STRUCTURE
GEOTECHNICAL REPORT

Box Culvert Replacement
I-41 over Gallett Creek

Existing S. N. 029-1000
Proposed S. N. 029-2501

F.A.P. ROUTE 574
Section (12) CR
Fulton County, Illinois
Contract No.: 68C64
PTB: 149-23
Job No.: D-94-002-09
BFW No. 18020

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Executive Summary

Bacon Farmer Workman Engineering & Testing, Inc. (BFW) has developed this Structure Geotechnical Report (SGR) to provide a summary of geotechnical engineering analysis of a proposed replacement triple barrel, reinforced concrete box culvert for IL 41 crossing Gallett Creek (F.A.P. RTE. 574 – Section (12) CR) in Fulton County, Illinois.

Based on subsurface boring data, soft soils were encountered immediately below the proposed box culvert elevations. Due to potential problems with differential settlements across the culvert footprint, an undercut of 2 feet to remove unsuitable materials along the entire length of the culvert was recommended. The undercut area is to include wing wall foundation footprints if other than horizontal cantilever or sheet pile walls are used. The use of geotechnical fabric at the base of the undercut with backfill of 18-inch of rock fill with 6-inch cap of porous granular embankment is recommended. With the recommended undercut, the natural soils beneath and the newly placed backfill materials are adequate to support the proposed box culvert and wingwall loads without excessive settlement.

Phased construction is proposed for the construction of the box culvert. Due to potential interference of temporary sheet piles with 24-inch undercut and excess retained height, the use of Temporary Sheet Piles walls is not feasible for phased construction. The use of a Temporary Soil Retention System will be required.

Slope stability analysis for the box culvert end slopes was analyzed for a wingwall geometry of 1 vertical to 2 horizontal (1V:2H) slopes. The required factor of safety (FOS) for each of the three conditions analyzed were met or exceeded. If the final design of the wingwall sideslopes are greater than the assumed geometry, then BFW should be contacted to determine if the required FOS are still met.

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1.0 General Project Description and Proposed Structure Information

1.1 Introduction

The purpose of this Structure Geotechnical Report (SGR) is to document subsurface conditions observed at the project site and provide geotechnical analysis of anticipated conditions related to the proposed structure and to provide engineering design and construction recommendations. This SGR was developed by Bacon Farmer Workman Engineering and Testing, Inc. (BFW) using drilling data provided by Geo Services Inc.

1.2 Project Description

The project will consist of the complete replacement of the existing double box culvert (SN 029-1000) with a triple barrel, cast-in-place reinforced concrete box culvert (Proposed SN 029-2501) located on IL 41 crossing Gallett Creek (F.A.P. RTE. 574 – Section (12) CR) in Fulton County, Illinois. The project site is approximately 1.0 miles east of Prairie City, Illinois.

A general structure location map is shown on a USGS Topographic Location Map, Appendix A. The site lies within the limits of Forth Principal Meridian (T. 7N R. 1E Section 6) within Fulton County in the Galesburg Plain Physiographic Region.

1.3 Existing Structure Information

The existing structure (SN 029-1000) was originally build in 1924 under S.B.I. Rte. 41, Section 11. The existing culvert was constructed as double (6' W x 7' H) barrel box culvert with attached T-type wingwalls that are parallel to the roadway.

An Abbreviated Bridge Condition Report (BCR) dated November 2017 recommends the complete replacement of the existing structure due to inadequate freeboard and to being severely deteriorated with spalling of the barrel and top slab with exposed rebar and cracked wingwalls. In addition, current modelling indicates that a design storm would overtop the existing structure.

1.4 Proposed Structure Information

The proposed structure (SN 029-2501) will consist of a triple barrel, 10 feet by 7 feet concrete box culvert with 45° skew. The proposed structure length along the skew is 61'- 3" out to out headwalls. The proposed culvert centerline station will be 17+93.50.

A preliminary Type, Size and Location Plan (TS&L), as provided by Fuhrmann Engineering is included in Appendix B. The need for channel protection is anticipated due to the presence of noncohesive materials within the creek channel and the potential for scour.

Based on TS&L, the upstream and downstream flowline elevations are El. 624.57 and 623.91, respectively. The proposed roadway profile grade will be raised by approximately 1.33 feet at the structure to meet freeboard requirements for the design storm. Stage construction will be used to construct new structure. Two-way traffic will be maintained on a single lane by use of temporary traffic signals.

2.0 Site Investigation, Subsurface Exploration and Generalized Subsurface Conditions

The subsurface investigation was conducted and logged by Geo Services, Inc. BFW was not present on-site during subsurface activities. Therefore, no observations were made by BFW concerning the conditions of subsurface surface samples or test results obtained.

Based on information provided, three Standard Penetration Test (SPT) borings were advanced on the east side of the existing structure and were designated as B-1 (Sta. 17+88, 8.0 ft. LT), B-2 (Sta. 17+86, 63.0 ft. LT) and B-3 (Sta. 17+74, 40.0 ft. RT). Boring were advanced on June 27, 2017.

Subsurface boring locations are shown on the TS&L Plan found in the Appendix B of this report. Boring logs provided by Geo Services, Inc are included in Appendix C with a subsurface soil profile included in Appendix C.

2.1 Subsurface Conditions

General subsurface conditions for all three borings across the site are presented in the following paragraph. Surface coverage ranged from approximately 1.0 ft. thick hot mix asphalt (HMA) and Portland cement concrete (PCC) to grass covered earth. Below the surface coverage, a dark brown, medium stiff to stiff, silty clay loam was encountered and extended to depths between approximately El. 625.30 to 623.90 to. Standard Penetration Tests (SPT) driving resistances (N-values) ranged between 3 to 11 with unconfined compressive strengths (Q_u) ranging from 0.3 to 2.0 tons per square foot (tsf) with soil moistures ranging from 19 to 41 percent. Below the stiff silty clay loam, a dark gray to blue-gray, moist, very soft clay was encountered and extended to depths between 622.80 to 621.40. N-value of 2 to 6 and Qu value of <0.25 to 0.6 tsf were encountered. Below these depths a light gray to light brown, moist to wet

Below Elev. 622.80 the soils transitioned to light gray to brown, soft to medium stiff, silty clay loams. N-values within the soils ranged from 5 to 6 with Qu values ranging from 0.4 to 1.0 tsf and soil moisture ranging from 21 to 22 percent. Below Elev. 617.80 the soils transitioned to gray stiff to very stiff, silty clay loam till. N-values ranged from 7 to 16 with Qu values ranging from 1.0 to 2.1 with moistures ranging from 12 to 14 percent. The boring was terminated in clay loam till at El. 601.30 approximately 35 ft. below ground surface.

Boring B-2, (El. 632.40) profile included a surface coverage of topsoil/organics followed by approximately 8.5 ft. (El. 623.90) of dark brown, very stiff, silty clay loam. N-values ranged from 5 to 11, Q_u values of 2.0 tsf and moisture contents of 19 percent. From El. 623.90 to El. 621.40, a medium stiff blue-gray silty clay layer was encountered with N-value of 6 and

Q_u value of 0.6 tsf and moisture of 25 percent. Below El. 621.40, the silty clays transitioned into medium stiff, silty clay loams with N-values ranging from 7 to 9, Qu values ranging from 0.5 to 1.0 tsf and soil moistures ranging from 19 to 24 percent. Below El. 616.40 the soils transitioned into a gray, moist, stiff, clay loam till. With the clay loam till, N-values ranged from 11 to 16, Qu values ranged from 1.0 to 1.8 tsf and soil moisture ranged from 12 to 14 percent. The boring was terminated at El. 597.40 approximately 35 feet below ground surface.

Boring B-3, (El. 633.30) profile included a surface coverage of 6.5 feet. thick layer of sand and gravel. An N-values of 7 was the only data available for the upper 6.5 feet of sand and gravel. Below the upper sand and gravel layer from El. 626.80 to El. 624.30, a brown to gray, stiff silty clay was encountered. An N-value of 4, Q_u values from 0.6 tsf and moisture content of 30 percent was obtained. Below El. 624.30 to medium stiff silty clay transitioned in a wet, very soft, gray silty clay loam with N-values of 4 and Qu values of < 0.25 tsf and moisture content of 32. The very soft layer extended for approximately 2.5 feet where the silty clay load transitioned into interbedded, loose sands with trace gravel and sandy clay loam tills and sandy loams. Within the loose sands, sandy clay tills and sandy loams, N-value ranging from 4 to 22, Q_u values (where available) ranged from 0.5 to 1.2 tsf and moistures ranging from 14 to 20 percent. Below El. 599.30 the soil transitioned to gray, very stiff, clay loam till. N-values with in the clay loam till ranged from 17 to 25, Qu values ranged from 2.5 to 3.7 with soil moistures ranging from 12 to 13 percent. The boring was terminated in the very stiff clay loam till at El. 592.80 approximately 40.5 feet below ground surface.

2.2 Groundwater

Groundwater was first encountered during drilling activities in each of the borings at similar depths of between El. 619.9 to 622.8. Twenty-four-hour groundwater readings were observed in two of the borings and ranged from Elev. 626.5 to 629.3. Given the short time for groundwater elevation monitoring, the true groundwater elevation may not be known. Longer times are required for more accurate groundwater elevation readings. All groundwater readings are subject to seasonal and rainfall variations.

3.0 Geotechnical Evaluations

3.1 Settlement

As stated in the Subsurface Conditions section of this report, the soil profile consisted of silty clay, loams, sands, sandy loams and clay loam till with cohesive soil consistencies ranging from soft to medium stiff and loose to dense for non-cohesive.

Based on subsurface boring data, soft soils were encountered immediately below the proposed box culvert elevations. In addition, based on the preliminary TS&L, the end portions of the new culvert location will extend to the existing stream channel in previously unloaded channel sediments. Therefore, differential settlements are likely across the box culvert area.

Due to the potential for differential settlements across the culvert footprint, it is recommended that the culvert plans include a 2-ft undercut to remove unsuitable material along the entire length of culvert. The undercut should extend the width of the box culvert plus 2 feet beyond each side of the box. Geotechnical fabric should be placed for ground stabilization at the base of the undercut and backfill with 18" of rock fill and cap with 6" porous granular embankment. See IDOT CADD Standard 540000-D4. The undercut area should include wing wall foundation footprints if other than horizontal cantilever or sheet pile walls are used.

With the recommended undercut the natural soils beneath and the newly placed backfill materials are adequate to support the proposed box culvert and wingwall loads with anticipated settlements less than 0.5-inch.

3.2 Bearing Resistance

Based on the preliminary TS&L, wingwall lengths for the proposed culvert will be 21'-6" for the northeast and southwest corners and 9'-3" for the northwest and southeast corners. Due to the lengths L-Type two-way cantilevered wingwalls are proposed for the northeast and southwest corners. Horizontal cantilever wingwalls are proposed for the northwest and southeast corners. The use of L-type cantilever wingwalls may be used provided that the undercut area includes wing wall foundation footprints.

For non-cantilevered wingwall foundations founded on the granular embankment, then the foundation should be sized at the service limit state using an allowable bearing resistance of **2.4 ksf**. For checking strength and extreme limits states, the nominal bearing resistance was determined to be **7.5 ksf**. Use resistance factors of 0.45 and 1.0 for the strength and extreme limit state analysis, respectively should be used.

If during construction, the conditions of the foundation subgrades encountered are not representative of the conditions of the borings, BFW should be contacted.

3.3 Slope Stability

Slope stability of the wingwall sideslopes was evaluated using a slope stability analysis software: *GSTABL7 with STEDwin* using a wingwall sideslope geometry of 1V:2H and soil characteristics from borings, B-1, B-2 and B-3. Site conditions including end-of-construction, long term stability and design seismic event were modeled. The *GSTABL7* program calculated critical factor of safety (FOS) for each condition. Based on IDOT requirements, the target FOS for end-of-construction and long-term slope stability is 1.5 and 1.0 for the design seismic event.

To model the end-of-construction conditions, undrained soil parameters were used with a friction angle of 0° assumed for cohesive soils. Drained soil parameters with assumed friction angles ranging from 22° to 27° were used to model the long-term and seismic conditions to analyze the conditions where excess pore water pressure from construction has dissipated. For cohesive materials, a nominal cohesion value of 20 to 50 psf was included in the drained strength parameters.

The Modified Bishop Method was used to calculate the factor of safety for given conditions. The Modified Bishop Method generates circular-arc failure surfaces to calculate critical failure surfaces. The calculated FOS are provided in Table 1.0 Output from the GSTABLE7 *with STEDwin* can be found in Appendix E.

Based on slope stability analysis, results indicated acceptable FOS for all three conditions.

Table 1.0

Location	Short Term (End of Construction	Long Term	Seismic
Wingwall Sideslope Station 17+86 (B-2)	2.5	1.8	1.3

3.4 Seismic Considerations

Per IDOT Culvert Manual (Jan. 2017), Page 3-2, buried structures are not designed for seismic effects. Wingwalls and retaining walls adjacent to culvert are considered parts of the buried structure.

3.5 Scour

Based on the preliminary TS&L (Appendix B), the approximate invert elevation at the upstream end of the box culvert is El. 624.57 and at the discharge end is EL. 623.91. The assumed design scour elevations for the proposed box culvert are at the bottom of the cutoff wall shown on the preliminary TS&L, approximately 3 ft. below the invert elevations. Based on the Culvert Waterway Information Table (Oct 21, 2016), the calculated outlet velocities are approximately 2.46 fps. Therefore, potential scour should be minimal near the culvert inlet and outlet. However, given the presence of some cohesionless soils in the existing creek channel the use of channel protection at the inlet and outlet are recommended.

3.6 Mining Activity

Based on a review of the Illinois State Geological Survey's (ISGS) website (http://isgs.illinois.edu/ilmines), no coal mining has been conducted in the area of the proposed box culvert area.

4.0 Foundation Evaluations and Design Recommendations

Based on the results of the subsurface exploration, current site conditions observed, and laboratory results, items of geotechnical interest and considerations are discussed in the following sections.

4.1 Box Culvert

Due to unsuitable soils immediately below the culvert bottom slab elevation, the plans should include a 2-ft undercut to remove unsuitable material along the entire length of culvert. The undercut should extend the width of the box culvert plus 2 feet beyond each side of the box. Geotechnical fabric for ground stabilization should be placed at the base of the undercut and backfill with 18" of rock fill and cap with 6" porous granular embankment. See IDOT CADD Standard 540000-D4. The undercut area should include wing wall foundation footprints if other than horizontal cantilever or sheet pile walls are used.
Based on the recommended soil undercut below the bearing elevation of the culvert bottom slab the potential for excessive settlement will be minimized. Additionally, based on the available waterway information the proposed culvert is not in a flood prone area. Therefore, the use of either precast culvert sections or cast-in-place concrete appear feasible for design.

5.0 Construction Considerations

Based on the results of the subsurface exploration, current site conditions observed, and laboratory results, items of geotechnical interest and considerations are discussed in the following sections.

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. Should any design considerations that were assumed by BFW change, BFW should be contacted to determine if the recommendations are still valid.

5.2 Temporary Sheeting and Soil Retention

Based on information provided in the TS&L, two-way traffic will be maintained, and construction will involve staged construction. The proposed culvert is positioned such that during Stage 1, new construction of the northern box section and wingwalls will begin immediately east of the existing box culvert. The existing box culvert will remain in place to allow for normal water flow and drainage. The existing soil will need to be temporarily retained during this phase.

During Stage 2, the existing box culvert will remain, but temporary pipes will be placed in the north end of the existing box culvert to provide drainage during Stage 2 construction. Once new structure has been completed, the temporary pipes and existing structure cells are proposed to be filled with flowable fill. Additional area will need to be temporarily retained during the Stage 2 construction.

Due to potential interference of recommended 24-inch undercut and excess retained height, the use of Temporary Sheet Piles walls is not feasible for phased construction. The use of a Temporary Soil Retention System will be required for the phased construction. The Temporary Soil Retention System will require an Illinois licensed structural engineer for design.

5.3 Site and Soil Conditions

Based on subsurface soil data obtained the provisions of the Standard Specifications will adequately address the anticipated site and soils conditions.

5.4 Wing Wall Types

Based on the preliminary TS&L, wingwall lengths for the proposed culvert will be 21'-6" for the northeast and southwest corners and 9'-3" for the northwest and southeast corners. Due to the lengths L-Type two-way cantilevered wingwalls are proposed for the northeast and southwest corners. Horizontal cantilever wingwalls are proposed for the northwest and southeast corners. The use of L-type cantilever wingwalls may be used provided that the undercut area includes wing wall foundation footprints.

From the IDOT Culvert Manual - Section 4 Headwalls and Wingwalls, lateral earth pressures were determined from Table 4.1.1.2-1 by method shown on Figure 4.1.1.2-2 and are provided on the following chart.

Table 2
Earth Pressures

Horizontal Cantilever		**Sheet Piling**	
P_H (pcf)	P_V (pcf)	P_H (pcf)	P_V (pcf)
63	11	45	8

6.0 Computations

Any engineering computations that were conducted for special circumstances, if present, are provided in the appendix of this report. Slope stability calculations were conducted using *GSTABL7 with STEDwin*.

7.0 Geotechnical Data

Subsurface boring logs and boring profile sheet are provided in the appendix of this report.

Appendix A

USGS Topographic Location Map

Project Location

Avon

Bushnell

E

41

650

660

Project Location Map

I-41 Over Gallett Creek

Fulton County, Illnois

BFW
BACON | FARMER | WORKMAN
ENGINEERING & TESTING, INC.
500 SOUTH 17TH STREET
PADUCAH, KY 42003

Appendix B

Type, Size, and Location Plan (TS&L)

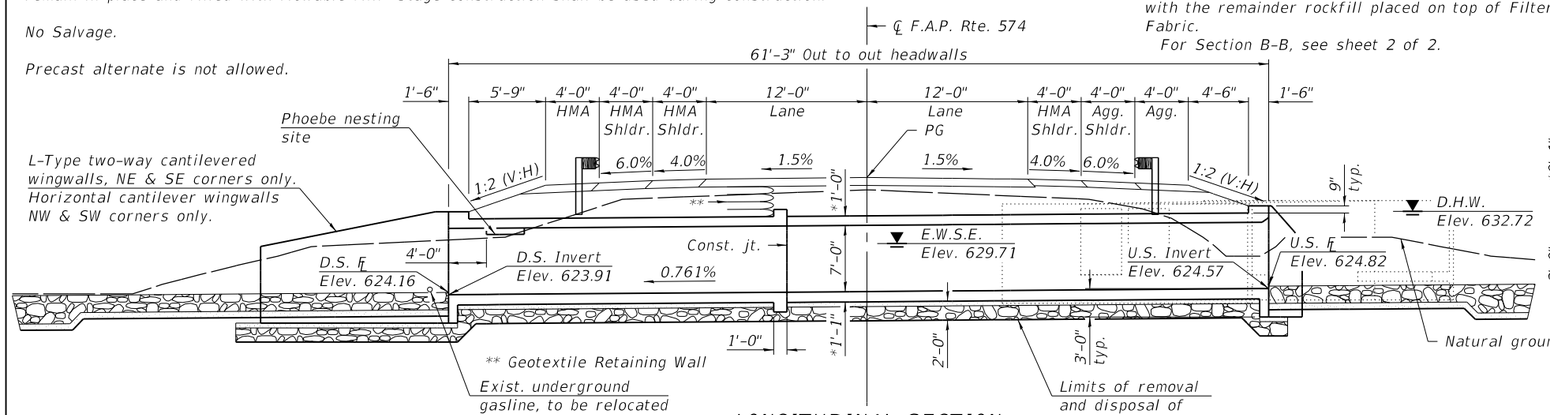
Benchmark: R.R. spike in South face of North power pole east of S.N. 029-1000, Sta. 15+64.50, 25.6' Lt., Elev. 637.933.

Existing Structure: S.N. 029-1000 was built in 1924 under S.B.I. Rte. 41, Section 11. The existing structure is a a double 6'x7' barrel culvert with attached T-type wingwalls that are parallel to the roadway. Existing structure to remain in place and filled with flowable fill. Stage construction shall be used during construction.

No Salvage.

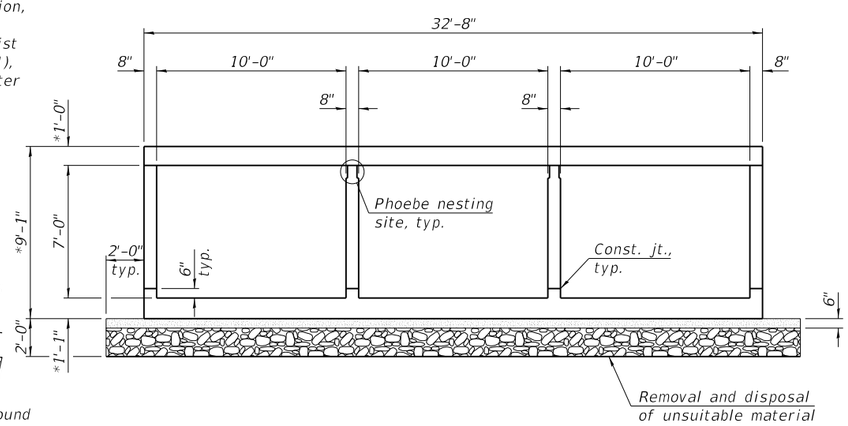
Precast alternate is not allowed.

Notes:
Stage construction details, waterway information, and profile grade shown on sheet 2 of 2.
Replacement of unsuitable material shall consist of 6" Porous Granular Embankment (CA7 or CA11), with the remainder rockfill placed on top of Filter Fabric.
For Section B-B, see sheet 2 of 2.



LONGITUDINAL SECTION

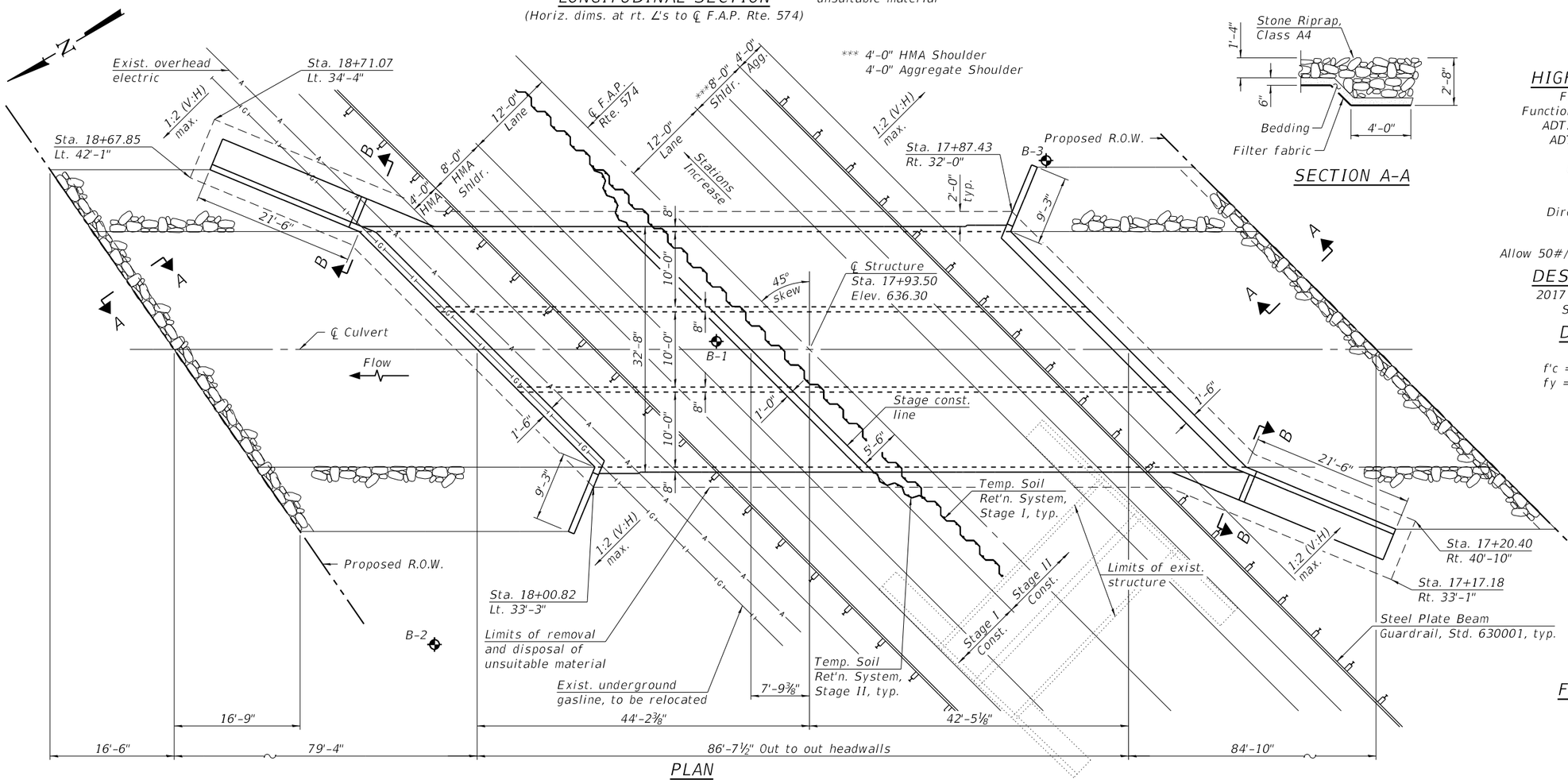
(Horiz. dims. at rt. ∠'s to ℄ F.A.P. Rte. 574)



SECTION THRU BARREL

*Slab thickness may be refined in final design.

*** 4'-0" HMA Shoulder
4'-0" Aggregate Shoulder



PLAN

SECTION A-A

HIGHWAY CLASSIFICATION

F.A.P. Rte. 574 - IL Rte. 41
Functional Class: Minor Arterial-Rural
ADT: 1,950 (2015); 2,379 (2035)
ADTT: 370 (2015); 452 (2035)
DHV: 216 (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.

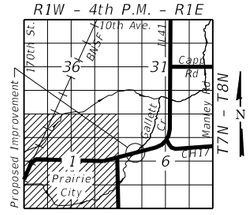
DESIGN SPECIFICATIONS

2017 AASHTO LRFD Bridge Design Specifications, 8th Edition

DESIGN STRESSES

FIELD UNITS

f'c = 3,500 psi
fy = 60,000 psi (Reinforcement)



LOCATION SKETCH

GENERAL PLAN & ELEVATION
IL 41 OVER GALLETT CREEK
F.A.P. RTE. 574 - SECTION (12)CR
FULTON COUNTY
17+93.50
STRUCTURE NO. 029-2501

FUHRMANN ENGINEERING

USER NAME =	DESIGNED - E.M. Lagemann	REVISED -	
	CHECKED - R.A. Lee	REVISED -	
PLOT SCALE =	DRAWN - E.M. Lagemann	REVISED -	
PLOT DATE =	CHECKED - R.A. Lee	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET 1 OF 2 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
574	(12)CR	Fulton		
		CONTRACT NO. 68C64		
	ILLINOIS	FED. AID PROJECT		

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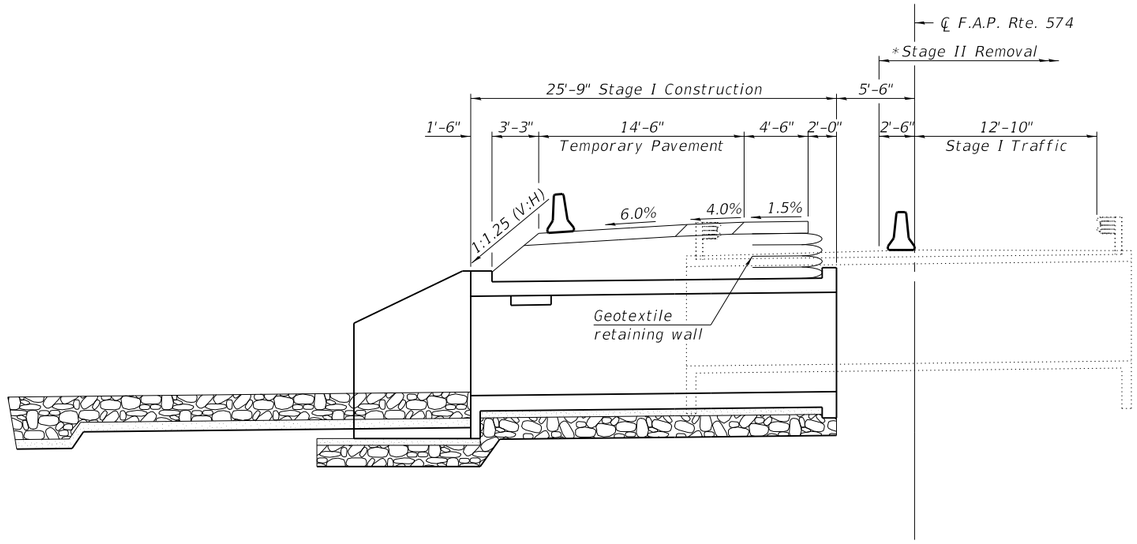
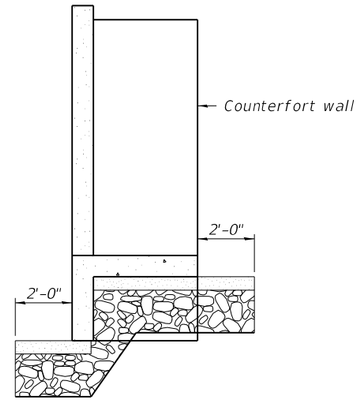


LONGITUDINAL SECTION - STAGE I CONSTRUCTION

*Stage II Removal limited to southeast wingwall.

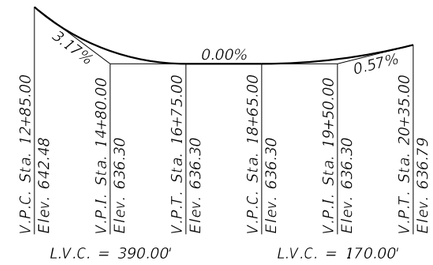


SECTION B-B

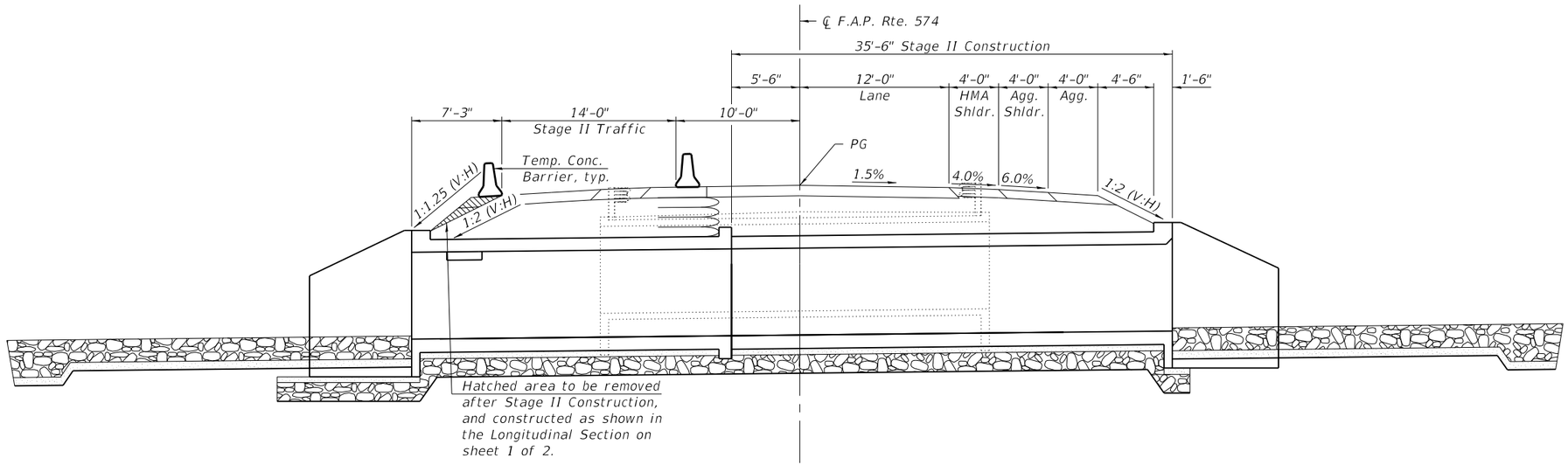
WATERWAY INFORMATION

Drainage Area = 1.92 Sq. Mi. Low Grade Elev. 636.30 @ Sta. 16+75 to 18+90

Flood	Freq. Yr.	Q C.F.S.	Opening Ft² Exist.	Opening Ft² Prop.	Nat. H.W.E.	Head - Ft. Exist.	Head - Ft. Prop.	Headwater El. Exist.	Headwater El. Prop.
	10	517	67	210	631.94	1.20	0.00	633.14	631.92
Design	50	819	76	210	632.72	2.30	0.29	635.05	632.87
Base	100	958	80	210	632.98	2.24	0.44	635.25	633.23
Existing Overtopping	25	688	73	N/A	632.43	2.24	N/A	634.70	N/A
Proposed Overtopping	>500		N/A	210		N/A		N/A	
Max. Calc.	500	1,290	86	210	633.49	2.14	0.86	635.66	633.95



PROFILE GRADE
(Along CL F.A.P. Rte. 574)



LONGITUDINAL SECTION - STAGE II CONSTRUCTION

Notes:
Horizontal dimensions on Longitudinal Sections are perpendicular to ℄ Roadway.
Temporary pipes shall be placed in the north end of the existing structure to provide drainage during Stage II Construction. Contractor to determine water diversion location. Once new structure has been completed, the temporary pipes and existing structure cells are to be filled with flowable fill, see Roadway plans.
For location of Section B-B, see sheet 1 of 2.

DETAILS
IL 41 OVER GALLETT CREEK
F.A.P. RTE. 574 - SECTION (12)CR
FULTON COUNTY
17+93.50
STRUCTURE NO. 029-2501

FUHRMANN ENGINEERING

USER NAME = ____	DESIGNED - E.M. Lagemann	REVISED - ____	
	CHECKED - R.A. Lee	REVISED - ____	
PLOT SCALE = ____	DRAWN - E.M. Lagemann	REVISED - ____	
PLOT DATE = ____	CHECKED - R.A. Lee	REVISED - ____	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET 2 OF 2 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
574	(12)CR	Fulton	__	__
		CONTRACT NO. 68C64		
	ILLINOIS	FED. AID PROJECT		

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Appendix C

Soil Boring Logs

Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 6/27/17

ROUTE FAP 574 (IL 41) **DESCRIPTION** Structure Boring for Culvert Replacement **LOGGED BY** DLR/JW

SECTION (12)CR **LOCATION** Midpoint of proposed culvert, **SEC.** 6, **TWP.** 7 N, **RNG.** 1 E, 4th **PM**, **Latitude** 40d 37' 18" N, **Longitude** 90d 26' 34"W

COUNTY Fulton **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. 029-1000 EX / 029-2501 PR
Station

BORING NO. B-1
Station 17+88
Offset 8.0 ft LT
Ground Surface Elev. 636.30 ft

Surface Water Elev. ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 622.8 ft ▼
Upon Completion ft
After Hrs. ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
HMA and PCC PAVEMENT 635.30			
Dark Brown, Moist, Soft to Medium Stiff SILTY CLAY LOAM (Topsoil)	2		
	3 5	0.8 P	28
	1		
-5	1 2	0.3 P	41
	2		
	3 3	0.5 B	31
627.80			
Dark Gray, Moist, Medium Stiff CLAY	2		
-10	2 3	1.0 S	26
625.30			
Light Gray/Light Brown, Wet, Very Soft SILTY CLAY	1		
	1 1	<0.25 P	30
622.80 ▼			
Light Gray/Light Brown, Wet, Medium Stiff SILTY CLAY LOAM with sand seams	0		
-15	2 3	1.0 B	21
620.30			
Brown, Moist to Wet, Soft SILT LOAM, trace gravel	2		
	3 3	0.4 S	22
617.80			
Gray, Moist, Stiff to Very Stiff CLAY LOAM (Till)	2		
-20	2 5	1.0 B	15

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Gray, Moist, Stiff to Very Stiff CLAY LOAM (Till) *(continued)*			
	2		
	3 5	1.4 B	13
	5		
-25	6 8	2.0 B	12
	3		
	6 8	2.1 B	14
	4		
-30	7 9	2.1 B	12
	5		
601.30 -35	7 9	1.6 B	13
End of Boring			
-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)

Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 6/27/17

ROUTE FAP 574 (IL 41) **DESCRIPTION** Structure Boring for Culvert Replacement **LOGGED BY** DLR/JW

SECTION (12)CR **LOCATION** North end of proposed culvert, **SEC.** 6, **TWP.** 7 N, **RNG.** 1 E, 4th **PM**, **Latitude** 40d 37' 19" N, **Longitude** 90d 26' 34"W

COUNTY Fulton **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. 029-1000 EX / 029-2501 PR
Station

BORING NO. B-2
Station 17+86
Offset 63.0 ft LT
Ground Surface Elev. 632.40 ft

Surface Water Elev. ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 619.9 ft
Upon Completion 616.5 ft
After 24 **Hrs.** 626.5 ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				Dark Brown, Moist, Very Stiff SILTY CLAY LOAM (Topsoil)
	5			
-5	5 6	2.0 P	19	
626.40				
	3			No Recovery
	2 3		19	
623.90				
	1			Blue/Gray, Moist, Medium Stiff SILTY CLAY
-10	3 3	0.6 B	25	
621.40				
	3			Brown/Gray, Moist to Wet, Medium Stiff SILTY CLAY LOAM
	3 4	0.5 B	24	
	3			with sand seams
-15	4 5	1.0 B	19	
616.40				
	3			Gray, Moist, Stiff CLAY LOAM (Till)
	5 6	1.2 B	14	
	4			
-20	5 8	1.8 B	13	
				Gray, Moist, Stiff CLAY LOAM (Till) *(continued)*
	4			
	6 7	1.0 S	12	
	4			
-25	6 8	1.6 B	13	
	4			
	8 8	1.6 B	13	2" sand seam
	5			
-30	7 9	1.4 B	14	
	4			
597.40 -35	6 8	1.2 B	14	
				End of Boring
-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)

Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 6/27/17

ROUTE FAP 574 (IL 41) **DESCRIPTION** Structure Boring for Culvert Replacement **LOGGED BY** DLR/JW

SECTION (12)CR **LOCATION** South end of proposed culvert, **SEC.** 6, **TWP.** 7 N, **RNG.** 1 E, 4th **PM**, **Latitude** 40d 37' 17" N, **Longitude** 90d 26' 34"W

COUNTY Fulton **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. 029-1000 EX / 029-2501 PR
Station

BORING NO. B-3
Station 17+74
Offset 40.0 ft RT
Ground Surface Elev. 633.30 ft

Surface Water Elev. ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 621.3 ft
Upon Completion 617.5 ft
After 24 **Hrs.** 629.3 ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				SAND and GRAVEL
				630.30
				No Recovery
	2			
-5	3 4			
				626.80
	2			Brown/Dark Brown, Moist, Medium Stiff SILTY CLAY
	2 2	0.6 B	30	
				624.30
	1			Gray, Moist to Wet, Very Soft SILTY CLAY LOAM
-10	2 2	<0.25 P	32	
				621.80
	1		20	Brown/Gray, Wet, Loose SAND, trace gravel
				621.00
	4 12	1.0 P	11	Brown/Gray, Moist, Medium Stiff CLAY LOAM (Till)
				618.80
	1	0.5	20	Gray, Wet, Soft SANDY LOAM
-15	2 2	S	41	
				616.80
	4			Gray, Moist, Stiff SANDY CLAY LOAM (Till)
	7 10	1.2 B	15	
				Sand seam @ 18'
				614.30
	5			Gray, Wet, Medium Dense SANDY LOAM
-20	9		14	
	11			Gray, Wet, Medium Dense SANDY LOAM *(continued)* with Clay Loam seams
	6			
	10 12		18	
	7			
-25	8 10		15	with some Clay
	5			
	9 12		17	
	5			
-30	8 11		19	
				599.30
	5			Gray, Moist, Very Stiff CLAY LOAM (Till)
-35	6 11	2.5 B	12	
	7			
-40	11	3.7	13	

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

Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 6/27/17

ROUTE FAP 574 (IL 41) **DESCRIPTION** Structure Boring for Culvert Replacement **LOGGED BY** DLR/JW

SECTION (12)CR **LOCATION** South end of proposed culvert, **SEC.** 6, **TWP.** 7 N, **RNG.** 1 E, 4th **PM**, **Latitude** 40d 37' 17" N, **Longitude** 90d 26' 34"W

COUNTY Fulton **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. 029-1000 EX / 029-2501 PR
Station

BORING NO. B-3
Station 17+74
Offset 40.0 ft RT
Ground Surface Elev. 633.30 ft

Surface Water Elev. ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 621.3 ft
Upon Completion 617.5 ft
After 24 **Hrs.** 629.3 ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
592.80		14	B	
End of Boring	-45			
	-50			
	-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)

Appendix D

Subsurface Soil Boring Profile

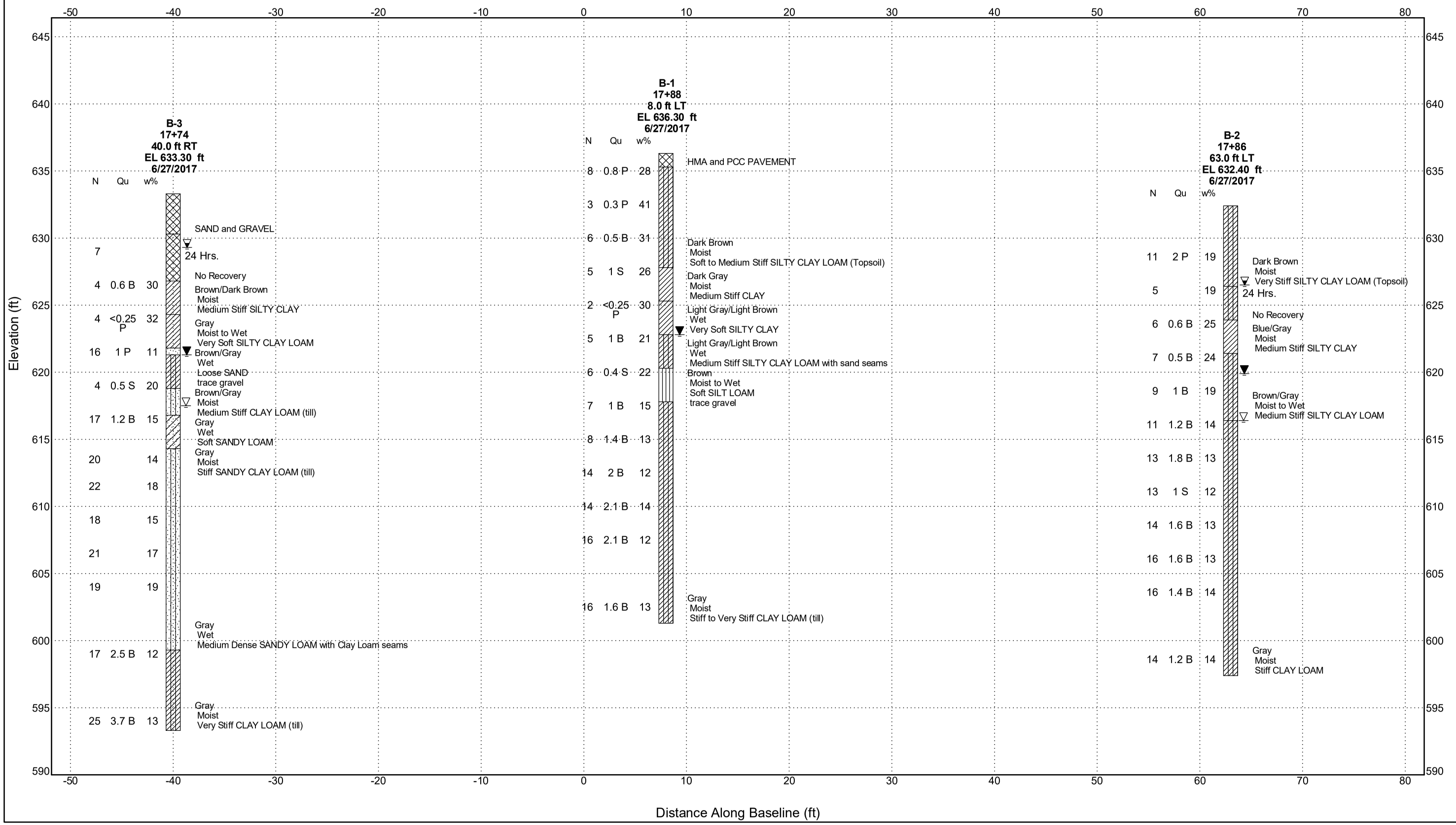
Illinois Department of Transportation
Division of Highways
BFW Engineering & Testing Inc.

ROUTE FAP 574 (IL 41)
SECTION (12)CR
COUNTY Fulton
PROJECT LOCATION

SUBSURFACE PROFILE

LEGEND
EL = Elevation (ft)
D = Depth Below Existing Ground Surface (ft)
N = SPT N-Value (AASHTO T206)
Qu = Unconfined compressive Strength (tsf)
Failure Mode (B= Bulge, S= shear, P= penetrometer)
w% = Moisture Content Percentage

WATER TABLE LEGEND
▼ = First Encountered
▽ = Upon Completion
▼ = After __ hours



ROADWAY PROFILE - BETA 18020 IL 41.GPJ IL_DOT_D4_9-15-10.GDT 3/28/18

Appendix E

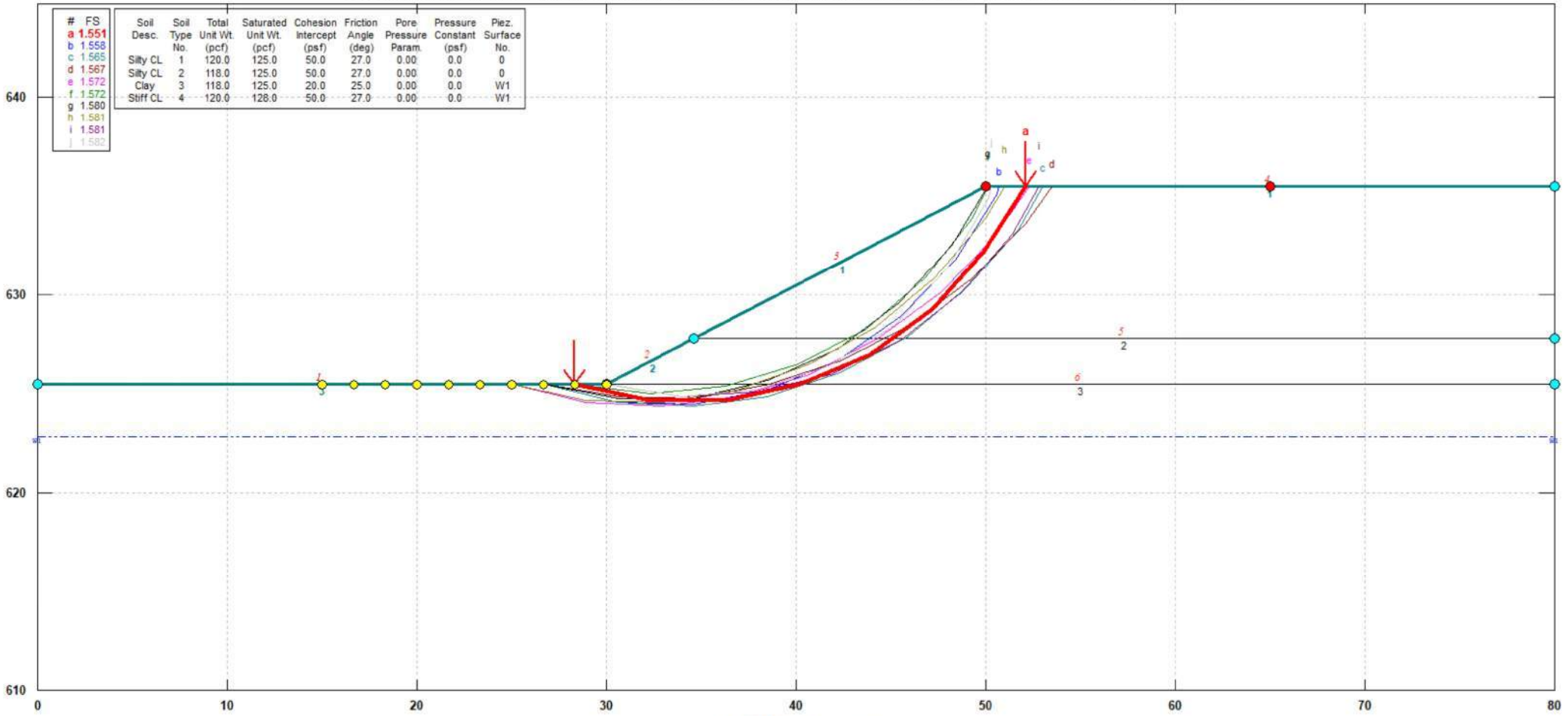
GSTABL 7 Slope Stability Analysis

IL 41 Over Gallett Creek RCBC (029-2501)Long Term

c:\users\cfarmer\desktop\chris temp folder\gallett creek slope stability\ptb 149-23 wo 16 - il41 slope stability long term term slope 1-2.pl2 Run By: John Smith, XYZ Company 10/31/2018 11:09AM

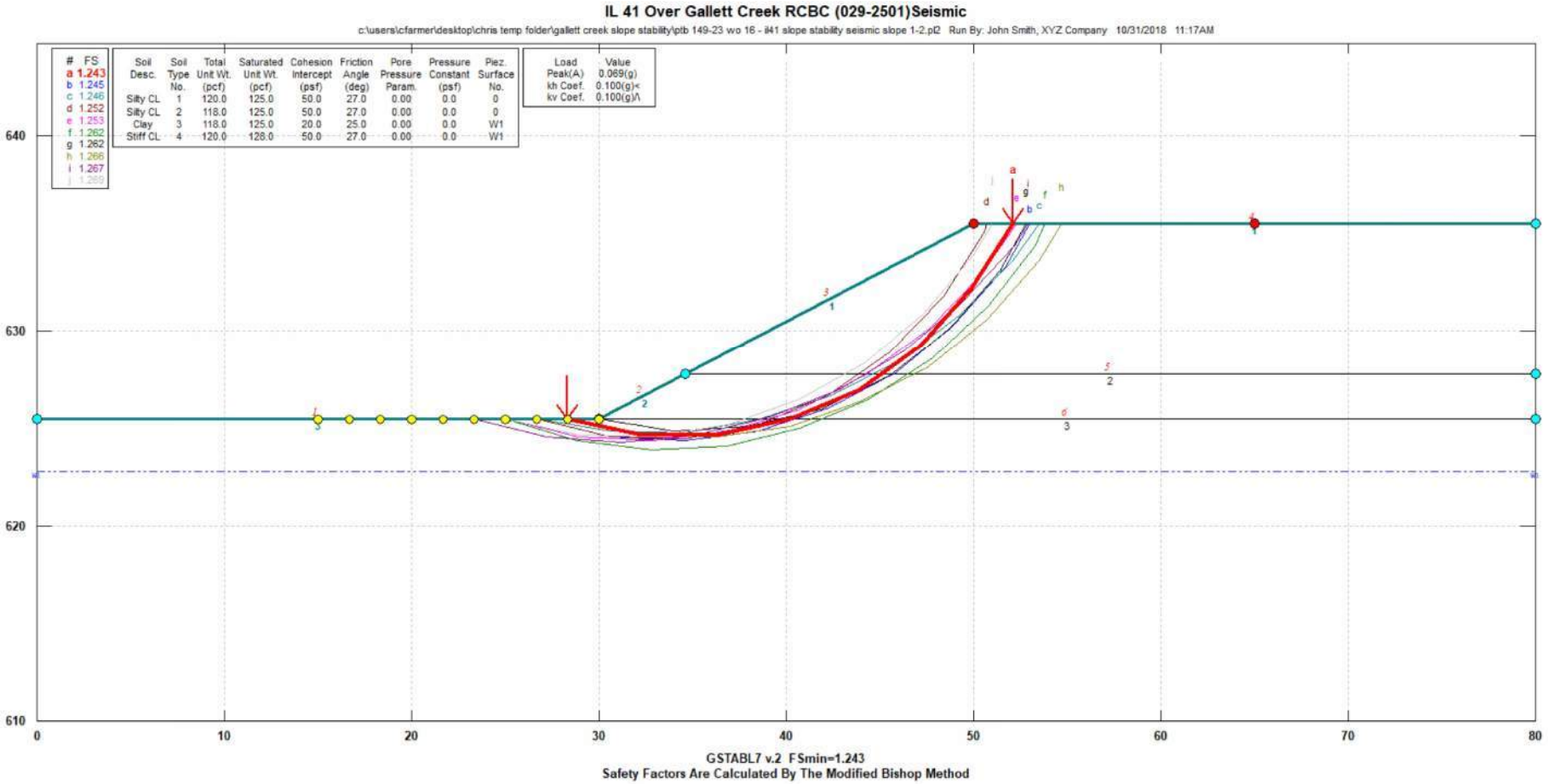
#	FS
a	1.551
b	1.558
c	1.565
d	1.567
e	1.572
f	1.572
g	1.580
h	1.581
i	1.581
j	1.582

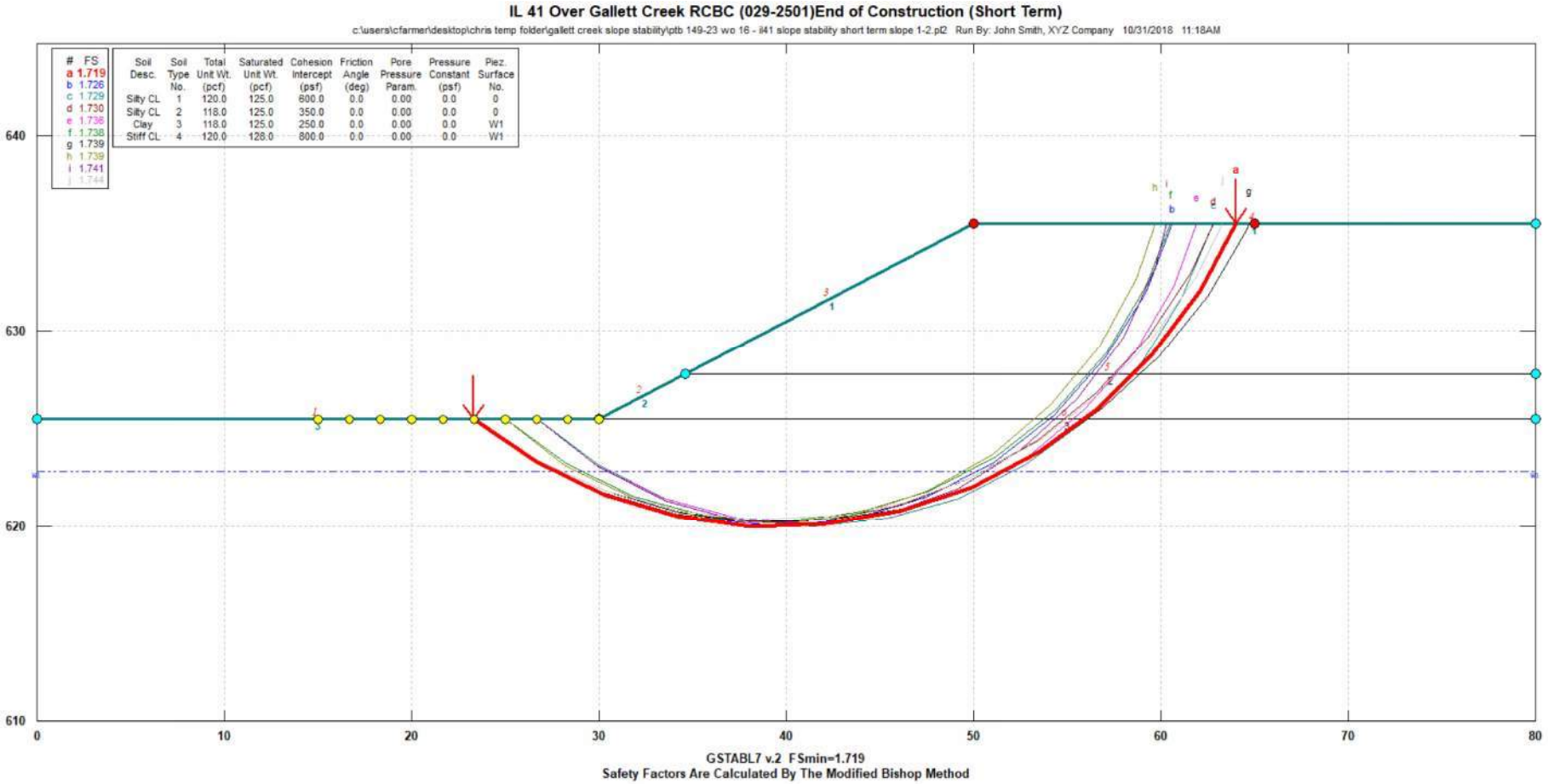
Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
Silty CL	1	120.0	125.0	50.0	27.0	0.00	0.0	0
Silty CL	2	118.0	125.0	50.0	27.0	0.00	0.0	0
Clay	3	118.0	125.0	20.0	25.0	0.00	0.0	W1
Stiff CL	4	120.0	128.0	50.0	27.0	0.00	0.0	W1



GSTABL7 v.2 FSmin=1.551

Safety Factors Are Calculated By The Modified Bishop Method


IL 41 Over Gallett Creek RCBC (029-2501)Seismic
c:\users\cfarmer\desktop\chris temp folder\gallett creek slope stability\ptb 149-23 wo 16 - il41 slope stability seismic slope 1-2.pl2 Run By: John Smith, XYZ Company 10/31/2018 11:17AM
FS
a 1.243
b 1.245
c 1.246
d 1.252
e 1.253
f 1.262
g 1.262
h 1.266
i 1.267
j 1.269
Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Pore Pressure Param. | Pressure Constant (psf) | Piez. Surface No.
Silty CL | 1 | 120.0 | 125.0 | 50.0 | 27.0 | 0.00 | 0.0 | 0
Silty CL | 2 | 118.0 | 125.0 | 50.0 | 27.0 | 0.00 | 0.0 | 0
Clay | 3 | 118.0 | 125.0 | 20.0 | 25.0 | 0.00 | 0.0 | W1
Stiff CL | 4 | 120.0 | 128.0 | 50.0 | 27.0 | 0.00 | 0.0 | W1
Load | Value
Peak(A) | 0.069(g)
kh Coef. | 0.100(g)×
kv Coef. | 0.100(g)\
640
630
620
610
0
10
20
30
40
50
60
70
80
GSTABL7 v.2 FSmin=1.243
Safety Factors Are Calculated By The Modified Bishop Method


IL 41 Over Gallett Creek RCBC (029-2501)End of Construction (Short Term)
c:\users\cfarmer\desktop\chris temp folder\gallett creek slope stability\ptb 149-23 wo 16 - il41 slope stability short term slope 1-2.pl2 Run By: John Smith, XYZ Company 10/31/2018 11:18AM
FS
a 1.719
b 1.726
c 1.729
d 1.730
e 1.736
f 1.738
g 1.739
h 1.739
i 1.741
j 1.744
Soil Desc. | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Pore Pressure Param. | Pressure Constant (psf) | Piez. Surface No.
Silty CL | 1 | 120.0 | 125.0 | 600.0 | 0.0 | 0.00 | 0.0 | 0
Silty CL | 2 | 118.0 | 125.0 | 350.0 | 0.0 | 0.00 | 0.0 | 0
Clay | 3 | 118.0 | 125.0 | 250.0 | 0.0 | 0.00 | 0.0 | W1
Stiff CL | 4 | 120.0 | 128.0 | 800.0 | 0.0 | 0.00 | 0.0 | W1
640
630
620
610
0
10
20
30
40
50
60
70
80
GSTABL7 v.2 FSmin=1.719
Safety Factors Are Calculated By The Modified Bishop Method