STRUCTURE GEOTECHNICAL REPORT

F.A.P. Route 331 (IL 13 W.B.) over Crab Orchard Creek Overflow Widening

S.N. 039-0062 (E)

F.A.P. ROUTE 331
SECTION (5-3) BR-1
JOB NO. D-99-019-12
CONTRACT NO. 78295
JACKSON COUNTY, ILLINOIS
PTB 148/34 WO#18
KEG NO. 08-0061.18

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10/25/2016
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April 12, 2016
Revised October 25, 2016

Kaskaskia
Engineering Group, LLC

EXECUTIVE SUMMARY

IL 13 W.B. over Crab Orchard Creek Overflow
F.A.P. 331
Section (5-3) BR-1
Jackson County, Illinois
Job No. D-99-019-12
Contract No. 78295
PTB 148/34 WO #18
Existing Structure No. 039-0062

The project includes the rehabilitation and widening of a westbound triple-span bridge (SN 039-0062) located in Jackson County, Illinois. The existing superstructure will be rehabilitated and a lane will be added. Two lanes of traffic will be maintained during widening. Upon completion, traffic will be maintained through crossovers.

The results of the slope stability analysis indicates that an acceptable factor of safety (FOS) will exist at the west and east abutments during the end-of-construction, long-term, and seismic conditions. In order to achieve acceptable FOS for the seismic condition, the abutment piles were included in the model with a maximum spacing of 8 feet.

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1.0 Project Description and Proposed Structure Information

1.1 Introduction

The geotechnical study summarized in this report was performed for the proposed rehabilitation and widening of the triple-span structure carrying westbound IL 13 over Crab Orchard Creek Overflow in Jackson County, Illinois. The purpose of this report is to present design and construction recommendations for the proposed structure.

1.2 Project Description

The project includes the rehabilitation of the existing triple-span bridge (SN 039-0062) located in Jackson County, Illinois. The existing superstructure will be rehabilitated and a lane will be added. Two lanes of traffic will remain open during widening. Upon completion, traffic with be maintained through crossovers. The general location of the structure is shown on a USGS Topographic Location Map, Exhibit A. The site lies within the limits of the Third Principal Meridian, (T. 9S R. 1W Section 14) within the Mt. Vernon Hill Country of the Till Plains section of the Central Lowland Province.

1.3 Existing Structure

The existing structure was constructed in 1995 and is a three-span continuous P.P.C. I-beam bridge. It consists of integral abutments supported on H piles and solid wall piers supported on a single row of H piles driven to refusal. Back to back abutments measure 146 ft. – 7 in. with an out to out width of 43 ft. – 11 in. The existing bridge will remain and be widened.

1.4 Proposed Bridge Information

The proposed lane addition to the structure located at F.A.P. Route 331 (IL 13) over Crab Orchard Creek Overflow will require widening the substructure units to accommodate an additional 12 ft. wide driving lane. The addition will result in a triple-span structure built on a zero degree skew. The structure will have a width of 55 ft. - 11 in. out-to-out deck. The outside spans will measure 45 ft. – 11 in., and the middle span will measure 52 ft. – 3 in. The structure will be located at station 65+54.28 (IL 13).

The structure will measure 146 ft. – 7 in., measured parallel to the centerline of IL 13, from back-to-back of abutments. The structure will support three, 12-ft. lanes, with shoulder widths of approximately 6 ft. and 10 ft. Further substructure details will be based on the findings of this SGR.

2.0 Site Investigation, Subsurface Exploration, and Generalized Subsurface Conditions

The site investigation plan was developed and performed by IDOT. A KEG representative did not observe any part of the field exploration, or make site observations, including review of the soil samples retained during drilling.

Two Standard Penetration Test (SPT) borings, designated 1-S and 2-S were drilled between July 18 and July 22, 2014. The boring locations are shown on the Type, Size, and Location Plan (TS&L), Exhibit B, as provided by Crawford, Murphy and Tilly, Inc. (CM&T). Detailed information regarding the nature and thickness of the soils encountered and the results of the field sampling and laboratory testing are shown on the Boring Logs, Exhibit C. A soil profile can be found under Subsurface Profile, Exhibit D.

Table 2.0 – Boring Summary

Boring Location	Station	Offset	Ground Surface Elevation
1-S	164+48* (64+51)	16 ft. LT	391.4
2-S	166+64* (66+38)	15 ft. LT	390.7

*****The stationing of the borings are based off the previous IL 13 alignment. The stationing in parenthesis are approximations based off of the new stationing provided on the current TS&L.

2.1 Subsurface Conditions

Boring 1-S consisted of approximately 3.5 ft. of asphalt over crushed aggregate from the ground surface (El. 391.4) to El. 387.9. A very stiff silty clay to clay followed to El. 384.4, with a driving resistance (N-value) of 6 blows per foot (bpf), an unconfined compressive strength (Q_u) value of 2.3 tons per square foot (tsf), and a moisture content of 22 percent. A medium to soft silty clay to clay followed to El. 381.9, with an N-value of 3 bpf, a Q_u value of 0.5 tsf, and a moisture content of 25 percent. A stiff clay followed to El. 379.4, with an N-value of 5 bpf, a Q_u value of 1.6 tsf, and a moisture content of 25 percent. A very stiff clay to silty clay followed to El. 376.9, with an N-value of 6 bpf, a Q_u value of 2.9 tsf, and a moisture content of 18 percent. A very soft clay followed to El. 374.4, with an N-value of 2 bpf, a Q_u value of 0.2 tsf, and a moisture content of 31 percent. A stiff clay followed El. 371.9, with an N-value of 6 bpf, a Q_u value of 1.9 tsf, and a moisture content of 33 percent. A very stiff clay followed to El. 369.4, with an N-value of 7 bpf, a Q_u value 2.5 tsf, and a moisture content of 35 percent. A stiff clay followed to El. 356.9, with N-values between 2 and 6 bpf, Q_u values between 1.2 and 1.9 tsf, and moisture contents between 26 to 33 percent. A very stiff clay followed to El. 346.9, with N-values between 7 and 10 bpf, Q_u values between 2.0 and 2.7 tsf, and moisture contents 27 to 31 percent. A hard clay followed to El. 341.4, with an N-value of 14 bpf, a Q_u value of 4.5 tsf, and a moisture content of 24 percent. A very stiff clay followed to El. 336.9, with an N-value of 10 bpf, a Q_u value of 2.7 tsf, and a moisture content of 23 percent. A medium sandy clay loam to clay loam followed to El. 328.9, with N-values between 3 and 12 bpf, Q_u values between 0.6 to 0.8 tsf, and moisture contents from 18 to 25 percent. A hard clay shale followed to boring termination, with N-values of 100/6 inches and 100/2 inches.

Boring 2-S consisted of approximately 3 ft. of asphalt over crushed aggregate from the ground surface (El. 390.7) to El. 387.7. A stiff clay layer followed to El. 386.2, with an N-value of 3 bpf, a Q_u of 1.1 tsf, and a moisture content of 29 percent. A medium clay followed to El. 383.7, with an N-value of 2 bpf, a Q_u value of 0.7 tsf, and a moisture content of 27 percent. A medium silty clay followed to El. 381.2, with an N-value of 2 bpf, a Q_u value of 0.7 tsf, and a moisture content of 25 percent. A stiff clay followed to El. 378.7, with an N-value of 4 bpf, with a Q_u value of 1.4 tsf, and a moisture content of 26 percent. A very stiff clay followed to El. 373.7, with N-values from 6 to 8 bpf, a Q_u value of 2.9 tsf, and moisture contents between 23 and 24 percent. A soft to medium silt loam to silty clay loam followed to El. 371.2, with an N-value of 1 bpf, a Q_u value of 0.5 tsf, and a moisture content of 25 percent. A stiff silt loam to silty clay loam followed to El. 368.7, with an

N-value of 7 bpf, a Q_u value of 1.2 tsf, and a moisture content of 22 percent. A soft, silty clay loam followed to El. 366.2, with an N-value of 1 bpf, a Q_u value of 0.4 tsf, and a moisture content of 29 percent. A very soft, silty clay loam followed to El. 363.7, with an N-value of 2 bpf, a Q_u value of 0.2 tsf, and a moisture content of 30 percent. A soft, silty clay loam followed to El. 361.2, with an N-value of 0 bpf, a Q_u of 0.3 tsf, and a moisture content of 28 percent. A very soft, silty clay loam followed to El. 356.2, with an N-value of 0 bpf, Q_u values between 0.1 and 0.2 tsf, and moisture contents between 29 to 31 percent. A stiff clay followed to El. 353.7, with an N-value of 6 bpf, a Q_u value of 1.6 tsf, and a moisture content of 31 percent. A very stiff clay followed to El. 346.2, with an N-value between 6 and 9 bpf, Q_u values between 2.7 and 3.1 tsf, and moisture contents from 29 to 33 percent. Another very stiff clay followed to El. 331.2, with N-values between 9 and 12 bpf, Q_u values between 2.3 to 3.9 tsf, and moisture contents from 24 to 26 percent. A stiff clay was encountered until El. 327.2, with an N-value of 5 bpf, a Q_u value of 1.5 tsf, and a moisture content of 19 percent. A limestone followed until El. 326.7, with an N-value of 100/0.5 inches. A five-foot rock core run was conducted from a depth of 63.6 to 68.6 ft. below ground surface. This run resulted in approximately 2 ft. of limestone over a hard clay shale. Core recovery was 53 percent, and Rock Quality Designation (RQD) was 0 percent. The boring was terminated at a depth of 68.6 ft. below ground surface.

2.2 Groundwater

Groundwater was encountered during drilling in Boring 1-S at El. 369.4 and in 2-S at El. 366.2. It should be noted that the groundwater level is subject to seasonal and climatic variations. In addition, without extended periods of observation, measurement of true groundwater levels may not be possible.

3.0 Geotechnical Evaluations

3.1 Settlement

Since no significant grading or changes to the existing embankments are expected, and minimal changes in elevations from the existing substructure units are anticipated due to the retrofitting of the existing pier, it is estimated that settlement magnitudes of less than 0.4 inches will be experienced. Therefore, no settlement calculations were performed for the proposed structure and downdrag was not included in the pile capacity calculations.

3.2 Slope Stability

The construction of the proposed structure will result in new endslopes for the widened portion of the bridge. It should be noted that the existing concrete slopewall that was widened in 1995 shows no signs of deterioration or movement. Both existing and widened sections are in very good condition.

The proposed endslopes for the widened portion of the east and west abutment locations were modeled at a 1V:2H inclination. Three conditions were modeled: end-of-construction, long-term, and a design seismic event. A critical factor of safety (FOS) was calculated for each condition. According to current standards of practice, the target FOS is 1.5 for end-of-construction and long-term slope stability and 1.0 for the design seismic event.

In order to model the end-of-construction condition, undrained soil parameters were used with a friction angle of 0 degrees assumed for cohesive soils. Drained soil parameters with an assumed friction angle of 12 to 42 degrees were used to model the long-term and seismic conditions and to analyze the condition where excess pore water pressure from construction has dissipated. For non-engineered cohesive materials, a nominal cohesion value ranging from 50 to 100 psf was included in the drained strength parameters.

The Modified Bishop Method, which generates circular-arc failure surfaces, was used to calculate the critical failure surfaces and FOS for the analyzed conditions. The FOS obtained in the analysis are shown in Table 3.2. SLOPE-W program output from this analysis can be found in SLOPE-W Slope Stability Analysis, Exhibit E.

Table 3.2 – Slope Stability Critical FOS

Location	Slope	End-of-Construction	Long-Term	Seismic	Seismic with Abutment Pile
East Abutment	1V :2H	2.1	1.6	0.8	1.0
West Abutment	1V :2H	5.6	1.6	0.8	1.1

The results of the analysis, as provided in Table 3.2, indicate an acceptable FOS will exist at the east and west abutment endslopes under end-of-construction and long-term conditions. In order to achieve an acceptable FOS, the abutment pile was included in the stability model with a maximum pile spacing of 8 feet.

3.3 Seismic Considerations

The determination of Seismic Site Class was based on the method described by IDOT AGMU Memo 09.1 - Seismic Site Class Definition and the IDOT-provided spreadsheet titled: *Seismic Site Class Determination*. Using these resources, the controlling global site class for this project is Soil Site Class D.

Additional seismic parameters were calculated for use in design of the structure and evaluation of liquefaction potential. The USGS published information and mapping (http://earthquake.usgs.gov/), including software directly applicable to the *AASHTO Guide Specifications for LRFD Seismic Bridge Design*, was used to develop the parameters for the project site location. The values, based on a 1000-Year Return Period with a Probability of Exceedance (PE) of 7 percent in 75 years and Soil Site Class D, are summarized below.

Table 3.3 – Summary of Seismic Parameters

Parameter	Value
Soil Site Class	D
Spectral Response Acceleration, 0.2 Sec, S_{DS}	0.845 g (Site Class D)
Spectral Response Acceleration, 1.0 Sec, S_{D1}	0.360 g (Site Class D)
Seismic Performance Zone	3

As indicated in the table above, the Seismic Performance Zone is 3, based on S_{D1} and Table 3.15.2-1 in the IDOT Bridge Manual, the Soil Site Class D, and Figure 2.3.10-3 in the IDOT Bridge Manual.

3.4 Scour

The design scour elevations for the proposed structure are shown in Table 3.4. Class A4 stone riprap will be placed on the surface of the proposed abutment endslopes, to reduce the potential for future scour. As per IDOT ABD Memo 14.2 for existing structures designed using ASD or LFD, if the countermeasures present mitigate the Q_{100} flood, no additional countermeasures are required. However, if the current countermeasures present do not mitigate the Q_{100} flood, the countermeasures shall be retrofitted to mitigate the Q_{200} flood.

Table 3.4 – Design Scour Elevations

Event/Limit State	Design Scour Elevations (ft.)				
	West Abutment	Pier 1	Pier 2	East Abutment	Item 113
Q_{100}	384.88	366.50	366.50	384.85	5
Q_{200}	384.88	365.50	365.50	384.85	
Design	384.88	366.50	366.50	384.85	

3.5 Mining Activity

The Illinois State Geological Survey (ISGS) website indicates that coal mining has occurred in Jackson County. According to the Saline County, Illinois Coal Mines and Underground Industrial Mines Map, dated January 29, 2015, obtained from the Illinois Geological Survey website (http://www.isgs.illlinois.edu/maps-data-pub/coal-maps.shtml), the project site was not undermined. However, several mine features are noted south of the project area. The closest underground mine proximity region boundary is approximately 0.5 miles south of the project area.

The listed disclaimer indicates the locations of some features on the mine map may be offset by 500 ft. or more due to errors in the original source maps, the compilation process, digitizing, or a combination of these factors.

No visual indications were noted on the boring logs of apparent depressions, which could be due to mine subsidence or shafts beneath the site. A KEG representative did not make a site visit in order to observe if any indications of subsurface mining activities were present.

3.6 Liquefaction

A liquefaction analysis was performed using the liquefaction worksheet provided by IDOT BBS Central Geotechnical Unit (Mod. 5/24/2010). The Peak Horizontal Ground Acceleration value in the spreadsheet was set equivalent to the PGA (0.350g for NMSZ and n/a for CEUS), as determined based on information from the USGS website and the 2009 AASHTO Guide Specifications for LRFD Seismic Bridge Design. The Design Earthquake Mean Magnitude (8.0 for NMSZ and n/a for CEUS) was determined using the USGS data and deaggregation methods provided at http://earthquake.usgs.gov/. The soil profiles for Boring 1-S and 2-S were analyzed.

Plasticity Index (PI) and Liquid Limits (LL) are a required input in the liquefaction spreadsheet. However, Atterberg limits testing was not available for the individual soil layers encountered in both borings; therefore, these values were estimated based off of the visual classifications provided on the boring logs.

Groundwater was encountered between 22 and 24.5 ft. below the ground surface. As previously mentioned, groundwater elevations will vary with climatic and seasonal conditions. The liquefaction analysis assumed that the depth to groundwater observed during the subsurface exploration, would be the same. It should be noted, that the liquefaction spreadsheets did not identify potential layers of liquefiable below the ground surface. Therefore, liquefaction was not considered as a reduction for pile design capacity at any of the substructure units.

4.0 Foundation Evaluations and Design Recommendations

4.1 General Feasibility

According to the IDOT All Bridge Designers (ABD) Memo 12.3 dated July 25, 2012, by IDOT; Metal Shell: MS 12 and larger and H-pile: HP 8X36 and larger are feasible pile types for foundation support of the proposed integral abutments. In order to match the stiffness characteristics to the existing structure, KEG recommends using HP 12X74 H-piles.

The Modified IDOT Static Method of Estimating Pile Length, provided by IDOT BBS Foundations and Geotechnical Unit, was used to calculate the design length of the piles. Drilled shafts were not considered due to cost and the depth to bedrock.

4.2 Pile Supported Foundations

The foundations supporting the proposed bridge must provide sufficient support to resist dead and live loads, including seismic loadings. Based on the encountered subsurface conditions, the Modified IDOT Static Method of Estimating Pile Length provided by IDOT BBS Foundations and Geotechnical Unit, and the information available to date, H-piles are acceptable for use at all the substructure units. The Modified IDOT Static Method uses the ASD Pile Design Guide Procedure to estimate the pile lengths (Pile Length/Pile Type, Exhibit F).

The widened abutment and pier loads were provided by CM&T. The widened portion of the abutments will each experience a Total Factored Load of 942 kips per pile, and the widened portion of the existing piers will experience a Total Factored Load of 1779 kips per pile. The estimated pile lengths for the recommended pile type are shown in Table 4.2.1, below.

The Nominal Required Bearing (R_N) represents the resistance the pile will experience during driving, and will assist the contractor in selecting a proper hammer size. The Maximum Allowable Resistance Available documents the net long-term axial factored pile capacity available at the top of the pile to support factored substructure loadings estimated pile lengths and capacities of other feasible pile types that may be considered for the proposed structure are included in Pile Length/Pile Type, Exhibit F.

Table 4.2 – Estimated Pile Lengths for HP 12X74 H-Pile

	Estimated Pile Tip Elevation (ft.)	R_n Nominal Required Bearing (kips)	Maximum Allowable Resistance (ASD) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
West Abutment (1-S)	322.9	589	196	64	386.9
Pier 1 (1-S)	321.9	589	196	65	386.9
Pier 2 (2-S)	323.9	589	196	63	386.9
East Abutment (2-S)	324.9	589	196	62	386.9

***Assumed pile cut-off elevation at the piers is based off of the Piling Diagram Reports**

The current bridge, which is proposed to be widened, currently is supported on 6 HP 12X74 H-piles placed on 7 ft. 7 in. centers. It should be noted, that HP 12X74 is the preferred choice based on the previous design of the current bridge to match the existing substructure stiffness. The as-built plans provided for the existing structure indicate that the H-piles were driven to refusal in a shale bedrock material. The proposed bridge widening will add 2 piles at 6 ft. 0 in. centers for the abutments and piers. The capacity of the existing H-piles should be verified based on pile driving records, if available. If the pile driving records indicate that the existing H-piles were not driven to refusal, KEG should be notified.

4.3 Lateral Pile Response

Generally, the geotechnical engineer provides soil parameters to the structural engineer so that an L-Pile program or other approved software can be used for the lateral or displacement analysis of the foundations. Table 4.3 is included for the structural engineer's use in evaluating lateral pile response. The values were estimated based on the descriptions as listed on the boring logs. No specific hydrometer analyses were performed on the site soils for estimation of parameters.

Table 4.3 – Soil Parameters for Lateral Pile Load Analysis

Boring	Elev. At Bottom of Layer	γ (pcf)	Short-term		Long-term		K (pci)	N	Assumed % fines < #200	ε_{50}
			c' (psf)	Φ (degrees)	c' (psf)	Φ (degrees)				
East Abutment (2-S)	383.7	125	900	0	50	26	100	3	80	0.010
	381.2	120	700	0	50	26	100	2	70	0.010
	373.7	125	2400	0	100	26	1000	6	80	0.005
	356.2	120	420	0	50	26	30	2	70	0.020
	353.7	125	1600	0	100	26	500	6	80	0.007
	331.2	125	3000	0	100	26	1000	10	80	0.005
	327.2	125	1500	0	100	26	500	5	80	0.007
West Abutment (1-S)	384.4	120	2300	0	100	26	1000	6	70	0.005
	381.9	120	500	0	50	26	30	3	70	0.020
	379.4	125	1600	0	100	26	500	5	80	0.007
	376.9	120	2900	0	100	26	1000	6	70	0.005
	374.4	125	200	0	50	26	30	2	80	0.020
	356.9	125	1830	0	100	26	500	5	80	0.007
	346.9	125	2400	0	100	26	1000	8	80	0.005
	336.9	125	3600	0	100	26	1000	12	80	0.005
	328.9	115	700	0	50	28	100	7	70	0.010
Pier 1 (1-S)	356.9	125	1680	0	100	26	500	4	80	0.007
	346.9	125	2400	0	100	26	1000	8	80	0.005
	336.9	125	3600	0	100	26	1000	12	80	0.005
	328.9	115	700	0	50	28	100	7	70	0.010
Pier 2 (2-S)	356.2	120	400	0	50	26	30	2	70	0.020
	353.7	125	1600	0	100	26	500	6	80	0.007
	331.2	125	3000	0	100	26	1000	10	80	0.005
	327.2	125	1500	0	100	26	500	5	80	0.007

5.0 Construction Considerations

5.1 Construction Activities

Construction activities should be performed in accordance with the current IDOT Standard Specifications for Road and Bridge Construction and any pertinent Special Provisions or Policies.

5.2 Temporary Sheeting and Soil Retention

Since traffic will be maintained during construction utilizing cross-overs, temporary shoring should not be required at the substructure units; however, if during final design the use of temporary sheeting is determined to be necessary, the average unconfined compressive strength for an assumed embedment depth of 15 ft. is 1.7 tsf at the west abutment and 1.2 tsf for an assumed embedment depth of 28 ft. at the east abutment. The IDOT Temporary Sheet Piling Design Guide and Charts indicates that a Cantilevered Sheet Piling System would be feasible for retained heights up to 20 ft. However, if the retained height exceeds 20 ft., the design charts will no longer be feasible and a soil retention system will be required. An Illinois-licensed structural engineer is required to seal the design of the temporary soil retention system, if deemed necessary.

5.3 Site and Soil Conditions

Should any bridge or embankment design considerations assumed by either IDOT or KEG change, KEG should be contacted to determine if the recommendations stated in this report still apply.

5.4 Foundation Construction

Conventional pile-driving equipment and methodologies should be assumed.

Prior to construction, a JULIE locate shall be conducted to determine if any underground utilities are present in the area of the proposed structure. IDOT shall also be contacted to locate any private utilities. If utilities become a problem during construction, the appropriate owner shall be contacted immediately.

5.5 Cofferdams

Cofferdams may be required at the proposed pier locations. The water surface elevation is not recorded on the provided boring logs; however, based off of the streambed elevation and the design high water elevation, it should be anticipated that the surface water elevation will be greater than 6 ft. above the bottom elevation of the proposed pier foundations. Therefore, a Type 2 cofferdam will be required. All cofferdams are required to be dewatered. Cohesive silty clays and silty clay loam soils are present at the proposed sites of the cofferdams and proposed pier foundations and the use of a seal coat should not be required. If during construction, pockets of sands and gravels are present at the pier foundation locations, a seal coat will reduce the potential for water from seeping beneath the cofferdam.

6.0 Computations

Computations and analyses for special circumstances, if any, are included as exhibits. Please refer to each section of the report for reference to the exhibit containing any such calculations or analysis used.

7.0 Geotechnical Data

Soil boring logs can be found in Exhibit C. The Subsurface Profile can be found in Exhibit D.

8.0 Limitations

The recommendations provided herein are for the exclusive use of CM&T and IDOT. They are specific only to the project described and are based on the subsurface information obtained by IDOT at two boring locations in 2014, KEG's understanding of the project as described herein, and geotechnical engineering practice consistent with the standard of care. No other warranty is expressed or implied. KEG should be contacted if conditions encountered during construction are not consistent with those described.

EXHIBIT A

USGS TOPOGRAPHIC LOCATION MAP

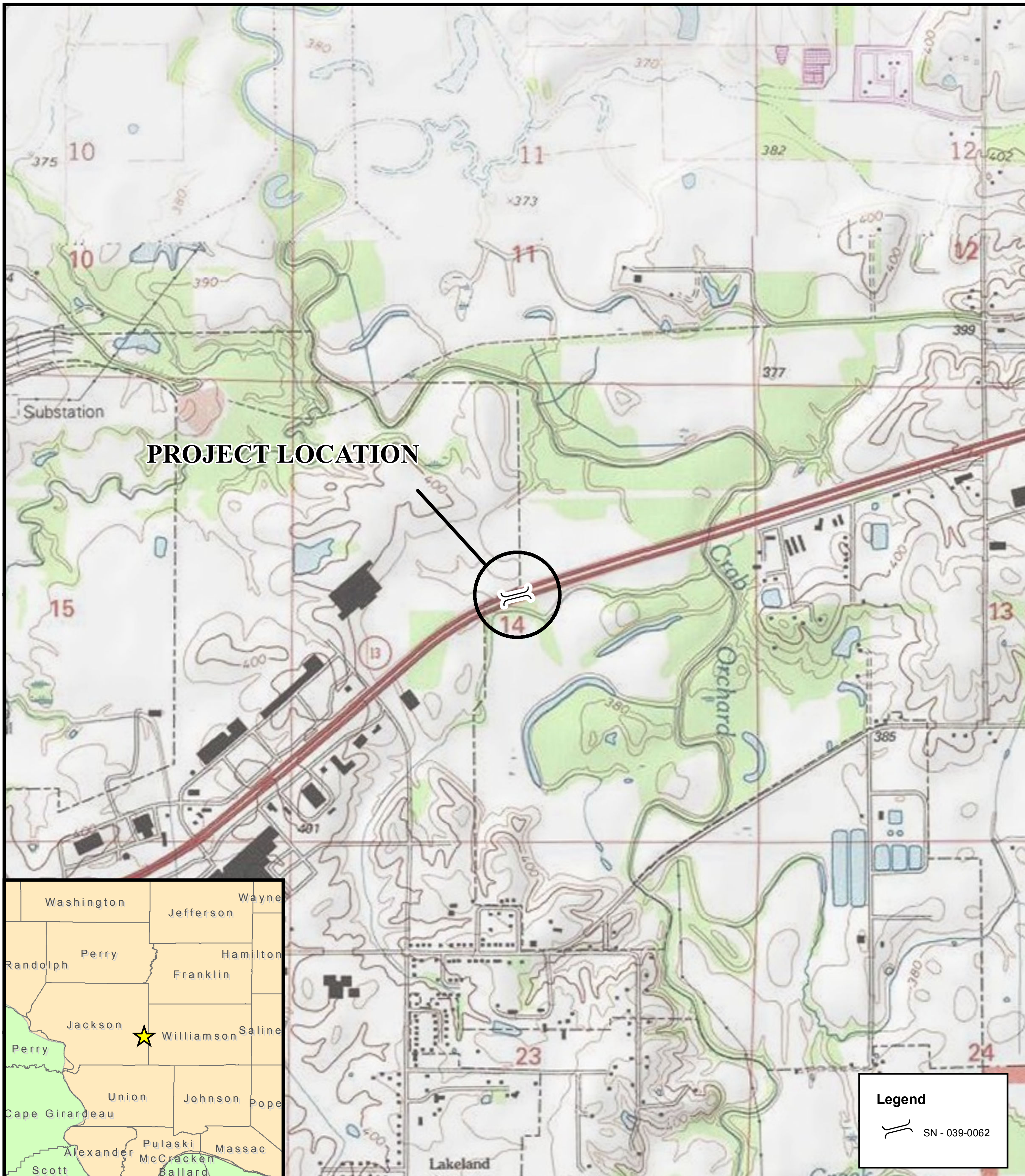


Exhibit A
Location Map
F.A.P. Route 331 (IL 13)
over Crab Orchard Creek Overflow
Jackson County, Illinois

N

0 500 1,000 Feet

Designed By: MMJ
Drawn By: MMJ
Checked By: CRG
Date: 11/2/15
Project #: 08-0061.18

Kaskaskia Engineering Group, LLC

EXHIBIT B

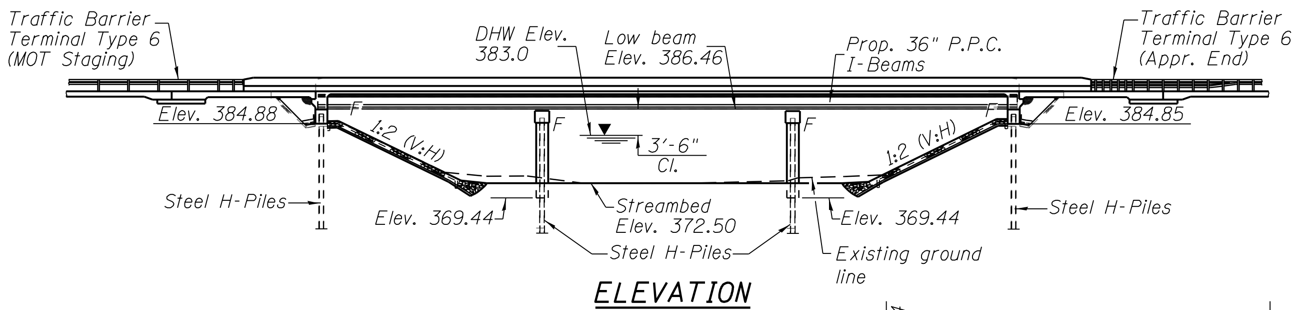
TYPE, SIZE, AND LOCATION PLAN (TS&L)

Bench Mark: Cut square on Southwest corner of Structure 039-0062 of Illinois Route 13 WBL @ Sta. 64+81±. Elev. 390.24

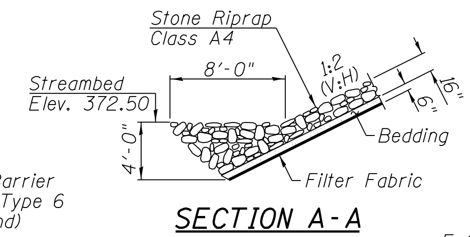
Existing Structure: S.N. 039-0062, built in 1995 is a three span P.P.C. I-Beam Bridge. Substructure consists of intergral abutments supported on steel piles and solid wall pile bent piers. Bk. to Bk. abutments measures 146'-7" and out-to-out width of 43'-11".

Salvage: Existing bridge to remain and shall be widened.

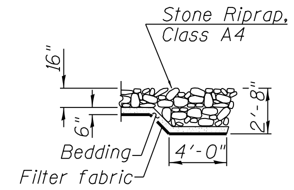
Traffic Maintenance: Maintain traffic 2 - 11'-0" lanes during widening. Once complete, traffic to be maintained through crossovers.



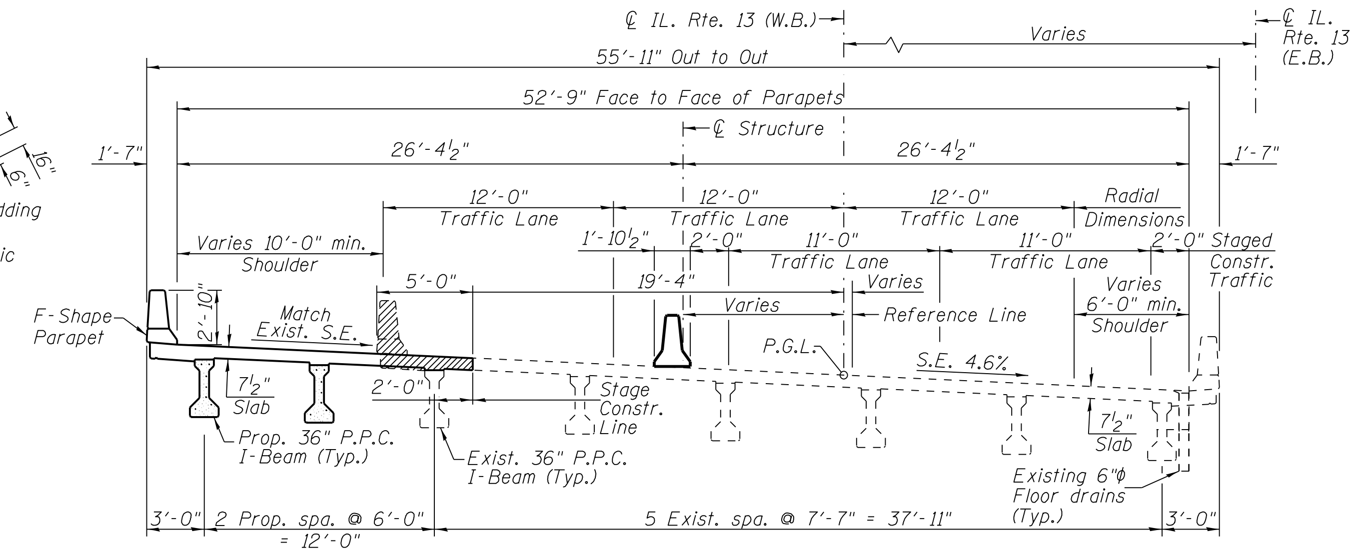
ELEVATION



SECTION A-A

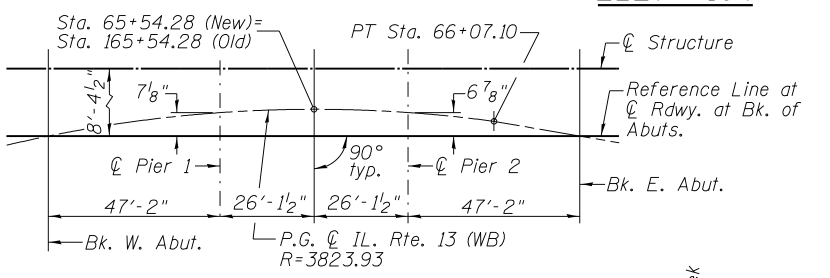


SECTION B-B

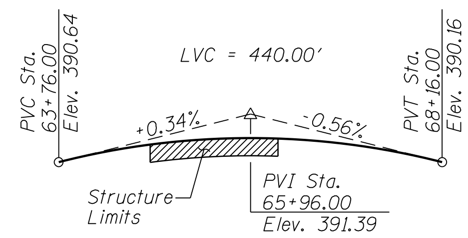


CROSS SECTION

(Looking East)



OFFSET SKETCH

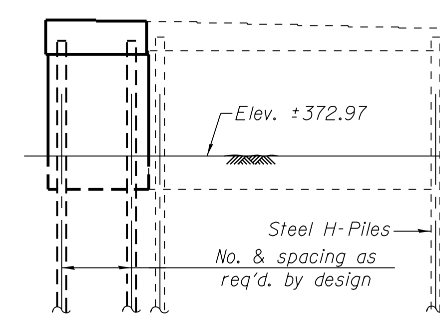


PROFILE GRADE

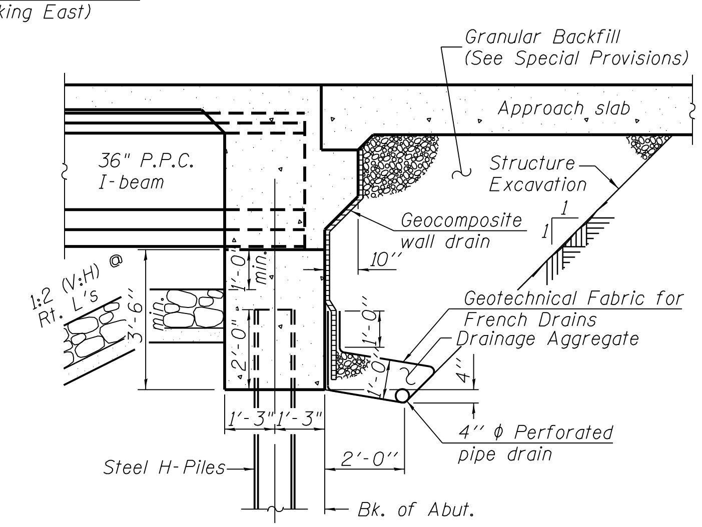
(Along ℄ IL. Rte. 13 W.B.)
(Existing Profile)

CURVE DATA

P.I. Sta. = 58+67.93
Δ = 22°26'32" Rt.
D = 1°29'54"
R = 3,823.93'
T = 758.62'
L = 1,497.79'
e = 74.52
S.E. = 0.046'/'
S.E. Attained Sta. 64+50.99 to Sta. 68+83.59
P.C. Sta. = 51+09.31
P.T. Sta. = 66+07.10

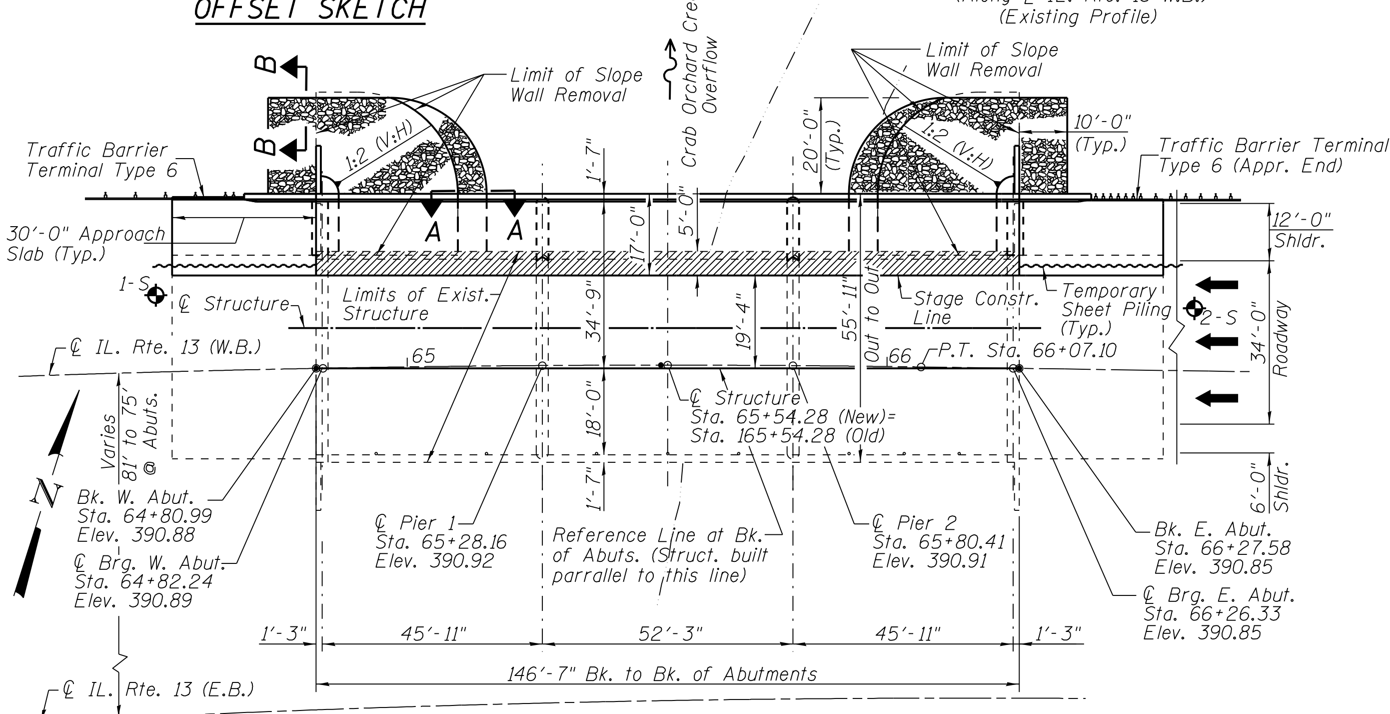


PIER SKETCH



SECTION THRU INTEGRAL ABUTMENT

(Match Existing Abutment)



PLAN

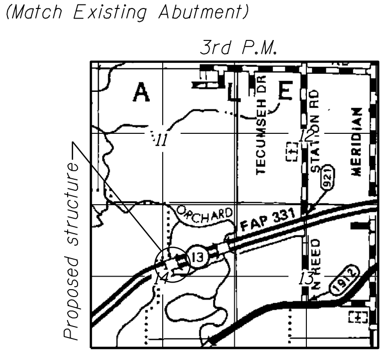
DESIGN SCOUR ELEVATION TABLE

Event / Limit State	Design Scour Elevations (ft.) W. Abut.	Pier 1	Pier 2	E. Abut.	Item 113
Q100	384.88	369.44	369.44	384.85	8
Q200	384.88	369.44	369.44	384.85	
Design	384.88	369.44	369.44	384.85	
Check	384.88	369.44	369.44	384.85	

WATERWAY INFORMATION

Drainage Area = 255 Sq. Mi.
Exist. Low Grade Elev. 388.69 @ Sta. 80+50.00
Prop. Low Grade Elev. 388.88 @ Sta. 80+50.00

Flood	Freq. Yr.	Structure Number	Q (C.F.S.) Exist.	Q (C.F.S.) Prop.	Opening Sq. Ft. Exist.	Opening Sq. Ft. Prop.	Nat. H.W.E.	Head - Ft. Exist.	Head - Ft. Prop.	Headwater El. Exist.	Headwater El. Prop.
	10	039-0061/79	6,158	6,628	2,342	2,367	381.2	0.2	0.1	381.4	381.3
		O'flow Culvert	186	137	67	67					
		039-0062/78	2,056	1,635	779	772					
		Total	8,400		3,188	3,206					
Design	50	039-0061/79	8,788	9,417	2,682	2,715	383.0	0.3	0.2	383.3	383.2
		O'flow Culvert	269	235	85	85					
		039-0062/78	3,343	2,748	995	987					
		Total	12,400		3,762	3,787					
Base	100	039-0061/79	9,878	10,577	2,857	2,894	383.9	0.3	0.3	384.2	384.2
		O'flow Culvert	326	269	94	94					
		039-0062/78	3,896	3,254	1,109	1,099					
		Total	14,100		4,060	4,087					
Scour Design Check	200	039-0061/79	11,055	11,616	2,995	3,036	384.6	0.4	0.3	385.0	384.9
		O'flow Culvert	379	332	101	101					
		039-0062/78	4,576	4,062	1,200	1,189					
		Total	16,010		4,296	4,326					
Max. Calc.	500	039-0061/79	12,694	12,917	3,116	3,158	385.2	0.5	0.4	385.7	385.6
		O'flow Culvert	417	393	107	107					
		039-0062/78	5,389	5,190	1,279	1,268					
		Total	18,500		4,502	4,533					



LOCATION SKETCH

GENERAL PLAN
F.A.P. ROUTE 331 (IL 13 W.B.)
OVER CRAB ORCHARD CREEK
OVERFLOW
SECTION (5-3) BR-1
JACKSON COUNTY
STATION 65+54.28
STRUCTURE NO. 039-0062

HIGHWAY CLASSIFICATION

F.A.P. Rte. 331 (IL 13 W.B.)
Functional Class: Other Principal Arterial
ADT: 13,150 (2015); 19,328 (2032)
ADTT: 790 (2015); 1160 (2032)
DHV: 1,930
Design Speed: 65 m.p.h.
Posted Speed: 55 m.p.h.
One-Way Traffic
Directional Distribution: 100% WB

DESIGN STRESSES (EXIST. & PROP.)

FIELD UNITS

f'c = 3,500 psi (concrete)
f'c = 4,000 psi (Superstr. concrete)
fy = 60,000 psi (Reinforcement)
fy = 50,000 psi (M270 Grade 50)

PRECAST PRESTRESSED UNITS

f'c = 6,000 psi (concrete)
f'ci = 5,000 psi
fpu = 270,000 psi (½"ϕ low lax strands)
fpbt = 201,960 psi (½"ϕ low lax strands)

LOADING HS 20-44

Allow 25 psf for future wearing surface

DESIGN SPECIFICATIONS

2002 AASHTO Standard Specifications for Highway Construction 17th Edition

SEISMIC DATA

Seismic Performance Zone (SPZ) = 3
Design Spectral Acceleration at 1.0 sec (SD1) = 0.360g
Design Spectral Acceleration at 0.2 sec (SDS) = 0.845g
Soil Site Class = D

CMT	USER NAME =	DESIGNED MJL	REVISED
		CHECKED WLB/JMM	REVISED
	PLOT SCALE =	DRAWN GLD	REVISED
	PLOT DATE =	CHECKED WLB/JMM	REVISED

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

GENERAL PLAN
STRUCTURE NO. 039-0062
SHEET NO. OF SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
331	(5-3)R-1,N-1,B-5,BR-1,B-6,BR-2	JACKSON		
CONTRACT NO. 78295				
ILLINOIS FED. AID PROJECT				

EXHIBIT C

BORING LOGS

ILLINOIS DEPARTMENT OF TRANSPORTATION
District Nine Materials

Bridge Foundation Boring Log

Westbound FAP 331 (IL 13) Over Crab Orchard Creek Overflow

Route: FAP 331 (IL 13) Structure Number: 039-0062 Date: 7/22/2014

Section (5B-2) DR Bored By: R Moberly

County: Jackson Location: 0.4 mi East of Giant City Road Checked By: R Graeff

Boring No 1-S
Station 164+48
Offset 16' Lt CL WBL
Ground Surface 391.4 Ft

Surf Wat Elev:
Ground Water Elevation
when Drilling 369.4
At Completion
At: Hrs:

Description	Elev.	DEPTH	BLOWS	Qu tsf	W%
Asphalt over crushed aggregate					
			3		
			4		
	387.9		5		
Very stiff, moist, brown, Silty Clay to Clay A7-6					
		5.0	1		
			2	2.3B	22
			4		
	384.4				
Medium to soft, very moist, brown and grey, Silty Clay to Clay A7-6			1		
			1	0.5B	25
			2		
	381.9				
Stiff, moist, brown, Clay A7-6		10.0	WH		
			2	1.6B	25
			3		
	379.4				
Very stiff, moist, brown, Clay to Silty Clay A7-6			1		
			2	2.9B	18
			4		
	376.9				
Very soft, very moist, grey, Clay A7-6		15.0	WH		
			1	0.2B	31
			1		
	374.4				
Stiff, moist, grey, Clay A7-6			1		
			2	1.9B	33
			4		
	371.9				
Very stiff, moist, grey and brown, Clay A7-6		20.0	1		
			3	2.5B	35
			4		
	369.4				
Stiff, moist, brown and grey, Clay A7-6			1		
			1	1.6B	33
			1		
		25.0	1		

Description	Elev.	DEPTH	BLOWS	Qu tsf	W%
Stiff, moist, brown and grey, Clay A7-6			1	1.2B	26
			2		
			1		
			2	1.8B	26
			3		
		30.0	1		
			2	1.9B	29
			3		
			1		
			2	1.9B	31
			4		
	356.9				
Very stiff, moist, grey and brown, Clay A7-6		35.0	1		
			3	2.0B	27
			5		
			1		
			3	2.7S	31
			4		
		40.0	1		
			4	2.5S	28
			6		
	346.9				
Hard, moist, brown, Clay A7-6		45.0	2		
			6	4.5B	24
			8		
	341.4	50.0	2		

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

Route: FAP 331 (IL 13)

Date: 7/22/2014

Section: (5B-2) DR

County: Jackson

Boring No: 1-S
Station: 164+48
Offset: 16' Lt CL WBL
Ground Surface: 391.4 Ft

Description	DEPTH	BLOWS	Qu tsf	W%
Very stiff, moist, brown, Clay A7-6		4	2.7B	23
		6		
336.9				
Medium, very moist, brown and black, Sandy Clay Loam to Clay Loam A-4 with coal and sand layers	55.0	WH		
		1	0.6B	25
		2		
	60.0	2		
		6	0.8S	18
		6		
328.9				
Hard, dry, grey, Clay Shale				
	65.0	100/6"		
Hard, dry, grey, Clay Shale 321.4	70.0	100/2"		
Bottom of hole = 69.7 feet				
Free water observed at 22.0 feet				
Elevation referenced to BM at SE corner of 039-0019; Elevation = 385.1 feet				
	75.0			

Description	DEPTH	BLOWS	Qu tsf	W%
Borehole advanced with hollow stem auger (8" O.D, 3.25" I.D.)				
To convert "N" values to "N60" multiply by 1.25				
	80.0			
	85.0			
	90.0			
	95.0			
	100.0			

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

ILLINOIS DEPARTMENT OF TRANSPORTATION
District Nine Materials

Bridge Foundation
Boring Log
Sheet 1 of 2

Westbound FAP 331 (IL 13) Over Crab Orchard Creek Overflow

Route: FAP 331 (IL 13) Structure Number: 039-0062 Date: 7/18/2014

Section (5B-2) DR Bored By: R Moberly

County: Jackson Location: 0.4 mi East of Giant City Road Checked By: R Graeff

Boring No 2-S
Station 166+64
Offset 15' Lt CL WBL
Ground Surface 390.7 Ft

Surf Wat Elev:
Ground Water Elevation
when Drilling 366.2
At Completion
At: Hrs:

	DEPTH	BLOWS	Qu tsf	W%
Asphalt over crushed aggregate				
		2		
387.7		2		
Stiff, moist to very moist, brown,		1	1.1B	29
Clay A7-6				
386.2				
Medium, moist to v. moist, brown,	5.0	1		
Clay A7-6		1	0.7B	27
		1		
383.7				
Medium, moist to very moist, grey,		WH		
Silty Clay A-6		1	0.7B	25
(poor embankment construction)		1		
381.2				
Stiff, moist, brown, Clay A7-6	10.0	1		
		1	1.4B	26
		3		
378.7				
Very stiff, moist, brown and grey,		1		
Clay A7-6		3	2.9B	24
		3		
	15.0	1		
		4	2.9B	23
		4		
373.7				
Soft to medium, very moist, grey		1		
mottled brown, Silt Loam to Silty		WH	0.5B	25
Clay Loam A-4		1		
371.2				
Stiff, moist, grey and brown, Silt	20.0	1		
Loam to Silty Clay Loam A-4		3	1.2S	22
		4		
368.7				
Soft, very moist, brown, Silty Clay		WH		
Loam A-6		WH	0.4B	29
		1		
366.2				
	25.0	WH		

	DEPTH	BLOWS	Qu tsf	W%
Very soft, wet, brown, Silty Clay		1	0.2B	30
Loam A-6		1		
363.7				
Soft, very moist, brown, Silty Clay		WH		
Loam A-6		WH	0.3B	28
		WH		
361.2				
Very soft, wet, brown, Silty Clay	30.0	WH		
Loam A-6		WH	0.1B	29
		WH		
		WH		
		WH	0.2B	31
		WH		
356.2				
Stiff, moist, grey, Clay A7-6	35.0	1		
		2	1.6B	31
		4		
353.7				
Very stiff, moist, grey, Clay A7-6		1		
		2	3.1B	29
		4		
	40.0	2		
		4	2.7B	33
		5		
346.2				
Very stiff, moist, brown, Clay A7-6	45.0	2		
		5	3.9B	24
		7		
	50.0	2		

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

Route: FAP 331 (IL 13) Date: 7/18/2014
Section: (5B-2) DR
County: Jackson

Boring No: 2-S
Station: 166+64
Offset: 15' Lt CL WBL
Ground Surface: 390.7 Ft

Description	DEPTH	BLOWS	Qu tsf	W%
Very stiff, moist, brown, Clay A7-6		5	2.9B	25
		7		
	55.0	2		
		4	2.3B	26
		5		
331.2				
Stiff, moist, grey, Clay A7-6	60.0	1		
		2	1.5B	19
		3		
Sand blow-in; washout procedures used 327.2				
Hard, dry, grey, Limestone 326.7		100/0.5"		
Cored 63.6 to 68.6 feet	65.0			
+/- 2' Limestone over Hard, dry, grey and black, Clay Shale				
53% Recovery; 0% RQD				
322.2				
Bottom of hole = 68.6 feet				
Free water observed at 24.5 feet	70.0			
Elevation referenced to BM at SE corner of 039-0019; Elevation = 385.1 feet				
Borehole advanced with hollow stem auger (8" O.D, 3.25" I.D.)				
To convert "N" values to "N60" multiply by 1.25	75.0			

Description	DEPTH	BLOWS	Qu tsf	W%
Note: Sand was encountered directly above the Limestone layer. We were unable to seal the augers in the Limestone which allowed sand to continually seep into the bore hole. This caused difficulty in removing the core barrel. I did not want to take a chance of losing the second barrel so the hole was abandoned RM	80.0			
	85.0			
	90.0			
	95.0			
	100.0			

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

EXHIBIT D

SUBSURFACE PROFILE

Kaskaskia Engineering Group, LLC

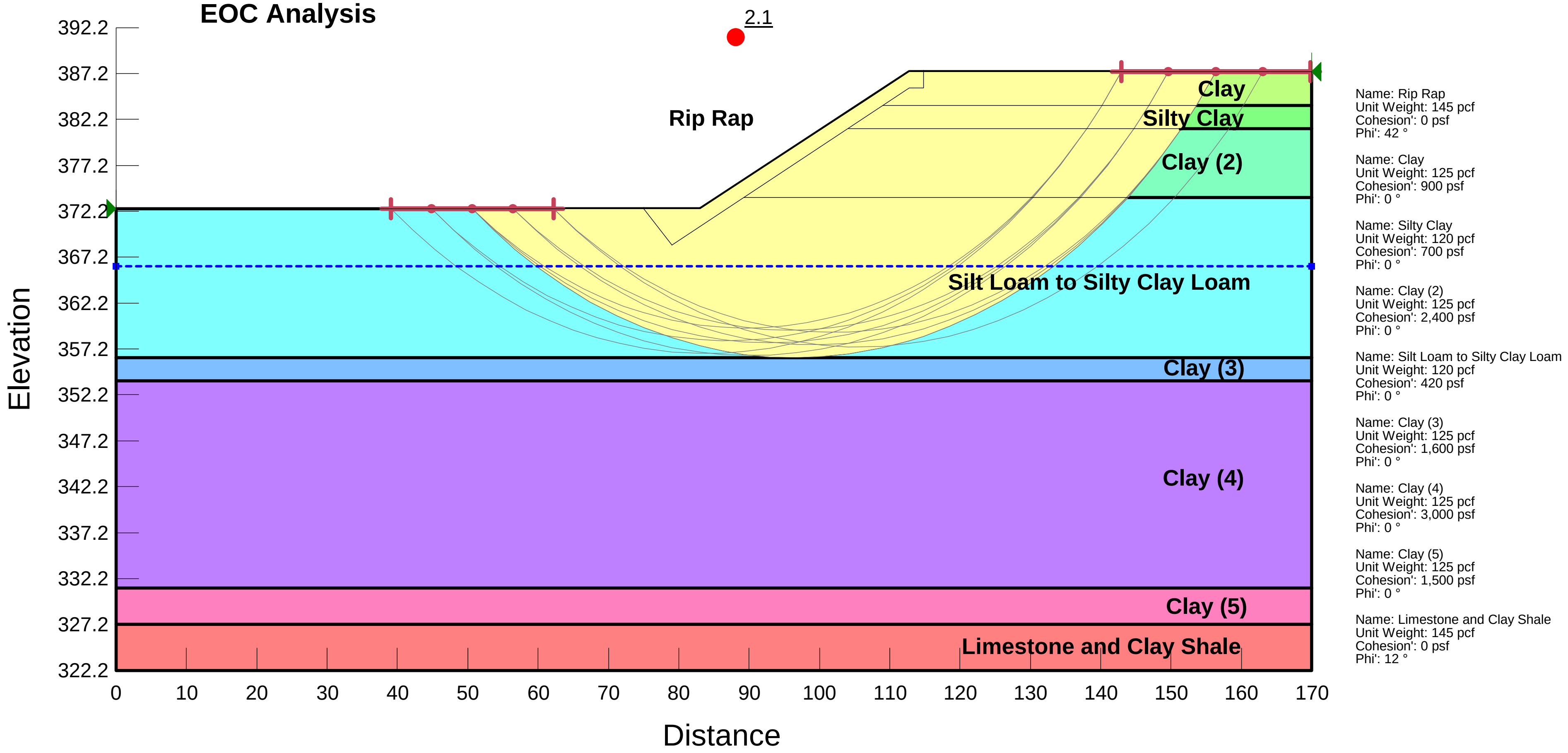
SUBSURFACE PROFILE: IL 13 over Crab Orchard Creek Overflow (SN 039-0062)

Route: F.A.P. 331
Section: (5-3) BR-1
County: Jackson

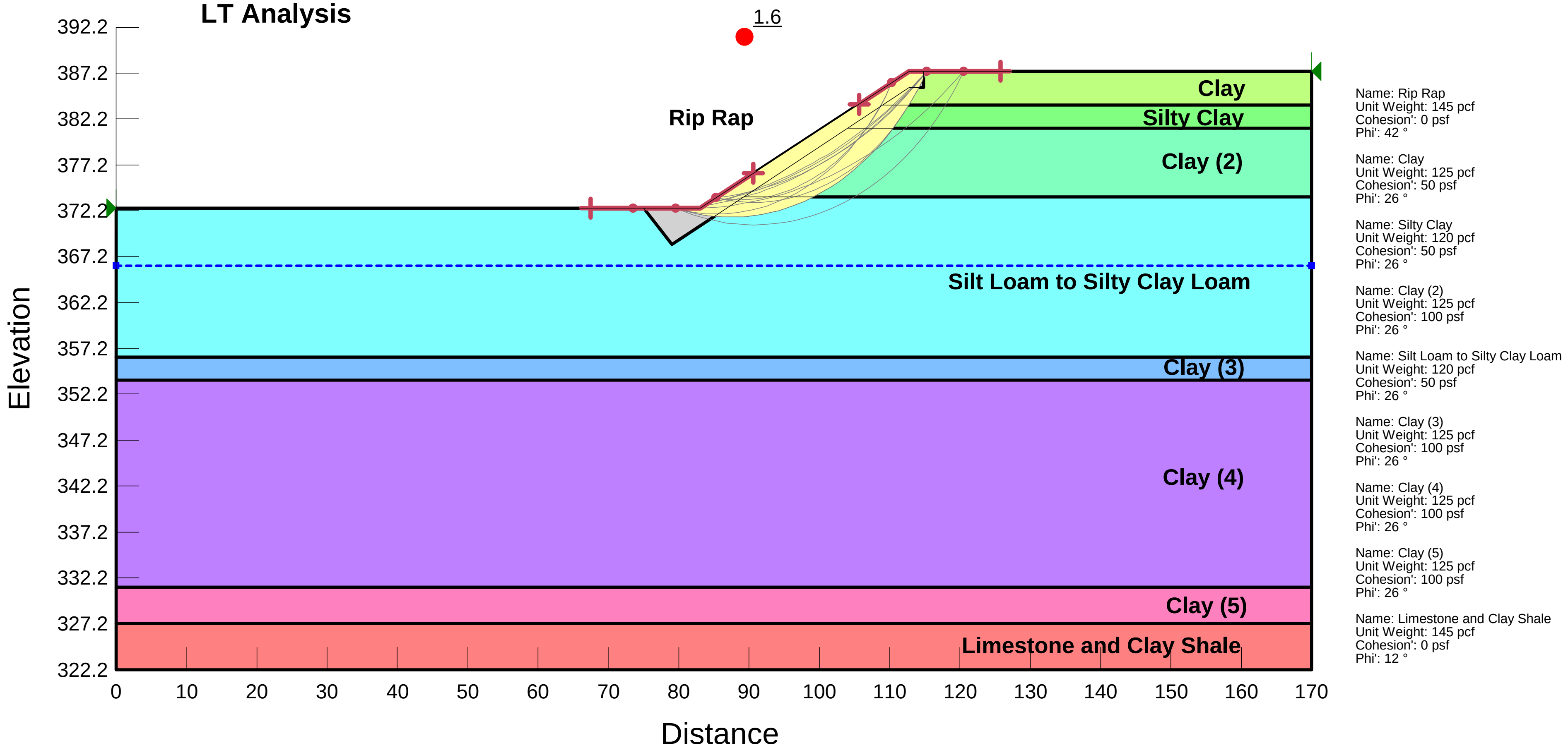
EXHIBIT E

SLOPE/W SLOPE STABILITY ANALYSIS

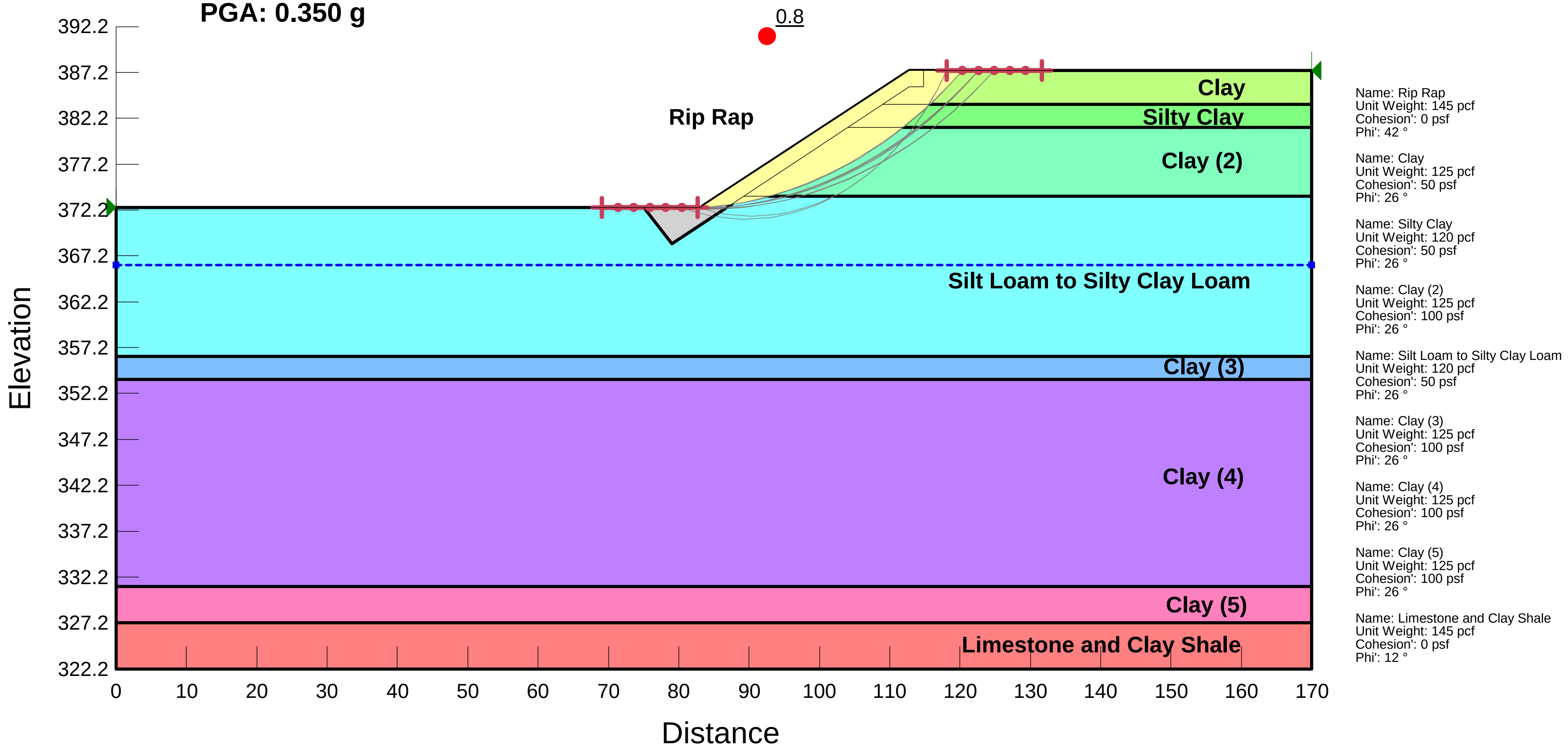
IL 13 over Crab Orchard Creek Overflow (SN 039-0062)
East Abutment (Boring 2-S)
EOC Analysis

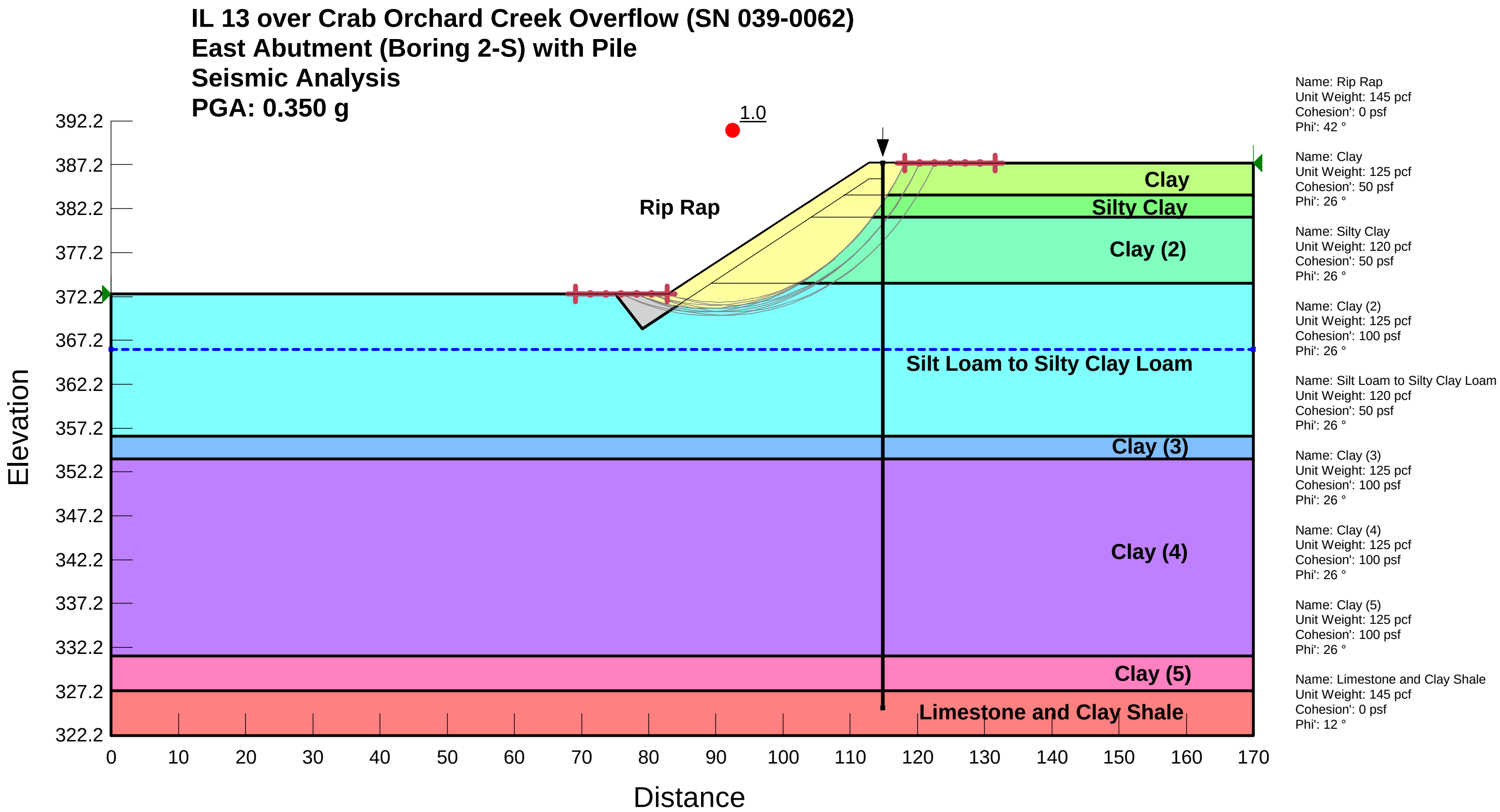


IL 13 over Crab Orchard Creek Overflow (SN 039-0062)
East Abutment (Boring 2-S)
LT Analysis



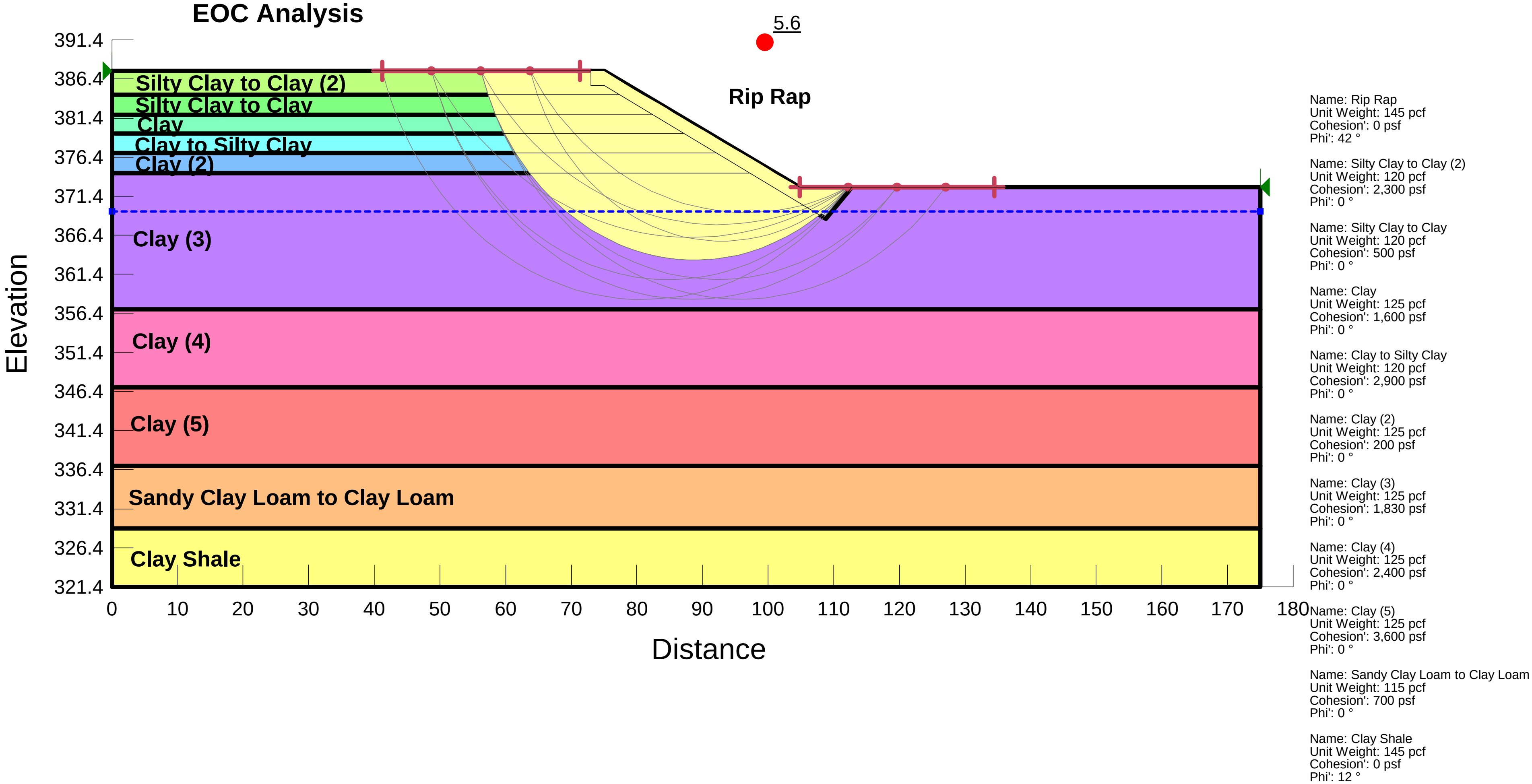
IL 13 over Crab Orchard Creek Overflow (SN 039-0062)
East Abutment (Boring 2-S)
Seismic Analysis
PGA: 0.350 g



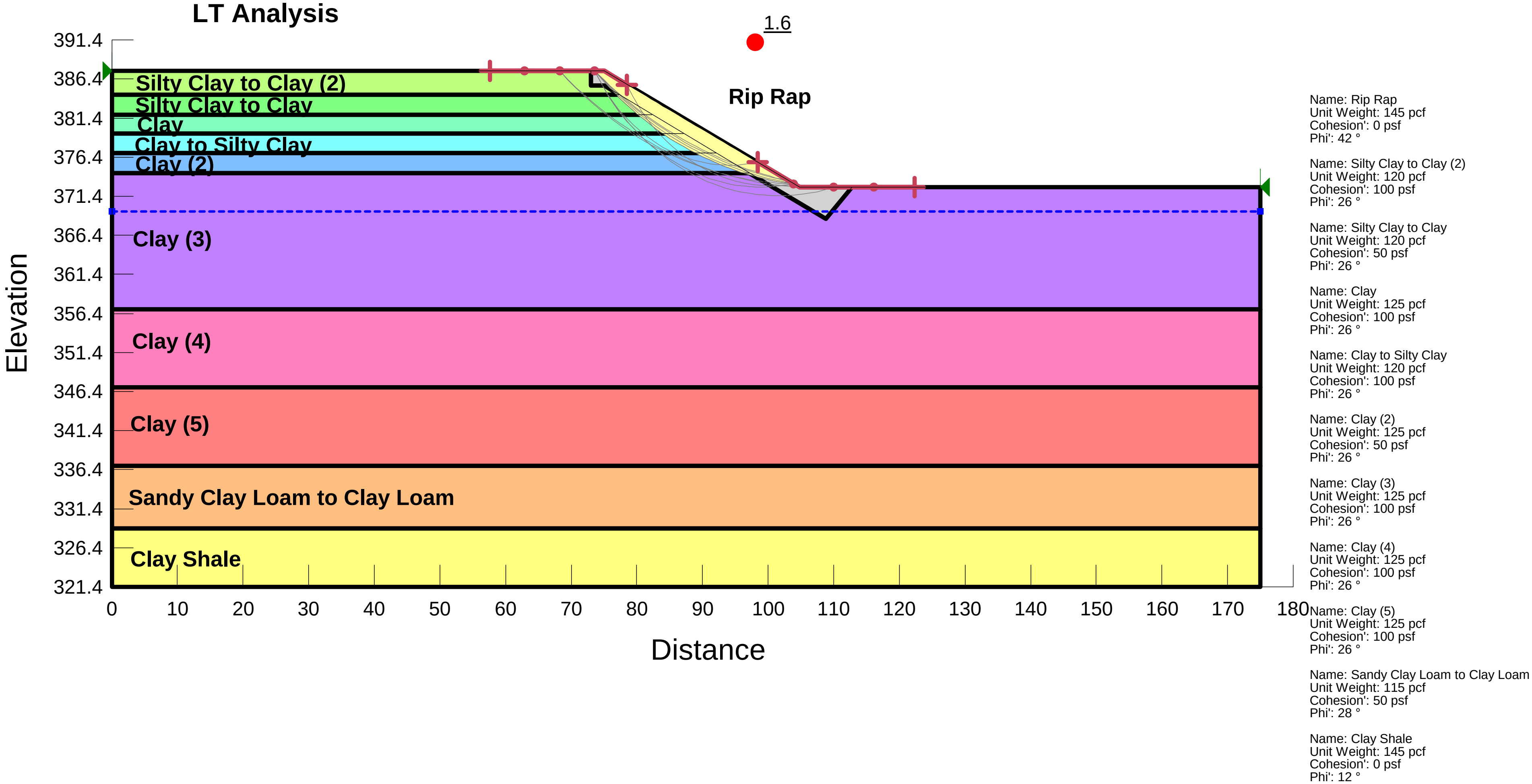


IL 13 over Crab Orchard Creek Overflow (SN 039-0062)
East Abutment (Boring 2-S) with Pile
Seismic Analysis
PGA: 0.350 g
1.0
Rip Rap
Clay
Silty Clay
Clay (2)
Silt Loam to Silty Clay Loam
Clay (3)
Clay (4)
Clay (5)
Limestone and Clay Shale
Elevation
392.2
387.2
382.2
377.2
372.2
367.2
362.2
357.2
352.2
347.2
342.2
337.2
332.2
327.2
322.2
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
Distance
Name: Rip Rap
Unit Weight: 145 pcf
Cohesion': 0 psf
Phi': 42 °
Name: Clay
Unit Weight: 125 pcf
Cohesion': 50 psf
Phi': 26 °
Name: Silty Clay
Unit Weight: 120 pcf
Cohesion': 50 psf
Phi': 26 °
Name: Clay (2)
Unit Weight: 125 pcf
Cohesion': 100 psf
Phi': 26 °
Name: Silt Loam to Silty Clay Loam
Unit Weight: 120 pcf
Cohesion': 50 psf
Phi': 26 °
Name: Clay (3)
Unit Weight: 125 pcf
Cohesion': 100 psf
Phi': 26 °
Name: Clay (4)
Unit Weight: 125 pcf
Cohesion': 100 psf
Phi': 26 °
Name: Clay (5)
Unit Weight: 125 pcf
Cohesion': 100 psf
Phi': 26 °
Name: Limestone and Clay Shale
Unit Weight: 145 pcf
Cohesion': 0 psf
Phi': 12 °

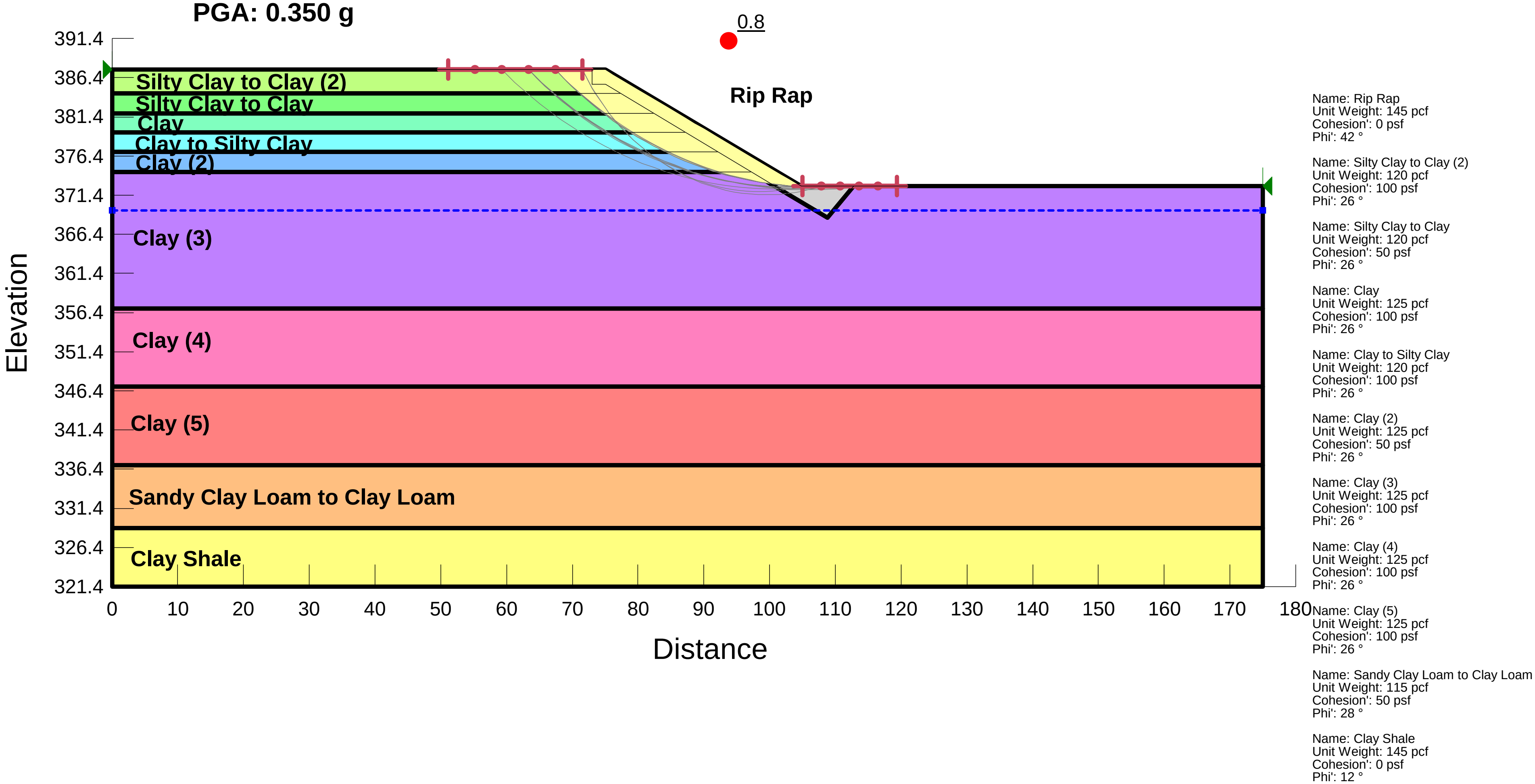
IL 13 over Crab Orchard Creek Overflow (SN 039-0062)
West Abutment (Boring 1-S)
EOC Analysis



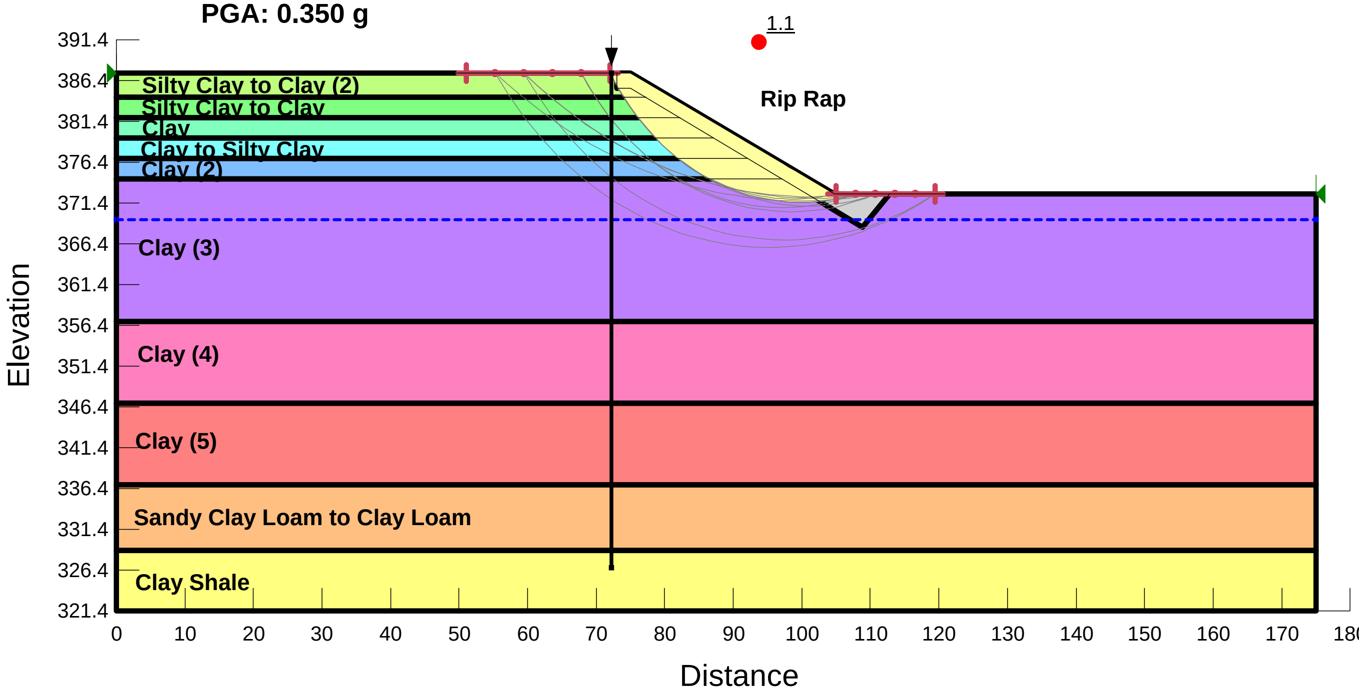
IL 13 over Crab Orchard Creek Overflow (SN 039-0062)
West Abutment (Boring 1-S)
LT Analysis



IL 13 over Crab Orchard Creek Overflow (SN 039-0062)
West Abutment (Boring 1-S)
Seismic Analysis
PGA: 0.350 g



IL 13 over Crab Orchard Creek Overflow (SN 039-0062)
West Abutment (Boring 1-S) with Pile
Seismic Analysis
PGA: 0.350 g



Name: Rip Rap
Unit Weight: 145 pcf
Cohesion': 0 psf
Phi': 42 °

Name: Silty Clay to Clay (2)
Unit Weight: 120 pcf
Cohesion': 100 psf
Phi': 26 °

Name: Silty Clay to Clay
Unit Weight: 120 pcf
Cohesion': 50 psf
Phi': 26 °

Name: Clay
Unit Weight: 125 pcf
Cohesion': 100 psf
Phi': 26 °

Name: Clay to Silty Clay
Unit Weight: 120 pcf
Cohesion': 100 psf
Phi': 26 °

Name: Clay (2)
Unit Weight: 125 pcf
Cohesion': 50 psf
Phi': 26 °

Name: Clay (3)
Unit Weight: 125 pcf
Cohesion': 100 psf
Phi': 26 °

Name: Clay (4)
Unit Weight: 125 pcf
Cohesion': 100 psf
Phi': 26 °

Name: Clay (5)
Unit Weight: 125 pcf
Cohesion': 100 psf
Phi': 26 °

Name: Sandy Clay Loam to Clay Loam
Unit Weight: 115 pcf
Cohesion': 50 psf
Phi': 28 °

Name: Clay Shale
Unit Weight: 145 pcf
Cohesion': 0 psf
Phi': 12 °

EXHIBIT F

PILE LENGTH/PILE TYPE

I D O T   S T A T I C   M E T H O D   O F   E S T I M A T I N G   P I L E   L E N G T H

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 10/18/2011

SUBSTRUCTURE============================== East Abut
REFERENCE BORING ========================== 2-S
LRFD or ASD or SEISMIC ======================== ASD
PILE CUTOFF ELEV. =========================== 386.90 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRI 381.90 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ================= ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ============ ft

TOTAL SERVICE SUBSTRUCTURE LOAD ========== 942 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)==== 52.00 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 1
Approx. Service Loading Applied per pile spaced at 8 ft. Cts : 144.92 KIPS
Approx. Service Loading Applied per pile spaced at 3 ft. Cts : 54.35 KIPS

PILE TYPE AND SIZE ========== Steel HP 12 X 74
Plugged Pile Perimeter==================== 4.050 FT. Unplugged Pile Perimeter=========== 5.908 FT.
Plugged Pile End Bearing Area============== 1.025 SQFT. Unplugged Pile End Bearing Area===== 0.151 SQFT.

MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Allowable Resistance Available in Boring	Maximum Pile Driveable Length in Boring
589 KIPS	**589** KIPS	**196** KIPS	**62** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	ULTIMATE PLUGGED SIDE RESIST. (KIPS)	ULTIMATE PLUGGED END BRG. RESIST. (KIPS)	ULTIMATE PLUGGED TOTAL RESIST. (KIPS)	ULTIMATE UNPLUGGED SIDE RESIST. (KIPS)	ULTIMATE UNPLUGGED END BRG. RESIST. (KIPS)	ULTIMATE UNPLUGGED TOTAL RESIST. (KIPS)	NOMINAL REQ'D BEARING (KIPS)	ALLOWABLE GEOTECH. LOSS FROM SCOUR or DD (KIPS)	ULTIMATE GEOTECH. LOSS LOAD FROM DD (KIPS)	ALLOW. RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
381.20	0.70	0.70			1.5		21.6	2.2		***5.1***	5	0	0	2	6
378.70	2.50	1.40			9.3	20.1	52.4	13.5	3.0	***21.9***	22	0	0	7	8
376.20	2.50	2.90			15.1	41.7	67.6	22.1	6.2	***43.9***	44	0	0	15	11
373.70	2.50	2.90			15.1	41.7	***48.2***	22.1	6.2	60.9	48	0	0	16	13
371.20	2.50	0.50			3.9	7.2	***62.2***	5.8	1.1	68.1	62	0	0	21	16
368.70	2.50	1.20			8.3	17.2	***59.0***	12.1	2.5	78.5	59	0	0	20	18
366.20	2.50	0.40			3.2	5.7	***59.3***	4.7	0.8	82.8	59	0	0	20	21
363.70	2.50	0.20			1.7	2.9	***62.4***	2.4	0.4	85.5	62	0	0	21	23
361.20	2.50	0.30			2.5	4.3	***62.0***	3.6	0.6	88.6	62	0	0	21	26
358.70	2.50	0.10			0.8	1.4	***64.3***	1.2	0.2	90.0	64	0	0	21	28
356.20	2.50	0.20			1.7	2.9	***86.1***	2.4	0.4	95.4	86	0	0	29	31
353.70	2.50	1.60			10.2	23.0	***84.8***	14.8	3.4	108.6	85	0	0	28	33
351.20	2.50		6	Hard Till	0.7	11.5	***112.7***	1.0	1.7	113.6	113	0	0	38	36
348.70	2.50	2.70			14.4	38.8	***127.1***	21.0	5.7	134.6	127	0	0	42	38
346.20	2.50	2.70			14.4	38.8	***125.7***	21.0	5.7	153.2	126	0	0	42	41
343.70	2.50		12	Hard Till	1.3	23.0	***127.0***	1.9	3.4	155.1	127	0	0	42	43
341.20	2.50		12	Hard Till	1.3	23.0	***147.0***	1.9	3.4	159.8	147	0	0	49	46
338.70	2.50	2.90			15.1	41.7	***162.1***	22.1	6.2	181.9	162	0	0	54	48
336.20	2.50	2.90			15.1	41.7	***168.6***	22.1	6.2	202.7	169	0	0	56	51
333.70	2.50	2.30			12.9	33.0	***181.5***	18.8	4.9	221.5	182	0	0	61	53
331.20	2.50	2.30			12.9	33.0	***182.9***	18.8	4.9	238.6	183	0	0	61	56
328.70	2.50	1.50			9.7	21.5	***192.7***	14.2	3.2	252.8	193	0	0	64	58
327.20	1.50	1.50			5.8	21.5	432.4	8.5	3.2	***295.9***	296	0	0	99	60
327.00	0.20			Limestone	20.2	255.4	452.5	29.4	37.7	***325.3***	325	0	0	108	59.9
326.80	0.20			Limestone	20.2	255.4	472.7	29.4	37.7	***354.8***	355	0	0	118	60.1
326.30	0.50			Limestone	50.5	255.4	523.2	73.6	37.7	***428.4***	428	0	0	143	60.6
325.80	0.50			Limestone	50.5	255.4	573.6	73.6	37.7	***502.0***	502	0	0	167	61.1
325.30	0.50			Limestone	50.5	255.4	624.1	73.6	37.7	***575.6***	576	0	0	192	61.6
324.80	0.50			Limestone	50.5	255.4	674.5	73.6	37.7	***649.2***	~~649~~	~~0~~	~~0~~	~~216~~	~~62.1~~
323.80	1.00			Limestone	100.9	255.4	***775.4***	147.2	37.7	796.4	~~775~~	~~0~~	~~0~~	~~258~~	~~63.1~~
322.80	1.00			Limestone	100.9	255.4	***876.3***	147.2	37.7	943.6	~~876~~	~~0~~	~~0~~	~~292~~	~~64.1~~
321.80	1.00			Limestone	100.9	255.4	***977.2***	147.2	37.7	1090.8	~~977~~	~~0~~	~~0~~	~~326~~	~~65.1~~
320.80	1.00			Limestone	100.9	255.4	***1078.1***	147.2	37.7	1238.0	~~1078~~	~~0~~	~~0~~	~~359~~	~~66.1~~
319.80	1.00			Limestone	100.9	255.4	***1179.0***	147.2	37.7	1385.2	~~1179~~	~~0~~	~~0~~	~~393~~	~~67.1~~
318.80	1.00			Limestone	100.9	255.4	***1279.9***	147.2	37.7	1532.4	~~1280~~	~~0~~	~~0~~	~~427~~	~~68.1~~
317.80	1.00			Limestone	100.9	255.4	***1380.9***	147.2	37.7	1679.6	~~1381~~	~~0~~	~~0~~	~~460~~	~~69.1~~
316.80	1.00			Limestone	100.9	255.4	***1481.8***	147.2	37.7	1826.8	~~1482~~	~~0~~	~~0~~	~~494~~	~~70.1~~
315.80	1.00			Limestone		255.4			37.7						

I D O T   S T A T I C   M E T H O D   O F   E S T I M A T I N G   P I L E   L E N G T H

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 10/18/2011

SUBSTRUCTURE============================== Pier 1
REFERENCE BORING ========================== 1-S
LRFD or ASD or SEISMIC ======================== ASD
PILE CUTOFF ELEV. ============================ 386.90 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRI 366.40 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ================ ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ============ ft

TOTAL SERVICE SUBSTRUCTURE LOAD ========== 1779 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)==== 52.00 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 1
Approx. Service Loading Applied per pile spaced at 8 ft. Cts = 273.69 KIPS
Approx. Service Loading Applied per pile spaced at 3 ft. Cts = 102.63 KIPS

PILE TYPE AND SIZE ========== Steel HP 12 X 74
Plugged Pile Perimeter==================== 4.050 FT. Unplugged Pile Perimeter=========== 5.908 FT.
Plugged Pile End Bearing Area============== 1.025 SQFT. Unplugged Pile End Bearing Area===== 0.151 SQFT.

MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Allowable Resistance Available in Boring	Maximum Pile Driveable Length in Boring
589 KIPS	**583** KIPS	**194** KIPS	**64** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	ULTIMATE PLUGGED SIDE RESIST. (KIPS)	ULTIMATE PLUGGED END BRG. RESIST. (KIPS)	ULTIMATE PLUGGED TOTAL RESIST. (KIPS)	ULTIMATE UNPLUGGED SIDE RESIST. (KIPS)	ULTIMATE UNPLUGGED END BRG. RESIST. (KIPS)	ULTIMATE UNPLUGGED TOTAL RESIST. (KIPS)	NOMINAL REQ'D BEARING (KIPS)	ALLOWABLE GEOTECH. LOSS FROM SCOUR or DD (KIPS)	ULTIMATE GEOTECH. LOSS LOAD FROM DD (KIPS)	ALLOW. RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
364.40	2.00	1.20			6.6		32.5	9.7		***13.5***	14	0	0	5	23
361.90	2.50	1.80			11.0	25.9	44.9	16.1	3.8	***29.8***	30	0	0	10	25
359.40	2.50	1.90			11.4	27.3	56.4	16.6	4.0	***46.4***	46	0	0	15	28
356.90	2.50	1.90			11.4	27.3	69.2	16.6	4.0	***63.3***	63	0	0	21	30
354.40	2.50	2.00			11.8	28.7	91.0	17.2	4.2	***81.9***	82	0	0	27	33
351.90	2.50	2.70			14.4	38.8	102.5	21.0	5.7	***102.5***	103	0	0	34	35
349.40	2.50	2.50			13.6	35.9	***116.2***	19.9	5.3	122.4	116	0	0	39	38
346.90	2.50	2.50			13.6	35.9	***120.7***	19.9	5.3	140.9	121	0	0	40	40
344.40	2.50		14	Hard Till	1.5	26.8	***122.3***	2.3	4.0	143.2	122	0	0	41	43
341.90	2.50		14	Hard Till	1.5	26.8	***135.8***	2.3	4.0	147.2	136	0	0	45	45
339.40	2.50	2.70			14.4	38.8	***150.2***	21.0	5.7	168.2	150	0	0	50	48
336.90	2.50	2.70			14.4	38.8	***134.4***	21.0	5.7	184.7	134	0	0	45	50
334.40	2.50	0.60			4.7	8.6	***139.0***	6.8	1.3	191.5	139	0	0	46	53
331.90	2.50	0.60			4.7	8.6	***146.5***	6.8	1.3	198.7	147	0	0	49	55
329.40	2.50	0.80			6.0	11.5	***152.5***	8.7	1.7	207.4	153	0	0	51	58
328.90	0.50	0.80			1.2	11.5	269.9	1.7	1.7	***226.4***	226	0	0	75	58
328.70	0.20			Shale	10.1	127.7	280.0	14.7	18.9	***241.1***	241	0	0	80	58.2
328.20	0.50			Shale	25.2	127.7	305.2	36.8	18.9	***277.9***	278	0	0	93	58.7
327.70	0.50			Shale	25.2	127.7	330.5	36.8	18.9	***314.7***	315	0	0	105	59.2
326.70	1.00			Shale	50.5	127.7	***380.9***	73.6	18.9	388.3	381	0	0	127	60.2
325.70	1.00			Shale	50.5	127.7	***431.4***	73.6	18.9	461.9	431	0	0	144	61.2
324.70	1.00			Shale	50.5	127.7	***481.8***	73.6	18.9	535.5	482	0	0	161	62.2
323.70	1.00			Shale	50.5	127.7	***532.3***	73.6	18.9	609.1	532	0	0	177	63.2
322.70	1.00			Shale	50.5	127.7	***582.7***	73.6	18.9	682.7	583	0	0	194	64.2
321.70	1.00			Shale	50.5	127.7	***633.2***	73.6	18.9	756.3	~~633~~	~~*0*~~	~~*0*~~	~~*211*~~	~~*65.2*~~
320.70	1.00			Shale	50.5	127.7	***683.6***	73.6	18.9	829.9	~~684~~	~~*0*~~	~~*0*~~	~~*228*~~	~~*66.2*~~
319.70	1.00			Shale	50.5	127.7	***734.1***	73.6	18.9	903.5	~~734~~	~~*0*~~	~~*0*~~	~~*245*~~	~~*67.2*~~
318.70	1.00			Shale	50.5	127.7	***784.5***	73.6	18.9	977.1	~~785~~	~~*0*~~	~~*0*~~	~~*262*~~	~~*68.2*~~
317.70	1.00			Shale	50.5	127.7	***835.0***	73.6	18.9	1050.7	~~835~~	~~*0*~~	~~*0*~~	~~*278*~~	~~*69.2*~~
316.70	1.00			Shale	50.5	127.7	***885.4***	73.6	18.9	1124.3	~~885~~	~~*0*~~	~~*0*~~	~~*295*~~	~~*70.2*~~
315.70	1.00			Shale	50.5	127.7	***935.9***	73.6	18.9	1197.9	~~936~~	~~*0*~~	~~*0*~~	~~*312*~~	~~*71.2*~~
314.70	1.00			Shale	50.5	127.7	***986.3***	73.6	18.9	1271.5	~~986~~	~~*0*~~	~~*0*~~	~~*329*~~	~~*72.2*~~
313.70	1.00			Shale	50.5	127.7	***1036.8***	73.6	18.9	1345.1	~~1037~~	~~*0*~~	~~*0*~~	~~*346*~~	~~*73.2*~~
312.70	1.00			Shale	50.5	127.7	***1087.2***	73.6	18.9	1418.7	~~1087~~	~~*0*~~	~~*0*~~	~~*362*~~	~~*74.2*~~
311.70	1.00			Shale	50.5	127.7	***1137.7***	73.6	18.9	1492.3	~~1138~~	~~*0*~~	~~*0*~~	~~*379*~~	~~*75.2*~~
310.70	1.00			Shale	50.5	127.7	***1188.1***	73.6	18.9	1565.9	~~1188~~	~~*0*~~	~~*0*~~	~~*396*~~	~~*76.2*~~
309.70	1.00			Shale	50.5	127.7	***1238.6***	73.6	18.9	1639.5	~~1239~~	~~*0*~~	~~*0*~~	~~*413*~~	~~*77.2*~~
308.70	1.00			Shale		127.7			18.9						

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 10/18/2011

SUBSTRUCTURE============================== Pier 2
REFERENCE BORING ========================== 2-S
LRFD or ASD or SEISMIC ======================== ASD
PILE CUTOFF ELEV. ============================ 386.90 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRI 363.40 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ================ ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ============ ft

TOTAL SERVICE SUBSTRUCTURE LOAD =========== = 1779 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)==== = 52.00 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE == 1
Approx. Service Loading Applied per pile spaced at 8 ft. Cts == 273.69 KIPS
Approx. Service Loading Applied per pile spaced at 3 ft. Cts == 102.63 KIPS

PILE TYPE AND SIZE =========== Steel HP 12 X 74
Plugged Pile Perimeter===================== 4.050 FT. Unplugged Pile Perimeter=========== 5.908 FT.
Plugged Pile End Bearing Area============== 1.025 SQFT. Unplugged Pile End Bearing Area===== 0.151 SQFT.

MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Allowable Resistance Available in Boring	Maximum Pile Driveable Length in Boring
589 KIPS	**579** KIPS	**193** KIPS	**62** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	ULTIMATE PLUGGED SIDE RESIST. (KIPS)	ULTIMATE PLUGGED END BRG. RESIST. (KIPS)	ULTIMATE PLUGGED TOTAL RESIST. (KIPS)	ULTIMATE UNPLUGGED SIDE RESIST. (KIPS)	ULTIMATE UNPLUGGED END BRG. RESIST. (KIPS)	ULTIMATE UNPLUGGED TOTAL RESIST. (KIPS)	NOMINAL REQ'D BEARING (KIPS)	ALLOWABLE GEOTECH. LOSS FROM SCOUR or DD (KIPS)	ULTIMATE GEOTECH. LOSS LOAD FROM DD (KIPS)	ALLOW. RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
361.20	2.20	0.30			2.2		3.6	3.1		***3.4***	3	0	0	1	26
358.70	2.50	0.10			0.8	1.4	5.9	1.2	0.2	***4.8***	5	0	0	2	28
356.20	2.50	0.20			1.7	2.9	27.7	2.4	0.4	***10.2***	10	0	0	3	31
353.70	2.50	1.60			10.2	23.0	26.3	14.8	3.4	***23.4***	23	0	0	8	33
351.20	2.50		6	Hard Till	0.7	11.5	54.3	1.0	1.7	***28.4***	28	0	0	9	36
348.70	2.50	2.70			14.4	38.8	68.7	21.0	5.7	***49.3***	49	0	0	16	38
346.20	2.50	2.70			14.4	38.8	***67.3***	21.0	5.7	68.0	67	0	0	22	41
343.70	2.50		12	Hard Till	1.3	23.0	***68.6***	1.9	3.4	69.9	69	0	0	23	43
341.20	2.50		12	Hard Till	1.3	23.0	88.6	1.9	3.4	***74.6***	75	0	0	25	46
338.70	2.50	2.90			15.1	41.7	103.7	22.1	6.2	***96.6***	97	0	0	32	48
336.20	2.50	2.90			15.1	41.7	***110.2***	22.1	6.2	117.4	110	0	0	37	51
333.70	2.50	2.30			12.9	33.0	***123.1***	18.8	4.9	136.2	123	0	0	41	53
331.20	2.50	2.30			12.9	33.0	***124.5***	18.8	4.9	153.4	124	0	0	41	56
329.20	2.00	1.50			7.8	21.5	***132.3***	11.4	3.2	164.7	132	0	0	44	58
327.20	2.00	1.50			7.8	21.5	373.9	11.4	3.2	***210.6***	211	0	0	70	60
327.00	0.20			Limestone	20.2	255.4	394.1	29.4	37.7	***240.1***	240	0	0	80	59.9
326.80	0.20			Limestone	20.2	255.4	414.3	29.4	37.7	***269.5***	270	0	0	90	60.1
326.60	0.20			Limestone	20.2	255.4	434.5	29.4	37.7	***299.0***	299	0	0	100	60.3
326.40	0.20			Limestone	20.2	255.4	454.7	29.4	37.7	***328.4***	328	0	0	109	60.5
326.20	0.20			Limestone	20.2	255.4	474.8	29.4	37.7	***357.8***	358	0	0	119	60.7
326.00	0.20			Limestone	20.2	255.4	495.0	29.4	37.7	***387.3***	387	0	0	129	60.9
325.80	0.20			Limestone	20.2	255.4	515.2	29.4	37.7	***416.7***	417	0	0	139	61.1
325.60	0.20			Limestone	20.2	255.4	535.4	29.4	37.7	***446.2***	446	0	0	149	61.3
325.40	0.20			Limestone	20.2	255.4	555.6	29.4	37.7	***475.6***	476	0	0	159	61.5
325.20	0.20			Limestone	20.2	255.4	575.7	29.4	37.7	***505.0***	505	0	0	168	61.7
324.70	0.50			Limestone	50.5	255.4	626.2	73.6	37.7	***578.6***	579	0	0	193	62.2
323.70	1.00			Limestone	100.9	255.4	727.1	147.2	37.7	***725.8***	~~726~~	~~0~~	~~0~~	~~242~~	~~63.2~~
322.70	1.00			Limestone	100.9	255.4	***828.0***	147.2	37.7	873.0	~~828~~	~~0~~	~~0~~	~~276~~	~~64.2~~
321.70	1.00			Limestone	100.9	255.4	***928.9***	147.2	37.7	1020.2	~~929~~	~~0~~	~~0~~	~~310~~	~~65.2~~
320.70	1.00			Limestone	100.9	255.4	***1029.8***	147.2	37.7	1167.4	~~1030~~	~~0~~	~~0~~	~~343~~	~~66.2~~
319.70	1.00			Limestone	100.9	255.4	***1130.7***	147.2	37.7	1314.6	~~1131~~	~~0~~	~~0~~	~~377~~	~~67.2~~
318.70	1.00			Limestone	100.9	255.4	***1231.6***	147.2	37.7	1461.8	~~1232~~	~~0~~	~~0~~	~~411~~	~~68.2~~
317.70	1.00			Limestone	100.9	255.4	***1332.5***	147.2	37.7	1609.1	~~1333~~	~~0~~	~~0~~	~~444~~	~~69.2~~
316.70	1.00			Limestone	100.9	255.4	***1433.4***	147.2	37.7	1756.3	~~1433~~	~~0~~	~~0~~	~~478~~	~~70.2~~
315.70	1.00			Limestone	100.9	255.4	***1534.3***	147.2	37.7	1903.5	~~1534~~	~~0~~	~~0~~	~~511~~	~~71.2~~
314.70	1.00			Limestone	100.9	255.4	***1635.2***	147.2	37.7	2050.7	~~1635~~	~~0~~	~~0~~	~~545~~	~~72.2~~
313.70	1.00			Limestone	100.9	255.4	***1736.1***	147.2	37.7	2197.9	~~1736~~	~~0~~	~~0~~	~~579~~	~~73.2~~
312.70	1.00			Limestone		255.4			37.7						

I D O T   S T A T I C   M E T H O D   O F   E S T I M A T I N G   P I L E   L E N G T H

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 10/18/2011

SUBSTRUCTURE============================== West Abutment
REFERENCE BORING ========================== 1-S
LRFD or ASD or SEISMIC ======================= ASD
PILE CUTOFF ELEV. =========================== 386.90 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRI 381.90 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ================ ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ============ ft

MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Allowable Resistance Available in Boring	Maximum Pile Driveable Length in Boring
589 KIPS	**589** KIPS	**196** KIPS	**64** FT.

TOTAL SERVICE SUBSTRUCTURE LOAD ========== 942 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)==== 52.00 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 1
Approx. Service Loading Applied per pile spaced at 8 ft. Cts : 144.92 KIPS
Approx. Service Loading Applied per pile spaced at 3 ft. Cts : 54.35 KIPS

PILE TYPE AND SIZE ========== Steel HP 12 X 74
Plugged Pile Perimeter==================== 4.050 FT. Unplugged Pile Perimeter=========== 5.908 FT.
Plugged Pile End Bearing Area============= 1.025 SQFT. Unplugged Pile End Bearing Area===== 0.151 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	ULTIMATE PLUGGED SIDE RESIST. (KIPS)	ULTIMATE PLUGGED END BRG. RESIST. (KIPS)	ULTIMATE PLUGGED TOTAL RESIST. (KIPS)	ULTIMATE UNPLUGGED SIDE RESIST. (KIPS)	ULTIMATE UNPLUGGED END BRG. RESIST. (KIPS)	ULTIMATE UNPLUGGED TOTAL RESIST. (KIPS)	NOMINAL REQ'D BEARING (KIPS)	ALLOWABLE GEOTECH. LOSS FROM SCOUR or DD (KIPS)	ULTIMATE GEOTECH. LOSS LOAD FROM DD (KIPS)	ALLOW. RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
379.40	2.50	1.60			10.2		51.8	14.8		***21.0***	21	0	0	7	8
376.90	2.50	2.90			15.1	41.7	***28.2***	22.1	6.2	37.3	28	0	0	9	10
374.40	2.50	0.20			1.7	2.9	54.3	2.4	0.4	***43.4***	43	0	0	14	13
371.90	2.50	1.90			11.4	27.3	74.3	16.6	4.0	***61.3***	61	0	0	20	15
369.40	2.50	2.50			13.6	35.9	***75.0***	19.9	5.3	79.3	75	0	0	25	18
366.90	2.50	1.60			10.2	23.0	***79.4***	14.8	3.4	93.3	79	0	0	26	20
364.40	2.50	1.20			8.3	17.2	***96.3***	12.1	2.5	106.6	96	0	0	32	23
361.90	2.50	1.80			11.0	25.9	***108.8***	16.1	3.8	122.9	109	0	0	36	25
359.40	2.50	1.90			11.4	27.3	***120.2***	16.6	4.0	139.6	120	0	0	40	28
356.90	2.50	1.90			11.4	27.3	***133.0***	16.6	4.0	156.4	133	0	0	44	30
354.40	2.50	2.00			11.8	28.7	***154.9***	17.2	4.2	175.1	155	0	0	52	33
351.90	2.50	2.70			14.4	38.8	***166.4***	21.0	5.7	195.6	166	0	0	55	35
349.40	2.50	2.50			13.6	35.9	***180.0***	19.9	5.3	215.5	180	0	0	60	38
346.90	2.50	2.50			13.6	35.9	***184.6***	19.9	5.3	234.1	185	0	0	62	40
344.40	2.50		14	Hard Till	1.5	26.8	***186.1***	2.3	4.0	236.3	186	0	0	62	43
341.90	2.50		14	Hard Till	1.5	26.8	***199.6***	2.3	4.0	240.4	200	0	0	67	45
339.40	2.50	2.70			14.4	38.8	***214.0***	21.0	5.7	261.3	214	0	0	71	48
336.90	2.50	2.70			14.4	38.8	***198.2***	21.0	5.7	277.9	198	0	0	66	50
334.40	2.50	0.60			4.7	8.6	***202.9***	6.8	1.3	284.6	203	0	0	68	53
331.90	2.50	0.60			4.7	8.6	***210.4***	6.8	1.3	291.9	210	0	0	70	55
329.40	2.50	0.80			6.0	11.5	***216.4***	8.7	1.7	300.6	216	0	0	72	58
328.90	0.50	0.80			1.2	11.5	333.8	1.7	1.7	***319.5***	319	0	0	106	58
327.90	1.00			Shale	50.5	127.7	***384.2***	73.6	18.9	393.1	384	0	0	128	59
326.90	1.00			Shale	50.5	127.7	***434.7***	73.6	18.9	466.7	435	0	0	145	60
325.90	1.00			Shale	50.5	127.7	***485.1***	73.6	18.9	540.3	485	0	0	162	61
324.90	1.00			Shale	50.5	127.7	***535.6***	73.6	18.9	613.9	536	0	0	179	62
323.90	1.00			Shale	50.5	127.7	***586.0***	73.6	18.9	687.5	586	0	0	195	63
322.90	1.00			Shale	50.5	127.7	***636.5***	73.6	18.9	761.1	~~636~~	~~*0*~~	~~*0*~~	~~*212*~~	~~*64*~~
321.90	1.00			Shale	50.5	127.7	***686.9***	73.6	18.9	834.7	~~687~~	~~*0*~~	~~*0*~~	~~*229*~~	~~*65*~~
320.90	1.00			Shale	50.5	127.7	***737.4***	73.6	18.9	908.3	~~737~~	~~*0*~~	~~*0*~~	~~*246*~~	~~*66*~~
319.90	1.00			Shale	50.5	127.7	***787.8***	73.6	18.9	981.9	~~788~~	~~*0*~~	~~*0*~~	~~*263*~~	~~*67*~~
318.90	1.00			Shale	50.5	127.7	***838.3***	73.6	18.9	1055.5	~~838~~	~~*0*~~	~~*0*~~	~~*279*~~	~~*68*~~
317.90	1.00			Shale	50.5	127.7	***888.7***	73.6	18.9	1129.1	~~889~~	~~*0*~~	~~*0*~~	~~*296*~~	~~*69*~~
316.90	1.00			Shale	50.5	127.7	***939.2***	73.6	18.9	1202.7	~~939~~	~~*0*~~	~~*0*~~	~~*313*~~	~~*70*~~
315.90	1.00			Shale	50.5	127.7	***989.6***	73.6	18.9	1276.3	~~990~~	~~*0*~~	~~*0*~~	~~*330*~~	~~*71*~~
314.90	1.00			Shale	50.5	127.7	***1040.1***	73.6	18.9	1349.9	~~1040~~	~~*0*~~	~~*0*~~	~~*347*~~	~~*72*~~
313.90	1.00			Shale	50.5	127.7	***1090.5***	73.6	18.9	1423.5	~~1091~~	~~*0*~~	~~*0*~~	~~*364*~~	~~*73*~~
312.90	1.00			Shale		127.7			18.9						

EXHIBIT G

MINES MAP

Coal Mines and Underground Industrial Mines
JACKSON
County

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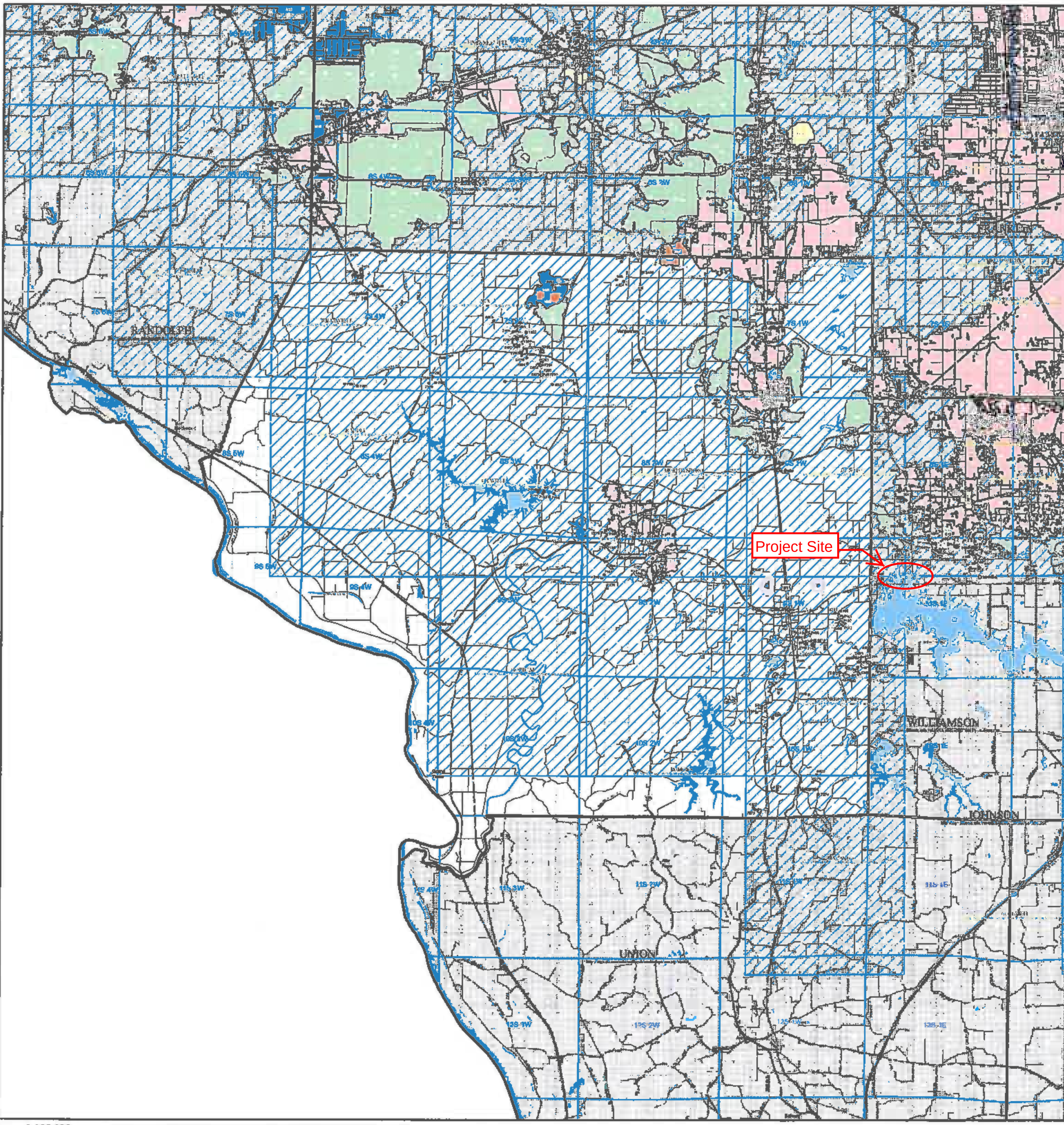
County Coal Map Series
ISGS Coal Section
Map construction: January 29, 2015

This product is under review and may not meet the standards of the Illinois State Geological Survey

County coal maps and select quadrangle maps available as downloadable PDF files at: http://www.isgs.illinois.edu



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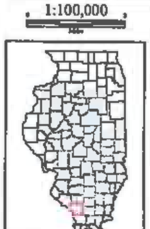

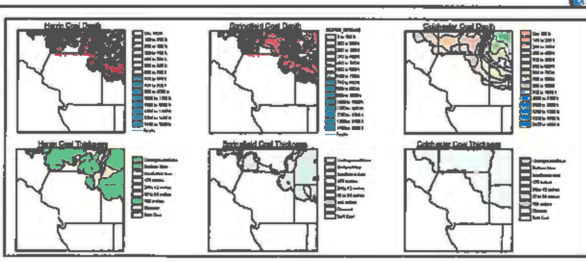

County	Opening type unknown
Township	Uncertain location
Section	Active surface tipple
Quadrangle study (Available on Website)	Abandoned surface tipple
Lake or river	Active shaft
Coal mine - active	Abandoned shaft
Underground coal mine - abandoned	Active slope
Surface coal mine - abandoned	Abandoned slope
Indefinite underground coal mine boundary - abandoned	Active drift
Underground industrial mine and surrounding buffer region	Abandoned drift
951, 951 Coal mine index number (polygon label, point label)	Underground industrial mine entrance or general location

Map Explanation

This map accompanies the coal mines directory for this county. Please consult the directory for an explanation of the coal mine information shown on this map. Buffer regions for industrial mineral mines were incorporated into this map due to limited information regarding these mines. The size of the buffer region is dependent on the uncertainty or inaccuracy of the mine location. For more information regarding industrial mineral mines please contact the ISGS Industrial Minerals Section.

The maps and digital files used for this study were compiled from data obtained from a variety of public and private sources and have varying degrees of completeness and accuracy. They present reasonable interpretations of the geology of the area and are based on available data. These data were compiled and digitized at a scale of 1:62,500. Locations of some features may be offset by 500 feet or more due to errors in the original source maps, the compilation process, digitizing, or a combination of these factors.

These data are not intended for use in site-specific screening or decision-making. Data included in this map are suitable for use at a scale of 1:100,000.

Disclaimer

The Illinois State Geological Survey and the University of Illinois make no guarantee, expressed or implied, regarding the correctness of the interpretations presented in this data set and accept no liability for the consequences of decisions made by others on the basis of the information presented here.