
Composite Surfaces:	Disabled
Reverse Curvature:	Invalid Surfaces
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Loading

Seismic Load Coefficient (Horizontal):	0.19

Material Properties

Property	1-Clay	2-Sandy Clay Loam	3-Loam	4-Clay	5-Clay Loam	6-Silty Clay Loam (LIQUEFIED)	7-Silty Loam (LIQUEFIED)	8-Sand
Color								
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	120	120	120	120	120	120	120	115
Cohesion [psf]	2890	2965	1985	2200	1200	148	15	0
Friction Angle [deg]	0	2	0	0	0	0	0	30
Water Surface	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table
Hu Value	1	1	1	1	1	1	1	1

Property	9-Sand	10-Sand (LIQUEFIED)	11-Clay	12-Silt (LIQUEFIED)	13-Sandy Loam	14-Sand	15-Clay	16-Loam
Color								
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	117	115	120	120	120	115	120	120
Cohesion [psf]	0	0	1650	16	410	0	2890	3680
Friction Angle [deg]	32	4.5	0	0	2	32	0	0
Water Surface	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table
Hu Value	1	1	1	1	1	1	1	1

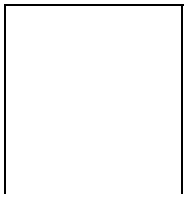
Property	17-Sandy Loam	18-Sandy Loam Till	19-Sandstone
Color			
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	120	120	135
Cohesion [psf]	620	0	5000
Friction Angle [deg]	0	28	20
Water Surface	Water Table	Water Table	Water Table
Hu Value	1	1	1

List Of Coordinates

Water Table

X	Y
-230	404.15
0	404.15

External Boundary



X	Y
-100	431.5
-114.7	424.15
-124.7	419.15
-130	416.5
-230	416.5
-230	414.15
-230	411.65
-230	409.15
-230	406.65
-230	404.15
-230	397.15
-230	391.15
-230	386.15
-230	381.65
-230	371.65
-230	361.65
-230	351.65
-230	341.65
-230	331.65
-230	321.65
-230	316.45
-230	250
0	250
0	316.45
0	321.65
0	331.65
0	341.65
0	351.65
0	361.65
0	371.65
0	381.65
0	386.15
0	391.15
0	397.15
0	404.15
0	406.65
0	409.15
0	411.65
0	414.15
0	419.15
0	424.15
0	431.5

Material Boundary

X	Y
-114.7	424.15
0	424.15

Material Boundary

X	Y
-124.7	419.15
0	419.15

Material Boundary

X	Y
-230	414.15
0	414.15

Material Boundary

X	Y
-230	411.65
0	411.65

Material Boundary

X	Y
-230	409.15
0	409.15

Material Boundary

X	Y
-230	406.65
0	406.65

Material Boundary

X	Y
-230	404.15
0	404.15

Material Boundary

X	Y
-230	397.15
0	397.15

Material Boundary

X	Y
-230	391.15
0	391.15

Material Boundary

X	Y
-230	386.15
0	386.15

Material Boundary

X	Y
-230	381.65
0	381.65

Material Boundary

X	Y
-230	371.65
0	371.65

Material Boundary

X	Y
-230	361.65
0	361.65

Material Boundary

X	Y
-230	351.65
0	351.65

Material Boundary

X	Y
-230	341.65
0	341.65

Material Boundary

X	Y
-230	331.65
0	331.65

Material Boundary

X	Y
-230	321.65
0	321.65

Material Boundary

X	Y
-230	316.45
0	316.45

Appendix F

South Abutment

Estimated Pile Lengths

Assumptions:

Boring Log Referenced	Estimated Factored Load (kips)	Pile Cutoff Elevation (ft)	Pile Embedment Depth (ft)	Ground Surface Elev. Against Pile During Driving (ft)
B-1		426.5	2	423.8

Strength Limit State (ϕ = 0.55)

Scour Elevation (ft)
NA

Extreme Limit State (ϕ = 1.0)

Bottom of Liquefaction Elev. (ft)	Top of Liquefaction Elev. (ft)
401.24	403.74

	HP 12x53		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
104	418	0	230

HP 12x53		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
418	138	280

	HP 12x63		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
104	497	0	273

HP 12x63		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
497	140	357

	HP 14x73		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
105	578	0	215

HP 14x73		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
578	164	414

	HP 14x89		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
110	705	0	388

HP 14x89		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
705	165	540

	HP 14x102		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*115	810	0	446

HP 14x102		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
810	167	643

	HP 14x117		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*117	929	0	511

HP 14x117		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
929	169	760

Note: * Indicates it is estimated the pile can be driven to rock.
Pile Shoes are recommended.

Pier 1

Estimated Pile Lengths

Assumptions:

Boring Log Referenced	Estimated Factored Load (kips)	Pile Cutoff Elevation (ft)	Pile Embedment Depth (ft)	Ground Surface Elev. Against Pile During Driving (ft)
B-2		428.5	2	410.0

Strength Limit State (ϕ = 0.55)

Scour Elevation (ft)
408.6

Extreme Limit State (ϕ = 1.0)

Bottom of Liquefaction Elev. (ft)	Top of Liquefaction Elev. (ft)
367.29	404.79

	HP 12x53		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
111	418	1	229

HP 12x53		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
418	181	237

	HP 12x63		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
113	497	1	272

HP 12x63		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
497	182	315

	HP 14x73		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
113	578	1	317

HP 14x73		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
578	214	364

	HP 14x89		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
115	705	1	387

HP 14x89		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
705	217	488

	HP 14x102		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*117	810	1	445

HP 14x102		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
810	219	591

	HP 14x117		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*117	929	1	510

HP 14x117		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
929	221	708

Note: * Indicates it is estimated the pile can be driven to rock.
Pile shoes are recommended.

Pier 2

Estimated Pile Lengths

Assumptions:

Boring Log Referenced	Estimated Factored Load (kips)	Pile Cutoff Elevation (ft)	Pile Embedment Depth (ft)	Ground Surface Elev. Against Pile During Driving (ft)
B-3		428.75	2	410.0

Strength Limit State (ϕ = 0.55)

Scour Elevation (ft)
409

Extreme Limit State (ϕ = 1.0)

Bottom of Liquefaction Elev. (ft)	Top of Liquefaction Elev. (ft)
366.61	406.31

	HP 12x53		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
115	418	0	230

HP 12x53		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
418	195	223

	HP 12x63		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
116	497	0	273

HP 12x63		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
497	196	301

	HP 14x73		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*117	578	0	318

HP 14x73		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
578	231	347

	HP 14x89		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*117	705	0	388

HP 14x89		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
705	234	471

	HP 14x102		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*119	810	0	446

HP 14x102		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
810	236	574

	HP 14x117		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*119	929	0	511

HP 14x117		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
929	239	690

Note: * Indicates it is estimated the pile can be driven to rock.
Pile shoes are recommended.

Pier 3

Estimated Pile Lengths

Assumptions:

Boring Log Referenced	Estimated Factored Load (kips)	**Pile Cutoff Elevation (ft)	Pile Embedment Depth (ft)	Ground Surface Elev. Against Pile During Driving (ft)
B-4		429	2	410

Strength Limit State (ϕ = 0.55)

Scour Elevation (ft)
409

Extreme Limit State (ϕ = 1.0)

Bottom of Liquefaction Elev. (ft)	Top of Liquefaction Elev. (ft)
366.68	401.68

	HP 12x53		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
105	418	0	230

HP 12x53		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
418	208	210

	HP 12x63		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
115	497	0	273

HP 12x63		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
497	209	288

	HP 14x73		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
115	578	0	318

HP 14x73		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
578	246	332

	HP 14x89		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*117	705	0	388

HP 14x89		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
705	248	457

	HP 14x102		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*118	810	0	446

HP 14x102		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
810	251	559

	HP 14x117		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*119	929	0	511

HP 14x117		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
929	254	675

Note: * Indicates it is estimated the pile can be driven to rock.
Pile shoes are recommended.
**Pile Cutoff Elevation is for a Pile Bent Pier. If a pile supported footing is used instead, subtract from the pile length the distance from the cutoff elevation shown to the proposed top of pile elevation.

Route: FAP 332 (IL 1)
Section:
County: Lawrence

Pier 4

Estimated Pile Lengths

Proposed SN: 051-0075
Existing SN: 051-0005
Contract:

Assumptions:

Boring Log Referenced	Estimated Factored Load (kips)	**Pile Cutoff Elevation (ft)	Pile Embedment Depth (ft)	Ground Surface Elev. Against Pile During Driving (ft)
B-5		429.5	2	410

Strength Limit State (ϕ = 0.55)

Scour Elevation (ft)
409

Extreme Limit State (ϕ = 1.0)

Bottom of Liquefaction Elev. (ft)	Top of Liquefaction Elev. (ft)
364.47	402.27

	HP 12x53		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
105	418	0	230

HP 12x53		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
418	221	197

	HP 12x63		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
109	497	0	273

HP 12x63		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
497	224	273

	HP 14x73		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
110	578	0	318

HP 14x73		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
578	262	316

	HP 14x89		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
114	705	0	388

HP 14x89		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
705	265	440

	HP 14x102		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
115	810	0	446

HP 14x102		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
810	268	542

	HP 14x117		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*117	929	0	511

HP 14x117		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
929	270	659

Note: * Indicates it is estimated the pile can be driven to rock.
Pile shoes are recommended.
**Pile Cutoff Elevation is for a Pile Bent Pier. If a pile supported footing is used instead, subtract from the pile length the distance from the cutoff elevation shown to the proposed top of pile elevation.

Pier 5

Estimated Pile Lengths

Assumptions:

Boring Log Referenced	Estimated Factored Load (kips)	**Pile Cutoff Elevation (ft)	Pile Embedment Depth (ft)	Ground Surface Elev. Against Pile During Driving (ft)
B-6		410.5	2	408.5

Strength Limit State (ϕ = 0.55)

Scour Elevation (ft)
409

Extreme Limit State (ϕ = 1.0)

Bottom of Liquefaction Elev. (ft)	Top of Liquefaction Elev. (ft)
355.87	405.67

	HP 12x53		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
91	418	0	230

HP 12x53		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
418	140	278

	HP 12x63		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
93	497	0	273

HP 12x63		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
497	140	357

	HP 14x73		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
93	578	0	318

HP 14x73		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
578	165	413

	HP 14x89		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
99	705	0	388

HP 14x89		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
705	168	537

	HP 14x102		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*102	810	0	446

HP 14x102		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
810	169	641

	HP 14x117		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*103	929	0	511

HP 14x117		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
929	170	759

Note: * Indicates it is estimated the pile can be driven to rock.
Pile shoes are recommended.
**Pile Cutoff Elevation is for a Pile Supported Footing Pier. If a pile bent pier is used instead, add to the pile length the distance from the cutoff elevation shown to the proposed top of pile elevation.

Pier 6

Estimated Pile Lengths

Assumptions:

Boring Log Referenced	Estimated Factored Load (kips)	**Pile Cutoff Elevation (ft)	Pile Embedment Depth (ft)	Ground Surface Elev. Against Pile During Driving (ft)
B-7		410.5	2	408.5

Strength Limit State (ϕ = 0.55)

Scour Elevation (ft)
408.5

Extreme Limit State (ϕ = 1.0)

Bottom of Liquefaction Elev. (ft)	Top of Liquefaction Elev. (ft)
367.07	407.03

	HP 12x53		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
94	418	0	230

HP 12x53		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
418	122	296

	HP 12x63		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*98	497	0	273

HP 12x63		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
497	123	374

	HP 14x73		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*98	578	0	318

HP 14x73		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
578	144	434

	HP 14x89		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*98	705	0	388

HP 14x89		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
705	146	559

	HP 14x102		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*99	810	0	446

HP 14x102		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
810	147	663

	HP 14x117		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*100	929	0	511

HP 14x117		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
929	149	780

Note: * Indicates it is estimated the pile can be driven to rock.
Pile shoes are recommended.
**Pile Cutoff Elevation is for a Pile Supported Footing Pier. If a pile bent pier is used instead, add to the pile length the distance from the cutoff elevation shown to the proposed top of pile elevation.

Pier 7

Estimated Pile Lengths

Assumptions:

Boring Log Referenced	Estimated Factored Load (kips)	Pile Cutoff Elevation (ft)	Pile Embedment Depth (ft)	Ground Surface Elev. Against Pile During Driving (ft)
B-8		429.75	2	410

Strength Limit State (ϕ = 0.55)

Scour Elevation (ft)
408.3

Extreme Limit State (ϕ = 1.0)

Bottom of Liquefaction Elev. (ft)	Top of Liquefaction Elev. (ft)
367.23	404.73

	HP 12x53		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
109	418	1	229

HP 12x53		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
418	119	299

	HP 12x63		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*114	497	1	272

HP 12x63		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
497	121	376

	HP 14x73		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*114	578	1	317

HP 14x73		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
578	142	436

	HP 14x89		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*114	705	0	388

HP 14x89		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
705	143	562

	HP 14x102		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*115	810	1	445

HP 14x102		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
810	145	665

	HP 14x117		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*116	929	1	510

HP 14x117		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
929	146	783

Note: * Indicates it is estimated the pile can be driven to rock.
Pile shoes are recommended.

Pier 8

Estimated Pile Lengths

Assumptions:

Boring Log Referenced	Estimated Factored Load (kips)	Pile Cutoff Elevation (ft)	Pile Embedment Depth (ft)	Ground Surface Elev. Against Pile During Driving (ft)
B-9		429.5	2	410

Strength Limit State (ϕ = 0.55)

Scour Elevation (ft)
408.1

Extreme Limit State (ϕ = 1.0)

Bottom of Liquefaction Elev. (ft)	Top of Liquefaction Elev. (ft)
367.44	404.94

	HP 12x53		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
110	418	0	230

HP 12x53		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
418	106	312

	HP 12x63		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*111	497	0	273

HP 12x63		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
497	106	391

	HP 14x73		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*111	578	0	318

HP 14x73		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
578	125	453

	HP 14x89		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*112	705	0	388

HP 14x89		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
705	127	578

	HP 14x102		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*112	810	0	446

HP 14x102		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
810	128	682

	HP 14x117		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*112	929	0	511

HP 14x117		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
929	130	799

Note: * Indicates it is estimated the pile can be driven to rock.
Pile shoes are recommended.

Pier 9

Estimated Pile Lengths

Assumptions:

Boring Log Referenced	Estimated Factored Load (kips)	Pile Cutoff Elevation (ft)	Pile Embedment Depth (ft)	Ground Surface Elev. Against Pile During Driving (ft)
B-10		428	2	410

Strength Limit State (ϕ = 0.55)

Scour Elevation (ft)
407.2

Extreme Limit State (ϕ = 1.0)

Bottom of Liquefaction Elev. (ft)	Top of Liquefaction Elev. (ft)
367.48	407.48

	HP 12x53		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*108	418	3	227

HP 12x53		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
418	85	333

	HP 12x63		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*108	497	3	270

HP 12x63		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
497	87	410

	HP 14x73		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*108	578	3	315

HP 14x73		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
578	102	476

	HP 14x89		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*109	705	3	385

HP 14x89		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
705	103	602

	HP 14x102		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*110	810	3	443

HP 14x102		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
810	103	707

	HP 14x117		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*111	929	3	508

HP 14x117		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
929	105	824

Note: * Indicates it is estimated the pile can be driven to rock.
Pile shoes are recommended.

Pier 10

Estimated Pile Lengths

Assumptions:

Boring Log Referenced	Estimated Factored Load (kips)	Pile Cutoff Elevation (ft)	Pile Embedment Depth (ft)	Ground Surface Elev. Against Pile During Driving (ft)
B-11		429.5	2	410

Strength Limit State (ϕ = 0.55)

Scour Elevation (ft)
405.5

Extreme Limit State (ϕ = 1.0)

Bottom of Liquefaction Elev. (ft)	Top of Liquefaction Elev. (ft)
367.57	405.07

	HP 12x53		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*112	418	3	227

HP 12x53		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
418	146	272

	HP 12x63		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*113	497	3	270

HP 12x63		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
497	147	350

	HP 14x73		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*113	578	3	315

HP 14x73		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
578	173	405

	HP 14x89		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*113	705	0	388

HP 14x89		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
705	175	530

	HP 14x102		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*114	810	3	443

HP 14x102		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
810	177	633

	HP 14x117		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*115	929	3	508

HP 14x117		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
929	179	750

Note: * Indicates it is estimated the pile can be driven to rock.
Pile shoes are recommended.

North Abutment

Estimated Pile Lengths

Assumptions:

Boring Log Referenced	Estimated Factored Load (kips)	Pile Cutoff Elevation (ft)	Pile Embedment Depth (ft)	Ground Surface Elev. Against Pile During Driving (ft)
B-12		426.75	2	424.5

Strength Limit State (ϕ = 0.55)

Scour Elevation (ft)
NA

Extreme Limit State (ϕ = 1.0)

Bottom of Liquefaction Elev. (ft)	Top of Liquefaction Elev. (ft)
371.65	409.15

	HP 12x53		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
105	418	0	230

HP 12x53		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
418	211	207

	HP 12x63		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*110	497	0	273

HP 12x63		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
497	213	284

	HP 14x73		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*110	578	0	318

HP 14x73		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
578	250	328

	HP 14x89		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*111	705	0	388

HP 14x89		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
705	252	453

	HP 14x102		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*111	810	0	446

HP 14x102		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
810	255	555

	HP 14x117		
Estimated Pile Length (ft)	Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Factored Resistance Available (kips)
*112	929	0	511

HP 14x117		
Nominal Required Bearing (kips)	Factored Geotechnical Loss (kips)	Seismic Resistance Available (kips)
929	259	670

Note: * Indicates it is estimated the pile can be driven to rock.
Pile Shoes are recommended.

Appendix G

Benchmark: Chiseled square on Souteast corner of bridge hubguard of S.N. 051-0005; 15.4' Rt. Sta. 54+72.6
Elev. 431.29

Existing Structure: Structure No. 051-0005, a 22 span structure was built in 1923 as SBI Route 1, Section 16. The superstructure was replaced in 1964 and the three north end spans were filled in, reducing the number of spans to 19. The bridge is 819'-1½" back-to-back and 35'-8" out-to-out. The superstructure consists of a reinforced concrete deck on wide flange beams, supported by one closed and one open abutment and two-column piers on pile supported footings. The bridge is to be removed and replaced utilizing stage construction.

Salvage: None

DESIGN SPECIFICATIONS

2017 AASHTO LRFD Bridge Design Specifications, 8th 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

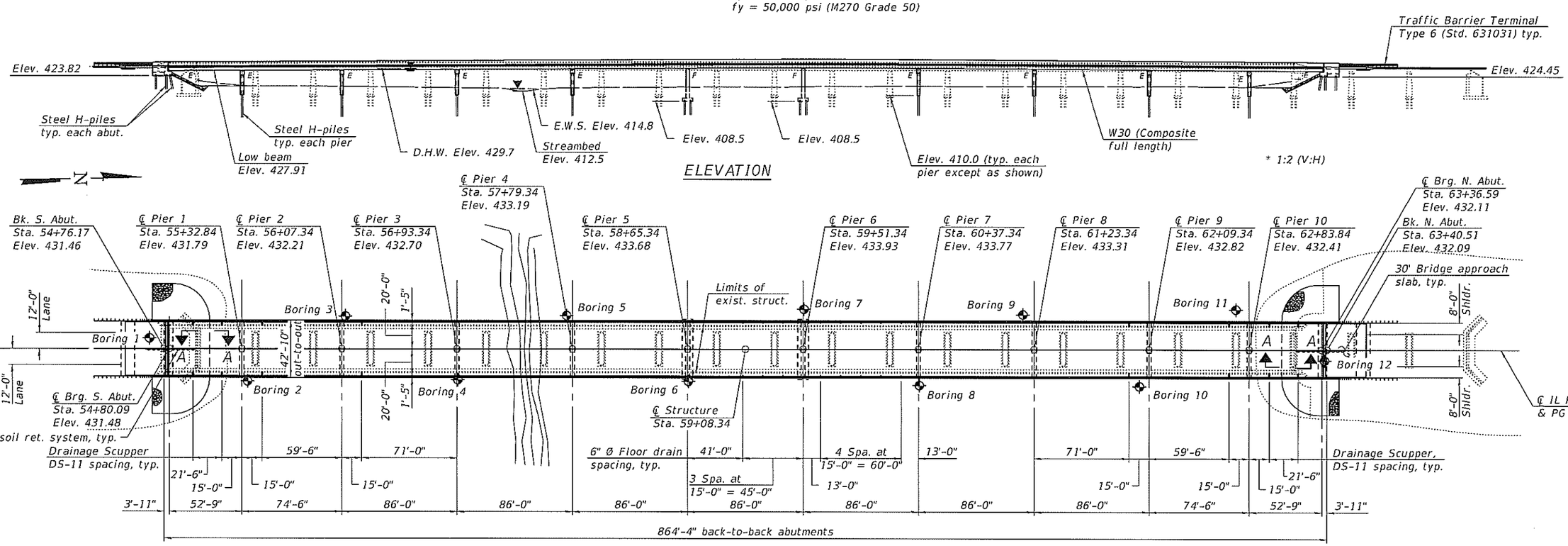
F.A.P. Rte. 332 - IL Rte. 1
Functional Class: Other Principal Arterial
ADT: 5400 (2020); 6600 (2040)
ADTT: 902 (2020); 1102 (2040)
DHV: 706 (2040)
Design Speed: 60 m.p.h.
Posted Speed: 55 m.p.h.
Two-Way Traffic
Directional Distribution: 50:50

LOADING HL-93

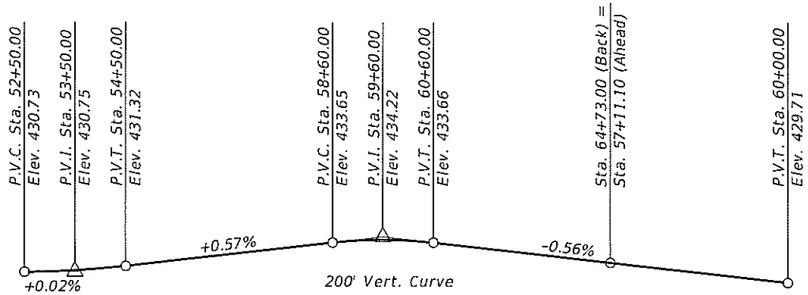
Allow 50#/sq. ft. for future wearing surface.

SEISMIC DATA

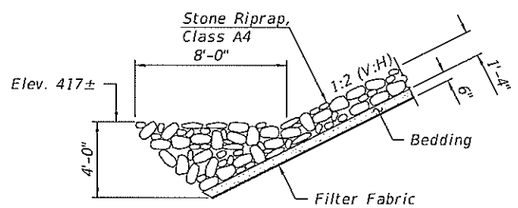
Seismic Performance Zone (SPZ) = 3
Design Spectral Acceleration at 1.0 sec. (SD1) = 0.328 g
Design Spectral Acceleration at 0.2 sec. (SDS) = 0.748 g
Soil Site Class = E



PLAN

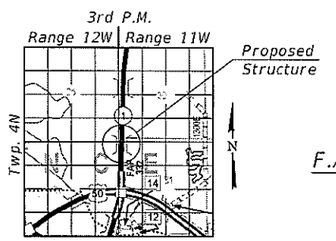


PROFILE GRADE
(Along ℄ IL Rte. 1)



SECTION A-A

Note:
Up to ¼" may be ground off the bridge deck and the bridge approach slab.
The profile grade shows the final elevations after grinding.
All structural steel within 6 feet of an expansion joint shall be metalized or galvanized.



LOCATION SKETCH

GENERAL PLAN & ELEVATION
ILLINOIS ROUTE 1 OVER
EMBARRAS RIVER OVERFLOW
F.A.P. RTE. 332 - SEC. (16BR-1,BR-2)B-1
LAWRENCE COUNTY
STATION 59+08.34
STRUCTURE NO. 051-0075

DESIGNED	-	NICHOLAS R. BARNETT
CHECKED	-	JUSTIN T. BELUE
DRAWN	-	MICHAEL B. MOSSMAN
CHECKED	-	N.R.B. / J.T.B.

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STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET 1 OF 2 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
332	(16BR-1,BR-2)B-1	LAWRENCE	--	--
		CONTRACT NO. 74164		
	ILLINOIS	FED. AID PROJECT		

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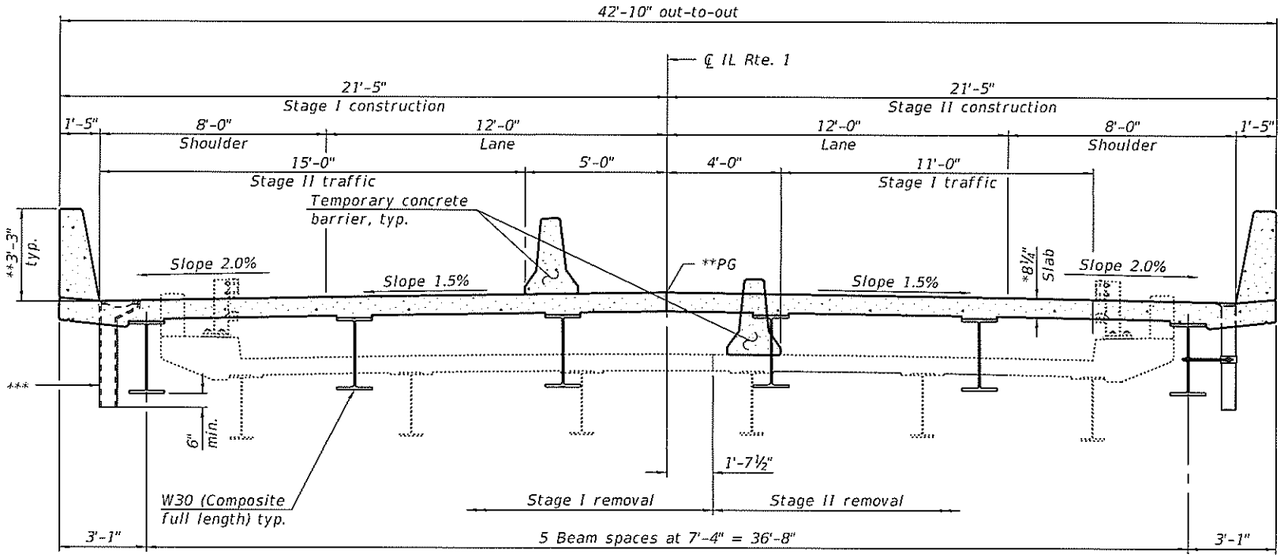


CROSS SECTION
(Looking North)

* Prior to grinding.

** After grinding.

*** DS-11 drainage scupper or 6" Ø floor drain (See Plan for locations and spacing).

WATERWAY INFORMATION

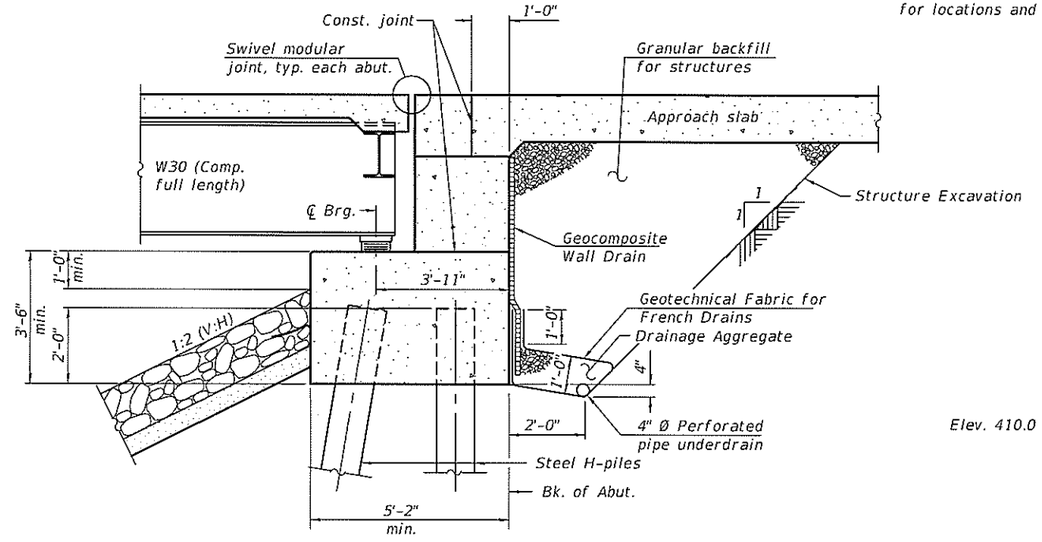
Drainage Area = 2,329.3 sq. mi.

Existing Overtopping Elev. 428.23 at Sta. 66+41
Proposed Overtopping Elev. 428.23 at Sta. 66+41

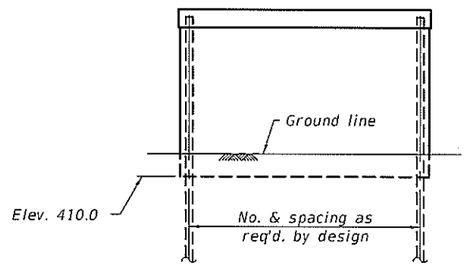
Flood Event		Discharge (cfs)		Opening Ft²		Nat.	Head - Ft.		Headwater Elev.	
		Exist.	Prop.	Exist.	Prop.	H.W.E.	Exist.	Prop.	Exist.	Prop.
10	SN 051-0063	20466	20466	7639	7639	426.5	0.2	0.2	426.7	426.7
	SN 051-0075	12950	12860	7560	8349					
	SN 051-0074	6913	7003	4045	4609					
	Total	40329	40329	19244	20597					
30 Overtopping	SN 051-0063	27365	27365	8450	8450	428.5	0.1	0.1	428.6	428.6
	SN 051-0075	17240	17185	8555	9896					
	SN 051-0074	8843	8898	4425	5232					
	Total	53448	53448	21430	23578					
50	SN 051-0063	31775	31775	8933	8933	429.7	0.1	0.0	429.8	429.7
	SN 051-0075	18512	18760	8555	10310					
	SN 051-0074	9579	9331	4425	5232					
	Total	59866	59866	21913	24475					
100	SN 051-0063	39647	39647	9899	9899	432.0	0.1	0.1	432.1	432.1
	SN 051-0075	18858	19021	8555	10310					
	SN 051-0074	9623	9460	4425	5232					
	Total	68128	68128	22879	25441					
200	SN 051-0063	42689	42689	10488	10488	433.4	0.0	0.0	433.4	433.4
	SN 051-0075	22598	22833	8555	10310					
	SN 051-0074	11590	11355	4425	5232					
	Total	76877	76877	23468	26030					
500	SN 051-0063	45887	45887	10681	10681	434.9	0.1	0.0	435.0	434.9
	SN 051-0075	27792	28082	8555	10310					
	SN 051-0074	14255	13965	4425	5232					
	Total	87934	87934	23661	26223					

DESIGN SCOUR ELEVATION TABLE

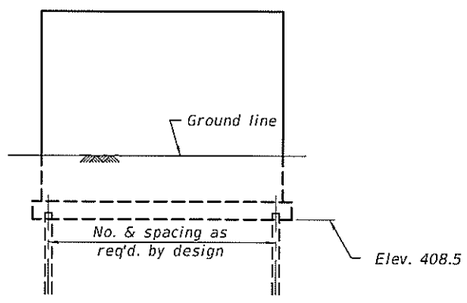
Event / Limit State	Design Scour Elevations (ft.)												
	S. Abut.	Pier 1	Pier 2	Pier 3	Pier 4	Pier 5	Pier 6	Pier 7	Pier 8	Pier 9	Pier 10	N. Abut.	Item 113
Q100	423.8	408.6	409.0	409.0	409.0	409.0	408.5	408.3	408.1	407.2	405.5	424.5	5
Q200	423.8	408.6	409.0	409.0	409.0	409.0	408.5	408.3	408.1	407.2	405.5	424.5	
Design	423.8	408.6	409.0	409.0	409.0	409.0	408.5	408.3	408.1	407.2	405.5	424.5	
Check	423.8	408.6	409.0	409.0	409.0	409.0	408.5	408.3	408.1	407.2	405.5	424.5	



SECTION THRU PILE SUPPORTED STUB ABUTMENT



PIER SKETCH
(Piers 1 thru 4 & 7 thru 10)



PIER SKETCH
(Piers 5 & 6)

DETAILS
ILLINOIS ROUTE 1 OVER EMBARRAS RIVER OVERFLOW
F.A.P. RTE. 332 - SEC. (16BR-1,BR-2)B-1
LAWRENCE COUNTY
STATION 59+08.34
STRUCTURE NO. 051-0075

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STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET 2 OF 2 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
332	(16BR-1,BR-2)B-1	LAWRENCE	---	---
		CONTRACT NO. 74164		
	ILLINOIS FED AID PROJECT			

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