STRUCTURE GEOTECHNICAL REPORT

Dickson Mound Road over Dickson Creek
F.A.S. Route 457 (CH 31)

S.N. 029-0049 (E)
S.N. 029-0076 (P)

F.A.S. ROUTE 457 (CH 31)
SECTION (11A) BR-1
FULTON COUNTY, ILLINOIS
JOB NO. D-94-102-00
PTB 156/31 WO#4
KEG NO. 10-1063.04

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12/19/2016
Exp 11/30/2017

Prepared for:
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907 South 4th Street
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September 28, 2016

Revised December 19, 2016

Kaskaskia Engineering Group, LLC

EXECUTIVE SUMMARY

Dickson Mound Road over Dickson Creek
F.A.S. 457 (CH 31)
Fulton County, Illinois
Job No. D-94-102-00
PTB 156/31 WO #4
Existing Structure No. 029-0049
Proposed Structure No. 029-0076

The project includes the replacement of an existing single-span bridge (SN 029-0049) with a single-span bridge in Fulton County, Illinois. Integral abutments are proposed for use at the abutments. The proposed structure will be constructed under road closure and traffic will be detoured.

The results of the stability analysis indicates that an acceptable FOS will exist at the north and south abutments during the end-of-construction, long term, and seismic conditions.

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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 replacement of a single-span bridge carrying Dickson Mound Road (CH 31) over Dickson Creek in Fulton 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 replacement of an existing single-span bridge (SN 029-0049) located in Fulton County, Illinois. 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. 4N R. 3E and R. 4E Sections 12 and 7). The project location lies in the Galesburg Plain of the Till Plains section of the Central Lowland Province.

1.3 Existing Structure

The existing structure (SN 029-0049) was constructed in 1939 as a single-span bridge consisting of a concrete deck on steel stringers, and supported on closed timber abutments. Back to back abutment length measures +/-25 ft. with an out to out width of +/-25 ft. The Bridge Condition Report (BCR) submitted June of 2000 recommends complete removal and replacement of the existing structure based on age and poor condition of the existing structure.

1.4 Proposed Bridge Information

The proposed structure (SN 029-0076) located at F.A.S. Route 457 Dickson Mound Road (CH 31) over Dickson Creek, will consist of a single-span, PPC deck-beam, bridge with a hot-mix asphalt driving surface. The bridge will have steel rails Type SM. The back to back abutment length will be 50 ft., 6 inches, therefore pushing the proposed abutments behind the existing abutments. The out to out width would be 28 ft. – 0 in. The bridge will have no skew to Dickson Creek. The roadway width would be 28 ft., with one 14 ft. lane of traffic in each direction. Further substructure details will be based on the findings of this SGR.

2.0 Site Investigation, Subsurface Exploration, and Generalized Subsurface Conditions

The site exploration plan was developed by KEG. A representative of KEG conducted a site visit, laid out the borings, observed the drilling operations, and logged the subsurface conditions.

Two standard penetration test (SPT) borings, designated B-1 and B-2 were drilled near the east and west abutments, respectively, on May 9th and 10th, 2011. Boring B-1 was located at Station 38+18 and offset 25 ft. right of the centerline, and B-2 was located at Station 38+52 and was offset 24 ft. left of the proposed centerline. The boring locations are included on the TS&L, Exhibit B, provided by Allen Henderson & Associates, Inc. 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.

2.1 Subsurface Conditions

The profiles at both borings exhibited layers of silts, clays, silty sands, with interbedded layers of sand. Both boring locations had a termination depth of approximately 55 ft., in shale, and contained a 12" layer of topsoil. In general, the lithologic succession beneath the ground surface is as follows:

a) Silt – The borings encountered 10.5 to 11.0 ft. of brown silt. The driving resistances (N-values) ranged from weight of hammer (WOH) to 4 blows per foot (bpf), and unconfined compressive strength (Q_u) values of 0.2 to 0.3 tons per square foot (tsf). The moisture content varies from 26 to 37 percent.

b) Silty clay/ clay – From approximate El. 435.63 to El. 428.45, the borings advanced through 2.5 to 7.5 ft. of gray silty clay and clay. The N-values recorded were between WOH and 6 bpf, with Q_u values of 0.3 to 0.5 tsf. The moisture content varies from 33 to 40 percent. Shelby tube samples were obtained from B-1 and B-2. A consolidation test was performed on the sample from B-1, and a triaxial unconsolidated undrained compressive strength test was performed on the sample from B-2.

c) Sand – Approximately 2.5 to 5 ft. of fine to coarse grained sand with trace clay and gravel was encountered below the silty clay / clay. The N-values ranged from 1 to 6 bpf. The samples that contained cohesive material had Q_u values of 0.1 to 0.4 tsf. The moisture content varies from 19 to 35 percent.

d) Silt – Below the sands lie a layer of gray silt, approximately, 25.0 to 27.5 ft. thick. The N-values range from 1 to 18 bpf, with Q_u values of 0.1 to 0.2 tsf. The moisture content varies from 19 to 39 percent.

e) Clayey shale – Borings were terminated after advancing 6.0 to 8.5 ft into clayey shale. The N-values were 100+ bpf, with Q_u values of 4.2 to 7.2 tsf. The moisture content varies from 13 to 24 percent .

One anomaly occurred in Boring B-2, a layer of silty sand was encountered from El. 412.95 to EL. 409.45. This layer had an N-value of 3 bpf, with Q_u of 0.2 tsf. The moisture content was 33 percent. The layer included trace organics. Both borings terminated in clayey shale.

2.2 Groundwater

Groundwater was encountered in Boring B-1 at El. 433.13 during drilling and at El. 437.95 during drilling in Boring B-2. Surface water elevation of Dickson Creek was measured at the time of drilling at El. 444.7. Groundwater elevations at extended periods of time were not measured. 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 grading and changes to the existing approach embankments are anticipated to raise the proposed grade by less than one foot, 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 end-slopes at the abutment locations and cutting of side slopes.

The proposed end-slope at the west and east abutments are composed of a 1 Vertical to 2 Horizontal (1V:2H) slope from the top of the slope to the streambed. Slope stability of the end-slopes was analyzed using SLOPE-W; the soil properties at the site, including those in Borings B-1 and B-2; and the end-slope geometrics. 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, un-drained 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 32 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 between 0 and 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
West Abutment	1V:2H	2.6	1.8	1.6
East Abutment	1V:2H	2.6	1.8	1.6

The results of the analysis, as provided in Table 3.2, indicates that an acceptable FOS will exist at the north and south abutments during the end-of-construction, long term, and seismic conditions.

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 E.

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 E, are summarized below.

Table 3.3 – Summary of Seismic Parameters

Parameter	Value
Soil Site Class	E
Spectral Response Acceleration, 0.2 Sec, S_{DS}	0.302 g (Site Class E)
Spectral Response Acceleration, 1.0 Sec, S_{D1}	0.176 g (Site Class E)
Seismic Performance Zone	2

As indicated in the table above, the Seismic Performance Zone is 2, based on S_{D1} and Table 3.15.2-1 in the IDOT Bridge Manual, the Soil Site Class E, and Figure 2.3.10-4 in the IDOT Bridge Manual.

3.4 Scour

The approximate elevation at the bottom of the proposed abutments (TS&L, Exhibit B) is El. 446.79. The design scour elevations, based off of the hydraulic analysis provided by Allen Henderson & Associates, for the proposed abutments are listed in Table 3.4 below.

Table 3.4 – Design Scour Elevations

Event/Limit State	Design Scour Elevations (ft.)		Item 113
	West Abutment	East Abutment	
Q_{10}	447.87	447.87	8
Q_{200}	447.87	447.87	
Design	447.87	447.87	
Check	447.87	447.87	

3.5 Mining Activity

The Illinois State Geological Survey (ISGS) website indicates that some mining has occurred in Fulton County. According to the Fulton County, Illinois Coal Mines and Underground Industrial Mines Map, dated August 6, 2016, obtained from the Illinois Geological Survey website (http://www.isgs.illlinois.edu/maps-data-pub/coal-maps.shtml), the project site was not undermined.

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 at the site of apparent depressions, which could be due to mine subsidence or shafts beneath the site.

3.6 Liquefaction

As per the IDOT AGMU 10.1 Liquefaction Analysis, a liquefaction analysis is not required to be performed for structures located in Seismic Performance Zone 2 and a Peak Seismic Ground Acceleration (A_s) less than 0.15. A_s = 0.126 for this structure location. Therefore, liquefaction was not considered as a reduction for the pile design capacity or other foundation considerations included herein.

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, 12 in. Metal Shell (MS) and HP 8X36 or larger H-piles are feasible pile types for foundation support of the proposed Integral abutments. The average shear strength ($Q_{u\ avg}$) within the critical depth zone is approximately 0.3 tsf in both abutment locations.

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. According to ABD 12.3, MS piles are a feasible option for foundation support; however, the relatively weak cohesive soils will not allow for adequate pile capacities to support the proposed foundations. 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 the abutment locations. The Modified IDOT Static Method uses the LRFD Pile Design Guide Procedure to estimate the pile lengths (Pile Length/Pile Type, Exhibit F).

The abutment loads were provided by Allen Henderson and Associates. The abutments will each experience a Total Factored Load of 715.5 kips. The estimated pile lengths for the recommended pile types are shown in Tables 4.2.1 through 4.2.6, below.

The Maximum 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 Factored Resistance Available (R_F) 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. Since bedrock will be encountered at depth, and all H-piles will likely be driven into bedrock, it is recommended to drive the H-piles to their Maximum Nominal Required Bearing.

Table 4.2.1 – Estimated Pile Lengths for HP 10X42 H-pile

	Estimated Pile Tip Elevation (ft.)	R_n Maximum Nominal Required Bearing (kips)	R_F Factored Resistance Available (LRFD) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
West Abutment (B-1)	395.8	335	184	53	448.8
East Abutment (B-2)	392.8	335	184	56	448.8

Table 4.2.2 – Estimated Pile Lengths for HP 12X53 H-pile

	Estimated Pile Tip Elevation (ft.)	R_n Maximum Nominal Required Bearing (kips)	R_F Factored Resistance Available (LRFD) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
West Abutment (B-1)	395.8	418	230	53	448.8
East Abutment (B-2)	392.8	418	230	56	448.8

Table 4.2.3 – Estimated Pile Lengths for HP 12X74 H-pile

	Estimated Pile Tip Elevation (ft.)	R_n Maximum Nominal Required Bearing (kips)	R_F Factored Resistance Available (LRFD) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
West Abutment (SB-2)	392.8	589	324	56	448.8
East Abutment (SB-1)	389.8	589	324	59	448.8

Table 4.2.4 – Estimated Pile Lengths for HP 14X73 H-pile

	Estimated Pile Tip Elevation (ft.)	R_n Maximum Nominal Required Bearing (kips)	R_F Factored Resistance Available (LRFD) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
West Abutment (B-1)	394.8	578	318	54	448.8
East Abutment (B-2)	391.8	578	318	57	448.8

Table 4.2.5 – Estimated Pile Lengths for HP 14X89 H-pile

	Estimated Pile Tip Elevation (ft.)	R_n Maximum Nominal Required Bearing (kips)	R_F Factored Resistance Available (LRFD) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
West Abutment (B-1)	392.8	705	388	56	448.8
East Abutment (B-2)	389.8	705	388	59	448.8

Table 4.2.6 – Estimated Pile Lengths for HP 14X117 H-pile

	Estimated Pile Tip Elevation (ft.)	R_n Maximum Nominal Required Bearing (kips)	R_F Factored Resistance Available (LRFD) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
West Abutment (B-1)	389.8	929	511	59	448.8
East Abutment (B-2)	386.8	929	511	62	448.8

Due to the varying estimated pile lengths between the west and east abutment locations, KEG recommends a test pile be performed at the east abutment location. A test pile is performed prior to production driving so that actual, on-site field data can be gathered to further evaluate pile driving requirements for the project. This also is the manner in which contractor's proposed equipment and methodologies identified in their Pile Installation Plan can be assessed.

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)				
West Abutment (B-1)	435.6	115	250	0	50	28	30	2	65	0.020
	433.1	120	600	0	50	26	100	n/a	70	0.010
	428.1	110	0	32	0	32	20	2	3	n/a
	400.6	115	290	0	50	28	30	5	65	0.020
	392.3	125	6750	12	6750	12	2000	75	n/a	0.004
East Abutment (B-2)	438.5	115	0	0	0	28	30	WOH	65	0.020
	436.0	120	600	0	50	26	100	n/a	70	0.010
	428.5	125	400	0	50	26	30	3	80	0.020
	426.5	110	0	32	0	32	20	6	3	n/a
	413.0	115	100	0	50	28	30	2	65	0.020
	409.5	115	200	0	50	28	30	3	50	0.020
	398.0	115	150	0	50	28	30	3	65	0.020
	391.5	125	5050	12	5050	12	2000	70	n/a	0.004

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

Temporary shoring may not be required during construction as the structure is to be removed and replaced under road closure and traffic will be detoured. If that changes, KEG needs to be notified. 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.

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

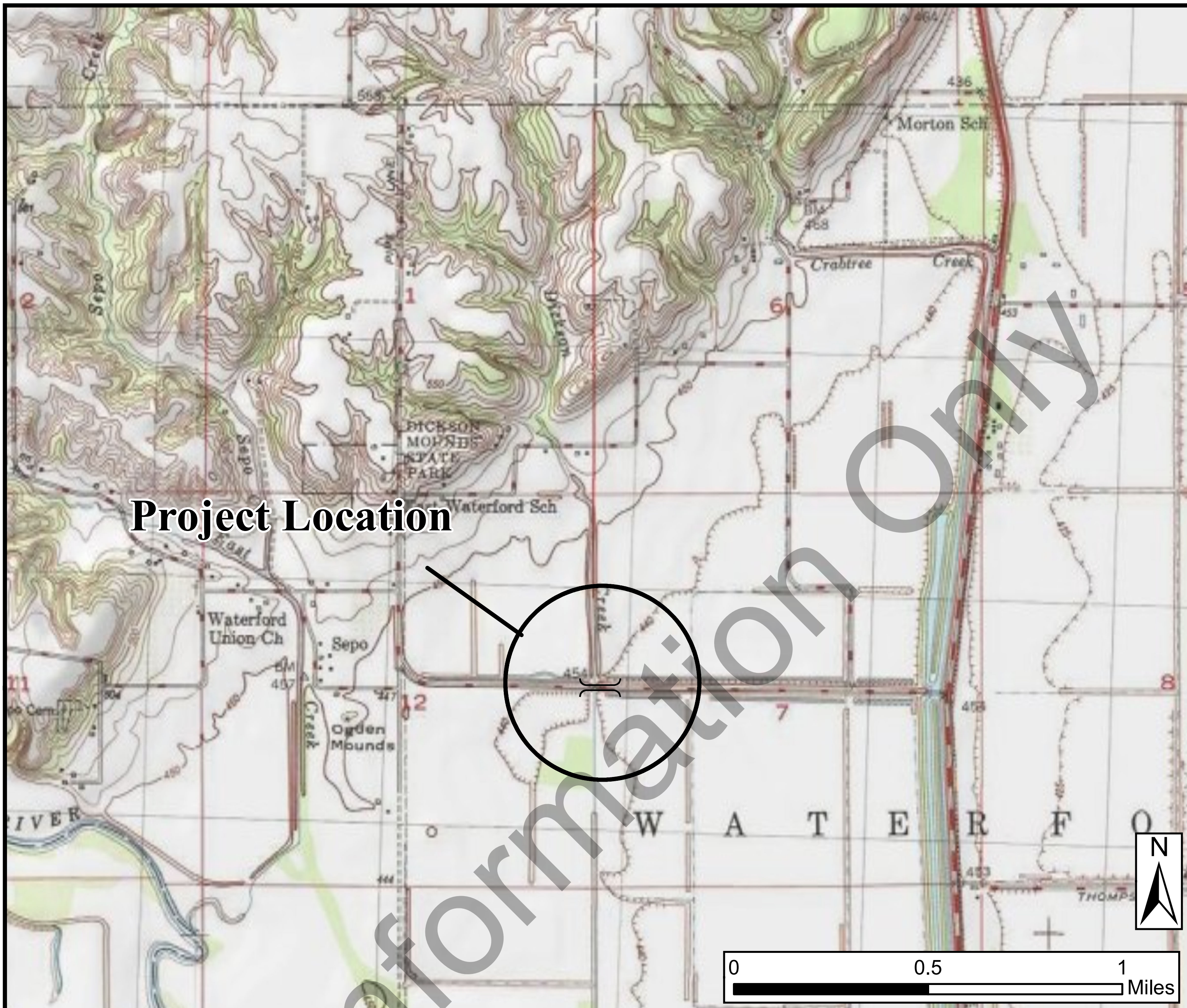
Soil boring logs can be found in Exhibit C. The Subsurface Profile can be found in Exhibit D.

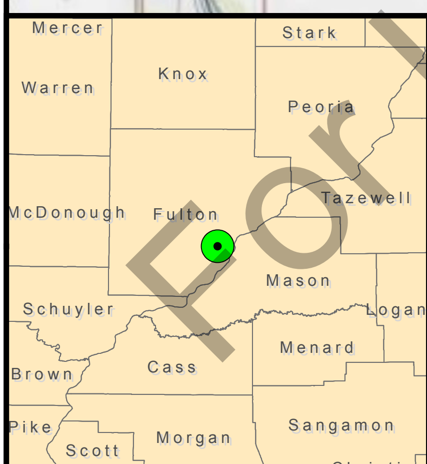
8.0 Limitations

The recommendations provided herein are for the exclusive use of Allen Henderson and Associates and IDOT. They are specific only to the project described and are based on the subsurface information obtained by KEG at two boring locations in 2011, 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





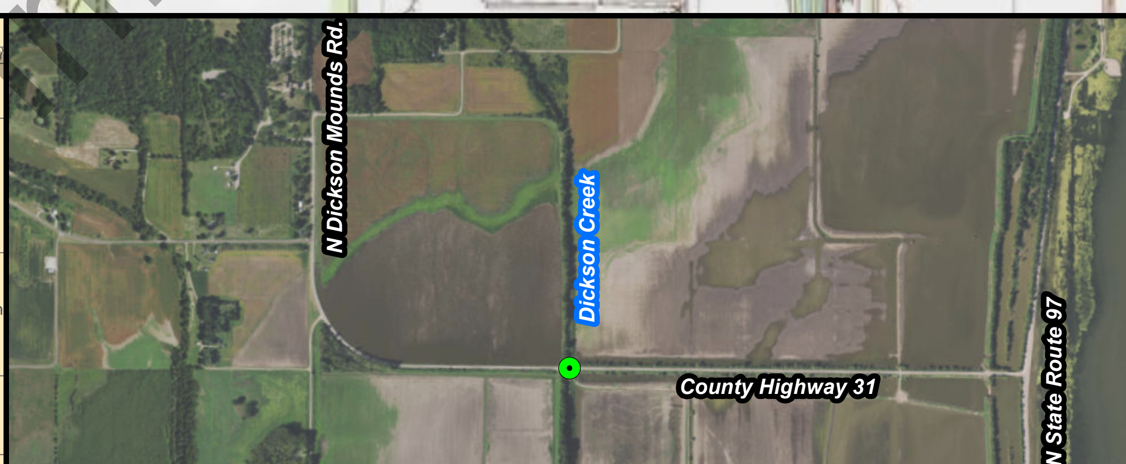


Exhibit A
Location Map
County HWY 31 over Dickson Creek
Fulton County, Illinois

Designed By: CRG
Drawn By: MMJ
Checked By: CRG
Date: 08/29/16
Project #: 10-1063.04

Kaskaskia Engineering Group, LLC

EXHIBIT B

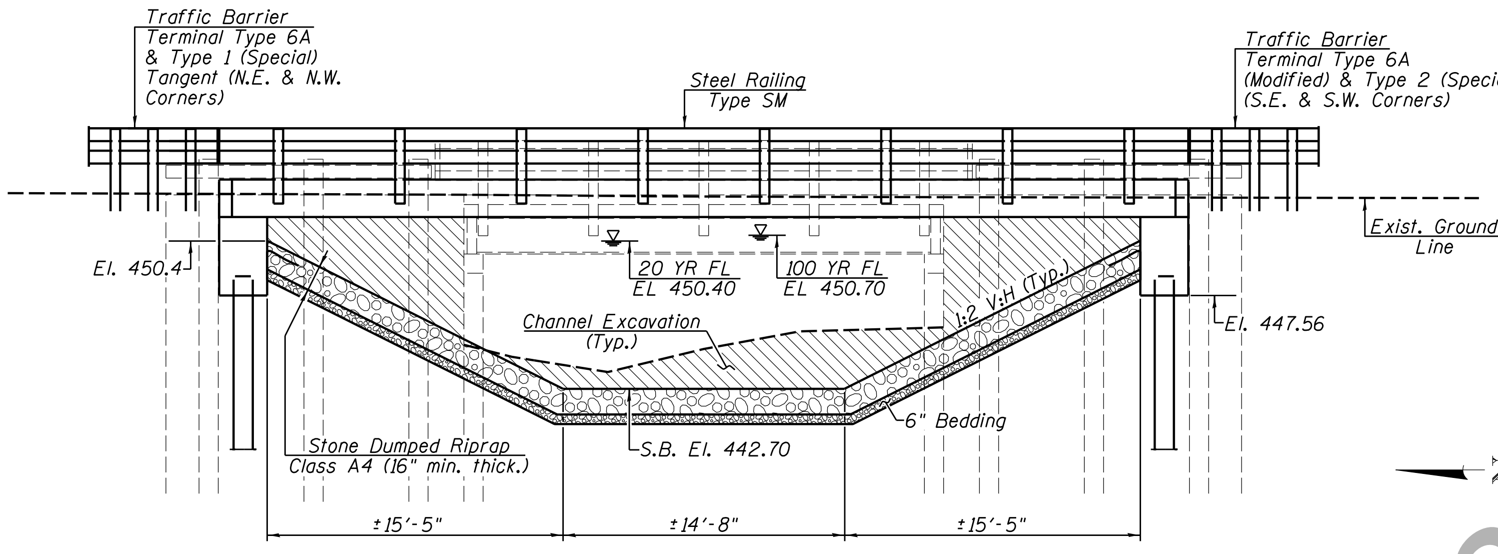
TYPE, SIZE, AND LOCATION PLAN (TS&L)

(PRELIMINARY)

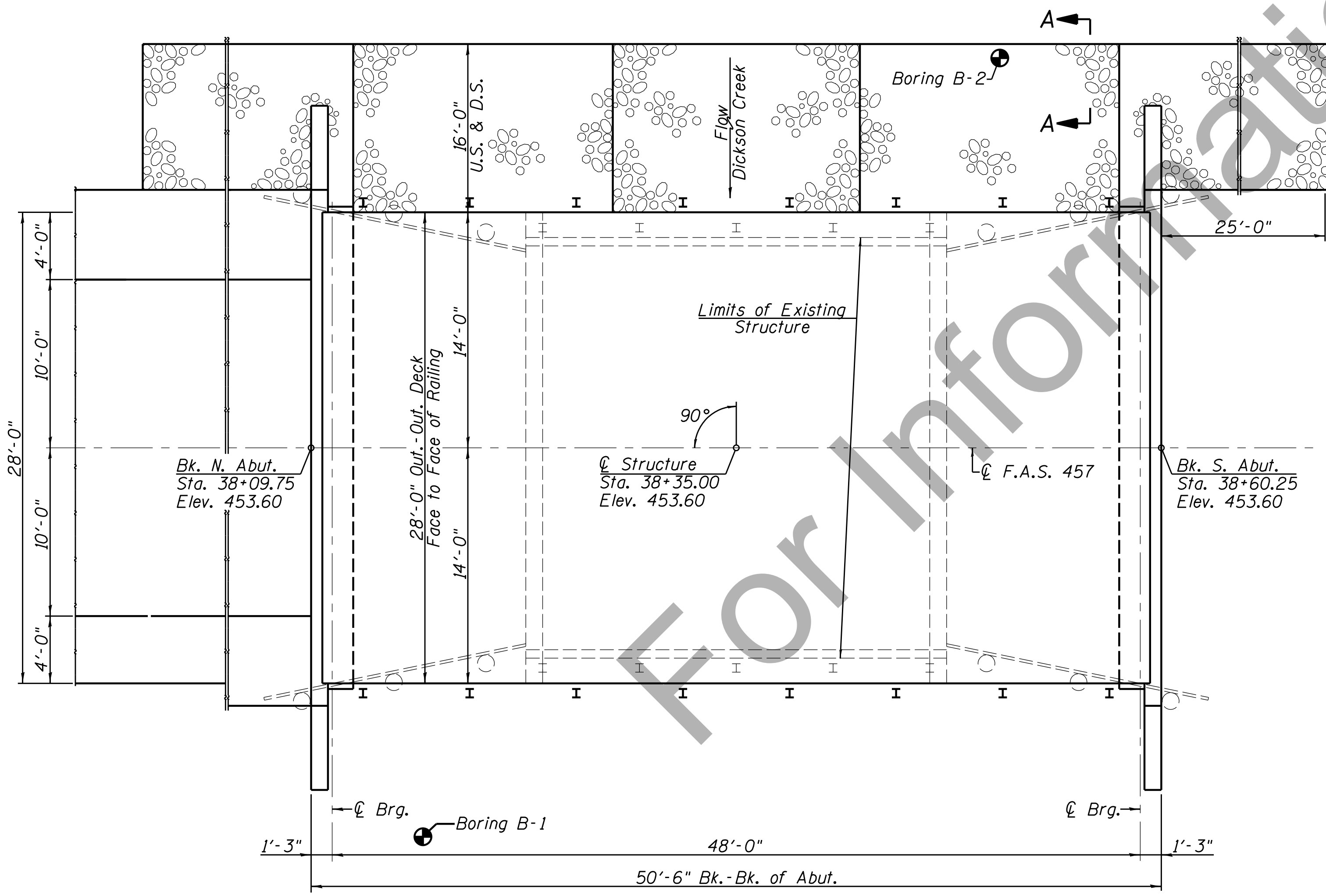
Benchmark: Chiseled "□" on southeast corner of bridge, East end of south concrete guardrail
Sta. 38+47, El. 453.27

Existing Structure: S.N. 029-0049 Built in 1939 as a single span concrete deck on steel stringers on closed timber abutments, ±25'-0" Out.-Out. deck, ±25'-0" Bk.-Bk. abutments. The existing structure is to be removed and replaced with a double 12' x 8' C.I.P. box culvert. Traffic to be detoured. Project will be under road closure.

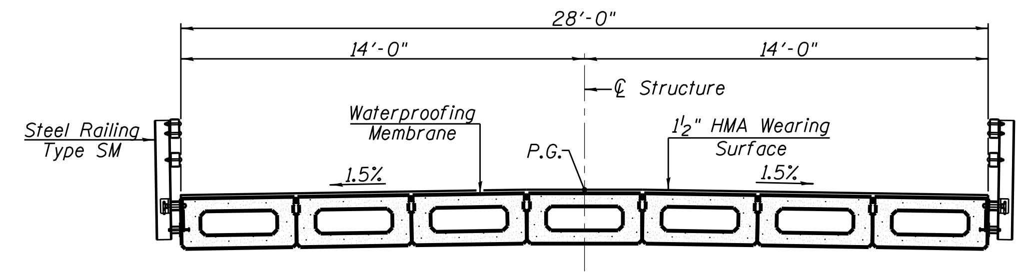
No salvage.



ELEVATION



PLAN



CROSS SECTION

WATERWAY INFORMATION

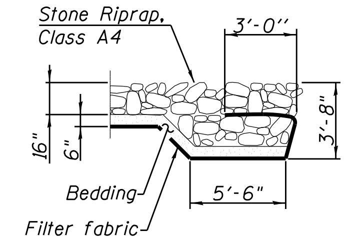
Drainage Area = 1.53 mi²
Exist. Low Grade Elev. 451.6 @ Sta. 45+00
Prop. Low Grade Elev. 451.6 @ Sta. 45+00

Flood	Freq. Yr.	Q C.F.S.	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	671	116	190	449.8	0.2	-0.3	450.0	449.5
Design	20	825	127	212	450.4	0.2	-0.3	450.6	450.1
	50	894	131	223	450.6	0.2	-0.2	450.8	450.4
Base	100	924	132	227	450.7	0.2	-0.2	450.9	450.5
	200	951	133	231	450.8	0.3	-0.2	451.1	450.6
Max. Calc.	500	972	134	235	450.8	0.3	-0.2	451.1	450.7

10 year velocity through existing bridge = 5.8 fps
10 year velocity through prop. bridge = 3.5 fps
* A portion of this flow value overtops the levees upstream of the bridge and discharges to the floodplain

DESIGN SCOUR ELEVATION TABLE

Design Scour Elevation (ft.)	D.S. Invert	U.S. Invert
	440.00	440.00

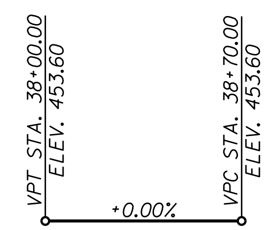


SECTION A-A

DESIGN SPECIFICATIONS
2014 AASHTO LRFD Bridge Design Specifications, 5th Edition, with 2015 & 2016 Interims

DESIGN STRESSES
FIELD UNITS
f'c = 3,500 psi
fy = 60,000 psi (Reinforcement)

PRECAST PRESTRESSED UNITS
f'c = 6,000 psi
f'ci = 5,000 psi
f's = 270,000 psi (½" ϕ low lax. strands)
f si = 201,960 psi (½" ϕ low lax. strands)
fy = 60,000 psi (Reinforcement)

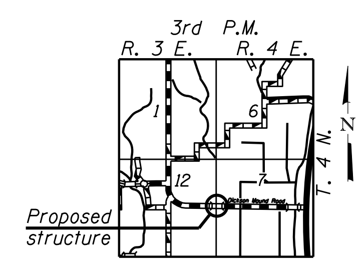


PROFILE GRADE
(Along ℄ Rdwy.)

HIGHWAY CLASSIFICATION
F.A.S. Rte. 457 - Dickson Mound Road
Functional Class: Major Collector Rural
ADT: 600 (2015), 605 (2035)
ADTT: 6 (2015), 6 (2035)
DHV: 66 (2035)
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
(EXISTING CONSTRUCTION)
Seismic Performance Category (SPC) = A
Bedrock Acceleration Coeffecient (A) = 0.037 g
Site Coeffecient (SI) = 1.5



LOCATION SKETCH

GENERAL PLAN & ELEVATION
DICKSON MOUND ROAD
OVER DICKSON CREEK
F.A.S. RTE. 457 - SEC. (11A)BR-1
FULTON COUNTY
STATION 38+35
STRUCTURE NO. 029-2013

EXHIBIT C

BORING LOGS

Kaskaskia Engineering Group, LLC

SOIL BORING LOG

Date 5/9/11

ROUTE CH 31 **DESCRIPTION** CH 31 over Dickson Creek **LOGGED BY** KEG (AC)

SECTION (11A) BR-1 **LOCATION** 1 mile west of IL 97 & Dickson Mounds Road

COUNTY Fulton **DRILLING METHOD** CME 55 w/HSA/Mud Rotary **HAMMER TYPE** Automatic

STRUCT. NO. 029-0049
Station 38+35

BORING NO. B-1
Station 38+18
Offset 25.0 ft Rt
Ground Surface Elev. 446.63 ft

Surface Water Elev. 444.70 ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 433.1 ft ▼
Upon Completion ft
After Hrs. ft

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
TOPSOIL				
445.6				
SILT: Brown		WOH WOH WOH		36
Some organics	-5	WOH WOH WOH		34
Becomes brown to gray		WOH WOH 4	0.3 B	26
Becomes gray	-10	2 1 2	0.2 B	35
435.6				
SILTY CLAY: Gray, trace organics, trace sand lenses Consolidation test performed on ST sample			--	33
433.1 ▼				
SAND: Gray, fine to medium, some clay, trace gravel	-15	2 1 1		35
		WOH WOH 1		20
Switched to mud rotary. 428.1				
SILT: Gray, with gravel	-20	1 2 1	0.2 B	39

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SILT: Gray, with gravel *(continued)*				
		1 1 1	0.1 B	28
	-25	1 1 2	0.2 B	19
		1 1 2	0.2 B	32
With fine sand	-30	1 2 2	0.2 B	30
	-35	1 2 1	0.2 B	36
	-40	1 1 2	0.2 B	39

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)

Kaskaskia Engineering Group, LLC

SOIL BORING LOG

Date 5/9/11

ROUTE CH 31 DESCRIPTION CH 31 over Dickson Creek LOGGED BY KEG (AC)

SECTION (11A) BR-1 LOCATION 1 mile west of IL 97 & Dickson Mounds Road

COUNTY Fulton DRILLING METHOD CME 55 w/HSA/Mud Rotary HAMMER TYPE Automatic

STRUCT. NO. 029-0049
Station 38+35

BORING NO. B-1
Station 38+18
Offset 25.0 ft Rt
Ground Surface Elev. 446.63 ft

Surface Water Elev. 444.70 ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 433.1 ft ▼
Upon Completion ft
After Hrs. ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SILT: Gray, with gravel *(continued)*					
Some gravel		-45	1 1 17	1.0 B	31
	400.6				
Slow drilling starting at 46.0 feet. CLAYEY SHALE: Dark gray					
		-50	70 50/3" 50/2"	7.2 B	19
Some coal	392.3		43 50/4"	6.3 B	13
Boring terminated at 54.3 ft.		-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, form 137 (Rev. 8-99)

Kaskaskia Engineering Group, LLC

SOIL BORING LOG

Date 5/10/11

ROUTE CH 31 **DESCRIPTION** CH 31 over Dickson Creek **LOGGED BY** KEG (AC)

SECTION (11A) BR-1 **LOCATION** 1 mile west of IL 97 & Dickson Mounds Road

COUNTY Fulton **DRILLING METHOD** CME 55 w/HSA/Mud Rotary **HAMMER TYPE** Automatic

STRUCT. NO. 029-0049
Station 38+35

BORING NO. B-2
Station 38+52
Offset 24.0 ft Lt
Ground Surface Elev. 446.45 ft

Surface Water Elev. 444.70 ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 438.0 ft ▼
Upon Completion ft
After Hrs. ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
TOPSOIL	445.5				
SILT: Brown			WOH WOH WOH		37
			WOH WOH WOH		35
		-5			
			WOH WOH WOH		33
	438.5				
SILTY CLAY: Greenish gray, trace organics ▼				0.6 UU	30
	436.0	-10			
CLAY: Gray			0 3 3	0.5 B	34
Mottled brown			1 2 2	0.3 B	33
		-15			
Some silt			WOH WOH WOH		40
	428.5				
SAND: Brown, medium to coarse, trace gravel			4 4 2		19
	426.5	-20			

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Switched to mud rotary. SILT: Gray					
			WOH 1 1	0.1 B	39
			WOH WOH 2	0.1 B	37
		-25			
			WOH WOH 1		34
Some fine sand			WOH WOH 2	0.1 B	37
		-30			
	413.0				
SILTY SAND: Gray, fine, trace organics			3 1 2	0.2 B	33
		-35			
	409.5				
SILT: Gray, some fine sand			WOH 1 2	0.2 B	37
		-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)

Kaskaskia Engineering Group, LLC

SOIL BORING LOG

Date 5/10/11

ROUTE CH 31 **DESCRIPTION** CH 31 over Dickson Creek **LOGGED BY** KEG (AC)

SECTION (11A) BR-1 **LOCATION** 1 mile west of IL 97 & Dickson Mounds Road

COUNTY Fulton **DRILLING METHOD** CME 55 w/HSA/Mud Rotary **HAMMER TYPE** Automatic

STRUCT. NO. 029-0049
Station 38+35

BORING NO. B-2
Station 38+52
Offset 24.0 ft Lt
Ground Surface Elev. 446.45 ft

Surface Water Elev. 444.70 ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 438.0 ft ▼
Upon Completion ft
After ___ **Hrs.** ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SILT: Gray, some fine sand *(continued)*					
			WOH WOH 2	0.1 B	36
		-45			
Coarse gravel observed.					
	398.0				
CLAYEY SHALE: Gray			26 50	4.2 B	24
		-50			
Becomes light gray			10 39 50/5"	5.9 B	13
	391.5	-55			
Boring terminated at 55.0 ft.					
		-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, form 137 (Rev. 8-99)

CONSOLIDATION TEST SUMMARY

Project: CH 31 (FAS 457) over Dickson Creek　　Project Number: 2011-3114.10

Summary Data for B-1　　Depth 11-13ft

	Pressure TSF	Reading at d_{100} (in)	Rig Deflic. 94	Height (in)	Height (cm)
0	0.001	0	0.0000	0.7500	1.905
1	0.125	0.0102	0.0001	0.7399	1.879
2	0.25	0.0186	0.0013	0.7327	1.861
3	0.50	0.0297	0.0022	0.7225	1.835
4	1.0	0.0428	0.0037	0.7109	1.806
5	2.0	0.0575	0.0051	0.6976	1.772
6	4.0	0.0736	0.0064	0.6828	1.734
7	8.0	0.0909	0.0080	0.6671	1.694
8	16.0	0.1094	0.0096	0.6502	1.652
9	32.0	0.1290	0.0114	0.6324	1.606
10R	16.0	0.1267	0.0103	0.6336	1.609
11R	4.0	0.1211	0.0078	0.6367	1.617
12R	1.0	0.1159	0.0056	0.6397	1.625
13RL	0.25	0.1108	0.0033	0.6425	1.632

before test

Wet Wt. (g)	Soil & Ring (g)	Ring (g)	diam (in)	height (in)	height (cm)
115.64	192.47	76.83	2.5	0.75	1.91
			area (in2)	volume (in3)	area (cm2)
	Moisture	Dry Wt. (g)	4.909	3.682	31.7
	32.9	87.0			
			vol of solids	spec g	
	Density (pcf)		32.464	2.68	
WET	119.7		equiv height of solids (cm)		
DRY	90.0		1.025		

after test

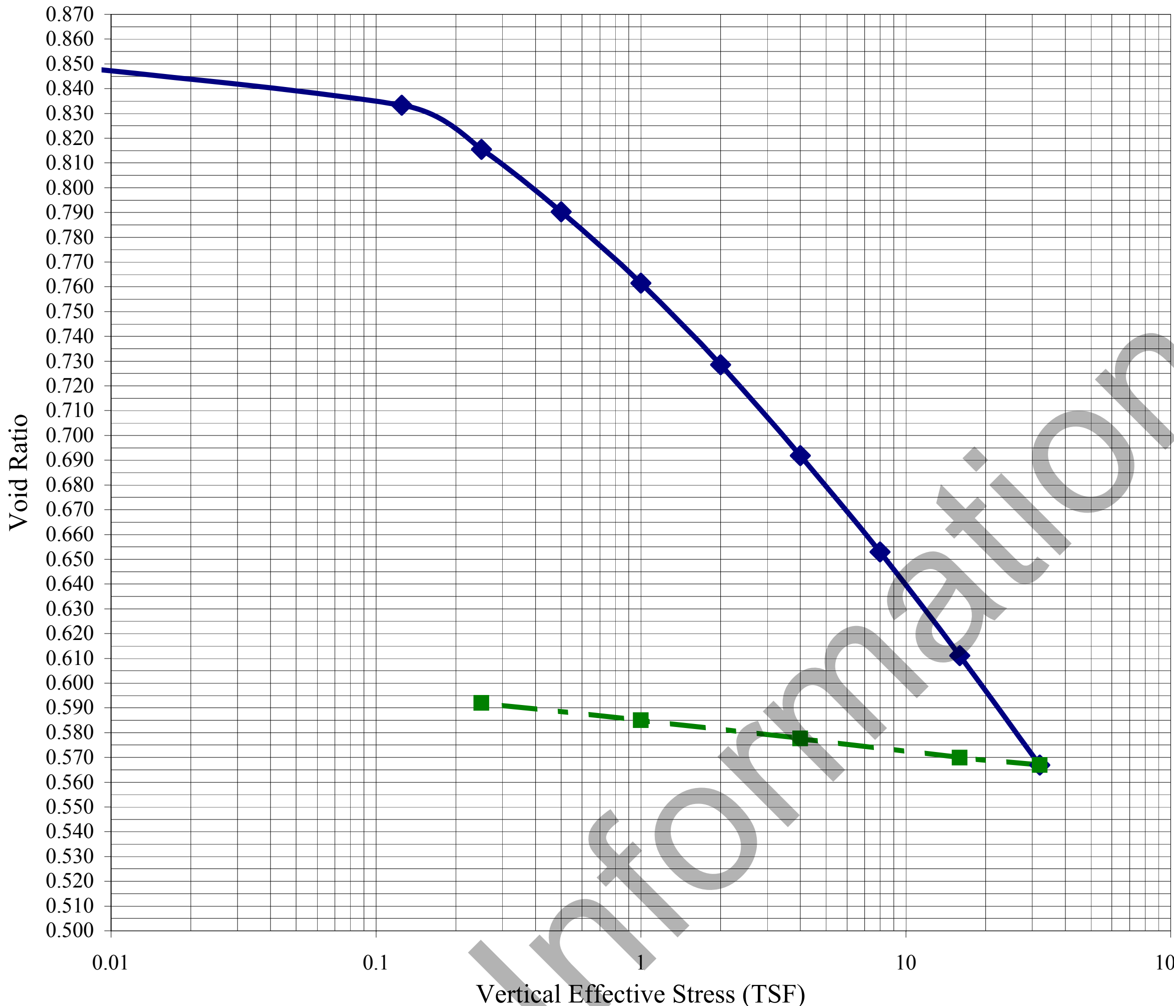
Wet Wt. (g)	Soil & Ring (g)	Ring (g)	Moisture	volume (in3)	**Wet Density (pcf)**
106.99	183.82	76.83	22.7	3.139	129.8
Dry Wt.	Dry Soil & Ring				**Dry Density (pcf)**
87.20	164.03				105.8
	last reading	0.1105			

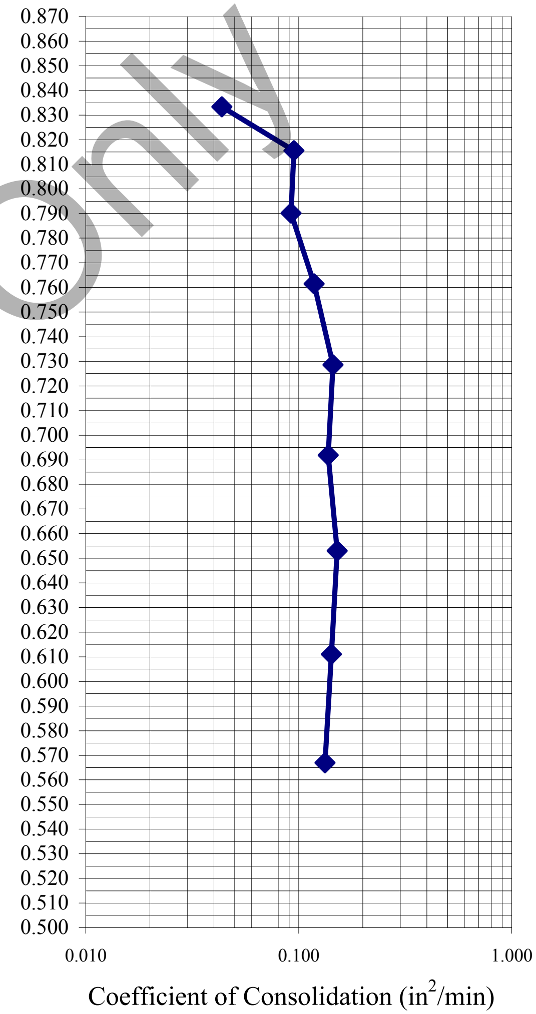
	Void Ratio	C_v (in^2/min)
0.01	0.858	
0.125	0.833	0.044
0.25	0.816	0.095
0.5	0.790	0.092
1	0.761	0.118
2	0.729	0.145
4	0.692	0.138
8	0.653	0.152
16	0.611	0.142
32	0.567	0.133
16	0.570	
4	0.578	
1	0.585	
0.25	0.592	

Moisture Content Calculation

Before		After	
tare & wet	56.37	tare & wet	270.42
tare & dry	45.89	tare & dry	250.64
tare	14.05	tare	163.44
moisture (%)	32.9	moisture (%)	22.7

Consolidation Test Summary





Project Name CH 31 (FAS 457) over Dickson Creek

Project Number 2011-3114.10

Boring No. B-1

Depth 11-13ft

Soil Description LEAN CLAY (CL): Grey, low plasic, trace roots, trace thin fine sand lenses

Initial Moisture Content (%) 32.9

Liquid Limit 37

σ_p' 0.6 tsf

Plastic Limit 23

C_c 0.142

Initial Dry Density (pcf) 90.0

Plasticity Index 14

C_r 0.016

SCI Engineering, Inc.

Unconsolidated-Undrained
Triaxial Compression Test - Q-test

Project Name: CH31 (FAS457) Over Dickman Creek

Project No.: 2011-3114.10 | Tested By:

Boring No.: B-2 | Sample No.: S-5 | Checked By:

Soil Description: LEAN CLAY (CL): Greenish gray, low plastic, some roots | Depth: 8.5-10.5-

Liquid Limit		%	Specimen Data:					
Plastic Limit		%	Height	6.000	in	Deformation	0.001	in/div
Plasticity Index		%	Diameter	2.868	in	Load Cell	461	S.N.
USCS			Hgt/Dia ratio	2.09		Load	1	lbs/div
Specific Gravity	2.68	*	Volume	635.04	cc	Strain Rate	0.02	in/min
*estimated			Wet Weight	1209.34	gm		0.33	%/min
Moisture Content Data:			Wet Density	118.9	pcf	Failure Sketch		
Wet & Tare	701.13	gm	Dry Density	91.8	pcf			
Dry & Tare	561.40	gm	Water Content	29.5	%			
Tare	87.99	gm	Saturation	96	%			
	29.5		Void Ratio	0.82				

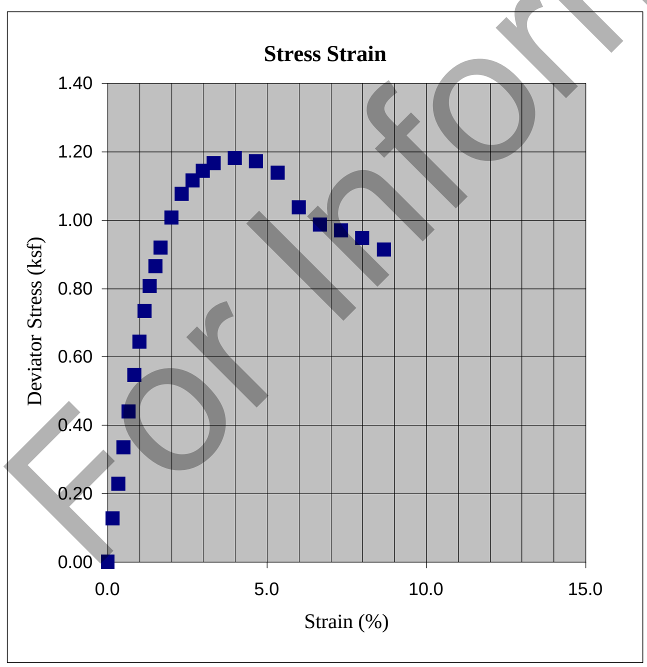
Failure Sketch

Moisture content sample taken from: portion of entire sample

Sample Condition: good

Confining Pressure (psi) 7.7

Compressive Strength (ksf)		1.18
Principal Stresses (ksf)	major	2.29
	minor	1.11
Axial Strain (%)		4.0



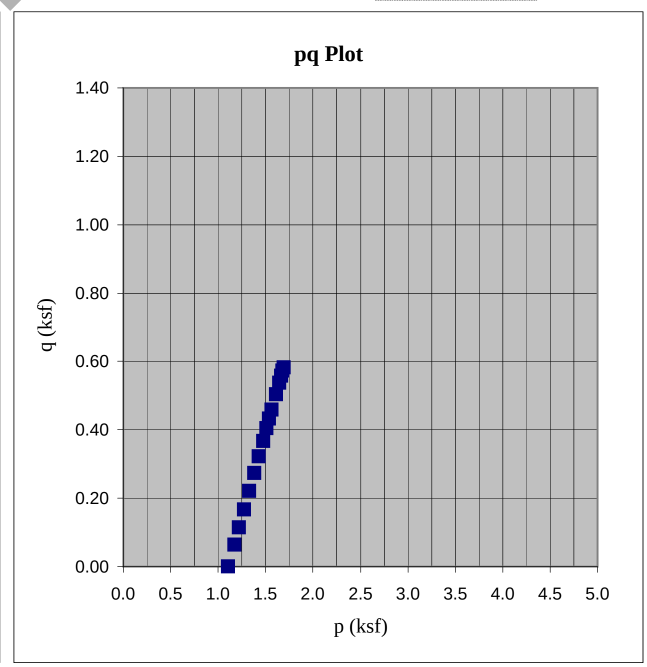
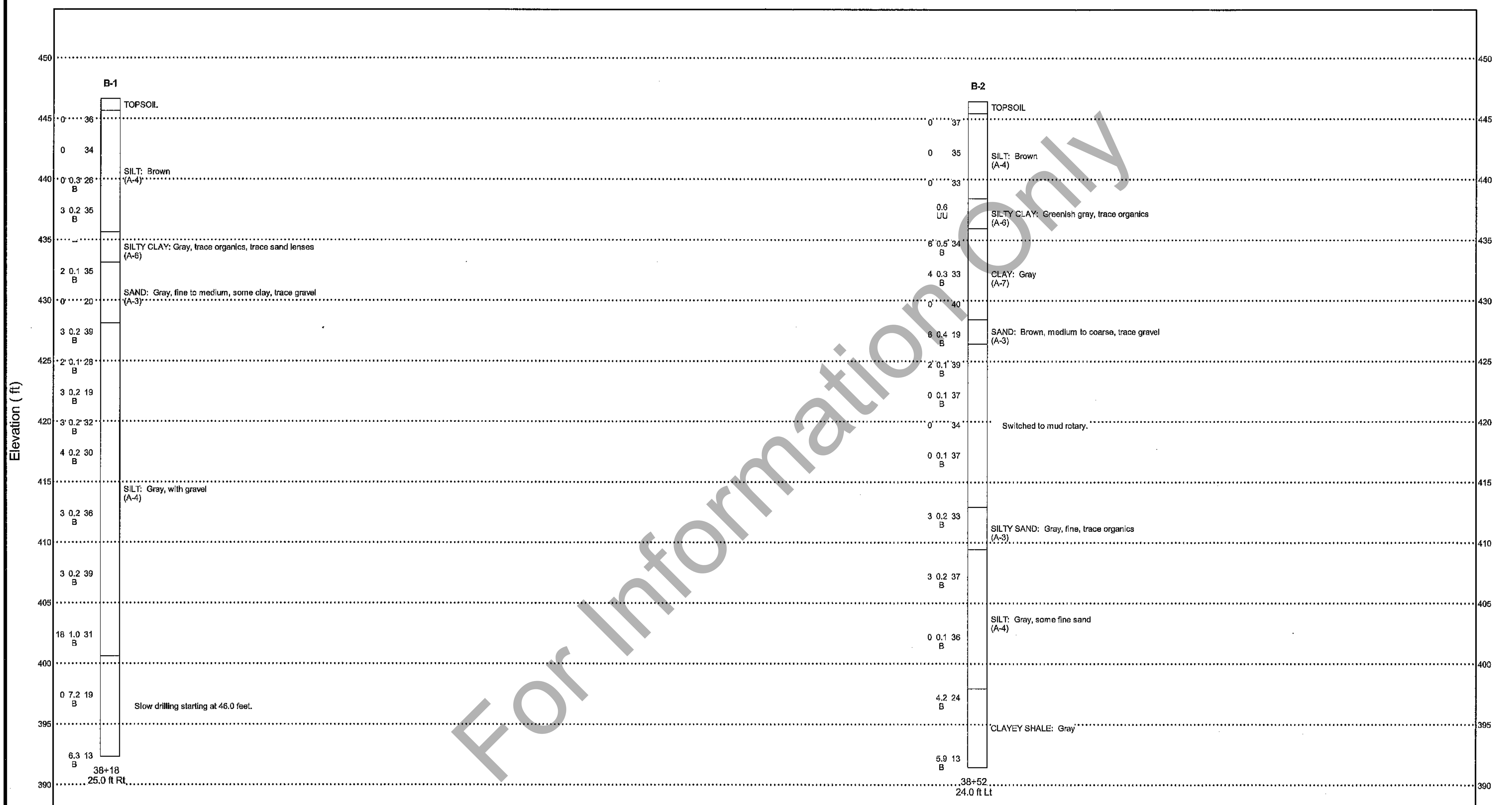


EXHIBIT D

SUBSURFACE PROFILE



Kaskaskia Engineering Group, LLC

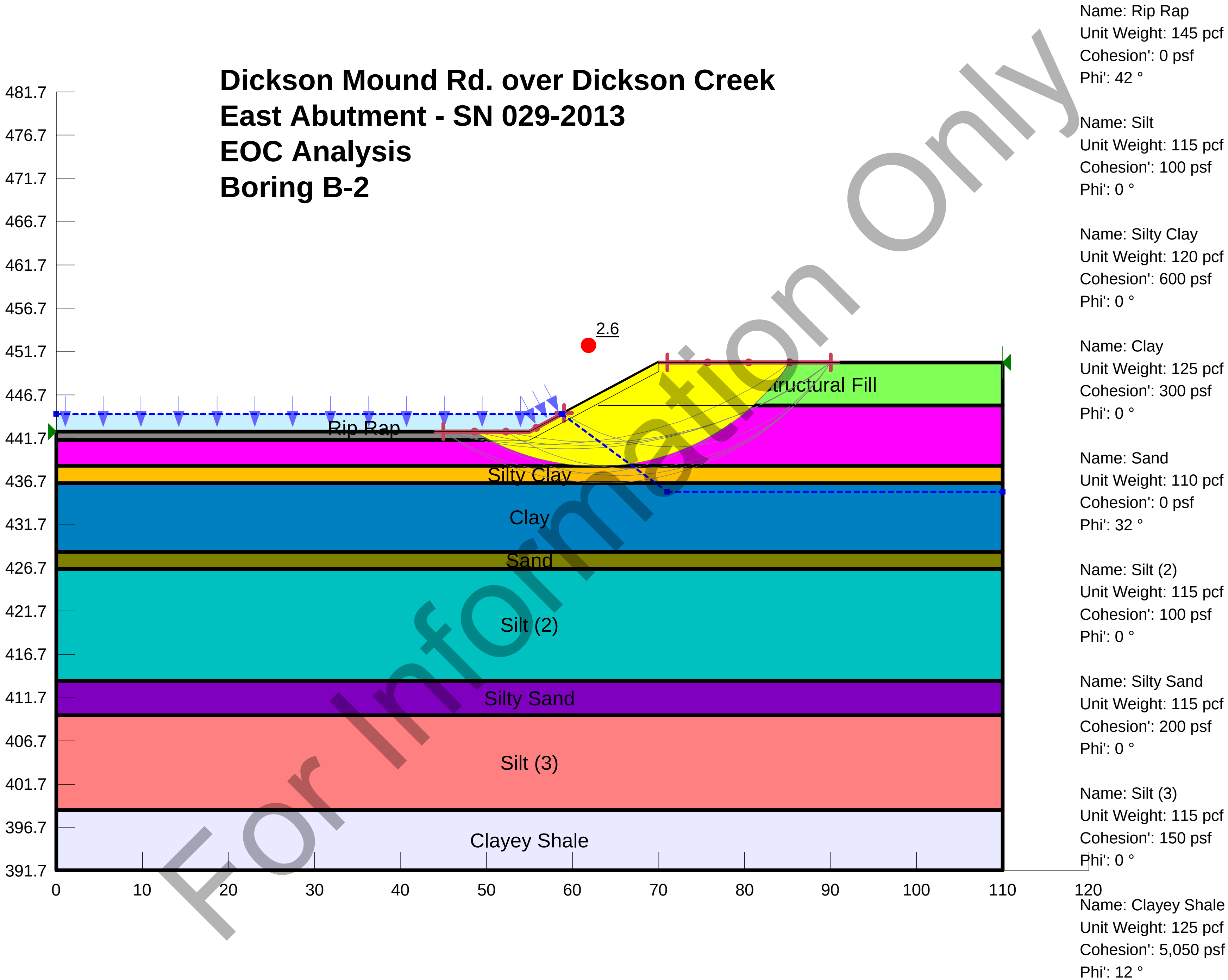
SUBSURFACE PROFILE

Route: CH 31
Section: (11A) BR-1
County: Fulton

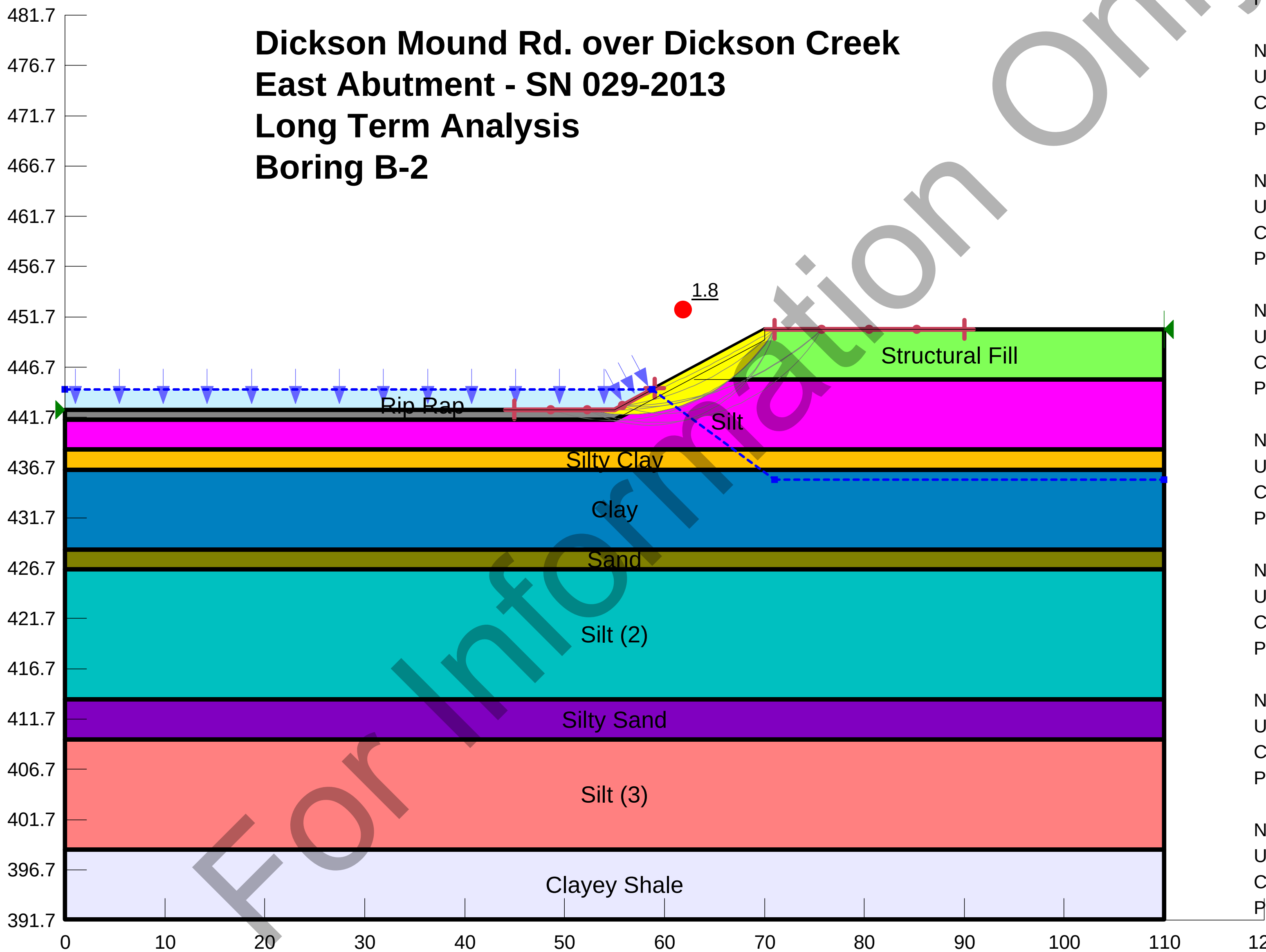
PRINTERMOD 11X17 2011-3114.10 CH31 OVER DICKSON CREEK.GPJ IL_DOT.GDT 7/8/11

EXHIBIT E

SLOPE/W SLOPE STABILITY ANALYSIS



Dickson Mound Rd. over Dickson Creek
East Abutment - SN 029-2013
EOC Analysis
Boring B-2
2.6
Rip Rap
Structural Fill
Silty Clay
Clay
Sand
Silt (2)
Silty Sand
Silt (3)
Clayey Shale
481.7
476.7
471.7
466.7
461.7
456.7
451.7
446.7
441.7
436.7
431.7
426.7
421.7
416.7
411.7
406.7
401.7
396.7
391.7
0
10
20
30
40
50
60
70
80
90
100
110
120
Name: Rip Rap
Unit Weight: 145 pcf
Cohesion': 0 psf
Phi': 42 °
Name: Silt
Unit Weight: 115 pcf
Cohesion': 100 psf
Phi': 0 °
Name: Silty Clay
Unit Weight: 120 pcf
Cohesion': 600 psf
Phi': 0 °
Name: Clay
Unit Weight: 125 pcf
Cohesion': 300 psf
Phi': 0 °
Name: Sand
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 32 °
Name: Silt (2)
Unit Weight: 115 pcf
Cohesion': 100 psf
Phi': 0 °
Name: Silty Sand
Unit Weight: 115 pcf
Cohesion': 200 psf
Phi': 0 °
Name: Silt (3)
Unit Weight: 115 pcf
Cohesion': 150 psf
Phi': 0 °
Name: Clayey Shale
Unit Weight: 125 pcf
Cohesion': 5,050 psf
Phi': 12 °



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

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

Name: Silt
Unit Weight: 115 pcf
Cohesion': 50 psf
Phi': 28 °

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

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

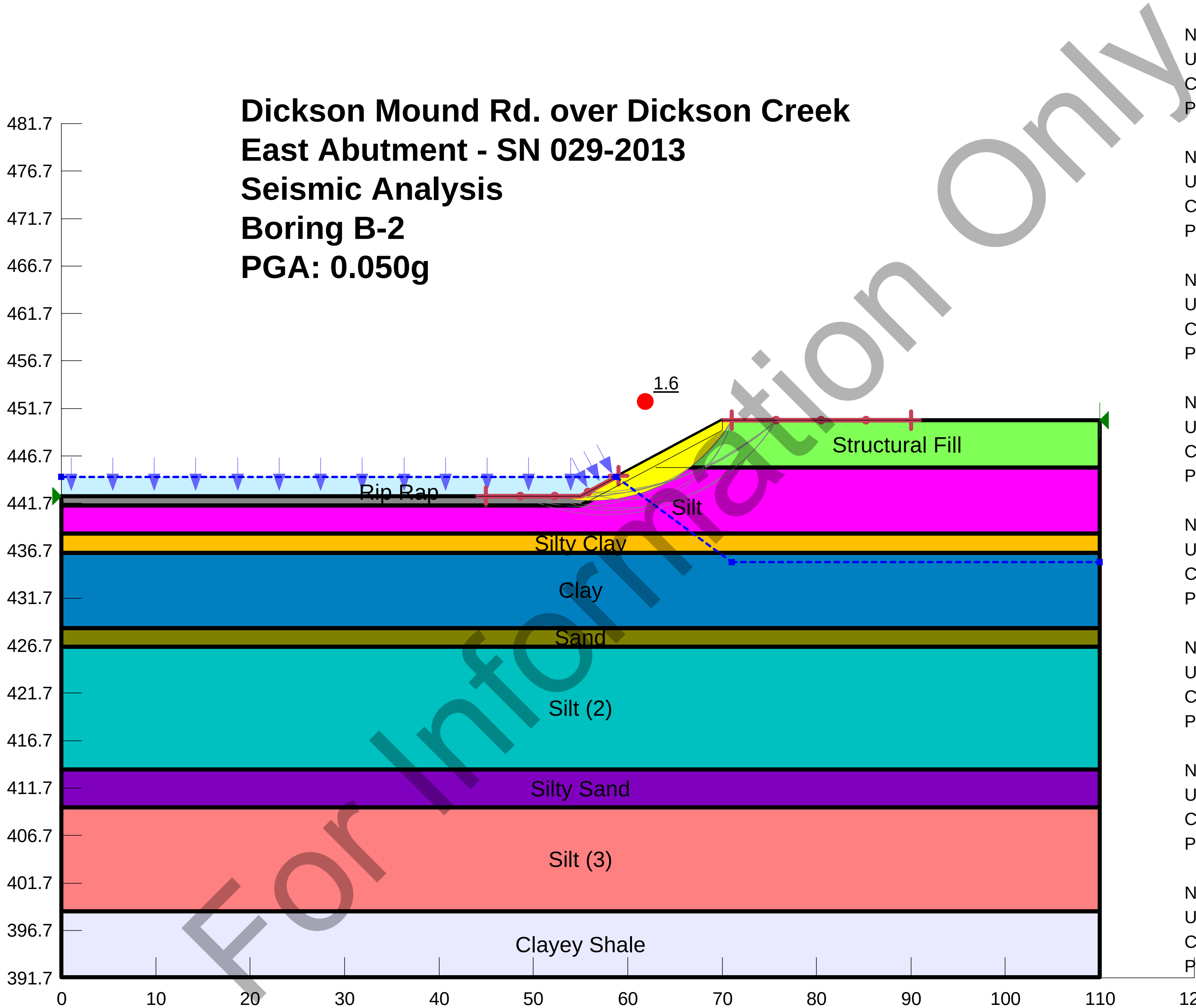
Name: Sand
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 32 °

Name: Silt (2)
Unit Weight: 115 pcf
Cohesion': 50 psf
Phi': 28 °

Name: Silty Sand
Unit Weight: 115 pcf
Cohesion': 50 psf
Phi': 28 °

Name: Silt (3)
Unit Weight: 115 pcf
Cohesion': 50 psf
Phi': 28 °

Name: Clayey Shale
Unit Weight: 125 pcf
Cohesion': 5,050 psf
Phi': 0 °



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

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

Name: Silt
Unit Weight: 115 pcf
Cohesion': 50 psf
Phi': 28 °

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

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

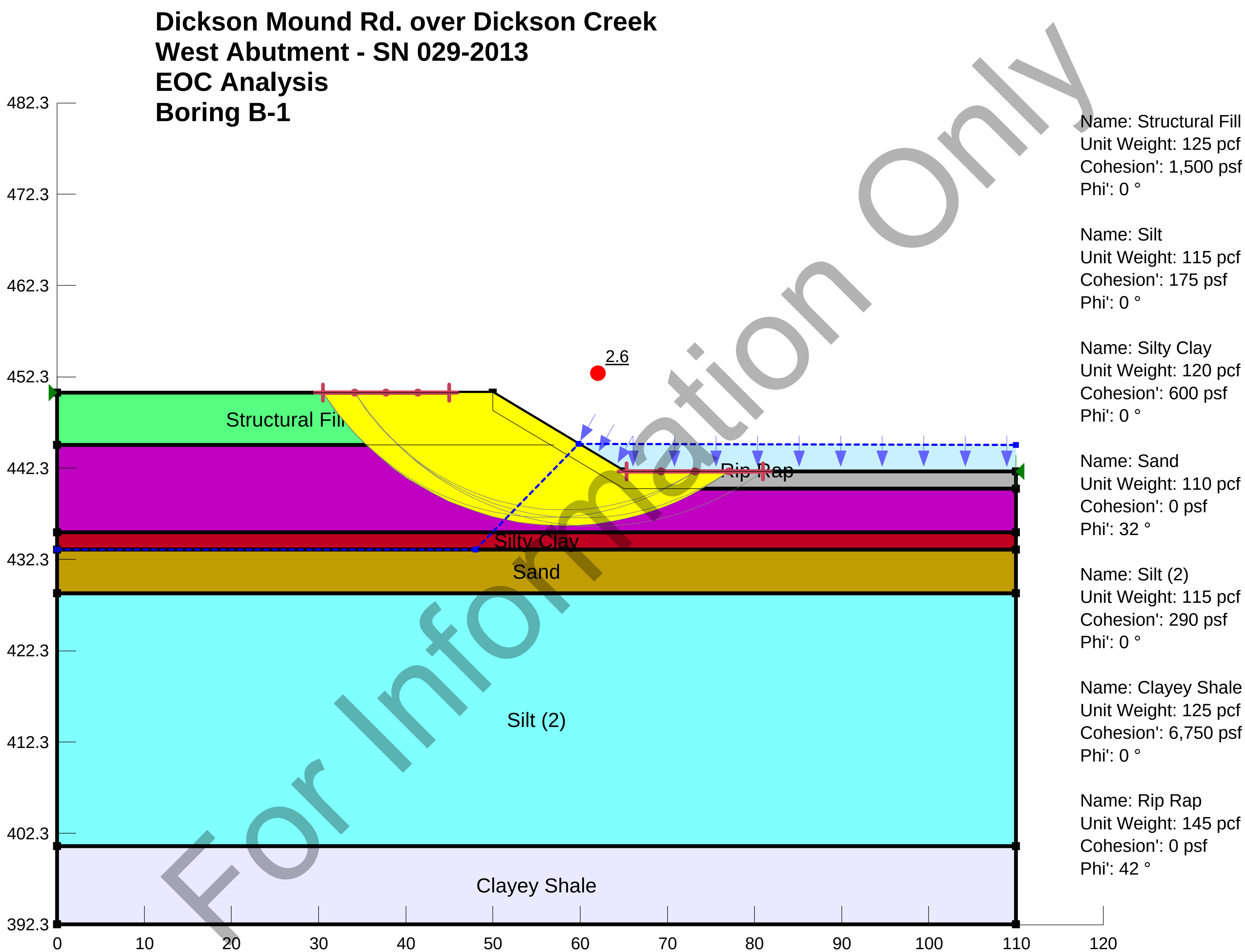
Name: Sand
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 32 °

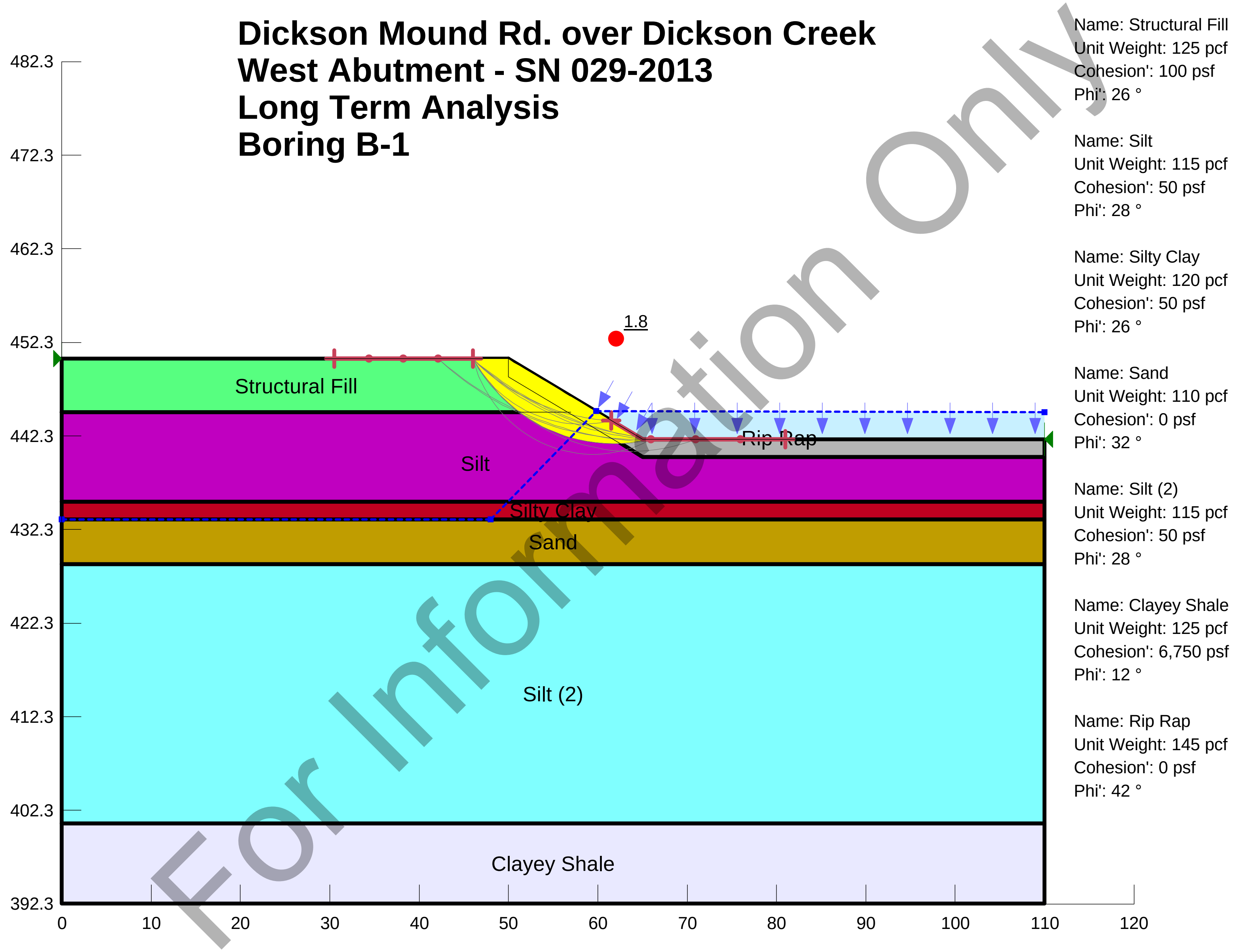
Name: Silt (2)
Unit Weight: 115 pcf
Cohesion': 50 psf
Phi': 28 °

Name: Silty Sand
Unit Weight: 115 pcf
Cohesion': 50 psf
Phi': 28 °

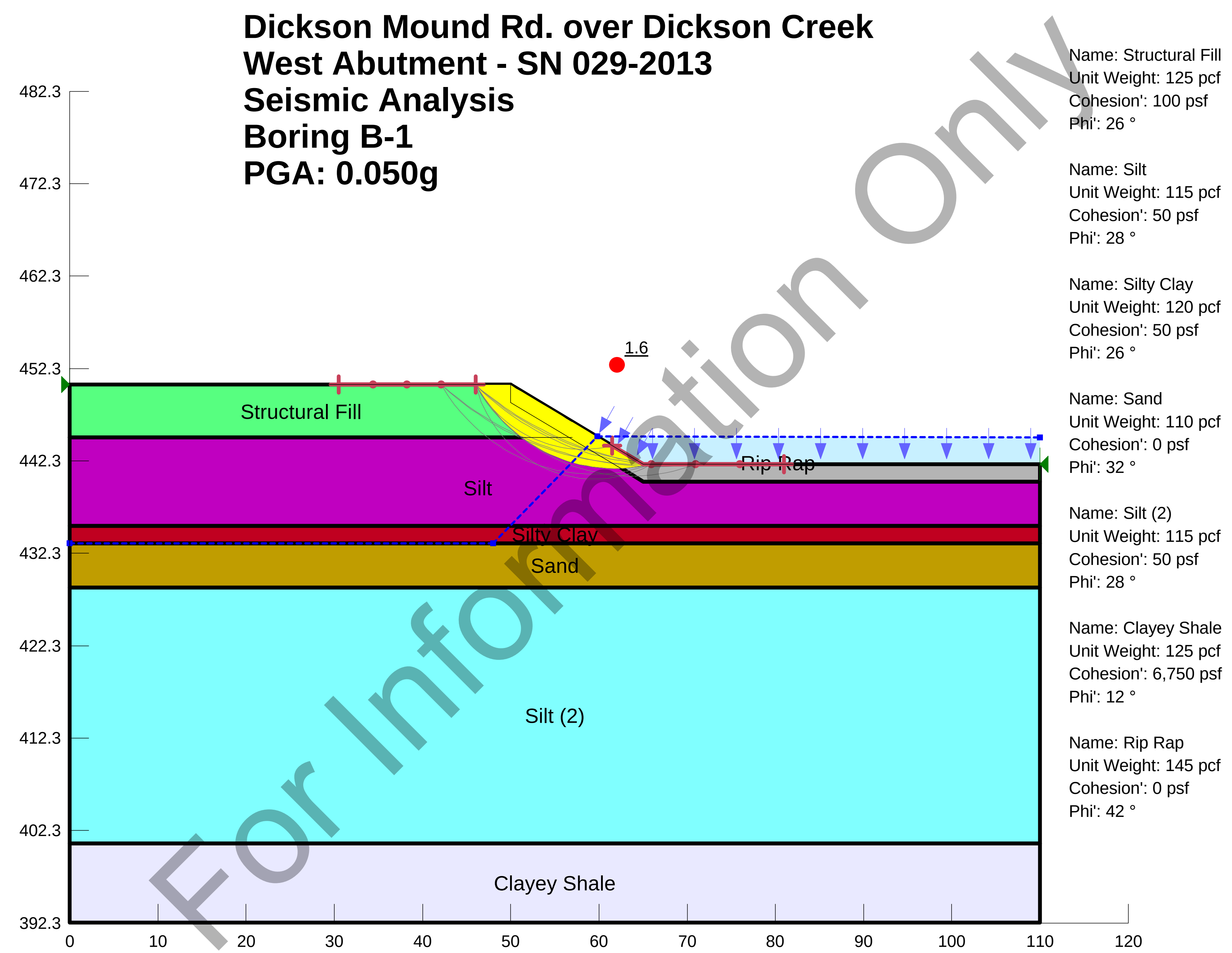
Name: Silt (3)
Unit Weight: 115 pcf
Cohesion': 50 psf
Phi': 28 °

Name: Clayey Shale
Unit Weight: 125 pcf
Cohesion': 5,050 psf
Phi': 0 °


Dickson Mound Rd. over Dickson Creek
West Abutment - SN 029-2013
EOC Analysis
Boring B-1
2.6
Structural Fill
Rip Rap
Silty Clay
Sand
Silt (2)
Clayey Shale
482.3
472.3
462.3
452.3
442.3
432.3
422.3
412.3
402.3
392.3
0
10
20
30
40
50
60
70
80
90
100
110
120
Name: Structural Fill
Unit Weight: 125 pcf
Cohesion': 1,500 psf
Phi': 0 °
Name: Silt
Unit Weight: 115 pcf
Cohesion': 175 psf
Phi': 0 °
Name: Silty Clay
Unit Weight: 120 pcf
Cohesion': 600 psf
Phi': 0 °
Name: Sand
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 32 °
Name: Silt (2)
Unit Weight: 115 pcf
Cohesion': 290 psf
Phi': 0 °
Name: Clayey Shale
Unit Weight: 125 pcf
Cohesion': 6,750 psf
Phi': 0 °
Name: Rip Rap
Unit Weight: 145 pcf
Cohesion': 0 psf
Phi': 42 °
For Information Only



Dickson Mound Rd. over Dickson Creek
West Abutment - SN 029-2013
Long Term Analysis
Boring B-1
1.8
Structural Fill
Silt
Silty Clay
Sand
Silt (2)
Clayey Shale
Rip Rap
482.3
472.3
462.3
452.3
442.3
432.3
422.3
412.3
402.3
392.3
0
10
20
30
40
50
60
70
80
90
100
110
120
Name: Structural Fill
Unit Weight: 125 pcf
Cohesion': 100 psf
Phi': 26 °
Name: Silt
Unit Weight: 115 pcf
Cohesion': 50 psf
Phi': 28 °
Name: Silty Clay
Unit Weight: 120 pcf
Cohesion': 50 psf
Phi': 26 °
Name: Sand
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 32 °
Name: Silt (2)
Unit Weight: 115 pcf
Cohesion': 50 psf
Phi': 28 °
Name: Clayey Shale
Unit Weight: 125 pcf
Cohesion': 6,750 psf
Phi': 12 °
Name: Rip Rap
Unit Weight: 145 pcf
Cohesion': 0 psf
Phi': 42 °



Dickson Mound Rd. over Dickson Creek
West Abutment - SN 029-2013
Seismic Analysis
Boring B-1
PGA: 0.050g
1.6
Structural Fill
Silt
Silty Clay
Sand
Rip Rap
Silt (2)
Clayey Shale
482.3
472.3
462.3
452.3
442.3
432.3
422.3
412.3
402.3
392.3
0
10
20
30
40
50
60
70
80
90
100
110
120
Name: Structural Fill
Unit Weight: 125 pcf
Cohesion': 100 psf
Phi': 26 °
Name: Silt
Unit Weight: 115 pcf
Cohesion': 50 psf
Phi': 28 °
Name: Silty Clay
Unit Weight: 120 pcf
Cohesion': 50 psf
Phi': 26 °
Name: Sand
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 32 °
Name: Silt (2)
Unit Weight: 115 pcf
Cohesion': 50 psf
Phi': 28 °
Name: Clayey Shale
Unit Weight: 125 pcf
Cohesion': 6,750 psf
Phi': 12 °
Name: Rip Rap
Unit Weight: 145 pcf
Cohesion': 0 psf
Phi': 42 °

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================================ West Abutment
REFERENCE BORING =========================== B-1
LRFD or ASD or SEISMIC ======================== LRFD
PILE CUTOFF ELEV. ============================ 448.79 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRI 443.79 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========= 439.90 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 Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
418 KIPS	**410** KIPS	**225** KIPS	**53** FT.

TOTAL FACTORED SUBSTRUCTURE LOAD ========= 716 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)==== 28.00 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 204.43 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 76.66 KIPS

PILE TYPE AND SIZE =========== Steel HP 12 X 53
Plugged Pile Perimeter===================== 3.967 FT. Unplugged Pile Perimeter=========== 5.800 FT.
Plugged Pile End Bearing Area============== 0.983 SQFT. Unplugged Pile End Bearing Area===== 0.108 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
441.63	2.16	0.10			0.7		4.8	1.0		***1.5***	1	0	0	0	7
439.13	2.50	0.30			2.4	4.1	5.9	3.5	0.5	***4.9***	5	0	0	2	10
435.63	3.50	0.20			2.3	2.8	13.7	3.3	0.3	***8.8***	9	0	0	4	13
433.13	2.50	0.60			4.6	8.3	***14.9***	6.7	0.9	15.1	15	0	0	8	16
430.63	2.50		2	Medium Sand	0.4	4.9	***12.8***	0.5	0.5	15.4	13	0	0	7	18
428.13	2.50		1	Medium Sand	0.2	2.4	***13.3***	0.3	0.3	15.6	13	0	0	7	21
425.63	2.50	0.20			1.6	2.8	***13.5***	2.4	0.3	17.9	14	0	0	7	23
423.13	2.50	0.10			0.8	1.4	***15.7***	1.2	0.2	19.2	16	0	0	8	26
420.63	2.50	0.20			1.6	2.8	***17.3***	2.4	0.3	21.6	17	0	0	9	28
418.13	2.50	0.20			1.6	2.8	***19.0***	2.4	0.3	24.0	19	0	0	10	31
415.63	2.50	0.20			1.6	2.8	***20.6***	2.4	0.3	26.4	21	0	0	11	33
411.63	4.00	0.20			2.6	2.8	***23.2***	3.8	0.3	30.2	23	0	0	12	37
406.63	5.00	0.20			3.3	2.8	37.5	4.8	0.3	***36.2***	36	0	0	19	42
400.63	6.00	1.00			16.9	13.8	163.1	24.7	1.5	***72.8***	73	0	0	40	48
400.13	0.50			Shale	24.7	122.5	187.8	36.1	13.4	***108.9***	109	0	0	60	48.7
399.63	0.50			Shale	24.7	122.5	212.5	36.1	13.4	***145.0***	145	0	0	79	49.2
399.13	0.50			Shale	24.7	122.5	237.2	36.1	13.4	***181.2***	181	0	0	99	49.7
398.63	0.50			Shale	24.7	122.5	261.9	36.1	13.4	***217.3***	217	0	0	119	50.2
398.13	0.50			Shale	24.7	122.5	286.6	36.1	13.4	***253.4***	253	0	0	139	50.7
397.63	0.50			Shale	24.7	122.5	311.3	36.1	13.4	***289.5***	290	0	0	159	51.2
397.13	0.50			Shale	24.7	122.5	336.1	36.1	13.4	***325.7***	326	0	0	179	51.7
396.63	0.50			Shale	24.7	122.5	***360.8***	36.1	13.4	361.8	361	0	0	198	52.2
396.13	0.50			Shale	24.7	122.5	***385.5***	36.1	13.4	397.9	385	0	0	212	52.7
395.63	0.50			Shale	24.7	122.5	***410.2***	36.1	13.4	434.0	410	0	0	225	53.2
395.13	0.50			Shale	24.7	122.5	***434.9***	36.1	13.4	470.2	~~435~~	~~0~~	~~0~~	~~239~~	~~53.7~~
394.63	0.50			Shale	24.7	122.5	***459.6***	36.1	13.4	506.3	~~460~~	~~0~~	~~0~~	~~252~~	~~54.2~~
394.13	0.50			Shale	24.7	122.5	***484.3***	36.1	13.4	542.4	~~484~~	~~0~~	~~0~~	~~266~~	~~54.7~~
393.63	0.50			Shale	24.7	122.5	***509.0***	36.1	13.4	578.5	~~509~~	~~0~~	~~0~~	~~280~~	~~55.2~~
393.13	0.50			Shale	24.7	122.5	***533.7***	36.1	13.4	614.7	~~534~~	~~0~~	~~0~~	~~293~~	~~55.7~~
392.63	0.50			Shale	24.7	122.5	***558.4***	36.1	13.4	650.8	~~558~~	~~0~~	~~0~~	~~307~~	~~56.2~~
392.30	0.33			Shale	16.3	122.5	***574.7***	23.8	13.4	674.6	~~575~~	~~0~~	~~0~~	~~316~~	~~56.5~~
391.80	0.50			Shale	24.7	122.5	***599.4***	36.1	13.4	710.8	~~599~~	~~0~~	~~0~~	~~329~~	~~57~~
391.30	0.50			Shale	24.7	122.5	***624.1***	36.1	13.4	746.9	~~624~~	~~0~~	~~0~~	~~343~~	~~57.5~~
390.80	0.50			Shale	24.7	122.5	***648.8***	36.1	13.4	783.0	~~649~~	~~0~~	~~0~~	~~356~~	~~58~~
390.30	0.50			Shale	24.7	122.5	***673.5***	36.1	13.4	819.1	~~674~~	~~0~~	~~0~~	~~370~~	~~58.5~~
389.80	0.50			Shale	24.7	122.5	***698.3***	36.1	13.4	855.3	~~698~~	~~0~~	~~0~~	~~384~~	~~59~~
388.80	1.00			Shale	49.4	122.5	***747.7***	72.3	13.4	927.5	~~748~~	~~0~~	~~0~~	~~411~~	~~60~~
387.80	1.00			Shale		122.5			13.4						

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 Abutment
REFERENCE BORING ========================== B-2
LRFD or ASD or SEISMIC ======================== LRFD
PILE CUTOFF ELEV. ============================ 448.79 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRI 443.79 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ======== 439.90 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 Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
418 KIPS	**394** KIPS	**216** KIPS	**56** FT.

TOTAL FACTORED SUBSTRUCTURE LOAD ========= 716 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)==== 28.00 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 204.57 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 76.71 KIPS

PILE TYPE AND SIZE =========== Steel HP 12 X 53
Plugged Pile Perimeter====================== 3.967 FT.   Unplugged Pile Perimeter=========== 5.800 FT.
Plugged Pile End Bearing Area=============== 0.983 SQFT.   Unplugged Pile End Bearing Area===== 0.108 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
441.30	2.49	0.10			0.8		2.2	1.2		***1.4***	1	0	0	0	7
438.50	2.80	0.10			0.9	1.4	10.0	1.4	0.2	***3.5***	3	0	0	1	10
436.00	2.50	0.60			4.6	8.3	13.2	6.7	0.9	***10.0***	10	0	0	5	13
433.50	2.50	0.50			3.9	6.9	***14.3***	5.7	0.8	15.3	14	0	0	7	15
431.00	2.50	0.30			2.4	4.1	***14.0***	3.5	0.5	18.5	14	0	0	7	18
428.50	2.50	0.10			0.8	1.4	28.1	1.2	0.2	***21.2***	21	0	0	11	20
426.00	2.50		6	Medium Sand	1.1	14.7	***15.9***	1.6	1.6	21.3	16	0	0	8	23
422.50	3.50	0.10			1.2	1.4	***17.0***	1.7	0.2	23.0	17	0	0	9	26
420.00	2.50	0.10			0.8	1.4	***17.9***	1.2	0.2	24.2	18	0	0	9	29
417.00	3.00	0.10			1.0	1.4	***18.8***	1.5	0.2	25.7	19	0	0	10	32
413.00	4.00	0.10			1.3	1.4	***21.5***	1.9	0.2	27.8	22	0	0	11	36
409.50	3.50	0.20			2.3	2.8	***22.5***	3.3	0.3	31.0	22	0	0	12	39
404.50	5.00	0.10			1.7	1.4	***24.1***	2.4	0.2	33.4	24	0	0	13	44
398.00	6.50	0.10			2.2	1.4	147.4	3.1	0.2	***49.8***	50	0	0	27	51
397.50	0.50			Shale	24.7	122.5	172.1	36.1	13.4	***85.9***	86	0	0	47	51.3
397.00	0.50			Shale	24.7	122.5	196.8	36.1	13.4	***122.0***	122	0	0	67	51.8
396.50	0.50			Shale	24.7	122.5	221.5	36.1	13.4	***158.2***	158	0	0	87	52.3
396.00	0.50			Shale	24.7	122.5	246.2	36.1	13.4	***194.3***	194	0	0	106	52.8
395.50	0.50			Shale	24.7	122.5	270.9	36.1	13.4	***230.4***	230	0	0	126	53.3
395.00	0.50			Shale	24.7	122.5	295.6	36.1	13.4	***266.5***	267	0	0	146	53.8
394.50	0.50			Shale	24.7	122.5	320.3	36.1	13.4	***302.7***	303	0	0	166	54.3
394.00	0.50			Shale	24.7	122.5	345.0	36.1	13.4	***338.8***	339	0	0	186	54.8
393.50	0.50			Shale	24.7	122.5	***369.7***	36.1	13.4	374.9	370	0	0	203	55.3
393.00	0.50			Shale	24.7	122.5	***394.4***	36.1	13.4	411.0	394	0	0	216	55.8
392.50	0.50			Shale	24.7	122.5	***419.1***	36.1	13.4	447.2	~~419~~	~~0~~	~~0~~	~~230~~	~~56.3~~
392.00	0.50			Shale	24.7	122.5	***443.9***	36.1	13.4	483.3	~~444~~	~~0~~	~~0~~	~~244~~	~~56.8~~
391.50	0.50			Shale	24.7	122.5	***468.6***	36.1	13.4	519.4	~~469~~	~~0~~	~~0~~	~~257~~	~~57.3~~
391.00	0.50			Shale	24.7	122.5	***493.3***	36.1	13.4	555.5	~~493~~	~~0~~	~~0~~	~~271~~	~~57.8~~
390.50	0.50			Shale	24.7	122.5	***518.0***	36.1	13.4	591.7	~~518~~	~~0~~	~~0~~	~~284~~	~~58.3~~
390.00	0.50			Shale	24.7	122.5	***542.7***	36.1	13.4	627.8	~~543~~	~~0~~	~~0~~	~~298~~	~~58.8~~
389.50	0.50			Shale	24.7	122.5	***567.4***	36.1	13.4	663.9	~~567~~	~~0~~	~~0~~	~~312~~	~~59.3~~
389.00	0.50			Shale	24.7	122.5	***592.1***	36.1	13.4	700.0	~~592~~	~~0~~	~~0~~	~~325~~	~~59.8~~
388.50	0.50			Shale	24.7	122.5	***616.8***	36.1	13.4	736.2	~~617~~	~~0~~	~~0~~	~~339~~	~~60.3~~
388.00	0.50			Shale	24.7	122.5	***641.5***	36.1	13.4	772.3	~~642~~	~~0~~	~~0~~	~~352~~	~~60.8~~
387.50	0.50			Shale	24.7	122.5	***666.2***	36.1	13.4	808.4	~~666~~	~~0~~	~~0~~	~~366~~	~~61.3~~
386.50	1.00			Shale	49.4	122.5	***715.6***	72.3	13.4	880.7	~~716~~	~~0~~	~~0~~	~~393~~	~~62.3~~
385.50	1.00			Shale	49.4	122.5	***765.0***	72.3	13.4	952.9	~~765~~	~~0~~	~~0~~	~~420~~	~~63.3~~
384.50	1.00			Shale		122.5			13.4						

EXHIBIT G

ISGS MINE MAP

FULTON COUNTY, ILLINOIS

ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

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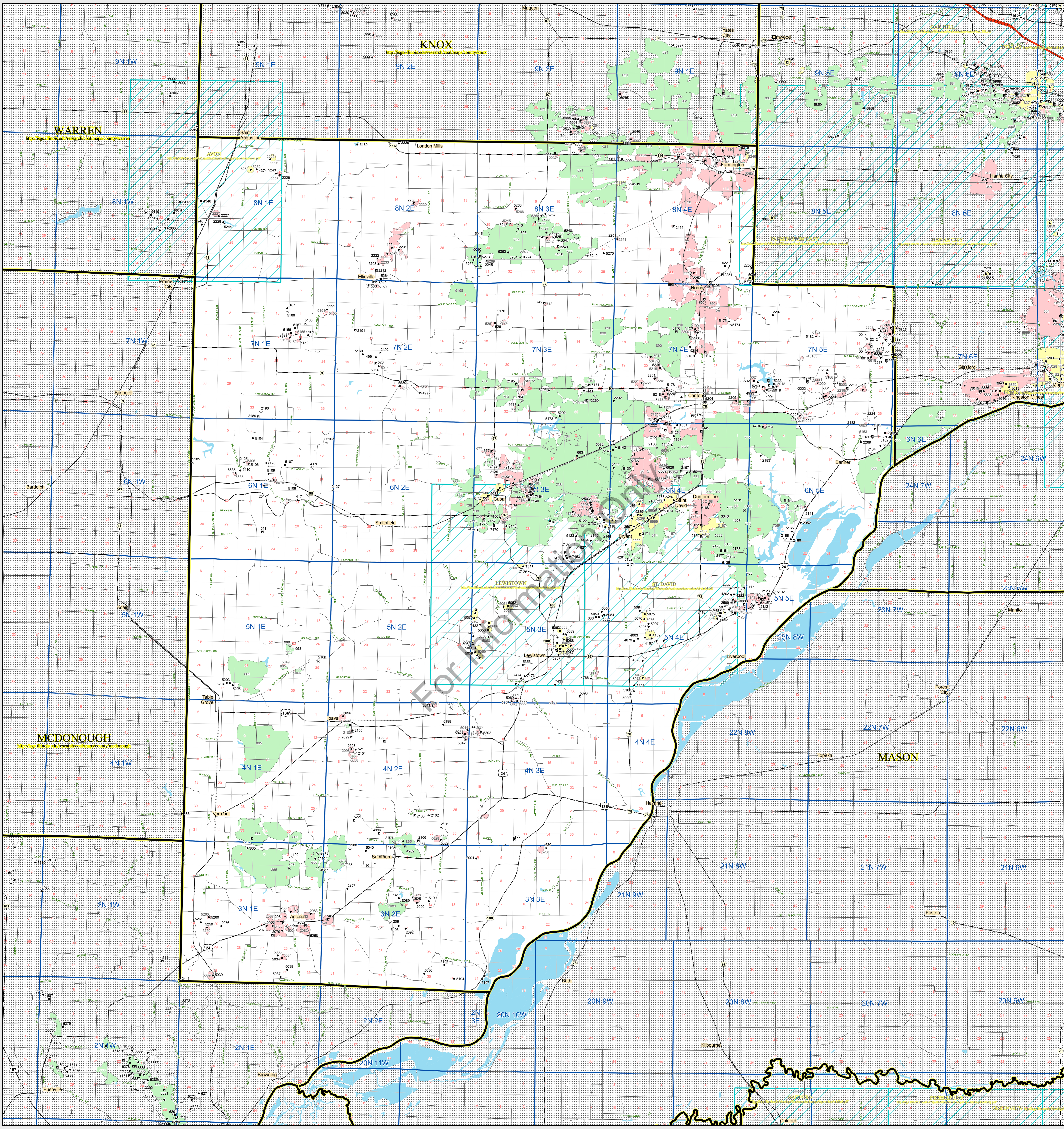
Coal Mines and Industrial Mineral Mines
FULTON
County

County Coal Map Series
ISGS Coal Section
Map construction: August 03, 2016

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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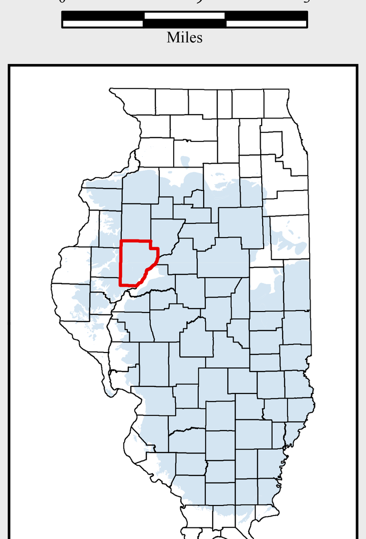

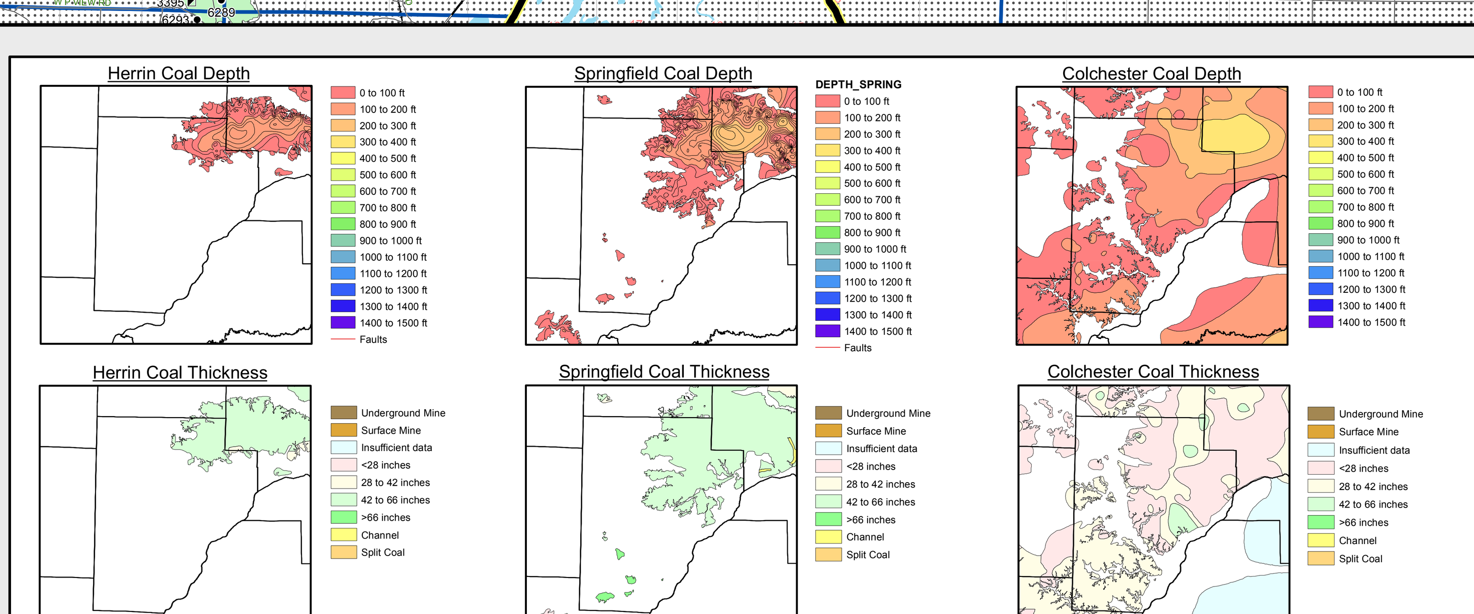

- County
- Township
- Section
- Quadrangle study (Available on Website)
- Lake or river
- Coal mine - active
- Underground coal mine - abandoned
- Surface coal mine - abandoned
- Indefinite underground coal mine boundary - abandoned
- Underground industrial mine and surrounding buffer region
- 951, 951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