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June 23, 2017
Job No. 14-030

Bridgefarmer & Associates, Inc.
12801 North Central Expressway, Suite 400
Dallas, Texas 75243

Attn: Mr. Shahriar Azad, P.E.

GEOTECHNICAL REPORT
RETAINING WALL PP
AHTD JOB rCA0608
UNIVERSITY AVENUE RAMP
LITTLE ROCK, PULASKI COUNTY, ARKANSAS

INTRODUCTION

This report provides the results of the geotechnical investigation performed relevant to the Retaining Wall PP of AHTD Job CA0608: Baptist Hospital-University Avenue (Widening)(S) project in Little Rock, Pulaski County, Arkansas. Specifically, the wall is a part of the AHTD Job rCA0608 University Ramp modifications project. The results of the geotechnical investigation performed for the CA0608 project have been previously submitted under separate cover.

We understand that this project phase includes the new retaining wall (Wall PP) at the University Ramp of the I-630 project. It is understood that the wall will be a mechanically stabilized earth (MSE) wall. The Wall PP alignment extends roughly between Hughes Street and University Avenue, on the north (left) side of the I-630 interstate highway. The wall has a plan length of about 1082 ft and the wall height ranges from 6 to 15 feet.

The area to be retained by Wall PP is on the north side of I-630 between Hughes Street and University Avenue. This area is presently an existing highway embankment. We understand that I-630 will be widened in the wall area and an on-ramp for University Avenue and an adjacent retail development will be built. The proposed Wall PP will retain the widened highway and ramp. The site vicinity is shown on Plate 1 of Attachment 1. The Wall PP layout is shown on Plates 2 through 5 of Attachment 1. The approximate locations of the borings drilled for this study are also shown on the layout drawings.

Bearing capacity and global stability analyses have been performed for the plan wall location. Unless noted otherwise, the referenced stationing in this submittal refers to Wall PP stationing.

SUBSURFACE EXPLORATION

Subsurface conditions in the Wall PP alignment were evaluated by drilling six (6) sample borings to depths of 9.5 to 30 ft below existing grades. To supplement information on subsurface conditions in and near the wall alignment, borings drilled for the noise barrier wall study were

reviewed and incorporated into analyses. In particular, Borings NSA5, NSA6, and NSA7 were utilized.

As noted, the site vicinity is shown on Plate 1 of Attachment 1. The approximate locations of the borings utilized for this project phase are shown on Plates 2 through 5 of Attachment 1. A summary of the subsurface exploration program is provided on Plate 1 of Attachment 2. The results of the borings used to develop geotechnical conclusions and recommendations for this project phase are presented on the logs provided as Plates 2 through 10 of Attachment 2. The logs show soil and rock stratigraphy and the results of the field and laboratory tests. The approximate ground surface elevation at the boring locations, as inferred from the topographic information provided by the Engineer, is also shown on each log. It must be recognized that these elevations are approximate only and actual elevations may vary. Keys to the terms and symbols used on the logs are included as Plates 11 and 12 of Attachment 2.

The borings were advanced using dry-auger drilling procedures to the extent possible to facilitate groundwater observations. Observations regarding groundwater are noted in the lower-right portion of each log. All boreholes were backfilled after obtaining final groundwater readings.

LABORATORY TESTING

Laboratory testing was performed to evaluate subgrade and foundation soil and weathered rock plasticity and to confirm visual classification. Testing included natural water content determinations, liquid and plastic (Atterberg) limit determinations, and sieve analyses through the No. 200 sieve. The test results are shown on the logs at the appropriate depth. The water contents and Atterberg limits are plotted in accordance with the scale and symbols contained in the legend in the upper-right portion of the log forms. The Atterberg limits are plotted on the boring logs as pluses connected with a dashed line using the water content scale. The percent of soil passing through the No. 200 sieve is noted in the "Minus No. 200" column on the appropriate log forms.

ANALYSES and RECOMMENDATIONS

General Wall Design Considerations

Wall PP will be located on the north side of I-630 between Hughes Street and University Avenue. It is understood that the MSE wall will be designed by Others on behalf of the Contractor. MSE wall backfill in the reinforced zone must comply with the Designer's specifications. As a minimum, we recommend that the reinforced zone backfill comply with AHTD Standard Specifications Section 302, SM-1 or Section 303, Class 7. Consequently, the reinforced backfill should have a minimum total unit weight (γ) of 125 lbs per cu ft and a minimum angle of internal friction (ϕ) of 28°.

The wall layout drawings indicate the MSE wall subgrade elevations are planned at El 349± to El 371±. The MSE walls are expected to bear in the moderately hard weathered shale or compacted undercut backfill. Wall recommendations are summarized in Attachment 3.

Wall Bearing

Analyses related to bearing capacity have been performed assuming a strap length of 70 percent of the wall height (0.7H) or a minimum length of 8 feet, whichever is greater. Based on the results of the borings, it is expected that walls will bear in either moderately hard tan, gray, and brown weathered shale, stiff tannish brown and reddish brown silty clay, or undercut backfill, depending on

the wall section and specific foundation conditions. We recommend that undercut backfill consist of selected material (AHTD Standard Specifications Section 302, SM-1), select granular fill (#57 stone - AASHTO M43), or an alternate approved by the Engineer or Department.

Recommendations for nominal bearing resistance (q_{ult}) are summarized in Table 1 below.

Table 1: Recommended Wall PP Nominal Bearing Pressure

Approximate Station	Recommended Nominal Unit Bearing Resistance, lbs per sq ft	Bearing Stratum
0+60 to 2+45	12,000	compact SM-1 or #57 stone backfill
2+45 to 3+20	20,000	competent weathered shale
3+20 to 5+70	12,000	compact SM-1 or #57 stone backfill
5+70 to 6+25	20,000	competent weathered shale
6+25 to 7+10	10,000	stiff silty CLAY
7+10 to 9+55	12,000	compact SM-1 or #57 stone backfill
9+55 to 10+10	12,000	compact SM-1 or #57 stone backfill
10+10 to 11+42	12,000	compact SM-1 or #57 stone backfill

We recommend a minimum embedment of 3 ft for all retaining walls. Suitability of the MSE wall bearing stratum must be field verified by the Engineer or Department at the time of construction. Undercuts should extend at least 5 ft outside the reinforced zone to the extent possible.

For MSE wall design, a resistance factor (φ_b) of 0.65 is recommended. Long-term post-construction settlement of the moderately hard weathered shale wall foundation stratum is expected to be negligible. For walls supported in undercut backfill or the stiff silty clay as recommended above, long-term post-construction settlement is expected to be less than 1.0 inch.

Resistance to MSE wall sliding can be evaluated using a nominal friction factor (tan δ) value of 0.35 for the recommended bearing strata. A resistance factor (φ_τ) of 1.0 is recommended for evaluation of sliding resistance.

Global Stability

Stability analyses were performed to verify the global stability of the new wall. The wall cross section at Sta 7+60, where the MSE walls are moderately high and subsurface conditions are relatively poor, was selected for evaluation in stability analyses. A cross section at this wall location is shown on Plate 1 of Attachment 4. A uniform surcharge of 250 lbs per sq ft was included on the right section to account for the surcharge of vehicle traffic loads.

To model the lower strength boundary of unclassified embankment fill (outside the reinforced zone), a cohesion value of 750 lbs per sq ft and an internal friction angle (ϕ) of 0^0 were assumed. It is understood that MSE walls will be designed by Others on behalf of the Contractor. MSE wall backfill in the reinforced zone must comply with the Designer's specifications. As a

minimum, the reinforced zone backfill is expected to comply with AHTD Standard Specifications Section 302, SM-1 or Section 303, Class 7. Consequently, the reinforced backfill should have a minimum total unit weight (γ) of 125 lbs per cu ft and a minimum angle of internal friction (ϕ) of 28°. For the purposes of stability analyses, the foundation soil properties were modeled based on the results of the borings and our experience with similar soils.

Stability analyses were performed using the computer program SLOPE/W 2007[1] and a Morgenstern-Price analysis. End of construction, long-term, and seismic conditions were analyzed. For the seismic condition, a horizontal acceleration coefficient (k_h) value equal to one-half the design peak ground acceleration value (A_s) was utilized in the stability analyses. Groundwater was not encountered in the borings and was not considered in the stability analyses.

The results of the stability analyses performed for the walls are provided in Attachment 4. These results indicate acceptable stability for all conditions analyzed.

Site Grading and Earthwork Considerations

Site preparation will begin with clearing and grubbing the trees or underbrush (if any) in the wall alignment areas and stripping the organic-containing surface soils. Site preparation should include the entire reinforced zone footprint. Tree stumps should be completely excavated and properly backfilled. The depth of stripping will be variable, with deeper stripping depths in the low-lying, poorly drained, and/or heavily wooded areas, and less stripping required on hillsides and in the areas of higher terrain. In general, the stripping depth is estimated to be about 6 to 12 in. in open areas, but may be 18 to 24 in. or more in wooded areas.

Following stripping, and prior to fill placement or otherwise continuing with subgrade preparation, the extent of weak and unsuitable soils should be determined. Proof-rolling is recommended to evaluate subgrade stability. Proof-rolling should be performed with a loaded tandem-wheel dump truck or similar equipment. Unstable soils exhibiting a tendency to rut and/or pump should be undercut and replaced with suitable fill. Care should be taken that undercuts, stump holes, and other excavations or low areas resulting from subgrade preparation are properly backfilled with compacted fill. Based on the results of the borings, the potential for undercut is generally moderate in the retaining wall alignments, typically ranging from 4 to 10 feet. As-built undercut requirements must be field verified by the Engineer or by the Department.

Suitability of the retaining wall bearing strata must be field verified by the Engineer or Department at the time of construction. For MSE walls which require the higher bearing value of moderately hard weathered shale, all undercuts should be backfilled with crushed stone aggregate base (AHTD Standard Specifications Section 303, Class 7) or any alternate approved by the Engineer or Department. For MSE walls utilizing the lower bearing values for SM-1 or stiff silty clay, all undercuts should be backfilled with selected material (AHTD Standard Specifications Section 302, SM-1), select granular fill (AASHTO M43), or an approved alternate. For all MSE walls, we recommend that undercuts extend at least 5 ft outside the reinforced zone to the extent possible.

General site grading, including fill and backfill, should be performed as per AHTD Standard Specifications Subsection 210. Subgrade preparation should comply with AHTD Standard Specifications, Section 212. Embankments should be constructed in accordance with AHTD

[1] Slope/W 2007; GEO-SLOPE International; March 2008.

criteria (AHTD Standard Specifications, Section 210). Fill and backfill for undercuts and retained fill should be placed in nominal 6- to 8-in.-thick loose lifts. All fill and backfill must be placed in horizontal lifts. Thinner lifts may be required for retaining wall backfill. The in-place density and water content should be determined for each lift and should be tested to verify compliance with the specified density and water content prior to placement of subsequent lifts. Fill placement against existing slope should be benched to facilitate horizontal fill placements.

CONSTRUCTION CONSIDERATIONS

Positive surface drainage should be established at the start of the work, be maintained during construction and following completion of the project to prevent surface water ponding and subsequent saturation of subgrade soils. Density and water content of all earthwork should be maintained until all work is completed.

Groundwater was not encountered within the exploration depths of the borings in September 2016 and May 2017. Though not encountered in the field studies, localized perched water could be encountered during the work. In addition, seasonal seeps could be encountered. If seepage into excavations becomes a problem, undercut backfill should consist of clean crushed stone (AHTD Standard Specifications Section 207 or AASHTO M43 #57 stone), clean aggregate (AHTD Standard Specifications Subsections 403.01 and 403.02 Class 3 mineral aggregate), or an approved alternate to an elevation above the inflow of seepage. In areas of seepage infiltration, the granular fill should be fully encapsulated with a filter fabric complying with AHTD Standard Specifications Subsection 625.02, Type 2 and vented to positive discharge. Where surface seeps or springs are encountered during site grading, we recommend the seepage be directed via French drains or blanket drains to positive discharge at daylight or to storm drainage lines.

CLOSURE

The Engineer or Department or a designated representative thereof should monitor site preparation, grading work and all wall construction. Subsurface conditions significantly at variance with those encountered in the borings should be brought to the attention of the Geotechnical Engineer. The conclusions and recommendations of this report should then be reviewed in light of the new information.

The following attachments are included and complete this submittal.

Attachment 1	Site Vicinity and Wall PP Layout
Attachment 2	Subsurface Exploration
Attachment 3	Summary of Wall Recommendations
Attachment 4	Results of Global Stability Analyses

* * * * *

We appreciate the opportunity to be of continued service to you on this project. Should you have any questions regarding this report, or if we may be of additional assistance during final design, please call on us.

Sincerely,

GRUBBS, HOSKYN,
BARTON &WYATT, INC.

Ben Davis, E.I.
Staff Engineer

Mark E. Wyatt, P.E.
President

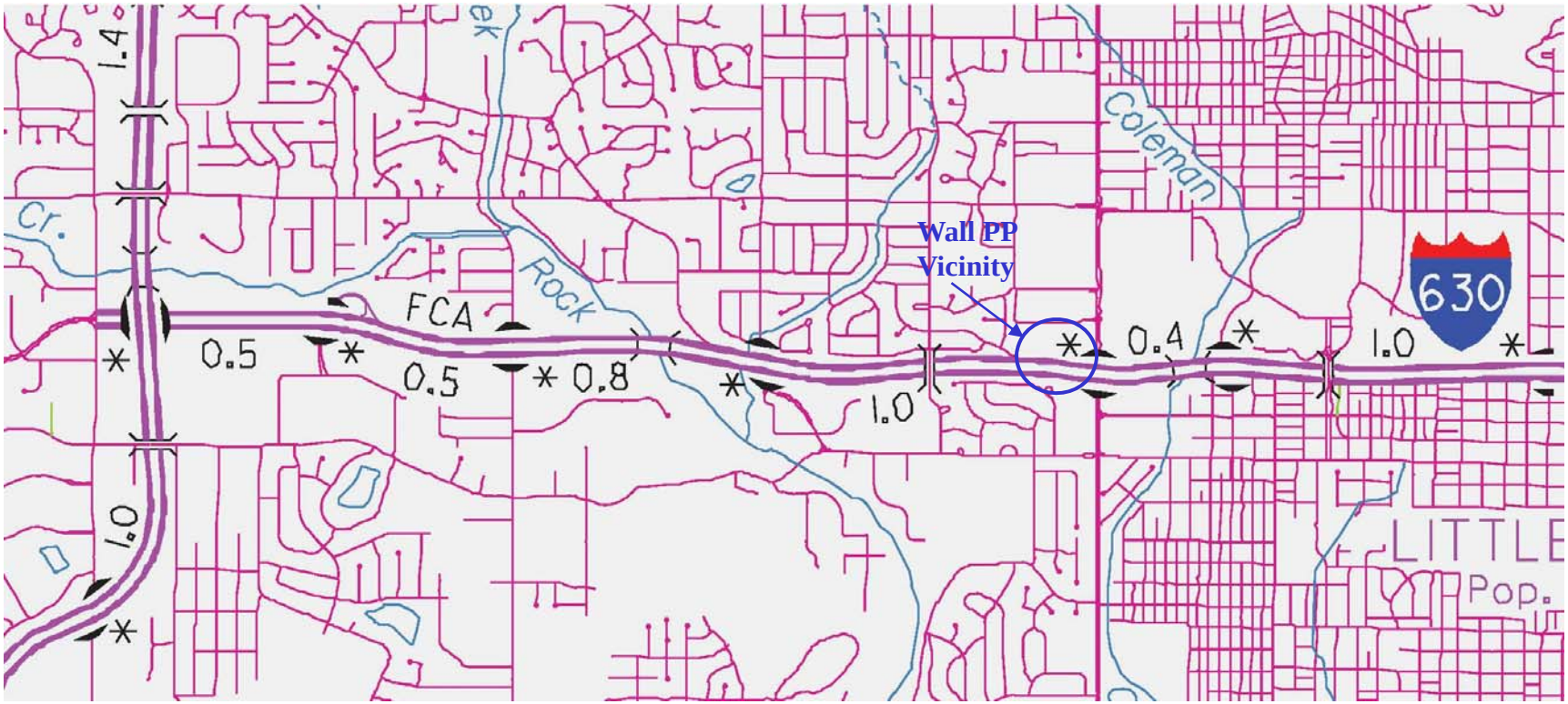
STATE OF ARKANSAS
REGISTERED PROFESSIONAL ENGINEER
No. 7791
MARK E. WYATT

BJD/MEW:jw

Copies Submitted: Bridgefarmer & Associates, Inc.

Attn:	Mr. Shahriar Azad, P.E.	(2+electronic)
Attn:	Mr. David Dang, E.I.T.	(1-electronic)
Attn:	Mr. Chris Silver, E.I.T.	(1-electronic)

ATTACHMENT 1



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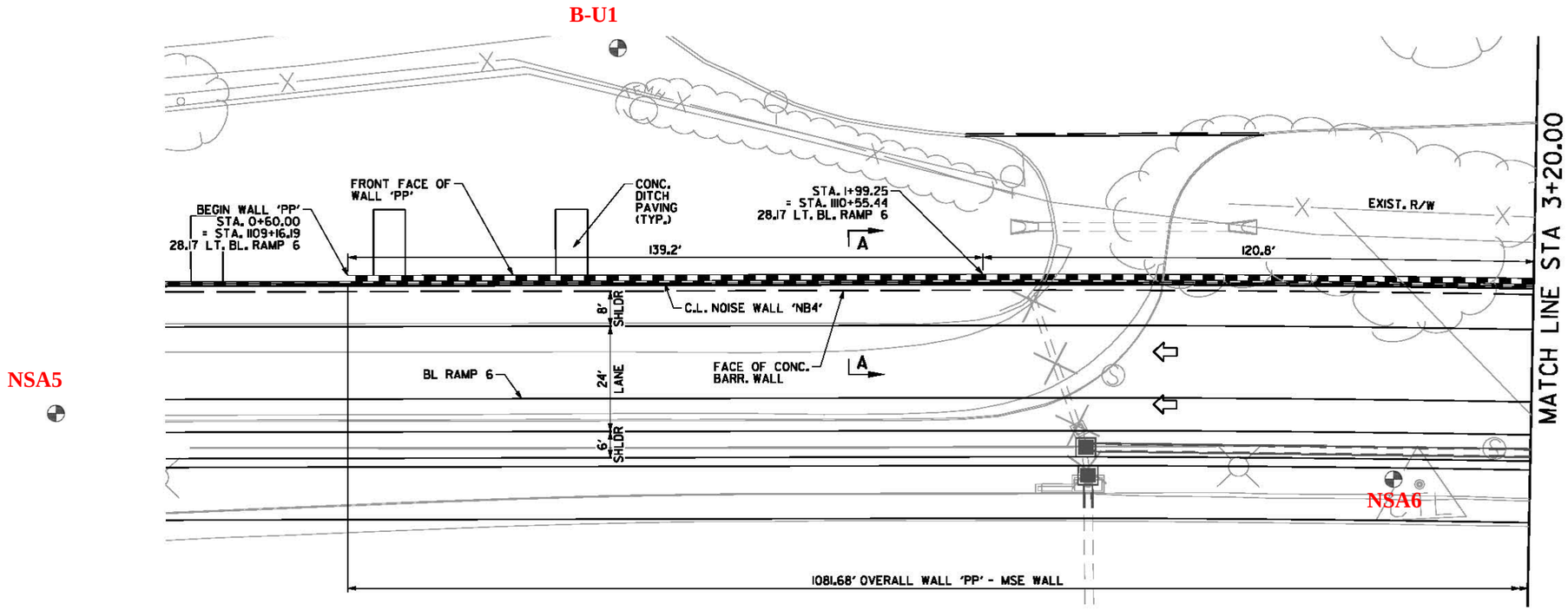
Wall PP Location
rCA0608 – I-630
Little Rock, Pulaski County, Arkansas

Job No. 14-030

Plate 1



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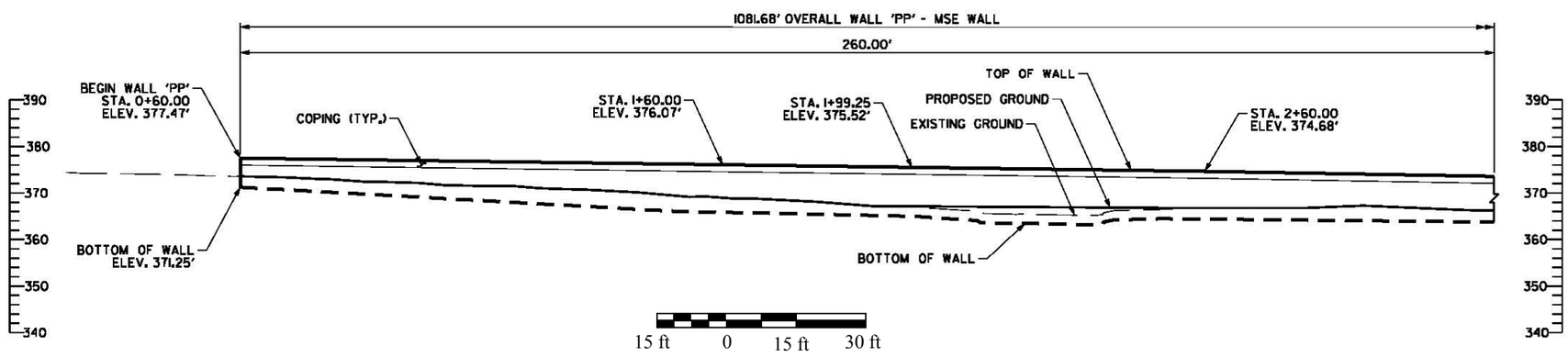
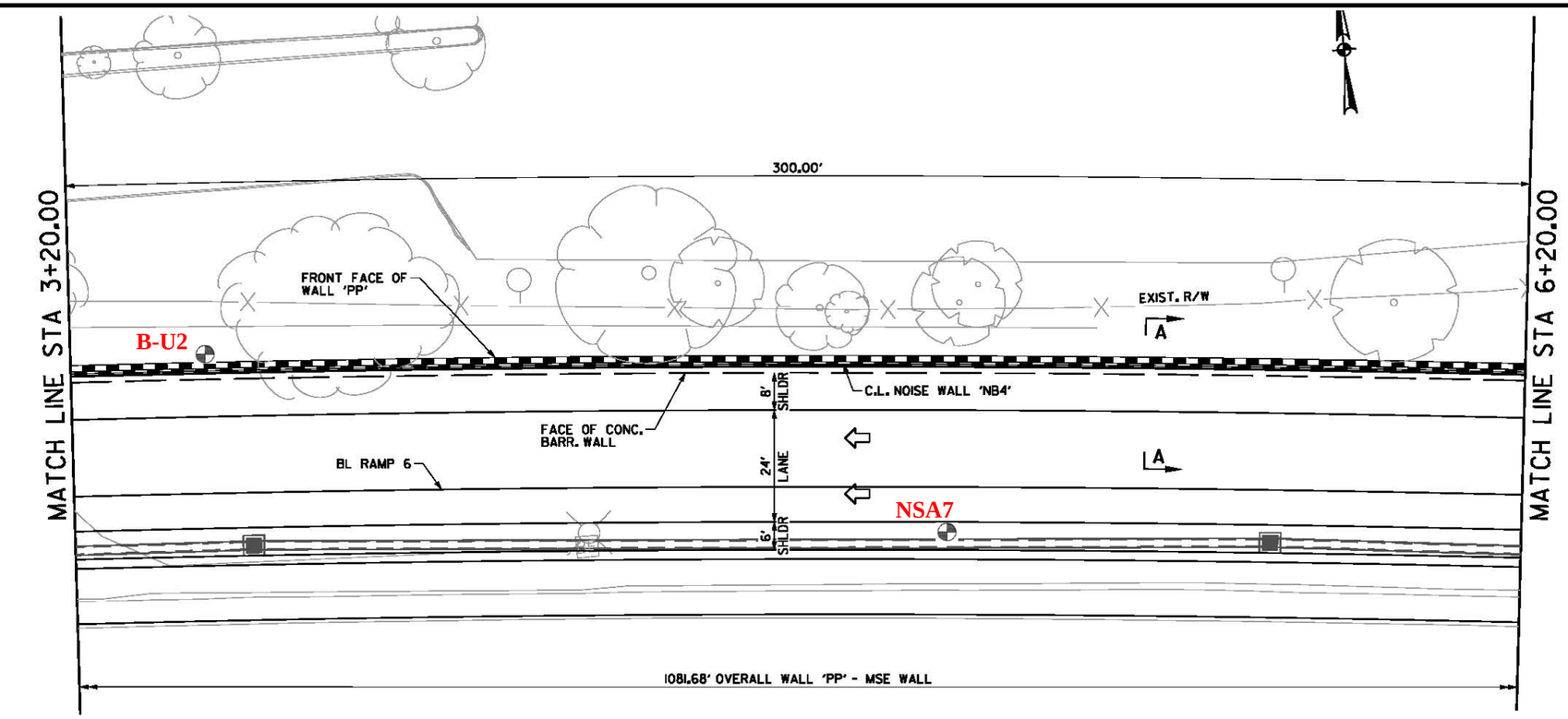


Grubbs, Hoskyn, Barton & Wyatt, INC. CONSULTING ENGINEERS	**PLAN OF BORINGS** **rCA0608 University Ramp** **Little Rock, Arkansas**	**Scale: As Shown** **Date: May 2017**	**Job No. 14-030**	**PLATE 2**



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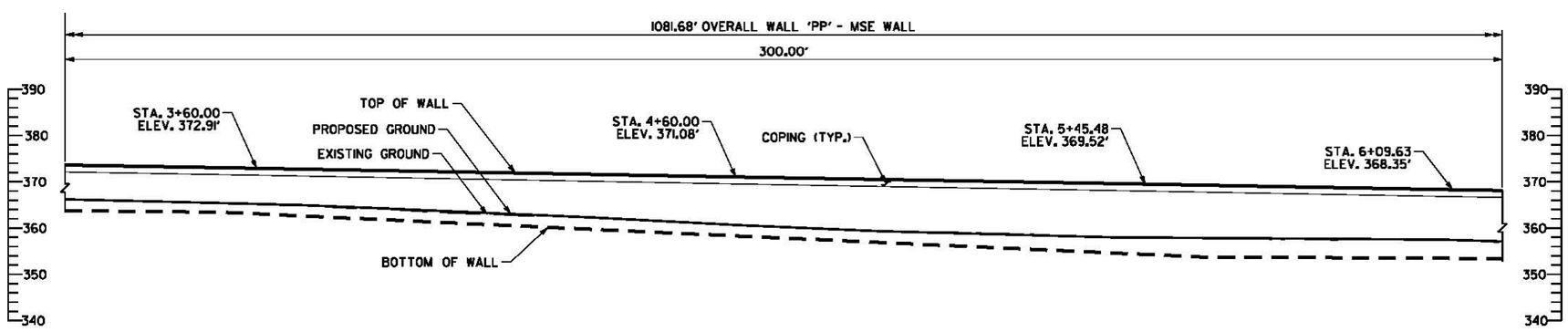
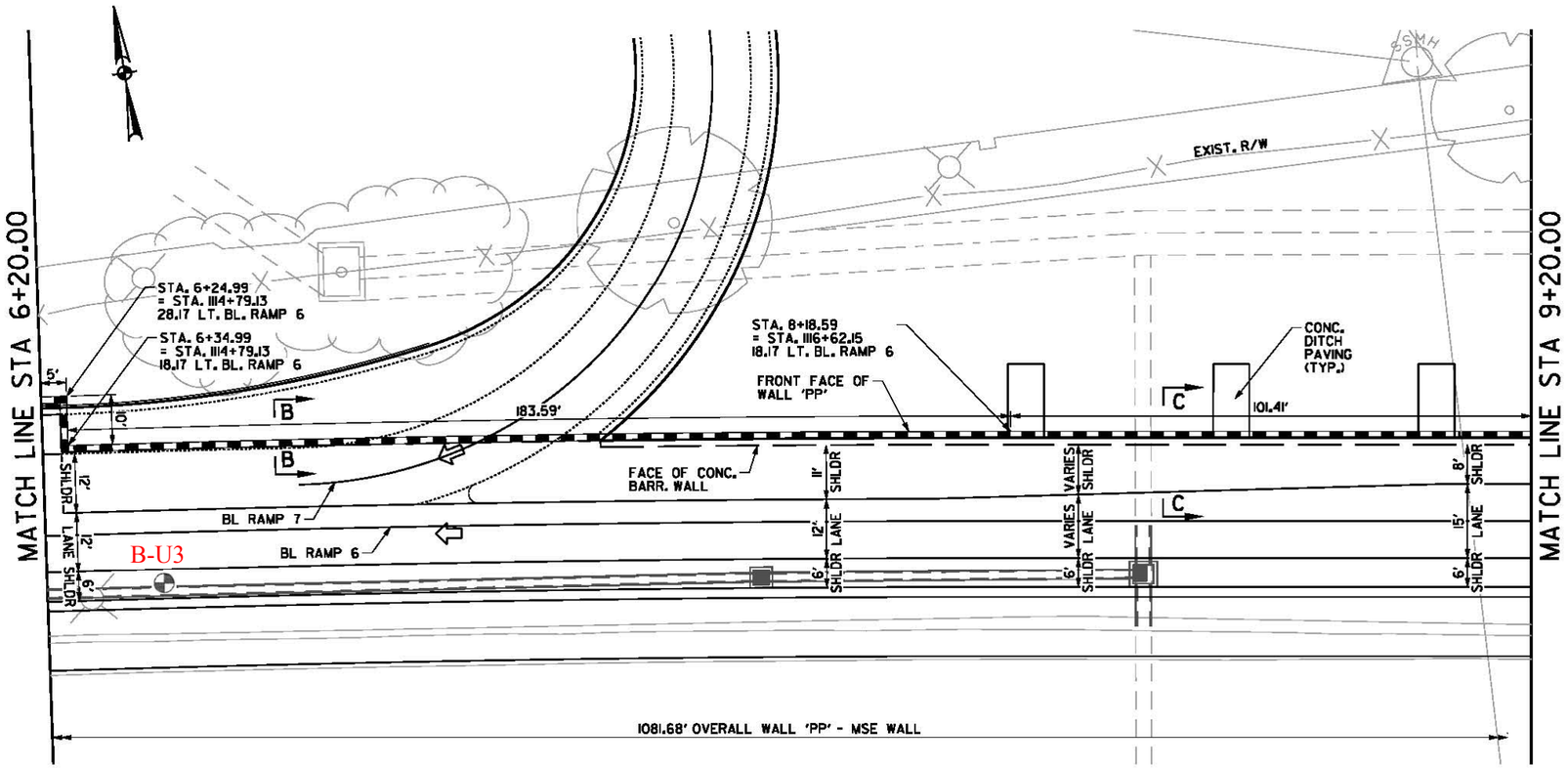


15 ft 0 15 ft 30 ft

Grubbs, Hoskyn, Barton & Wyatt, INC. CONSULTING ENGINEERS	**PLAN OF BORINGS** **rCA0608 University Ramp** **Little Rock, Arkansas**	**Scale: As Shown** **Date: May 2017**	**Job No. 14-030**	**PLATE 3**



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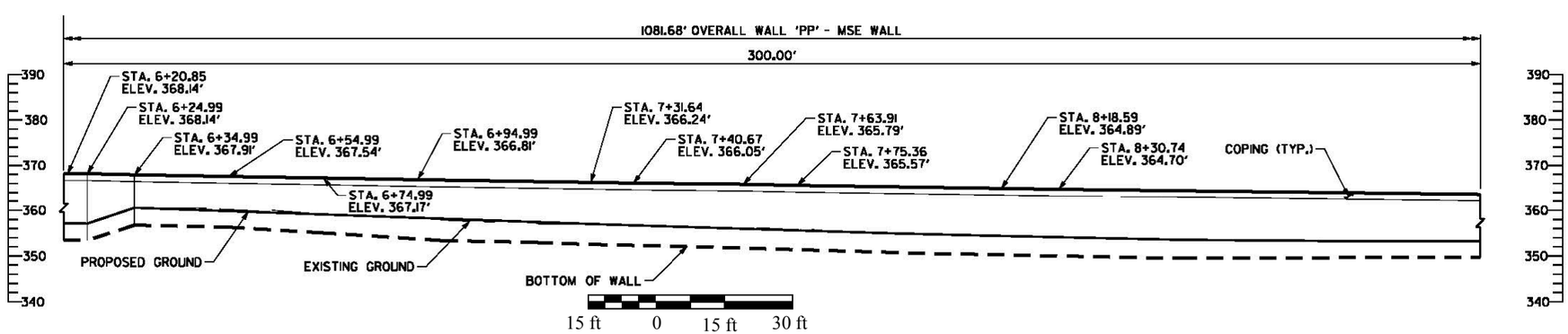
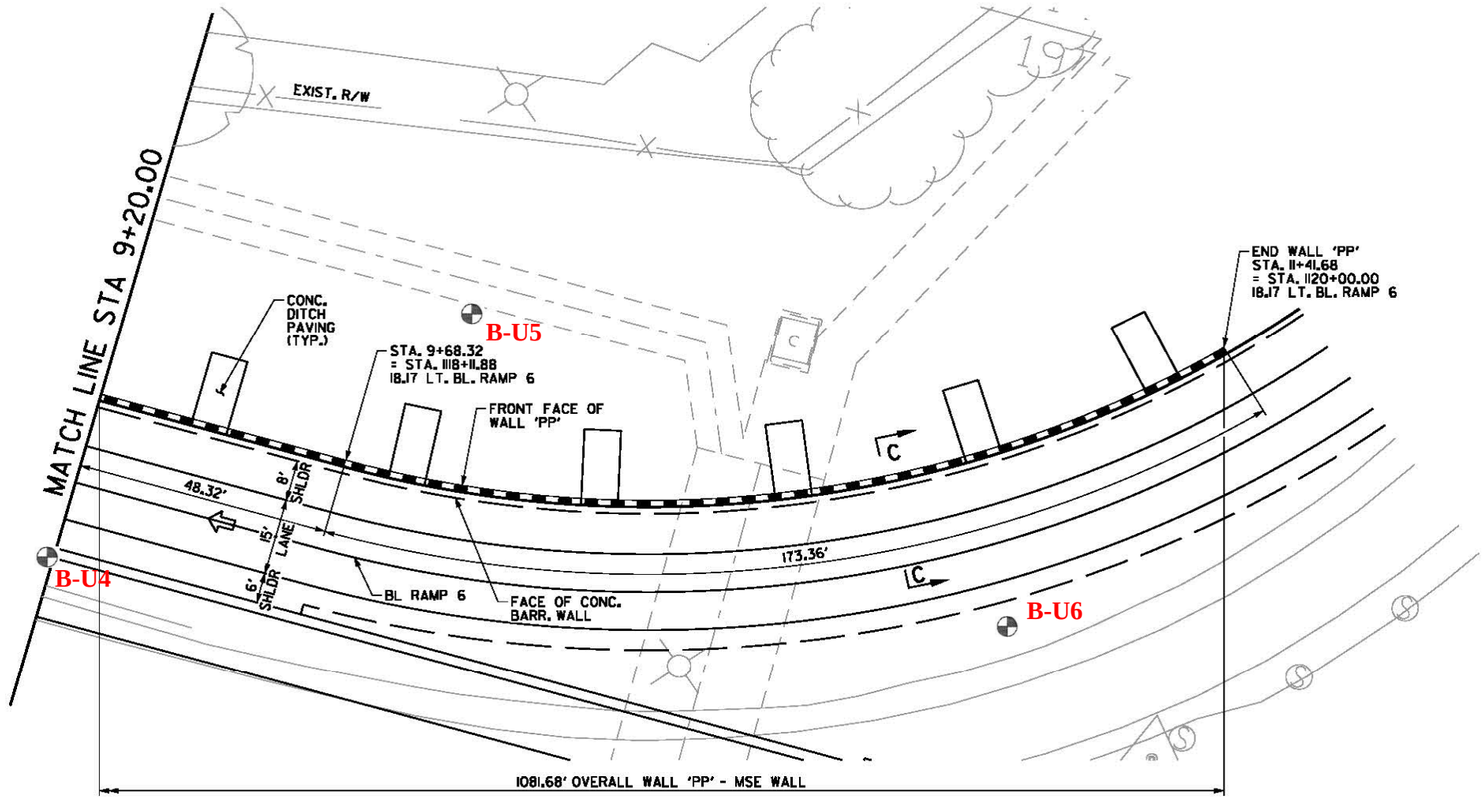


ELEVATION

SCALE 1"=15'

Grubbs, Hoskyn, Barton & Wyatt, INC. CONSULTING ENGINEERS	**PLAN OF BORINGS** **rCA0608 University Ramp** **Little Rock, Arkansas**	**Scale: As Shown** **Date: May 2017**	**Job No. 14-030**	**PLATE 4**



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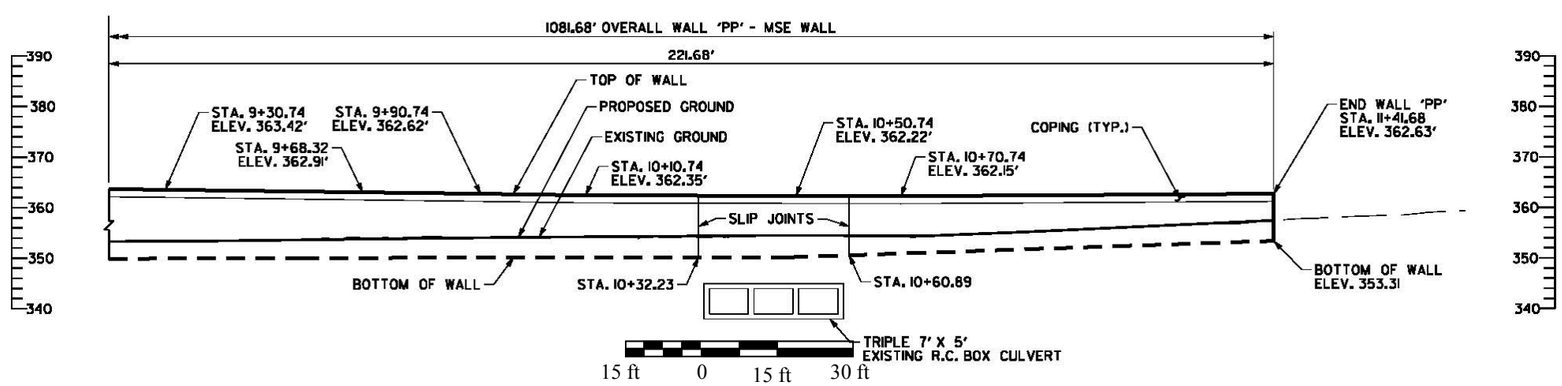

Grubbs, Hoskyn, Barton & Wyatt, INC. CONSULTING ENGINEERS	**PLAN OF BORINGS** **rCA0608 University Ramp** **Little Rock, Arkansas**	**Scale: As Shown** **Date: May 2017**	**Job No. 14-030**	**PLATE 5**

ATTACHMENT 2

SUMMARY of SUBSURFACE EXPLORATION

PROJECT: rCA0608 University Ramp

LOCATION: Interstate I-630 - Little Rock, Arkansas

GHBW JOB No.: 14-030

Boring No.	Approx Wall PP Sta	Approx Offset, ft	Approx Surf El, ft	Completion Depth, ft
Drilled for this study				
U1	0+90	50 Lt	362	19
U2	3+45	CL	366	19
U3	6+55	45 Rt	370	25
U4	9+20	35 Rt	369	30
U5	9+90	30 Lt	349	9.5
U6	11+15	40 Rt	366	30
Drilled for prior studies				
NSA5	0+10	30 Rt	379	30
NSA6	2+90	50 Rt	372	30
NSA7	5+00	40 Rt	372	28.5

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LOG OF BORING NO. U1

rCA0608 University Ramp
Little Rock, Arkansas

TYPE: Auger

LOCATION: Approx Sta 0+90, 50 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURF. EL: 362±	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT / WATER CONTENT / LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			Stiff brown, olive gray, gray and tan silty clay w/some concrete debris (fill)	13			
			Soft tan, yellowish tan and reddish brown silty clay	4			
5			- stiff, with some sandstone cobbles below 4 ft	19			
			Low hardness tan, gray and pale red highly weathered shale w/interbedded silty clay seams and partings	45			
10				20			
			Moderately hard reddish brown and dark gray weathered shale	50/6"			
15			- maroon below 17 ft	50/3"			
20							
25							

COMPLETION DEPTH: 19.0 ft
DATE: 5-17-17

DEPTH TO WATER IN BORING: 4 ft

DATE: 5/17/2017

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. U2

rCA0608 University Ramp
Little Rock, Arkansas

TYPE: Auger

LOCATION: Approx Sta 3+45, CL

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURF. EL: 366±	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT (10 20 30) / WATER CONTENT (40 50 60) / LIQUID LIMIT (70)	- No. 200 %
			Stiff brownish tan silty clay w/shale and sandstone fragments (fill)	11			
			Dense to very dense tan and brown clayey fine to coarse gravel, sandy	50			
5				50/9"			8
			Moderately hard tan and brown weathered shale	50/7"			
			- reddish brown below 8 ft	50/4"			
10							
				50/3"			
15							
				50/3"			
20							
25							

COMPLETION DEPTH: 19.0 ft
DATE: 5-17-17

DEPTH TO WATER IN BORING: Dry

DATE: 5/17/2017

LGBNEW 14-030_UNIVERSITY RAMP LOGS.GPJ 6-22-17

Grubbs, Hoskyn, Barton & Wyatt, Inc.
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LOG OF BORING NO. U3

rCA0608 University Ramp
Little Rock, Arkansas

TYPE: Auger

LOCATION: Approx Sta 6+55, 45 ft Rt

SURF. EL: 370±

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT – WATER CONTENT – LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			Dense brown silt, cement treated (fill)	25/0"			
			Firm brown, maroon and gray silty clay w/some shale and sandstone fragments (fill)	7			27
5			- stiff at 4 - 6 ft	12			
			- firm to stiff at 6 - 13 ft	10			
10				10			
15			Stiff tan, tannish brown and reddish brown silty clay w/some shale fragments and occasional rootlets	16			81
20			Moderately hard tan, gray and brown weathered shale	50/6"			
25				50/4"			

COMPLETION DEPTH: 25.0 ft
DATE: 5-16-17

DEPTH TO WATER IN BORING: Dry

DATE: 5/16/2017

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. U4

rCA0608 University Ramp
Little Rock, Arkansas

TYPE: Auger

LOCATION: Approx Sta 9+20, 35 ft Rt

SURF. EL: 369±

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			Medium dense dark gray fine sandy silt (fill)	10			
			Stiff tannish brown and brown silty clay w/some shale and sandstone fragments (fill)	12			
			- firm at 4 - 13 ft	7			36
5				8			
10				8			
			- stiff at 13 - 18 ft	20			
15							
			- firm below 18 ft	8			
20							
			Very stiff tan and brown silty clay w/sandstone fragments and interbedded weathered shale seams and layers	38			
25							
			Low hardness tan and brown highly weathered shale	43			
30							

COMPLETION DEPTH: 30.0 ft
DATE: 5-16-17

DEPTH TO WATER IN BORING: Dry

DATE: 5/16/2017

LGBNEW 14-030_UNIVERSITY RAMP LOGS.GPJ 6-13-17

Grubbs, Hoskyn, Barton & Wyatt, Inc.
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LOG OF BORING NO. U5

rCA0608 University Ramp
Little Rock, Arkansas

TYPE: Auger

LOCATION: Approx Sta 9+90, 30 ft Lt

SURF. EL: 349±

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT – WATER CONTENT – LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			Firm to stiff reddish brown, tan and gray silty clay w/shale and sandstone fragments (fill)	10			
			- very soft at 2 - 4 ft	3			38
			- stiff at 4 - 6 ft	16			
5			Medium dense olive gray clayey fine to coarse gravel, sandy	12			31
				50/6"			
			- auger refusal at 9.5 ft				
10							
15							

COMPLETION DEPTH: 9.5 ft
DATE: 5-17-17

DEPTH TO WATER IN BORING: Dry

DATE: 5/17/2017

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. U6

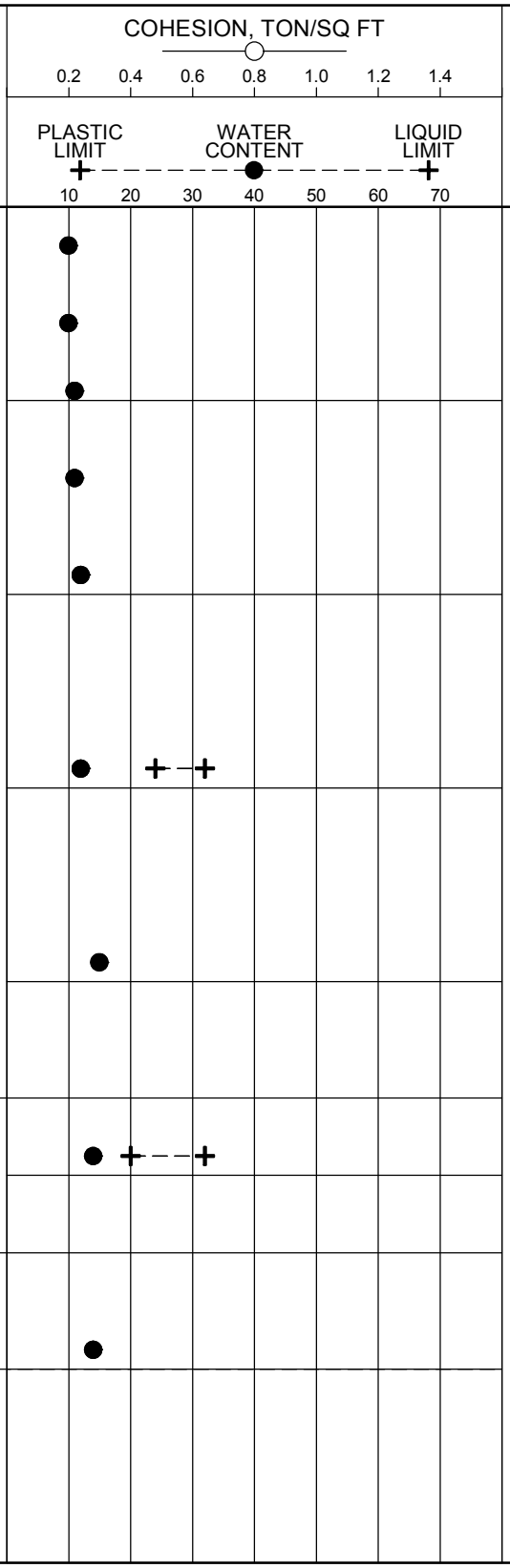
rCA0608 University Ramp
Little Rock, Arkansas

TYPE: Auger

LOCATION: Approx Sta 11+15, 40 ft Rt

SURF. EL: 366±

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	- No. 200 %
	Stiff reddish brown, brown and gray silty clay w/some shale and sandstone fragments (fill)	11		
	- firm at 2 - 4 ft	8		
5		12		
	- firm at 6 - 8 ft	9		
10		13		
	- firm to stiff at 13 - 18 ft	10		13
15				
	- firm at 18 - 23 ft	8		
20				
	Dense olive gray clayey fine to coarse gravel, sandy	45		28
25				
	Very stiff tan and brown silty clay w/interbedded highly weathered shale seams and layers	40		
30				



COMPLETION DEPTH: 30.0 ft
DATE: 5-16-17

DEPTH TO WATER IN BORING: 18 ft

DATE: 5/16/2017

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. NSA5

CA0608: I-630 Noise Barriers
Little Rock, Arkansas

TYPE: Auger to 17 ft /Wash

LOCATION: Approx Sta 1165+50

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURF. EL: 379±	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			Medium dense brown silt w/occasional organics and sandstone fragments (fill)	20			
			- firm tan and maroon silty clay below 2.5 ft	9			
5			- stiff below 4.5 ft	12			34
			- very soft to soft below 6.5 ft	4			
10			- soft below 9 ft	6			
15			Low hardness gray, maroon and brown highly weathered shale w/silty clay seams and layers	17			
			Moderately hard brown weathered fine-grained sandstone w/ferrous stains				
20			Moderately hard brown and maroon highly weathered shale w/occasional clay laminations and ferrous stains	50/6"			
25				50/7"			
30				50/3"			

COMPLETION DEPTH: 30.0 ft
DATE: 9-16-16

DEPTH TO WATER IN BORING: Dry

DATE: 9/19/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. NSA6

CA0608: I-630 Noise Barriers
Little Rock, Arkansas

TYPE: Auger to 10 ft /Wash

LOCATION: Approx Sta 1168+45

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURF. EL: 372±	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT — WATER CONTENT — LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			Dense tan silt w/occasional asphalt debris (fill)	50/9"			
			- loose tan and gray sandy fine to coarse gravel below 2.5 ft	9		-NON-PLASTIC-	13
5			- firm brown silty clay w/occasional sandstone fragments below 4.5 ft	9			42
			- very loose to loose brown and tan sandy fine gravel below 6.5 ft	4			
10			Moderately hard tan and brown weathered shale w/interbedded sandstone seams and layers	50/3"			
15			Moderately hard to hard gray fine-grained sandstone w/interbedded weathered shale seams and layers	50/0" 30/0"			
20			Moderatedly hard tan and brown weathered shale w/interbedded sandstone seams and layers				
25							
30							

COMPLETION DEPTH: 30.0 ft
DATE: 9-14-16

DEPTH TO WATER
IN BORING: Dry to 10 ft

DATE: 9/14/2016

LGBNEW 14-030_NSA LOGS.GPJ 10-14-16

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

LOG OF BORING NO. NSA7

CA0608: I-630 Noise Barriers
Little Rock, Arkansas

TYPE: Auger

LOCATION: Approx Sta 1170+40

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL SURF. EL: 372±	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT (0.2 0.4 0.6 0.8 1.0 1.2 1.4) / PLASTIC LIMIT, WATER CONTENT, LIQUID LIMIT (10 20 30 40 50 60 70)	- No. 200 %
			Dense brown silt w/some shale and rock fragments (fill)	50/3"			
			- stiff tan silty clay w/some shale fragments below 2.5 ft	11			
5			- firm below 4.5 ft	8			32
			- stiff below 6.5 ft	15			
10				11			
15			- very stiff below 14 ft - occasional organics below 14 ft	28			
				34			
20			- gray, tan and maroon below 19 ft	32			
			Moderately hard gray and tan weathered shale w/sandstone seams and layers	50/3"			
25							
30							

COMPLETION DEPTH: 28.5 ft
DATE: 9-14-16

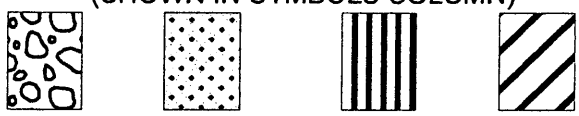
DEPTH TO WATER IN BORING: Dry

DATE: 9/14/2016

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

SYMBOLS AND TERMS USED ON BORING LOGS

SOIL TYPES
(SHOWN IN SYMBOLS COLUMN)



Gravel Sand Silt Clay

Predominant type shown heavy

SAMPLER TYPES
(SHOWN ON SAMPLES COLUMN)

Shelby Tube | Rock Core | Split Spoon | No Recovery | Cutting

TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE GRAINED SOILS (major portion retained on No. 200 sieve): Includes (I) Clean gravels and sands, and (2) silty or clayey gravels and sands. Condition is rated according to relative density, as determined by laboratory tests.

DESCRIPTIVE TERM	N-VALUE	RELATIVE DENSITY
VERY LOOSE	0-4	0-15%
LOOSE	4-10	15-35%
MEDIUM DENSE	10-30	35-65%
DENSE	30-50	65-85%
VERY DENSE	50 and above	85-100%

FINE GRAINED SOILS (major portion passing No. 200 sieve): Includes (1) Inorganic and organic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength, as indicated by penetrometer readings or by unconfined compression tests.

DESCRIPTIVE TERM	UNCONFINED COMPRESSIVE STRENGTH TON/SQ. FT.
VERY SOFT	Less than 0.25
SOFT	0.25-0.50
FIRM	0.50-1.00
STIFF	1.00-2.00
VERY STIFF	2.00-4.00
HARD	4.00 and higher

NOTE: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above, because of planes of weakness or cracks in the soil. The consistency ratings of such soils are based on penetrometer readings.

TERMS CHARACTERIZING SOIL STRUCTURE

SLICKENSIDED - having inclined planes of weakness that are slick and glossy in appearance.
FISSURED - containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.
LAMINATED - composed of thin layers of varying color and texture.
INTERBEDDED - composed of alternate layers of different soil types.
CALCAREOUS - containing appreciable quantities of calcium carbonate.
WELL GRADED - having a wide range in grain sizes and substantial amounts of all intermediate particle sizes.
POORLY GRADED - predominantly of one grain size, or having a range of sizes with some intermediate sizes missing.

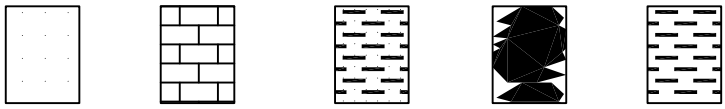
Terms used on this report for describing soils according to their texture or grain size distribution are in accordance with the UNIFIED SOIL CLASSIFICATION SYSTEM, as described in Technical Memorandum No.3-357, Waterways Experiment Station, March 1953

KEY 3-4-03

Grubbs, Hoskyn, Barton & Wyatt, Inc.
Consulting Engineers

BORING LOG TERMS – ROCK

ROCK TYPES
(SHOWN IN SYMBOLS COLUMN)



Sandstone Limestone Siltstone Coal Shale

Joint Characteristics –

Spacing	
Very Close	0.75 to 2.5 in.
Close	2.5 to 8 in.
Moderately Close	8 to 24 in.
Wide	2 to 6 ft
Very Wide	More than 6 ft

Bedding Characteristics –

Very Thin	0.75 to 2.5 in.
Thin	2.5 to 8 in.
Medium	8 to 24 in.
Thick	2 to 6 ft
Massive	More than 6 ft

Lithologic Characteristics –

Clayey
Shaly
Calcareous (limy)
Siliceous
Sandy (Arenaceous)
Silty
Plastic Seams

Parting – Less than 1/16 inch
Seam – 1/16 to 1/2 inch
Layer – 1/2 to 12 inches
Stratum – Greater than 12 inches

Hardness–

Soft (S) – Reserved for plastic material alone.

Friable (F) – Easily crumbled by hand, pulverized or reduced to powder and is too soft to be cut with a pocket knife.

Low Hardness (LH) – Can be gouged deeply or carved with a pocket knife.

Moderately Hard (MH) – Can be readily scratched by a knife blade; scratch leaves a heavy trace of dust and scratch is readily visible after the powder has been blown away.

Hard (H) – Can be scratched with difficulty; scratch produces little powder and is often faintly visible; traces of the knife steel may be visible.

Very hard (VH) – Cannot be scratched with a pocket knife. Knife steel marks left on surface.

Texture –

Fine – Barely seen with naked eye
Medium – Barely seen up to 1/8 in.
Coarse – 1/8 in. to 1/4 in.

Structure –

Bedding
- Flat – 0° – 5°
- Gently Dipping – 5° – 35°
- Moderately Dipping – 55° – 85°
- Steeply Dipping – 55° – 85°

Fractures, scattered
- Open
- Cemented or Tight

Fractures, closely spaced
- Open
- Cemented or Tight

Brecciated (Sheared and Fragmented)
- Open
- Cemented or Tight

Joints
- Faulted
- Slickensides

Degree of Weathering –

Fresh – No visible signs of decomposition or discoloration. Rings under hammer impact.

Slighty Weathered – Slight discoloration inwards from open fractures, otherwise similar to fresh.

Moderately Weathered – Discoloration throughout. Weaker minerals such as feldspar decomposed. Strength somewhat less than fresh rock, but cores cannot be broken by hand or scraped by knife. Texture preserved.

Highly Weathered – Most minerals somewhat decomposed. Specimens can be broken by hand with effort or shaved with knife. Core stones present in rock mass. Texture becoming indistinct but fabric

Completely Weathered – Minerals decomposed to soil but fabric and structure preserved (Saprolite). Specimens easily crumbled or penetrated.

Residual Soil – Advanced state of decomposition resulting in plastic soils. Rock fabric and structure completely destroyed. Large volume change.

Solution and Void Conditions –

Solid, contains no voids
Vuggy (pitted)
Vesicular (igneous)
Porous
Cavities
Cavernous

Swelling Properties –

Nonswelling
Swelling

Slaking Properties –

Nonslaking
Slakes slowly on exposure
Slakes readily on exposure

Rock Quality Designation (RQD) –

RQD (Percent)	Diagnostic Description
Greater than 90	Excellent
75 – 90	Good
50 – 75	Fair
25 – 50	Poor
Less than 25	Very Poor

KEYROCK FHWA 3-2-12

ATTACHMENT 3

Summary of Recommendations for rCA0608 Retaining Wall PP

PROJECT: AHTD JOB CA0608 - I-630 University Ramp
LOCATION: Little Rock, Pulasi County, Arkansas
GHBW JOB NO.: 14-030

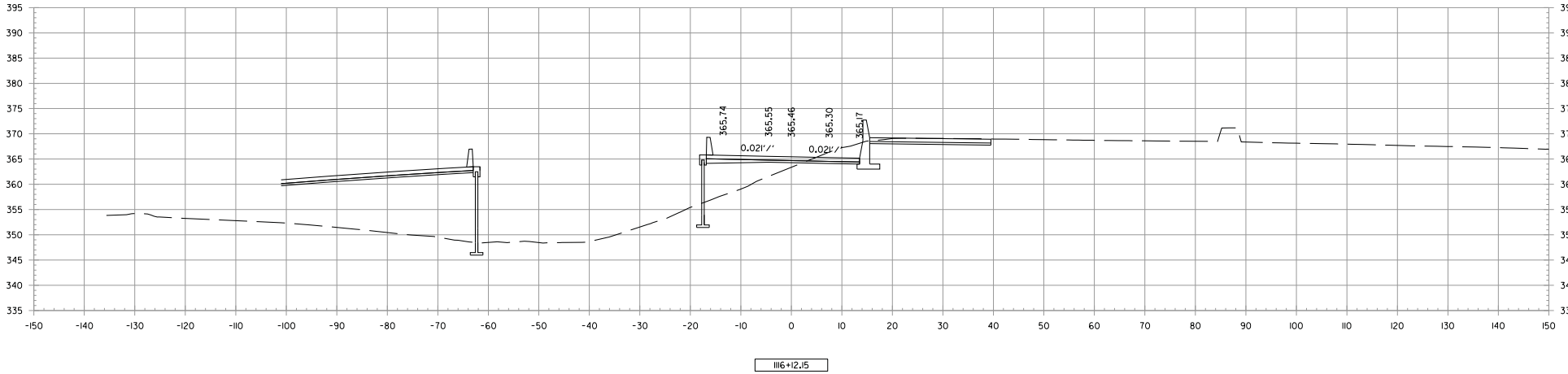
Approximate Sta	Wall Length, ft	Approximate Wall Height, ft	Relevant Borings	Recommended Nominal Unit Bearing Resistance, psf	Recommended Resistance Factor (φ_b)	Factored Unit Bearing Resistance, psf	Estimated Reinforcing Strap Length, ft	Anticipated Undercut Requirements, ft	Bearing Stratum
0+60 to 2+45	185	6 to 12	NSA5	12,000	0.65	7,800	0.7H, 8 to 9 ft	9	compact SM-1 or #57 stone backfill
2+45 to 3+20	75	9 to 12	NSA6	20,000	0.65	13,000	0.7H, 8 to 9 ft	minimal	competent weathered shale
3+20 to 5+70	250	9 to 15	NSA7 & U2	12,000	0.65	7,800	0.7H, 8 to 11 ft	5	compact SM-1 or #57 stone backfill
5+70 to 6+25	55	15	U3	20,000	0.65	13,000	0.7H: 11 ft	minimal	competent weathered shale
6+25 to 7+10	85	11 to 15	U3	10,000	0.65	6,500	0.7H: 8 to 11 ft	minimal	stiff silty CLAY
7+10 to 9+55	220	12 to 14	U4	12,000	0.65	7,800	0.7H: 9 to 10 ft	4	compact SM-1 or #57 stone backfill
9+55 to 10+10	55	12 to 13	U5	12,000	0.65	7,800	0.7H: 9	7	compact SM-1 or #57 stone backfill
10+10 to 11+42	136	9 to 12	U6	12,000	0.65	7,800	0.7H: 8 to 9 ft	10	compact SM-1 or #57 stone backfill

Notes: 1. Strap length is an estimate only. The Designer must select the length for use in final design.
2. The suitability of the MSE wall bearing stratum must be field verified by the Engineer or Department at the time of construction.
3. The on-site fill contains variable amounts of cobble- (i.e., 3 in. to 12 in.) to boulder-sized (i.e., larger than 12 in.) sandstone fragments. Where cobbles or boulders are encountere at plan footing elevations, these large rock fragments should be removed and the cavities should be properly backfilled.
3. Undercuts required to develop suitable bearing should be backfilled with selected material (AHTD Standard Specifications Section 302, SM-1), select granular fill (#57 stone - A select granular fill (#57 stone - AASHTO M43), or an approved alternate.
4. Undercuts should extend at least 5 ft outside the reinforced zone to the extent possible.

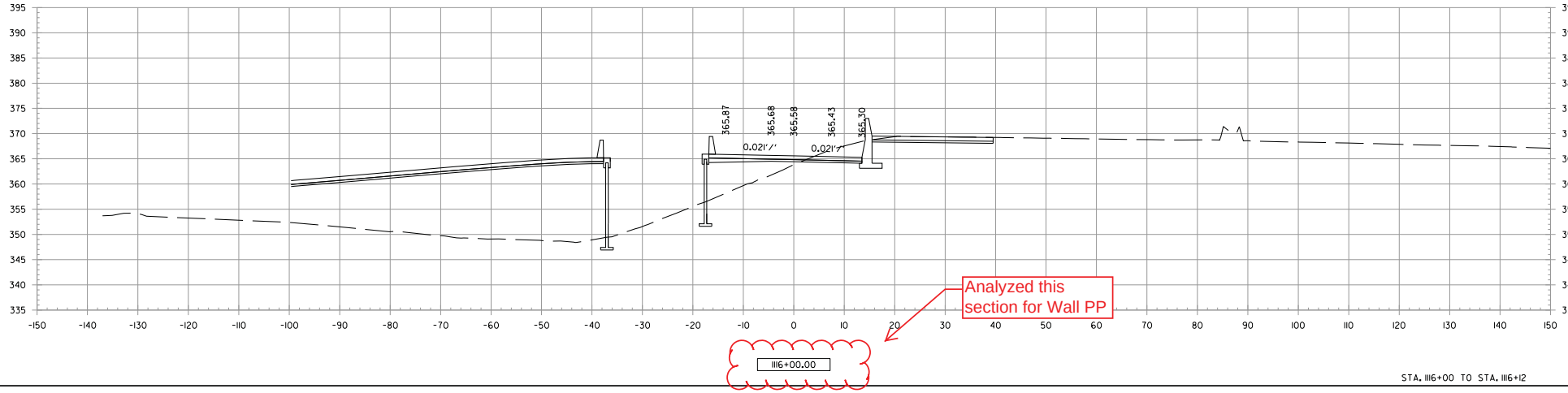
ATTACHMENT 4

DATE REVISED	DATE FILMED	DATE REVISED	DATE FILMED	FED.RD. DIST.NO.	STATE	FED.AID PROJ.NO.	SHEET NO.	TOTAL SHEETS
				6	ARK.			
				JOB NO.		CA0608		868

② CROSS SECTIONS UNIVERSITY RAMP 6



Analyzed section



STA. 1116+00 TO STA. 1116+12

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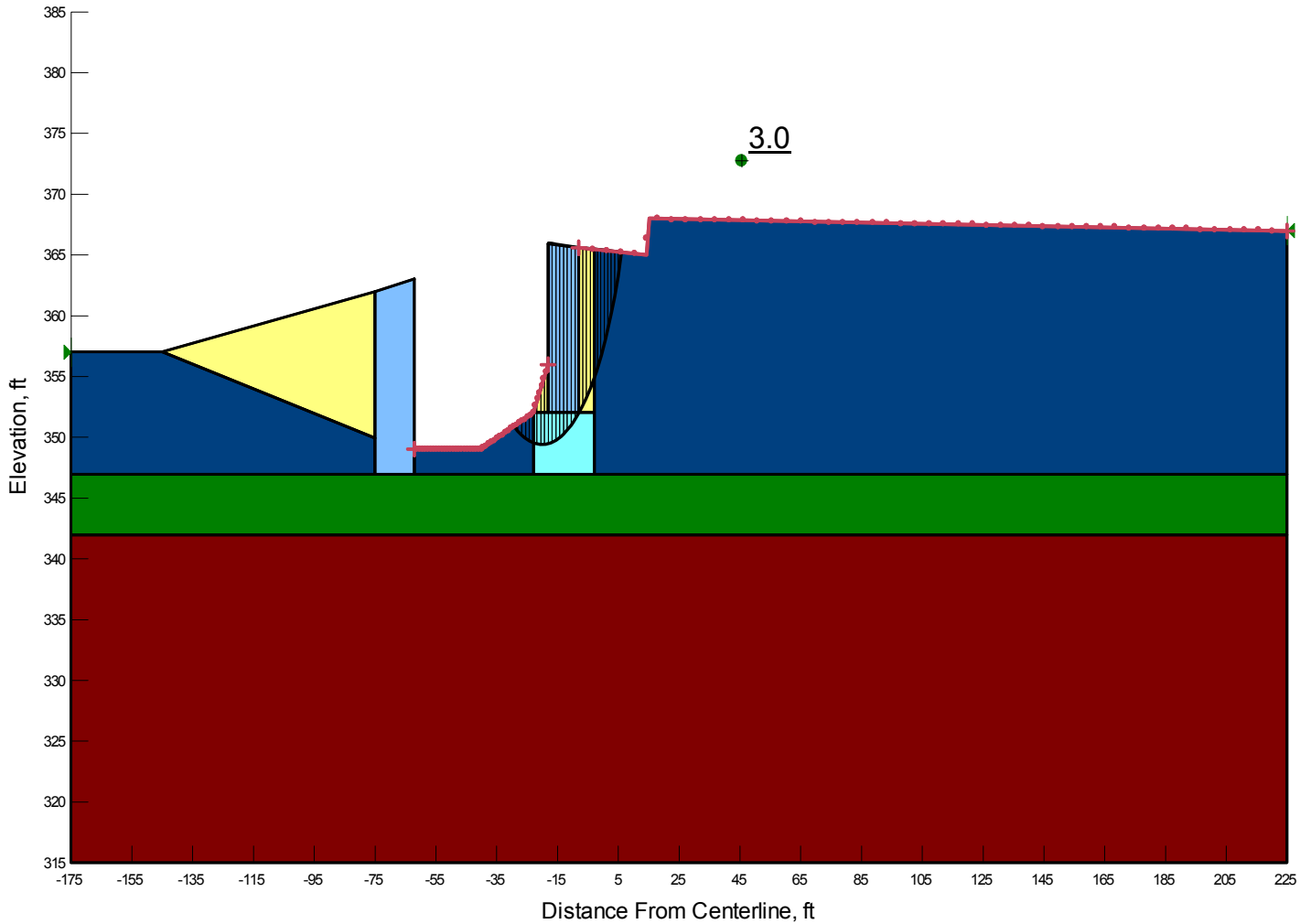
PLATE 1

Summary of Stability Analysis Results
Wall PP @ Sta 7+60
14-030 – University Ramp
AHTD Job No. rCA0608 – I-630

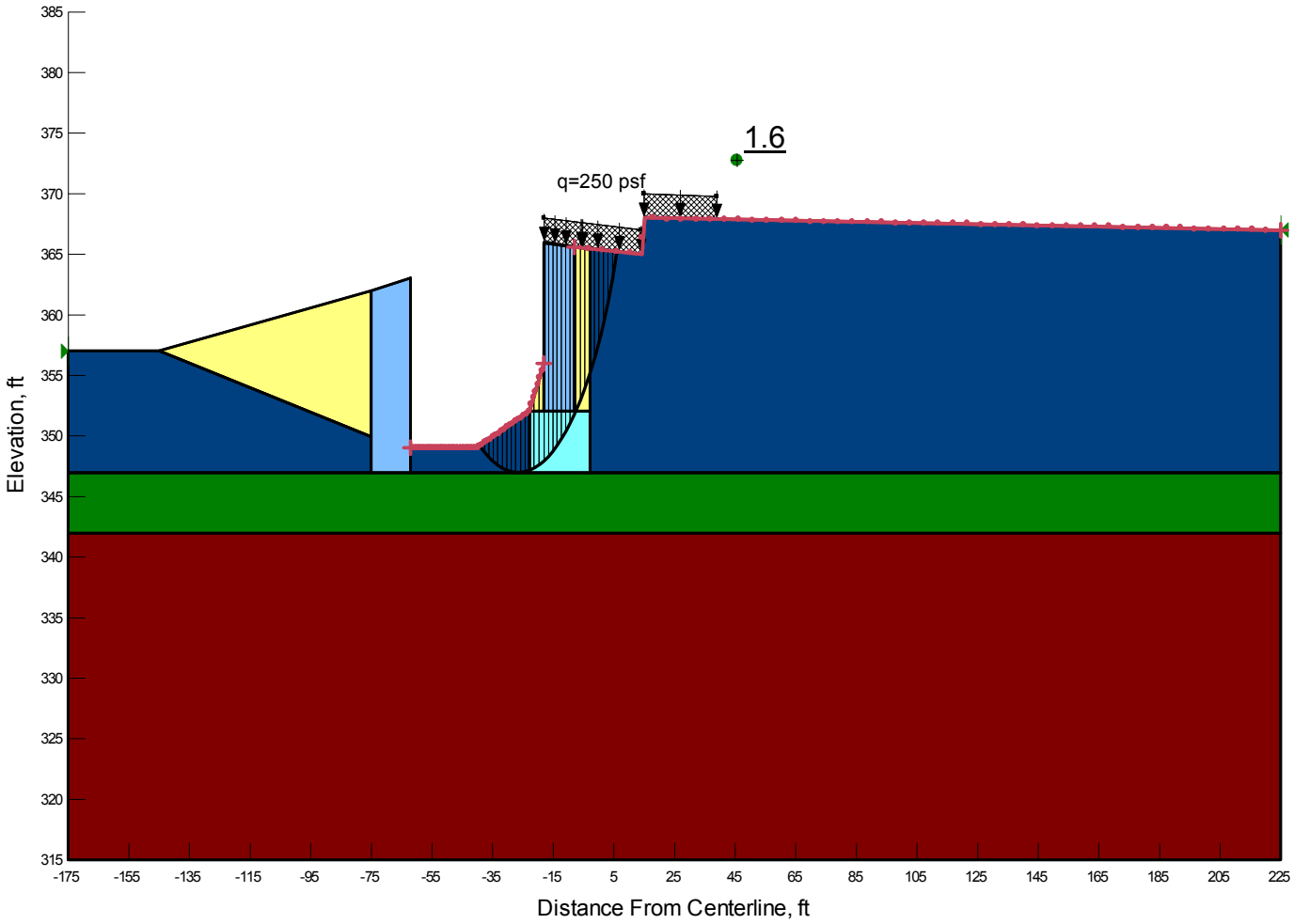
Project Feature	Design Loading Condition	Calculated Minimum Factor of Safety
Wall PP Sta 7+60 Right Side	End of Construction	3.0
	Long Term	1.6
	Seismic (K_h=A_s/2 = 0.08)	1.5
Sta 7+60 Left Side	End of Construction	4.6
	Long Term	2.5
	Seismic (K_h=A_s/2 = 0.08)	2.1

Summary of Soil Strength Parameters

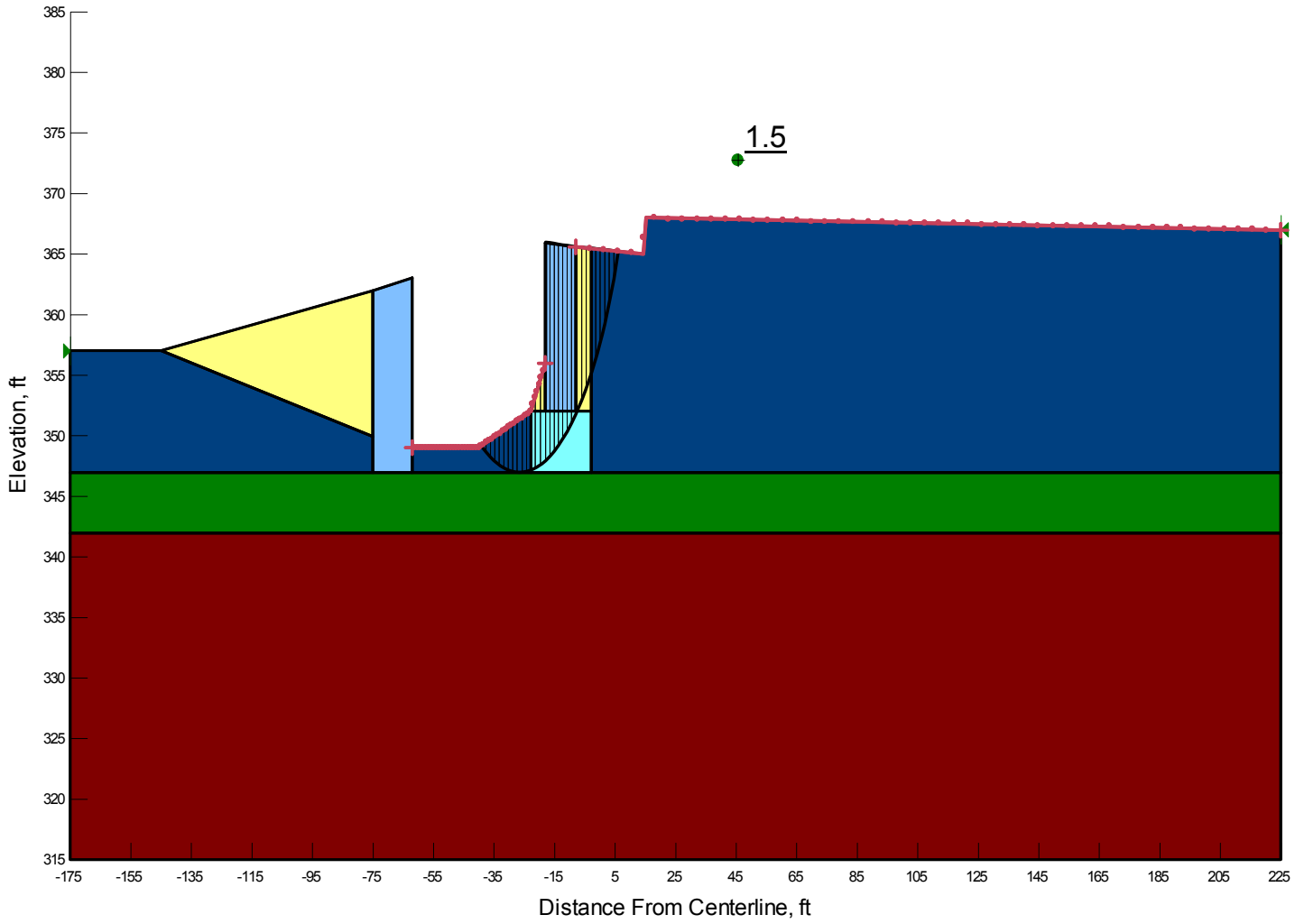
Soil Description	Total Unit Weight (γ), pcf	Undrained Shear Strength (s_u), psf	Effective Cohesion (c'), psf	Effective Friction Angle (φ'), deg
Existing Fill	125	1000	150	20
Embankment Fill (Unclassified Borrow)	125	750	750	0
Stiff to Very Stiff Silty Clay	120	1750	200	24
SM-1	125	0	0	32
Moderately Hard Weathered Shale	150	3000	1000	20



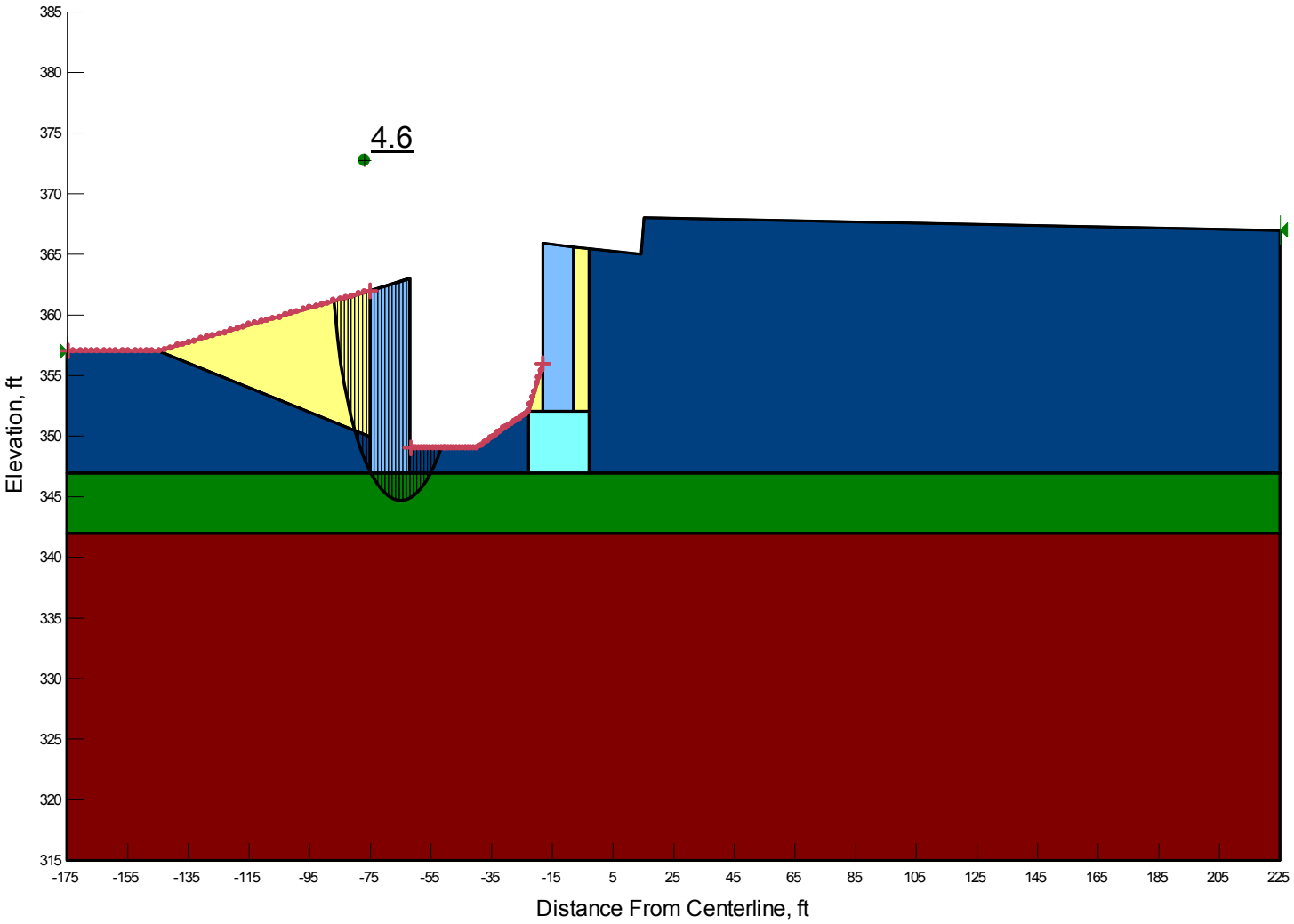
Results of Stability Analyses – End of Construction Condition
Wall PP Right Side @ Sta 7+60
14-030 – University Ramp
AHTD Job No. rCA0608 – I-630



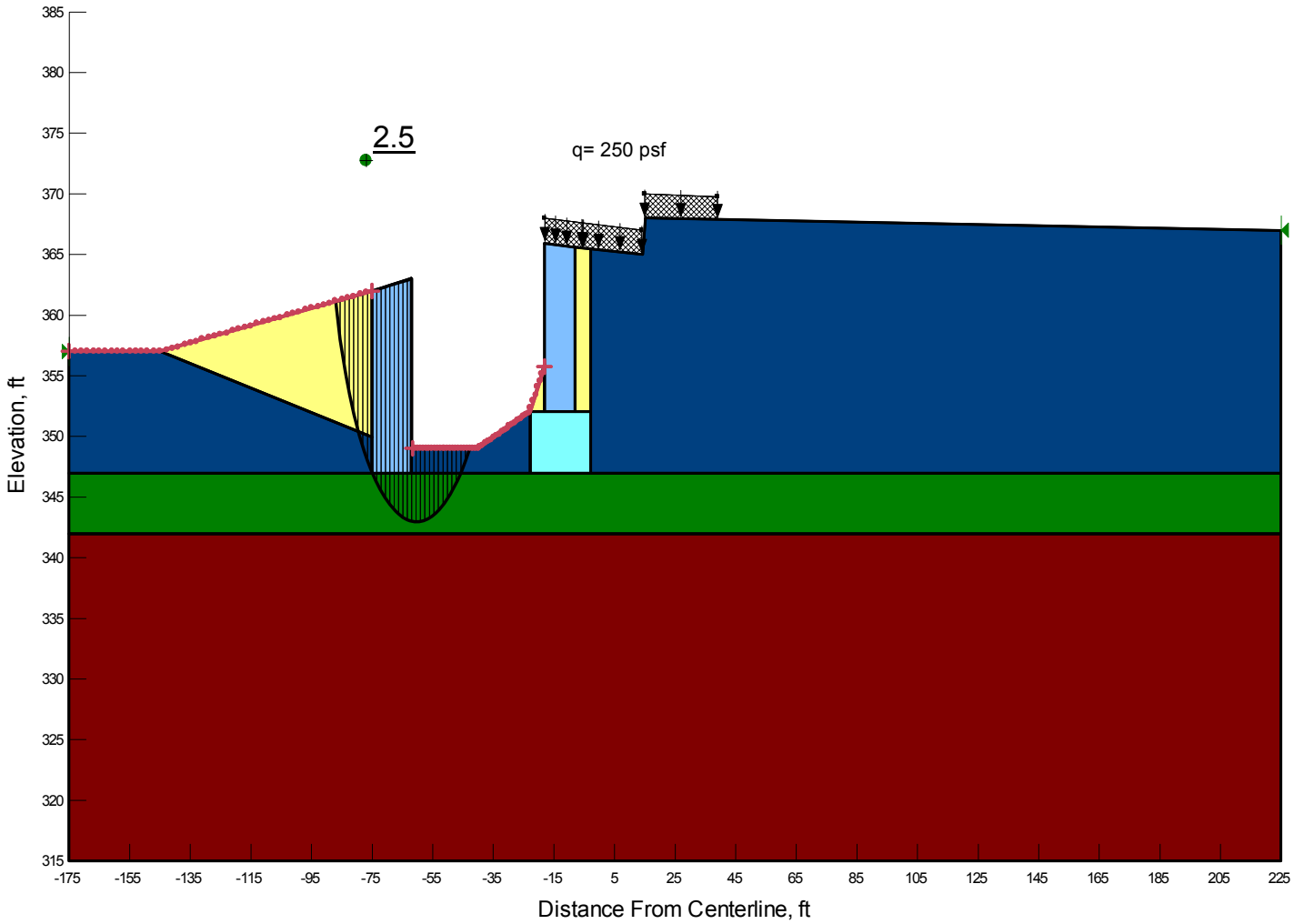
Results of Stability Analyses – Long Term Condition
Wall PP Right Side @ Sta 7+60
14-030 – University Ramp
AHTD Job No. rCA0608 – I-630



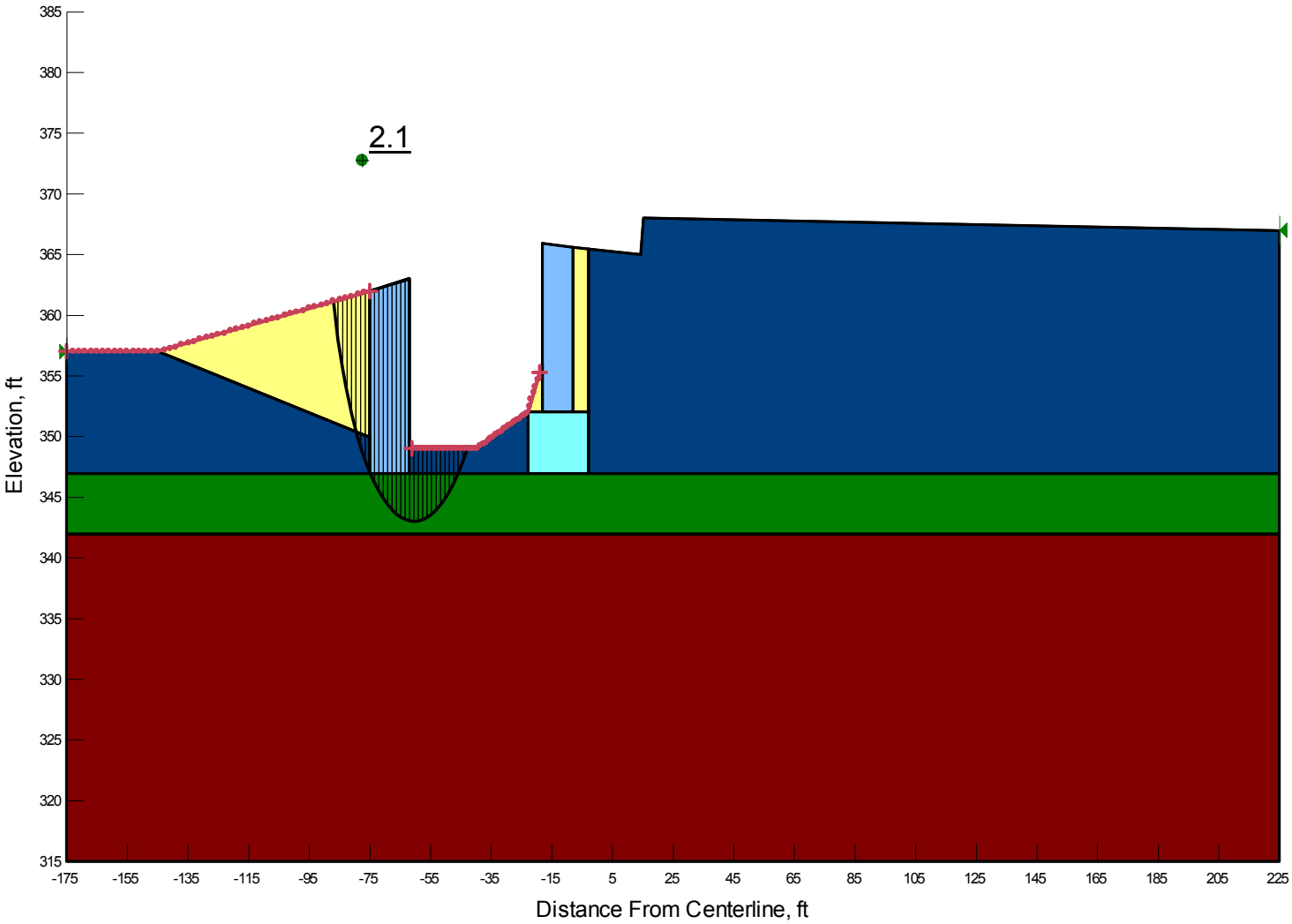
Results of Stability Analyses – Seismic Condition ($K_h = 0.08$)
Wall PP Right Side @ Sta 7+60
14-030 – University Ramp
AHTD Job No. rCA0608 – I-630



Results of Stability Analyses – End of Construction Condition
Wall PP Left Side @ Sta 7+60
14-030 – University Ramp
AHTD Job No. rCA0608 – I-630



Results of Stability Analyses – Long Term Condition
Wall PP Left Side @ Sta 7+60
14-030 – University Ramp
AHTD Job No. rCA0608 – I-630



Results of Stability Analyses – Seismic Condition ($K_h = 0.08$)
Wall PP Left Side @ Sta 7+60
14-030 – University Ramp
AHTD Job No. rCA0608 – I-630