STRUCTURE GEOTECHNICAL REPORT

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

S.N. 039-0061 (E)

F.A.P. ROUTE 331
SECTION (5-3) BR-2
JACKSON COUNTY, ILLINOIS
JOB NO. D-99-019-12
CONTRACT NO. 78295
PTB 148/34 WO#18
KEG NO. 08-0061.18

12/07/2016

Exp 11/30/2017

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Engineering Group, LLC

EXECUTIVE SUMMARY

IL 13 W.B. over Crab Orchard Creek Expansion
F.A.P. 331
Section (5-3) BR-2
Jackson County, Illinois
Job No. D-99-019-12
Contract No. 78295
PTB 148/34 WO #18
Existing Structure No. 039-0061

The project includes the rehabilitation and lane addition of a westbound triple-span bridge (SN 039-0061) 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 bridge widening. Upon completion, traffic will be maintained through crossovers.

The results of the slope stability analysis indicates that an acceptable FOS will exist at the east and west abutments during the end-of-construction and long-term conditions. In order to achieve an acceptable FOS for the seismic condition, several models required the inclusion of the abutment and/or pier piles with a maximum spacing of 8 ft.

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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 lane addition of the triple-span structure carrying westbound IL 13 over Crab Orchard Creek 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 039-0061) 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. When complete, traffic will 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 247 ft. – 4.75 in. with an out-to-out width of 43 ft. – 2 in, on a 30 degree left ahead skew. 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 W.B.) over Crab Orchard Creek 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 30 degree skew. All spans will measure 81 ft. – 6 in. The structure will have a width of 55 ft. - 2 in. out-to-out deck. The structure will be located at approximate station 188+00 (IL 13).

The structure will measure 247 ft. – 4.75 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 15 and July 16, 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	186+50	16 ft. LT	390.1
2-S	189+69	15 ft. LT	390.0

2.1 Subsurface Conditions

Boring 1-S consisted of approximately 2.5 ft. of asphalt over crushed aggregate from the ground surface to El. 387.6. A layer of stiff clay followed to El. 385.6. This clay had a driving resistance (N-value) of 3 blows per foot (bpf), an unconfined compressive strength (Qu) value of 1.2 tons per square foot (tsf) and a moisture content of 28 percent. A very stiff layer of clay to silty clay followed to El. 383.1. The N-value was 5 bpf, with a Qu value of 3.5 tsf, and a moisture content of 19 percent. Stiff silty clays followed to El. 380.6. The N-value was 6 bpf, the Qu value was 1.7 tsf, and the moisture content was 20 percent. A very stiff silty clay followed to El. 370.6. The N-value for this layer ranged from 5 to 7 bpf, with an average of 6 bpf. The Qu values varied from 2.1 to 2.7 tsf, with an average of 2.5 tsf. The moisture content ranged from 19 to 23 percent, with an average of 21 percent. Soft silty clay loam followed to El. 368.1. The N-value was 1 bpf, with a Qu value of 0.3 tsf, and a moisture content of 29 percent. A very soft silt loam to silty clay loam followed to El 363.1. This layer had a total N-value of 0 bpf, Qu values from 0.1 to 0.2 tsf, and moisture contents from 29 to 30 percent. Following was a soft silty clay to silty clay loam to El. 360.6. The N-value was 0 bpf, the Qu was 0.4 tsf, and the moisture content was 28 percent. A soft to medium silty clay to silty clay loam followed to El. 355.6. The N-value for this layer was 0 bpf, with Qu values of 0.5 tsf, and moisture contents of 27 and 28 percent. Medium to stiff clay followed to El. 350.6 with N-values of 2 and 6 bpf, Qu values from 0.7 to 1.8 tsf, and moisture contents of 29 and 30 percent. Very stiff to stiff clay followed to El 340.1. N-values were 7 bpf, with Qu values of 1.6 and 2.1 tsf, and moisture contents were 26 and 27 percent. Layers of loose sand, stiff clay, and soft sand loam to sandy clay loam followed to El. 330.6. N-values were 2 bpf, with a moisture content of 23 percent. A medium dense sand with some pea gravel followed to El 325.1. The N-value was 26 bpf, with a moisture content of 21 percent. Soft to medium sandy clay loam with sand and clay layers followed to El. 323.1. This had an N-value of 8 bpf, a Qu of 0.5 tsf, and moisture content of 18 percent. A hard clay shale followed until the termination of the boring at El. 320.6, with an N-value of 100 blows for 6 inches.

Boring 2-S consisted of approximately 3 ft. of asphalt over crushed aggregate from the ground surface to approximate El. 387.0. A very stiff to stiff clay followed to El. 383.0, with N-values of 5 bpf, Qu values of 1.7 and 2.3 tsf, and moisture contents of 17 and 21 percent. A very stiff clay to silty clay followed to El. 373.0, with N-values ranging from 3 to 7 bpf, averaging to be 6 bpf. The Qu values ranged from 2.1 to 2.9 tsf, averaging to be 2.5 tsf. The moisture contents varied from 17 to 21 percent, with an average of 19 percent. A very stiff silt loam to silty clay loam followed to El. 370.5, with an N-value of 10 bpf, a Qu value was 3.3 tsf, and a moisture content of 20 percent. Following was a medium to soft silt loam to silty clay loam to El. 363.0. The N-values varied from 0 to 2 bpf, averaging to be 1 bpf. Qu values ranged from 0.3 to 0.6 tsf, with an average

of 0.4 tsf. The moisture contents ranged from 27 to 30 percent, averaging to be 29 percent. A very soft to medium silty clay loam followed to El. 355.5. N-values ranged from 0 to 1 bpf. Qu values ranged from 0.2 to 0.5 tsf, with an average of 0.3 tsf. Moisture content varied from 31 to 32 percent. A medium silty clay loam with sand and clay layers to a clay with sand seams followed to El. 350.5. N-values were 0 and 1 bpf, with Qu values of 0.6 and 0.7 tsf, and a moisture content of 35 percent. Very stiff clay followed to El. 341.5. N-values ranged from 6 to 7 bpf. Qu values ranged from 2.3 to 2.9 tsf. Moisture content varied from 25 to 36 percent. Very loose sand with clay layers followed to El. 335.5. The N-value was 0 bpf, with a moisture content of 26 percent. Medium silty clay followed to El. 330.5. The N-value was 5 bpf, with a Qu of 0.8 tsf, and a moisture content of 21 percent. Following that to El. 322.5 was stiff clay loam to sandy clay loam with sand layers. The N-values were 5 and 8 bpf. The Qu was 1.1 tsf and the moisture content was 17 percent. Hard clay shale, sometimes with coal, followed to the bottom of the hole at El. 310.0. N-values were 100 blows over 6 inches, 100 blows over 2 inches, and 100 blows over 3 inches.

2.2 Groundwater

Groundwater was encountered during drilling in Boring 1-S and 2-S at El. 363.1. The surface water elevation of Crab Orchard Creek was recorded at El. 362.1 at the time of drilling. 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 current endslopes appear to be performing satisfactorily with no visual signs of stability issues.

The proposed endslopes for the widened portion of the east and west abutment locations were modeled at a 1V :2H inclination for the top portion of the embankment endslopes. The bottom slope geometrics into the creek were modeled as variable slopes. 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 of 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 Pile Reinforcement
East Abutment (Full Slope)	1V:2H to Varies	2.7	2.5	0.8	1.0
East Abutment (Top Slope)	1V:2H	3.1	1.8	1.0	n/a
East Abutment (Bottom Slope)	Varies	2.0	1.7	0.7	1.0
West Abutment (Full Slope)	1V:2H to Varies	2.9	2.4	0.8	1.1
West Abutment (Top Slope)	1V:2H	3.3	2.4	1.1	n/a
West Abutment (Bottom Slope)	Varies	2.3	1.7	0.7	1.0

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 for the seismic condition, several models required the inclusion of the abutment and/or pier piles with a maximum spacing of 8 ft.

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}	0.845g (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 2.3.10-4 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. Class A5 stone riprap will be placed on the surface of the slopes located at the piers. In addition, KEG recommends extending the A5 riprap protection across the entire channel between the piers to reduce the potential for future scour of both the pier caps and the streambed. 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}	381.98	346.80	349.80	381.81	7
Q_{200}	381.98	345.80	348.80	381.81	
Design	381.98	352.96	355.96	381.81	

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. There are several areas of mining south of the project site, with the nearest underground mine proximity region located approximately 0.7 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 (0.345g 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 (7.7 for NMSZ and n/a for CEUS) was determined using the USGS data and deaggregation methods provided at http://earthquake.usgs.gov/. The soil profile for Boring 1-S and 2-S was 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 at 27 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 identified potential layers of soils that might be susceptible to liquefaction at depths of 60.0 ft. or more below the ground surface. Typically, soils that are 30 ft. or more below the ground surface are not considered susceptible to liquefaction. 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, H-piles 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 abutments will each experience a Total Factored Load of 1904 kips, and the widened portion of the existing piers will experience a Total Factored Load of 3553 kips. The estimated pile lengths for the recommended pile type are shown in Table 4.2, 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 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)	316	589	196	68	384
East Abutment (2-S)	315.8	589	196	68	383.8
Pier 1 (1-S)	315	589	196	69	384
Pier 2 (2-S)	314.8	589	196	69	383.8

KEG recommends a test pile be performed at one of the abutment locations. 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 the 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'	Φ (degrees)	c'	Φ (degrees)				
East Abutment (2-S)	370.5	120	2500	0	100	26	1000	6	70	0.005
	350.5	120	425	0	50	26	30	1	70	0.020
	341.5	125	2600	0	100	26	1000	7	80	0.005
	335.5	110	0	30	0	30	20	WR	3	N/A
	322.5	115	1000	0	50	28	100	6	70	0.007
West Abutment (1-S)	370.6	120	2500	0	100	26	1000	6	70	0.005
	353.1	120	400	0	50	26	30	0	70	0.020
	340.1	125	1800	0	100	26	500	7	80	0.007
	330.6	115	0	28	0	28	20	2	3	N/A
	323.1	110	0	30	0	30	60	17	3	N/A
Pier 1 (1-S)	340.1	125	1800	0	100	26	500	7	80	0.007
	330.6	115	0	28	0	28	20	2	3	N/A
	323.1	110	0	30	0	30	60	17	3	N/A
Pier 2 (2-S)	350.5	120	525	0	50	26	100	1	70	0.010
	341.5	125	2600	0	100	26	1000	7	80	0.005
	335.5	110	0	30	0	30	20	WR	3	N/A
	322.5	115	1000	0	50	28	100	6	70	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 20 ft. is 2.3 tsf at the west abutment and 2.5 tsf 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 21 ft. However, if

the retained height exceeds 21 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; however, the presence of sand seams are indicated on the borings logs interbedded in these cohesive soils and the use of a seal coat is recommended. A seal coat will reduce the potential for water from seeping beneath the cofferdams. As per 2012 IDOT Bridge Manual, if a seal coat is specified, General Note 26 shall be added to the plans.

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

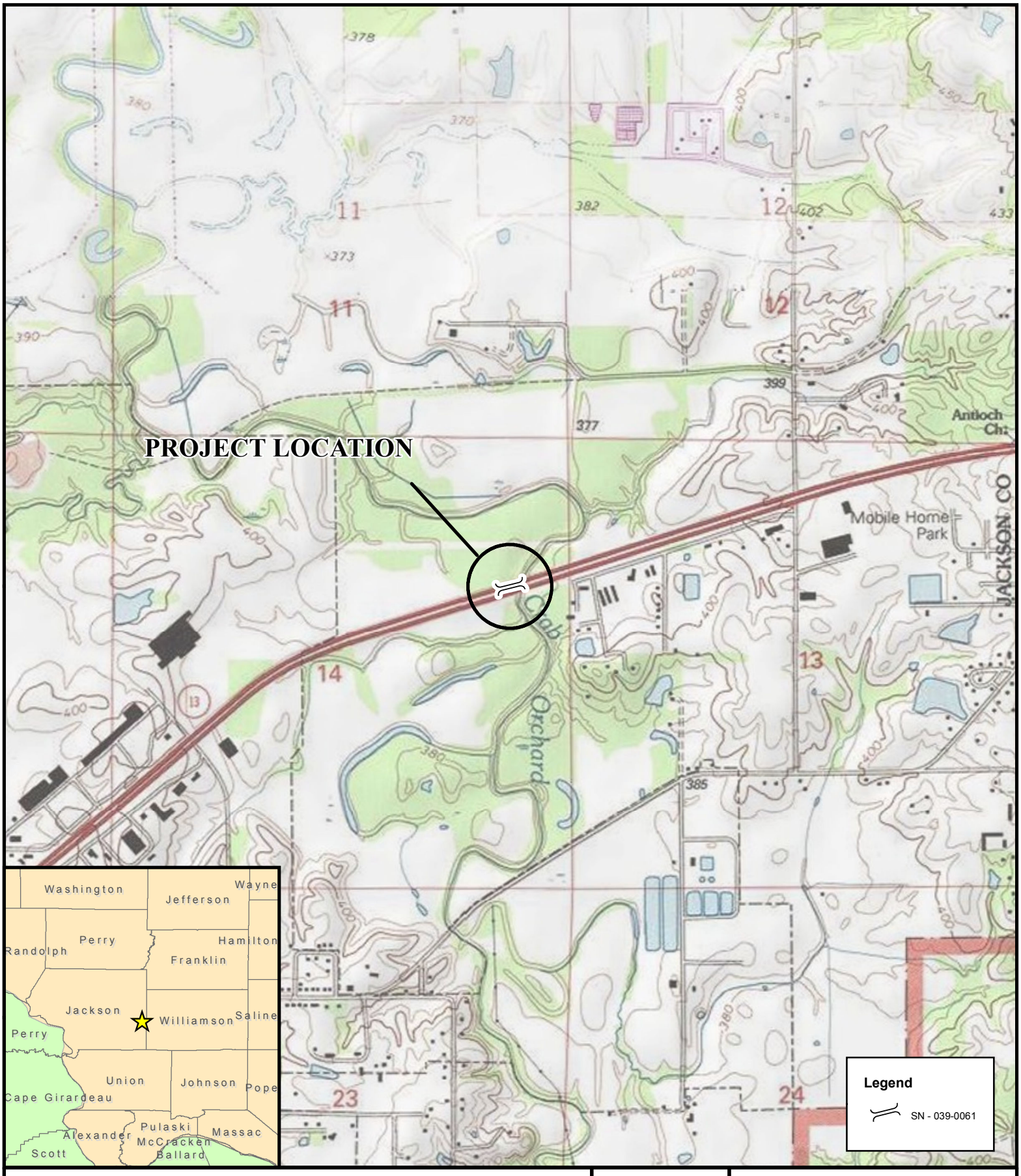


Exhibit A
Location Map
F.A.P. Route 331 (IL 13)
over Crab Orchard Creek
Jackson County, Illinois

N

Feet
0 500 1,000

Designed By: MMJ
Drawn By: MMJ
Checked By: CRG
Date: 10/28/15
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 039-0061 of Illinois Route 13 WBL @ Sta. 86+65±. Elev. 390.262

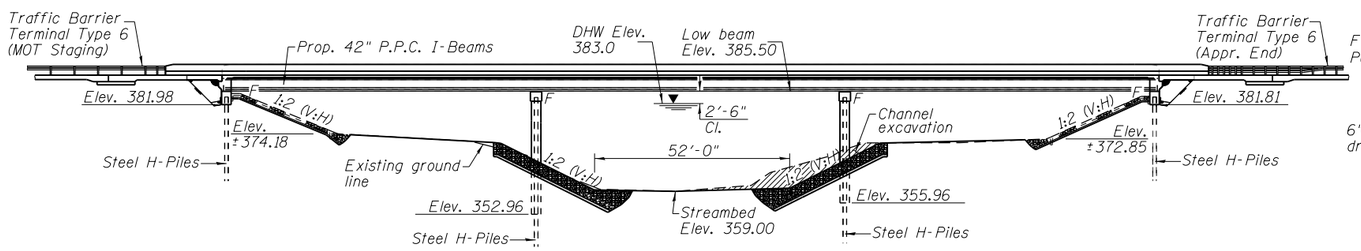
Existing Structure: S.N. 039-0061, built in 1995 is a three span P.P.C. I-Beam Bridge. Substructure consists of intergral abutments supported on steel piles and solid wall pile bent piers. Bk. to Bk. abutments measures 247'-4 3/4" and out-to-out width of 43'-2".

Salvage: Existing bridge to remain and shall be widened.

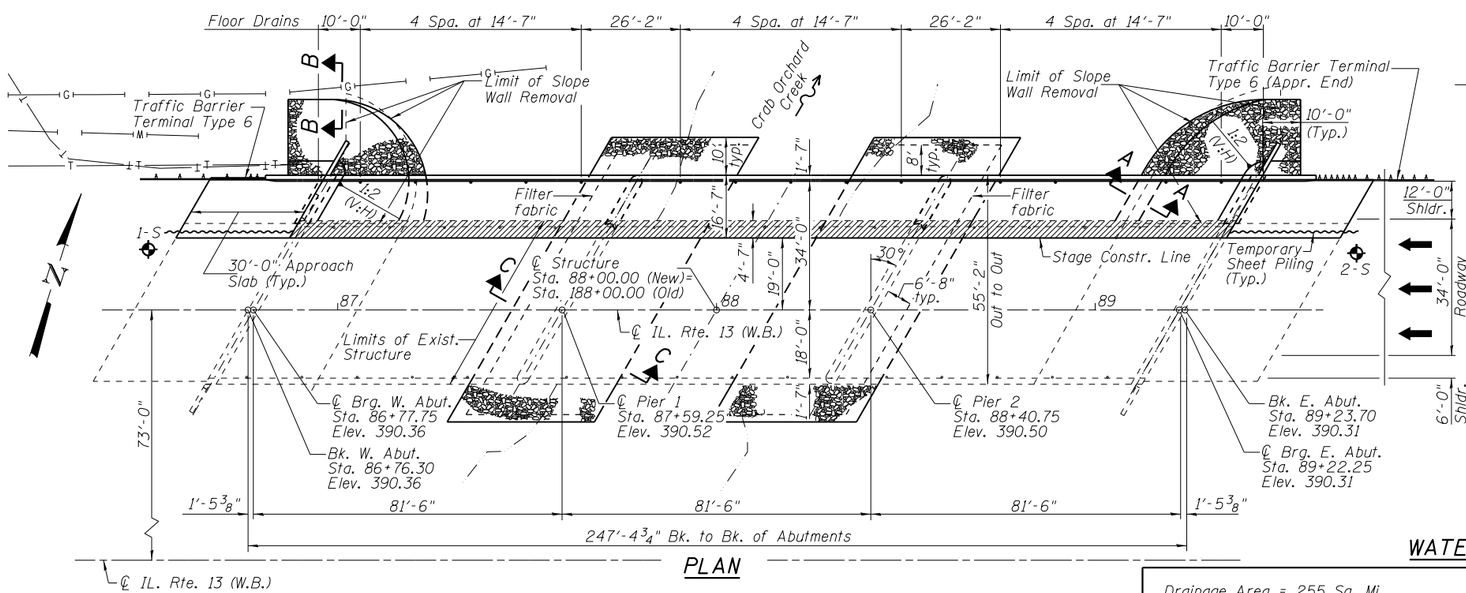
Traffic Maintenance: Maintain traffic 2 - 11'-0" lanes during widening. Once complete, traffic to be maintained through crossovers.

DESIGN SCOUR ELEVATION TABLE

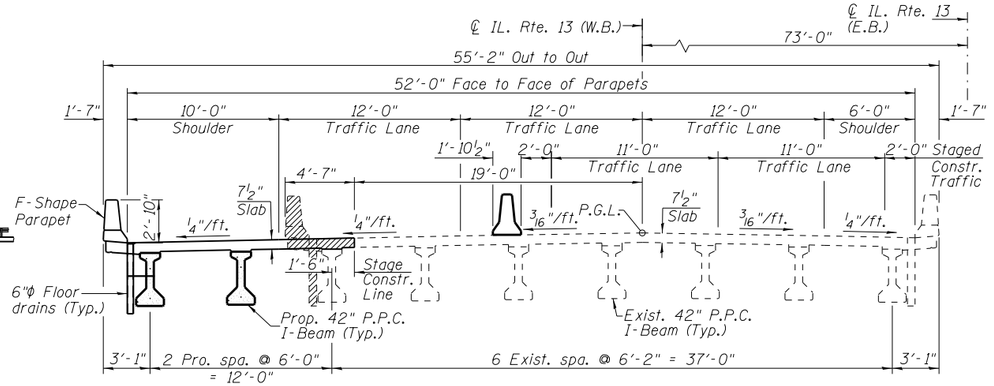
Event / Limit State	Design Scour Elevations (ft.)				Item 113
	W. Abut.	Pier 1	Pier 2	E. Abut.	
Q100	381.98	352.96	355.96	381.81	8
Q200	381.98	352.96	355.96	381.81	
Design	381.98	352.96	355.96	381.81	
Check	381.98	352.96	355.96	381.81	



ELEVATION

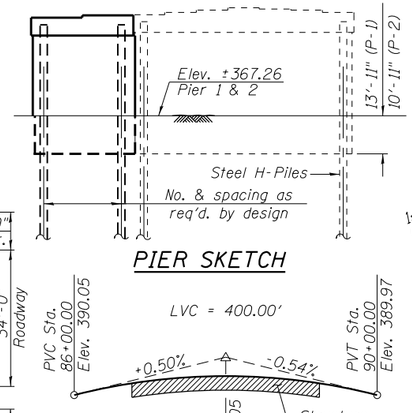


PLAN



CROSS SECTION

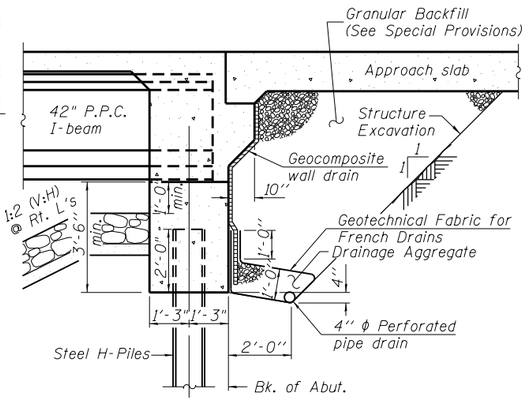
(Looking East)



PIER SKETCH

PROFILE GRADE

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



SECTION THRU INTEGRAL ABUTMENT

(Horiz. dim. @ Rt. L's)
(Match Existing Abutment)

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

LOADING HS 20-44

Allow 25 psf for future wearing surface

DESIGN SPECIFICATIONS

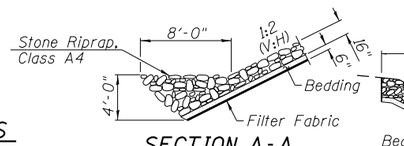
2002 AASHTO Standard Specifications for Highway Construction

SEISMIC DATA

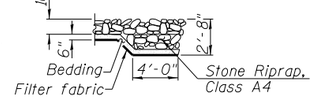
Seismic Performance Zone (SPZ) = 3
Design Spectral Acceleration at 1.0 sec (SD1) = 0.360g
Design Spectral Acceleration at 0.2 sec (SDS) = 0.845g
Soil Site Class = D

DESIGN STRESSES

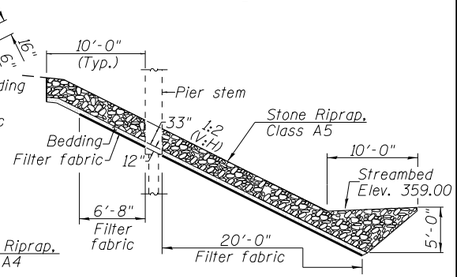
FIELD UNITS	PRECAST PRESTRESSED UNITS
f'c = 3,500 psi (concrete)	f'c = 6,000 psi (concrete)
f'c = 4,000 psi (Superstr. concrete)	f'ci = 5,000 psi
fy = 60,000 psi (Reinforcement)	fpu = 270,000 psi (1/2"ϕ low lax strands)
fy = 50,000 psi (M270 Grade 50)	fpbt = 201,960 psi (1/2"ϕ low lax strands)



SECTION A-A



SECTION B-B

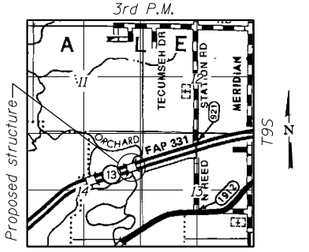


SECTION C-C

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.
		039-0061/79	6,158	6,628	2,342	2,367					
	10	O'flow Culvert	186	137	67	67	381.2	0.2	0.1	381.4	381.3
		039-0062/78	2,056	1,635	779	772					
		Total	8,400		3,188	3,206					
		039-0061/79	8,788	9,417	2,682	2,715					
Design	50	O'flow Culvert	269	235	85	85	383.0	0.3	0.2	383.3	383.2
		039-0062/78	3,343	2,748	995	987					
		Total	12,400		3,762	3,787					
		039-0061/79	9,878	10,577	2,857	2,894					
Base	100	O'flow Culvert	326	269	94	94	383.9	0.3	0.3	384.2	384.2
		039-0062/78	3,896	3,254	1,109	1,099					
		Total	14,100		4,060	4,087					
		039-0061/79	11,055	11,616	2,995	3,036					
Scour Design Check	200	O'flow Culvert	379	332	101	101	384.6	0.4	0.3	385.0	384.9
		039-0062/78	4,576	4,062	1,200	1,189					
		Total	16,010		4,296	4,326					
		039-0061/79	12,694	12,917	3,116	3,158					
Max. Calc.	500	O'flow Culvert	417	393	107	107	385.2	0.5	0.4	385.7	385.6
		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
SECTION (5-3) BR-2
JACKSON COUNTY
STATION 88+00.00
STRUCTURE NO. 039-0061

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

CMT

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

GENERAL PLAN
STRUCTURE NO. 039-0061
SHEET NO. OF SHEETS

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

L:\IDOT\080610\WD.18\Draw\Sheets\...

EXHIBIT C

BORING LOGS

ILLINOIS DEPARTMENT OF TRANSPORTATION
District Nine Materials

Bridge Foundation Boring Log

Westbound FAP 331 (IL 13) Over Crab Orchard Creek

Sheet 1 of 2

Route: FAP 331 (IL 13) Structure Number: 039-0061 Date: 7/16/2014

Section 5-3B-2 Bored By: R Moberly

County: Jackson Location: 0.6 mi West of Reed Station Road Checked By: R Graeff

Boring No 1-S
Station 186+50
Offset 16' Lt CL WBL
Ground Surface 390.1 Ft

Surf Wat Elev: 362.1
Ground Water Elevation
when Drilling 363.1
At Completion
At: Hrs:

DEPTH	BLOWS	Qu tsf	W%	Description
				Asphalt over crushed aggregate
387.6	2			
	2	1.2B	28	Stiff, moist, grey, Clay A7-6
	1			
385.6				
5.0	1			Very stiff, moist, grey and brown,
	2	3.5S	19	Clay to Silty Clay A7-6
	3			
383.1				
	1			Stiff, moist, grey, Silty Clay A-6
	3	1.7S	20	
	3			
380.6				
10.0	1			Very stiff, moist, grey, Silty Clay
	3	2.7S	19	A-6
	4			
	1			
	2	2.1B	20	
	3			
15.0	1			
	2	2.5B	22	
	3			
	1			
	2	2.5B	23	
	3			
370.6				
20.0	WH			Soft, very moist, grey, Silty Clay
	WH	0.3B	29	Loam A-6
	1			
368.1				
	WH			Very soft, very moist, grey, Silt
	WH	0.2B	30	Loam to Silty Clay Loam A-4
	WH			
25.0	WH			

DEPTH	BLOWS	Qu tsf	W%	Description
	WH	0.1B	29	Very soft, very moist, grey, Silt
	WH			Loam to Silty Clay Loam A-4
363.1				
	WH			Soft, very moist, grey, Silty Clay to
	WH	0.4B	28	Silty Clay Loam A-6
	WH			
360.6				
30.0	WH			Soft to medium, very moist, brown
	WH	0.5B	27	mottled grey, Silty Clay to Silty
	WH			Clay Loam A-6
	WH			
	WH	0.5B	28	
	WH			
355.6				
35.0	WH			Medium, very moist, grey, Clay
	WH	0.7B	30	A7-6
	2			
353.1				
	1			Stiff, moist, grey, Clay A7-6
	2	1.8B	29	
	4			
350.6				
40.0	1			Very stiff, moist, grey mottled
	3	2.1B	27	brown, Clay A7-6
	4			
345.6				
45.0	1			Stiff, moist, grey, Clay A7-6
	3	1.6B	26	
	4			
340.1				
50.0	WH			

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)
Section: 5-3B-2
County: Jackson

Date: 7/16/2014

Boring No: 1-S
Station: 186+50
Offset: 16' Lt CL WBL
Ground Surface: 390.1 Ft

	DEPTH	BLOWS	Qu tsf	W%
Layers of loose, wet grey, Sand and stiff, moist, grey Clay A7-6 and soft, very moist, grey, Sand Loam to Sandy Clay Loam A-4		1 1		23
5' sand blow-in wash-out procedures used	55.0	WH 1 1		
wash-out procedures used 330.6				
Medium dense, very moist, grey, Sand with some pea gravel 78% Sand 8% Silt 8% Clay 6% Gravel	60.0	5 10 16		21
wash-out procedures used 325.1	65.0			
Soft to medium, very moist, grey, Sandy Clay Loam with sand and clay layers		2 5 3	0,5	18
323.1 Hard, dry, grey, Clay Shale				
320.6		100/6"		
	70.0			
Bottom of hole = 69.5 feet Free water observed at 27.0 feet Elevation referenced to BM 22 at SW corner SN 039-0061; Elev.= 390.3 feet				
	75.0			

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

Route: FAP 331 (IL 13) Structure Number: 039-0061 Date: 7/15/2014

Section 5-3B-2 Bored By: R Moberly

County: Jackson Location: 0.6 mi West of Reed Station Road Checked By: R Graeff

Boring No 2-S
Station 189+69
Offset 15' Lt CL WBL
Ground Surface 390.0 Ft

Surf Wat Elev: 362.1
Ground Water Elevation
when Drilling 363.1
At Completion
At: Hrs:

DEPTH	BLOWS	Qu tsf	W%	Description
				Asphalt over crushed aggregate
	3			
387.0	3			
	2	2.3B	17	Very stiff, moist, grey and brown, Clay A7-6
385.5				
5.0	1			Stiff, moist, brown and grey, Clay A7-6
	2	1.7B	21	
	3			
383.0				
	1			Very stiff, moist, brown, Clay to Silty Clay A7-6
	2	2.9B	17	
	4			
10.0	1			
	1	2.1B	19	
	2			
	1			
	3	2.7B	19	
	4			
15.0	1			
	3	2.3B	21	
	3			
373.0				
	3			Very stiff, moist, grey, Silt Loam to Silty Clay Loam A-4
	4	3.3B	20	
	6			
370.5				
20.0	WH			Medium, very moist, grey, Silt Loam to Silty Clay Loam A-4
	1	0.6B	27	
	1			
368.0				
	WH			Soft, very moist, grey, Silt Loam to Silty Clay Loam A-4
	WH	0.3B	29	
	1			
25.0	WH			

DEPTH	BLOWS	Qu tsf	W%	Description
	WH	0.3B	30	Soft, very moist, grey, Silt Loam to Silty Clay Loam A-4
	WH			
363.0				
	WH			Very soft, very moist, brown mottled grey, Silty Clay Loam A-6
	WH	0.2B	32	
	WH			
360.5				
30.0	WH			Soft to medium, very moist, grey mottled brown, Silty Clay Loam A-6 with Sand seams
	WH	0.5B	32	
	1			
	WH			
	WH	0.3B	31	
	WH			
355.5				
35.0	WH			Medium, very moist, grey, Silty Clay Loam A-6 with sand and clay layers
	WH	0.6B	35	
	WH			
353.0				
	WH			Medium, very moist, grey, Clay A7-6 with sand seams
	WH	0.7B	35	
	1			
350.5				
40.0	1			Very stiff, moist, grey mottled brown, Clay A7-6
	3	2.3B	36	
	3			
45.0	1			
	3	2.9B	25	
	4			
341.5				
				5' blow-in
				Very loose, wet, grey, Sand with
50.0	WR			Clay layers

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)
Section: 5-3B-2
County: Jackson

Date: 7/15/2014

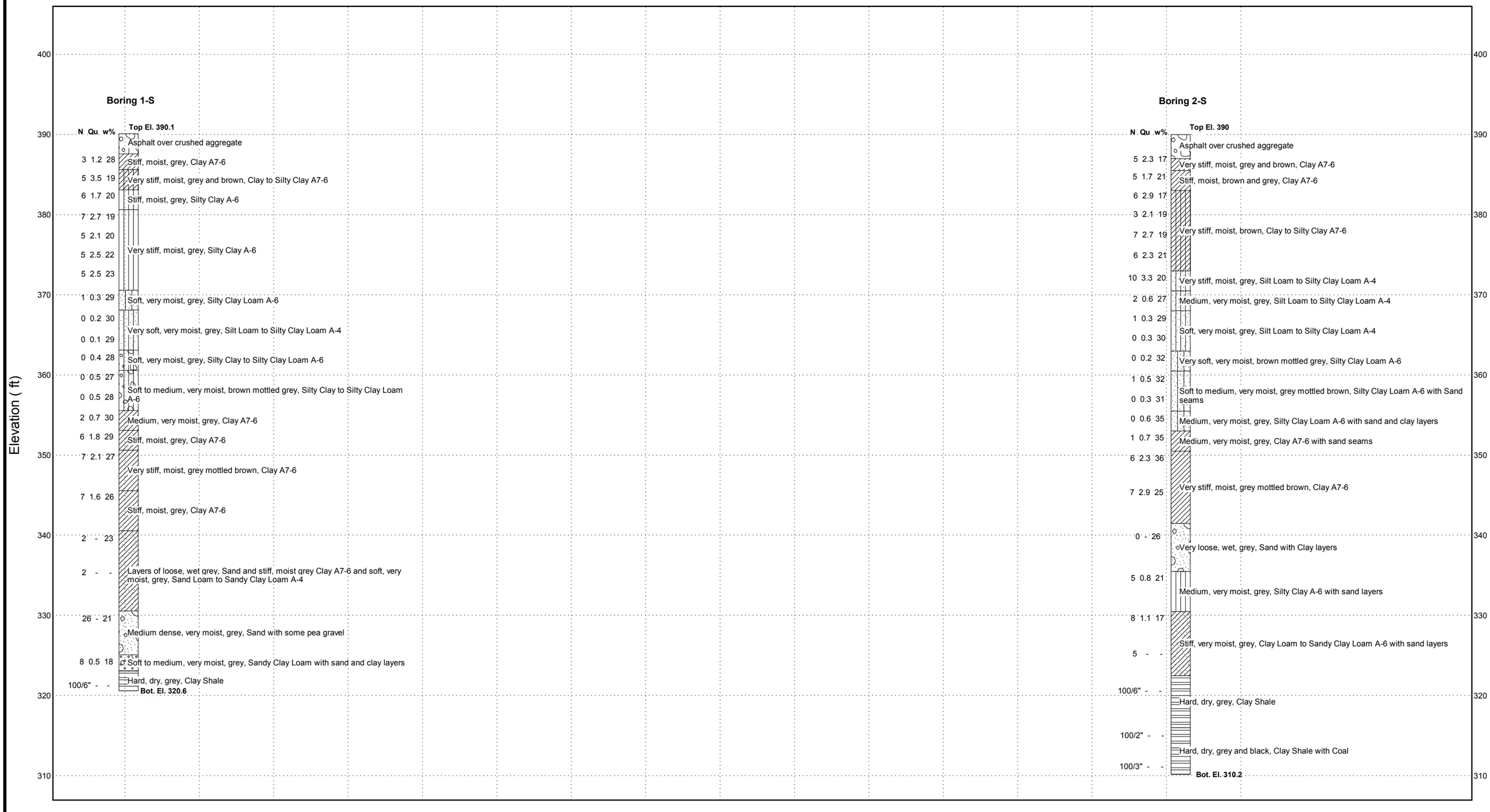
Boring No: 2-S
Station: 189+69
Offset: 15' Lt CL WBL
Ground Surface: 390.0 Ft

	DEPTH	BLOWS	Qu tsf	W%
Very loose, wet, grey, Sand with Clay layers 76% Sand 11% Silt 13% Clay		WR WR		26
Wash-out procedures used 335.5				
Medium, very moist, grey, Silty Clay A-6 with sand layers	55.0	2 2 3	0.8B	21
330.5				
Stiff, very moist, grey, Clay Loam to Sandy Clay Loam A-6 with sand layers	60.0	1 3 5	1.1S	17
	65.0	1		
(lost sample - broken retainer)		2 3		
322.5				
Hard, dry, grey, Clay Shale	70.0	100/6"		
316.0				
Hard, dry, grey and black, Clay Shale with Coal	75.0	100/2"		
Hard, dry, grey and black, Clay Shale with Coal				
310.0	80.0	100/3"		
Bottom of hole = 79.8 feet Free water observed at 27.0 feet Elevation referenced to BM 22 at SW corner SN 039-0061; Elev.= 390.3 feet Borehole advanced with hollow stem auger (8" O.D, 3.25" I.D.) To convert "N" values to "N60" multiply by 1.25	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 (SN 039-0061)

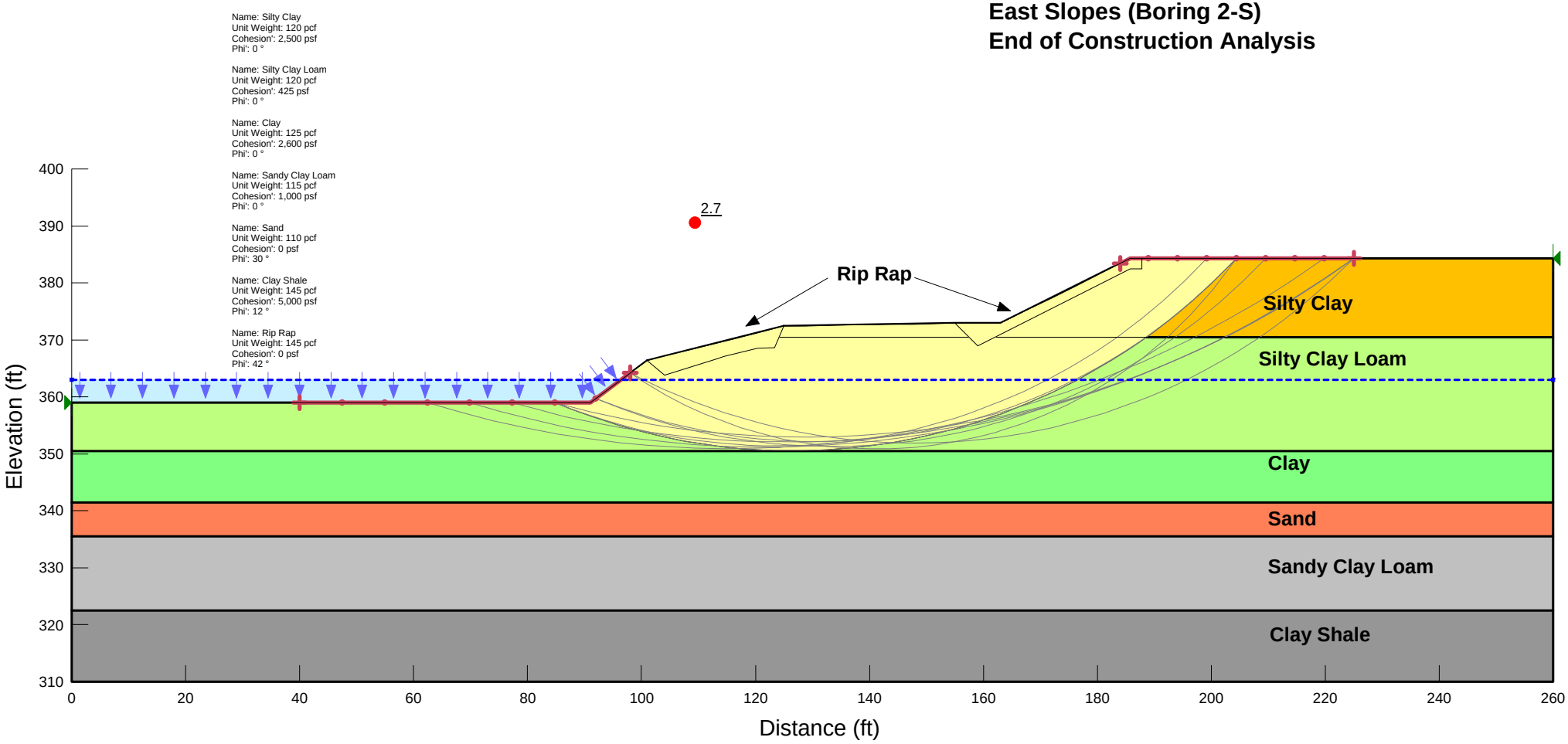
Route: F.A.P. 331
Section: 5-3B-2
County: Jackson

PRINTERMOD2 11X17 08-0061.18 IL 13 OVER CRAB ORCHARD CREEK SN 039-0061.GPJ IL_DOT.GDT 12/22/15

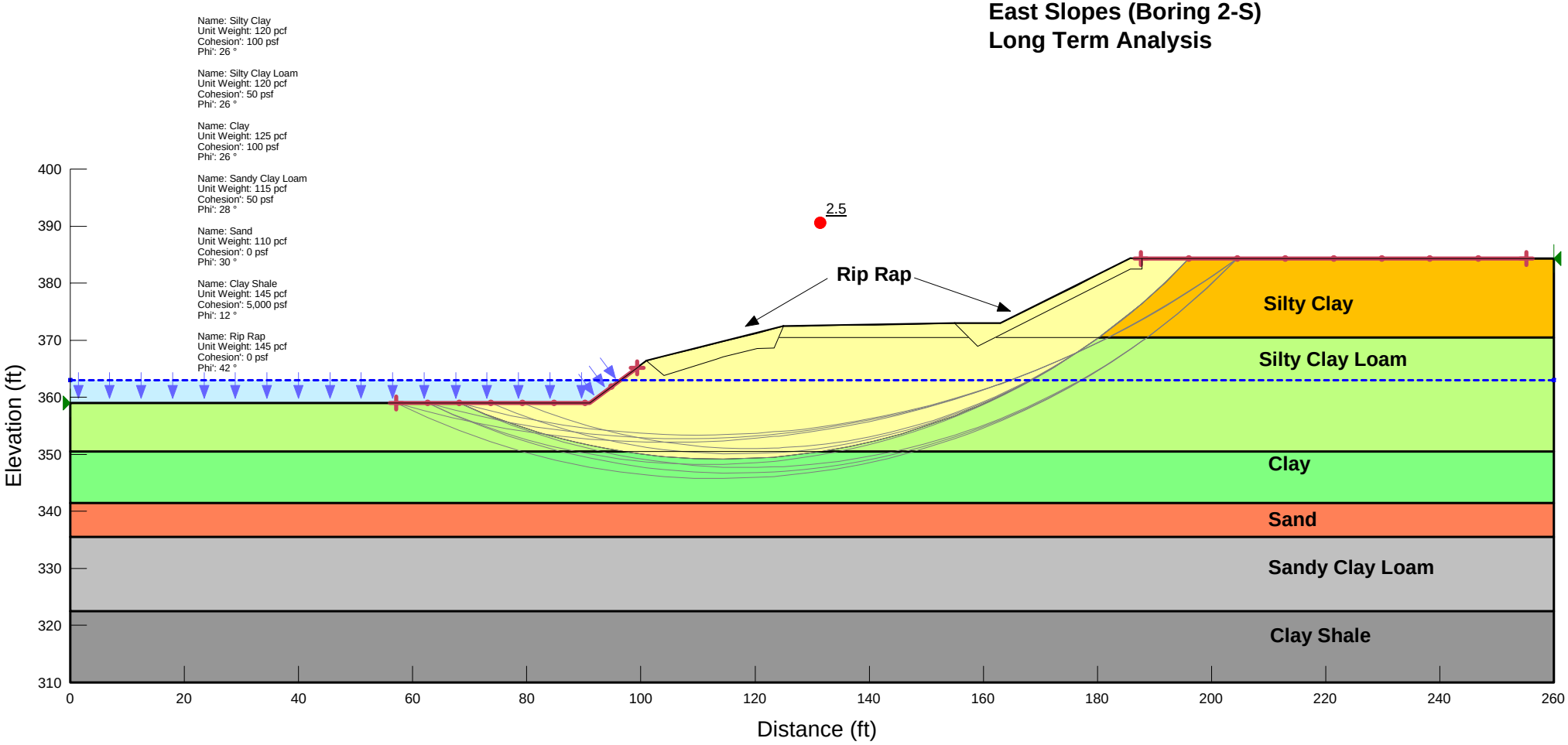
EXHIBIT E

SLOPE/W SLOPE STABILITY ANALYSIS

IL 13 over Crab Orchard Creek (SN 039-0061)
East Slopes (Boring 2-S)
End of Construction Analysis



IL 13 over Crab Orchard Creek (SN 039-0061)
East Slopes (Boring 2-S)
Long Term Analysis



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

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

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

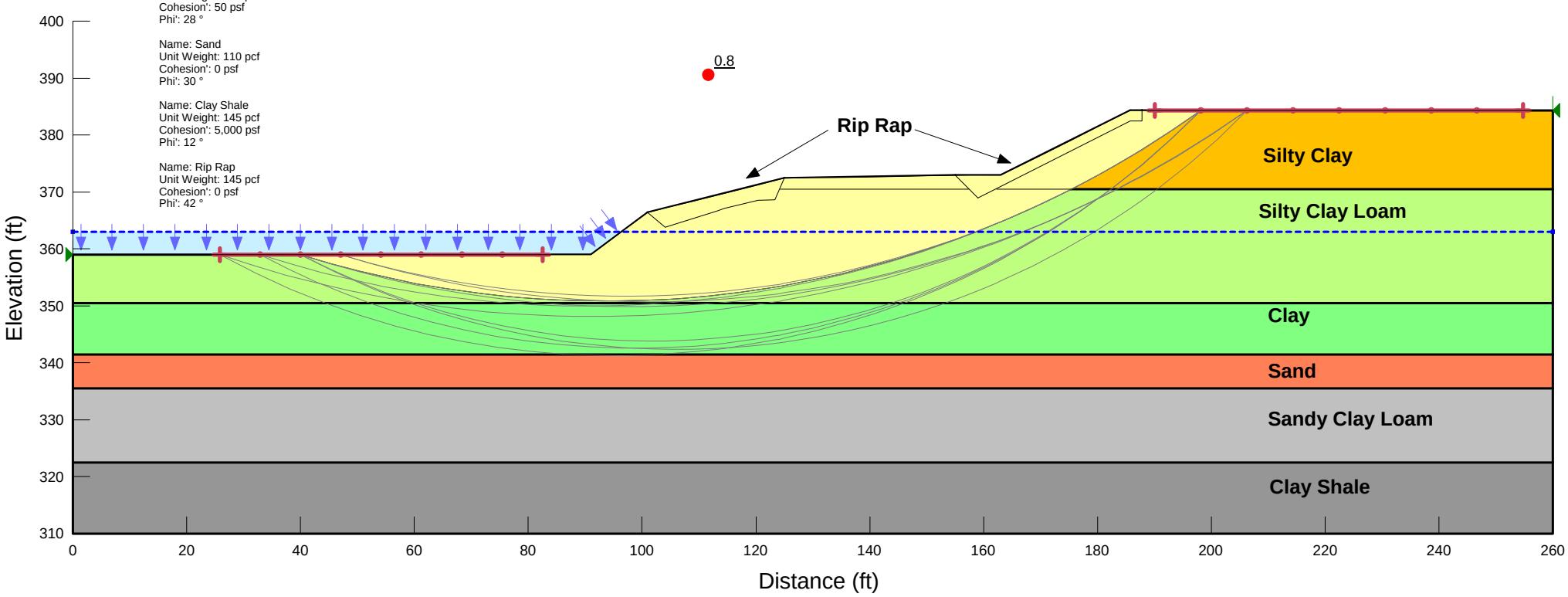
Name: Sandy Clay Loam
Unit Weight: 115 pcf
Cohesion': 50 psf
Phi': 28 °

Name: Sand
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 30 °

Name: Clay Shale
Unit Weight: 145 pcf
Cohesion': 5,000 psf
Phi': 12 °

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

IL 13 over Crab Orchard Creek (SN 039-0061)
East Slopes (Boring 2-S)
Seismic Analysis
PGA: 0.350 g



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

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

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

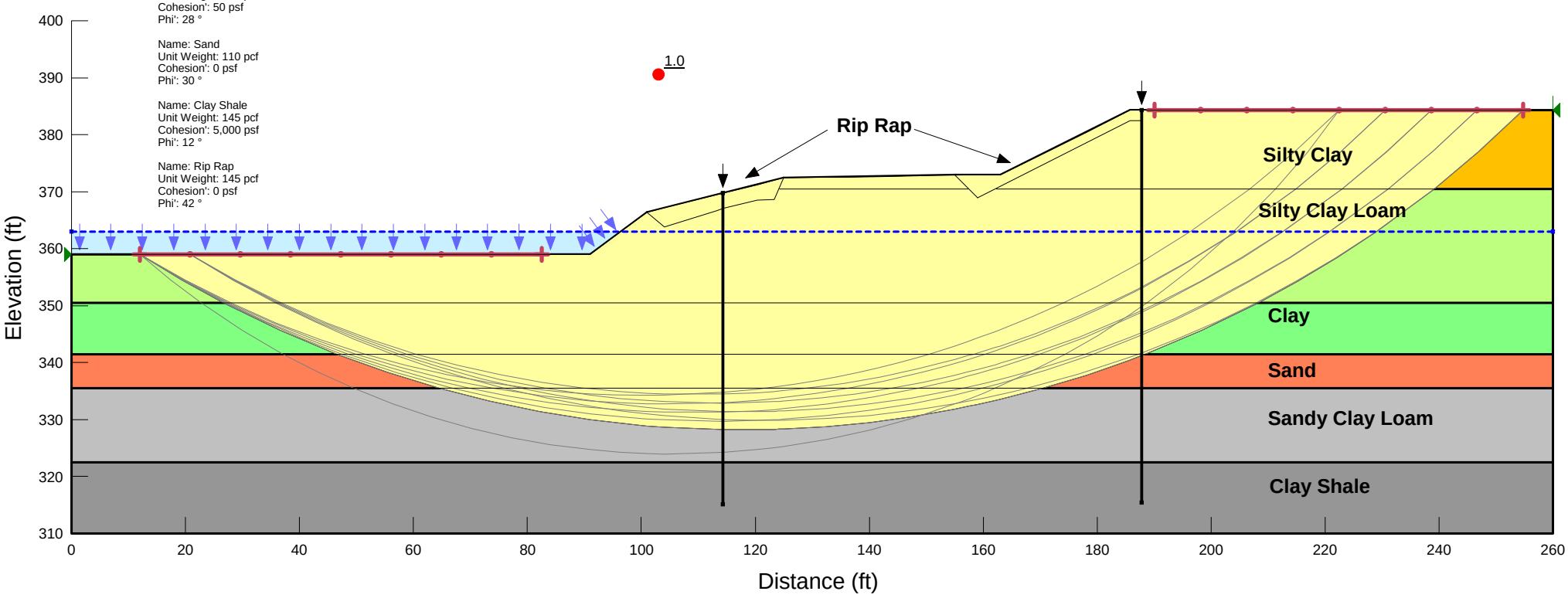
Name: Sandy Clay Loam
Unit Weight: 115 pcf
Cohesion': 50 psf
Phi': 28 °

Name: Sand
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 30 °

Name: Clay Shale
Unit Weight: 145 pcf
Cohesion': 5,000 psf
Phi': 12 °

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

IL 13 over Crab Orchard Creek (SN 039-0061)
East Slopes (Boring 2-S) with Piles
Seismic Analysis
PGA: 0.350 g



IL 13 over Crab Orchard Creek (SN 039-0061)
East Top Slope (Boring 2-S)
End of Construction Analysis

Name: Silty Clay
Unit Weight: 120 pcf
Cohesion': 2,500 psf
Phi': 0 °

Name: Silty Clay Loam
Unit Weight: 120 pcf
Cohesion': 425 psf
Phi': 0 °

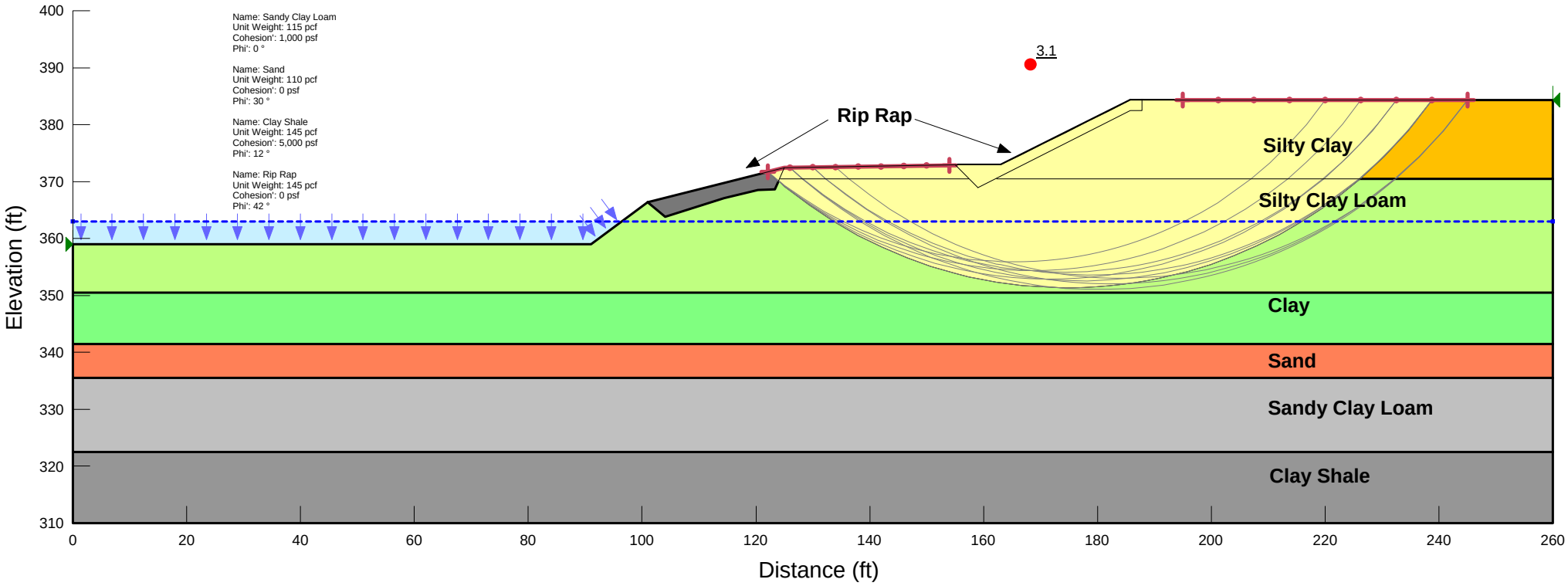
Name: Clay
Unit Weight: 125 pcf
Cohesion': 2,600 psf
Phi': 0 °

Name: Sandy Clay Loam
Unit Weight: 115 pcf
Cohesion': 1,000 psf
Phi': 0 °

Name: Sand
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 30 °

Name: Clay Shale
Unit Weight: 145 pcf
Cohesion': 5,000 psf
Phi': 12 °

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



IL 13 over Crab Orchard Creek (SN 039-0061)
East Top Slope (Boring 2-S)
Long Term Analysis

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

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

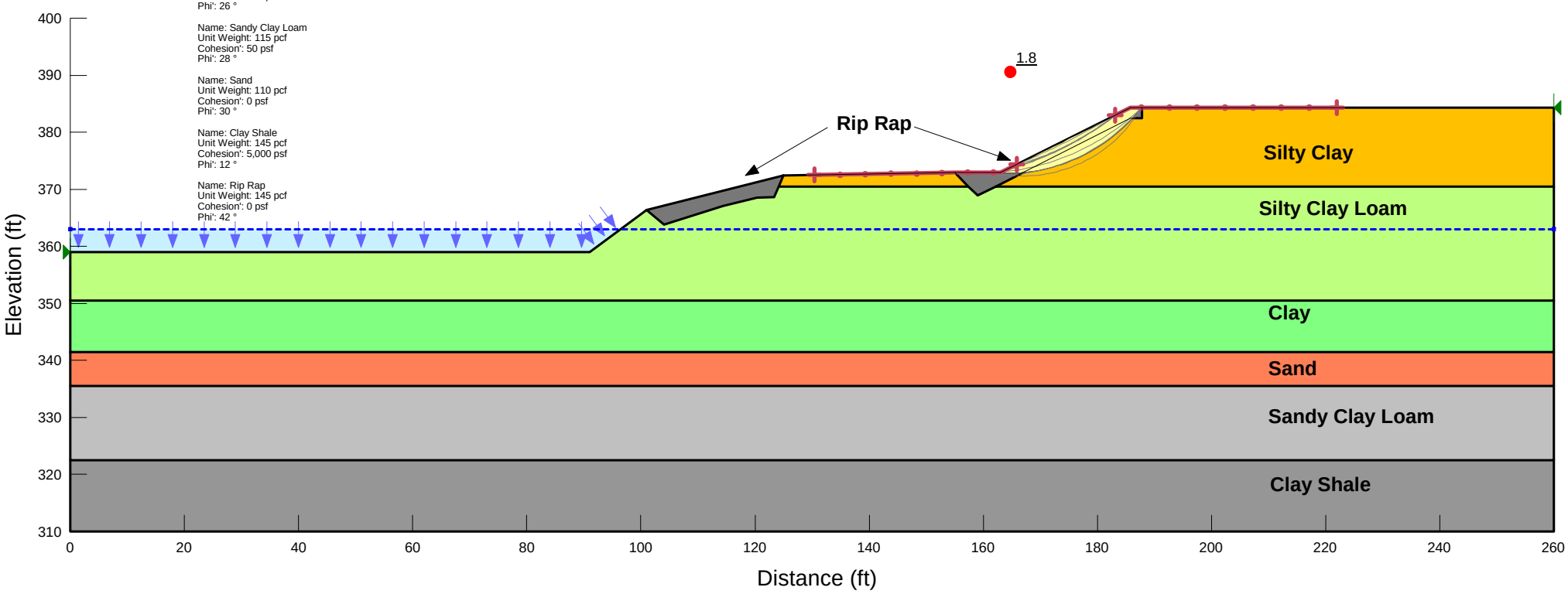
Name: Clay
Unit Weight: 125 pcf
Cohesion': 100 psf
Phi': 26 °

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

Name: Sand
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 30 °

Name: Clay Shale
Unit Weight: 145 pcf
Cohesion': 5,000 psf
Phi': 12 °

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



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

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

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

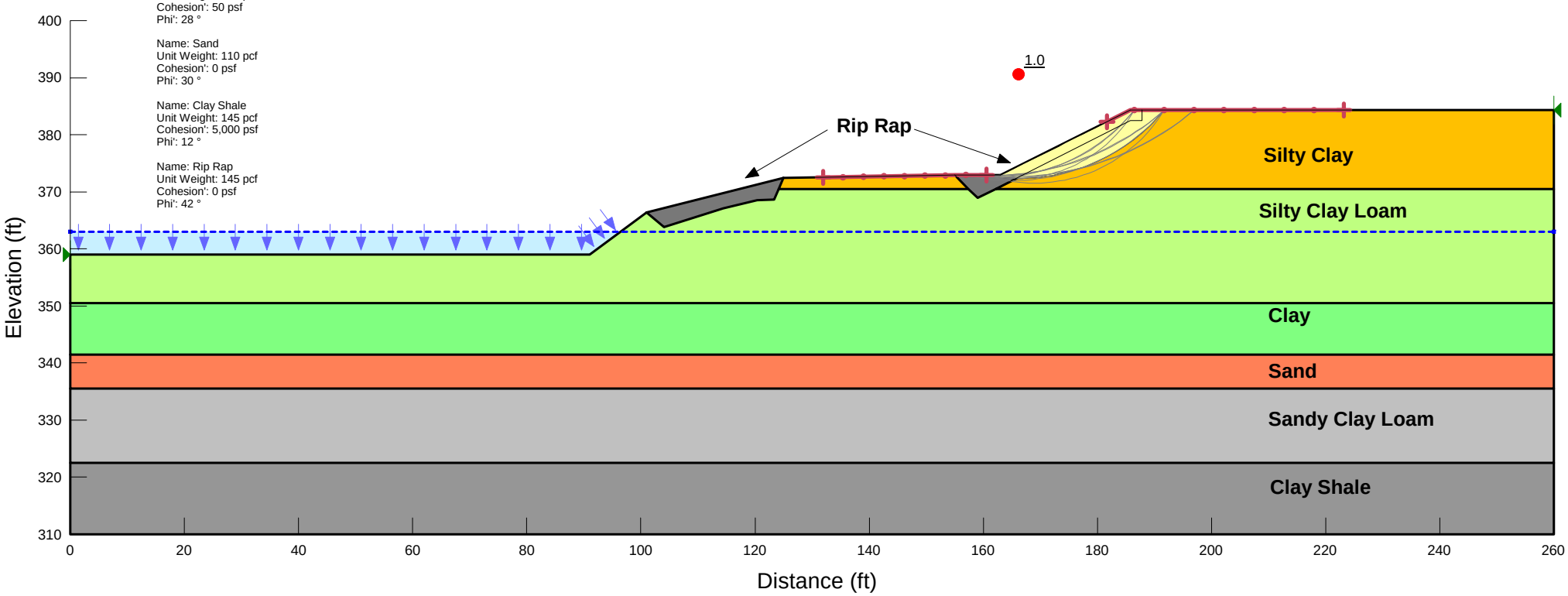
Name: Sandy Clay Loam
Unit Weight: 115 pcf
Cohesion': 50 psf
Phi': 28 °

Name: Sand
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 30 °

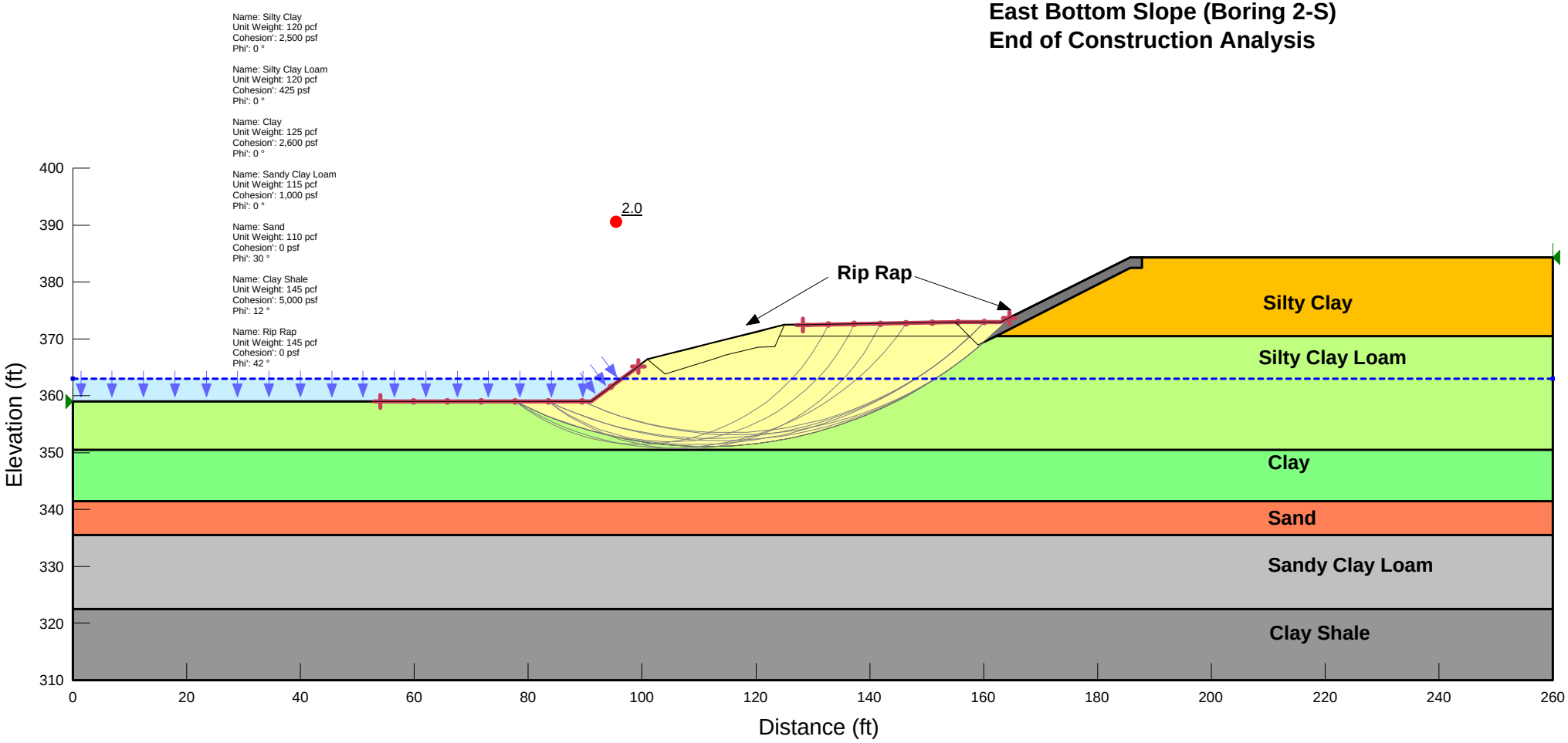
Name: Clay Shale
Unit Weight: 145 pcf
Cohesion': 5,000 psf
Phi': 12 °

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

IL 13 over Crab Orchard Creek (SN 039-0061)
East Top Slope (Boring 2-S)
Seismic Analysis
PGA: 0.350 g



IL 13 over Crab Orchard Creek (SN 039-0061)
East Bottom Slope (Boring 2-S)
End of Construction Analysis



IL 13 over Crab Orchard Creek (SN 039-0061)
East Bottom Slope (Boring 2-S)
Long Term Analysis

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

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

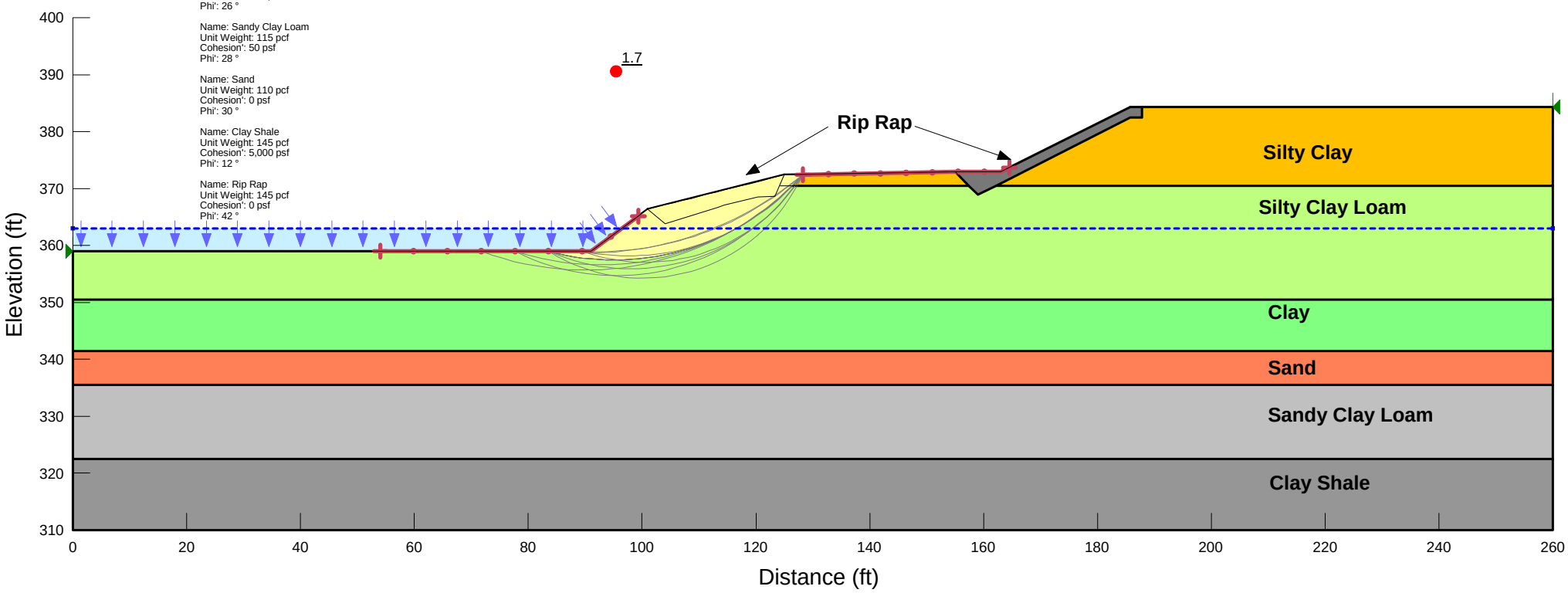
Name: Clay
Unit Weight: 125 pcf
Cohesion': 100 psf
Phi': 26 °

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

Name: Sand
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 30 °

Name: Clay Shale
Unit Weight: 145 pcf
Cohesion': 5,000 psf
Phi': 12 °

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



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

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

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

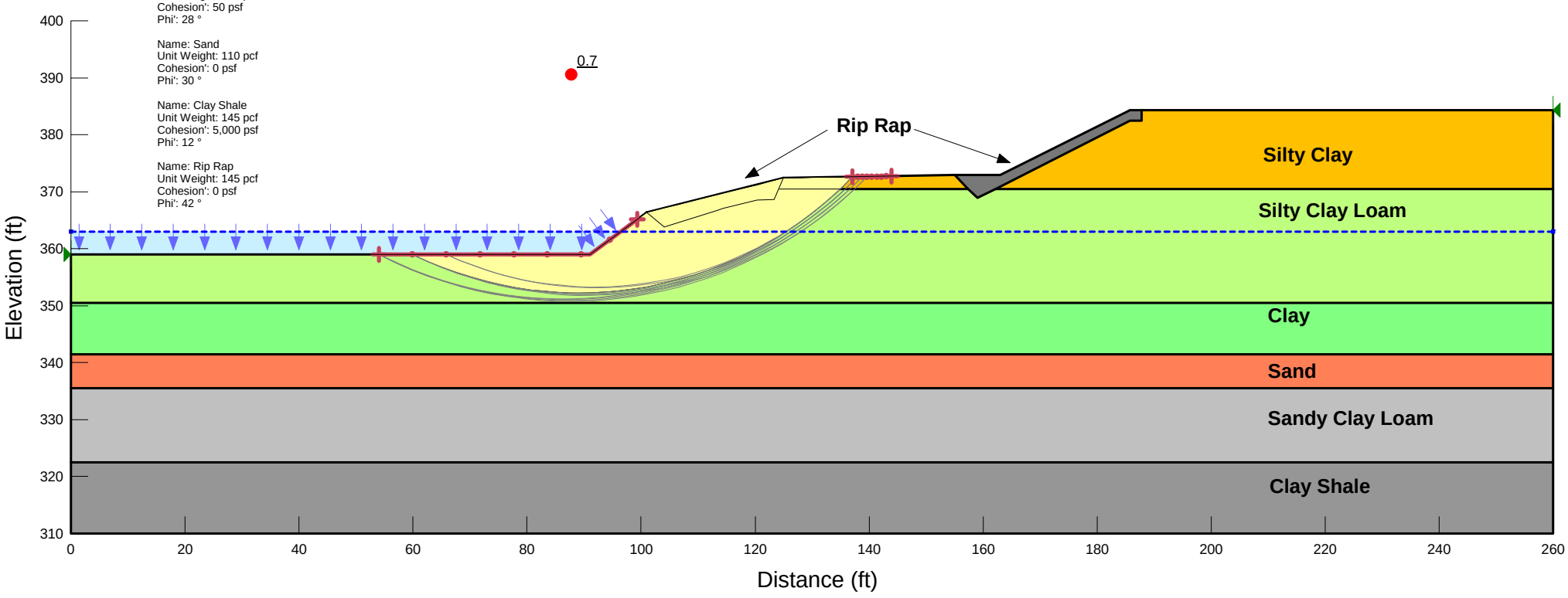
Name: Sandy Clay Loam
Unit Weight: 115 pcf
Cohesion': 50 psf
Phi': 28 °

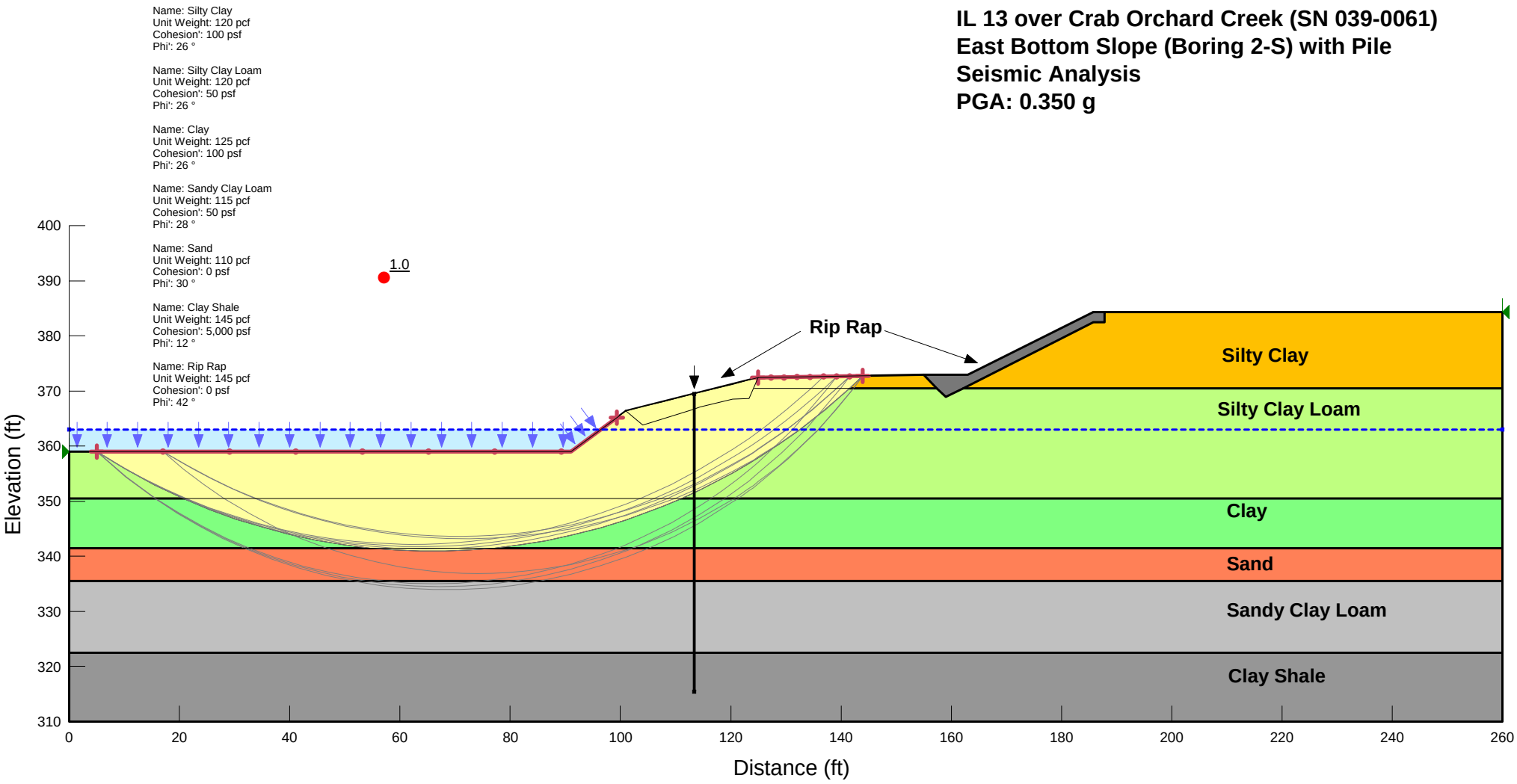
Name: Sand
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 30 °

Name: Clay Shale
Unit Weight: 145 pcf
Cohesion': 5,000 psf
Phi': 12 °

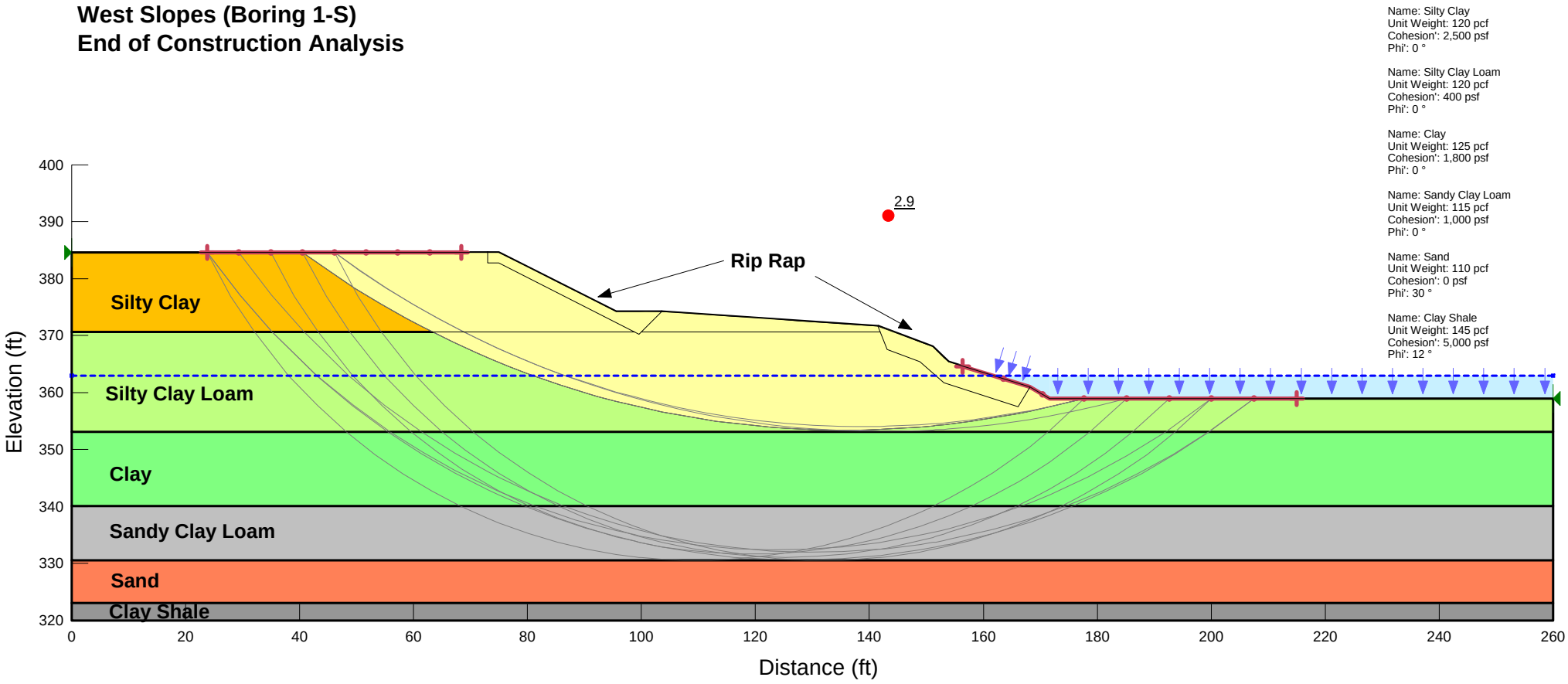
Name: Rip Rap
Unit Weight: 145 pcf
Cohesion': 0 psf
Phi': 42 °

IL 13 over Crab Orchard Creek (SN 039-0061)
East Bottom Slope (Boring 2-S)
Seismic Analysis
PGA: 0.350 g

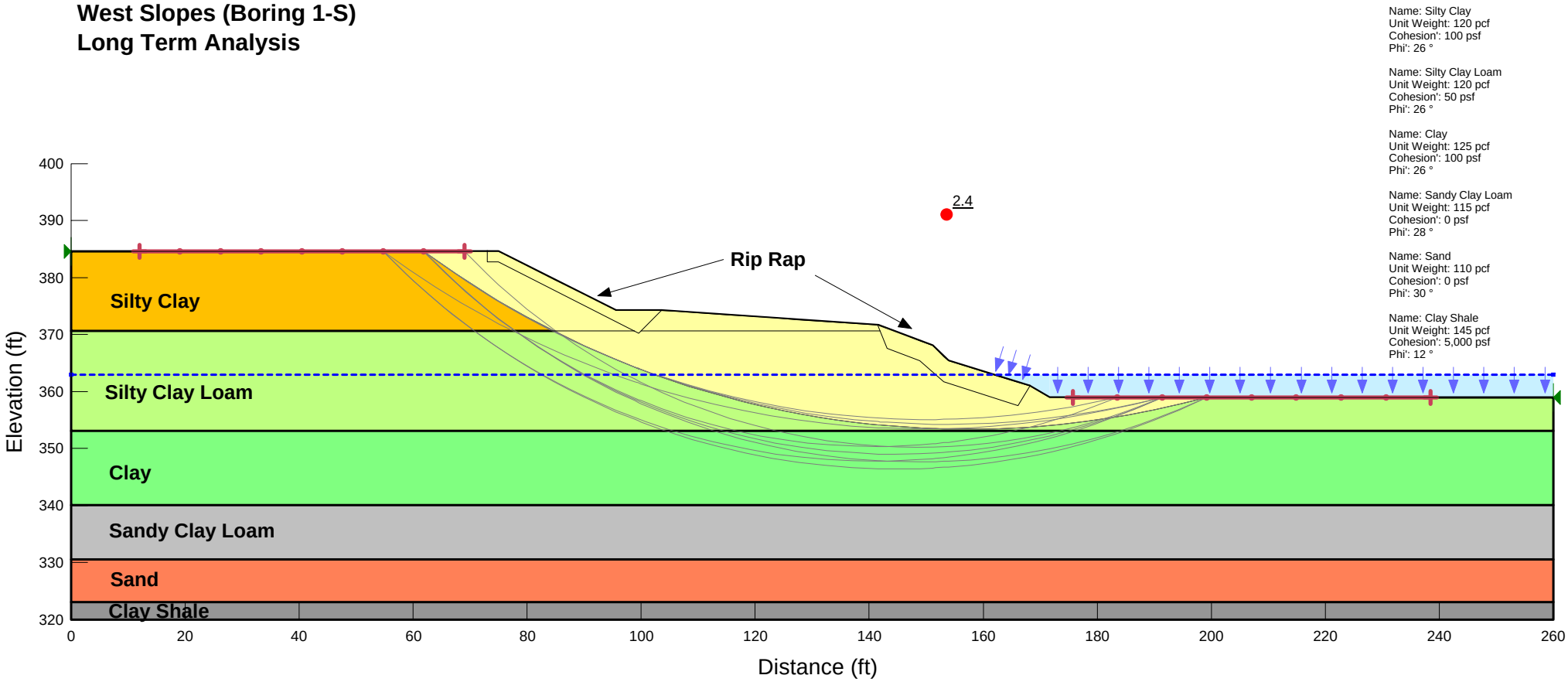



Name: Silty Clay
Unit Weight: 120 pcf
Cohesion': 100 psf
Phi': 26 °
Name: Silty Clay Loam
Unit Weight: 120 pcf
Cohesion': 50 psf
Phi': 26 °
Name: Clay
Unit Weight: 125 pcf
Cohesion': 100 psf
Phi': 26 °
Name: Sandy Clay Loam
Unit Weight: 115 pcf
Cohesion': 50 psf
Phi': 28 °
Name: Sand
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 30 °
Name: Clay Shale
Unit Weight: 145 pcf
Cohesion': 5,000 psf
Phi': 12 °
Name: Rip Rap
Unit Weight: 145 pcf
Cohesion': 0 psf
Phi': 42 °
IL 13 over Crab Orchard Creek (SN 039-0061)
East Bottom Slope (Boring 2-S) with Pile
Seismic Analysis
PGA: 0.350 g
1.0
Rip Rap
Silty Clay
Silty Clay Loam
Clay
Sand
Sandy Clay Loam
Clay Shale
Elevation (ft)
Distance (ft)
400
390
380
370
360
350
340
330
320
310
0
20
40
60
80
100
120
140
160
180
200
220
240
260

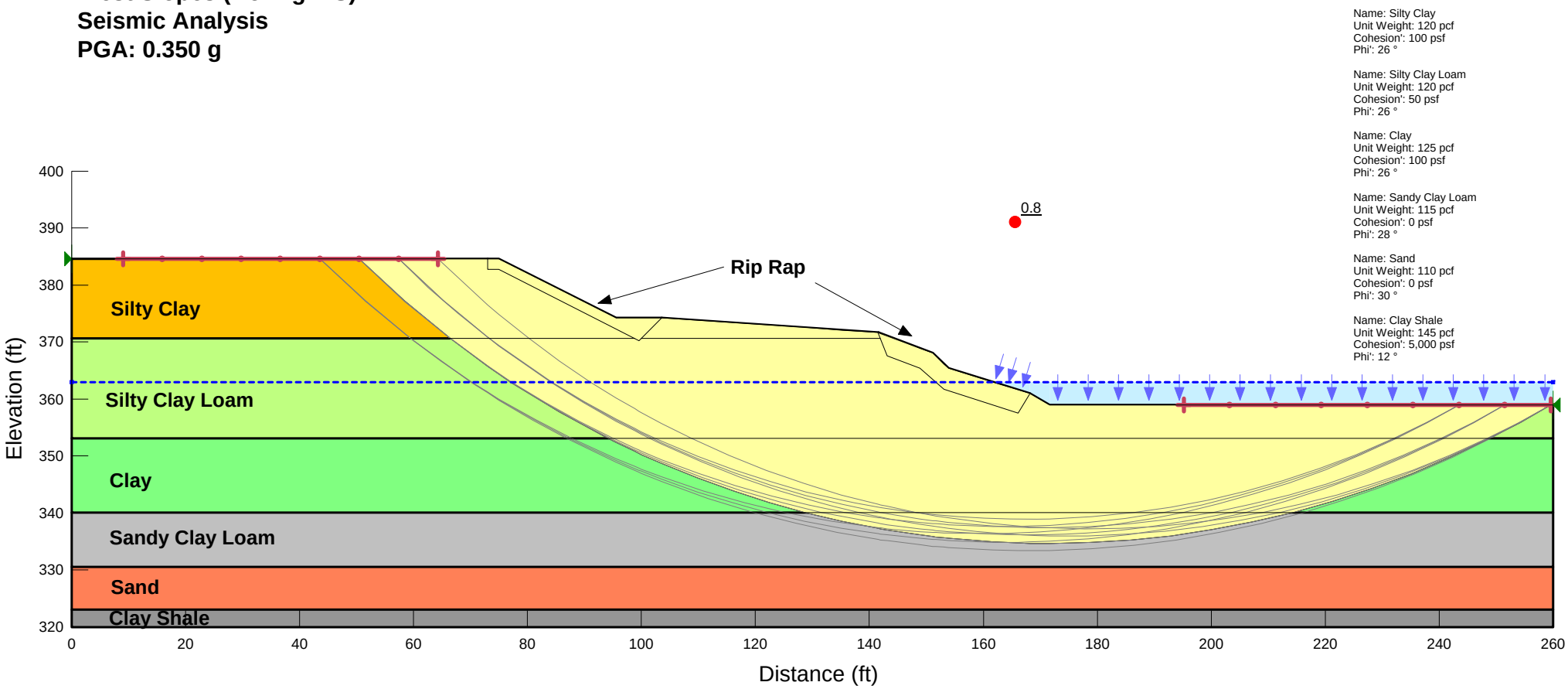
IL 13 over Crab Orchard Creek (SN 039-0061)
West Slopes (Boring 1-S)
End of Construction Analysis



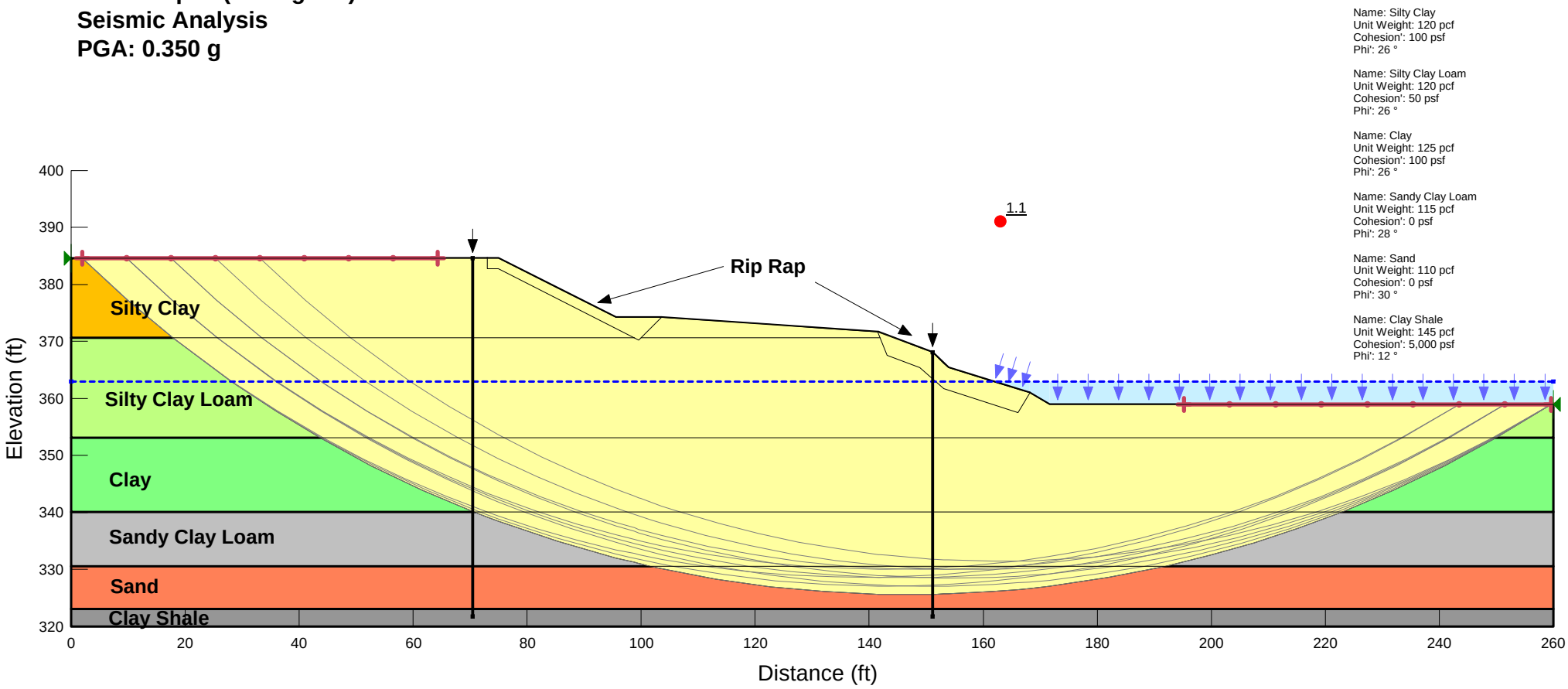
IL 13 over Crab Orchard Creek (SN 039-0061)
West Slopes (Boring 1-S)
Long Term Analysis



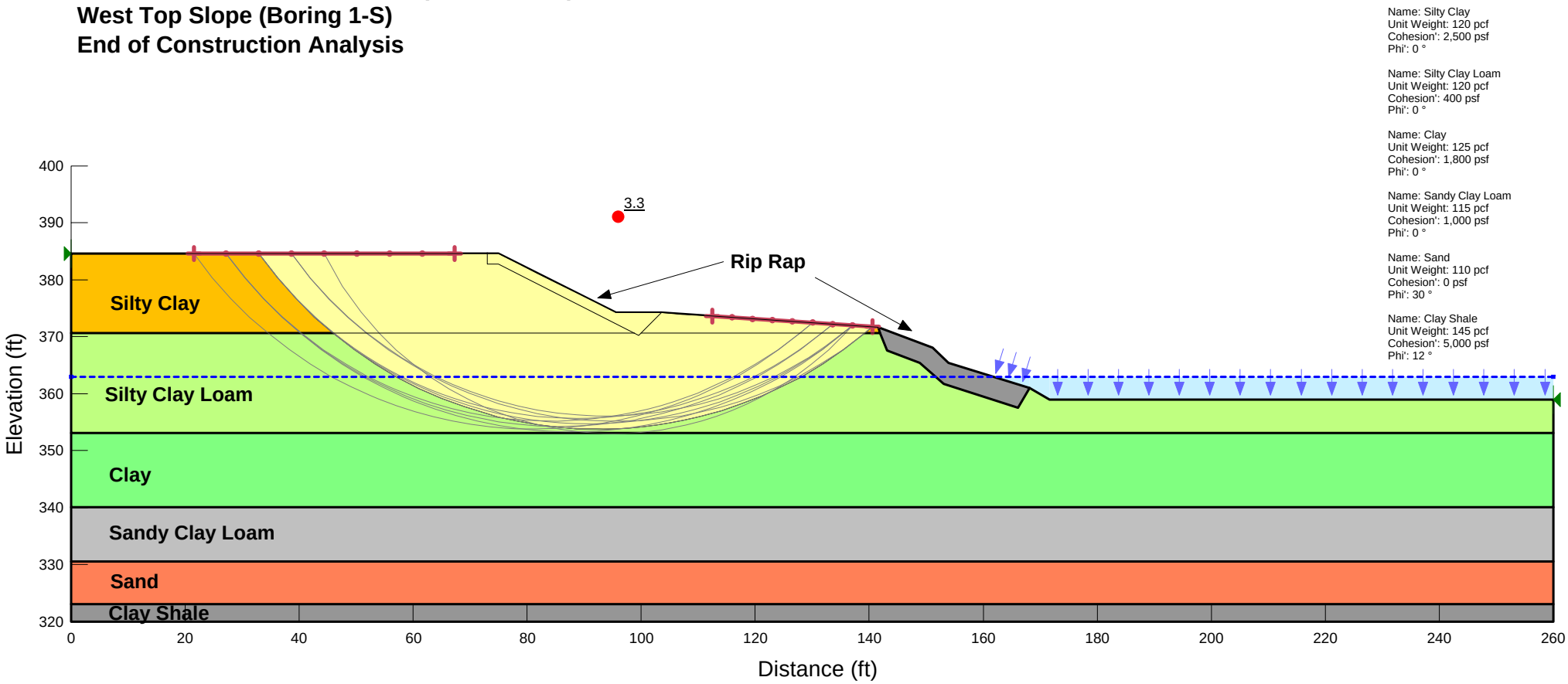
IL 13 over Crab Orchard Creek (SN 039-0061)
West Slopes (Boring 1-S)
Seismic Analysis
PGA: 0.350 g



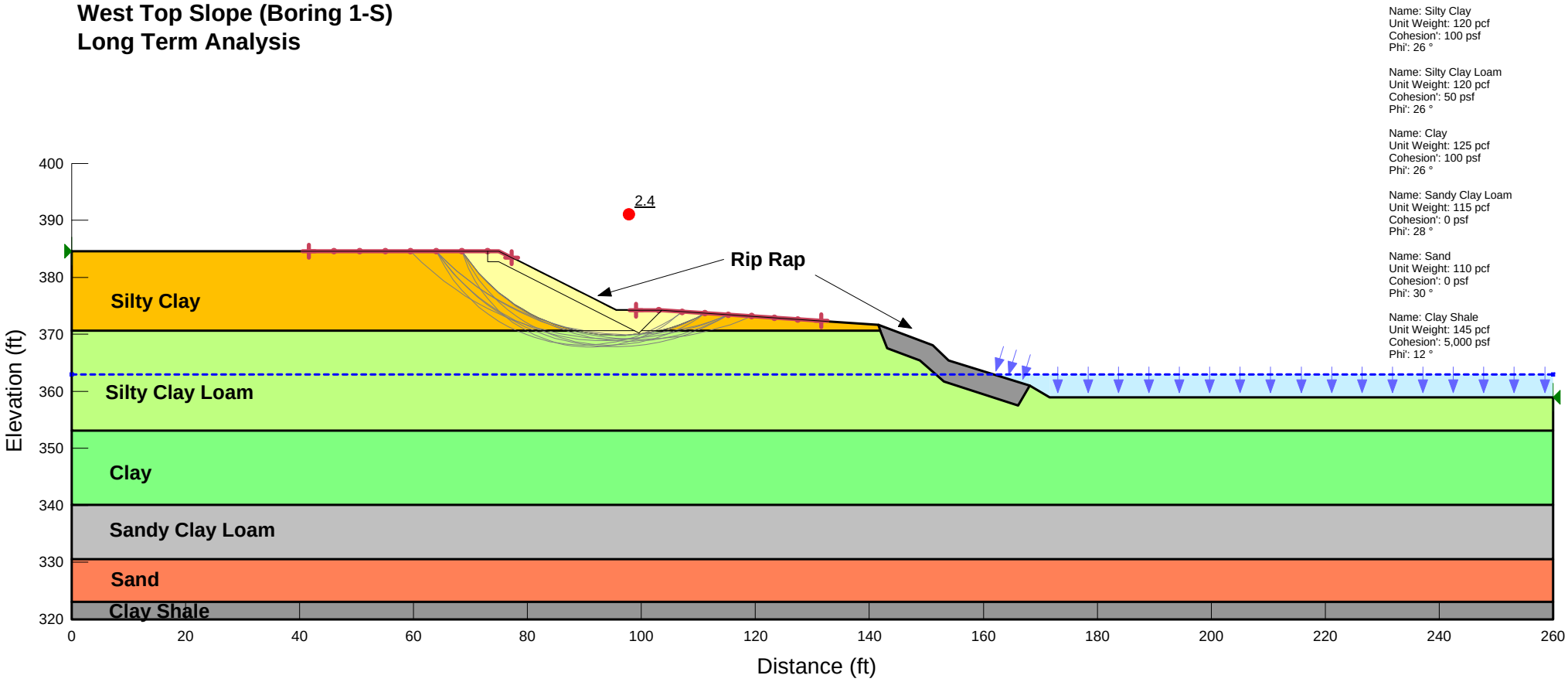
IL 13 over Crab Orchard Creek (SN 039-0061)
West Slopes (Boring 1-S) with Piles
Seismic Analysis
PGA: 0.350 g



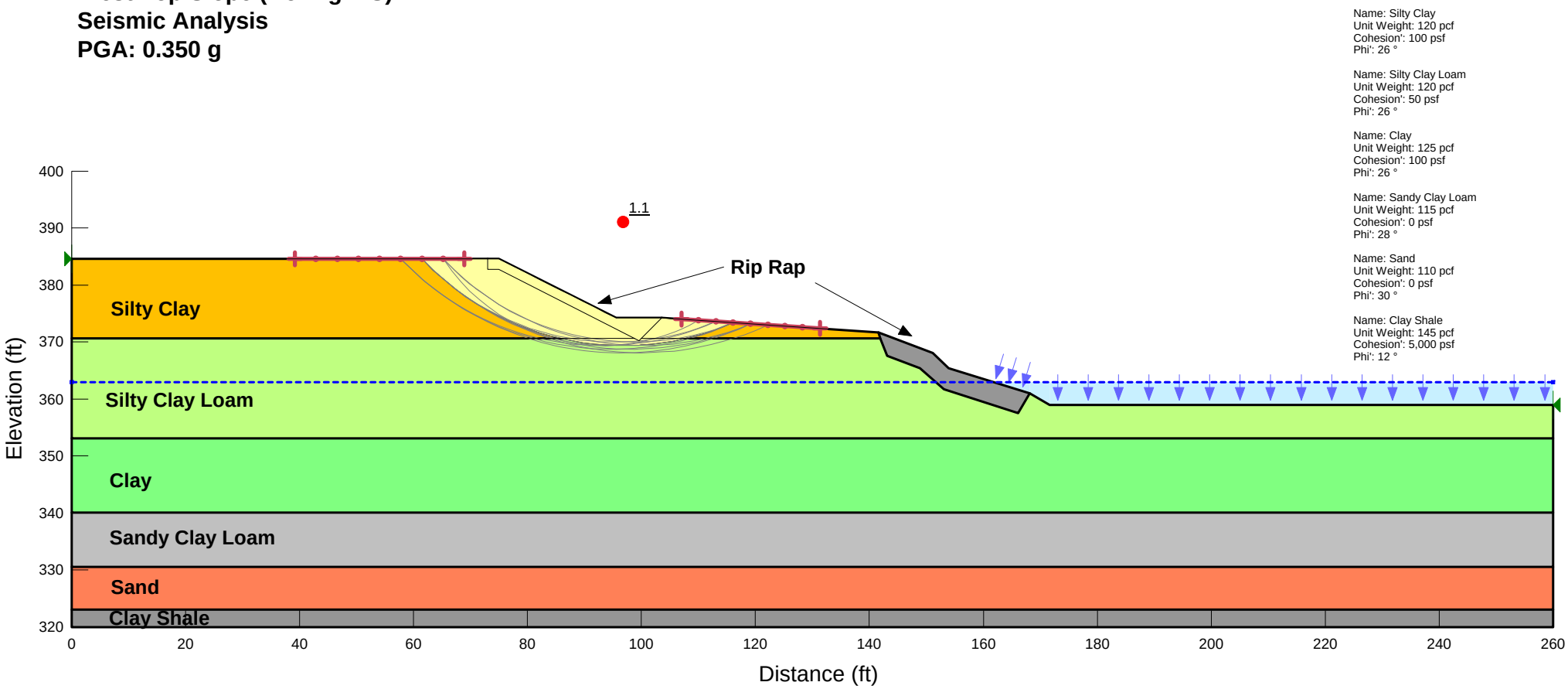
IL 13 over Crab Orchard Creek (SN 039-0061)
West Top Slope (Boring 1-S)
End of Construction Analysis



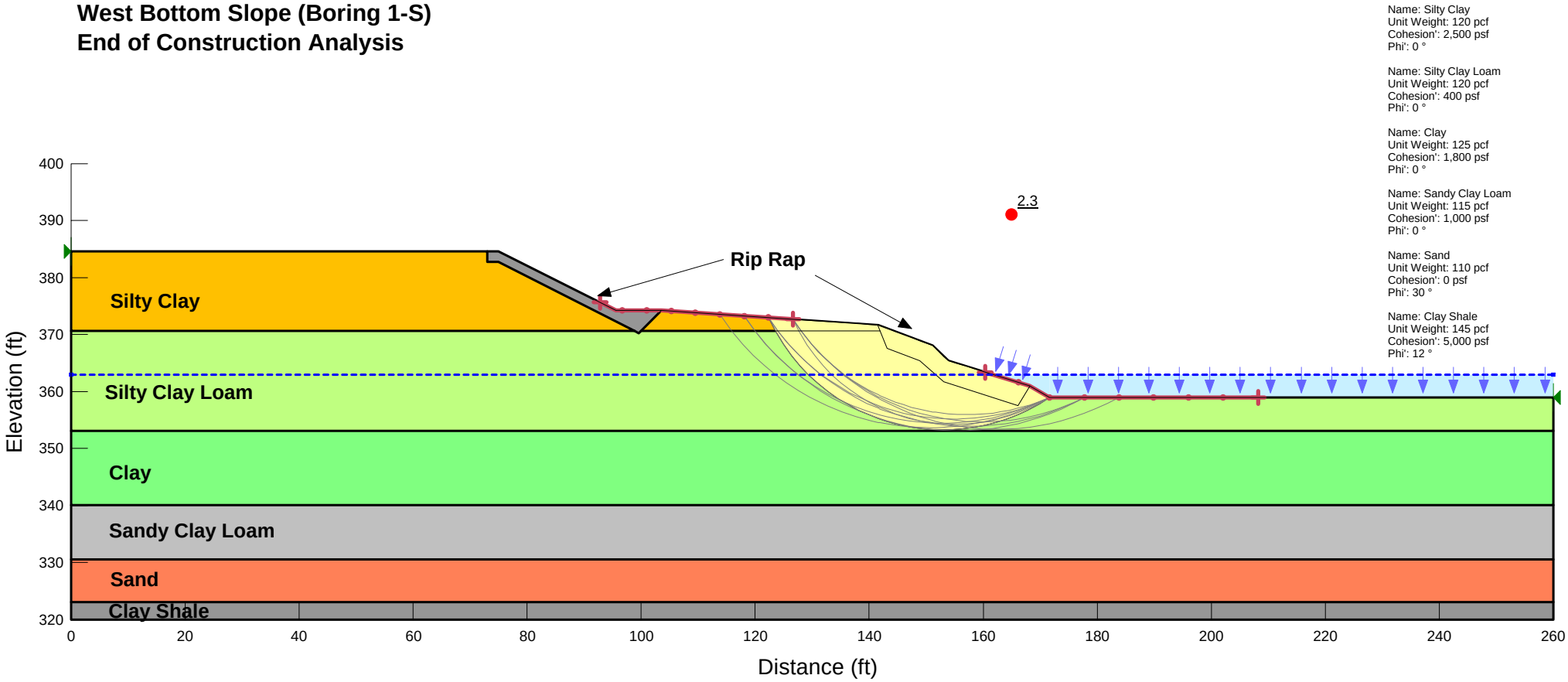
IL 13 over Crab Orchard Creek (SN 039-0061)
West Top Slope (Boring 1-S)
Long Term Analysis



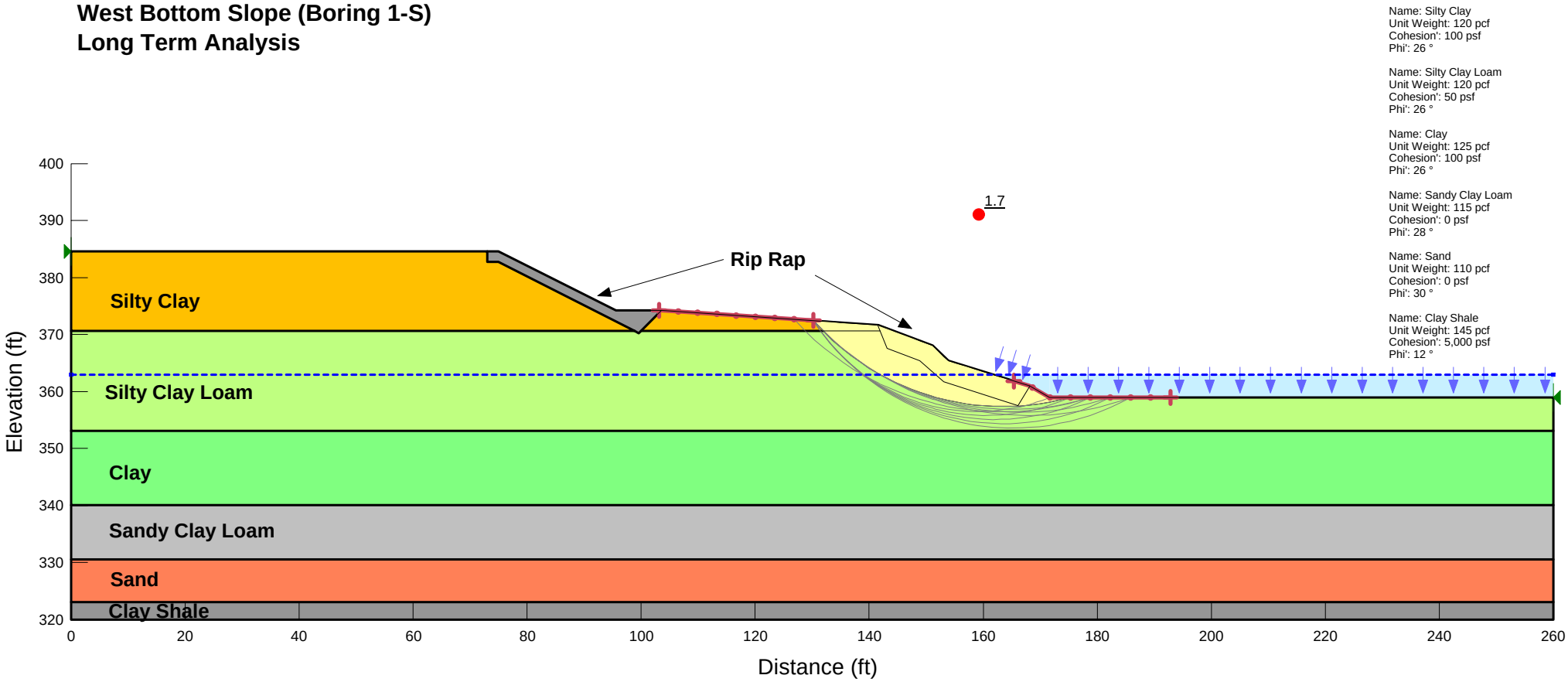
IL 13 over Crab Orchard Creek (SN 039-0061)
West Top Slope (Boring 1-S)
Seismic Analysis
PGA: 0.350 g



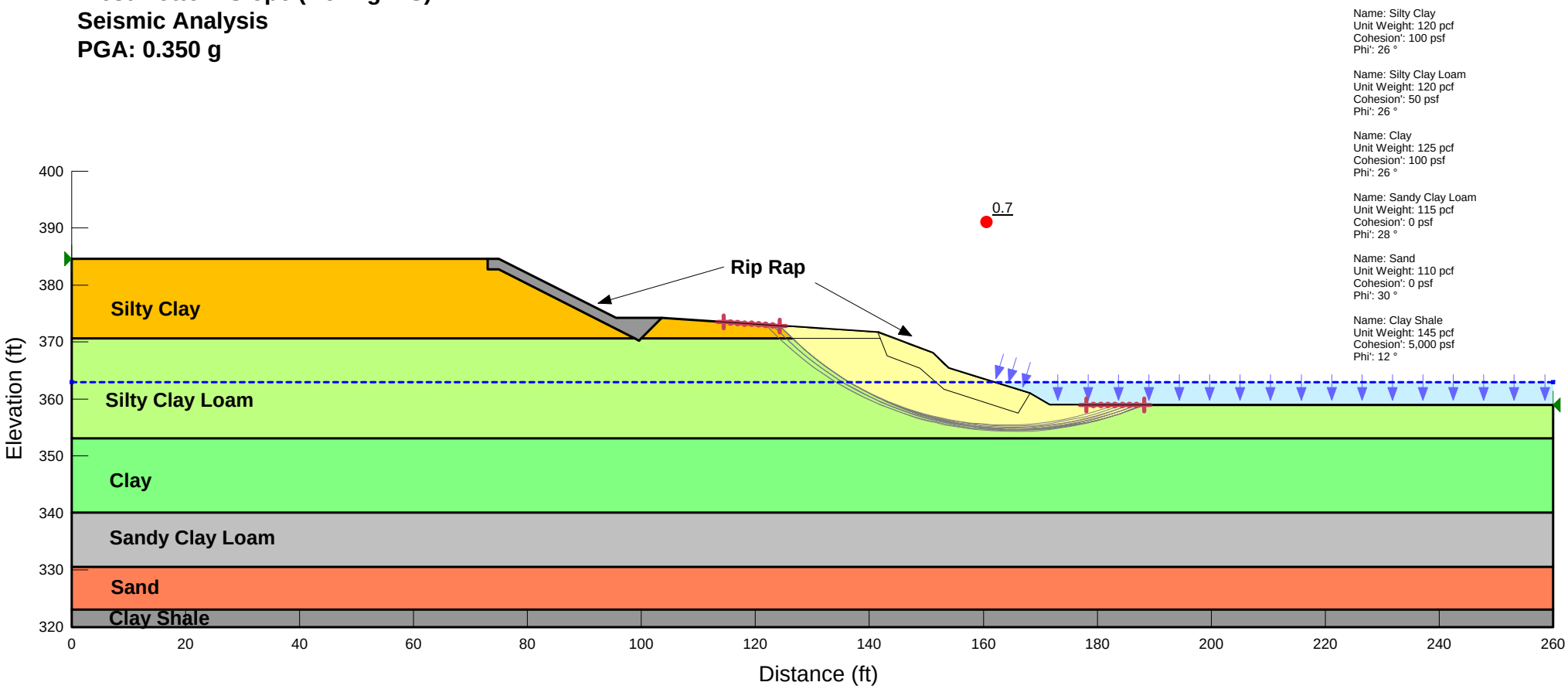
IL 13 over Crab Orchard Creek (SN 039-0061)
West Bottom Slope (Boring 1-S)
End of Construction Analysis



IL 13 over Crab Orchard Creek (SN 039-0061)
West Bottom Slope (Boring 1-S)
Long Term Analysis



IL 13 over Crab Orchard Creek (SN 039-0061)
West Bottom Slope (Boring 1-S)
Seismic Analysis
PGA: 0.350 g



IL 13 over Crab Orchard Creek (SN 039-0061)
West Bottom Slope (Boring 1-S) with Pile
Seismic Analysis
PGA: 0.350 g

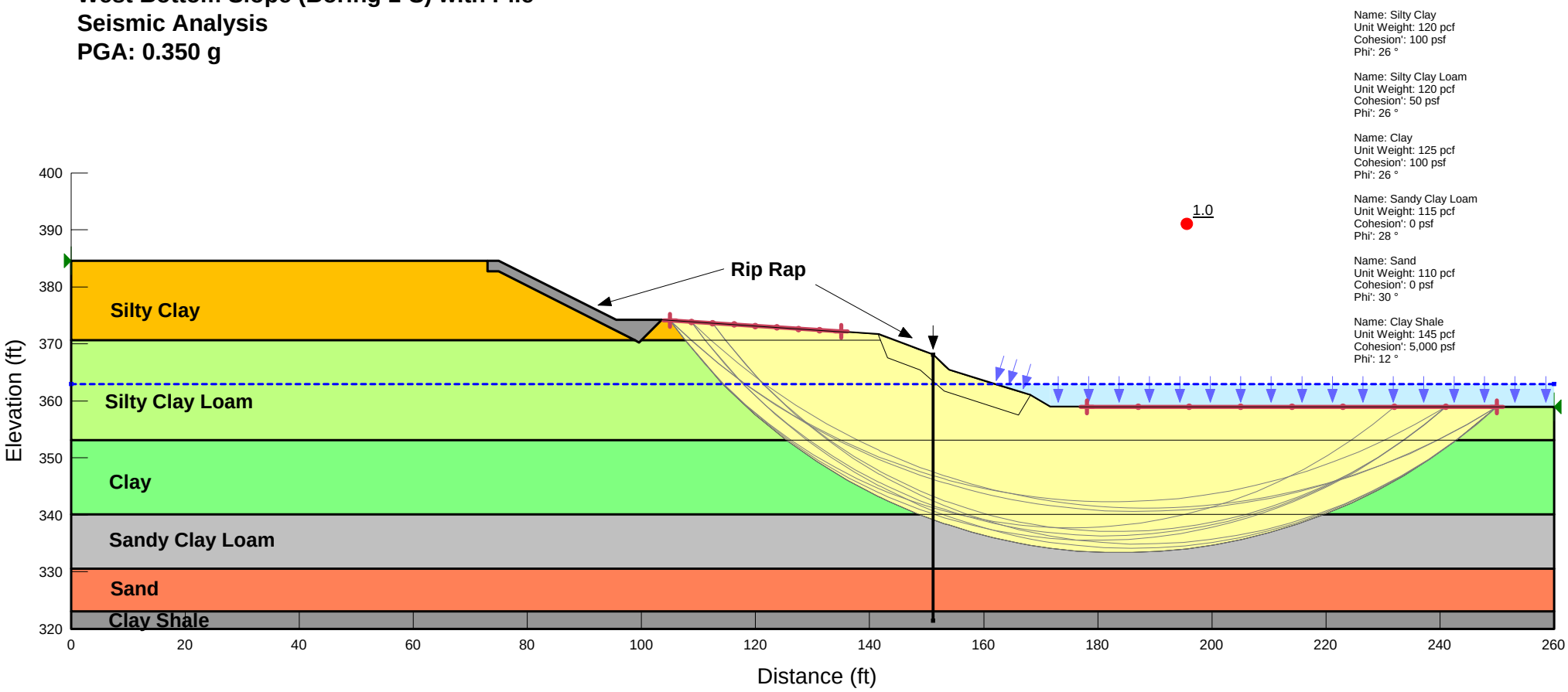


EXHIBIT F

PILE LENGTH/PILE TYPE

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

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. ========== 383.80 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRI 378.80 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 ========== 1904 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 = 292.92 KIPS
Approx. Service Loading Applied per pile spaced at 3 ft. Cts = 109.85 KIPS

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	**577** KIPS	**192** KIPS	**67** FT.

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.)
378.00	0.80	2.10			3.9		42.7	5.7		***11.4***	11	0	0	4	6
375.50	2.50	2.70			14.4	38.8	51.3	21.0	5.7	***31.5***	32	0	0	11	8
373.00	2.50	2.30			12.9	33.0	50.3	18.8	4.9	***48.3***	48	0	0	16	11
370.50	2.50		10	Hard Till	1.1	19.2	***40.9***	1.6	2.8	48.3	41	0	0	14	13
368.00	2.50	0.60			4.7	8.6	***41.2***	6.8	1.3	54.5	41	0	0	14	16
365.50	2.50	0.30			2.5	4.3	***43.7***	3.6	0.6	58.1	44	0	0	15	18
363.00	2.50	0.30			2.5	4.3	***44.7***	3.6	0.6	61.4	45	0	0	15	21
360.50	2.50	0.20			1.7	2.9	***50.7***	2.4	0.4	64.5	51	0	0	17	23
358.00	2.50	0.50			3.9	7.2	***51.7***	5.8	1.1	69.8	52	0	0	17	26
355.50	2.50	0.30			2.5	4.3	***58.5***	3.6	0.6	74.1	59	0	0	20	28
353.00	2.50	0.60			4.7	8.6	***64.6***	6.8	1.3	81.1	65	0	0	22	31
350.50	2.50	0.70			5.3	10.1	92.9	7.8	1.5	***92.2***	92	0	0	31	33
348.00	2.50	2.30			12.9	33.0	***105.8***	18.8	4.9	111.0	106	0	0	35	36
345.50	2.50	2.30			12.9	33.0	***127.3***	18.8	4.9	131.1	127	0	0	42	38
343.00	2.50	2.90			15.1	41.7	***142.4***	22.1	6.2	153.2	142	0	0	47	41
341.50	1.50	2.90			9.1	41.7	***109.9***	13.2	6.2	160.3	110	0	0	37	42
340.50	1.00		0		0.0	0.0	***109.9***	0.0	0.0	160.3	110	0	0	37	43
338.00	2.50		0		0.0	0.0	***109.9***	0.0	0.0	160.3	110	0	0	37	46
335.50	2.50		0		0.0	0.0	***121.3***	0.0	0.0	162.0	121	0	0	40	48
333.00	2.50	0.80			6.0	11.5	***127.3***	8.7	1.7	170.7	127	0	0	42	51
330.50	2.50	0.80			6.0	11.5	***137.6***	8.7	1.7	180.0	138	0	0	46	53
328.00	2.50	1.10			7.8	15.8	***145.4***	11.3	2.3	191.4	145	0	0	48	56
325.50	2.50	1.10			7.8	15.8	***153.1***	11.3	2.3	202.7	153	0	0	51	58
323.00	2.50	1.10			7.8	15.8	***160.9***	11.3	2.3	214.0	161	0	0	54	61
322.50	0.50	1.10			1.6	15.8	274.3	2.3	2.3	***232.8***	233	0	0	78	61
321.50	1.00			Shale	50.5	127.7	324.8	73.6	18.9	***306.4***	306	0	0	102	62.3
320.50	1.00			Shale	50.5	127.7	***375.2***	73.6	18.9	380.0	375	0	0	125	63.3
319.50	1.00			Shale	50.5	127.7	***425.7***	73.6	18.9	453.6	426	0	0	142	64.3
318.50	1.00			Shale	50.5	127.7	***476.2***	73.6	18.9	527.2	476	0	0	159	65.3
317.50	1.00			Shale	50.5	127.7	***526.6***	73.6	18.9	600.8	527	0	0	176	66.3
316.50	1.00			Shale	50.5	127.7	***577.1***	73.6	18.9	674.4	577	0	0	192	67.3
315.50	1.00			Shale	50.5	127.7	***627.5***	73.6	18.9	748.0	~~628~~	~~0~~	~~0~~	~~209~~	~~68.3~~
314.50	1.00			Shale	50.5	127.7	***678.0***	73.6	18.9	821.6	~~678~~	~~0~~	~~0~~	~~226~~	~~69.3~~
313.50	1.00			Shale	50.5	127.7	***728.4***	73.6	18.9	895.2	~~728~~	~~0~~	~~0~~	~~243~~	~~70.3~~
312.50	1.00			Shale	50.5	127.7	***778.9***	73.6	18.9	968.8	~~779~~	~~0~~	~~0~~	~~260~~	~~71.3~~
311.50	1.00			Shale	50.5	127.7	***829.3***	73.6	18.9	1042.4	~~829~~	~~0~~	~~0~~	~~276~~	~~72.3~~
310.50	1.00			Shale	50.5	127.7	***879.8***	73.6	18.9	1116.0	~~880~~	~~0~~	~~0~~	~~293~~	~~73.3~~
309.50	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 1
REFERENCE BORING ========== 1-S
LRFD or ASD or SEISMIC ========== ASD
PILE CUTOFF ELEV. ========== 384.00 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRI 350.00 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 ========== 3553 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 : 546.62 KIPS
Approx. Service Loading Applied per pile spaced at 3 ft. Cts : 204.98 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	**539** KIPS	**180** KIPS	**68** 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.)
348.10	1.90	2.10			9.2		39.4	13.5		***17.9***	18	0	0	6	36
345.60	2.50	2.10			12.2	30.2	44.4	17.7	4.5	***34.6***	35	0	0	12	38
343.10	2.50	1.60			10.2	23.0	54.6	14.8	3.4	***49.5***	49	0	0	16	41
340.60	2.50	1.60			10.2	23.0	***45.6***	14.8	3.4	61.5	46	0	0	15	43
338.10	2.50		2	Very Fine Silty Sand	0.3	3.8	***45.9***	0.5	0.6	61.9	46	0	0	15	46
335.60	2.50		2	Very Fine Silty Sand	0.3	3.8	***46.2***	0.5	0.6	62.4	46	0	0	15	48
333.10	2.50		2	Very Fine Silty Sand	0.3	3.8	***46.5***	0.5	0.6	62.9	47	0	0	16	51
330.60	2.50		2	Very Fine Silty Sand	0.3	3.8	109.4	0.5	0.6	***72.6***	73	0	0	24	53
328.10	2.50		26	Clean Coarse Sand	5.4	66.4	114.8	7.8	9.8	***80.4***	80	0	0	27	56
325.60	2.50		26	Clean Coarse Sand	5.4	66.4	***61.0***	7.8	9.8	79.5	61	0	0	20	58
325.10	0.50	0.50			0.8	7.2	***61.7***	1.2	1.1	80.7	62	0	0	21	59
323.10	2.00	0.50			3.2	7.2	185.4	4.6	1.1	***103.1***	103	0	0	34	61
322.10	1.00			Shale	50.5	127.7	235.9	73.6	18.9	***176.7***	177	0	0	59	61.9
321.10	1.00			Shale	50.5	127.7	286.3	73.6	18.9	***250.3***	250	0	0	83	62.9
320.10	1.00			Shale	50.5	127.7	336.8	73.6	18.9	***323.9***	324	0	0	108	63.9
319.10	1.00			Shale	50.5	127.7	***387.2***	73.6	18.9	397.5	387	0	0	129	64.9
318.10	1.00			Shale	50.5	127.7	***437.7***	73.6	18.9	471.1	438	0	0	146	65.9
317.10	1.00			Shale	50.5	127.7	***488.1***	73.6	18.9	544.7	488	0	0	163	66.9
316.10	1.00			Shale	50.5	127.7	***538.6***	73.6	18.9	618.3	539	0	0	180	67.9
315.10	1.00			Shale	50.5	127.7	***589.0***	73.6	18.9	691.9	~~589~~	~~0~~	~~0~~	~~196~~	~~68.9~~
314.10	1.00			Shale	50.5	127.7	***639.5***	73.6	18.9	765.5	~~639~~	~~0~~	~~0~~	~~213~~	~~69.9~~
313.10	1.00			Shale	50.5	127.7	***689.9***	73.6	18.9	839.1	~~690~~	~~0~~	~~0~~	~~230~~	~~70.9~~
312.10	1.00			Shale	50.5	127.7	***740.4***	73.6	18.9	912.7	~~740~~	~~0~~	~~0~~	~~247~~	~~71.9~~
311.10	1.00			Shale	50.5	127.7	***790.8***	73.6	18.9	986.3	~~791~~	~~0~~	~~0~~	~~264~~	~~72.9~~
310.10	1.00			Shale	50.5	127.7	***841.3***	73.6	18.9	1059.9	~~841~~	~~0~~	~~0~~	~~280~~	~~73.9~~
309.10	1.00			Shale	50.5	127.7	***891.7***	73.6	18.9	1133.5	~~892~~	~~0~~	~~0~~	~~297~~	~~74.9~~
308.10	1.00			Shale	50.5	127.7	***942.2***	73.6	18.9	1207.1	~~942~~	~~0~~	~~0~~	~~314~~	~~75.9~~
307.10	1.00			Shale	50.5	127.7	***992.6***	73.6	18.9	1280.7	~~993~~	~~0~~	~~0~~	~~331~~	~~76.9~~
306.10	1.00			Shale	50.5	127.7	***1043.1***	73.6	18.9	1354.3	~~1043~~	~~0~~	~~0~~	~~348~~	~~77.9~~
305.10	1.00			Shale	50.5	127.7	***1093.5***	73.6	18.9	1427.9	~~1094~~	~~0~~	~~0~~	~~365~~	~~78.9~~
304.10	1.00			Shale	50.5	127.7	***1144.0***	73.6	18.9	1501.5	~~1144~~	~~0~~	~~0~~	~~381~~	~~79.9~~
303.10	1.00			Shale	50.5	127.7	***1194.4***	73.6	18.9	1575.1	~~1194~~	~~0~~	~~0~~	~~398~~	~~80.9~~
302.10	1.00			Shale	50.5	127.7	***1244.9***	73.6	18.9	1648.7	~~1245~~	~~0~~	~~0~~	~~415~~	~~81.9~~
301.10	1.00			Shale	50.5	127.7	***1295.4***	73.6	18.9	1722.3	~~1295~~	~~0~~	~~0~~	~~432~~	~~82.9~~
300.10	1.00			Shale	50.5	127.7	***1345.8***	73.6	18.9	1795.9	~~1346~~	~~0~~	~~0~~	~~449~~	~~83.9~~
299.10	1.00			Shale	50.5	127.7	***1396.3***	73.6	18.9	1869.5	~~1396~~	~~0~~	~~0~~	~~465~~	~~84.9~~
298.10	1.00			Shale	50.5	127.7	***1446.7***	73.6	18.9	1943.1	~~1447~~	~~0~~	~~0~~	~~482~~	~~85.9~~
297.10	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. ========== 383.80 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRI 353.00 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 ========== 3553 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 : 546.62 KIPS
Approx. Service Loading Applied per pile spaced at 3 ft. Cts : 204.98 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	**68** 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.)
350.50	2.50	2.30			12.9		45.9	18.8		***23.7***	24	0	0	8	33
348.00	2.50	2.30			12.9	33.0	67.5	18.8	4.9	***43.8***	44	0	0	15	36
345.50	2.50	2.90			15.1	41.7	82.6	22.1	6.2	***65.8***	66	0	0	22	38
343.00	2.50	2.90			15.1	41.7	97.7	22.1	6.2	***87.9***	88	0	0	29	41
341.50	1.50	2.90			9.1	41.7	***65.1***	13.2	6.2	95.0	65	0	0	22	42
339.00	2.50		0	Very Fine Silty Sand	0.0	0.0	***65.1***	0.0	0.0	95.0	65	0	0	22	45
336.50	2.50		0	Very Fine Silty Sand	0.0	0.0	***65.1***	0.0	0.0	95.0	65	0	0	22	47
335.50	1.00		0	Very Fine Silty Sand	0.0	0.0	***76.6***	0.0	0.0	96.7	77	0	0	26	48
333.00	2.50	0.80			6.0	11.5	***82.6***	8.7	1.7	105.4	83	0	0	28	51
330.50	2.50	0.80			6.0	11.5	***92.9***	8.7	1.7	114.8	93	0	0	31	53
328.00	2.50	1.10			7.8	15.8	***100.6***	11.3	2.3	126.1	101	0	0	34	56
325.50	2.50	1.10			7.8	15.8	***108.4***	11.3	2.3	137.4	108	0	0	36	58
323.00	2.50	1.10			7.8	15.8	***116.1***	11.3	2.3	148.7	116	0	0	39	61
322.50	0.50	1.10			1.6	15.8	229.6	2.3	2.3	***167.5***	168	0	0	56	61
321.50	1.00			Shale	50.5	127.7	280.0	73.6	18.9	***241.1***	241	0	0	80	62.3
320.50	1.00			Shale	50.5	127.7	330.5	73.6	18.9	***314.7***	315	0	0	105	63.3
319.50	1.00			Shale	50.5	127.7	***381.0***	73.6	18.9	388.3	381	0	0	127	64.3
318.50	1.00			Shale	50.5	127.7	***431.4***	73.6	18.9	461.9	431	0	0	144	65.3
317.50	1.00			Shale	50.5	127.7	***481.9***	73.6	18.9	535.5	482	0	0	161	66.3
316.50	1.00			Shale	50.5	127.7	***532.3***	73.6	18.9	609.1	532	0	0	177	67.3
315.50	1.00			Shale	50.5	127.7	***582.8***	73.6	18.9	682.7	583	0	0	194	68.3
314.50	1.00			Shale	50.5	127.7	***633.2***	73.6	18.9	756.3	~~633~~	~~0~~	~~0~~	~~211~~	~~69.3~~
313.50	1.00			Shale	50.5	127.7	***683.7***	73.6	18.9	829.9	~~684~~	~~0~~	~~0~~	~~228~~	~~70.3~~
312.50	1.00			Shale	50.5	127.7	***734.1***	73.6	18.9	903.5	~~734~~	~~0~~	~~0~~	~~245~~	~~71.3~~
311.50	1.00			Shale	50.5	127.7	***784.6***	73.6	18.9	977.1	~~785~~	~~0~~	~~0~~	~~262~~	~~72.3~~
310.50	1.00			Shale	50.5	127.7	***835.0***	73.6	18.9	1050.7	~~835~~	~~0~~	~~0~~	~~278~~	~~73.3~~
309.50	1.00			Shale	50.5	127.7	***885.5***	73.6	18.9	1124.3	~~885~~	~~0~~	~~0~~	~~295~~	~~74.3~~
308.50	1.00			Shale	50.5	127.7	***935.9***	73.6	18.9	1197.9	~~936~~	~~0~~	~~0~~	~~312~~	~~75.3~~
307.50	1.00			Shale	50.5	127.7	***986.4***	73.6	18.9	1271.5	~~986~~	~~0~~	~~0~~	~~329~~	~~76.3~~
306.50	1.00			Shale	50.5	127.7	***1036.8***	73.6	18.9	1345.1	~~1037~~	~~0~~	~~0~~	~~346~~	~~77.3~~
305.50	1.00			Shale	50.5	127.7	***1087.3***	73.6	18.9	1418.7	~~1087~~	~~0~~	~~0~~	~~362~~	~~78.3~~
304.50	1.00			Shale	50.5	127.7	***1137.7***	73.6	18.9	1492.3	~~1138~~	~~0~~	~~0~~	~~379~~	~~79.3~~
303.50	1.00			Shale	50.5	127.7	***1188.2***	73.6	18.9	1565.9	~~1188~~	~~0~~	~~0~~	~~396~~	~~80.3~~
302.50	1.00			Shale	50.5	127.7	***1238.6***	73.6	18.9	1639.5	~~1239~~	~~0~~	~~0~~	~~413~~	~~81.3~~
301.50	1.00			Shale	50.5	127.7	***1289.1***	73.6	18.9	1713.1	~~1289~~	~~0~~	~~0~~	~~430~~	~~82.3~~
300.50	1.00			Shale	50.5	127.7	***1339.5***	73.6	18.9	1786.7	~~1340~~	~~0~~	~~0~~	~~447~~	~~83.3~~
299.50	1.00			Shale	50.5	127.7	***1390.0***	73.6	18.9	1860.3	~~1390~~	~~0~~	~~0~~	~~463~~	~~84.3~~
298.50	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========== West Abut
REFERENCE BORING ========== 1-S
LRFD or ASD or SEISMIC ========== ASD
PILE CUTOFF ELEV. ========== 384.00 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRI 379.00 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 ========== 1904 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 = 292.92 KIPS
Approx. Service Loading Applied per pile spaced at 3 ft. Cts = 109.85 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	**568** KIPS	**189** KIPS	**67** 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.)
378.10	0.90	2.70			5.2		35.3	7.6		***12.0***	12	0	0	4	6
375.60	2.50	2.10			12.2	30.2	53.2	17.7	4.5	***30.6***	31	0	0	10	8
373.10	2.50	2.50			13.6	35.9	66.9	19.9	5.3	***50.5***	50	0	0	17	11
370.60	2.50	2.50			13.6	35.9	***48.9***	19.9	5.3	65.7	49	0	0	16	13
368.10	2.50	0.30			2.5	4.3	***49.9***	3.6	0.6	69.1	50	0	0	17	16
365.60	2.50	0.20			1.7	2.9	***50.2***	2.4	0.4	71.3	50	0	0	17	18
363.10	2.50	0.10			0.8	1.4	***55.3***	1.2	0.2	73.2	55	0	0	18	21
360.60	2.50	0.40			3.2	5.7	***60.0***	4.7	0.8	78.1	60	0	0	20	23
358.10	2.50	0.50			3.9	7.2	***63.9***	5.8	1.1	83.8	64	0	0	21	26
355.60	2.50	0.50			3.9	7.2	***70.7***	5.8	1.1	90.0	71	0	0	24	28
353.10	2.50	0.70			5.3	10.1	***91.9***	7.8	1.5	100.1	92	0	0	31	31
350.60	2.50	1.80			11.0	25.9	***107.2***	16.1	3.8	116.8	107	0	0	36	33
348.10	2.50	2.10			12.2	30.2	***119.3***	17.7	4.5	134.5	119	0	0	40	36
345.60	2.50	2.10			12.2	30.2	***124.3***	17.7	4.5	151.2	124	0	0	41	38
343.10	2.50	1.60			10.2	23.0	***134.5***	14.8	3.4	166.1	134	0	0	45	41
340.60	2.50	1.60			10.2	23.0	***125.5***	14.8	3.4	178.1	126	0	0	42	43
338.10	2.50		2	Very Fine Silty Sand	0.3	3.8	***125.8***	0.5	0.6	178.5	126	0	0	42	46
335.60	2.50		2	Very Fine Silty Sand	0.3	3.8	***126.1***	0.5	0.6	179.0	126	0	0	42	48
333.10	2.50		2	Very Fine Silty Sand	0.3	3.8	***126.5***	0.5	0.6	179.5	126	0	0	42	51
330.60	2.50		2	Very Fine Silty Sand	0.3	3.8	189.4	0.5	0.6	***189.2***	189	0	0	63	53
328.10	2.50		26	Clean Coarse Sand	5.4	66.4	***194.7***	7.8	9.8	197.0	195	0	0	65	56
325.60	2.50		26	Clean Coarse Sand	5.4	66.4	***140.9***	7.8	9.8	196.1	141	0	0	47	58
325.10	0.50	0.50			0.8	7.2	***141.7***	1.2	1.1	197.3	142	0	0	47	59
323.10	2.00	0.50			3.2	7.2	265.4	4.6	1.1	***219.7***	220	0	0	73	61
322.10	1.00			Shale	50.5	127.7	315.8	73.6	18.9	***293.3***	293	0	0	98	61.9
321.10	1.00			Shale	50.5	127.7	***366.3***	73.6	18.9	366.9	366	0	0	122	62.9
320.10	1.00			Shale	50.5	127.7	***416.7***	73.6	18.9	440.5	417	0	0	139	63.9
319.10	1.00			Shale	50.5	127.7	***467.2***	73.6	18.9	514.1	467	0	0	156	64.9
318.10	1.00			Shale	50.5	127.7	***517.6***	73.6	18.9	587.7	518	0	0	173	65.9
317.10	1.00			Shale	50.5	127.7	***568.1***	73.6	18.9	661.3	568	0	0	189	66.9
316.10	1.00			Shale	50.5	127.7	***618.5***	73.6	18.9	734.9	~~619~~	~~0~~	~~0~~	~~206~~	~~67.9~~
315.10	1.00			Shale	50.5	127.7	***669.0***	73.6	18.9	808.5	~~669~~	~~0~~	~~0~~	~~223~~	~~68.9~~
314.10	1.00			Shale	50.5	127.7	***719.4***	73.6	18.9	882.1	~~719~~	~~0~~	~~0~~	~~240~~	~~69.9~~
313.10	1.00			Shale	50.5	127.7	***769.9***	73.6	18.9	955.7	~~770~~	~~0~~	~~0~~	~~257~~	~~70.9~~
312.10	1.00			Shale	50.5	127.7	***820.3***	73.6	18.9	1029.3	~~820~~	~~0~~	~~0~~	~~273~~	~~71.9~~
311.10	1.00			Shale	50.5	127.7	***870.8***	73.6	18.9	1102.9	~~871~~	~~0~~	~~0~~	~~290~~	~~72.9~~
310.10	1.00			Shale	50.5	127.7	***921.2***	73.6	18.9	1176.5	~~921~~	~~0~~	~~0~~	~~307~~	~~73.9~~
309.10	1.00			Shale		127.7			18.9						

EXHIBIT G

MINE MAP

ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

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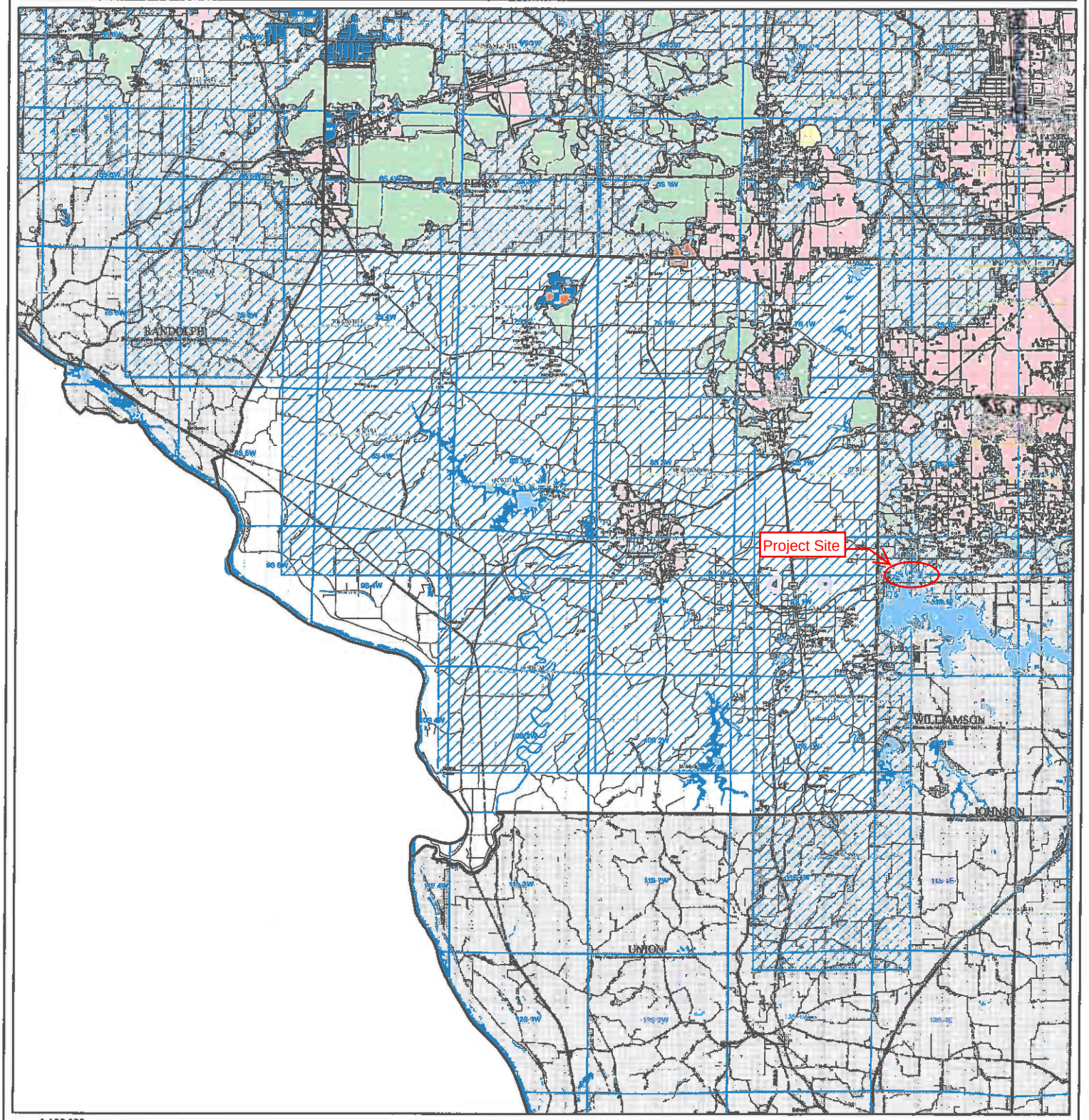
http://www.isgs.illinois.edu

Coal Mines and Underground Industrial Mines
JACKSON
County

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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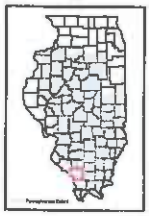

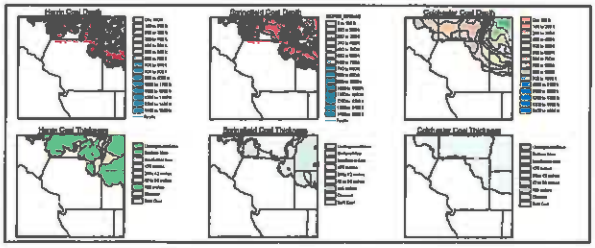

- County
- Township
- Section
- Quadrangle study (Available on Website)
- Lake or river
- Coal mine - active
- Underground coal mine - abandoned
- Surface coal mine - abandoned
- Indefinite underground coal mine boundary - abandoned
- Underground industrial mine and surrounding buffer region
- 951,884 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 encompasses 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 in 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 mine 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 ownership or decision-making. Data reduced in this final 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.