Structure Geotechnical Report

(In-House)

IL 143 over Indian Creek

Bridge Replacement

Proposed Structure Number:	060-0349
Existing Structure Number:	060-0082
Route:	FAP 789 (IL 143)
Section:	125B-2
County:	Madison
Project Number:	P-98-007-13

Prepared For:	Richard J. Chaput
Prepared By:	Foundations & Geotechnical Unit Lindsey N. Jones 217-524-4681 Lindsey.Jones@illinois.gov
Reviewed By:	Bradly L. Hessing
Original Report Date:	October 5, 2016
Revised Report Date:	December 28, 2016

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Appendix

1.0 Project Description and Scope of Work

It is proposed that the existing 4 span 214'-2" long structure (060-0082) be removed and replaced by a 3 span 250'-0" long structure. The existing abutments and piers are supported by concrete pile bents.

The proposed structure will be designed with the 2014 AASHTO LRFD code. The proposed structure includes Integral Abutments and Solid Wall Encased Pile Bent Piers. The preliminary estimated factored substructure loads were estimated by the Designer and are as follows:

	W. Abut.	Pier 1	Pier 2	E. Abut.
Estimated Factored Substructure Loads (kips)	978	2207	2207	978

2.0 Field Exploration

2.1 Subsurface Exploration and Testing

The driller (McCleary Engineering) coordinated with the District Geotechnical Engineer to determine the number of borings. Two (2) borings were taken in 2015 for subsurface exploration of the bridge. A Rock Core was taken for boring SB-02. Atterberg Limit Tests and Grain Size Analyses were performed on some samples.

The District drilled two (2) additional borings and rock cores in 2016 closer to the pier locations. The District tried to perform strength tests on the rock cores, but were unable to get results due to the poor quality of the rock.

The following borings were used to evaluate each substructure:

	W. Abut.	Pier 1	Pier 2	E. Abut.
Representative Boring	SB-01 (2015)	SB-1 (2016)	SB-2 (2016)	SB-02 (2015)

See the Appendices for the Boring Location Plan, Boring Logs, Rock Cores, Rock Core Photographs and Laboratory Test Results.

2.2 Subsurface Conditions

The soil is a combination of clay, silt and sand layers. Bedrock consists of shale and limestone and is located approximately 60 ft. below ground surface (approximately elevation 390). Top of Rock elevations are as follows for each substructure:

	W. Abut.	Pier 1	Pier 2	E. Abut.
Estimated Top of Rock Elev. (ft)	389.0	394.0	396.8	391.4

3.0 Geotechnical Evaluations and Recommendations

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 6 ft at the West Abutment and 5 ft at the East Abutment. Settlement is expected to be 1 inch or less at both abutments. The estimated time for 0.4 inches or less of settlement to remain is approximately 6 months. A 6 month waiting time will likely be unacceptable to the construction schedule given that traffic is being detoured during construction. Alternatives to a waiting period include applying a surcharge to accelerate settlement, installing wick drains to accelerate settlement, precoring to reduce/eliminate downdrag losses, or accounting for downdrag losses in the axial design of the piles.

Accounting for downdrag in the axial resistance of the abutment piles or precoring is recommended. If precoring is selected, then an 18 inch diameter hole may be used for metal shell piles and HP8 or HP10 H-piles. A 24 inch diameter hole may be used for HP 12 and HP14 H-piles. The West Abutment should be precored 25 ft below the bottom of abutment elevation (approximately elevation 422 ft) and the East Abutment should be precored 20 ft below the bottom of the abutment (approximately elevation 428 ft).

3.2 Slope Stability

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

Substructure	Static Slope Stability FOS
West Abutment	1.56
East Abutment	2.23

The short-term soil parameters were used for the seismic slope stability analysis and the resulting Factors of Safety for both abutments was above the required FOS of 1.0 (see Appendices for analyses):

Substructure	Seismic Slope Stability FOS
West Abutment	1.23
East Abutment	1.75

3.3 Scour

The August 26, 2016 Hydraulic Report Memorandum recommends the following raw scour depths, existing streambed elevation, and the substructure they are associated with are:

Location	Raw/Unadjusted Scour Depths (ft.)		Associated Substructure	Streambed Elev. (ft)
	Q100	Q200		
Channel	29.0	35.0	Piers 1 & 2	429.6

The raw scour depth calculations assumed the piers will be Solid Wall Encased Pile Bent Piers with an encasement thickness of 2.5 ft or less, or Drilled Shaft Bent with Webwall with a diameter of 2.5 ft or less. If a pile supported footing, drilled shaft supported footing, or drilled shaft bent with a shaft diameter greater than 2.5 ft is

selected, then the Hydraulics Unit should be contacted to see if the raw scour depths are still applicable.

The following table shows the bottom of substructure elevations and the borings that were used to evaluate each substructure for scour potential:

Substructure	Bottom of Substructure Elev. (ft)	Ground Surface Elev. at Substructure (ft)	Boring Name
Pier 1	427.1	429.6	SB-1 (2016)
Pier 2	427.1	440.0	SB-2 (2016)

Reductions were applied to the unadjusted scour depths as recommended in the 2012 Bridge Manual Section 2.3.6.3.2.

If the abutments are protected in accordance with the Bridge Manual and the piers are a Solid Wall Encased Pile Bent or Drilled Shaft (maximum shaft diameter of 2.5 ft.) Bent with Webwall, then the following is the recommended Design Scour Elevation Table:

Event/Limit State	Design Scour Elevations (ft.)				Item 113
	W. Abut.	Pier 1	Pier 2	E. Abut.	
Q100	446.93*	408.4	416.1	447.21*	5
Q200	446.93*	405.4	411.2	447.21*	
Design	446.93*	408.4	416.1	447.21*	
Check	446.93*	405.4	411.2	447.21*	

*Abutment scour elevations are set at the bottom of abutment. The elevations should be updated to match the bottom of abutment elevation on the final plans.

3.4 Seismic Considerations

The latitude and longitude coordinates for the site are 38.841 and -90.033 respectively. The LRFD seismic data for the structure site is as follows:

Seismic Performance Zone (SPZ) = 2
Design Spectral Acceleration at 1.0 sec. (SD1) = 0.222g
Design Spectral Acceleration at 0.2 sec. (SDS) = 0.493g
Soil Site Class = D

3.5 Liquefaction

A Source-To-Site Distance (R) of 209.1 km and Earth Moment Magnitude of 7.7 were used in the Liquefaction Analysis based on AGMU 10.1. The Atterberg Limit Test results for Boring SB-01 and the AASHTO soil classification were referenced when determining the input values for the Liquefaction Analysis spreadsheet. The soils at this site are considered non-liquefiable.

4.0 Foundation Recommendations

The proposed abutment type is Integral and the piers are proposed to be Solid Wall Encased Pile Bents.

H-Piles driven to refusal are recommended for the abutments. There is not a clearly favorable foundation type for the piers.

4.1 Spread Footing

Abutments: With the use of integral abutments, spread footing foundation is not allowed at the abutments. Spread Footing foundation is allowed with semi-integral abutments, however the soil at the abutments is not conducive for spread footing.

Piers: Spread Footing foundation should not be used at the piers due to scour and an unreasonable depth to bedrock for setting the spread footing in rock.

4.2 Driven Piles

Abutments: Metal shell piles are not allowed at the abutment as per All Bridge Designers (ABD) Memorandum 12.3. With the use of semi-integral abutments metal shell piles could be used, but it is estimated that metal shell piles driven to the Maximum Nominal Required Bearing will terminate very near or on bedrock. Due to the risk of damage, Metal shell piles are not recommended at the abutments.

With the use of integral abutments, H-Piles 10x42 or larger are feasible. The table below shows feasible pile sizes, capacities, and estimated lengths for the abutments. Piles should be driven to refusal on rock. Downdrag due to settlement was taken into consideration. A table has been provided for the options to precored and eliminate downdrag or to account for downdrag and not precored. A cost comparison should be performed to determine which option is most cost effective.

Pile cutoff elevations of 448.93 and 449.21 were used for the West and East Abutment, respectively.

Table 4.2.1 – Abutment Piles (No Precore)

Pile Section	Maximum Nominal Required Bearing R_N (Kips)	Factored Geotech. Loss (Kips)	Factored Resistance Available R_F (Kips)	Estimated Pile Length (ft)	
				West Abutment	East Abutment
HP 10x42	335	94	90	63	60
HP 12x53	418	113	117	63	60
HP 12x63	497	114	159	64	60
HP 14x73	578	134	184	64	60
HP 14x89	705	135	253	65	62
HP 14x102	810	136	309	65	62
HP 14x117	929	138	373	65	63

Table 4.2.2 – Abutment Piles (Precore)

Pile Section	Maximum Nominal Required Bearing R_N (Kips)	Factored Geotech. Loss (Kips)	Factored Resistance Available R_F (Kips)	Estimated Pile Length (ft)	
				West Abutment	East Abutment
HP 10x42	335	0	184	*63	**62
HP 12x53	418	0	230	*63	**62
HP 12x63	497	0	273	*64	**63
HP 14x73	578	0	318	*64	**63
HP 14x89	705	0	388	*65	**63
HP 14x102	810	0	445	*65	**64
HP 14x117	929	0	511	*65	**65

*Precore West Abutment 25 ft below bottom of abutment elevation (~422 ft).
**Precore East Abutment 20 ft below bottom of abutment elevation (~428 ft).

Piers: Due to deep scour at both piers, piles will need to be driven to Maximum Nominal Required Bearing to provide any appreciable resistance. It is estimated that metal shell piles driven to the Maximum Nominal Required Bearing capacity will terminate near or on bedrock. Due to the risk of damage, metal shell piles are not recommended at the piers.

H-Piles are geotechnically feasible, however before piles are used for foundation at the piers it will need to be verified that the piles can structurally withstand the large unbraced length resulting from deep scour. The table below shows feasible pile sizes, capacities, and estimated lengths for the piers:

A pile cutoff elevation of 450.00 was used for Pier 1 and Pier 2.

Table 4.2.3 – Pier 1

Pile Section	Maximum Nominal Required Bearing R_N (Kips)	Factored Geotech. Loss (Kips)	Factored Resistance Available R_F (Kips)	Estimated Pile Length (ft)
*HP 10x42	335	23	161	59
*HP 12x53	418	28	202	59
*HP 12x63	497	28	245	59
*HP 14x73	578	33	285	59
*HP 14x89	705	33	355	60
*HP 14x102	810	34	411	62
*HP 14x117	929	34	477	63

*Verify structurally capable of supporting unbraced length caused by scour.

Table 4.2.4 – Pier 2

Pile Section	Maximum Nominal Required Bearing R_N (Kips)	Factored Geotech. Loss (Kips)	Factored Resistance Available R_F (Kips)	Estimated Pile Length (ft)
*HP 10x42	335	11	173	57
*HP 12x53	418	14	216	57
*HP 12x63	497	14	259	57
*HP 14x73	578	16	302	57
*HP 14x89	705	16	372	58
*HP 14x102	810	16	430	58
*HP 14x117	929	17	494	61

*Verify structurally capable of supporting unbraced length caused by scour.

Pile shoes should be used at both the abutments and the piers due to the presence of limestone bedrock. One test pile per substructure is recommended.

4.3 Drilled Shafts

Piers: Drilled shafts are a feasible foundation type at the piers, however the rock type and quality varies greatly throughout the site making it difficult to estimate the resistance available. A Geotechnical Design Memorandum will be prepared if Drilled Shafts are chosen as the foundation type.

4.4 Piles Set in Rock

Piers: Piles Set in Rock are a feasible foundation type for the piers, however the rock type and quality varies greatly throughout the site making it difficult to estimate the resistance available. A Geotechnical Design Memorandum will be prepared if Piles Set in Rock is chosen as the foundation type.

4.5 Lateral Load Analysis

Lateral stability of the structure during a scour and/or seismic event will need to be investigated further during the design phase.

A preliminary lateral analysis was performed for the Strength Limit State (scour) of Pier 1 in the transverse to pier (longitudinal to bridge) direction as the Structural Designer was most concerned with piles being able to perform in this case. The following assumptions were made for the preliminary analysis:

Top of Pier Restraint (Fixed/Free)	Fixed
Bottom of Encasement Elev. & Elev. at which Loads Applied	427.1
Assumed Pile Type	HP 14x117
Number of Piles per Pier	11
Estimated Factored Axial Load per Pile	2207/11 = 200.64 kips
Applied Transverse Shear per Pile	1-50 kips

The preliminary graphs for Depth to Fixity for Deflection, Depth to Fixity for Moment and Critical Embedment can be found in Appendix H.

Soil parameters for the Strength Limit State (scour) lateral analysis are provided below. The default values for k and e50 from the lateral analysis program are adequate.

Table 4.5.1 – Boring SB-01 (2015) – West Abutment

Layer Top Elev.	Layer Bot. Elev.	Unit Weight (pcf)	ϕ (deg)	C (psf)
455.2	447.0	120.0	0	1000
447.0	434.0	120.0	0	1750
434.0	431.5	120.0	0	600
431.5	429.5	57.6	0	1200
429.5	424.5	57.6	0	300
424.5	422.5	57.6	0	600
422.5	420.5	57.6	0	200
420.5	408.5	52.6	34	0
408.5	405.5	57.6	0	800
405.5	398.0	52.6	34	0
398.0	393.0	57.6	0	1100
393.0	389.0	57.6	0	300
389.0	387.0	77.6	30	10000

Table 4.5.2 – Boring SB-02 (2015) – East Abutment

Layer Top Elev.	Layer Bot. Elev.	Unit Weight (pcf)	ϕ (deg)	C (psf)
456.48	448.23	120	0	1000
448.23	446.9	120	0	2500
446.9	444.4	120	0	600
444.4	439.4	120	0	1800
439.4	429.4	120	0	400
429.4	424.4	57.6	0	1900
424.4	417.4	57.6	0	950
417.4	412.9	57.6	0	1800
412.9	402.9	57.6	0	700
402.9	397.9	52.6	34	0
397.9	391.4	57.6	0	3700
391.4	389.9	77.6	30	5000
389.9	385.9	77.6	30	10000
385.9	380.9	77.6	30	5000

Table 4.5.3 – Boring SB-1 (2016) – Pier 1

Layer Top Elev.	Layer Bot. Elev.	Unit Weight (pcf)	ϕ (deg)	C (psf)
*429.6	428.0	57.6	0	290
*428.0	426.5	57.6	0	860
*426.5	421.5	57.6	0	1535
*421.5	415.0	57.6	0	940
*415.0	410.0	57.6	0	860
*410.0	408.4	57.6	0	3190
408.4	405.3	57.6	0	3190
405.3	400.3	57.6	0	1230
400.3	394.0	57.6	0	1920
394.0	390.4	77.6	30	7200
390.4	389.4	77.6	30	5000
389.4	388.3	77.6	30	5000
388.3	383.8	77.6	30	7200

*Exclude layers for evaluation of Q100 scour case.

Table 4.5.4 – Boring SB-2 (2016) – Pier 2

Layer Top Elev.	Layer Bot. Elev.	Unit Weight (pcf)	ϕ (deg)	C (psf)
*440.0	437.0	57.6	0	1500
*437.0	431.5	57.6	0	545
*431.5	427.0	57.6	0	425
*427.0	424.0	57.6	0	500
*424.0	423.5	57.6	0	200
*423.5	421.0	57.6	0	1230
*421.0	418.2	57.6	0	870
*418.2	417.0	57.6	0	1230
*417.0	416.5	52.6	28	0
*416.5	416.1	57.6	0	1060
416.1	413.0	57.6	0	1060
413.0	408.0	57.6	0	1720
408.0	402.0	57.6	26	0
402.0	396.8	57.6	0	6140
396.8	394.0	77.6	30	7200
394.0	391.8	77.6	30	10000
391.8	391.0	77.6	30	7200
391.0	389.3	77.6	30	10000
389.3	385.8	77.6	30	10000

*Exclude layers for evaluation of Q100 scour case.

5.0 Construction Considerations

5.1 Temporary Soil Retention

Traffic is to be detoured during construction of the proposed structure. Temporary soil retention does not appear necessary.

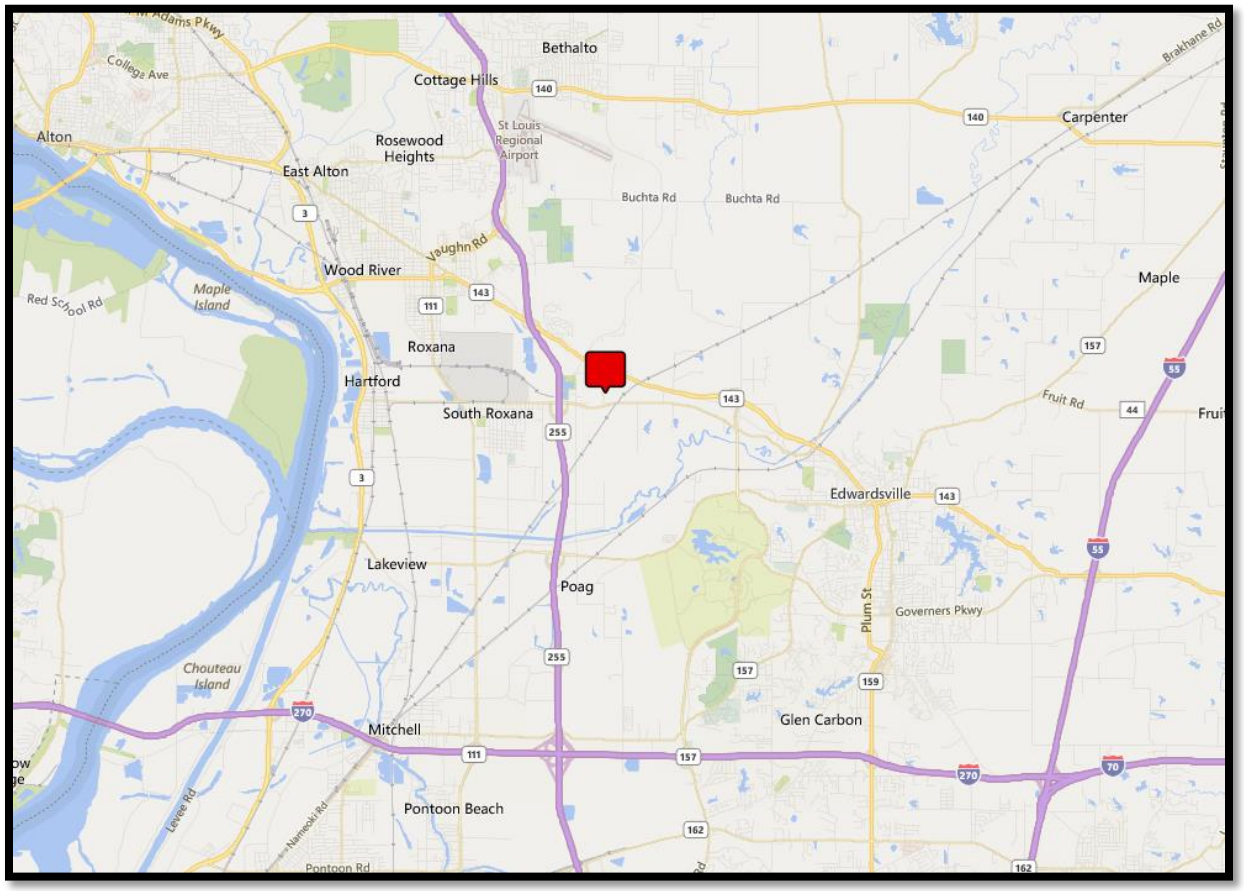
5.2 Cofferdam and Seal Coat

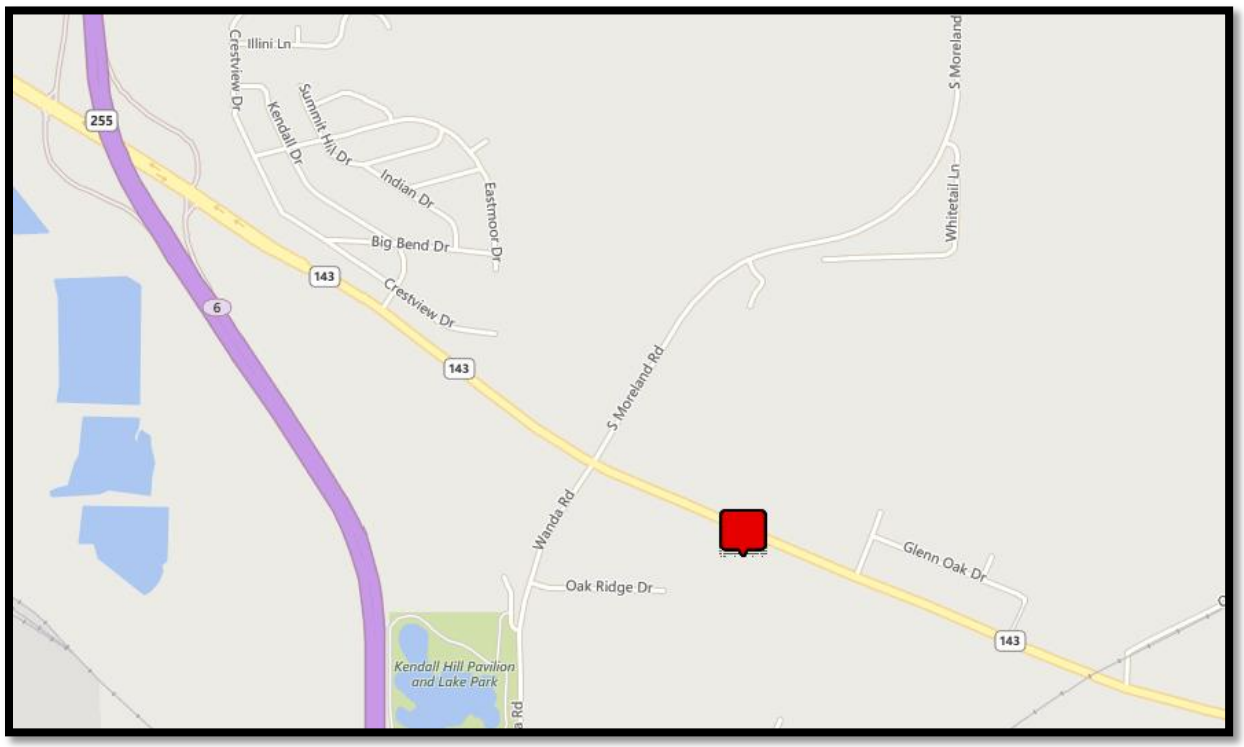
The Estimated Water Surface Elevation (EWSE) is 431.75 ft. The following recommendations are made with respect to the need for a cofferdam and/or a seal coat for the construction of the piers:

	Pier & Foundation Type	Bottom of Substructure Elev. (ft).	Cofferdam Needed?	Seal Coat Needed?
Pier 1	H-Pile Bent	427.1	Yes - Type 1	No
	H-Pile Supported Footing	425.6	Yes - Type 2	Yes
	Drilled Shaft w/Web Wall	427.1	No	No
Pier 2	H-Pile Bent	427.1	No	No
	H-Pile Supported Footing	436.0	No	No
	Drilled Shaft w/Web Wall	437.5	No	No

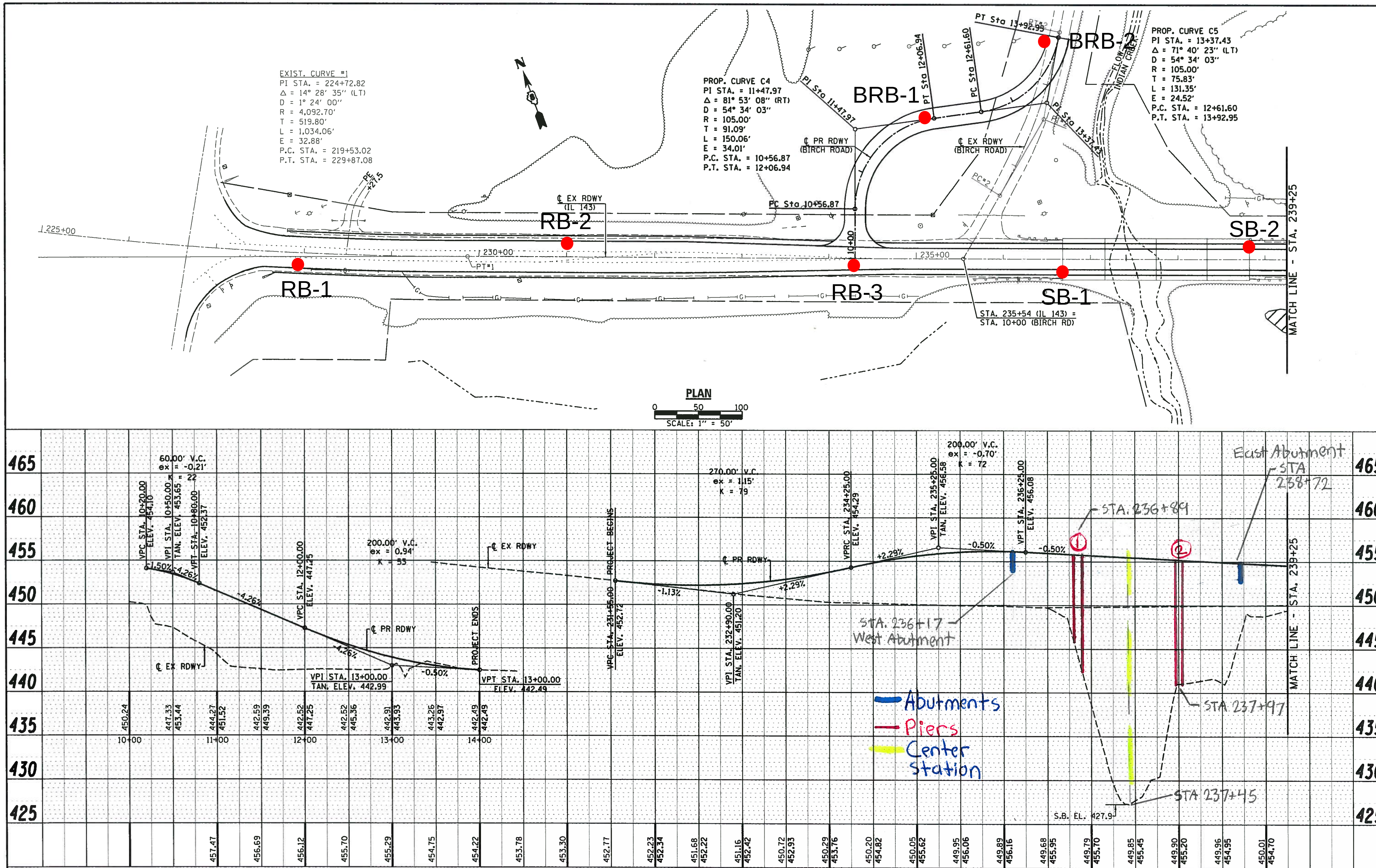
Appendix A

SN 060-0349: Site Location Plan





Appendix B



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		CHECKED -	REVISED -		

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ALIGNMENT APPROVED
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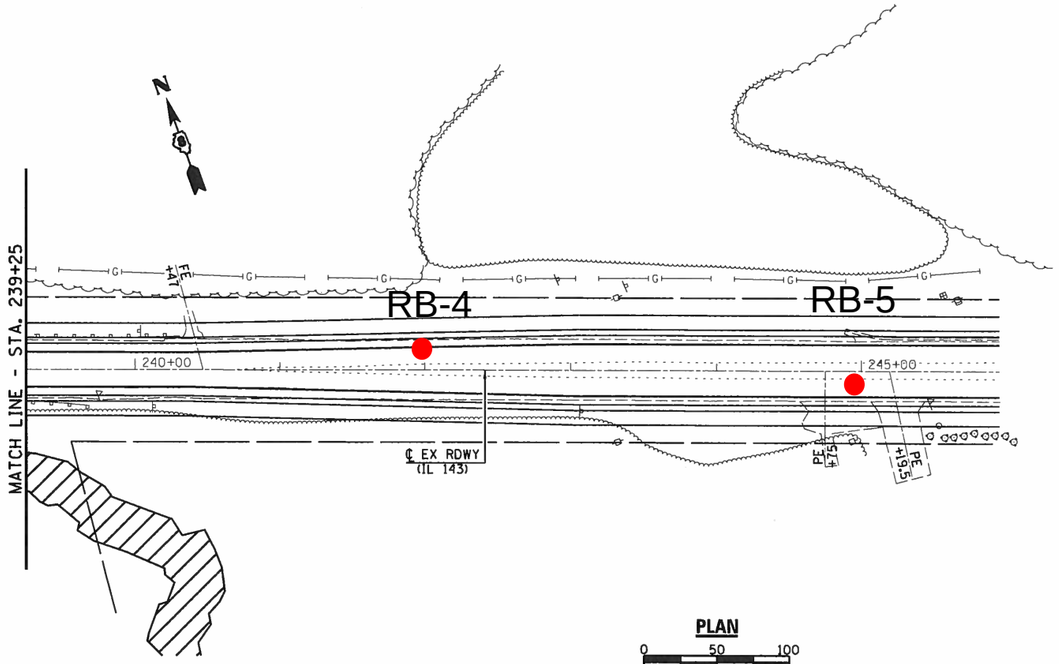

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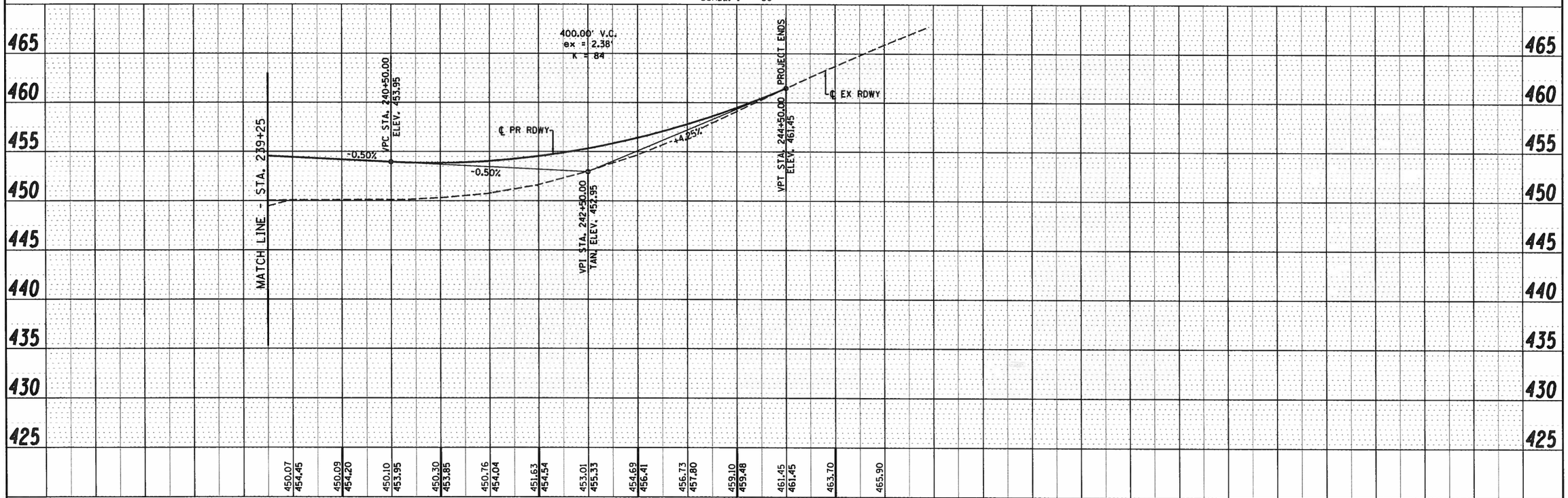

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	PLOT DATE = $DATE$	CHECKED -	REVISED -

Allen Henderson & Associates, Inc.
Civil and Structural Engineers Springfield, IL.
62703 Phone: (217)544-8033 IL. Design Firm
No. 184-001907

PLAN & PROFILE

SCALE: 1" = 50' | SHEET NO. 2 OF 2 SHEETS | STA. | TO STA.

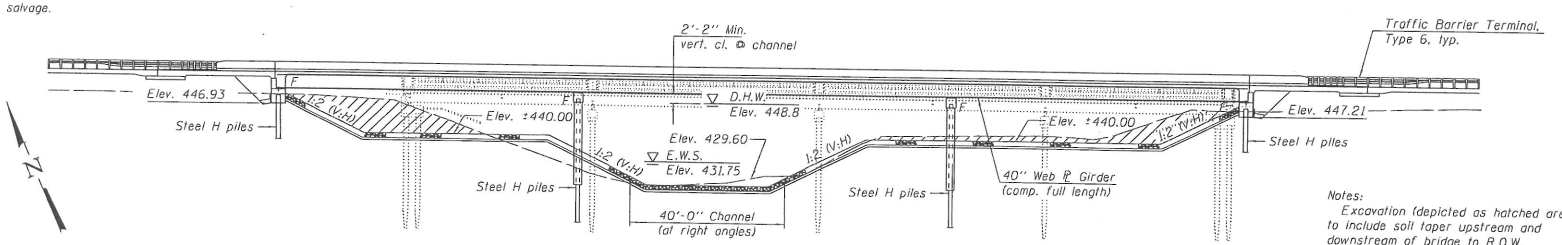
F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
789	125B-2	MADISON		
		CONTRACT NO.		
FED. ROAD DIST. NO.	ILLINOIS	FED. AID PROJECT		

Appendix C

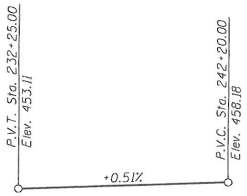
Benchmark: Chiseled "□" on North side of a light pole foundation at the SE corner of Wanda and Old Alton/Edwardsville Road; Elev. 438.84.

Existing Structure: S.N. 060-0082 built in 1936 as S.B.I Route 159, Section 125-B-C-D at Sta. 237+75.00. The existing structure consists of four spans simply supported WF beam superstructure supported on concrete pile bent abutments and piers. Back-to-back of abutment length is 214'-2". In 1980, bridge deck repair and resurfacing with concrete overlay. The existing structure is to be removed and replaced. Traffic is to be detoured during construction.

No salvage.

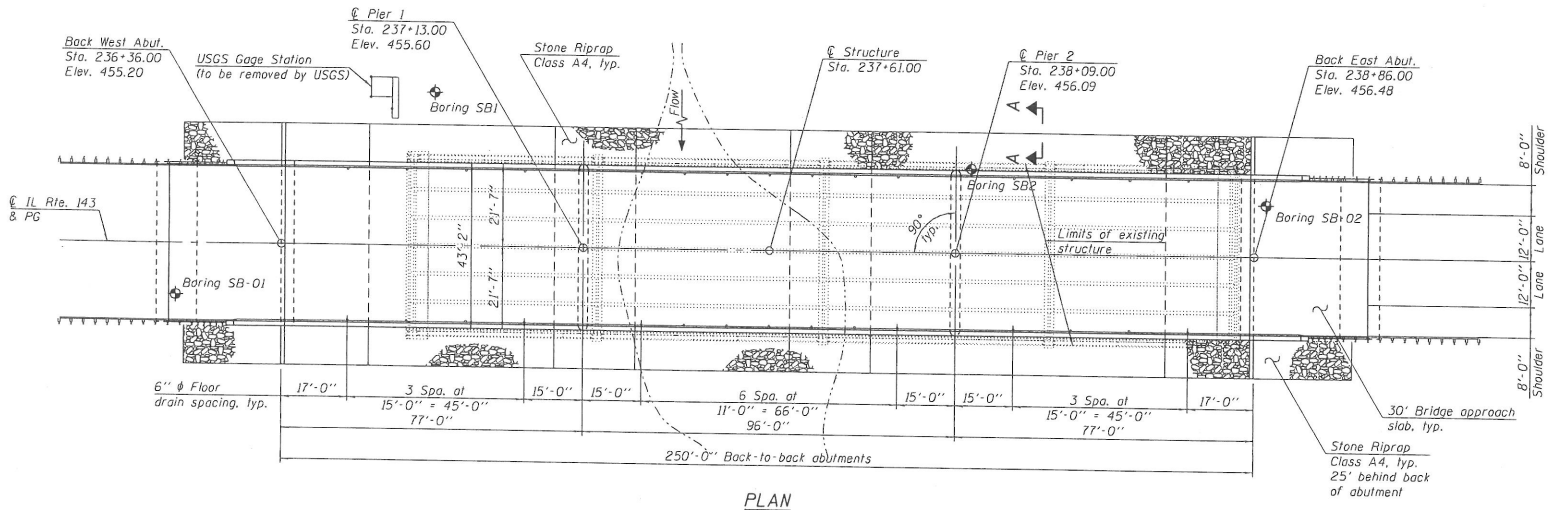


ELEVATION



PROFILE GRADE
(Along IL Rte. 143)

Notes:
Excavation (depicted as hatched areas) to include soil taper upstream and downstream of bridge to R.O.W. (See Roadway plans).
Upstream concrete debris in channel to be removed (See Roadway plans).



PLAN

DESIGN SPECIFICATIONS

2014 AASHTO LRFD Bridge Design Specifications, 7th Edition with 2015 and 2016 Interims

DESIGN STRESSES

FIELD & EXISTING UNITS

f'c = 3,500 psi
f'c = 4,000 psi (superstructure)
fy = 60,000 psi (reinforcement)
fy = 50,000 psi (structural steel)

HIGHWAY CLASSIFICATION

F.A.P. Rte. 789 - IL Rte. 143
Functional Class: Collector (Rural)
ADT: 10,400 (2013); 13,200 (2037)
ADTT: 822 (2013)
DHV: 1040 (one-way)
Design Speed: 55 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) = 2
Design Spectral Acceleration at 1.0 sec. (S_{D1}) = 0.22g
Design Spectral Acceleration at 0.2 sec. (S_{DS}) = 0.49g
Soil Site Class = D

DESIGN SCOUR ELEVATION TABLE

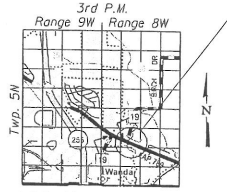
Event / Limit State	Design Scour Elevations (ft.)				Item 113
	W. Abut.	Pier 1	Pier 2	E. Abut.	
0.100	446.93	408.4	416.1	447.21	5
0.200	446.93	405.4	411.2	447.21	
Design	446.93	408.4	416.1	447.21	
Check	446.93	405.4	411.2	447.21	

WATERWAY INFORMATION

Drainage Area = 37.4 mi.²
Existing Overtopping Elev. 449.1 @ Sta. 236+50
Proposed Overtopping Elev. 453.0 @ Sta. 231+75

Flood	Freq. Yr.	Q C.F.S.	Opening Sq. Ft.		Nat. H.W.E.	Head - Ft.		Headwater El.	
			Exist.	Prop.		Exist.	Prop.	Exist.	Prop.
	10	4,530	1,522	1,782	445.9	0.2	0.0	446.1	445.9
Design	50	7,910	1,584	2,413	448.8	0.6	0.2	449.4	449.0
Overtop Exist.	59	8,344	1,585	2,504	449.1	0.6	0.2	449.7	449.3
Base	100	9,660	1,605	2,719	450.1	0.6	0.2	450.7	450.3
	200	11,600	1,608	2,964	451.4	0.3	0.3	451.7	451.7
Max. Calc.	500	14,600	1,608	2,971	453.2	0.1	0.3	453.3	453.5

10 Year velocity through existing bridge = 2.6 ft/s.
10 Year velocity through proposed bridge = 2.5 ft/s.



LOCATION SKETCH

GENERAL PLAN & ELEVATION
ILLINOIS ROUTE 143 OVER INDIAN CREEK
F.A.P. RTE. 789 - SEC. 125B-2
MADISON COUNTY
STATION 237+61.00
STRUCTURE NO. 060-0349

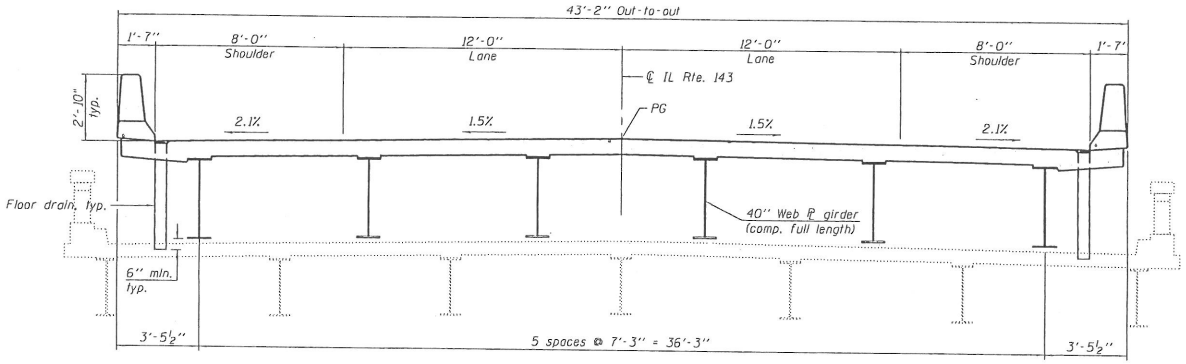
DESIGNED -	RICHARD J. CHAPUT
CHECKED -	FRANK W. SHARPE
DRAWN -	KORY E. CHAPMAN
CHECKED -	RICHARD J CHAPUT

DECEMBER 19, 2016

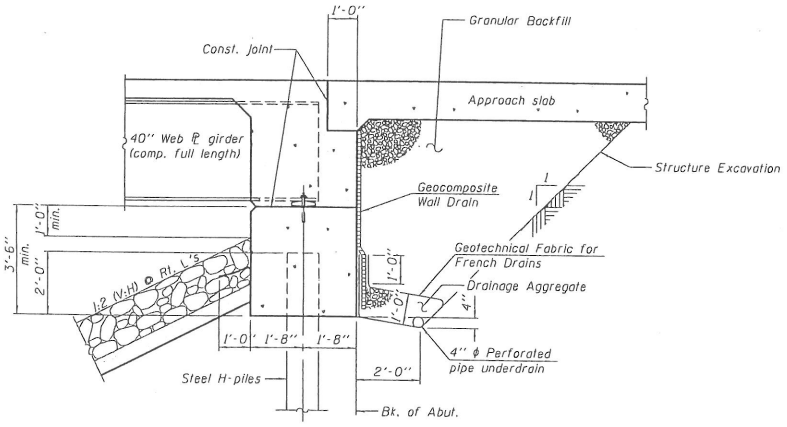
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET NO. 1 OF 2 SHEETS

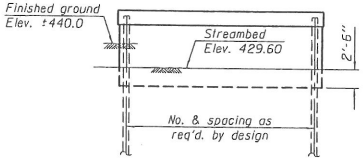
F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
789	125B-2	MADISON		
		CONTRACT NO. 76G56		
		ILLINOIS FED. AID PROJECT		



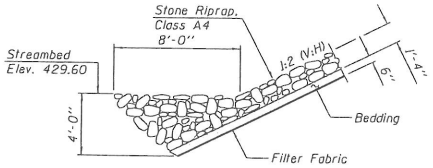
CROSS SECTION



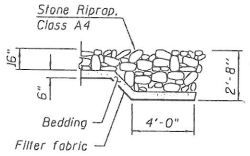
SECTION THRU INTEGRAL ABUTMENT
(Horiz. dim. @ Rt. L's)



PIER SKETCH



SECTION A-A



SECTION B-B

GENERAL PLAN & ELEVATION
ILLINOIS ROUTE 143 OVER
INDIAN CREEK
F.A.P. RTE. 789 - SEC. 125B-2
MADISON COUNTY
STATION 237+75
STRUCTURE NO. 060-0349

DESIGNED -	RICHARD J. CHAPUT
CHECKED -	FRANK W. SHARPE
DRAWN -	KORY E. CHAPMAN
CHECKED -	RICHARD J. CHAPUT

DECEMBER 15, 2016

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET NO. 2 OF 2 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
789	125B-2	MADISON		
		CONTRACT NO. 76656		
	ILLINOIS FED. AID PROJECT			

Appendix D

Proposed SN 060-0349: Subsurface Data Profile Plot

455.20 Proposed Ground Line at West Abutment

STRUCT. NO. 060-0082
Station 237+44.5

BORING NO. SB-01
Station 236+09
Offset 13.5 ft Rt.
Ground Surface Elev. 450.00 ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
448.60	3		
Gray Silty CLAY (A-6)	8 7	3.0 S	18
	2		
-5	3 4	1.9 B	22
	2		
	4 6	1.4 B	22
	3		
-10	5 7	1.8 B	20
	0		
	2 3	1.2 B	28
-15			
	0		
	2 2	0.6 B	25
431.50			
Brown mottled gray Silty CLAY (A-6)	1		
-20	2 3	1.2 S	26
429.50			
Gray Silty CLAY (A-6)	0		
	0 0	0.3 S	31
	ST		
-25			
424.50			
Gray Clayey SILT	0		
	1 2	0.6 B	28
	0		
420.50	0 1	0.2 B	29
Gray fine to medium SAND w/gravel	-30		
	1		
	2 2		45
-35			
	1		
	2 1		
-40			
Gray fine to medium SAND w/gravel *(continued)*			
408.50			
Brown Silty CLAY	3		
405.50	4 5	0.8 B	26
Gray fine to medium SAND	-45		
	2		
	3 3		
-50			
398.00			
	3		
Gray Silty CLAY (A-6)	3 3	1.1 B	25
-55			
	4		
390.50	6 11	0.3 P	14
Gray Sandy CLAY w/sandstone	-60		
Gray Sandy CLAY w/sandstone *(continued)*			
389.00			
Gray LIMESTONE			
387.00			
End of Boring			

446.93 Bottom of West Abut

~440 West Bank Elevation

STRUCT. NO. 060-0082 (E) / 060-0349 (P)
Station

BORING NO. SB 1 W Pier
Station 236+75
Offset 40.00ft Left
Ground Surface Elev. 447.0 ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
	3		
Brown Silty CLAY A-6(15) See Class @ 6.5 ft	4 4	3.27 B	20
	2		
-5	3 2	1.25 P	25
	2		
	2 2	1.02 B	25
-10			
	2		
	WH 1	0.82 B	33
Brown and Dark Gray	2		
	WH		
Dark Gray	2 1	0.86 B	33
-15			
431.0	WH		
Dark Gray Silty Clay LOAM A-6(10) See Class @ 16.5 ft	WH 1	0.29 B	34
428.0	1		
Dark Gray Silty CLAY	2 3	0.86 B	27
-20			
Dark Gray Silty CLAY *(continued)* 426.5			
Dark Gray CLAY	1		
	2 2	1.19 B	38
-25			
	1		
Trace Gravel	2 2	1.88 B	26
421.5			
Gray Silty CLAY	1		
	1 2	0.98 B	31
	WH		
6" Sand Seam	2 3	0.90 B	30
-30			
415.0			
Gray Silty Clay LOAM with some Sand	2		
	6 10	0.86 B	28
-35			
410.0			
Gray Sandy LOAM	4		
407.5	4 6	3.19 B	32
Brown and Gray CLAY	-40		
Brown and Gray CLAY *(continued)* Trace Clay			
	2		
Brown	2 3	1.23 B	28
-45			
	WH		
	2 2	1.92 B	25
-50			
394.0			
Gray SHALE	50/3"	NA	11
393.0			
Borehole continued with rock coring.			
-55			

427.1 Pier 1 - Bottom of Encasement or Webwall

STRUCT. NO. 060-0082 (E) / 060-0349 (P)
Station

BORING NO. SB 2 E Pier
Station 238+13
Offset 22.00ft Right
Ground Surface Elev. 455.0 ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Portland Cement Concrete 454.5			
Empty Space between Bridge Deck and Ground Surface			
-5			
446.5	2		
Brown and Gray Silty Clay LOAM with Trace Crushed Limestone (Fill) A-6(12) See Class @ 9 ft	1 1	0.50 P	25
-10			
	2		
	4 4	1.72 B	23
442.0			
Brown and Gray Silty Clay LOAM with Trace Wood Fragments A-6(11) See Class @ 16.5 ft	3		
	4 4	1.50 P	23
-15			
	1		
Trace Organics	2 2	1.50 P	25
	1		
	1 2	0.44 B	35
-20			
Brown and Gray Silty Clay LOAM with Trace Wood Fragments A-6(11) See Class @ 16.5 ft *(continued)* Trace Sand	2		
	3 3	0.65 B	26
431.5			
Greenish Gray CLAY with Trace Sand	1		
	2 2	0.41 B	28
-25			
	WH		
	1 2	0.44 B	30
427.0			
Gray Silty CLAY with Trace Sand	1		
	2 3	0.50 P	27
-30			
423.5	1 2	0.20 B	
Gray CLAY with Trace Organics and Shells	2	1.23 B	31
	2		
Gray and Maroon	3 3	0.87 B	41
-35			
	2		
Brown and Gray 418.2	3 2	1.23 B	36
Brown and Gray Clay LOAM with Trace Gravel and Organics 417.0			
Brown and Gray Fine to Medium SAND 416.5	2		
Brown and Gray CLAY	2 4	1.06 B	31
-40			
Brown and Gray CLAY *(continued)* 413.0			
Brown Sandy LOAM with Trace Gravel 411.0	1	--	
	2		
Brown CLAY	6	1.72 B	23
-45			
408.0			
Brown and Gray Loamy SAND with Trace Gravel, Organics, and Shells	14		
405.5	7 1	--	21
-50			
Gray Clay LOAM with Trace Gravel			
402.0			
Gray CLAY with Trace Sand, Gravel, Wood, and Shale Fragments	8		
	11 13	6.14 B	14
-55			
396.8			
Gray Weathered SHALE 396.3	50/2"	4.50+ P	11
Borehole continued with rock coring.			
-60			

447.21 Bottom of East Abutment

429.60 Channel Streambed Elevation

456.48 Proposed Ground Line at East Abutment

STRUCT. NO. 060-0082
Station 237+44.5

BORING NO. SB-02
Station 238+89
Offset 13.5 ft Lt.
Ground Surface Elev. 449.90 ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
12" Asphalt over 8" Crushed Stone	3		
448.23	6 7	2.5 S	21
Brown mottled gray Silty CLAY w/cinders & sand (A-6)	7		
	3 4	0.6 B	23
-5			
444.40	8		
Gray Silty CLAY (A-6)	6 8	1.6 S	16
441.90			
Gray mottled brown Silty CLAY (A-6)	2		
	3 4	2.0 S	19
-10			
	1		
	1 1	0.4 B	31
	1		
	1 1	0.3 B	28
-15			
	ST		
	2		
	0 2	0.6 B	30
429.90 -20			
Brown Silty CLAY	2		
	3 4	2.1 B	34
426.90			
Brown/gray Silty CLAY	3		
	3 5	1.7 B	41
-25			
424.40	3		
Gray Silty CLAY trace fine sand	3 4	1.1 B	32
421.90			
Gray Sandy CLAY (A-6)	1		
	2 2	0.8 S	33
-30			
	3		
	3 3	1.8 B	28
-35			
412.90			
Gray mottled brown Silty CLAY (A-6) *(continued)*	2		
	2 2	0.9 B	38
-40			
407.90			
Brown Silty CLAY w/sand lenses (A-6)	1		
	4 2	0.5 P	44
-45			
402.90			
Brown fine to medium SAND w/trace gravel (A-2-4)	1		
	13 14		11
-50			
397.90			
Brown Silty CLAY w/ pebbles (A-6)	12		
	13 20	3.7 B	15
-55			
391.40	100/1"		
Gray SHALE w/limestone partings Borehole continued with rock coring.			
-60			

427.1 Pier 2 - Bottom of Encasement or Webwall

~440 East Bank Elevation

Appendix E

Mc Cleary Engineering
3705 Progress Blvd
Peru, Il 61354
815 780-8486

Solutions You Can Build On

SOIL BORING LOG

Date 12/16/15

ROUTE ILL 143 **DESCRIPTION** Over Indian Creek **LOGGED BY** J. Carter & T. McCleary

SECTION 125BR-2 **LOCATION** NW 1/4, **SEC.** 31, **TWP.** 5N, **RNG.** 8W, 3rd **PM**,
Latitude , **Longitude**

COUNTY Madison **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE** CME Automatic

STRUCT. NO. 060-0082
Station 237+44.5

BORING NO. SB-01
Station 236+09
Offset 13.5 ft Rt.
Ground Surface Elev. 450.00 ft

Surface Water Elev. 431.17 ft
Stream Bed Elev. 427.90 ft

Groundwater Elev.:
First Encounter 431.8 ft ▼
Upon Completion 430.0 ft ▽
After - **Hrs.** - ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
6"Asphalt over 11" Crushed stone			
448.60			
Gray Silty CLAY (A-6)	3		
	8 7	3.0 S	18
	2		
	3 4	1.9 B	22
-5			
	2		
	4 6	1.4 B	22
	3		
	5 7	1.8 B	20
-10			
	0		
	2 3	1.2 B	28
	0		
	2 2	1.2 B	27
-15			
	0		
	2 2	0.6 B	25
431.50 ▼			
Brown mottled gray Silty CLAY (A-6)	1		
	2 3	1.2 S	26
▽ -20			

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
429.50			
Gray Silty CLAY (A-6)	0		
	0 0	0.3 S	31
	ST		
-25			
424.50			
Gray Clayey SILT	0		
	1 2	0.6 B	28
	0		
420.50	0 1	0.2 B	29
-30 Gray fine to medium SAND w/gravel			
	1		
	2 2		45
-35			
	1		
	2 1		
-40			

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

Mc Cleary Engineering
3705 Progress Blvd
Peru, Il 61354
815 780-8486

SOIL BORING LOG

Solutions You Can Build On

Date 12/16/15

ROUTE ILL 143 **DESCRIPTION** Over Indian Creek **LOGGED BY** J. Carter & T. McCleary

SECTION 125BR-2 **LOCATION** NW 1/4, **SEC.** 31, **TWP.** 5N, **RNG.** 8W, 3rd **PM**,
Latitude , **Longitude**

COUNTY Madison **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE** CME Automatic

STRUCT. NO. 060-0082
Station 237+44.5

BORING NO. SB-01
Station 236+09
Offset 13.5 ft Rt.
Ground Surface Elev. 450.00 ft

Surface Water Elev. 431.17 ft
Stream Bed Elev. 427.90 ft

Groundwater Elev.:
First Encounter 431.8 ft ▼
Upon Completion 430.0 ft ▽
After - **Hrs.** - ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Material Description
				Gray fine to medium SAND w/gravel *(continued)*
408.50				
				Brown Silty CLAY
	3			
405.50	4	0.8	26	
-45	5	B		Gray fine to medium SAND
	2			
	3			
-50	3			
398.00				
	3			Gray Silty CLAY (A-6)
	3	1.1	25	
-55	3	B		
	4			
390.50	6	0.3	14	
-60	11	P		Gray Sandy CLAY w/sandstone
389.00				Gray Sandy CLAY w/sandstone *(continued)*
				Gray LIMESTONE
387.00				
				End of Boring
-65				
-70				
-75				
-80				

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

Mc Cleary Engineering
3705 Progress Blvd
Peru, Il 61354
815 780-8486

SOIL BORING LOG

Solutions You Can Build On

Date 12/17/15

ROUTE ILL 143 **DESCRIPTION** Over Indian Creek **LOGGED BY** J. Carter & T. McCleary

SECTION 125BR-2 **LOCATION** NW 1/4, **SEC.** 31, **TWP.** 5N, **RNG.** 8W, 3rd **PM**,
Latitude , **Longitude**

COUNTY Madison **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE** CME Automatic

STRUCT. NO. 060-0082
Station 237+44.5

BORING NO. SB-02
Station 238+89
Offset 13.5 ft Lt.
Ground Surface Elev. 449.90 ft

Surface Water Elev. 431.17 ft
Stream Bed Elev. 427.90 ft

Groundwater Elev.:
First Encounter 432.9 ft ▼
Upon Completion 430.9 ft ▽
After - **Hrs.** - ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				12" Asphalt over 8" Crushed Stone
	3			
448.23				
	6 7	2.5 S	21	Brown mottled gray Silty CLAY w/cinders & sand (A-6)
	7			
	3 4	0.6 B	23	
-5				
444.40				
	8			Gray Silty CLAY (A-6)
	6 8	1.6 S	16	
441.90				
	2			Gray mottled brown Silty CLAY (A-6)
	3 4	2.0 S	19	
-10				
	1			
	1 1	0.4 B	31	
	1			
	1 1	0.3 B	28	
-15				
▼				
	ST			
▽	2			
	0 2	0.6 B	30	
429.90 -20				

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				Brown Silty CLAY
	2			
	3 4	2.1 B	34	
426.90				
	3			Brown/gray Silty CLAY
-25	3 5	1.7 B	41	
424.40				
	3			Gray Silty CLAY trace fine sand
	3 4	1.1 B	32	
421.90				
	1			Gray Sandy CLAY (A-6)
	2 2	0.8 S	33	
-30				
	3			
	3 3	1.8 B	28	
-35				
412.90				
	2			Gray mottled brown Silty CLAY (A-6)
	2 2	0.9 B	38	
-40				

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

BBS, form 137 (Rev. 8-99)

Mc Cleary Engineering
3705 Progress Blvd
Peru, Il 61354
815 780-8486

SOIL BORING LOG

Solutions You Can Build On

Date 12/17/15

ROUTE ILL 143 **DESCRIPTION** Over Indian Creek **LOGGED BY** J. Carter & T. McCleary

SECTION 125BR-2 **LOCATION** NW 1/4, **SEC.** 31, **TWP.** 5N, **RNG.** 8W, 3rd **PM**,
Latitude , **Longitude**

COUNTY Madison **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE** CME Automatic

STRUCT. NO. 060-0082
Station 237+44.5

BORING NO. SB-02
Station 238+89
Offset 13.5 ft Lt.
Ground Surface Elev. 449.90 ft

Surface Water Elev. 431.17 ft
Stream Bed Elev. 427.90 ft

Groundwater Elev.:
First Encounter 432.9 ft ▼
Upon Completion 430.9 ft ▽
After - **Hrs.** - ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Gray mottled brown Silty CLAY (A-6) *(continued)*				
407.90				
Brown Silty CLAY w/sand lenses (A-6)		1		
		4	0.5	44
	-45	2	P	
402.90				
Brown fine to medium SAND w/trace gravel (A-2-4)		1		
		13		11
	-50	14		
397.90				
Brown Silty CLAY w/ pebbles (A-6)		12		
		13	3.7	15
	-55	20	B	
391.40				
Gray SHALE w/limestone partings		100/1"		
Borehole continued with rock coring.	-60			

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

Mc Cleary Engineering
3705 Progress Blvd
Peru, Il 61354
815 780-8486

ROCK CORE LOG

Solutions You Can Build On

Date 12/17/15

ROUTE ILL 143 **DESCRIPTION** Over Indian Creek **LOGGED BY** J. Carter & T. McCleary

SECTION 125BR-2 **LOCATION** NW 1/4, **SEC.** 31, **TWP.** 5N, **RNG.** 8W, 3rd **PM**,
Latitude , **Longitude**

COUNTY Madison **CORING METHOD** Double Solid Barrel

STRUCT. NO. 060-0082
Station 237+44.5

BORING NO. SB-02
Station 238+89
Offset 13.5 ft Lt.
Ground Surface Elev. 449.90 **ft**

CORING BARREL TYPE & SIZE 2
Core Diameter 2 **in**
Top of Rock Elev. 391.40 **ft**
Begin Core Elev. 390.90 **ft**

	DEPTH (ft)	CORE (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
Gray SHALE w/limestone partings *(continued)*	389.90	1	82	53	3.5	
Gray LIMESTONE w/ very thin shale seams	-60					1420.1
						1617.3
	385.90					188.7
Light Gray weathered SHALE w/ limestone nodules	-65	2	100	27	4	
	383.90					
Gray weathered SHALE	381.40					
Dark Gray weathered SHALE	380.90					
End of Boring	-70					
	-75					

ROCK CORE IL 143 OVER INDIAN CREEK, EDWARDSVILLE.GPJ IL_DOT.GDT 1/7/16

Color pictures of the cores Yes
Cores will be stored for examination until
The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D-2938)


IL 143 Over Indian Ck
125BR-2
Madison County
Boring SB-2
59ft to 69ft


59ft to 69ft
-59'
-69'

HOLCOMB FOUNDATION ENGINEERING COMPANY
Rock Core Strength Tests

Project: Illinois Route #143 Core Diam.(In.) 1.97
Project No: H-15267
Date: 12/29/15

Boring	Depth(Ft.)	Length (In.)	L/D	L/D Corr.	Total Lbs.	PSI	Material Type
SB-2	61.0-61.5'	4.89	2.48	1.020	59060	19724	Limestone
SB-2	62.0-62.5'	4.97	2.52	1.020	67260	22462	Limestone
SB-2	63.5-64.0'	3.98	2.02	1.001	7990	2619	Limestone

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

SOIL BORING LOG

Date 11/1/16

ROUTE FAP 789 **DESCRIPTION** IL 143 over Indian Creek **LOGGED BY** ACE (TSi)

SECTION 125B-1 **LOCATION** , **SEC.** 31, **TWP.** 5N, **RNG.** 8W, 3 **PM**

COUNTY Madison **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE** Automatic

STRUCT. NO. 060-0082 (E) / 060-0349 (P)
Station

BORING NO. SB 1 W Pier
Station 236+75
Offset 40.00ft Left
Ground Surface Elev. 447.0 ft

Surface Water Elev. ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 431.0 ft ▼
Upon Completion ft
After Hrs. ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Material
	3			Brown Silty CLAY A-6(15) See Class @ 6.5 ft
	4 4	3.27 B	20	
	2			
-5	3 2	1.25 P	25	
	2			
	2 2	1.02 B	25	
	2			
-10	2 2	1.10 B	27	
	WH			Brown and Dark Gray
	1 2	0.82 B	33	
	WH			Dark Gray
-15	2 1	0.86 B	33	
431.0 ▼				
	WH			Dark Gray Silty Clay LOAM A-6(10) See Class @ 16.5 ft
	WH 1	0.29 B	34	
428.0	1			
-20	2 3	0.86 B	27	Dark Gray Silty CLAY

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Material
426.5				Dark Gray Silty CLAY *(continued)*
	1			Dark Gray CLAY
	2 2	1.19 B	38	
	1			
-25	2 2	1.88 B	26	Trace Gravel
421.5				
	1			Gray Silty CLAY
	1 2	0.98 B	31	
	WH			
-30	2 3	0.90 B	30	6" Sand Seam
415.0				
	2			Gray Silty Clay LOAM with some Sand
-35	6 10	0.86 B	28	
410.0				
	4			Gray Sandy LOAM
407.5				
-40	4 6	3.19 B	32	Brown and Gray CLAY

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

BBS, from 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

SOIL BORING LOG

Date 11/1/16

ROUTE FAP 789 DESCRIPTION IL 143 over Indian Creek LOGGED BY ACE (TSi)

SECTION 125B-1 LOCATION , SEC. 31, TWP. 5N, RNG. 8W, 3 PM

COUNTY Madison DRILLING METHOD Hollow Stem Auger HAMMER TYPE Automatic

STRUCT. NO. 060-0082 (E) / 060-0349 (P)
Station

BORING NO. SB 1 W Pier
Station 236+75
Offset 40.00ft Left
Ground Surface Elev. 447.0 ft

Surface Water Elev. ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 431.0 ft
Upon Completion ft
After Hrs. ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Brown and Gray CLAY *(continued)* Trace Clay				
		2		
Brown		2	1.23	28
	-45	3	B	
		WH		
		2	1.92	25
	-50	2	B	
	394.0			
Gray SHALE	393.0	50/3"	NA	11
Borehole continued with rock coring.	-55			
	-60			

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

BBS, from 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

ROCK CORE LOG

Date 11/1/16

ROUTE FAP 789 DESCRIPTION IL 143 over Indian Creek LOGGED BY ACE (TSi)

SECTION 125B-1 LOCATION , SEC. 31, TWP. 5N, RNG. 8W, 3 PM

COUNTY Madison CORING METHOD

STRUCT. NO. 060-0082 (E) / 060-0349 (P)
Station

CORING BARREL TYPE & SIZE NQ
Core Diameter 1.8 in
Top of Rock Elev. 393.00 ft
Begin Core Elev. 393.00 ft

BORING NO. SB 1 W Pier
Station 236+75
Offset 40.00ft Left
Ground Surface Elev. 447.0 ft

	DEPTH (ft)	CORE (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
393.00 Gray (Hard, Aphanitic, Thin Bedded, Dense) Slightly Weathered LIMESTONE	-55	1	100	0	4	
2" Gray Shale Seam Medium Bedded		2	78	33	3	
390.40 Gray (Soft, Aphanitic, Medium Bedded, Dense) Slightly to Moderately Weathered SHALE		2	78	33	2	
389.40 Gray (Hard, Aphanitic, Medium Bedded, Pitted) Moderately Weathered LIMESTONE		2	78	33	2	
388.30 Dark Gray (Soft, Aphanitic, Massive Bedded, Pitted) Slightly to Moderately Weathered SHALE		2	78	33	3	
	-60	2	78	33	4	
		3	97	66	3	
		3	97	66	2	
		3	97	66	3	
383.75 Black (Moderately Hard, Aphanitic, Massive Bedded, Pitted) Moderately Weathered COAL with Interbedded Pyrite Pieces		3	97	66	2	
	-65	3	97	66	1	
		4	87	15	1	
		4	87	15	0	
		4	87	15	1	
2" Shale Seam		4	87	15	1	
		4	87	15	1	
377.10 Gray (Soft, Aphanitic, Medium Bedded, Dense) Moderately Weathered SHALE	-70	5	100	83	4	
376.00 END OF BORING AND ROCK CORE						

Color pictures of the cores Yes
Cores will be stored for examination until Yes
The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D-2938)

BBS, form 138 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

SOIL BORING LOG

Date 10/31/16

ROUTE FAP 789 **DESCRIPTION** IL 143 over Indian Creek **LOGGED BY** DDI (TSi)

SECTION 125B-1 **LOCATION** , **SEC.** 31, **TWP.** 5N, **RNG.** 8W, 3 **PM**

COUNTY Madison **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE** Automatic

STRUCT. NO. 060-0082 (E) / 060-0349 (P)
Station

BORING NO. SB 2 E Pier
Station 238+13
Offset 22.00ft Right
Ground Surface Elev. 455.0 ft

Surface Water Elev. ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 431.5 ft ▼
Upon Completion ft
After Hrs. ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Portland Cement Concrete 454.5			
Empty Space between Bridge Deck and Ground Surface			
-5			
446.5			
	2		
Brown and Gray Silty Clay LOAM with Trace Crushed Limestone (Fill) A-6(12) See Class @ 9 ft	1	0.50	25
-10	1	P	
	2		
	4	1.72	23
	4	B	
442.0			
Brown and Gray Silty Clay LOAM with Trace Wood Fragments A-6(11) See Class @ 16.5 ft	3		
	4	1.50	23
-15	4	P	
	1		
Trace Organics	2	1.50	25
	2	P	
	1		
-20	1	0.44	35
	2	B	
Brown and Gray Silty Clay LOAM with Trace Wood Fragments A-6(11) See Class @ 16.5 ft *(continued)*	2		
Trace Sand	3	0.65	26
	3	B	
431.5 ▼			
	1		
Greenish Gray CLAY with Trace Sand	2	0.41	28
-25	2	B	
	WH		
	1	0.44	30
	2	B	
427.0			
Gray Silty CLAY with Trace Sand	1		
	2	0.50	27
-30	3	P	
423.5			
	1	0.20	
	2	B	
Gray CLAY with Trace Organics and Shells	2	1.23	31
		B	
	2		
Gray and Maroon	3	0.87	41
-35	3	B	
	2		
Brown and Gray 418.2	3	1.23	36
Brown and Gray Clay LOAM with Trace Gravel and Organics 417.0	2	B	
Brown and Gray Fine to Medium SAND 416.5	2		
Brown and Gray CLAY	2	1.06	31
-40	4	B	

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

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

SOIL BORING LOG

Date 10/31/16

ROUTE FAP 789 **DESCRIPTION** IL 143 over Indian Creek **LOGGED BY** DDI (TSi)

SECTION 125B-1 **LOCATION** , **SEC.** 31, **TWP.** 5N, **RNG.** 8W, 3 **PM**

COUNTY Madison **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE** Automatic

STRUCT. NO. 060-0082 (E) / 060-0349 (P)
Station

BORING NO. SB 2 E Pier
Station 238+13
Offset 22.00ft Right
Ground Surface Elev. 455.0 ft

Surface Water Elev. ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 431.5 ft ▼
Upon Completion ft
After Hrs. ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Brown and Gray CLAY *(continued)*				
413.0				
Brown Sandy LOAM with Trace Gravel				
411.0		1	--	
		2		
Brown CLAY	-45	6	1.72 B	23
408.0				
Brown and Gray Loamy SAND with Trace Gravel, Organics, and Shells		14		
405.5		7	--	21
	-50	1		
Gray Clay LOAM with Trace Gravel				
402.0				
Gray CLAY with Trace Sand, Gravel, Wood, and Shale Fragments		8		
		11	6.14	14
	-55	13	B	
396.8				
Gray Weathered SHALE		50/2"	4.50+ P	11
396.3				
Borehole continued with rock coring.				
	-60			

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

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

ROCK CORE LOG

Date 10/31/16

ROUTE FAP 789 **DESCRIPTION** IL 143 over Indian Creek **LOGGED BY** DDI (TSi)

SECTION 125B-1 **LOCATION** , **SEC.** 31, **TWP.** 5N, **RNG.** 8W, 3 **PM**

COUNTY Madison **CORING METHOD**

STRUCT. NO. 060-0082 (E) / 060-0349 (P) **CORING BARREL TYPE & SIZE** NQ

Station

Core Diameter 1.8 in

BORING NO. SB 2 E Pier **Top of Rock Elev.** 396.30 ft

Station 238+13 **Begin Core Elev.** 396.00 ft

Offset 22.00ft Right

Ground Surface Elev. 455.0 ft

	DEPTH (ft)	CORE (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
Greenish Gray (Moderately Hard, Banded to Medium Bedded) Slightly Weathered SHALE	396.30	1	100	87	6	
	-60					
	394.75					
Greenish Gray (Moderately Hard, Banded to Fine Bedded, Fossilized) Moderately to Highly Weathered Interbedded SHALE and LIMESTONE	394.04	2	100	62	4	
Gray (Moderately Hard to Hard, Thick Bedded, Fossilized) Slightly to Moderately Weathered LIMESTONE		2	100	62	2	
2" Green Shale Seam		2	100	62	3	
0.5" Green Shale Seam	391.79					
Dark Gray and Green (Moderately Hard, Banded to Thin Bedded, Fissile/Laminated) Highly Weathered SHALE	390.96	2	100	62	2	
Gray (Moderately Hard, Thin to Medium Bedded) Slightly to Moderately Weathered LIMESTONE		2	100	62	4	
2" Vertical Fracture	-65					
	389.25	3	100	66	5	
Dark Brown and Black (Soft to Moderately Hard, Banded to Medium Bedded, Fissile) Slightly to Moderately Weathered SHALE		3	100	66	4	
		3	100	66	3	
	385.83					
END OF BORING AND ROCK CORE	-70					
	-75					

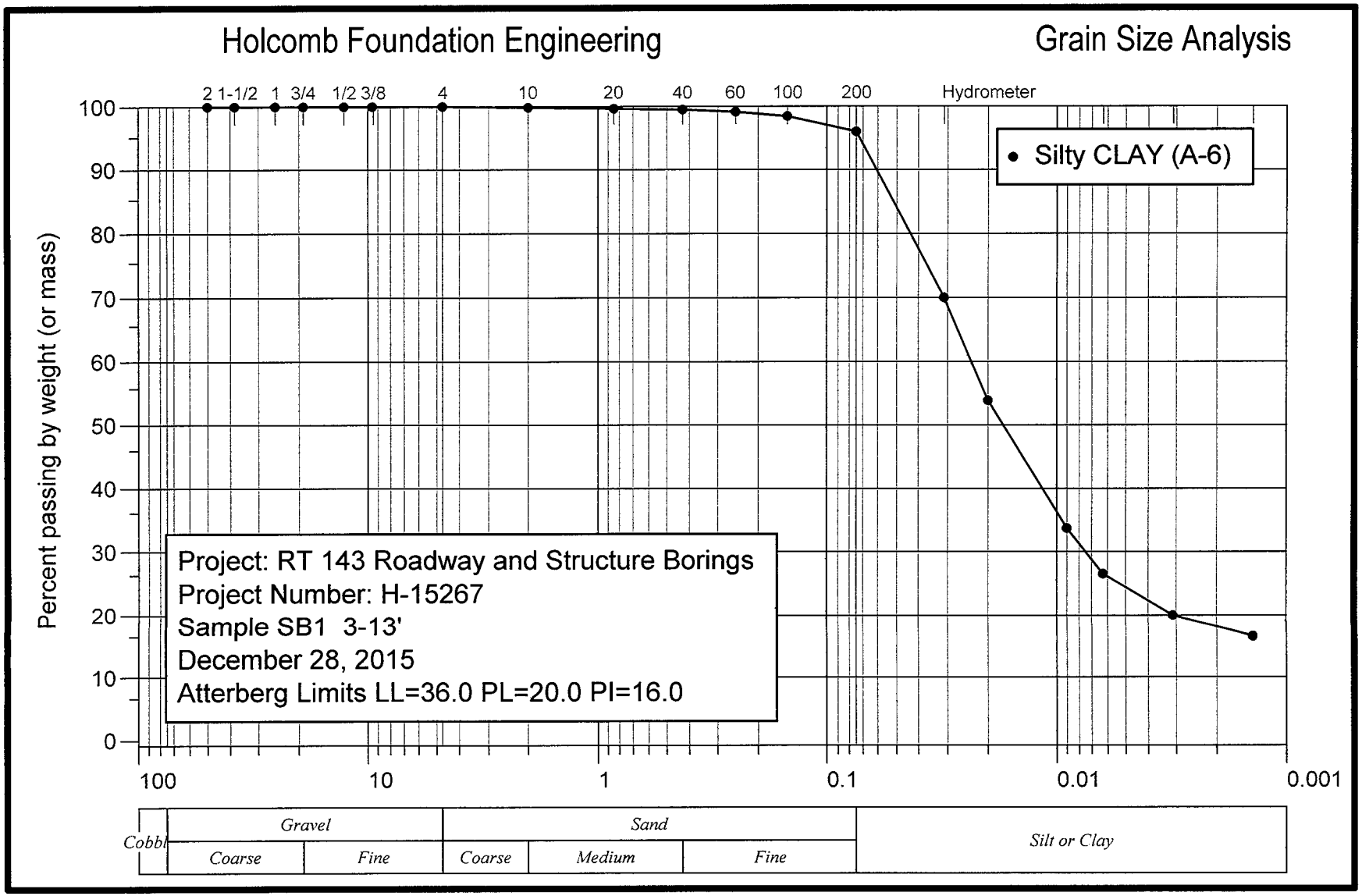
Color pictures of the cores Yes

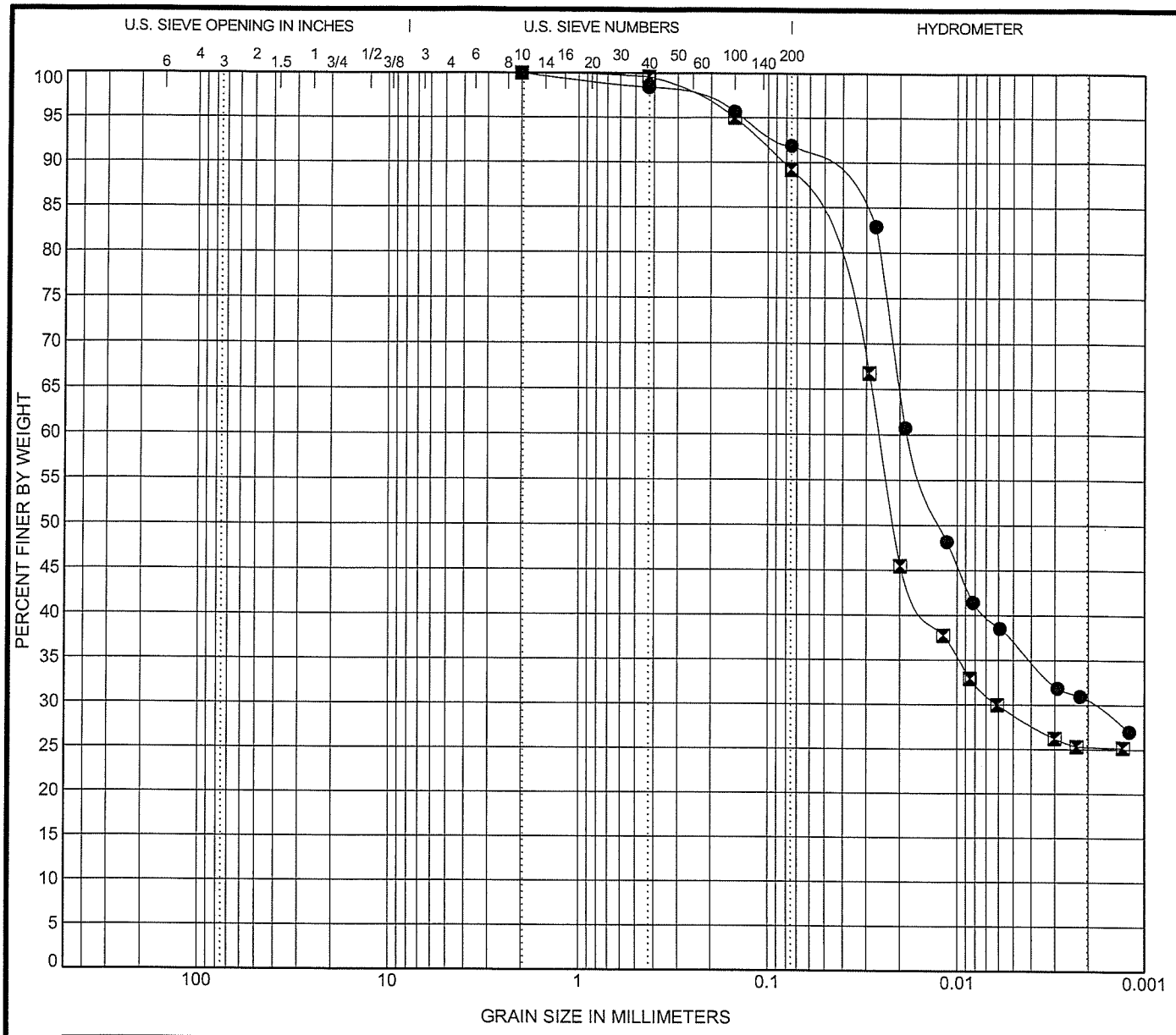
Cores will be stored for examination until Yes

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

BBS, form 138 (Rev. 8-99)

Appendix F


Holcomb Foundation Engineering
Grain Size Analysis
2 1-1/2 1 3/4 1/2 3/8 4 10 20 40 60 100 200 Hydrometer
Percent passing by weight (or mass)
100 90 80 70 60 50 40 30 20 10 0
Silty CLAY (A-6)
Project: RT 143 Roadway and Structure Borings
Project Number: H-15267
Sample SB1 3-13'
December 28, 2015
Atterberg Limits LL=36.0 PL=20.0 PI=16.0
100 10 1 0.1 0.01 0.001
Cobbl
Gravel
Coarse
Fine
Sand
Coarse
Medium
Fine
Silt or Clay



COBBLES	GRAVEL	SAND		SILT	CLAY
		coarse	fine		

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	SB 1	6.50	A-6 (15) SILTY CLAY	36.3	19.6	16.7		
⊠	SB 1	16.50	A-6 (10) SILTY CLAY LOAM	31.3	19.4	11.9		

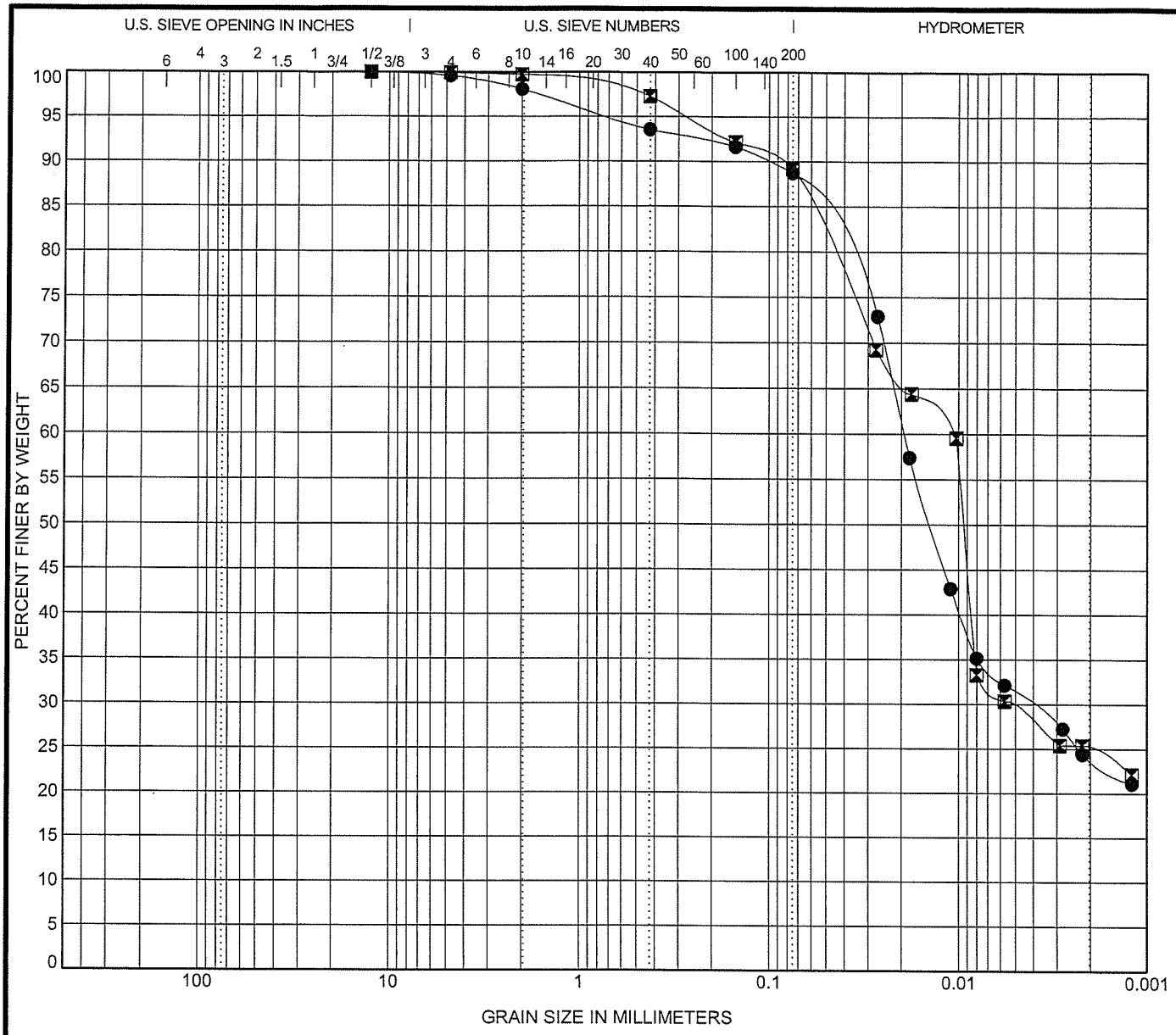
	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	SB 1	6.50	2	0.018	0.002		0.0	8.1	61.5	30.3
⊠	SB 1	16.50	2	0.026	0.006		0.0	10.8	63.9	25.3

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

IDH GRAIN SIZE DISTRIBUTION

Route: FAP 789
Section: 125B-1
County: Madison

GRAIN_SIZE_IDH_3-18-11 060-0082.GPJ IL_DOT.GDT 11/30/16



COBBLES	GRAVEL	SAND		SILT	CLAY
		coarse	fine		

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	SB 2	9.00	A-6 (12) SILTY CLAY LOAM	34.8	21.0	13.8		
⊠	SB 2	16.50	A-6 (11) SILTY CLAY LOAM	33.2	20.3	12.9		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	SB 2	9.00	12.5	0.019	0.004		1.9	9.4	64.8	23.9
⊠	SB 2	16.50	12.5	0.011	0.005		0.3	10.6	64.3	24.9

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Division of Highways
Illinois Department of Transportation

IDH GRAIN SIZE DISTRIBUTION

Route: FAP 789
Section: 125B-1
County: Madison

GRAIN_SIZE_IDH_3-18-11 060-0082.GPJ IL_DOT.GDT 11/30/16

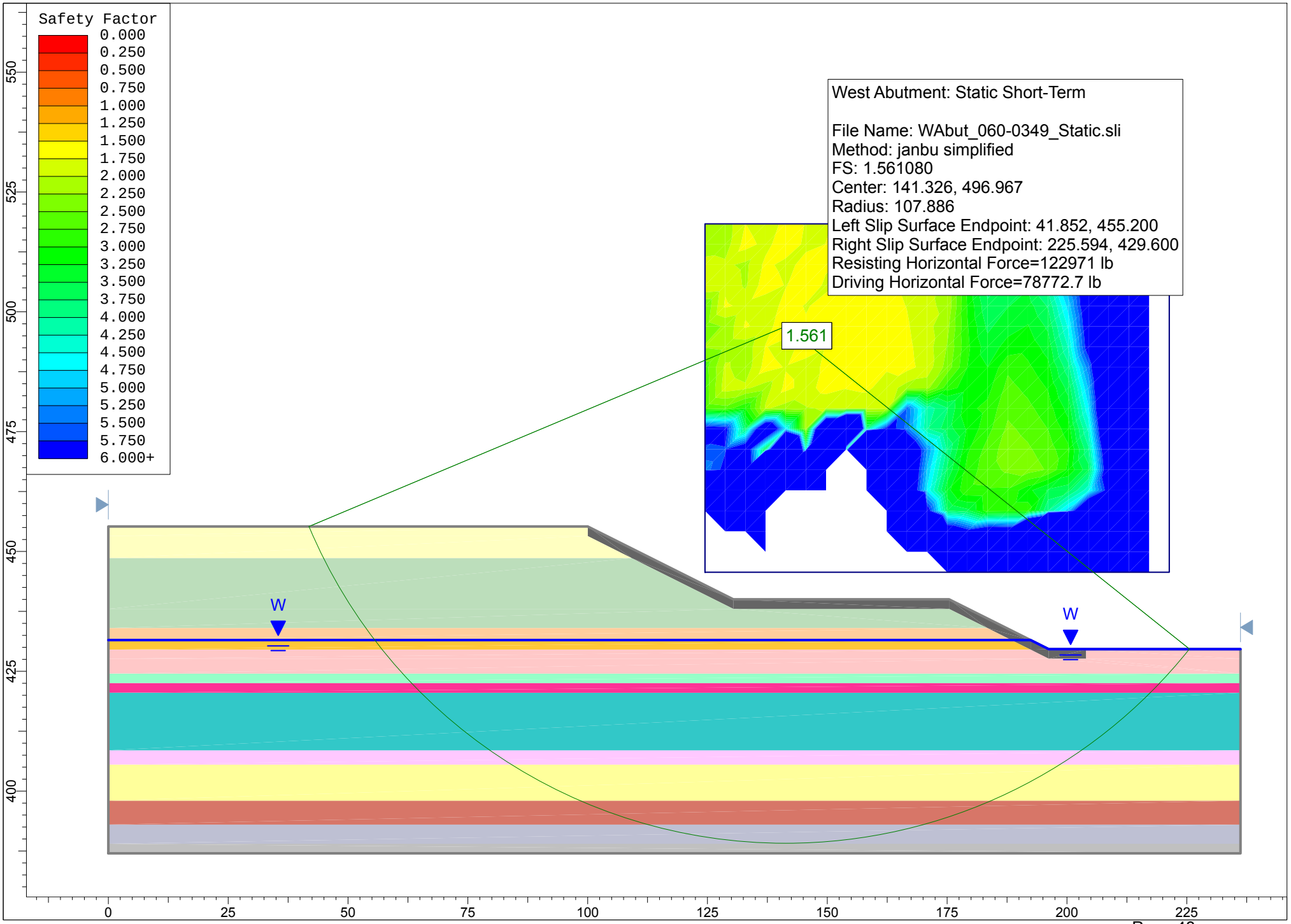
Appendix G

West Abutment Input

					Short Term		Long Term	
Layer #	Material Desc.	Top Elev	Bot. Elev	Unit Weight	Phi	C (psf)	Phi	C (psf)
1	New Fill	455.2	448.6	120	0	1000	28	200
2	Silty Clay	448.6	434	120	0	1750	0	1000
3	Silty Clay	434	431.5	120	0	600	28	120
4	Silty Clay	431.5	429.5	57.6	0	1200	28	240
5	Silty Clay	429.5	424.5	57.6	0	300	28	60
6	Clayey Silt	424.5	422.5	57.6	0	600	28	120
7	Clayey Silt	422.5	420.5	57.6	0	200	28	40
8	Sand	420.5	408.5	52.6	34	0	34	0
9	Silty Clay	408.5	405.5	57.6	0	800	28	160
10	Sand	405.5	398	52.6	34	0	34	0
11	Silty Clay	398	393	57.6	0	1100	28	220
12	Silty Clay	393	389	57.6	0	300	28	60
13	Limestone	389	387	77.6	30	10000	30	10000
14	Riprap			150	35	5000	35	5000

East Abutment Input

					Short Term		Long Term	
Layer #	Material Desc.	Top Elev	Bot. Elev	Unit Weight	Phi	C (psf)	Phi	C (psf)
1	New Fill	456.48	448.23	120	0	1000	28	200
2	Silty Clay	448.23	446.9	120	0	2500	0	1750
3	Silty Clay	446.9	444.4	120	0	600	28	120
4	Silty Clay	444.4	439.4	120	0	1800	0	1050
5	Silty Clay	439.4	429.4	120	0	400	28	80
6	Silty Clay	429.4	424.4	57.6	0	1900	0	1150
7	Silty/Sandy Clay	424.4	417.4	57.6	0	950	28	190
8	Silty/Sandy Clay	417.4	412.9	57.6	0	1800	0	1050
9	Silty Clay	412.9	402.9	57.6	0	700	28	140
10	Sand	402.9	397.9	52.6	34	0	34	0
11	Silty Clay	397.9	391.4	57.6	0	3700	0	2950
12	Shale	391.4	389.9	77.6	30	5000	30	5000
13	Limestone	389.9	385.9	77.6	30	10000	30	10000
14	Shale	385.9	380.9	77.6	30	5000	30	5000
15	Riprap			150	35	5000	35	5000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0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
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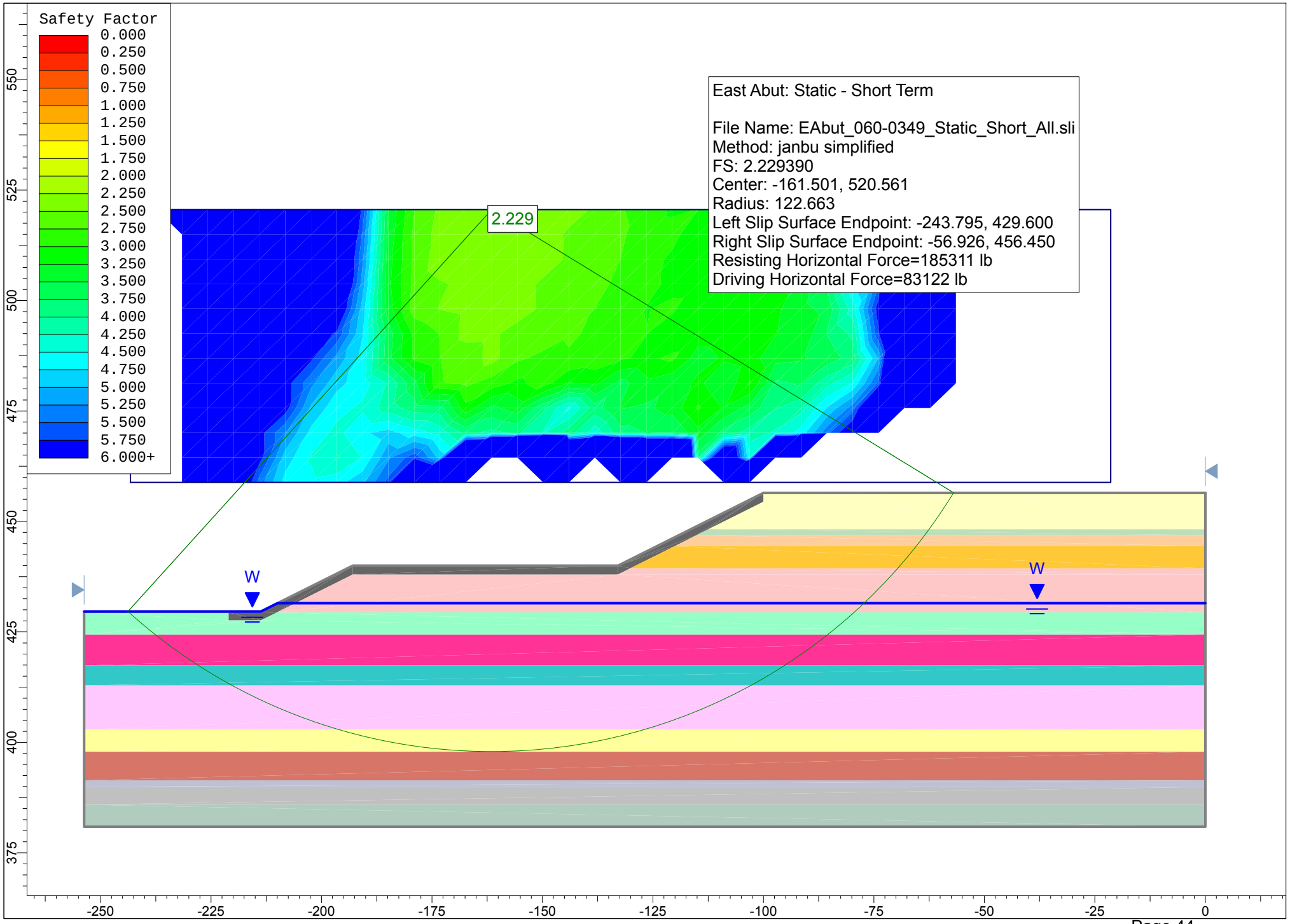
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
West Abutment: Static Short-Term
File Name: WAbut_060-0349_Static.sli
Method: janbu simplified
FS: 1.561080
Center: 141.326, 496.967
Radius: 107.886
Left Slip Surface Endpoint: 41.852, 455.200
Right Slip Surface Endpoint: 225.594, 429.600
Resisting Horizontal Force=122971 lb
Driving Horizontal Force=78772.7 lb
1.561
W
W
550
525
500
475
450
425
400
0
25
50
75
100
125
150
175
200
225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3.500
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4.500
4.750
5.000
5.250
5.500
5.750
6.000+
East Abut: Static - Short Term
File Name: EAbut_060-0349_Static_Short_All.sli
Method: janbu simplified
FS: 2.229390
Center: -161.501, 520.561
Radius: 122.663
Left Slip Surface Endpoint: -243.795, 429.600
Right Slip Surface Endpoint: -56.926, 456.450
Resisting Horizontal Force=185311 lb
Driving Horizontal Force=83122 lb
2.229
W
W
550
525
500
475
450
425
400
375
-250
-225
-200
-175
-150
-125
-100
-75
-50
-25
0

Route: FAP 789
Section: 125B-2
County: Madison

Seismic Slope Stability Analysis
Abutments

Proposed SN: 060-0349
Existing SN: 060-0082
Contract: 78G56

INPUT PARAMETERS:

LOCATION	E & W Abut	
EMBANKMENT HEIGHT (H)	24.98	FT
PEAK HORIZONTAL GROUND ACCELERATION (PGA)	0.079	DIM
SEISMIC SITE CLASSIFICATION	D	
SITE FACTOR AT ZERO PERIOD ON ACCELERATION SPECTRUM (F_{pga})	1.6	DIM
AASHTO SPECTRAL ACCELERATION AT 1.0 SEC. FOR SITE CLASS B (S_1)	0.092	DIM
AASHTO SITE FACTOR FOR 1.0 SEC. SPECTRAL ACCELERATION (F_V)	2.4	DIM

STEP 1: PSEUDO-STATIC SLOPE STABILITY ANALYSIS:

MAXIMUM POSSIBLE SEISMIC COEFFICIENT (k_{max}) = 0.1264 DIM

$k_{max} = F_{pga} * PGA$ = 1.6*0.079 = 0.1264 [EQ. 6-1 FHWA-NHI-11-032]

PEAK AVERAGE SEISMIC COEFFICIENT (k_{av}) = 0.122 DIM

$k_{av} = \alpha * k_{max}$ = 0.968*0.1264 = 0.122 [EQ. 6-2 FHWA-NHI-11-032]

SLOPE & HEIGHT ADJUSTMENT FACTORS

$\alpha = 1+0.01*H*(0.5*\beta-1)$ = 1+0.01*24.98*(0.5*1.75-1) = 0.968 [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.

$\alpha = 1.2*[1+0.01*H*(0.5*\beta-1)]$

$\beta = (F_v*S_1)/k_{max}$ = (2.4*0.092)/0.1264 = 1.747 [EQ. 6-4 FHWA-NHI-11-032]

HORIZONTAL SEISMIC COEFFICIENT FOR SEISMIC SLOPE STABILITY ANALYSIS (k_h) = 0.061

$k_h = 0.5*\alpha*F_{pga}*PGA = 0.5*\alpha*k_{max} = 0.5*k_{av}$ = 0.5*0.122 = 0.061 [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]

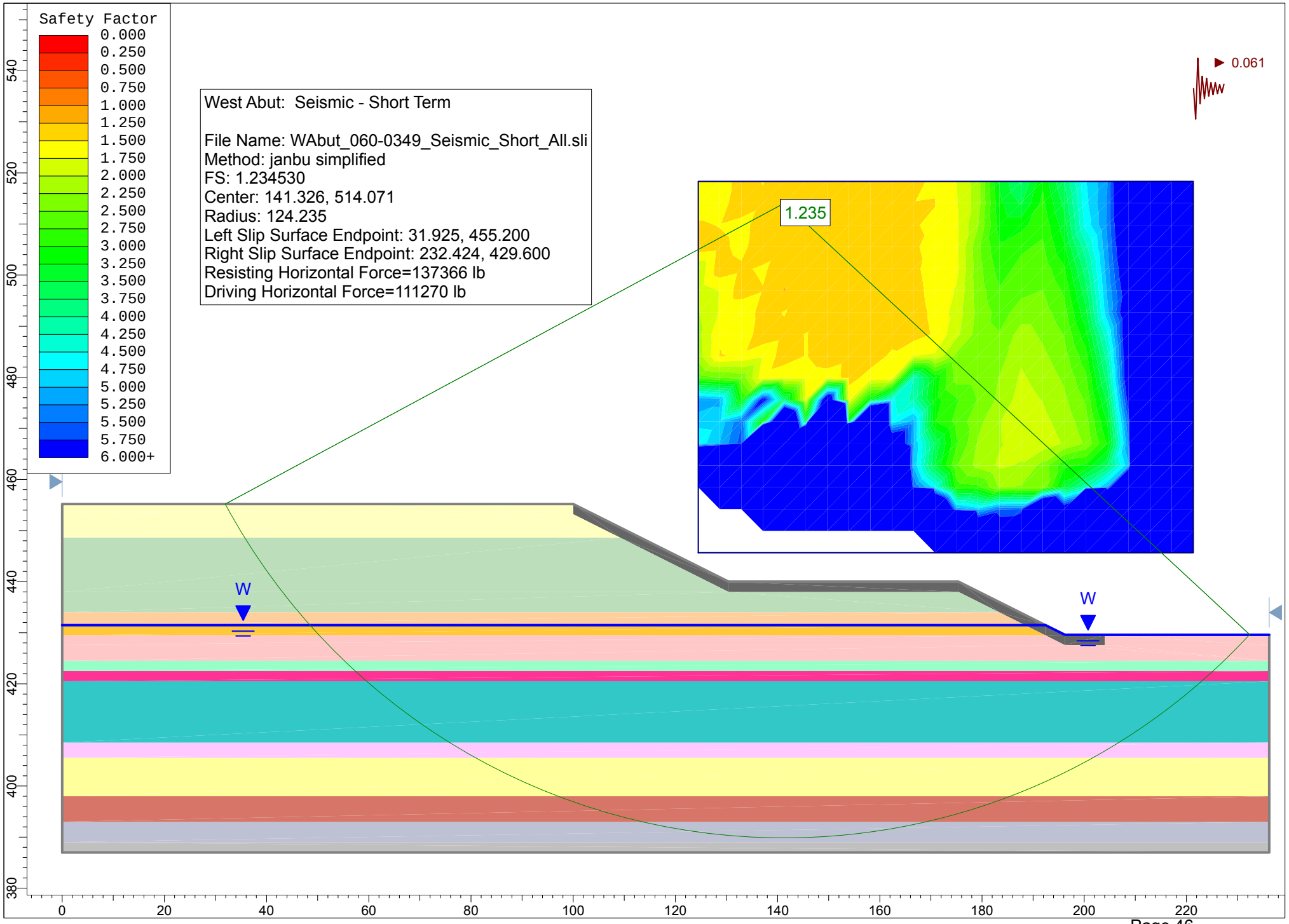
ESTIMATED HORIZONTAL DISPLACEMENT (d) = INCH

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]

$\log(d) = -1.51 -0.74*\log(k_y/k_{max}) +3.27*\log(1-(k_y/k_{max})) -0.80*\log(k_{max}) +1.59*\log(PGV)$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0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
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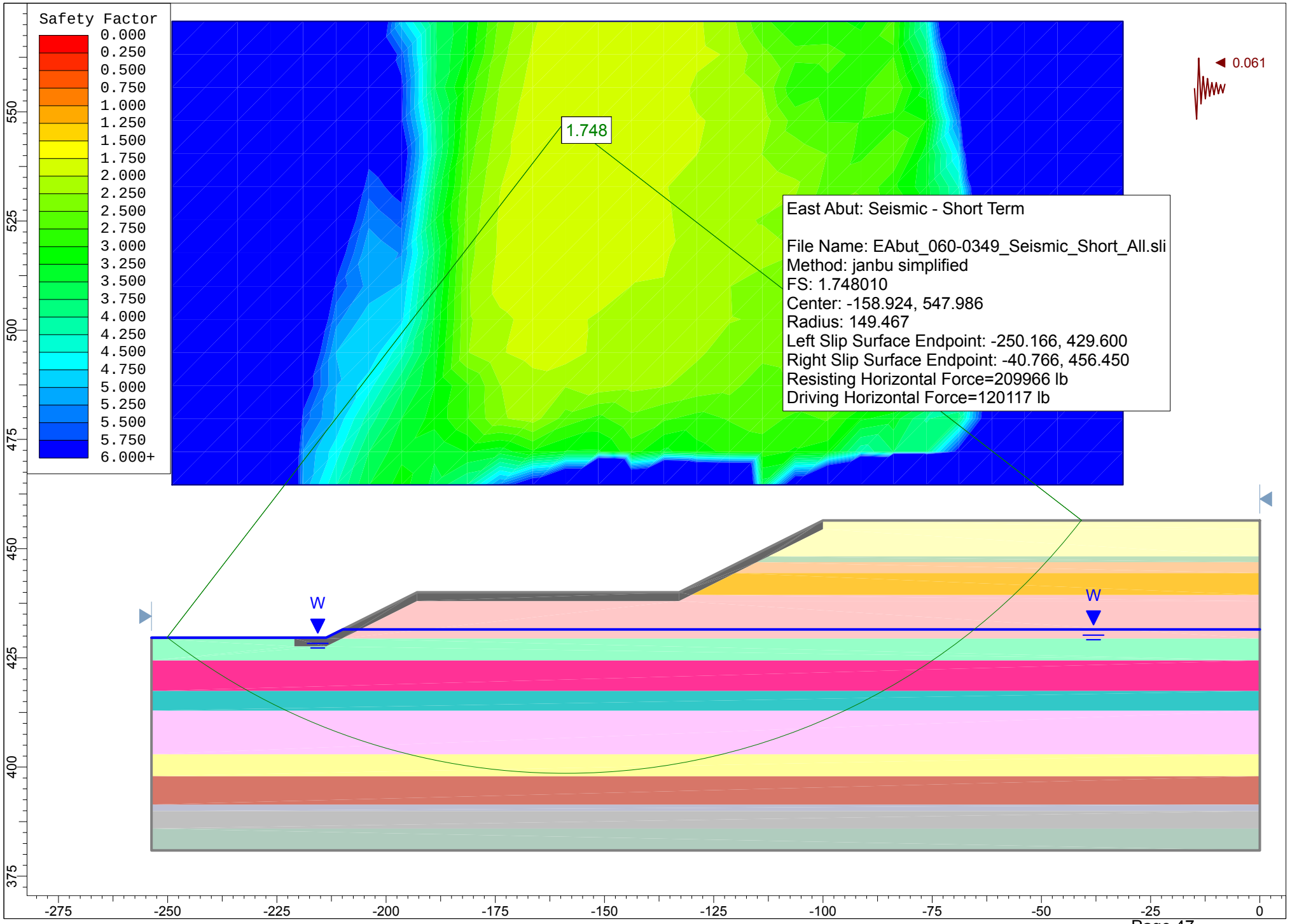
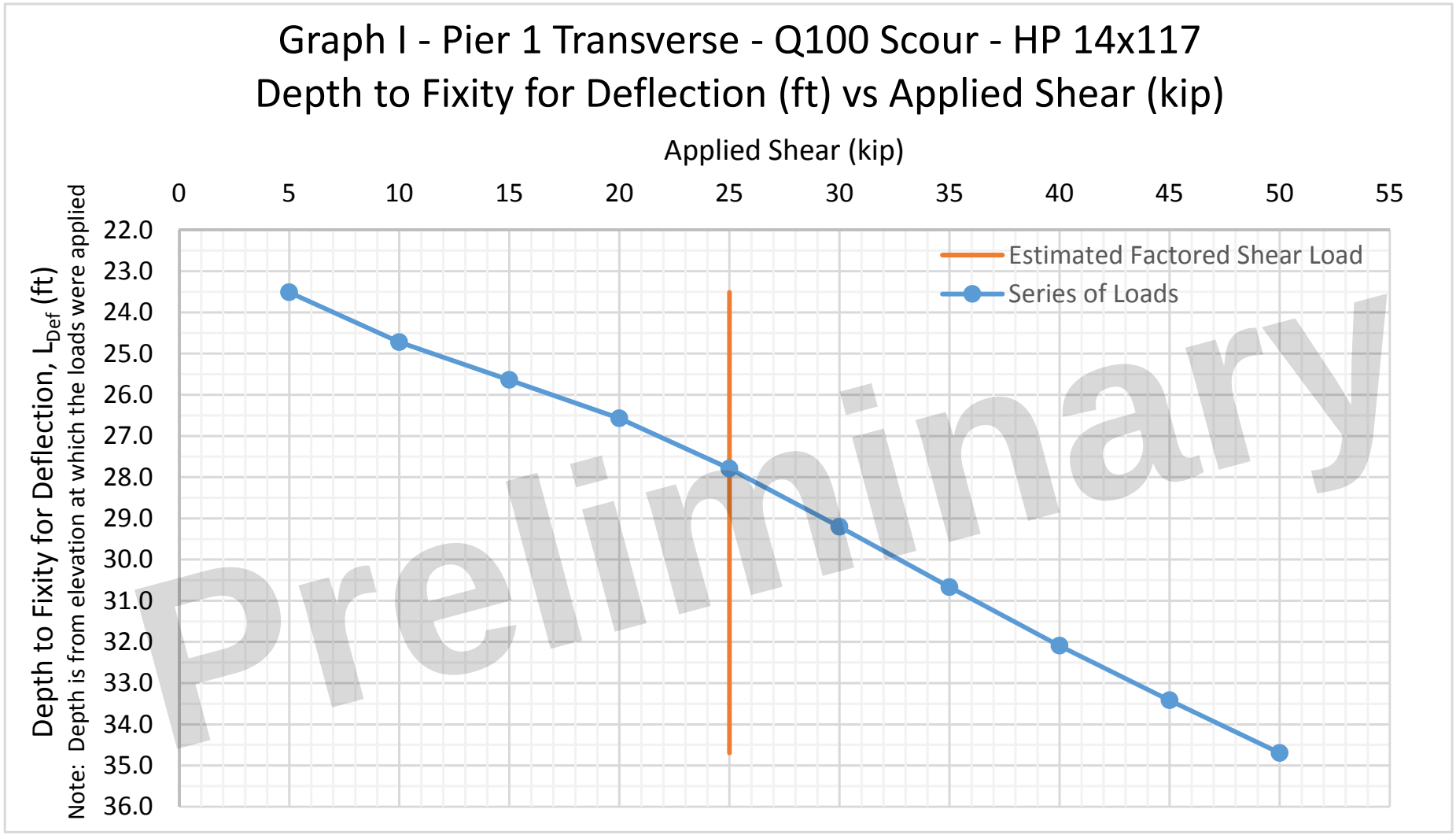
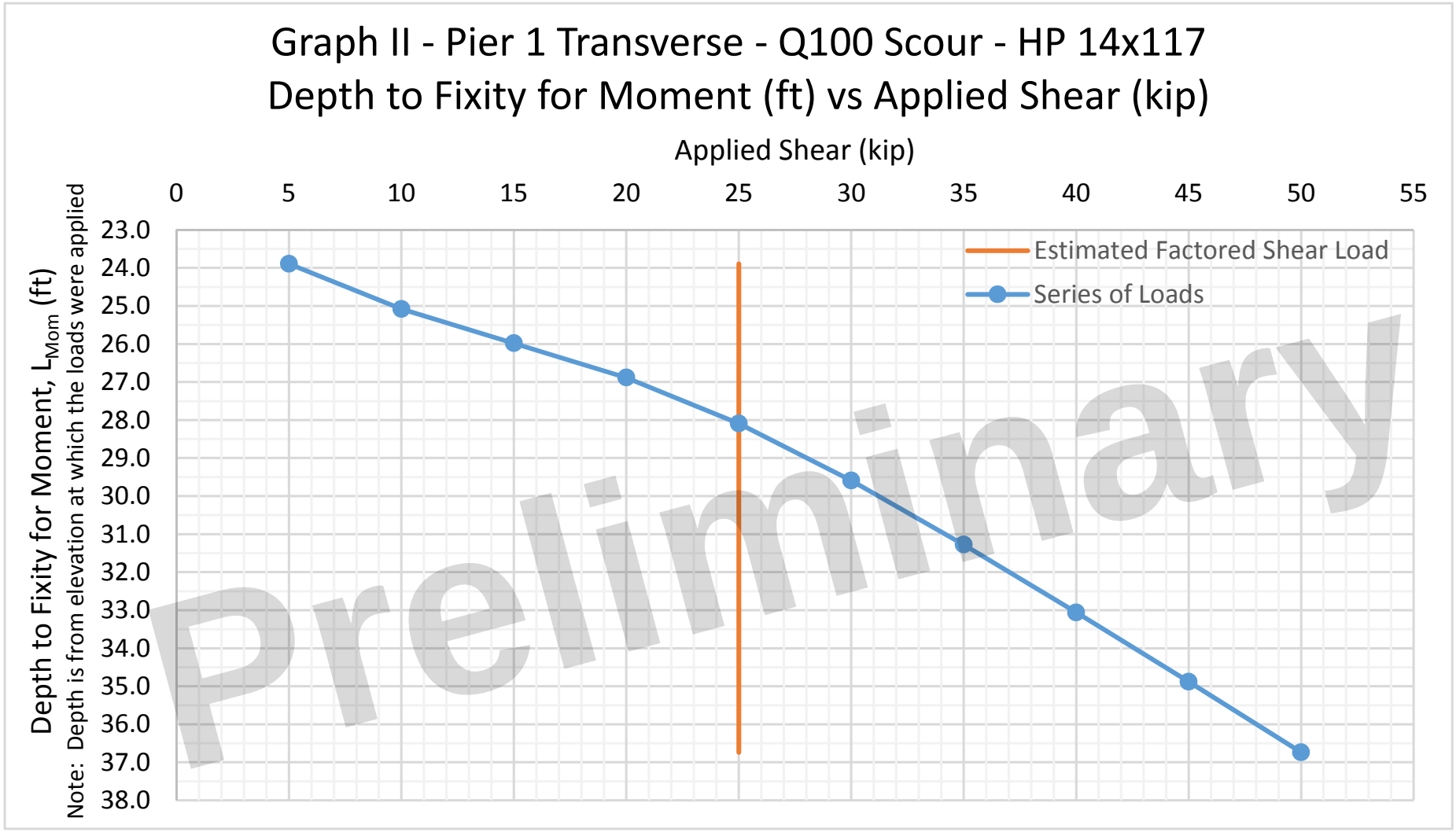
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
West Abut: Seismic - Short Term
File Name: WAbut_060-0349_Seismic_Short_All.sli
Method: janbu simplified
FS: 1.234530
Center: 141.326, 514.071
Radius: 124.235
Left Slip Surface Endpoint: 31.925, 455.200
Right Slip Surface Endpoint: 232.424, 429.600
Resisting Horizontal Force=137366 lb
Driving Horizontal Force=111270 lb
0.061
1.235
W
W
540
520
500
480
460
440
420
400
380
0
20
40
60
80
100
120
140
160
180
200
220


Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
1.748
0.061
East Abut: Seismic - Short Term
File Name: EAbut_060-0349_Seismic_Short_All.sli
Method: janbu simplified
FS: 1.748010
Center: -158.924, 547.986
Radius: 149.467
Left Slip Surface Endpoint: -250.166, 429.600
Right Slip Surface Endpoint: -40.766, 456.450
Resisting Horizontal Force=209966 lb
Driving Horizontal Force=120117 lb
W
W
550
525
500
475
450
425
400
375
-275
-250
-225
-200
-175
-150
-125
-100
-75
-50
-25
0

Appendix H


Graph I - Pier 1 Transverse - Q100 Scour - HP 14x117
Depth to Fixity for Deflection (ft) vs Applied Shear (kip)
Applied Shear (kip)
0
5
10
15
20
25
30
35
40
45
50
55
Depth to Fixity for Deflection, L_{Def} (ft)
Note: Depth is from elevation at which the loads were applied
22.0
23.0
24.0
25.0
26.0
27.0
28.0
29.0
30.0
31.0
32.0
33.0
34.0
35.0
36.0
Estimated Factored Shear Load
Series of Loads
Preliminary


Graph II - Pier 1 Transverse - Q100 Scour - HP 14x117
Depth to Fixity for Moment (ft) vs Applied Shear (kip)
Applied Shear (kip)
0
5
10
15
20
25
30
35
40
45
50
55
Depth to Fixity for Moment, L_{Mom} (ft)
Note: Depth is from elevation at which the loads were applied
23.0
24.0
25.0
26.0
27.0
28.0
29.0
30.0
31.0
32.0
33.0
34.0
35.0
36.0
37.0
38.0
Estimated Factored Shear Load
Series of Loads
Preliminary

Graph III - Pier 1 Transverse - Q100 Scour - HP 14x117
Required Embedment Depth (ft) vs Applied Shear (kip)