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Job No. 15-019

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

Attn: Mr. Shahriar Azad, P.E.

**GEOTECHNICAL REPORT
RETAINING WALLS
AHTD JOB CA0601
HWY. 70 - SEVIER ST. (WIDENING) (S)
SALINE COUNTY, ARKANSAS**

INTRODUCTION

Submitted herewith is the final report providing the results of the geotechnical investigation performed relevant to the retaining walls associated with the Job CA0601 I-30 widening project. These walls are part of the AHTD Job CA0601: Highway 70-Sevier Street (Widening)(S) project in Saline County, Arkansas. Foundation and embankment recommendations for the CA0601 bridges were submitted on April 14, 2016 under separate cover. Recommendations for pavements and subgrade support were provided on November 20, 2015. Geotechnical results for the study phase pertinent to the retaining walls were provided on April 4, 2016. This revised report incorporates the comments discussed with the Engineer (Bridgefarmer & Associates) and the Program Manager.

We understand that the project will include seven (7) new retaining walls (Walls AA through GG) in the project alignment. Of these, Walls BB and CC are planned as soil nail walls. The remaining five (5) walls will be mechanically stabilized earth (MSE) walls (Walls AA, DD, EE, FF, and GG). The various walls and geotechnical recommendations for design and construction are discussed in subsequent report sections. The project location is shown on Plate 1 of Attachment 1. Key maps showing the various walls are provided on Plates 2 and 3 of Attachment 1. The base drawings of the key plan and layouts were provided by the Engineer (Bridgefarmer).

At the I-30 and Highway 70 interchange, simple slopes are currently utilized to transition grades between Highway 70 Ramp 3 and Frontage Road B. Current plans are for the north

embankment of the Highway 70 Ramp 3 to be modified by incorporating an MSE wall (Wall AA) to accommodate the widened roadway section.

The existing I-30 and Highway 67 intersection does not include a ramp from I-30 eastbound to Highway 67. Currently, a ramp off I-30 eastbound connects with Frontage Road A, which in turn connects with Highway 67. We understand that this project includes the construction of a ramp, Highway 67 Ramp 1, which will connect traffic off I-30 eastbound directly to Highway 67. Simple slopes are currently utilized to transition grades between I-30 eastbound and Frontage Road A. We understand that this embankment will be modified by incorporating a soil nail wall (Wall BB) to retain Frontage Road A from Highway 67 Ramp 1. Current plans also call for the northern embankment of I-30 eastbound to be modified by installing a soil nail wall (Wall CC) to retain I-30 from the planned Highway 67 Ramp 1.

At the existing bridge abutments of the Highway 67 bridge, simple slopes are currently utilized to transition grades. Current plans are for the embankment side slopes to be modified by incorporating MSE walls, Wall DD and Wall EE, to retain the widened roadway section for both the west and east bridge embankments respectively. Both MSE walls will encompass its respective embankment and turn at the abutment corners to form the abutment walls for the bridge ends.

At the existing bridge abutments of the South Street over I-30 structure, simple slopes are also currently utilized to transition grades. For the replacement South Street over I-30 Bridge, MSE walls, Wall FF and Wall GG, are intended to replace the simple slopes at the bridge abutments for both the north and south bridge embankments respectively.

The general locations of the various new walls associated with the I-30 widening project are indicated on the key plan provided as Plates 2 and 3 of Attachment 1. Current layout drawings of all the new retaining walls are included in Attachment 3.

Analyses, have been performed for the following wall locations.

- Wall AA at the I-30 and Highway 70 Interchange
 - A critical cross section of Wall AA at Wall AA Sta 11+20 where the MSE walls are the highest (15 ft)
- Walls at Highway 67 Ramp 1
 - A critical cross section of Wall BB at Wall BB Sta 08+42 where the soil nail wall is the highest (14 ft)
 - A critical cross section of Wall CC at Wall CC Sta 05+27 where the soil nail wall is the highest (24 ft)
- Walls associated with the Highway 67 Bridge

- A representative cross (transverse) section of Wall DD at I-30 Sta 395+66 for both the north and south sides of the west bridge end
- A profile (longitudinal) section for evaluation of the abutment walls, Wall DD and Wall EE, for the west and east bridge ends respectively
- A representative cross (transverse) section of Wall EE at I-30 Sta 398+59 on the north side of I-30
- A representative cross (transverse) section of Wall EE at I-30 Sta 397+31 on the south side of I-30
- Walls at the South St over I-30 Bridge
 - A profile (longitudinal) section for evaluation of the abutment walls, Wall FF and Wall GG, for the north and south bridge ends respectively

Bearing capacity, sliding, and global stability analyses were performed for these walls. Results and recommendations are discussed in subsequent sections of this report.

SUBSURFACE EXPLORATION

Drilling and Sampling Procedures

The wall borings were drilled with SIMCO 2400, SIMCO 2800, and Mobile B-53 rotary drilling rigs. Soil and weathered rock samples were typically obtained at approximately 2-ft intervals to 10-ft depth and at 5-ft intervals thereafter. Samples were obtained using a 2-in.-diameter split-barrel sampler driven into the strata by blows of a 140-lb safety hammer or automatic dropped 30 inches, in accordance with Standard Penetration Test (SPT) procedures. The number of blows required to drive the standard split-barrel sampler the final 12 in. of an 18-in. total drive, or a portion thereof, is defined as the Standard Penetration Number (N). Recorded N-values are shown on the boring logs in the "Blows Per Ft" column. Where rock hardness precluded recovery via the SPT, cuttings were obtained for use in visual classification.

All samples were removed from samplers in the field. Samples were then visually classified by the field geologist or engineer and placed in appropriate containers to prevent moisture loss and/or disturbance during transfer to our laboratory for further examination and testing.

The borings were advanced using dry-auger procedures to the extent possible to facilitate evaluation of shallow groundwater conditions. Observations regarding groundwater are noted in the lower-right portion of each log.

As noted, the project alignment location is shown on Plate 1 of Attachment 1. Key maps showing the various walls are provided on Plates 2 and 3 of Attachment 1. The wall layouts are provided in Attachment 2. The approximate boring locations are shown on the Plans of Borings, Plates 1 through 5 of Attachment 3. The subsurface exploration program is summarized on Plate

6 of Attachment 3. Keys to the terms and symbols used on the logs are provided on Plates 7 and 8 of Attachment 3. The boring logs are provided in subsequent attachments.

The approximate boring locations are noted as station and centerline offset on each log. The approximate ground surface elevation at the borehole locations, as inferred from the available plan and profile drawings, are also shown on the logs. It should be noted that the location and surface elevation information shown on the logs are approximate and based on the available topographic information. Actual surface elevations and horizontal location could vary from that shown on the logs.

Wall AA at Highway 70 Interchange

Subsurface conditions in the vicinity of Wall AA between Highway 70 Ramp 3 of I-30 Exit 111 and Frontage Road E were investigated by drilling seven (7) sample borings to depths of 11 to 20 ft below existing grades. Specifically, Borings W1 through W7 were drilled in the wall alignment or in close proximity. The approximate boring locations are shown on the Plan of Borings, Plates 1 and 2 included in Attachment 3. Logs of these borings are included in Attachment 4.

Walls BB and CC at Highway 67 Ramp 1

Subsurface conditions in the vicinity of Walls BB and CC were explored by numerous borings performed in the vicinity of the Highway 67 Ramp 1. Specifically, six (6) borings were drilled in the Wall BB alignment or in close proximity to 9.5- to 25-ft depth, including Borings W8 through W13. These logs are provided in Attachment 5. Three (3) borings were drilled in or near the Wall CC alignment to 11- to 20-ft depth, including Borings W14 through W16. These logs are provided in Attachment 6. The approximate boring locations are shown on the Plan of Borings, Plates 3 and 4 included in Attachment 3.

Walls DD and EE at the Highway 67 Bridge Location

The subsurface exploration program in the Highway 67 Bridge wall alignments includes twelve (12) sample borings performed to 3.5- to 75-ft depth. Eight (8) borings were drilled in the Wall DD alignment or in close proximity. These borings include Borings W21 through W26 and Borings W26A and W26B. Logs of these borings are included in Attachment 7. Four (4) borings were drilled in or near the Wall EE alignment. These include Borings S2 and S3, Boring W27, and Boring R17. Logs of these borings are included in Attachment 8. The approximate boring locations are shown on the Plan of Borings, Plate 4 included in Attachment 3.

Walls FF and GG at the South Street Bridge

In the South Street Bridge wall alignments subsurface conditions were evaluated by drilling four (4) sample borings to depths of 12 to 20 ft below existing grades. The approximate boring and locations are shown on the Plan of Borings, Plate 5 included in Attachment 3. The results of the borings, which includes Borings W19 and W20 for Wall FF, and Borings W17 and W18 for Wall GG, are presented on the logs provided in Attachment 9 and Attachment 10, respectively.

The approximate ground surface elevation at the boring locations, as inferred from the topographic information provided by the Engineer, is 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 7 and 8 of Attachment 3.

The observations regarding groundwater are noted in the lower-right portion of each log and are discussed in subsequent sections of this report. All borings were backfilled after obtaining final groundwater level readings.

LABORATORY TESTING

Laboratory tests were performed to evaluate pertinent properties of the soil and weathered rock encountered in the wall borings. Laboratory tests consisting of classification and natural water content determinations were performed. Natural water content determinations (AASHTO T 265) were performed to develop information on *in-situ* soil water content for each boring. Water content results are plotted on the log forms in accordance with the scale and symbols shown in the legend located in the upper-right corner of the logs.

To verify field classification and to evaluate soil plasticity, Atterberg limit (liquid and plastic limits) determinations (AASHTO T 89 and T 90) and sieve analyses (AASHTO T 88) were performed on selected representative samples. The Atterberg limits are plotted on the boring logs as plus signs connected with a dashed line. The percentage by weight of soil passing the No. 200 sieve is noted in the “- No. 200%” column on the far right side of the log forms. A summary of classification test results and classification by the Unified Soil Classification System (ASTM D-2487) and AASHTO classification system (AASHTO M 145) is presented in Attachment 11.

GENERAL SITE and SUBSURFACE CONDITIONS

Site Conditions

The project alignment begins at the Interstate 30 and Highway 70 interchange, Sta 248+88.06, and extends east to the I-30 and Sevier Street/South Street, Sta 531+75.78. The alignment locale is a mixture of undeveloped areas and commercial development. The existing I-30 is an interstate highway with two traffic lanes each direction and an asphalt concrete pavement section. Outside the existing roadway and west of Benton, Arkansas, the north and south sides of the roadway alignment are predominantly undeveloped pasture and woodlands with scattered residential and commercial developments. In the rural areas, the roadway is bordered by both shallow ditches and steep hillsides. The alignment also crosses the Saline River and Saline River Relief between Haskell (Hwy 67 interchange) and Benton. Surface drainage of the project area is highly variable. Surface drainage of the existing roadway is good and drainage of the surrounding terrain varies from poor to fair.

Site Geology

The Geologic Map of Arkansas¹ indicates that the roadway alignment crosses mapped exposures of Quaternary Alluvium, the Tertiary Period Wilcox and Midway groups, the middle Ordovician Period Womble Shale Formation, and the lower Ordovician Mazarn Shale Formation. The alluvial deposits are comprised of variable sand, silt, gravel and clay units, and mixtures of any or all of these clastic materials and are underlain by the Tertiary Wilcox and Midway groups and the Ordovician Womble and Mazarn Formations.

Subsurface Conditions

The subsurface conditions revealed by the borings performed for this study are shown in detail on the boring logs presented in Attachments 4 through 10. The surface soils are often variable on-site fill. The fill ranges from localized areas of clay (A-7-6) to sandy fine to coarse gravel (A-1-a). However, the majority of the subgrade soils consist of clayey fine sand, fine sandy clay, silty clay, and fine sandy silt/silty fine sand with variable amounts of gravel. The highly variable on-site fill exhibits variable poor to good compaction.

The on-site fill is underlain by variable firm to very stiff to hard silty clay and soft to stiff clay units with localized and discontinuous units of very soft to very stiff fine sandy clay, dense clayey gravel, medium dense to dense clayey fine to medium sand, medium dense to dense clayey fine to coarse gravel, dense to very dense sandy fine to coarse gravel, medium dense silty

¹ Geologic Map of Arkansas, Arkansas Geologic Commission and U.S. Geologic Survey; 1993

fine sand, and medium dense clayey, fine sandy silt. Shear strength of the cohesive soils varies from low to moderate and relative density of the granular soils varies from medium to high. The predominant silty clay and granular soils exhibit low plasticity. The localized clay units have high to very high plasticity. The high to very high plasticity clay units appear to be predominantly in the alignment vicinity between approximately Sta 345 to Sta 395.

The existing embankment fill and natural soils are underlain by weathered shale and sandstone at variable depths of 6 in. to in excess of the boring completion depths. The low hardness to moderately hard highly weathered shale, weathered shale and shale exhibit low compressibility and moderate to high shear strength. Hard shale and hard sandstone, as indicated by auger refusal, was locally encountered at shallow depths.

Groundwater Conditions

The wall borings were advanced by dry-auger procedures to the extent possible to facilitate observation of groundwater conditions. Groundwater was locally encountered in some borings in June through October 2015. Groundwater observations are summarized below.

Boring No.	Wall	Approx Surf. El, ft	Groundwater depth, ft	Approx Groundwater El, ft	Date
W3	AA	407	8	399	06/29/15
W5	AA	408	13	395	07/02/15
W6	AA	417	13	404	06/29/15
W11	BB	360	13.7	346.3	07/07/15
W12	BB	355	12.5	342.5	07/06/15
W13	BB	341	13	328	07/06/15
S3	EE	296	13	283	10/17/15
W17	GG	350	6.5	343.5	07/22/15
W18	GG	348	6.5	341.5	07/22/15

Shallow groundwater was not encountered in the remaining borings within the maximum exploration depth or prior to introducing drilling fluids. Groundwater conditions will vary with seasonal precipitation, surface runoff and infiltration, and water levels in nearby ponds, streams, and drainage features.

ANALYSES and RECOMMENDATIONS

MSE Wall Design

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° unless otherwise accepted by the Engineer or Department.

Geotechnical recommendations for MSE walls are summarized in the table provided in Attachment 12. The information in the MSE Wall Recommendations summary table includes the wall locations, length and heights of representative wall sections which were evaluated. Relevant sample borings are also noted for these wall sections. The recommended maximum nominal unit bearing (q_{ult}), estimated strap length, estimated undercut requirements, bearing stratum, and sliding resistance ($\tan \delta$) are also summarized for the various wall sections. A resistance factor (ϕ_b) of 0.65 is recommended for wall bearing. A resistance factor (ϕ_r) of 1.0 is recommended for evaluation of sliding resistance.

Soil Nail Walls

Soil Nail Wall Design Considerations. The soil nail walls at Highway 67 Ramp 1 are expected to range from about 2.5- to 22-ft high. The backslope behind walls will vary from near horizontal to a maximum of 3-horizontal to 1-vertical (3H:1V). Preliminary design of soil nail walls has been performed utilizing the methodology of FHWA Circular No. 7² and verified by manual calculations based on lateral earth pressures and soil nail bonding. For the purposes of preliminary design, a nominal 4-in.-diameter soil nail anchorage was assumed. In addition, a 20° nail batter (from horizontal) was assumed.

Geotechnical recommendations for preliminary soil nail wall design are summarized in the table provided in Attachment 13. The information in the Soil Nail Wall Recommendations summary table includes the wall locations, and length and height of representative wall sections evaluated. Relevant sample borings are also noted for these wall sections. The recommended maximum nominal unit bearing (q_{ult}), bearing stratum, preliminary anchor length, and preliminary anchor spacing (horizontal and vertical) are also summarized for the various wall sections. A resistance factor (ϕ) of 1.0 is recommended for pullout resistance of anchors in conjunction with proof-testing. In lieu of proof-testing, a ϕ value of 0.70 is recommended for the predominantly cohesive soils.

Soil Nail Wall Preliminary Design. Analyses and preliminary design for Wall BB were performed for three (3) representative wall sections: (1) Sta 08+42, the section with maximum

² Geotechnical Engineering Circular No. 7 Soil Nail Walls; FHWA-IF-03-017; 2003.

wall height (14 ft), (2) Sta 10+60, a section with a wall height of 9 feet, and (3) Sta 11+51, a section with a wall height of 9 feet bearing in relatively weak firm clay. The results of these analyses for preliminary design are summarized in Tables 1 through 3 below.

Table 1: Preliminary Design – Soil Nail Wall BB at Sta 08+42 (H = 14 ft)

Vertical bar spacing (S_V), ft	4
Horizontal bar spacing (S_H), ft	3
Minimum bar length, ft	20
Bar size	#6
Bar length/wall height ratio (L/H)	1.43

Table 2: Preliminary Design – Soil Nail Wall BB at Sta 10+60 (H = 9 ft)

Vertical bar spacing (S_V), ft	4
Horizontal bar spacing (S_H), ft	4
Minimum bar length, ft	20
Bar size	#6
Bar length/wall height ratio (L/H)	2.2

Table 2: Preliminary Design – Soil Nail Wall BB at Sta 11+51 (H = 9 ft)

Vertical bar spacing (S_V), ft	4
Horizontal bar spacing (S_H), ft	3
Minimum bar length, ft	20
Bar size	#6
Bar length/wall height ratio (L/H)	2.2

Analyses and preliminary design for Wall CC were performed for three (3) representative wall sections: (1) Sta 05+27, the section with maximum wall height (22 ft), (2) Sta 06+45, a section with a wall height of 16 feet, and (3) Sta 01+90, a section with a wall height of 10 feet. The results of these analyses for preliminary design are summarized in Tables 4 through 6 below.

Table 4: Preliminary Design – Soil Nail Wall CC at Sta 05+27 (H = 22 ft)

Vertical bar spacing (S_V), ft	4
Horizontal bar spacing (S_H), ft	3
Minimum bar length, ft	31
Bar size	#6
Bar length/wall height ratio (L/H)	1.41

Table 5: Preliminary Design – Soil Nail Wall CC at Sta 06+45 (H = 16 ft)

Vertical bar spacing (S_V), ft	4
Horizontal bar spacing (S_H), ft	4
Minimum bar length, ft	28
Bar size	#6
Bar length/wall height ratio (L/H)	1.75

Table 6: Preliminary Design – Soil Nail Wall CC at Sta 01+90 (H = 10 ft)

Vertical bar spacing (S_v), ft	4
Horizontal bar spacing (S_H), ft	4
Minimum bar length, ft	20
Bar size	#6
Bar length/wall height ratio (L/H)	2.0

As mentioned above, a summary of Soil Nail Wall recommendations, is provided in Attachment 13. Final soil nail wall designs will be developed by Others on behalf of the Contractor. Final design could vary from the preliminary designs above depending on nail spacing and length, wall height, wall backslope, surcharge loads, nail installation method, drillhole diameter, and design grout-soil bond strength. We recommend that the design grout-soil bond strength be confirmed by at least one (1) verification test for each wall. We also recommend that for each wall, a minimum of 10 percent or at least three (3) production anchors, whichever number is greater, be proof-tested to at least 1.3 times the design load for each wall.

The Contractor should select the most suitable anchor type and installation method for the particular system being utilized. The Contractor's soil nail wall design, including the load test program, proposed anchor layout, corrosion protection details, connection to wall face, and the work plan should be reviewed and approved by the Engineer or Department prior to acceptance and the start of work. As per the AHTD Special Provision for soil nails, Class I corrosion protection requirements according to the Appendix C of FHWA Geotechnical Engineering Circular No. 7 "Soil Nail Walls". A sample Special Provision for soil nail walls is provided in Attachment 14.

Bearing and Sliding Stability – Retaining Walls

MSE Walls – Walls AA, DD, EE, FF, and GG. Bearing capacity and sliding resistance were analyzed along the alignment of all new MSE retaining walls. A summary of recommendations related to MSE wall bearing and sliding resistance is provided in Attachment 12.

The suitability of the MSE wall bearing strata must be field verified by the Engineer or Department at the time of construction. Where undercuts are warranted, these should extend at least 5 ft outside the reinforced zone to the extent possible. At the wall ends (longitudinally), the undercut should extend beyond the reinforced zone a minimum distance determined by a 1-horizontal to 2-vertical (1H:2V) projection from the edge of the reinforced zone to the undercut bottom. Where existing structures limit the undercut extent, the undercut limits should be field verified and adjusted as needed.

Undercut backfill should consist of selected material (AHTD Standard Specifications Section 302, SM-1) or an approved alternate. A minimum 2 ft embedment is recommended for all MSE Walls. A resistance factor (ϕ_b) of 0.65 is recommended for bearing. A resistance factor (ϕ_r) of 1.0 is recommended for evaluation of sliding resistance. Long-term post-construction settlement of the wall foundation soils or the recommended undercut backfill is expected to be less than 1.0 inch.

Rammed Aggregate Pier Alternate for Wall DD. As an alternative to deep undercut, rammed aggregate piers may be utilized to improve the foundation soils of MSE Wall DD within the section of MSE Wall DD Sta 01+79 to Sta 03+50. Compared to the undercut and backfill alternative, using rammed aggregate piers also has the advantage of a reduced foundation soil treatment area and improved global stability and reduced influence on existing structures. The rammed aggregate piers should be located under the reinforced soil zone of the MSE wall.

The Geopier™ system is a foundation system of rammed aggregate piers. Rammed aggregate pier elements are typically constructed by drilling 24- to 30-in.-diameter holes from the MSE wall subgrade elevation and ramming thin lifts of well-graded aggregate within the holes to form very stiff, high-density aggregate piers. The wall foundation soils would be reinforced by installing rammed aggregate pier elements. The first lift of compacted aggregate backfill forms a bulb below the bottoms of the piers, thereby prestressing and prestraining the soils to an approximate depth equal to one (1) pier diameter. Subsequent lifts are typically about 12-in. thick. Ramming is performed with a high-energy beveled tamper that densifies the aggregate and forces the aggregate laterally into the sidewalls of the hole. This action increases the lateral stress in the surrounding soil and further stiffens the stabilized composite soil mass. The result of rammed aggregate pier installation is a strengthening and stiffening of foundation soils.

Geopier™ design and construction is proprietary and provided by contractors licensed by Geopier Foundation Company, Inc. Detailed recommendations can be provided by Geopier Foundation Company when specific design concepts, wall foundation loads, and site grading plans are available. Based on the subsurface conditions in the wall alignment, an average rammed aggregate pier length on the order of 12 to 15 ft below the wall subgrade with a rammed aggregate pier spacing on the order of 4 to 6 ft on center would be anticipated. The spacing would be intended to provide an area ratio on the order of 20 percent rammed aggregate pier to

plan wall reinforced zone footprint area. The area stabilized by rammed aggregate piers should cover the complete footprint of the MSE wall reinforced zone.

Based on the results of the relevant borings drilled in the MSE wall vicinity, a maximum nominal bearing resistance (q_{ult}) of 7000 lbs per sq ft is considered fitting for the composite rammed aggregate pier and soil bearing stratum. The appropriate final design bearing pressure must be determined by Geopier Foundation Company. A resistance factor (ϕ_b) of 0.65 is recommended with respect to bearing. Accordingly, a factored unit bearing resistance (q_R) of 4550 lbs per sq ft would be expected with the use of rammed aggregate piers.

A composite nominal coefficient of sliding ($\tan \delta$) value of 0.5 may appropriately be assumed between the reinforced wall backfill on the composite soil/rammed aggregate pier bearing stratum. A resistance factor (ϕ_r) of 1.0 is recommended for evaluation of sliding resistance.

Soil Nail Walls – Walls BB and CC. As noted, a summary of recommendations related to the planned soil nail retaining walls are included in Attachment 13. The recommended bearing strata, as well as the respective nominal unit bearing resistance, is presented for representative sections along the alignment of each soil nail wall. The potential for bottom heave resulting from wall excavation and unbalanced loads is considered negligible for the new soil nail wall locations.

Global Stability of Retaining Walls

General. Stability analyses were performed to verify the global stability of the widened embankments comprising of retaining walls and / or slopes. As noted above, multiple sections were selected for analyses. Where appropriate, both the local stability of the new walls and the overall stability of the embankments were evaluated in the global stability analyses. An average uniform surcharge of 250 lbs per sq ft was included to account for the surcharge of vehicle traffic loads.

The results of the global stability analyses for MSE walls are presented in Attachment 15. The results of global stability analyses for the Soil Nail walls are exhibited in Attachment 16. Material properties used are shown on the summary of stability analyses for each section analyzed.

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° 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 2007³ and a Morgenstern-Price analysis. Three (3) general loading conditions were analyzed with respect to global slope stability:

- 1) End of construction. This condition utilizes total stress soil shear strength parameters.
- 2) Long-term condition. This condition utilizes effective stress soil shear strength parameters.
- 3) Seismic condition. Analysis of this condition assumes the long-term condition but includes additional seismic forces. A horizontal acceleration coefficient (k_h) value, which is equal to one half the design peak ground acceleration value ($A_s/2$), was utilized in the stability analyses. For all of the walls analyzed, a k_h value of 0.07 was utilized.

Groundwater elevations for each analysis were determined from water level data developed from relevant boring logs. The analyses results confirm that global stability of the plan configurations of the new retaining walls are within an acceptable range for all conditions evaluated.

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. 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

³ Slope/W 2007; GEO-SLOPE International; March 2008.

are properly backfilled with compacted fill. Based on the results of the borings, the potential for undercut is generally considered to be low in the retaining wall alignments. However, 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. All wall undercuts should be backfilled with selected material (AHTD Standard Specifications Section 302, SM-1), or an approved alternate. For the MSE walls, undercuts should extend at least 5 ft outside the reinforced zone to the extent possible.

Fill and backfill may consist of unclassified borrow free of organics and other deleterious materials as per AHTD Standard Specifications Subsection 210.06. It should be noted that the locally available shale fragment borrow is non-durable rock. The shale fragments should be processed to develop a shale fragment / silty clay blend. Where accepted by the Engineer or Department, we recommend that the shale fragment / silty clay blend be compacted to at least 95 percent of the AASHTO T-180 maximum density within a water content range of optimum to 3 percent above the optimum value. Granular soils must be protected from erosion with a minimum 18-in.-thick armor of clayey soil. The on-site silty clay, sandy clay, clay, and weathered shale are typically suitable for this use.

Subgrade preparation should comply with AHTD Standard Specifications, Section 212. Embankments should be constructed in accordance with AHTD criteria (AHTD Standard Specifications, Section 210). Fill and backfill 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 slopes 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.

Shallow groundwater was locally encountered in the wall alignments in June to October 2015. In addition, localized seeps or springs may be present or encountered during site grading or

excavation. Seepage into excavations and cuts can typically be controlled by ditching or sump-and-pump methods. If seepage into excavations becomes a problem, backfill should consist of clean crushed stone (AASHTO M43 #57) or an approved alternate up to an elevation above the inflow of seepage. In areas of seepage infiltration, the granular fill should be fully encapsulated by 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. Groundwater levels will vary with seasonal precipitation, surface infiltration, and stream level of nearby creeks and waterways.

Rock Excavation

Rock excavation methods could be required for some site grading cuts or for excavations. Rock excavation could be required for hard sandstone and more resistant weathered shale units encountered in wall or foundation excavations. Some overbreak of excavations advanced into the sandstone and weathered shale should be anticipated. Any overbreak or overexcavation of foundations should be backfilled as discussed in the appropriate sections of this report.

CLOSURE

The Engineer 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 & Retaining Wall Keyplan
Attachment 2	Wall Layouts
Attachment 3	Plans of Borings, Subsurface Exploration Summary, and Keys to Terms and Symbols
Attachment 4	Wall AA Boring Logs
Attachment 5	Wall BB Boring Logs
Attachment 6	Wall CC Boring Logs
Attachment 7	Wall DD Boring Logs
Attachment 8	Wall EE Boring Logs
Attachment 9	Wall FF Boring Logs
Attachment 10	Wall GG Boring Logs
Attachment 11	Classification Test Results
Attachment 12	Summary of MSE Wall Recommendations
Attachment 13	Summary of Soil Nail Wall Recommendations
Attachment 14	AHTD Special Provision for Soil Nail Wall
Attachment 15	Results of Stability Analyses – MSE Walls
Attachment 16	Results of Stability Analyses – Soil Nail Walls

* * * * *

We appreciate the opportunity to be of 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.

Dillon G. Goins
Staff Engineer

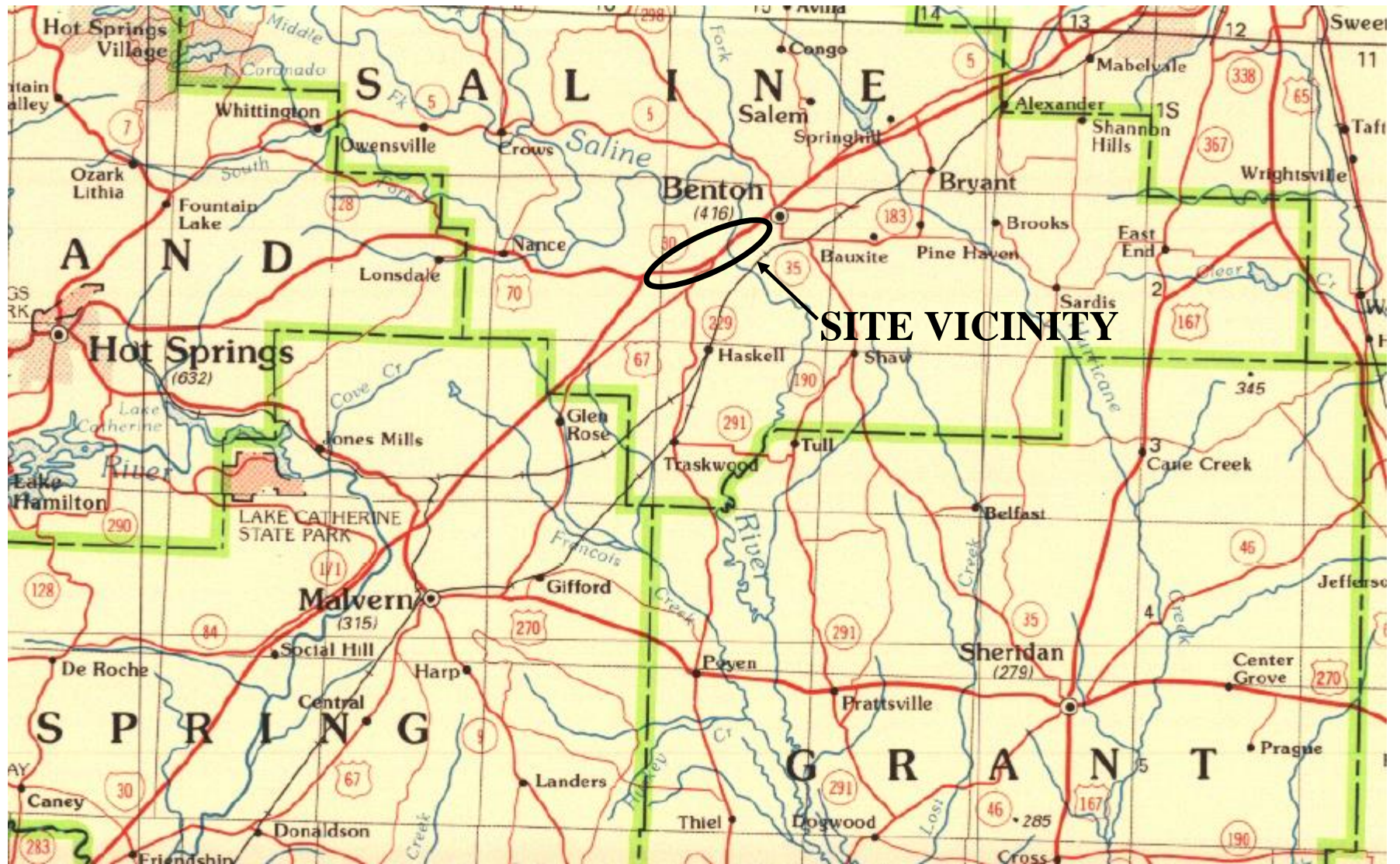
Mark E. Wyatt, P.E.
President



DGG/MEW:jw

Copies Submitted: Bridgefarmer & Associates, Inc.
Attn: Mr. Shahriar Azad, P.E. (1+electronic)
Attn: Mr. Stephen Smiley, P.E. (1-electronic)

ATTACHMENT 1

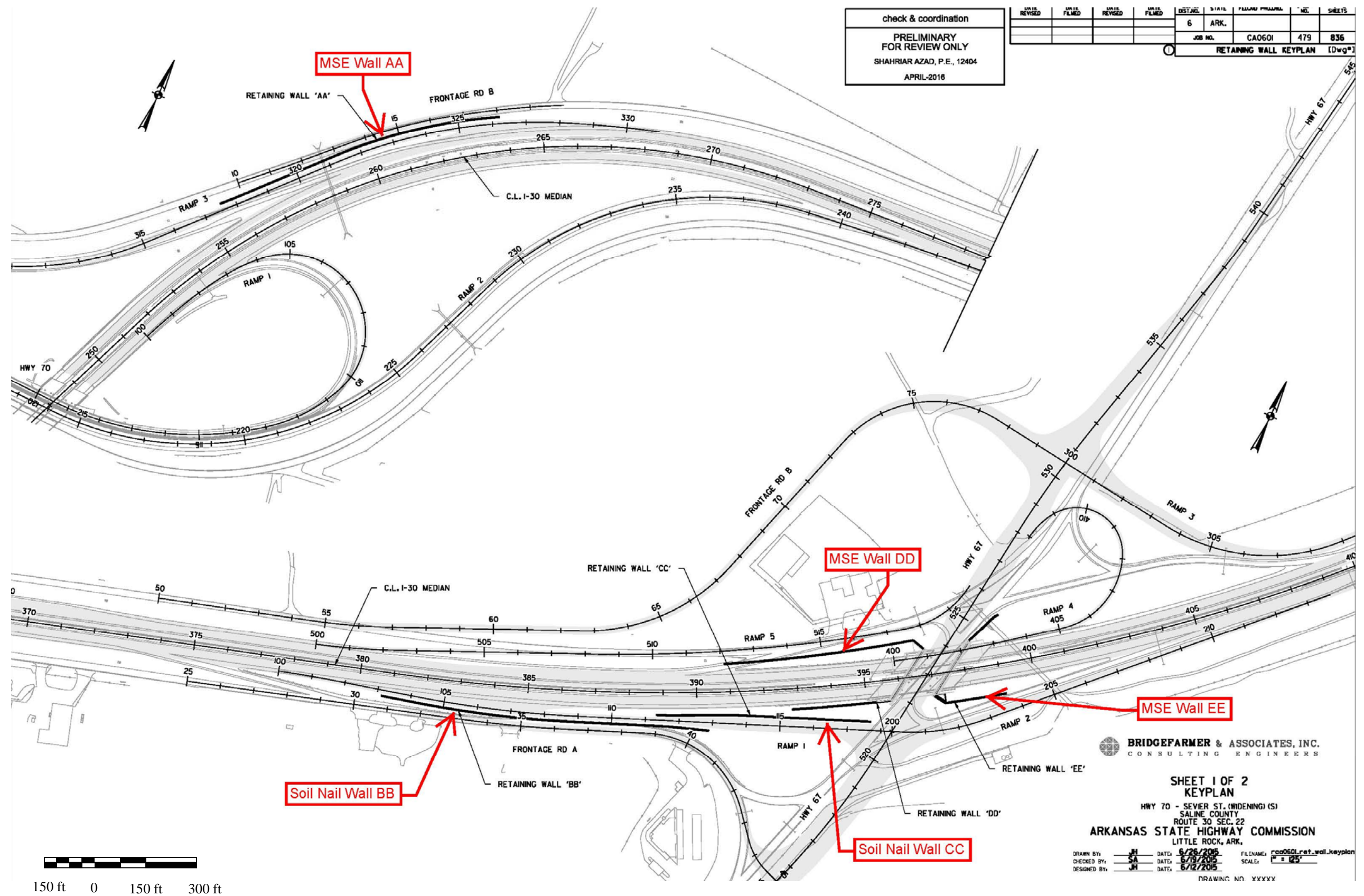


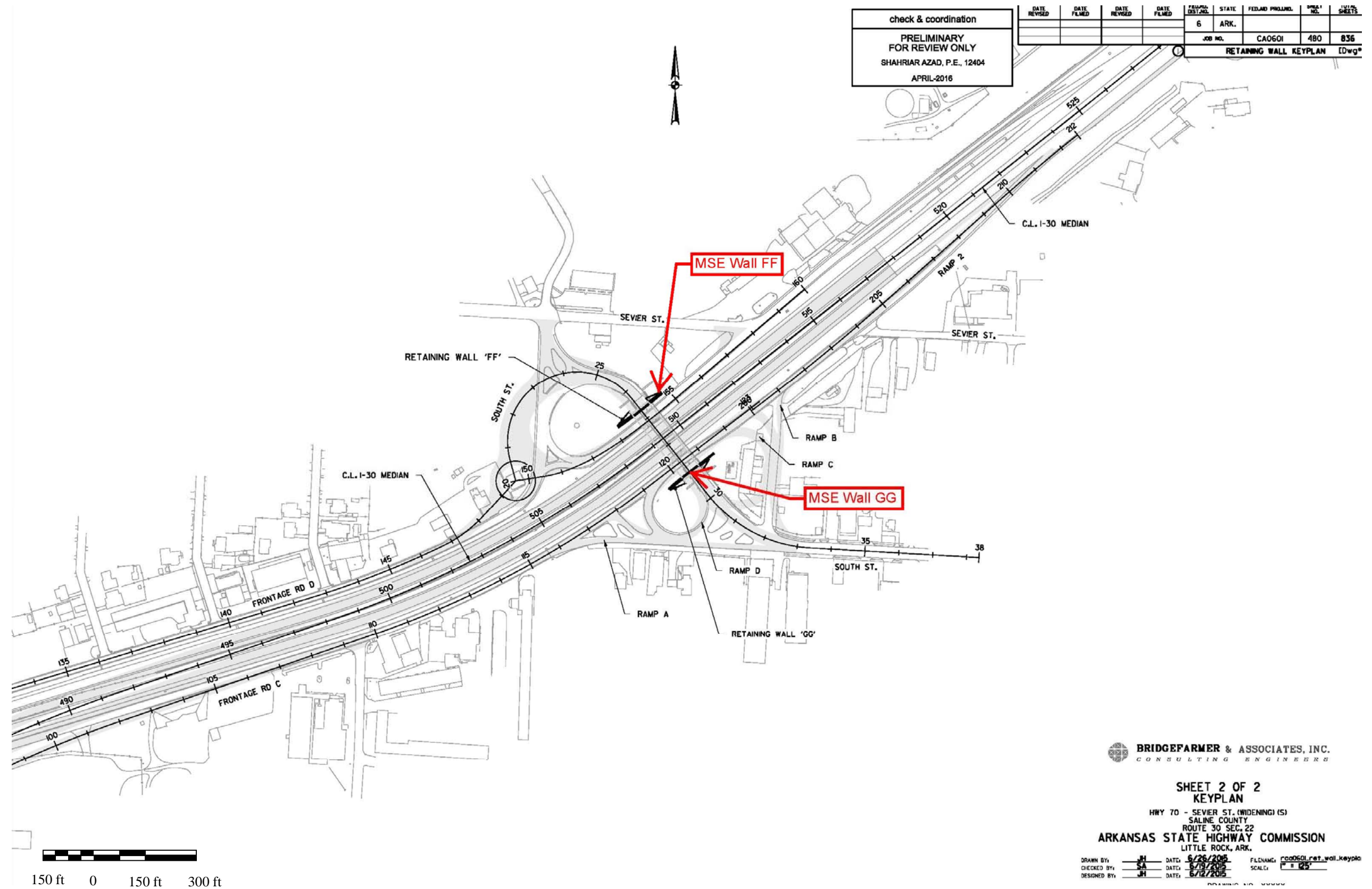
**Grubbs, Hoskyn,
Barton & Wyatt, INC.**
CONSULTING ENGINEERS

Site Vicinity Map
CA0601: Hwy 70 – Sevier St (Widening)(S)
I-30 - Saline County, Arkansas

Job No. 15-019

Plate 1





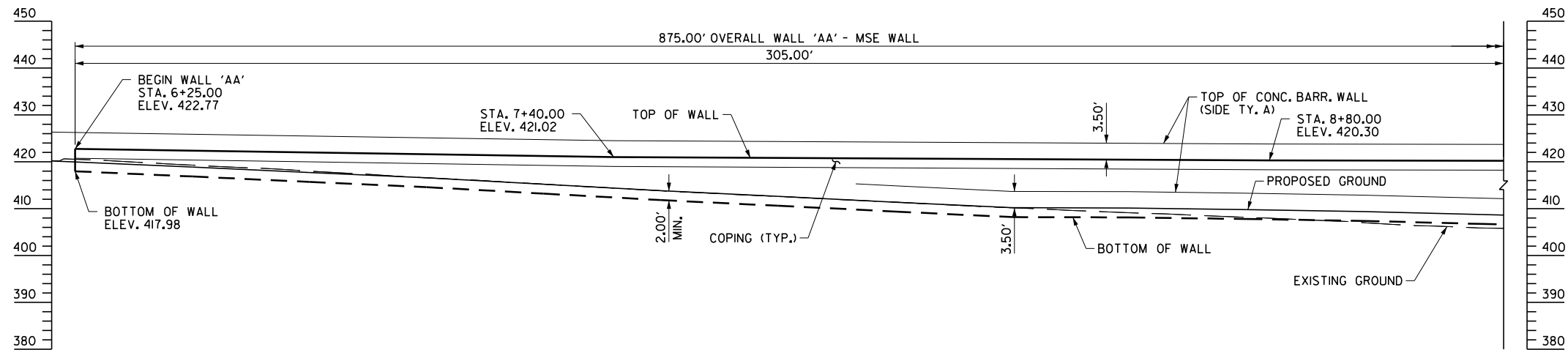
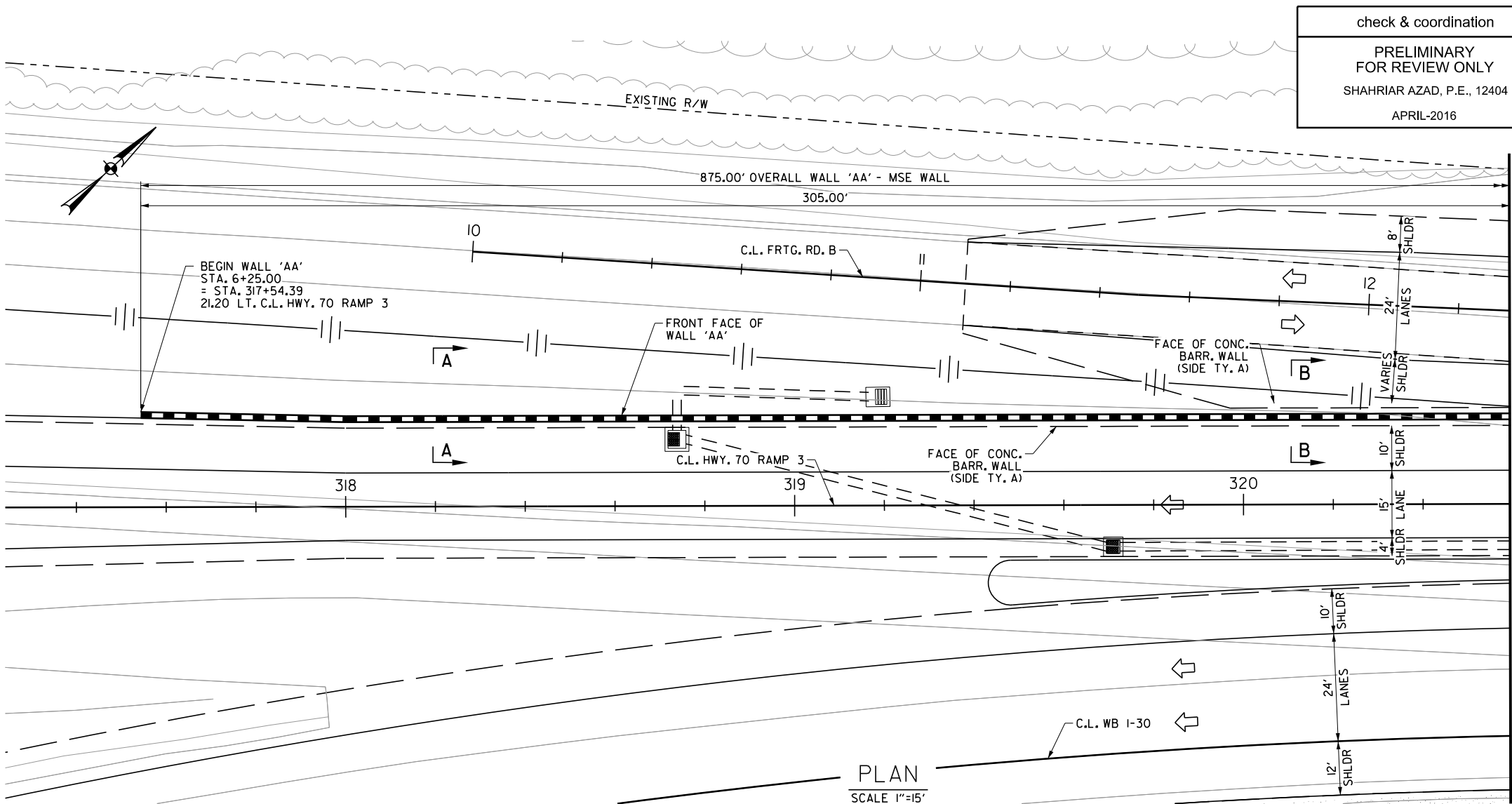
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NOTES:

- CONTROL POINT STATIONS AND OFFSETS ARE MEASURED TO THE OUTSIDE TOP CORNER OF COPING.
- SEE ROADWAY PLANS FOR ADDITIONAL ROADWAY HORIZONTAL ALIGNMENT DATA.
- UNDERDRAIN PIPE INFORMATION IS SHOWN FOR CONTRACTOR'S INFORMATION. THE ACTUAL LOCATION OF THE UNDERDRAIN PIPE SHALL BE DETERMINED BY THE CONTRACTOR INCLUDING CONNECTION TO A DRAINAGE SYSTEM.
- SEE DRAINAGE PLANS FOR ADDITIONAL DRAINAGE INFORMATION.

- THE CONTRACTOR SHALL SUBMIT DETAILED WORKING DRAWINGS AND DESIGN CALCULATIONS FOR APPROVAL AS DESCRIBED IN SP JOB CA0601 "MSE WALL."
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- REFER TO RETAINING WALL DETAIL SHEETS FOR ADDITIONAL INFORMATION.

RETAINING WALL 'AA'			
STATION ALONG WALL	TOP OF WALL ELEV.	FINISHED GRADE ELEV.	BOTTOM OF WALL ELEV.
6+25.00	422.77	419.98	417.98
6+50.00	422.39	418.86	416.86
6+75.00	422.01	417.72	415.72
7+00.00	421.63	416.59	414.59
7+25.00	421.25	415.21	413.21
7+50.00	420.97	413.83	411.83
7+75.00	420.84	412.62	410.62
8+00.00	420.72	411.39	409.39
8+25.00	420.59	410.19	408.19
8+50.00	420.46	410.13	408.13
8+75.00	420.33	409.79	407.79
9+00.00	420.27	409.39	407.39
9+25.00	420.23	408.74	406.74
9+50.00	420.19	408.26	406.26
9+75.00	420.15	407.89	405.89
10+00.00	420.11	407.60	405.60
10+25.00	420.07	407.41	405.41
10+50.00	420.03	407.22	405.22
10+75.00	420.00	407.04	405.04
11+00.00	419.96	406.96	404.96
11+25.00	419.89	407.01	405.01
11+50.00	419.74	407.29	405.29
11+75.00	419.59	407.66	405.66
12+00.00	419.44	408.13	406.13
12+25.00	419.29	408.70	406.70
12+50.00	419.14	409.37	407.37
12+75.00	418.99	410.13	408.13
13+00.00	418.95	410.97	408.97
13+25.00	418.95	411.82	409.82
13+50.00	418.94	412.65	410.65
13+75.00	418.93	413.51	411.51
14+00.00	418.92	414.31	412.31
14+25.00	418.93	415.04	413.04
14+50.00	419.01	415.70	413.70
14+75.00	419.09	416.19	414.19
15+00.00	419.17	416.60	414.60

BRIDGEFARMER & ASSOCIATES, INC.
CONSULTING ENGINEERS

SHEET 1 OF 3
LAYOUT OF RETAINING WALL 'AA'

HWY 70 - SEVIER ST. (WIDENING) (S)
SALINE COUNTY
ROUTE 30 SEC. 22
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

DRAWN BY: JH DATE: 6/26/2015
CHECKED BY: SA DATE: 6/19/2015
DESIGNED BY: JH DATE: 6/12/2015

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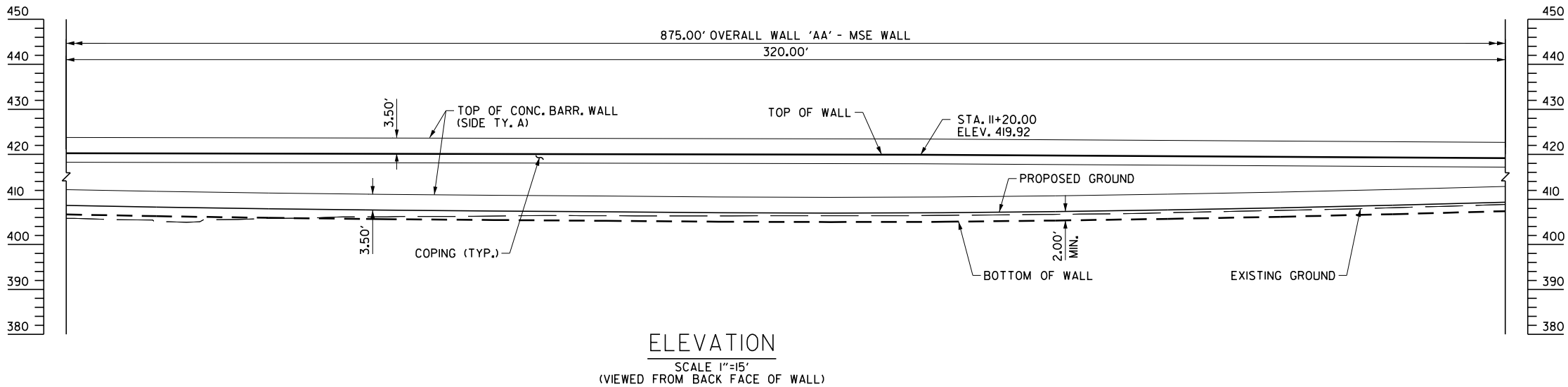
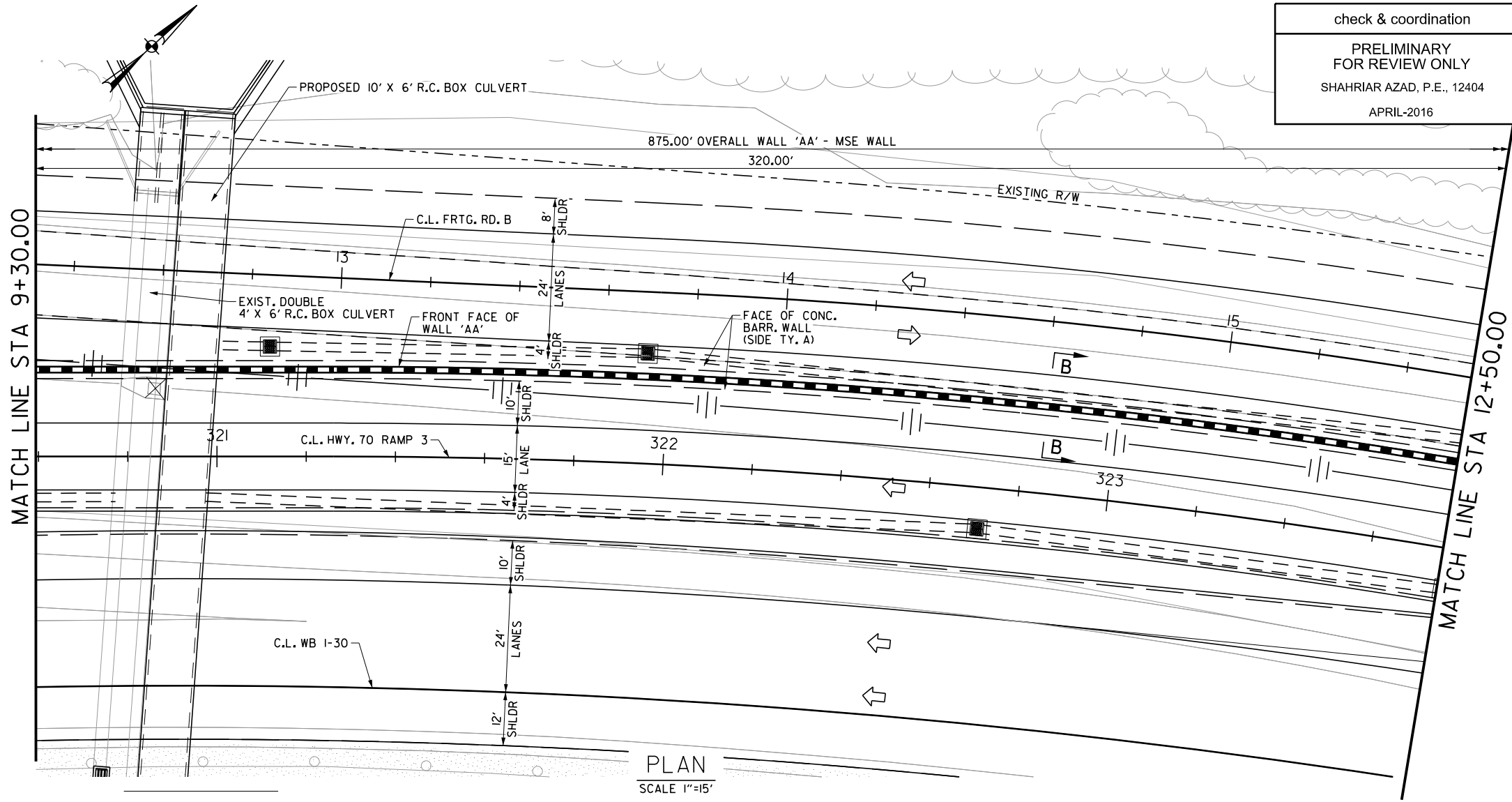
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SHAHRIAR AZAD, P.E., 12404

APRIL-2016

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.		CA0601	482	836
				P&P RET. WALL 'AA'				[Dwg*]



NOTES:

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BRIDGEFARMER & ASSOCIATES, INC.
CONSULTING ENGINEERS

SHEET 2 OF 3
LAYOUT OF RETAINING WALL 'AA'
HWY 70 - SEVIER ST. (WIDENING) (S)
SALINE COUNTY
ROUTE 30 SEC. 22
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

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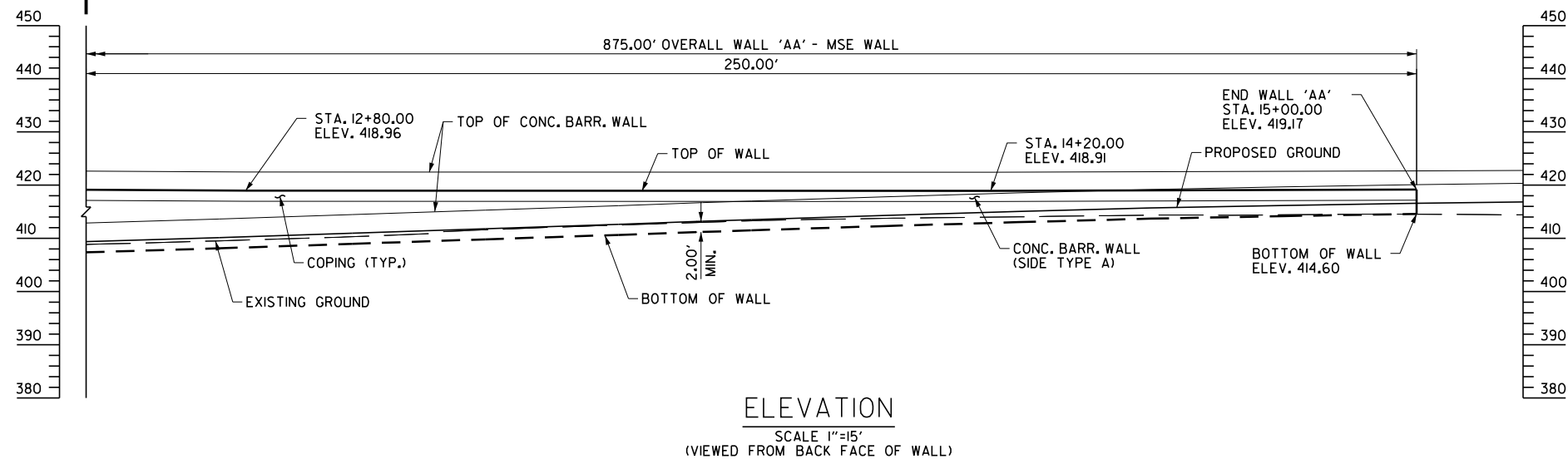
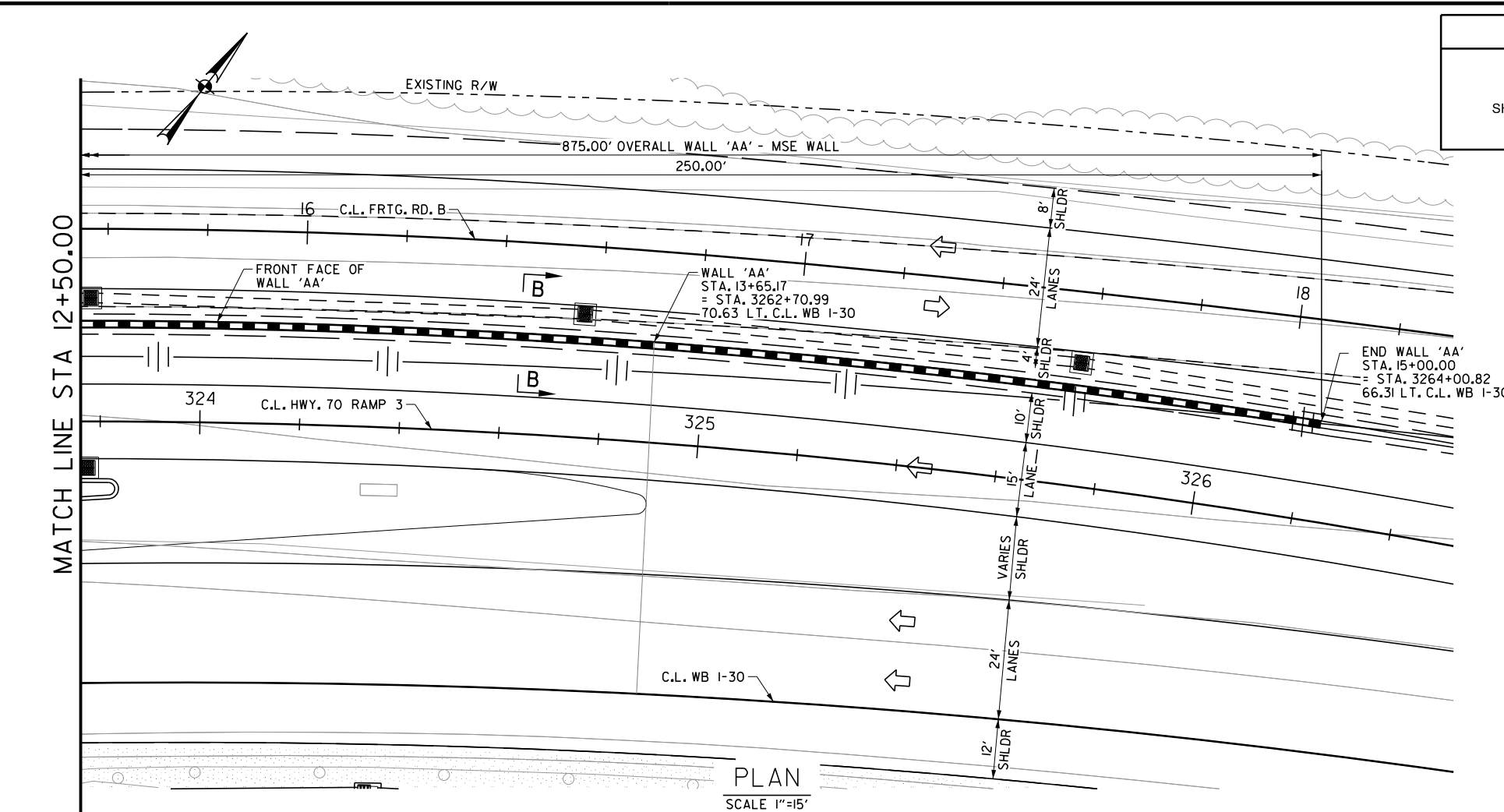
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NOTES:

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7. REFER TO RETAINING WALL DETAIL SHEETS FOR ADDITIONAL INFORMATION.

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PRELIMINARY
FOR REVIEW ONLY

SHAHRIAR AZAD, P.E., 12404

APRIL-2016

* Alignment name: RW*AA

* Alignment description: Retaining Wall AA near HWY 70 RAMP 3

		STATION	NORTHING	EASTING
Element: Linear				
POB ()		5+00.00	1993286.7420	1108697.7133
PI ()		6+70.77	1993410.4200	1108815.4711
Tangential Direction:		N 43° 35' 43.3" E		
Tangential Length:		170.77		
Element: Linear				
PI ()		6+70.77	1993410.4200	1108815.4711
PC ()		9+96.71	1993651.4661	1109034.8556
Tangential Direction:		N 42° 18' 23.1" E		
Tangential Length:		325.93		
Element: Circular				
PC ()		9+96.71	1993651.4661	1109034.8556
PI ()		13+39.67	1993905.1055	1109265.7017
CC ()			1992609.4780	1110179.7278
PCC ()		16+71.73	1994037.5121	1109582.0739
Radius:		1548.05		
Delta:		24° 59' 00.7" Right		
Degree of Curvature(Arc):		3° 42' 04.1"		
Length:		675.02		
Tangent:		342.96		
Chord:		669.69		
Middle Ordinate:		36.65		
External:		37.54		
Tangent Direction:		N 42° 18' 23.1" E		
Radial Direction:		S 47° 41' 36.9" E		
Chord Direction:		N 54° 47' 53.5" E		
Radial Direction:		S 22° 42' 36.2" E		
Tangent Direction:		N 67° 17' 23.8" E		
Element: Circular				
PCC ()		16+71.73	1994037.5121	1109582.0739
PI ()		18+26.81	1994097.3830	1109725.1294
CC ()			1991376.2259	1110695.8625
PCC ()		19+81.59	1994141.5735	1109873.7786
Radius:		2884.96		
Delta:		6° 09' 13.9" Right		
Degree of Curvature(Arc):		1° 59' 09.7"		
Length:		309.86		
Tangent:		155.08		
Chord:		309.71		
Middle Ordinate:		4.16		
External:		4.17		
Tangent Direction:		N 67° 17' 23.8" E		
Radial Direction:		S 22° 42' 36.2" E		
Chord Direction:		N 70° 22' 00.8" E		
Radial Direction:		S 16° 33' 22.3" E		
Tangent Direction:		N 73° 26' 37.7" E		
Element: Circular				
PCC ()		19+81.59	1994141.5735	1109873.7786
PI ()		21+13.92	1994179.2838	1110000.6294
CC ()			1992360.5980	1110403.2279
PT ()		22+45.81	1994198.6346	1110131.5445
Radius:		1858.01		
Delta:		8° 08' 53.1" Right		
Degree of Curvature(Arc):		3° 05' 01.4"		
Length:		264.23		
Tangent:		132.34		
Chord:		264.01		
Middle Ordinate:		4.70		
External:		4.71		
Tangent Direction:		N 73° 26' 37.7" E		
Radial Direction:		S 16° 33' 22.3" E		
Chord Direction:		N 77° 31' 04.3" E		
Radial Direction:		S 8° 24' 29.2" E		
Tangent Direction:		N 81° 35' 30.8" E		

 **BRIDGEFARMER & ASSOCIATES, INC.**
CONSULTING ENGINEERS

SHEET 3 OF 3
LAYOUT OF RETAINING WALL 'AA'

HWY 70 - SEVIER ST. (WIDENING) (S)
SALINE COUNTY
ROUTE 30 SEC. 22
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

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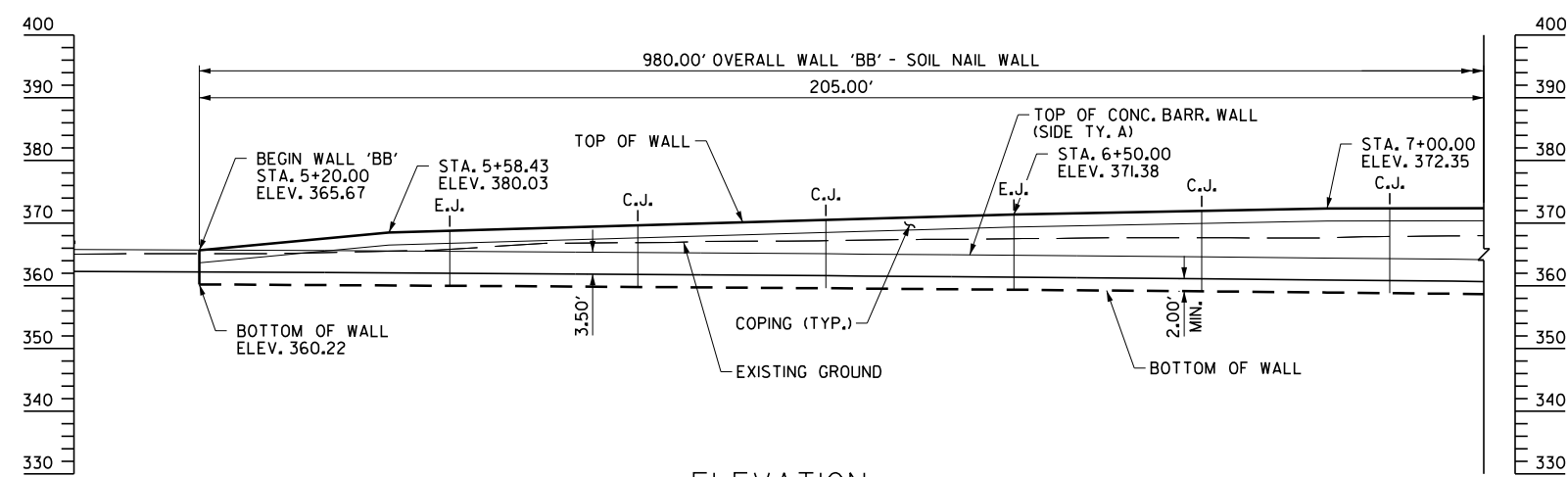
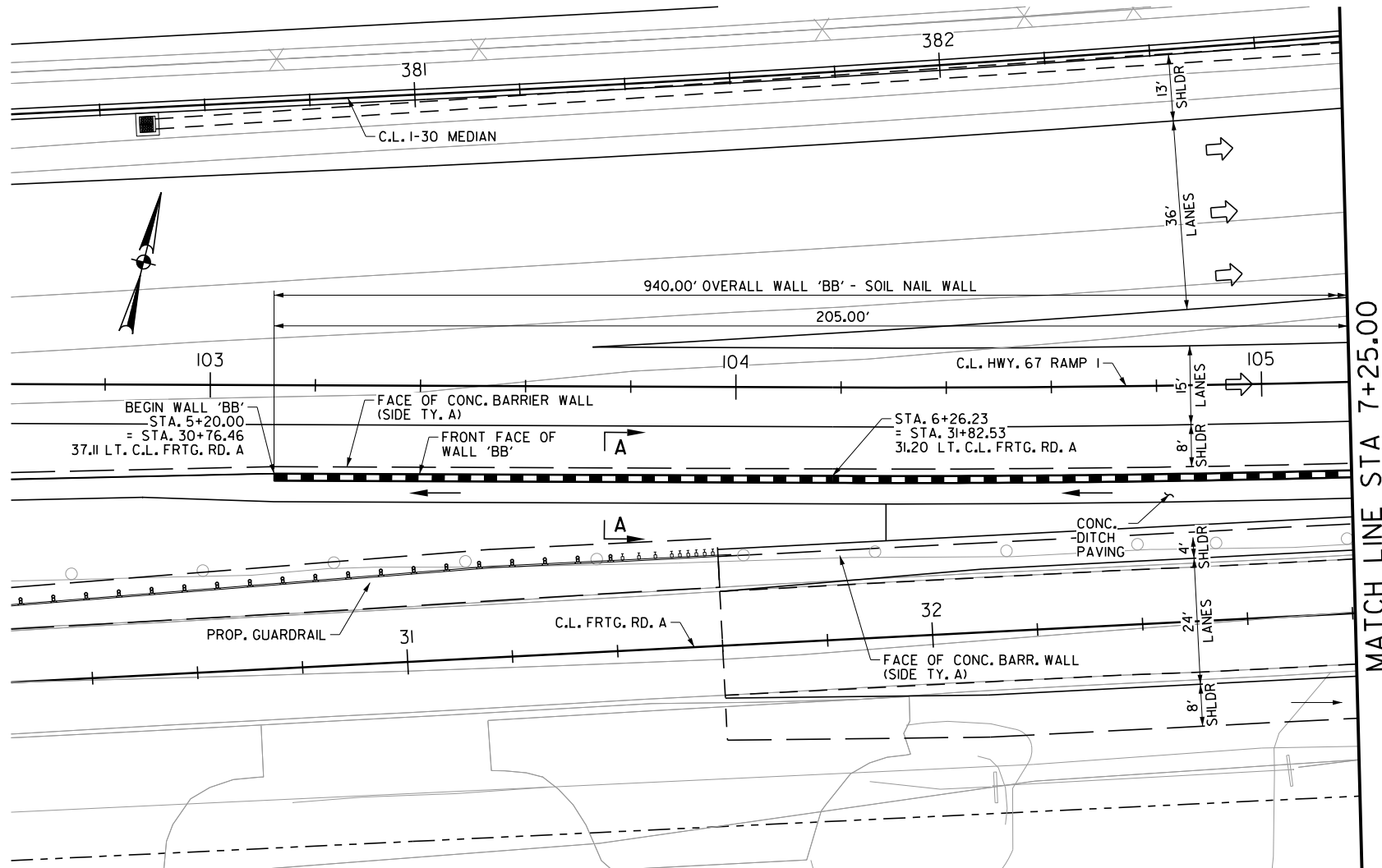
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C.J. AND E.J. - TYPICAL CONSTRUCTION JOINT AND EXPANSION JOINT LOCATIONS. LOCATIONS CAN BE ALTERED BY THE CONTRACTOR. LOCATIONS OF THE CONSTRUCTION JOINTS AND/OR EXPANSION JOINT NEED TO BE SHOWN IN THE WORKING DRAWINGS FOR ENGINEER'S APPROVAL.

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FOR REVIEW ONLY

SHAHRIAR AZAD, P.E., 12404

APRIL-2016

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.		CA0601	486	836
							P&P RET. WALL 'BB'	[Dwg*]

* Alignment name: RW*BB
* Alignment description: Retaining Wall BB near HWY 67 Ramp 1

Element	Linear	STATION	NORTHING	EASTING
POB ()		5+00.00	1995805.6531	1120921.9258
PC (WBB-1)		6+26.23	1995835.9971	1121044.4572
Tangential Direction:		N 76°05'27.5" E		
Tangential Length:		126.23		
Element	Circular			
PC (WBB-1)		6+26.23	1995835.9971	1121044.4572
PI ()		8+65.37	1995893.4810	1121276.5822
CC (1)			1999030.3817	1120253.3924
PT (2)		11+03.67	1995983.9194	1121497.9582
Radius:		3290.88		
Delta:		8°18'44.5" Left		
Degree of Curvature (Arc):		1°44'27.8"		
Length:		477.43		
Tangent:		239.14		
Chord:		477.02		
Middle Ordinate:		8.65		
External:		8.68		
Tangent Direction:		N 76°05'27.5" E		
Radial Direction:		S 13°54'32.5" E		
Chord Direction:		N 71°56'05.2" E		
Radial Direction:		S 22°13'17.0" E		
Tangent Direction:		N 67°46'43.0" E		
Element	Linear			
PT (2)		11+03.67	1995983.9194	1121497.9582
PI (WBBHXX002)		13+75.59	1996086.7562	1121749.6835
Tangential Direction:		N 67°46'43.0" E		
Tangential Length:		271.92		
Element	Linear			
PI (WBBHXX002)		13+75.59	1996086.7562	1121749.6835
POE ()		15+00.00	1996127.7059	1121867.1629
Tangential Direction:		N 70°46'59.0" E		
Tangential Length:		124.41		

NOTES:

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BRIDGEFARMER & ASSOCIATES, INC.
CONSULTING ENGINEERS

SHEET 1 OF 3
LAYOUT OF RETAINING WALL 'BB'
HWY 70 - SEVIER ST. (WIDENING) (S)
SALINE COUNTY
ROUTE 30 SEC. 22
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

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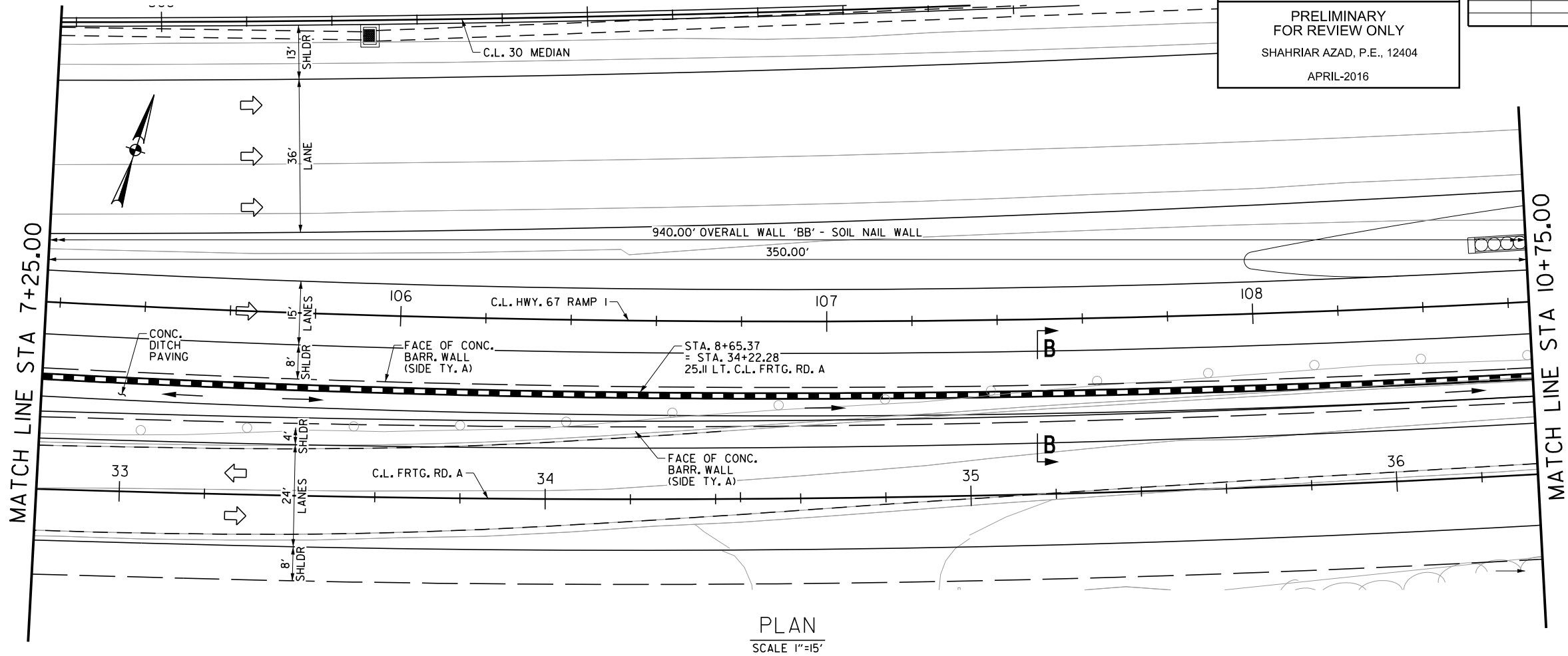
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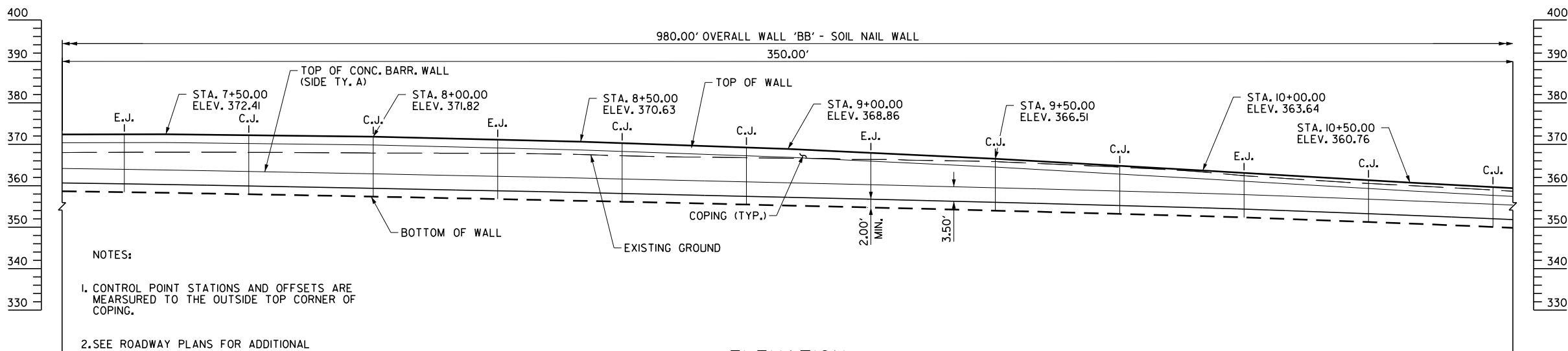
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DATE REVISED	DATE FILMED	DATE REVISED	DATE FILMED

FED. RD. DIST. NO.	STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
6	ARK.			
JOB NO.		CA0601	487	836
P&P RET. WALL 'BB'				[Dwg#]



PLAN
SCALE 1"=15'



ELEVATION
SCALE 1"=15'
(VIEWED FROM BACK FACE OF WALL)

- NOTES:
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RETAINING WALL 'BB'			
STATION ALONG WALL	TOP OF WALL ELEV.	FINISHED GRADE ELEV.	BOTTOM OF WALL ELEV.
5+20.00	365.67	362.22	360.22
5+25.00	366.14	362.19	360.19
5+50.00	368.49	362.06	360.06
5+75.00	369.22	361.91	359.91
6+00.00	369.94	361.75	359.75
6+25.00	370.66	361.57	359.57
6+50.00	371.38	361.38	359.38
6+75.00	371.86	361.16	359.16
7+00.00	372.35	360.93	358.93
7+25.00	372.38	360.66	358.66
7+50.00	372.41	360.28	358.28
7+75.00	372.11	359.84	357.84
8+00.00	371.82	359.37	357.37
8+25.00	371.22	358.87	356.87
8+50.00	370.63	358.35	356.35
8+75.00	369.74	357.79	355.79
9+00.00	368.86	357.22	355.22
9+25.00	367.69	356.62	354.62
9+50.00	366.51	355.99	353.99
9+75.00	365.08	355.33	353.33
10+00.00	363.60	354.60	352.60
10+25.00	362.20	353.80	351.80
10+50.00	360.70	352.80	350.80
10+75.00	359.40	351.80	349.80
11+00.00	358.00	350.70	348.70
11+25.00	356.60	349.50	347.50
11+50.00	355.30	348.20	346.20
11+75.00	354.00	346.80	344.80
12+00.00	352.80	345.30	343.30
12+25.00	351.80	343.70	341.70
12+50.00	350.80	342.10	340.10
12+75.00	349.60	340.30	338.30
13+00.00	348.50	338.60	336.60
13+25.00	347.20	336.80	334.80
13+50.00	346.00	334.90	332.90
13+75.00	343.60	332.90	330.90
14+00.00	341.30	330.90	328.90
14+25.00	337.90	328.90	326.90
14+50.00	334.40	326.90	324.90
14+75.00	331.40	324.90	322.90
15+00.00	328.40	322.90	320.90

BRIDGEFARMER & ASSOCIATES, INC.
CONSULTING ENGINEERS

SHEET 2 OF 3
LAYOUT OF RETAINING WALL 'BB'

HWY 70 - SEVIER ST. (WIDENING) (S)
SALINE COUNTY
ROUTE 30 SEC. 22
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

C.J. AND E.J. - TYPICAL CONSTRUCTION JOINT AND EXPANSION JOINT LOCATIONS. LOCATIONS CAN BE ALTERED BY THE CONTRACTOR. LOCATIONS OF THE CONSTRUCTION JOINTS AND/OR EXPANSION JOINT NEED TO BE SHOWN IN THE WORKING DRAWINGS FOR ENGINEER'S APPROVAL.

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check & coordination

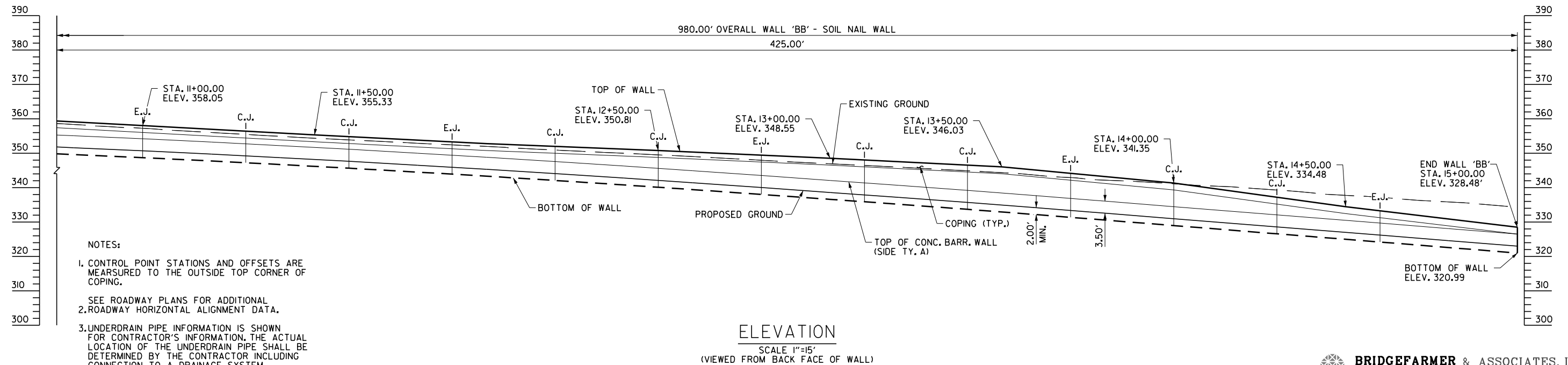
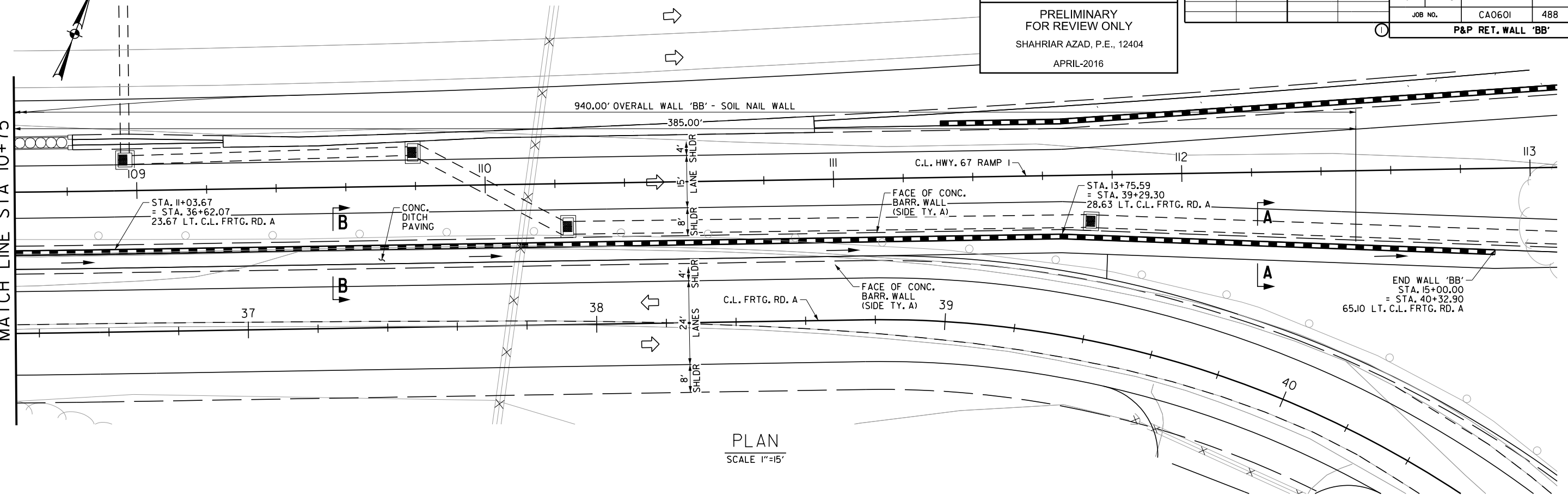
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SHAHRIAR AZAD, P.E., 12404

APRIL-2016

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.	CA0601	488	836	
				P&P RET. WALL 'BB'				[Dwg*]

MATCH LINE STA 10+75

BRIDGEFARMER & ASSOCIATES, INC.
CONSULTING ENGINEERSSHEET 3 OF 3
LAYOUT OF RETAINING WALL 'BB'HWY 70 - SEVIER ST. (WIDENING) (S)
SALINE COUNTY
ROUTE 30 SEC. 22
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.DRAWN BY: JH
CHECKED BY: SA
DESIGNED BY: JH
DATE: 6/26/2015
DATE: 6/19/2015
DATE: 6/12/2015
FILENAME: rca0601-ret-wall.p&p.bb.03
SCALE: As Shown

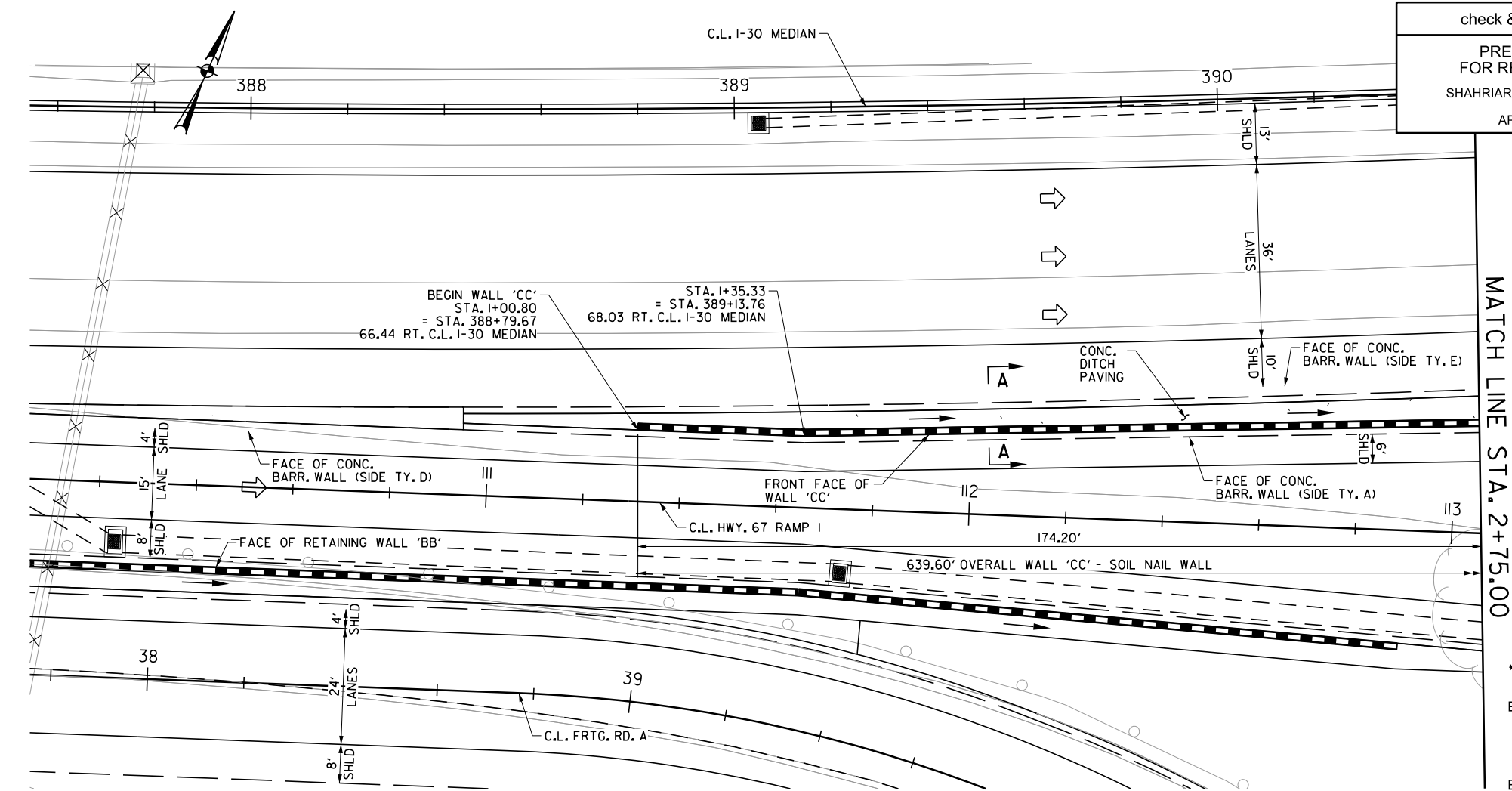
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APRIL-2016

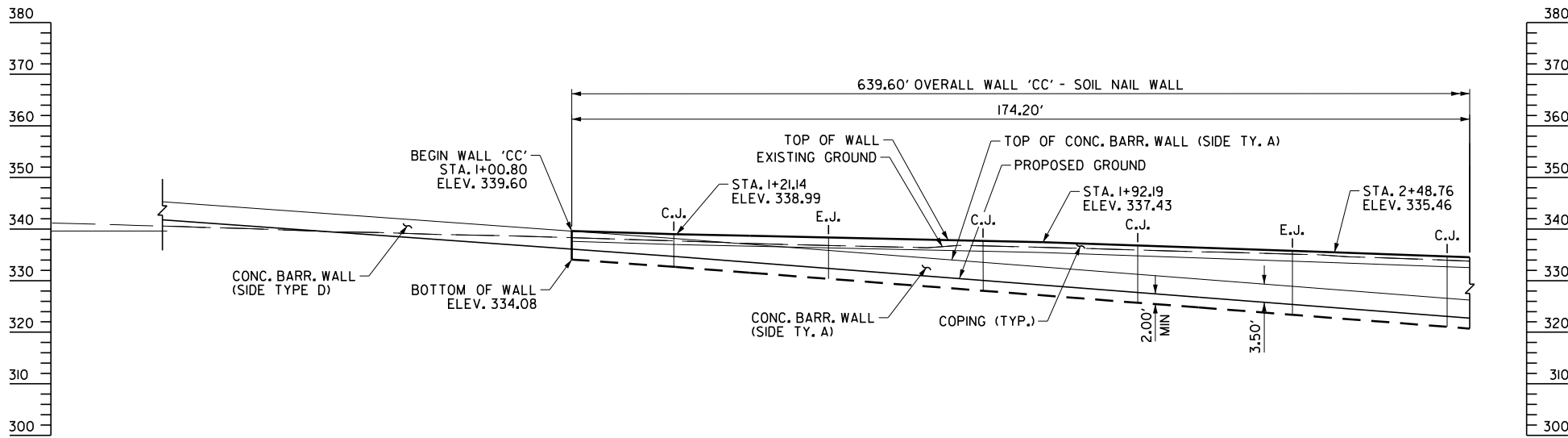
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				6	ARK.			
				JOB NO.	CA0601	490	836	
				P&P RET. WALL 'CC' [Dwg*]				

NOTES:

- CONTROL POINT STATIONS AND OFFSETS ARE MEASURED TO THE OUTSIDE TOP CORNER OF COPING.
- SEE ROADWAY PLANS FOR ADDITIONAL ROADWAY HORIZONTAL ALIGNMENT DATA.
- UNDERDRAIN PIPE INFORMATION IS SHOWN FOR CONTRACTOR'S INFORMATION. THE ACTUAL LOCATION OF THE UNDERDRAIN PIPE SHALL BE DETERMINED BY THE CONTRACTOR INCLUDING CONNECTION TO A DRAINAGE SYSTEM.
- SEE DRAINAGE PLANS FOR ADDITIONAL DRAINAGE INFORMATION.
- THE CONTRACTOR SHALL SUBMIT DETAILED WORKING DRAWINGS AND DESIGN CALCULATIONS FOR APPROVAL AS DESCRIBED IN SP JOB CA0601 "MSE WALL."
- BORING LOGS MAY BE OBTAINED FROM THE CONSTRUCTION CONTRACT PROCUREMENT SECTION OF THE PROGRAM MANAGEMENT DIVISION UPON REQUEST.
- REFER TO RETAINING WALL DETAIL SHEETS FOR ADDITIONAL INFORMATION.

* Alignment name: RETAINING WALL 'CC'

Element:	Linear	STATION	NORTHING	EASTING
POB ()		0+00.00	1996064.9117	1121612.4792
PI ()		1+35.33	1996116.0908	1121737.7561
Tangential Direction:		N 67° 46' 43.0" E		
Tangential Length:		135.33		
Element:	Linear			
PI ()		1+35.33	1996116.0908	1121737.7561
PI ()		3+35.66	1996201.4688	1121918.9813
Tangential Direction:		N 64° 46' 26.9" E		
Tangential Length:		200.33		
Element:	Linear			
PI ()		3+35.66	1996201.4688	1121918.9813
POE ()		7+48.89	1996357.7464	1122301.5191
Tangential Direction:		N 67° 46' 43.0" E		
Tangential Length:		413.23		



C.J. AND E.J. - TYPICAL CONSTRUCTION JOINT AND EXPANSION JOINT LOCATIONS. LOCATIONS CAN BE ALTERED BY THE CONTRACTOR. LOCATIONS OF THE CONSTRUCTION JOINTS AND/OR EXPANSION JOINT NEED TO BE SHOWN IN THE WORKING DRAWINGS FOR ENGINEER'S APPROVAL.

BRIDGEFARMER & ASSOCIATES, INC.
CONSULTING ENGINEERS

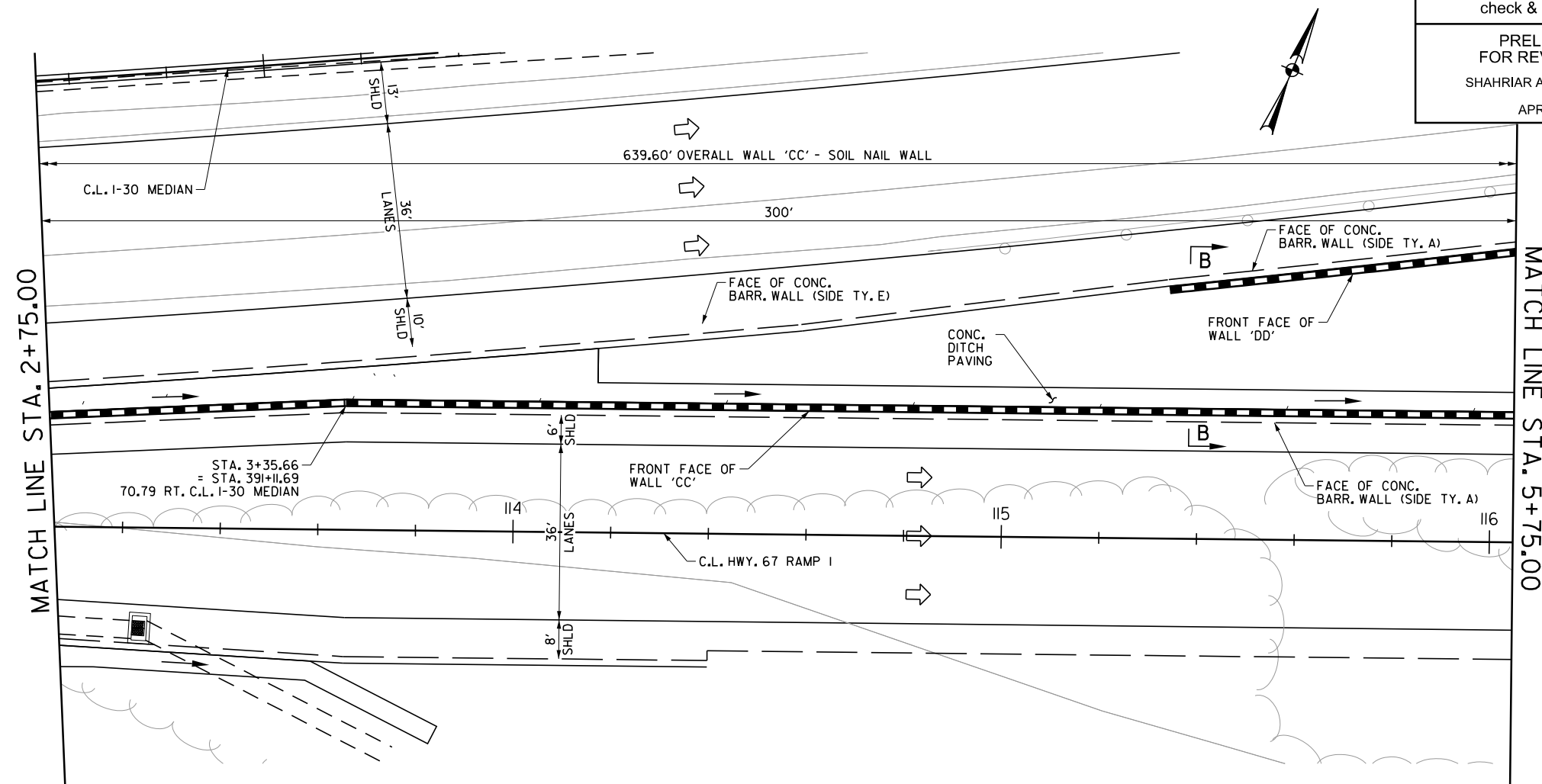
SHEET 1 OF 3
LAYOUT OF RETAINING WALL 'CC'
HWY 70 - SEVIER ST. (WIDENING) (S)
SALINE COUNTY
ROUTE 30 SEC. 22
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

DRAWN BY: DCD DATES: 6/26/2015
CHECKED BY: SA DATES: 6/19/2015
DESIGNED BY: DCD DATES: 6/12/2015
FILENAME: rca0601-ret-wall-p&p-cc-01 SCALE: As Shown

DRAWING NO. XXXXX

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.	CA0601	491	836
					P&P RET. WALL 'CC'			[Dwg#]

check & coordination
PRELIMINARY FOR REVIEW ONLY
SHAHRIAR AZAD, P.E., 12404
APRIL-2016

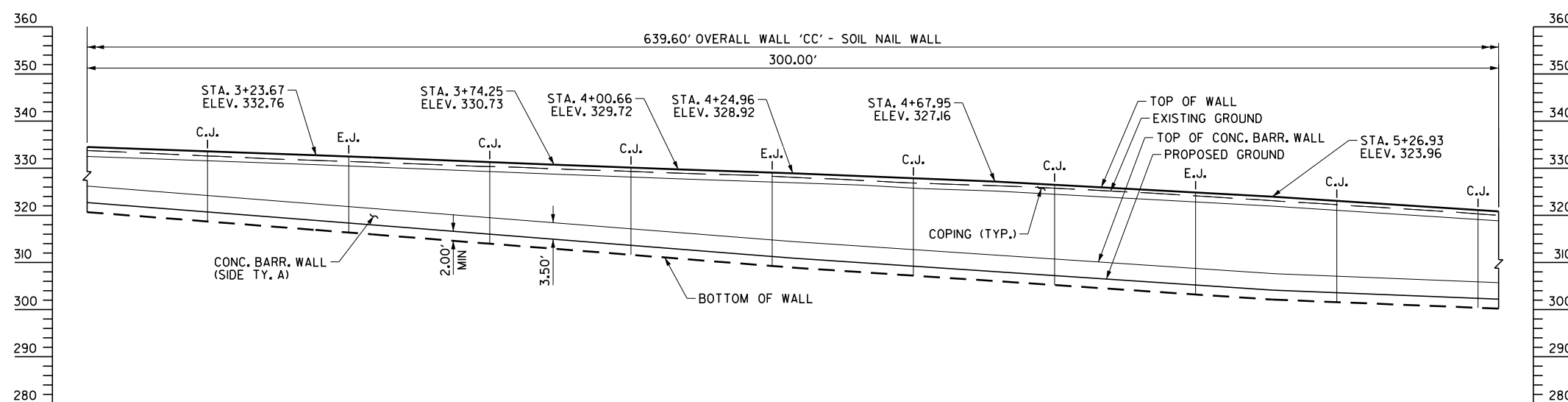


PLAN
SCALE 1"=15'

RETAINING WALL 'CC'			
STATION ALONG WALL	TOP OF WALL ELEV.	FINISHED GRADE ELEV.	BOTTOM OF WALL ELEV.
I+00.80	339.60	336.09	334.08
I+25.80	338.89	334.27	332.26
I+50.80	338.34	332.33	330.32
I+75.80	337.79	330.39	328.39
2+00.80	337.13	328.45	326.45
2+25.80	336.26	326.52	324.51
2+50.80	335.39	324.57	322.56
2+75.80	334.49	322.62	320.61
3+00.80	333.59	320.67	318.67
3+25.80	332.68	318.72	316.72
3+50.80	331.67	316.75	314.74
3+75.80	330.67	314.78	312.77
4+00.80	329.72	312.81	310.80
4+25.80	328.89	310.84	308.84
4+50.80	327.86	309.18	307.17
4+75.80	326.73	307.51	305.51
5+00.80	325.38	305.85	303.85
5+25.80	324.02	304.19	302.18
5+50.80	322.40	303.16	301.16
5+75.80	320.78	302.16	300.16
6+00.80	318.71	301.17	299.16
6+25.80	315.89	300.17	298.17
6+50.80	312.38	299.75	297.75
6+75.80	308.95	299.43	297.43
7+00.80	305.53	299.11	297.11
7+25.80	301.63	298.78	296.78
7+40.40	299.09	298.59	296.59

NOTES:

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2. SEE ROADWAY PLANS FOR ADDITIONAL ROADWAY HORIZONTAL ALIGNMENT DATA.
3. UNDERDRAIN PIPE INFORMATION IS SHOWN FOR CONTRACTOR'S INFORMATION. THE ACTUAL LOCATION OF THE UNDERDRAIN PIPE SHALL BE DETERMINED BY THE CONTRACTOR INCLUDING CONNECTION TO A DRAINAGE SYSTEM.
4. SEE DRAINAGE PLANS FOR ADDITIONAL DRAINAGE INFORMATION.
5. THE CONTRACTOR SHALL SUBMIT DETAILED WORKING DRAWINGS AND DESIGN CALCULATIONS FOR APPROVAL AS DESCRIBED IN SP JOB CA0601 "MSE WALL."
6. BORING LOGS MAY BE OBTAINED FROM THE CONSTRUCTION CONTRACT PROCUREMENT SECTION OF THE PROGRAM MANAGEMENT DIVISION UPON REQUEST.
7. REFER TO RETAINING WALL DETAIL SHEETS FOR ADDITIONAL INFORMATION.



ELEVATION
SCALE 1"=15'
(VIEWED FROM FRONT FACE OF WALL)

C.J. AND E.J. - TYPICAL CONSTRUCTION JOINT AND EXPANSION JOINT LOCATIONS. LOCATIONS CAN BE ALTERED BY THE CONTRACTOR. LOCATIONS OF THE CONSTRUCTION JOINTS AND/OR EXPANSION JOINT NEED TO BE SHOWN IN THE WORKING DRAWINGS FOR ENGINEER'S APPROVAL.


BRIDGEFARMER & ASSOCIATES, INC.
CONSULTING ENGINEERS

SHEET 2 OF 3
LAYOUT OF RETAINING WALL 'CC'
HWY 70 - SEVIER ST.(WIDENING) (S)
SALINE COUNTY
ROUTE 30 SEC. 22
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

DRAWN BY: DCD DATE: 6/26/2015 FILENAME: rca0601-ret-wall.p&p.cc_02
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 DESIGNED BY: DCD DATE: 6/12/2015

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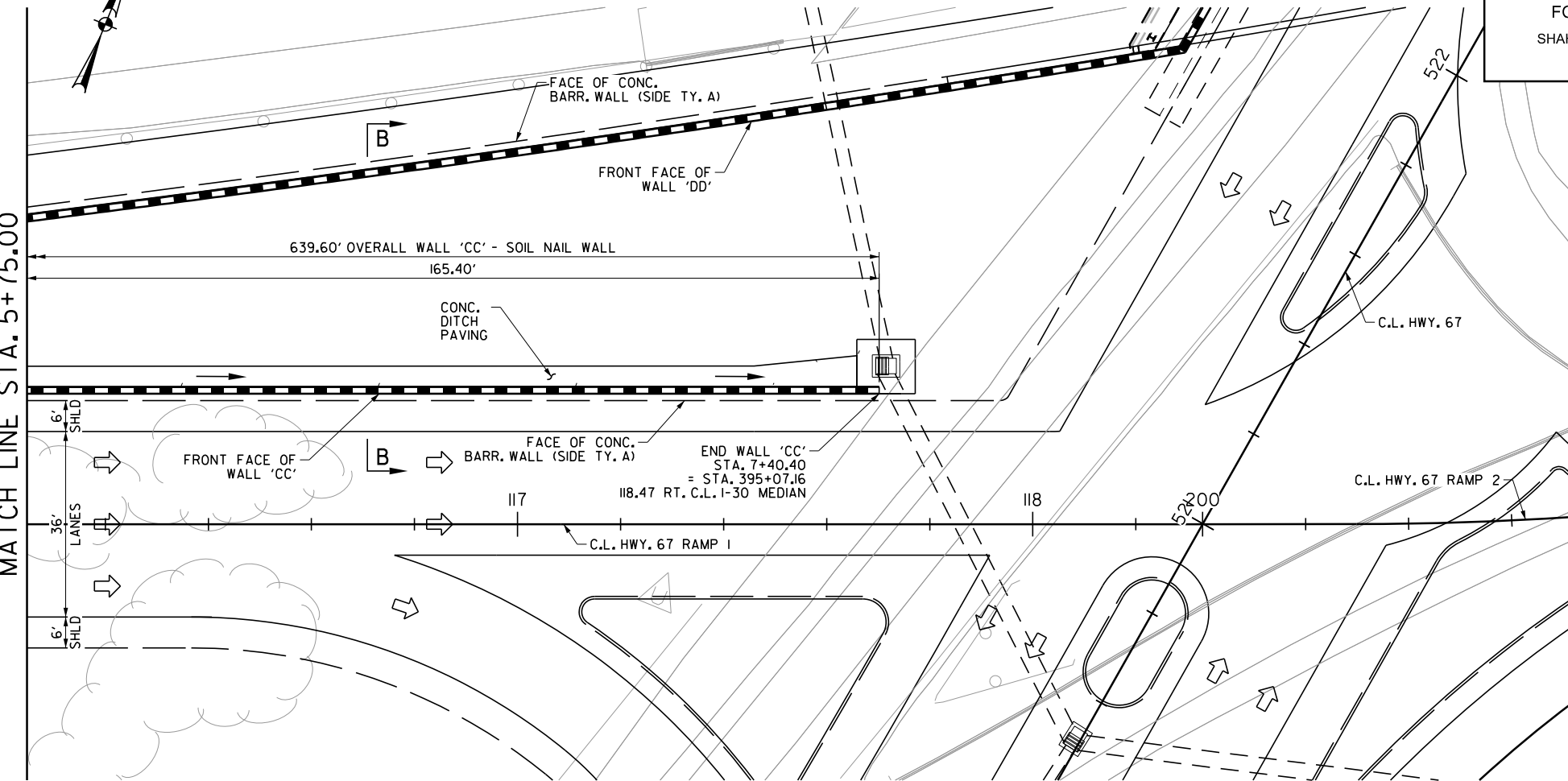
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MATCH LINE STA. 5+75.00



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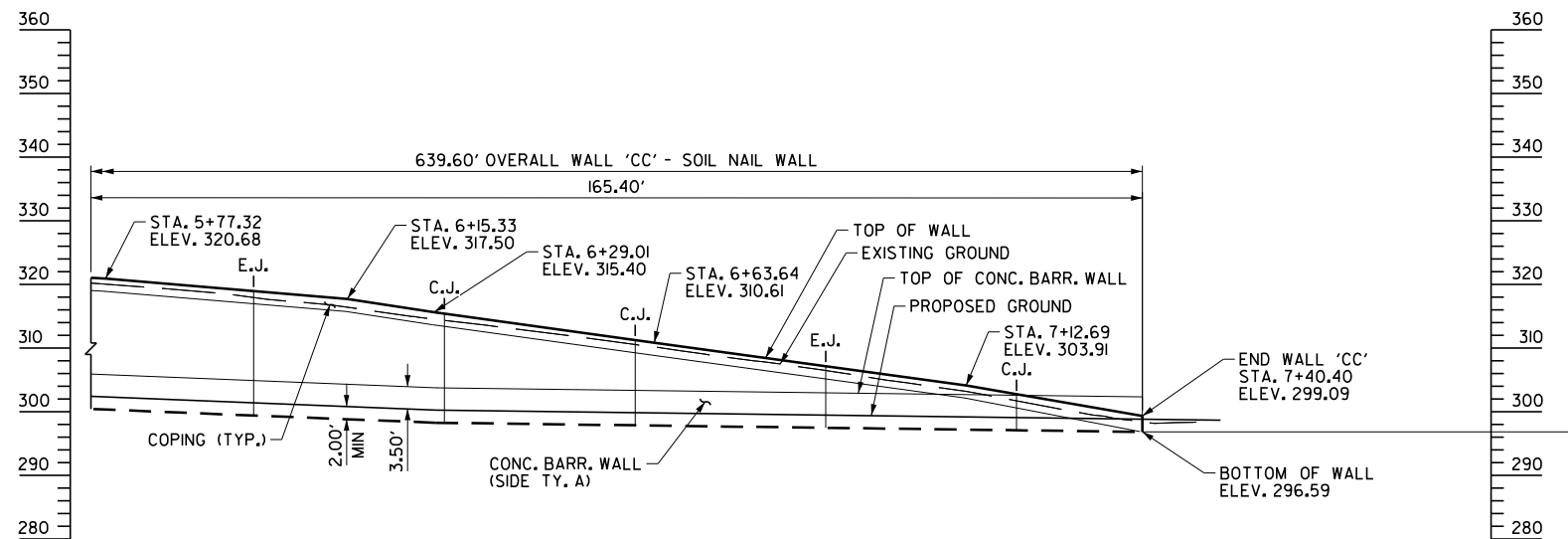
SHAHRIAR AZAD, P.E., 12404

APRIL-2016

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.		CA0601	492	836
							P&P RET. WALL 'CC'	[Dwg*]

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BRIDGEFARMER & ASSOCIATES, INC.
CONSULTING ENGINEERS

SHEET 3 OF 3
LAYOUT OF RETAINING WALL 'CC'

HWY 70 - SEVIER ST. (WIDENING) (S)
SALINE COUNTY
ROUTE 30 SEC. 22
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

DRAWN BY: DCD DATE: 6/26/2015
CHECKED BY: SA DATE: 6/19/2015
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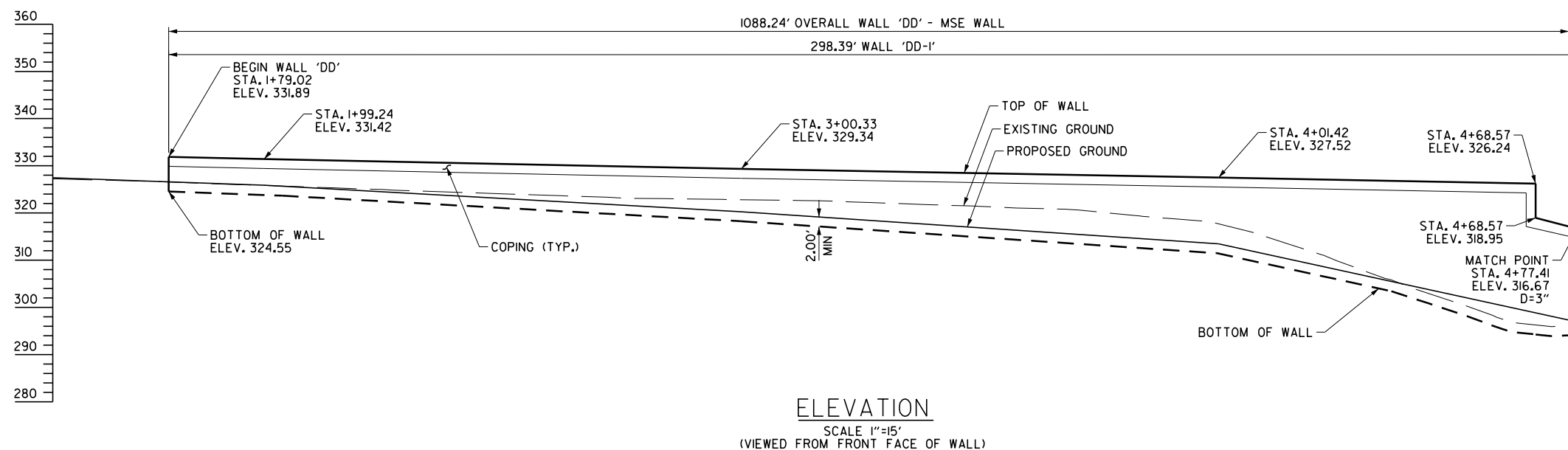
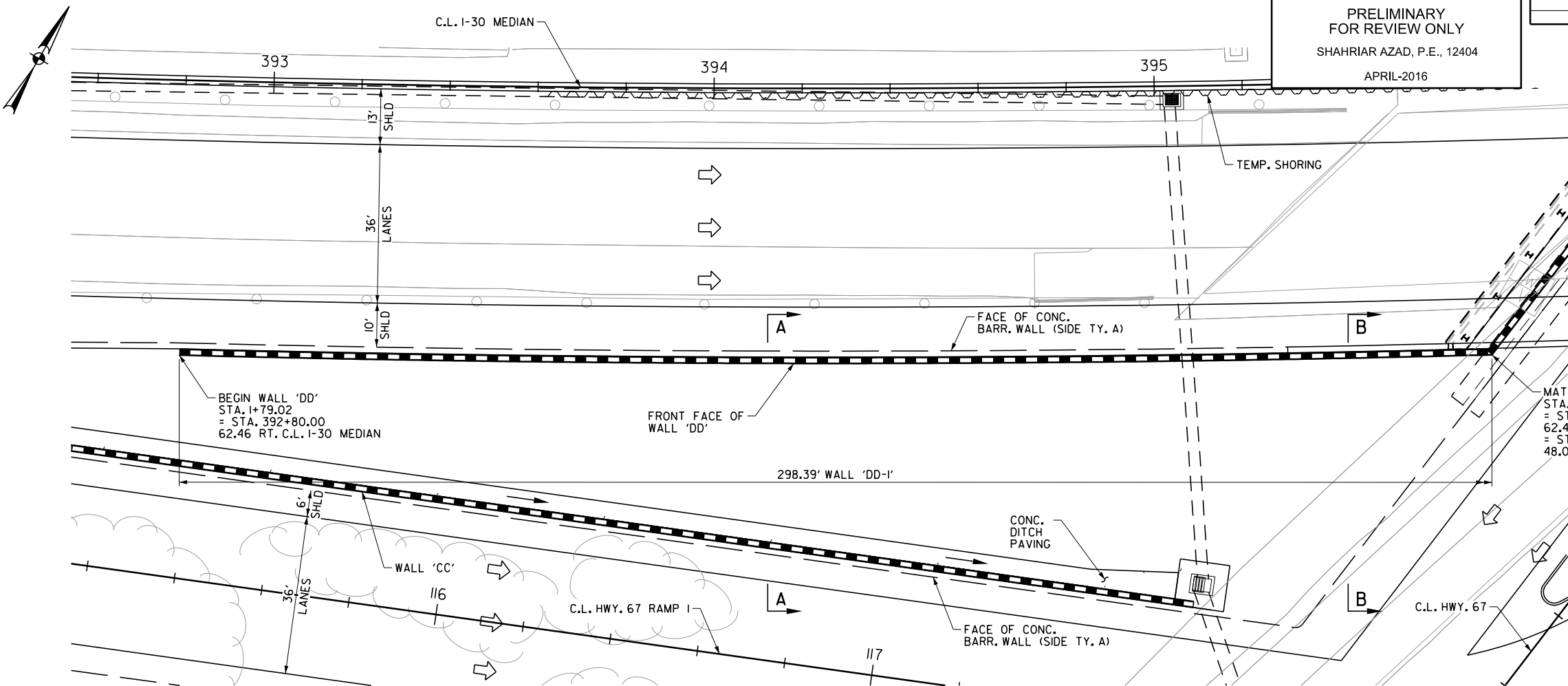
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APRIL-2016

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.		CA0601	495	836
							P&P RET. WALL 'DD'	[Dwg#]

NOTES:

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 **BRIDGEFARMER & ASSOCIATES, INC.**
CONSULTING ENGINEERS

SHEET 1 OF 4
LAYOUT OF RETAINING WALL 'DD'

HWY 70 - SEVIER ST. (WIDENING) (S)
SALINE COUNTY
ROUTE 30 SEC. 22

ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

DRAWN BY: DCD DATE: 6/26/2015 ENAME: rca0601-ret-wall-p&p-dd.01
CHECKED BY: SA DATE: 6/19/2015 SCALE: As Shown
DESIGNED BY: DCD DATE: 6/12/2015

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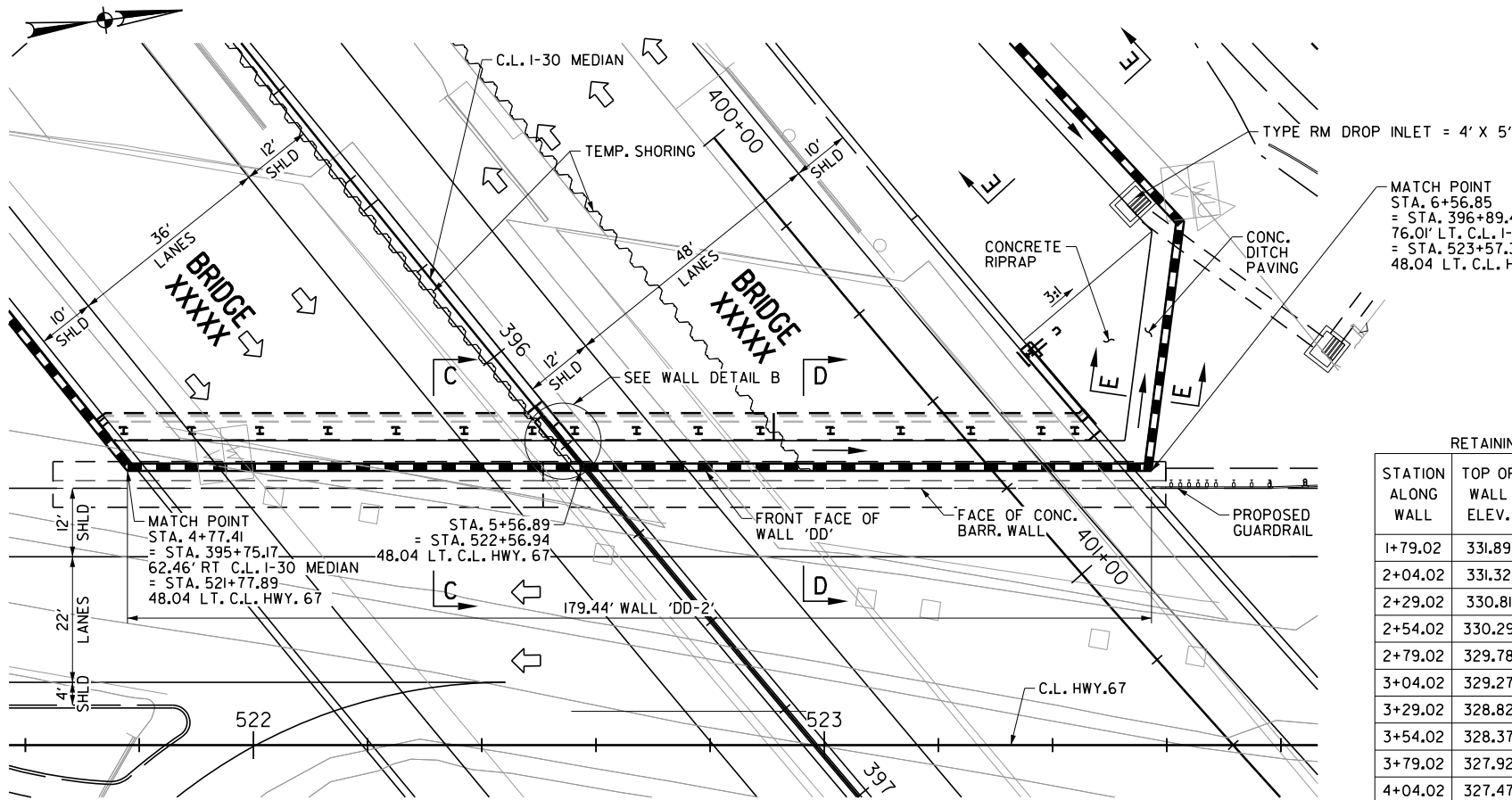
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SHAHRIAR AZAD, P.E., 12404

APRIL-2016

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.	CA0601	496	836	
				P&P RET. WALL 'DD' [Dwg#]				



RETAINING WALL 'DD'			
STATION ALONG WALL	TOP OF WALL ELEV.	FINISHED GRADE ELEV.	BOTTOM OF WALL ELEV.
1+79.02	331.89	326.61	324.55
2+04.02	331.32	325.62	323.62
2+29.02	330.81	324.23	322.23
2+54.02	330.29	322.84	320.84
2+79.02	329.78	321.45	319.44
3+04.02	329.27	320.01	318.01
3+29.02	328.82	318.33	316.33
3+54.02	328.37	316.64	314.65
3+79.02	327.92	314.96	312.97
4+04.02	327.47	312.88	310.84
4+29.02	326.99	307.45	305.40
4+54.02	326.52	302.01	298.15
4+79.02	318.04	296.89	294.15
5+04.02	316.99	296.47	294.16
5+29.02	315.94	296.27	294.18
5+54.02	314.89	296.07	294.07
5+79.02	317.30	295.84	293.84
6+04.02	316.34	295.61	293.61
6+29.02	315.38	295.47	293.47
6+54.02	314.59	295.33	293.33
6+79.02	314.09	295.93	293.93
7+04.02	313.73	296.64	294.64
7+29.02	314.40	297.39	295.38
7+54.02	315.07	298.13	296.13
7+79.02	315.79	298.97	296.97
8+04.02	316.69	300.13	298.13
8+29.02	317.59	301.29	299.29
8+54.02	318.44	302.80	300.80
8+79.02	319.29	304.40	302.40
9+04.02	320.10	306.03	304.02
9+29.02	320.88	307.70	305.69
9+54.02	321.66	309.37	307.37
9+79.02	322.41	311.05	309.04
10+04.02	323.16	312.72	310.72
10+29.02	323.93	314.39	312.39
10+54.02	324.71	316.07	314.06
10+79.02	325.50	317.74	315.74
11+04.02	326.33	319.42	317.41
11+29.02	327.15	321.09	319.09
11+54.02	328.01	322.75	320.74
11+79.02	328.87	324.40	322.39
12+04.02	329.75	326.01	324.00
12+29.02	330.66	327.52	325.52
12+54.02	331.57	329.58	327.01
12+67.26	332.05	331.42	327.76

* Alignment name: RETAINING WALL 'DD'		STATION	NORTHING	EASTING
* Element: Circular				
PC ()		0+00.00	1996204.8665	1121907.2897
PI ()		2+38.84	1996312.9896	1122120.2530
CC ()			2001369.4012	1119285.2168
PT ()		4+77.41	1996438.2791	1122323.5914
Radius:		5792.04		
Delta:		4° 43' 21.3"		
Degree of Curvature (Arc):	Left	0° 59' 21.2"		
Length:		477.41		
Tangent:		238.84		
Chord:		477.27		
Middle Ordinate:		4.92		
External:		4.92		
Tangent Direction:		N 63° 04' 57.9" E		
Radial Direction:		S 26° 55' 02.1" E		
Chord Direction:		N 60° 43' 17.3" E		
Radial Direction:		S 31° 38' 23.4" E		
Tangent Direction:		N 58° 21' 36.6" E		
* Element: Linear				
PT ()		4+77.41	1996438.2791	1122323.5914
PI ()		6+56.85	1996616.2739	1122346.3583
Tangential Direction:		N 7° 17' 20.5" E		
Tangential Length:		179.44		
* Element: Linear				
PC ()		6+56.85	1996616.2739	1122346.3583
PI ()		7+01.03	1996627.4712	1122303.6190
Tangential Direction:		N 75° 19' 08.1" W		
Tangential Length:		44.18		
* Element: Circular				
PC ()		7+01.03	1996627.4712	1122303.6190
PI ()		11+75.02	1996351.1270	1121918.5304
CC ()			2000381.9499	1119609.3600
PT ()		16+45.70	1996158.7096	1121485.3619
Radius:		4621.16		
Delta:		11° 42' 44.8"		
Degree of Curvature (Arc):	Right	1° 14' 23.5"		
Length:		944.66		
Tangent:		473.98		
Chord:		943.02		
Middle Ordinate:		24.12		
External:		24.24		
Tangent Direction:		S 54° 20' 10.8" W		
Radial Direction:		N 35° 39' 49.2" W		
Chord Direction:		S 60° 11' 33.2" W		
Radial Direction:		N 23° 57' 04.4" W		
Tangent Direction:		S 66° 02' 55.6" W		

NOTES:

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- REFER TO RETAINING WALL DETAIL SHEETS FOR ADDITIONAL INFORMATION.
- SEE BRIDGE LAYOUT FOR LOCATIONS OF TEMPORARY SHORING

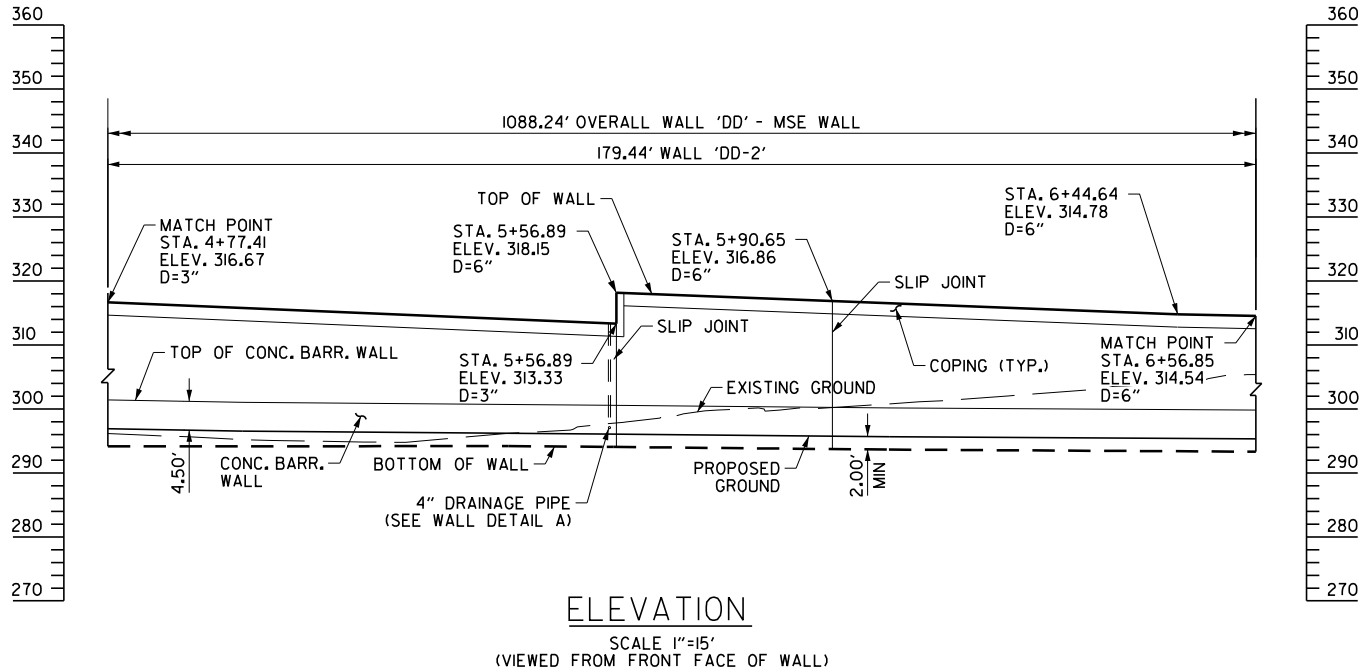


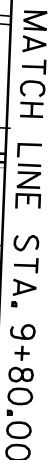
SHEET 2 OF 4
LAYOUT OF RETAINING WALL 'DD'

HWY 70 - SEVIER ST. (WIDENING) (S)
SALINE COUNTY
ROUTE 30 SEC. 22
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

DRAWN BY: DCD DATES: 6/26/2015
CHECKED BY: SA DATES: 6/19/2015
DESIGNED BY: DCD DATES: 6/12/2015
FILENAME: rca0601-ret-wall.p&p.dd
SCALE: As Shown

DRAWING NO. XXXXX





APRIL-2016

①	P&P RET. WALL 'DD'	[Dwg#]
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DRAWN BY: DCD DATE: 6/26/2015 FILENAME: rca0601-ret-wall_p&p-03
 CHECKED BY: SA DATE: 6/19/2015 SCALE: As Shown
 DESIGNED BY: DCD DATE: 6/12/2015

SCALE 1"=15'



HWY 70 - SEVIER ST.(WIDENING) (S)
SALINE COUNTY
ROUTE 30 SEC.22
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

DRAWN BY: DCD DATE: 6/26/2015 FILENAME: rca0601-ret-wall_p&p-03
 CHECKED BY: SA DATE: 6/19/2015 SCALE: As Shown
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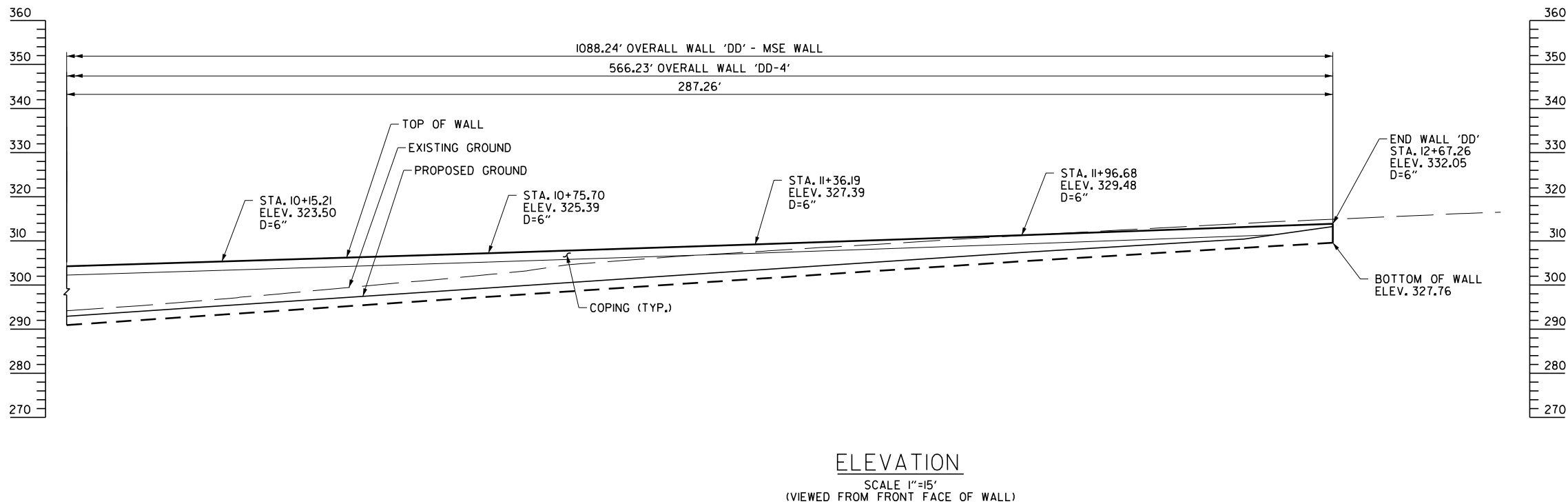
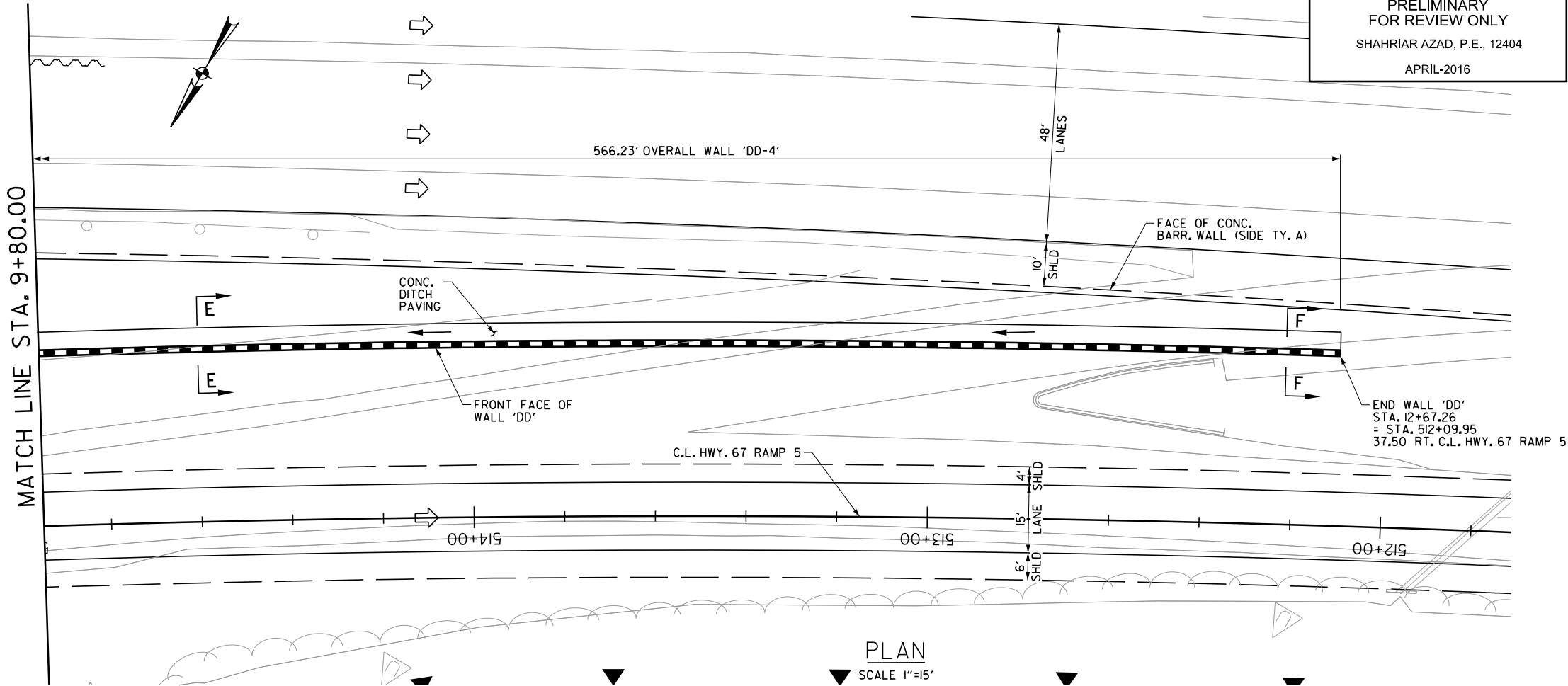
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SHAHRIAR AZAD, P.E., 12404

APRIL-2016

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.		CA0601	498	836
P&P RET. WALL 'DD'								[Dwg*]

- NOTES:
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BRIDGEFARMER & ASSOCIATES, INC.
CONSULTING ENGINEERS

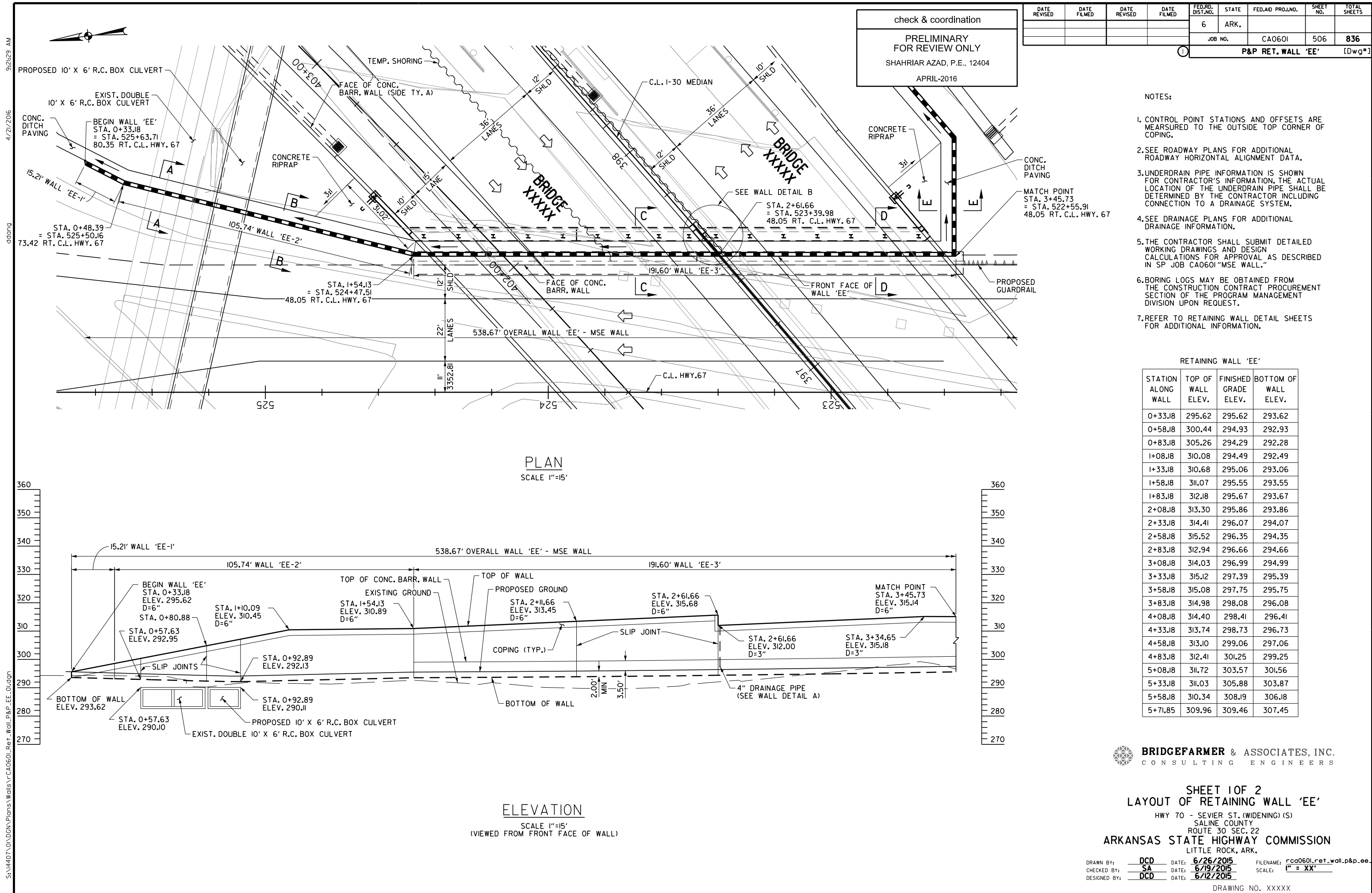
SHEET 4 OF 4
LAYOUT OF RETAINING WALL 'DD'

HWY 70 - SEVIER ST. (WIDENING) (S)
SALINE COUNTY
ROUTE 30 SEC. 22
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

DRAWN BY: DCD DATES: 6/26/2015
CHECKED BY: SA DATES: 6/19/2015
DESIGNED BY: DCD DATES: 6/12/2015

FILENAME: rca0601-ret-wall-p&p-dd.d4
SCALE: As Shown

XXXXX DRAWING NO. XXXXX



BRIDGEFARMER & ASSOCIATES, INC.
CONSULTING ENGINEERS

SHEET 1 OF 2
LAYOUT OF RETAINING WALL 'EE'
HWY 70 - SEVIER ST. (WIDENING) (S)
SALINE COUNTY
ROUTE 30 SEC. 22
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

DRAWN BY: DCD
CHECKED BY: SA
DESIGNED BY: DCD
DATE: 6/26/2015
DATE: 6/19/2015
DATE: 6/12/2015
FILENAME: rca0601-ret-wall.p&p-ee.dwg
SCALE: 1" = XX'

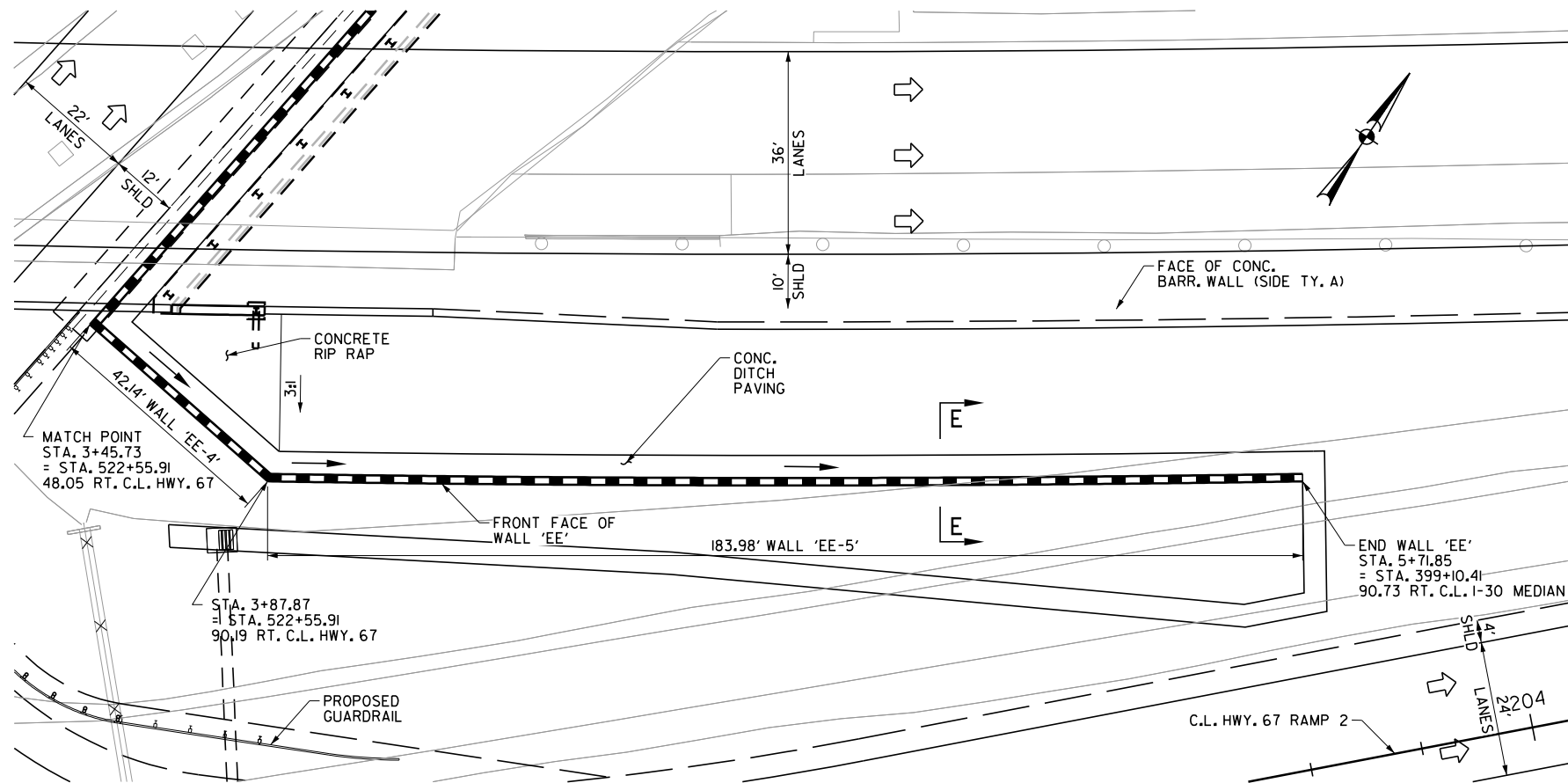
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4/21/2016

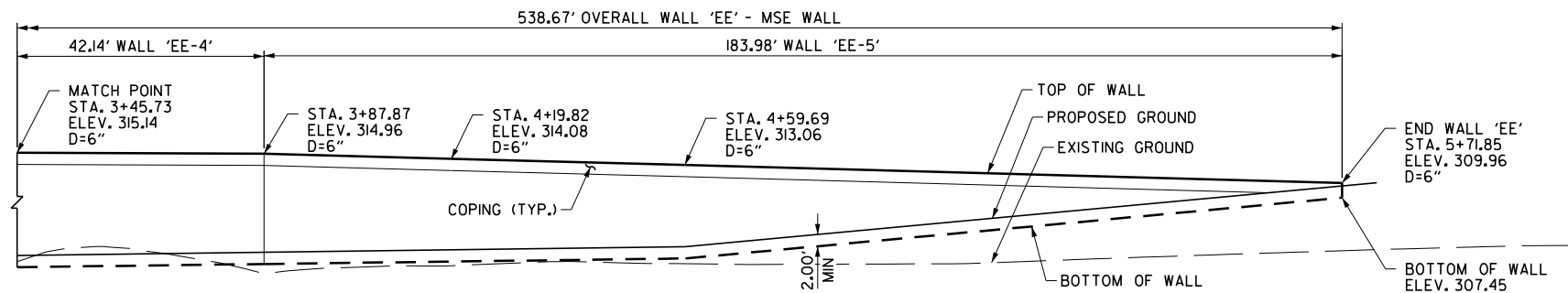
ddong

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PLAN

SCALE 1"=15'



ELEVATION

SCALE 1"=15'
(VIEWED FROM FRONT FACE OF WALL)

check & coordination

PRELIMINARY
FOR REVIEW ONLY

SHAHRIAR AZAD, P.E., 12404

APRIL-2016

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.	CA0601	507	836	
				P&P RET. WALL 'EE'				[Dwg*]

* Alignment name: RW*DD

Element:	Linear	STATION	NORTHING	EASTING
POB ()		0+00.00	1996832.0742	1122518.6169
PI ()		0+48.39	1996792.1250	1122491.3030
Tangential Direction:		S 34°21'39.7" W		
Tangential Length:		48.39		
Element:	Linear			
PI ()		0+48.39	1996792.1250	1122491.3030
PI ()		1+54.13	1996693.5249	1122453.1068
Tangential Direction:		S 21°10'32.1" W		
Tangential Length:		105.74		
Element:	Linear			
PI ()		1+54.13	1996693.5249	1122453.1068
PI ()		3+45.73	1996503.4789	1122428.7984
Tangential Direction:		S 7°17'20.5" W		
Tangential Length:		191.59		
Element:	Linear			
PI ()		3+45.73	1996503.4789	1122428.7984
PC ()		3+87.87	1996498.1310	1122470.6002
Tangential Direction:		S 82°42'34.1" E		
Tangential Length:		42.14		
Element:	Circular			
PI ()		3+87.87	1996498.1310	1122470.6002
PI ()		4+99.98	1996559.4883	1122564.4313
CC ()			2001369.4012	1119285.2168
PT ()			1996624.4136	1122655.8299
Radius:		6+12.07		
Delta:		5820.30		
Degree of Curvature (Arc):		2°12'25.2" Left		
Length:		0°59'03.9"		
Tangent:		224.20		
Chord:		112.11		
Middle Ordinate:		224.18		
External:		1.08		
Tangent Direction:		N 56°49'07.8" E		
Radial Direction:		S 33°10'52.2" E		
Chord Direction:		N 55°42'55.2" E		
Radial Direction:		S 35°23'17.4" E		
Tangent Direction:		N 54°36'42.6" E		

NOTES:

- CONTROL POINT STATIONS AND OFFSETS ARE MEASURED TO THE OUTSIDE TOP CORNER OF COPING.
- SEE ROADWAY PLANS FOR ADDITIONAL ROADWAY HORIZONTAL ALIGNMENT DATA.
- UNDERDRAIN PIPE INFORMATION IS SHOWN FOR CONTRACTOR'S INFORMATION. THE ACTUAL LOCATION OF THE UNDERDRAIN PIPE SHALL BE DETERMINED BY THE CONTRACTOR INCLUDING CONNECTION TO A DRAINAGE SYSTEM.
- SEE DRAINAGE PLANS FOR ADDITIONAL DRAINAGE INFORMATION.
- THE CONTRACTOR SHALL SUBMIT DETAILED WORKING DRAWINGS AND DESIGN CALCULATIONS FOR APPROVAL AS DESCRIBED IN SP JOB CA0601 "MSE WALL."
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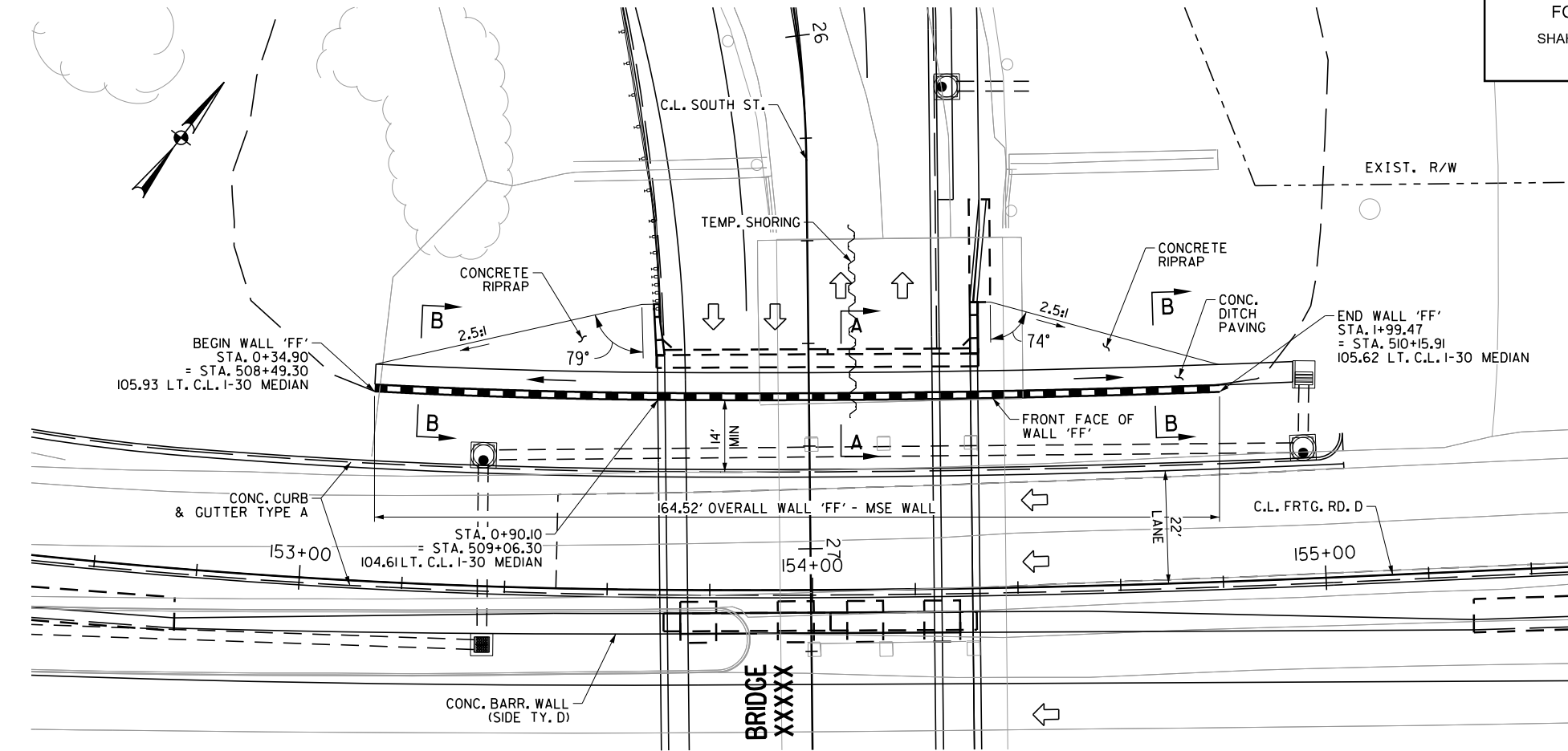
BRIDGEFARMER & ASSOCIATES, INC.
CONSULTING ENGINEERS

SHEET 2 OF 2
LAYOUT OF RETAINING WALL 'EE'

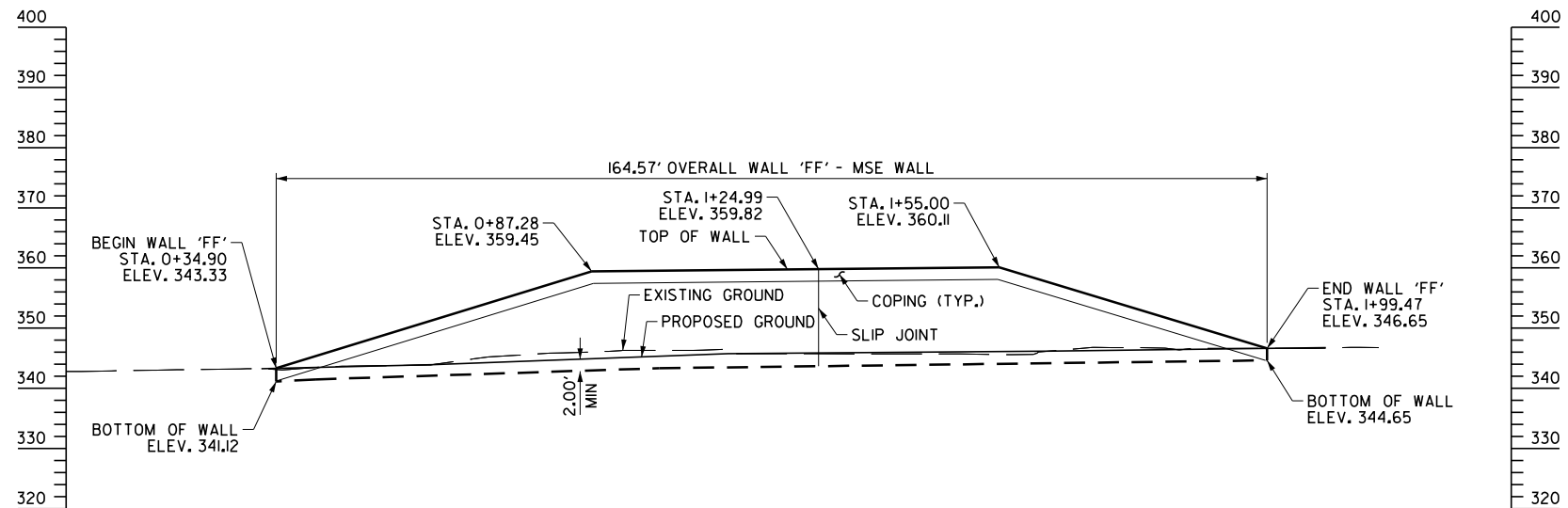
HWY 70 - SEVIER ST. (WIDENING) (S)
SALINE COUNTY
ROUTE 30 SEC. 22
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

DRAWN BY: DCD DATES: 6/26/2015
CHECKED BY: SA DATES: 6/19/2015
DESIGNED BY: DCD DATES: 6/12/2015
FILENAME: rca0601-ret-wall-p&p-ee_02
SCALE: As Shown

DRAWING NO. XXXXX



PLAN
SCALE 1"=15'



ELEVATION
SCALE 1"=15'
(VIEWED FROM FRONT FACE OF WALL)

check & coordination
PRELIMINARY
FOR REVIEW ONLY
SHAHRIAR AZAD, P.E., 12404
APRIL-2016

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.		CA0601	513	836

* Alignment name: RETAINING WALL 'FF'

Element:	Station	NORTHING	EASTING
Circular			
PC ()	0+00.00	2003743.8511	1130678.9670
PI ()	0+45.07	2003768.5560	1130716.6618
CC ()		2004777.8126	1130001.3154
PCC ()	0+90.10	2003795.9402	1130752.4577
Radius:	1236.24		
Delta:	4° 10' 32.8"		
Degree of Curvature (Arc):	4° 38' 04.9"		
Length:	90.10		
Tangent:	45.07		
Chord:	90.08		
Middle Ordinate:	0.82		
External:	0.82		
Tangent Direction:	N 56° 45' 33.9" E		
Radial Direction:	S 33° 14' 26.1" E		
Chord Direction:	N 54° 40' 17.5" E		
Radial Direction:	S 37° 24' 58.9" E		
Tangent Direction:	N 52° 35' 01.1" E		
Circular			
PCC ()	0+90.10	2003795.9402	1130752.4577
PI ()	1+54.06	2003834.8005	1130803.2548
CC ()		2005789.0720	1129227.6918
PT ()	2+17.98	2003876.1979	1130852.0064
Radius:	2509.48		
Delta:	2° 55' 11.5"		
Degree of Curvature (Arc):	2° 16' 59.4"		
Length:	127.89		
Tangent:	63.96		
Chord:	127.87		
Middle Ordinate:	0.81		
External:	0.81		
Tangent Direction:	N 52° 35' 01.1" E		
Radial Direction:	S 37° 24' 58.9" E		
Chord Direction:	N 51° 07' 25.4" E		
Radial Direction:	S 40° 20' 10.3" E		
Tangent Direction:	N 49° 39' 49.7" E		

NOTES:

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- REFER TO RETAINING WALL DETAIL SHEETS FOR ADDITIONAL INFORMATION.
- SEE BRIDGE LAYOUT FOR LOCATIONS OF TEMPORARY SHORING

STATION ALONG WALL	TOP OF WALL ELEV.	FINISHED GRADE ELEV.	BOTTOM OF WALL ELEV.
0+34.90	343.33	343.33	341.12
0+59.90	351.03	343.91	342.08
0+84.90	358.72	344.83	342.89
1+09.90	359.67	345.76	343.48
1+34.90	359.91	345.96	343.81
1+59.90	358.63	346.15	344.13
1+84.90	351.06	346.46	344.46
1+99.47	346.65	346.65	344.65

BRIDGEFARMER & ASSOCIATES, INC.
CONSULTING ENGINEERS

LAYOUT OF RETAINING WALL 'FF'
HWY 70 - SEVIER ST. (WIDENING) (S)
SALINE COUNTY
ROUTE 30 SEC. 22
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

DRAWN BY: DCD DATES: 6/26/2015
CHECKED BY: SA DATES: 6/19/2015
DESIGNED BY: DCD DATES: 6/12/2015
FILENAME: rca0601-ret-wall-p&p-ff.dwg
SCALE: As Shown

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4/21/2016

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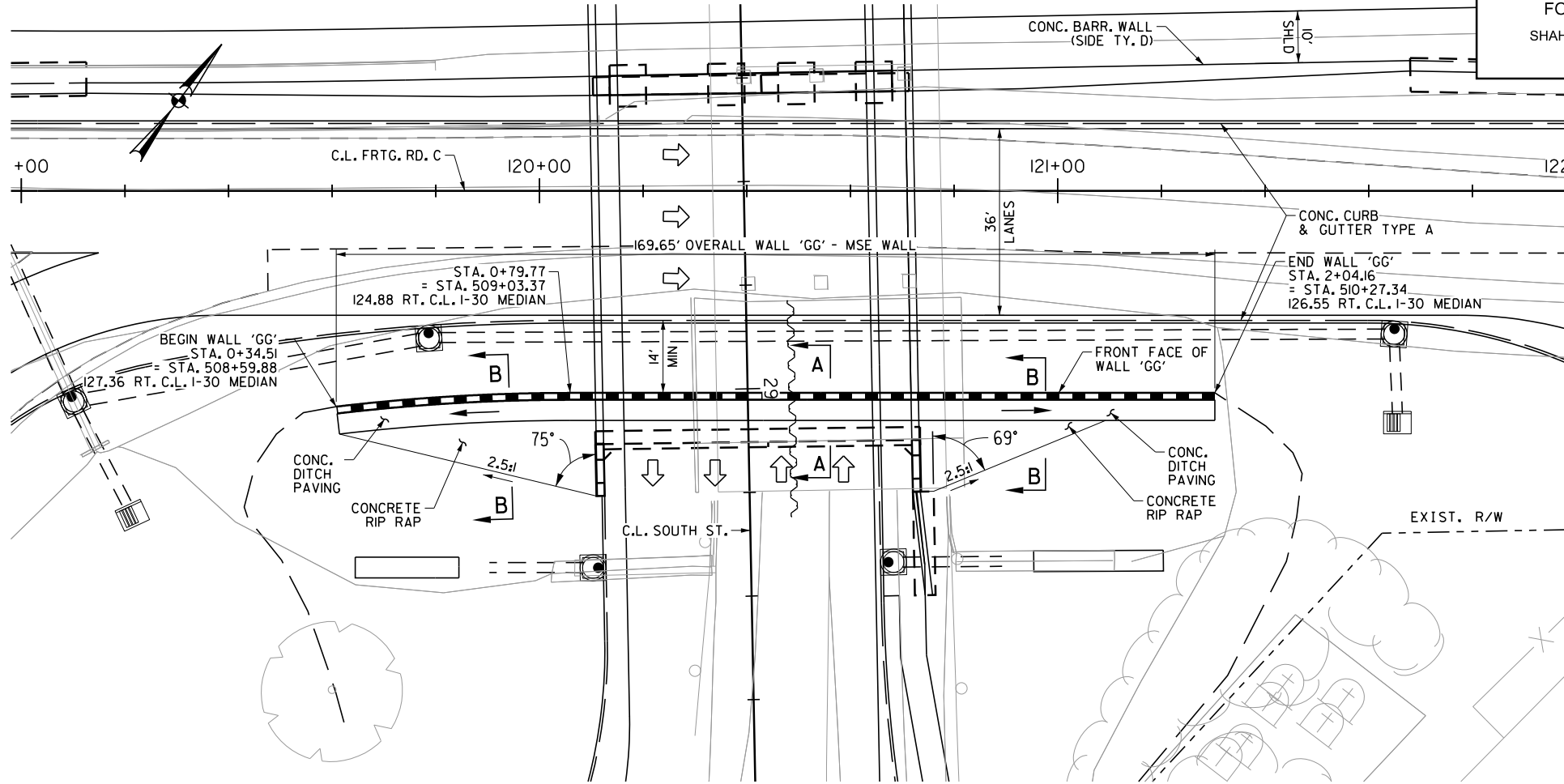
check & coordination

PRELIMINARY
FOR REVIEW ONLY

SHAHRIAR AZAD, P.E., 12404

APRIL-2016

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.	CA0601		516	836
				P&P RET. WALL 'GG' [Dwg#]				



PLAN
SCALE 1"=15'

		STATION	NORTHING	EASTING
* Alignment name: RW*GG				
* Element: Circular				
PC ()		0+00.00	2003558.6479	1130833.3993
PI ()		0+40.03	2003588.9486	1130859.5508
CC ()			2003306.4457	1131125.6151
PT ()		0+79.77	2003613.2388	1130891.3630
Radius:		386.00		
Delta:		11°50'24.0" Right		
Degree of Curvature (Arc):		14°50'36.5"		
Length:		79.77		
Tangent:		40.03		
Chord:		79.62		
Middle Ordinate:		2.06		
External:		2.07		
Tangent Direction:		N 40°47'47.2" E		
Radial Direction:		S 49°12'12.8" E		
Chord Direction:		N 46°42'59.2" E		
Radial Direction:		S 37°21'48.9" E		
Tangent Direction:		N 52°38'11.1" E		
Element: Linear				
PT ()		0+79.77	2003613.2388	1130891.3630
POE ()		2+33.60	2003706.5974	1131013.6321
Tangential Direction:		N 52°38'11.1" E		
Tangential Length:		153.84		

STATION ALONG WALL	TOP OF WALL ELEV.	FINISHED GRADE ELEV.	BOTTOM OF WALL ELEV.
0+34.51	345.00	345.00	343.00
0+59.51	352.14	345.87	343.87
0+84.51	359.27	346.45	344.23
1+09.51	360.73	346.51	344.23
1+34.51	360.68	346.57	344.23
1+59.51	357.96	346.63	344.23
1+84.51	351.71	346.75	344.23
2+04.16	346.80	346.80	344.23

NOTES:

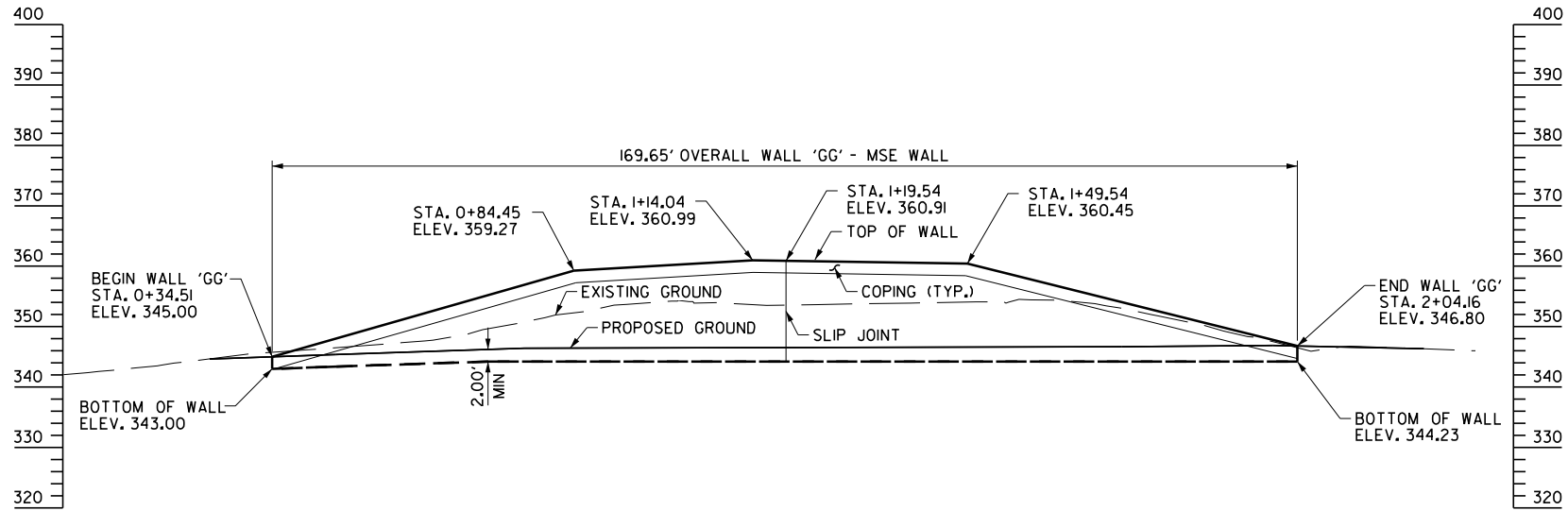
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- SEE BRIDGE LAYOUT FOR LOCATIONS OF TEMPORARY SHORING



LAYOUT OF RETAINING WALL 'GG'
HWY 70 - SEVIER ST. (WIDENING) (S)
SALINE COUNTY
ROUTE 30 SEC. 22
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

DRAWN BY: DCD DATES: 6/26/2015
CHECKED BY: SA DATES: 6/19/2015
DESIGNED BY: DCD DATES: 6/12/2015
FILENAME: rca0601-ret_wall.p&p-gg-01
SCALE: As Shown

DRAWING NO. XXXXX



ELEVATION
SCALE 1"=15'
(VIEWED FROM BACK FACE OF WALL)

ATTACHMENT 3



DELTA = 11°47'22" RT.
DOC = 3°45'00"
T = 157.75'
L = 314.39'
P.C.C. = 13+71.69
P.C.C. = 16+86.07
Ls = 200.00'
e = 0.049 '/'

DELTA = 3°22'09" RT.
DOC = 1°45'00"
T = 96.29'
L = 192.53'
P.C.C. = 16+86.07
P.C.C. = 18+78.60
Ls = 200.00'
e = 0.025 '/'

DELTA = 3°20'19" RT.
DOC = 2°45'00"
T = 60.72'
L = 121.40'
P.C.C. = 18+78.60
P.T. = 20+00.00
Ls = N/A
e = N/A

FOR REVIEW ONLY
SHAHRIAR AZAD, P.E., 12404
JULY-2015

2 PLAN STA.

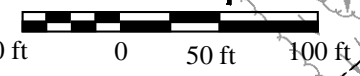
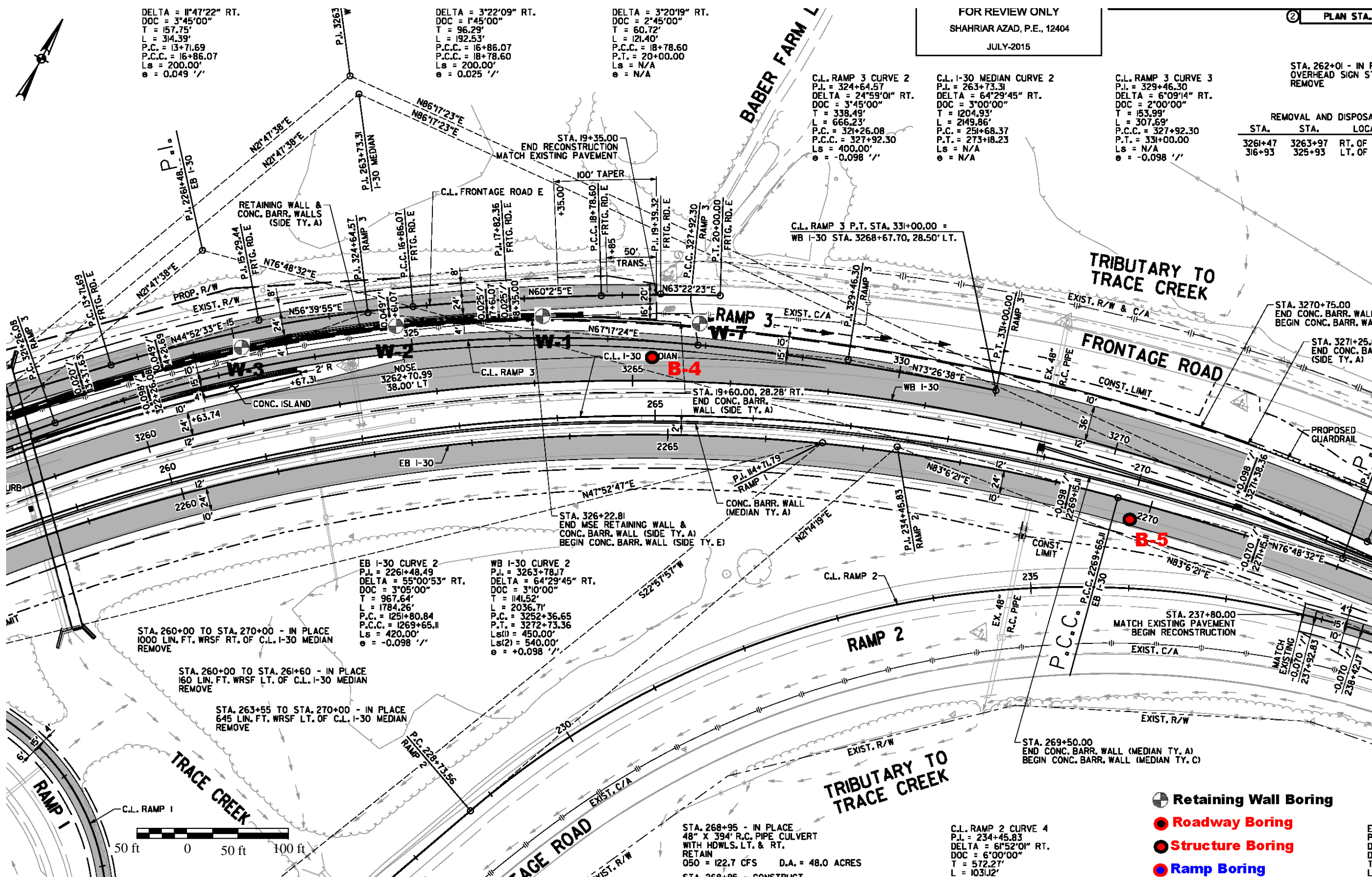
STA. 262+01 - IN P
OVERHEAD SIGN ST
REMOVE

REMOVAL AND DISPOSAL		
STA.	STA.	LOCA
3261+47 316+93	3263+97 325+93	RT. OF I LT. OF I

C.L. RAMP 3 CURVE 2
P.L. = 324+64.57
DELTA = 24°59'01" RT.
DOC = 3°45'00"
T = 338.49'
L = 666.23'
P.C. = 321+26.08
P.C.C. = 327+92.30
Ls = 400.00'
e = -0.098 '/'

C.L. I-30 MEDIAN CURVE 2
P.L. = 263+73.31
DELTA = 64°29'45" RT.
DOC = 3°00'00"
T = 1204.93'
L = 2149.86'
P.C. = 251+68.37
P.T. = 273+18.23
Ls = N/A
e = N/A

C.L. RAMP 3 CURVE 3
P.L. = 329+46.30
DELTA = 6°09'14" RT.
DOC = 2°00'00"
T = 153.99'
L = 307.69'
P.C.C. = 327+92.30
P.T. = 331+00.00
Ls = N/A
e = -0.098 '/'



- Retaining Wall Boring
- Roadway Boring
- Structure Boring
- Ramp Boring



FOR REVIEW ONLY
SHAHRIAR AZAD, P.E., 12404
JULY-2015

② PLAN STA. 375+00 TO STA. 39

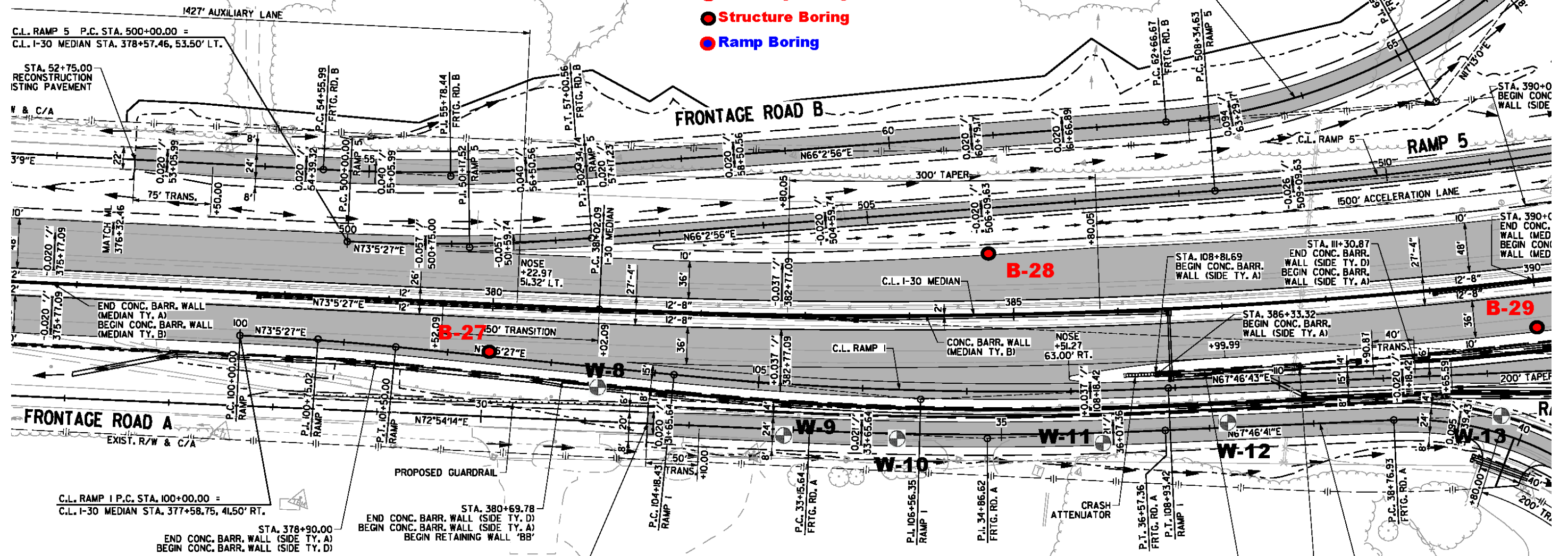
C.L. RAMP 5 CURVE 1
P.L. = 501+17.52
DELTA = 7°02'32" LT.
DOC = 3'00'00"
T = 117.52'
L = 234.74'
P.C. = 500+00.00
P.T. = 502+34.74
Ls = 300.00'
e = -0.057 %

C.L. FRONTAGE ROAD B CURVE 1
P.L. = 55+78.44
DELTA = 7°20'14" LT.
DOC = 3'00'00"
T = 122.45'
L = 244.57'
P.C. = 54+55.99
P.T. = 57+00.56
Ls = 200.00'
e = 0.040 %

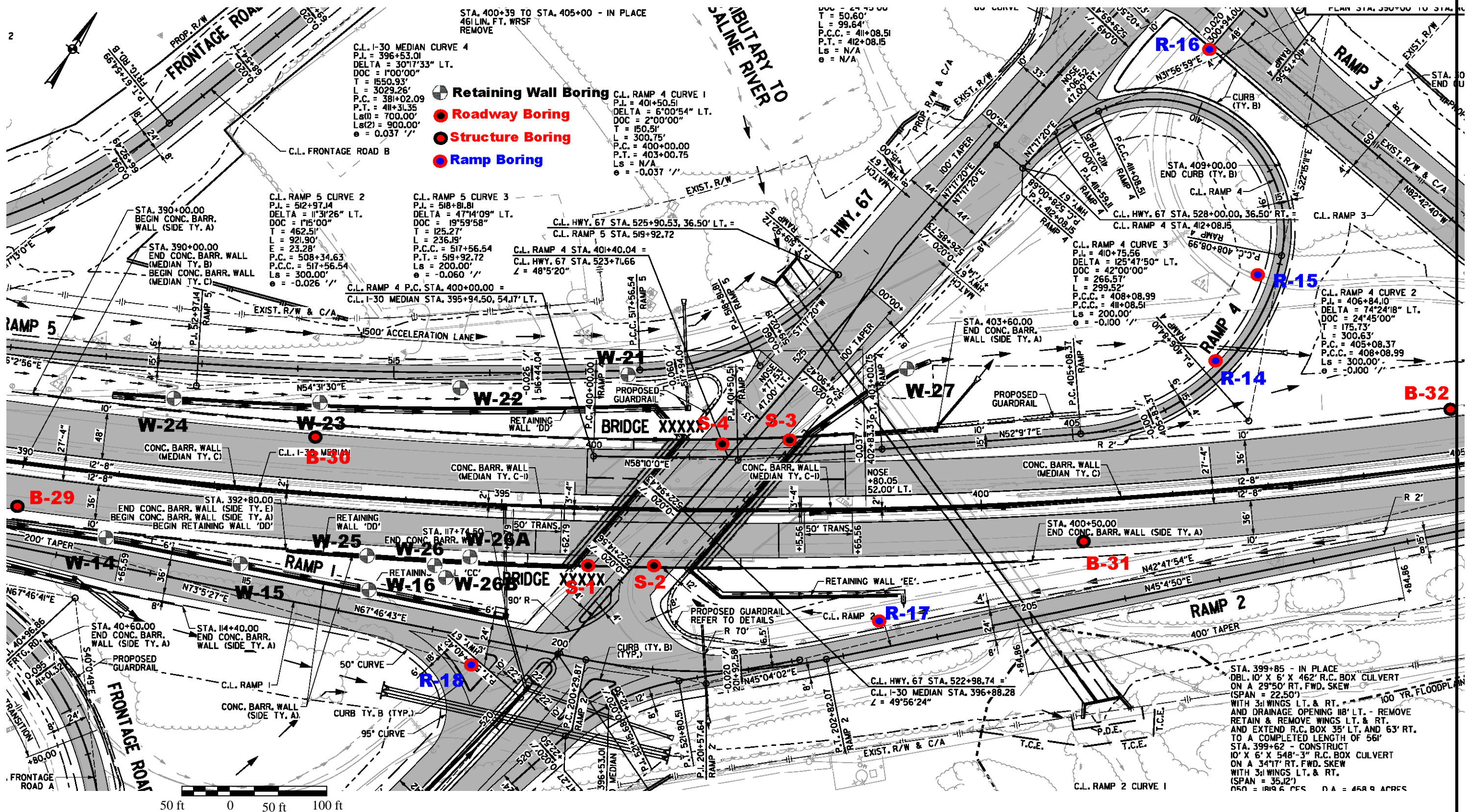
C.L. I-30 MEDIAN CURVE 4
P.L. = 396+53.01
DELTA = 30°17'33" LT.
DOC = 1'00'00"
T = 1550.93'
L = 3029.26'
P.C. = 381+02.09
P.T. = 411+31.35
Ls(1) = 700.00'
Ls(2) = 900.00'
e = 0.037 %

C.L. FRONTAGE ROAD B CURVE 2
P.L. = 65+26.77
DELTA = 48°49'56" LT.
DOC = 10'00'00"
T = 260.10'
L = 488.32'
P.C. = 62+66.67
P.T. = 67+54.99
Ls = 250.00'
e = 0.094 %

- Retaining Wall Boring
- Roadway Boring
- Structure Boring
- Ramp Boring



50 ft 0 50 ft 100 ft



SUBSURFACE EXPLORATION SUMMARY

PROJECT: CA0601 I-30 Retaining Walls

LOCATION: Saline County, AR

GHBW JOB No.: 15-019

Boring No.	I-30 CL Station	Offset from CL, ft		Wall No.	Approx Surface El, ft	Boring Completion Depth, ft
W1	264+00	100	LT	Wall AA	415	20
W2	262+50	105	LT	Wall AA	415	11
W3	261+00	110	LT	Wall AA	407	20
W4	259+50	110	LT	Wall AA	407	20
W5	258+00	110	LT	Wall AA	408	15
W6	256+50	135	LT	Wall AA	417	20
W7	266+50	85	LT	Wall AA	415	20
W8	381+00	75	RT	Wall BB	367	12
W9	382+80	120	RT	Wall BB	371	13
W10	384+40	120	RT	Wall BB	371	9.5
W11	386+00	120	RT	Wall BB	360	25
W12	388+00	100	RT	Wall BB	355	24
W13	389+50	110	RT	Wall BB	341	17
W14	391+00	65	RT	Wall CC	333	11
W15	392+50	70	RT	Wall CC	326	20
W16	394+00	85	RT	Wall CC	320	20
W17	395+00	90	RT	Wall GG	348	19
W18	510+25	100	RT	Wall GG	350	15
W19	508+55	105	LT	Wall FF	342	20
W20	510+10	100	LT	Wall FF	347	12
W21	396+22	142	LT	Wall DD	296	25
W22	394+50	120	LT	Wall DD	307	25
W23	393+20	90	LT	Wall DD	319	25
W24	392+70	80	LT	Wall DD	330	20
W25	393+65	75	RT	Wall DD	324	20
W26	394+30	50	RT	Wall DD	322	17
W26A	394+45	65	RT	Wall DD	321	17.5
W26B	394+45	70	RT	Wall DD	320	50
W27	399+20	142	LT	Wall EE	294	3.5
S2	396+65	60	RT	Wall EE	291	65
S3	398+00	75	LT	Wall EE	296	75
R17	398+95	120	RT	Wall EE	294	10

Notes: 1. Boring locations determined based on measurements from existing features.

2. Surface elevations are approximate and inferred from the topographic information provided by the Engineer.



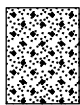
SYMBOLS AND TERMS USED ON BORING LOGS

SOIL TYPES

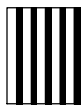
(SHOWN IN SYMBOLS COLUMN)



Gravel



Sand



Silt

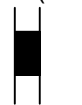


Clay

Predominant type shown heavy

SAMPLER TYPES

(SHOWN ON SAMPLES COLUMN)



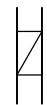
Shelby
Tube



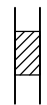
Rock
Core



Split
Spoon



No
Recovery



Cutting

TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE GRAINED SOILS (major portion retained on No. 200 sieve): Includes (1) 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.

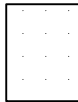
POORLY GRADED - predominantly of one grain size, or having a range of sizes with some intermediate sizes missing.

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

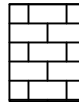


BORING LOG TERMS – ROCK

ROCK TYPES (SHOWN IN SYMBOLS COLUMN)



Sandstone



Limestone



Siltstone



Coal



Shale

Joint	<u>Spacing</u>		Degree of Weathering -		
Characteristics -	Very Close	0.75 to 2.5 in.		Fresh - No visible signs of decomposition or discoloration. Rings under hammer impact.	
	Close	2.5 to 8 in.			
	Moderately Close	8 to 24 in.			
	Wide	2 to 6 ft			
	Very Wide	More than 6 ft			
Bedding			Slightly Weathered - Slight		
Characteristics -	Very Thin	0.75 to 2.5 in.		discoloration inwards from open fractures, otherwise similar to fresh.	
	Thin	2.5 to 8 in.			
	Medium	8 to 24 in.			
	Thick	2 to 6 ft			
	Massive	More than 6 ft			
Lithologic			Moderately Weathered - Discoloration		
Characteristics -	Clayey			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.	
	Shaly				
	Calcareous (limy)				
	Siliceous				
	Sandy (Arenaceous)				
	Silty				
	Plastic Seams				
Parting -	Less than 1/16 inch	Approximate Range of Uniaxial Compressive Strength (psi)		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 preserved.	
Seam -	1/16 to 1/2 inch				
Layer -	1/2 to 12 inches				
Stratum -	Greater than 12 inches				
Hardness and Degree of Cementation -	Very Soft - Can be peeled with a knife	140 - 3500	Solution and Void Conditions -	Completely Weathered - Minerals decomposed to soil but fabric and structure preserved (Saprolite). Specimens easily crumbled or penetrated.	
	Soft - Can just be scraped with knife	3500 - 6900			
	Hard - Can be broken with single moderate blow with pick	6900 - 13,900			
	Very hard - Hand held specimen breaks with hammer end of pick under more than one blow	13,900 - 28,000			
	Extremely Hard - Many blows with hammer required to break intact specimen	More than 28,000			
	Poorly Cemented - Crumbles Easily				
	Cemented - Intact				
Texture -	Fine - Barely seen with naked eye		Swelling Properties -	Nonswelling Swelling	
	Medium - Barely seen up to 1/8 in.				
	Coarse - 1/8 in. to 1/4 in.				
Structure -	Bedding		Slaking Properties -	Nonslaking Slakes slowly on exposure Slakes readily on exposure	
	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				
			Rock Quality Designation (RQD) -		
				<u>RQD (Percent)</u>	
				<u>Diagnostic Description</u>	
				Greater than 90	Excellent
				75 - 90	Good
				50 - 75	Fair
				25 - 50	Poor
				Less than 25	Very Poor

ATTACHMENT 4



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

LOG OF BORING NO. W1

CA0601: I-30 Widening-Wall AA
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx Sta 264+00, 100 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT			- No. 200 %				
						0.2	0.4	0.6		0.8	1.0	1.2	1.4
SURF. EL: 415±						PLASTIC LIMIT WATER CONTENT LIQUID LIMIT							
						10	20	30	40	50	60	70	
			Stiff gray, reddish tan and tan silty clay w/some shale fragments and occasional weathered shale seams (completely weathered shale)	16									
			Low hardness, reddish tan and tan highly weathered shale w/some silty clay seams and medium close sandstone partings and seams	48									
5				50/7"									
			Moderately hard tan, reddish tan and dark gray moderately weathered shale w/occasional silty clay laminations - with fewer silty clay laminations below 8 ft	50/8"									
10				50/6"									
			- less weathered below 13 ft	50/3"									
15													
			Moderately hard to hard dark gray shale	50/1"									
20													
25													

COMPLETION DEPTH: 20.0 ft
DATE: 7-2-15

DEPTH TO WATER
IN BORING: Dry

DATE: 7/2/2015

LGBNEW 15-019 WALL AAGPJ 5-6-16



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

LOG OF BORING NO. W2

CA0601: I-30 Widening-Wall AA
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx Sta 262+50, 105 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT			- No. 200 %			
						PLASTIC LIMIT	WATER CONTENT	LIQUID LIMIT				
SURF. EL: 415±						0.2	0.4	0.6	0.8	1.0	1.2	1.4
						10	20	30	40	50	60	70
			Stiff gray, reddish tan and tan silty clay w/shale fragments (fill)	15								
			- with occasional crushed stone below 2 ft	11								
							+		+			
5			Low hardness reddish tan, tan and gray moderately weathered shale w/occasional silty clay seams and layers	50/10"								
			- moderately hard below 6 ft	50/5"								
							+		+			
10			Moderately hard to hard tan and dark gray weathered shale	50/2"								
			- auger refusal at 11 ft									
15												
20												
25												

COMPLETION DEPTH: 11.0 ft
DATE: 6-30-15

DEPTH TO WATER
IN BORING: Dry

DATE: 6/30/2015



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

LOG OF BORING NO. W3

CA0601: I-30 Widening-Wall AA
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx Sta 261+00, 110 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT							- No. 200 %
						0.2	0.4	0.6	0.8	1.0	1.2	1.4	
			SURF. EL: 407±			PLASTIC LIMIT WATER CONTENT LIQUID LIMIT +-----+-----+ 10 20 30 40 50 60 70							
5			Stiff gray, tan and reddish tan silty clay w/shale fragments (fill) - with occasional clay pockets below 2 ft - soft, less silty, moist below 4 ft	13 11 5		●	+	---	+				31
10			Firm to stiff brown and gray clayey silt w/some silty clay seams and shale and quartz fragments and trace organic inclusions (possible fill) Very stiff gray, reddish tan and tan silty clay w/shale fragments and some clay pockets	10 27			●						41
15			Low hardness dark gray, gray and tan highly weathered shale w/occasional silty clay seams and medium close sandstone partings and seams	50		●							
20			Moderately hard to hard tan and dark gray weathered shale	50/1"		●							
25													

COMPLETION DEPTH: 20.0 ft
DATE: 6-30-15

DEPTH TO WATER
IN BORING: Dry

DATE: 6/30/2015



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

LOG OF BORING NO. W4

CA0601: I-30 Widening-Wall AA
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx Sta 259+50, 110 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT							- No. 200 %
						0.2	0.4	0.6	0.8	1.0	1.2	1.4	
			SURF. EL: 407±										
						PLASTIC LIMIT			WATER CONTENT			LIQUID LIMIT	
						10	20	30	40	50	60	70	
5			Stiff gray, tan and reddish tan silty clay w/occasional clay pockets and some shale fragments and fine to coarse gravel (fill)	16			●						20
			- firm and less silty at 4 to 6 ft	16		●	+	+					
			- stiff, moist with some sandstone fragments below 6 ft	9			●						
			- water at 8 ft	11			●						
10				16			●						
15			Low hardness to moderately hard tan and gray weathered shale w/occasional clay seams, flat bedded	50/6"			●						
20			Moderately hard to hard tan and dark gray weathered shale	50/2"									
25													

COMPLETION DEPTH: 20.0 ft
DATE: 6-29-15

DEPTH TO WATER
IN BORING: 8 ft

DATE: 6/29/2015



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

LOG OF BORING NO. W5

CA0601: I-30 Widening-Wall AA
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx Sta 258+00, 110 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT							- No. 200 %
						0.2	0.4	0.6	0.8	1.0	1.2	1.4	
			SURF. EL: 408±			PLASTIC LIMIT: 10 WATER CONTENT: 40 LIQUID LIMIT: 70							
5			Firm gray, tan and reddish tan silty clay w/shale fragments and trace fine to coarse gravel and occasional fine sandy clay pockets, moist (fill) - with some clay pockets and seams below 2 ft - with occasional silt pockets and seams below 4 ft	10 9 8			●						54
			Stiff tan and gray silty clay, slightly sandy w/some silt pockets and seams, shale and quartz fragments and trace organics	15		●	+	+					56
10			Stiff gray and reddish tan silty clay w/some shale and quartz fragments and occasional clay pockets and seams	22		●							
15			Low hardness to moderately hard gray, tan and reddish tan highly weathered shale w/occasional silty clay seams - water at 13 ft	50/6"			●						
20													
25													

COMPLETION DEPTH: 15.0 ft
DATE: 7-2-15

DEPTH TO WATER
IN BORING: 13 ft

DATE: 7/2/2015



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

LOG OF BORING NO. W6

CA0601: I-30 Widening-Wall AA
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx Sta 256+50, 135 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT							- No. 200 %
						0.2	0.4	0.6	0.8	1.0	1.2	1.4	
			SURF. EL: 417±			<div> <div>PLASTIC LIMIT</div> <div>WATER CONTENT</div> <div>LIQUID LIMIT</div> </div>							
						10	20	30	40	50	60	70	
5			Firm gray, reddish tan and tan silty clay w/weathered shale seams and layers and occasional clay seams (completely weathered shale)	11			●						68
				14			●						
				16		●	+	---	+				
10			Low hardness gray, reddish tan, tan and brown highly weathered shale w/some silty clay seams and layers	36			●						68
				21		●							
			- water at 13 ft										
15				25			●						
20			Moderately hard tan and dark gray moderately weathered shale, slightly arenaceous, apparent dip = ±20°	50/9"		●							68
25													

COMPLETION DEPTH: 20.0 ft
DATE: 6-29-15

DEPTH TO WATER
IN BORING: 13 ft

DATE: 6/29/2015



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

LOG OF BORING NO. W7

CA0601: I-30 Widening-Wall AA
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx Sta 266+50, 85 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT							- No. 200 %
						0.2	0.4	0.6	0.8	1.0	1.2	1.4	
			SURF. EL: 415±			PLASTIC LIMIT: 10 WATER CONTENT: 40 LIQUID LIMIT: 70							
5			Very stiff reddish tan, tan and gray silty clay w/occasional clay seams and occasional weathered shale seams and fragments (completely weathered shale)	25		●	+	-	+				30
			Low hardness tan, reddish tan, gray and dark gray highly weathered shale w/silty clay seams and medium close sandstone partings and seams	36		●	+	-	+				
			Moderately hard dark gray, reddish tan and tan moderately weathered shale w/occasional silty clay seams and medium close sandstone partings and seams	50/6"		●							
				50/5"		●							
10			Moderately hard to hard dark gray shale	50/2"		●							
				50/1"		●							
15				50/1"		●							
20													
25													

COMPLETION DEPTH: 20.0 ft
DATE: 7-2-15

DEPTH TO WATER
IN BORING: Dry

DATE: 7/2/2015

ATTACHMENT 5



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

LOG OF BORING NO. W8

CA0601: I-30 Widening-Wall BB
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx Sta 381+00, 75 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT			- No. 200 %
						0.2	0.4	0.6	
			SURF. EL: 367±			PLASTIC LIMIT: 10 WATER CONTENT: 40 LIQUID LIMIT: 70			
			Medium dense reddish brown fine sand, slightly clayey w/fine to coarse gravel (fill)	19		++			16
5			Stiff reddish tan and gray clay w/occasional ferrous stains and nodules and organic stains and inclusions	12		●			
			- with some silt seams and layers and occasional quartz fragments below 6 ft	17		+ --- ● --- 94			100
				18		●			
10			Very stiff gray and tan silty clay w/some silt pockets and shale and quartz fragments, calcareous	37		●			
			- auger refusal at 12 ft						
15									
20									
25									

COMPLETION DEPTH: 12.0 ft
DATE: 7-2-15

DEPTH TO WATER
IN BORING: Dry

DATE: 7/2/2015



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

LOG OF BORING NO. W9

CA0601: I-30 Widening-Wall BB
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx Sta 382+80, 120 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT							- No. 200 %
						0.2	0.4	0.6	0.8	1.0	1.2	1.4	
			SURF. EL: 371±			PLASTIC LIMIT +			WATER CONTENT ●			LIQUID LIMIT +	
						10	20	30	40	50	60	70	
			Crushed Stone Base	9									
			Firm to stiff gray and tan clay, blocky w/occasional calcareous nodules	10									97
5			- stiff below 4 ft	14									100
			- with organic stains below 6 ft	20									
10			Stiff to very stiff tan and gray silty clay w/calcareous nodules	24									
			Moderately hard to hard tan moderately weathered shale w/medium close calcareous sandstone seams - auger refusal at 13 ft on sandstone	50/1"									
15													
20													
25													

COMPLETION DEPTH: 13.0 ft
DATE: 7-6-15

DEPTH TO WATER
IN BORING: Dry

DATE: 7/6/2015



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

LOG OF BORING NO. W10

CA0601: I-30 Widening-Wall BB
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx Sta 384+40, 120 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT			- No. 200 %
						0.2	0.4	0.6	
			SURF. EL: 371±			PLASTIC LIMIT: 10 WATER CONTENT: 40 LIQUID LIMIT: 70			
			Stiff brown fine sandy clay w/some quartz fragments, crushed stone and fine sand pockets (fill)	17					
			Stiff gray and tan clay, blocky	13					
5			13						
			- slightly silty with calcareous inclusions and seams below 6 ft	18					
			Very stiff tan and gray silty clay w/medium close calcareous sandstone partings and seams	50/6"					
10			- auger refusal at 9.5 ft in sandstone						
15									
20									
25									

COMPLETION DEPTH: 9.5 ft
DATE: 7-7-15

DEPTH TO WATER
IN BORING: Dry

DATE: 7/7/2015



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

LOG OF BORING NO. W11

CA0601: I-30 Widening-Wall BB
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx Sta 386+00, 120 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT							- No. 200 %
						0.2	0.4	0.6	0.8	1.0	1.2	1.4	
			SURF. EL: 360±										
			3.5 inches: Asphalt Concrete	6									
			Loose brown fine to coarse sand w/some fine to coarse gravel and occasional clay pockets (fill)	6			+	•			+		67
			Soft tan and olive gray clay, sandy w/occasional silt partings	11					•				
5			- stiff with occasional organic inclusions and fine sandy clay seams below 4 ft	10				•					
			- very stiff with occasional calcareous inclusions below 6 ft	27				•					
10			- less sandy, tan and gray with more calcareous partings and nodules below 8 ft	29			+	•				90	88
			Medium dense tan silty fine sand w/occasional clay pockets	50/6"				•					37
15			- water at 13.7 ft										
			Moderately hard tan and gray highly weathered shale w/clay seams and layers and occasional siltstone partings	50/6"				•					
20													
				50/9"									
25													
COMPLETION DEPTH: 25.0 ft				DEPTH TO WATER				DATE: 7/7/2015					
DATE: 7-7-15				IN BORING: 13.7 ft									

LGBNEW 15-019 WALL BB.GPJ 5-6-16



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

LOG OF BORING NO. W12

CA0601: I-30 Widening-Wall BB
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx Sta 388+00, 100 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT						- No. 200 %	
						0.2 0.4 0.6 0.8 1.0 1.2 1.4							
						PLASTIC LIMIT +	WATER CONTENT ●				LIQUID LIMIT +		
SURF. EL: 355±						10	20	30	40	50	60	70	
5			3 inches: Asphalt Concrete			●							
			12 inches: Reddish brown fine to medium sand, slightly clayey w/fine to coarse gravel (fill)	8		+		●			+	89	
			Firm to stiff reddish tan and gray clay, slightly sandy	10				●					
			- with trace silt partings below 2 ft										
			- with occasional organic stains and inclusions below 4 ft	9				●					
			- soft at 6 to 8 ft										
			- tan and olive gray with some calcareous nodules below 6 ft	6				●					
			- firm below 8 ft	7		+		●			+	83	
			- water at 12.5 ft										
			Firm tan and gray silty clay w/some shale fragments and clay pockets	7		+			+				
20			Very stiff tan, reddish tan and gray clay, slightly silty w/occasional highly weathered shale seams and fragments (completely weathered shale)	35				●					
			Moderately hard reddish tan, tan and dark gray moderately weathered shale w/occasional silty clay laminations and seams	50/3"				●					
25													
COMPLETION DEPTH: 24.0 ft				DEPTH TO WATER				DATE: 7/7/2015					
DATE: 7-7-15				IN BORING: 12.5 ft									

LGBNEW 15-019 WALL BB.GPJ 5-6-16



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

LOG OF BORING NO. W13

CA0601: I-30 Widening-Wall BB
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx Sta 389+50, 110 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT						- No. 200 %	
						<div><div></div><div>0.20.40.60.81.01.21.4</div></div>							
						PLASTIC LIMIT +	WATER CONTENT ●				LIQUID LIMIT +		
			SURF. EL: 341±			10	20	30	40	50	60	70	
			5 Inches: Asphalt Concrete										
			Reddish tan fine sand w/quartz fragments, slightly clayey (fill)	9									
			Stiff gray and tan clay w/trace fine gravel (fill)	12			+		●		+		83
5			Firm tan and gray clay	9									
			- stiff below 6 ft	17									
			Stiff gray and tan clay w/occasional silt partings, blocky	15									
10													
			- water at 13 ft	24									
15			Moderately hard to hard gray and tan moderately weathered shale w/occasional silty clay seams	50/1"									
			- auger refusal 17 ft										
20													
25													
COMPLETION DEPTH: 17.0 ft													
DATE: 7-6-15													
DEPTH TO WATER IN BORING: 13 ft													
DATE: 7/6/2015													

COMPLETION DEPTH: 17.0 ft
DATE: 7-6-15

DEPTH TO WATER
IN BORING: 13 ft

DATE: 7/6/2015

ATTACHMENT 6



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

LOG OF BORING NO. W14

CA0601: I-30 Widening-Wall CC
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx Sta 391+00, 65 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT							- No. 200 %
						0.2	0.4	0.6	0.8	1.0	1.2	1.4	
			SURF. EL: 333±			PLASTIC LIMIT +			WATER CONTENT ●			LIQUID LIMIT +	
						10	20	30	40	50	60	70	
			Medium dense brown clayey fine sand w/trace organics and some fine to coarse gravel (fill)	20		●							
			Firm gray, reddish tan and tan silty clay w/shale fragments and fine sandy clay pockets (fill)	9		+	●		+				58
5			Stiff tan, gray and reddish tan clay	15					●				
			- with some organic stains below 6 ft	12				+	●			99	93
10			Moderately hard to hard gray and tan weathered shale w/medium close sandstone partings	50/1"		●							
			- auger refusal at 11 ft										
15													
20													
25													

COMPLETION DEPTH: 11.0 ft
DATE: 7-1-15

DEPTH TO WATER
IN BORING: Dry

DATE: 7/1/2015



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

LOG OF BORING NO. W15

CA0601: I-30 Widening-Wall CC
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx Sta 392+50, 70 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT		- No. 200 %
						0.2 0.4 0.6 0.8 1.0 1.2 1.4	PLASTIC LIMIT 10 20 30 40 50 60 70	
			SURF. EL: 326±					
			Stiff gray, reddish tan and tan silty clay w/shale fragments (fill)	11				
			Stiff brown and tan clay, calcareous	19				
5			- firm to stiff with some organic inclusions at 4 to 6 ft	10				89
			- stiff with more organics below 6 ft	11				
10			Stiff reddish tan and gray clay w/occasional organic stains	12				
15			Very stiff tan silty clay w/some fine sandy silt pockets and numerous calcareous inclusions and nodules	44				68
20			Low hardness to moderately hard tan, reddish tan and gray highly weathered shale w/occasional silty clay seams and siltstone partings	50/6"				
25								

COMPLETION DEPTH: 20.0 ft
DATE: 7-1-15

DEPTH TO WATER
IN BORING: Dry

DATE: 7/1/2015



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

LOG OF BORING NO. W16

CA0601: I-30 Widening-Wall CC
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx Sta 393+74, 85 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT							- No. 200 %
						0.2	0.4	0.6	0.8	1.0	1.2	1.4	
			SURF. EL: 320±			PLASTIC LIMIT + 10	20	30	40	50	60	70	
			Firm gray, reddish tan and tan silty clay w/shale and sandstone fragments and trace organics (fill)	7									
			- stiff below 2 ft	13									46
5			Firm gray, reddish tan and tan clay w/some ferrous stains and organic inclusions and occasional calcareous nodules	9									
			- stiff with occasional silty fine sand partings below 8 ft	7									
10				12									83
15			Very stiff gray and reddish tan silty clay w/shale and sandstone fragments	36									
20			Moderately hard gray and tan highly weathered shale w/some silty clay seams and layers	50/7"									
25													
COMPLETION DEPTH: 20.0 ft				DEPTH TO WATER				DATE: 7/1/2015					
DATE: 7-1-15				IN BORING: Dry									

LGBNEW 15-019 WALL CC.GPJ 5-6-16

ATTACHMENT 7



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

LOG OF BORING NO. W21

CA0601: I-30 Widening - Wall DD
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx Sta 396+22, 142 ft Lt (Ramp 5)

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT							- No. 200 %
						0.2	0.4	0.6	0.8	1.0	1.2	1.4	
			SURF. EL: 296±										
			Dense brown and tan fine sand w/fine to coarse gravel and crushed stone (fill)	41									
			Firm reddish tan and tan fine sandy clay w/numerous shale fragments, some fine sand pockets and occasional clay seams (fill)	8									40
5			Firm to stiff reddish tan, tan and olive gray clay w/trace organics and some ferrous stains and nodules	10									
			Stiff tan, reddish tan and gray fine sandy clay w/fine sand partings w/occasional sandstone fragments	12									54
10			Stiff reddish tan, tan and olive gray clay w/occasional fine sand partings and calcareous inclusions	12									
15			Very stiff tan and reddish tan silty clay, slightly sandy w/shale fragments and sandstone and quartz fragments	25									
20			- stiff below 18 ft	23									
25			Low hardness to moderately hard tan, reddish tan and gray weathered shale w/sandstone partings	50/10"									

COMPLETION DEPTH: 25.0 ft
DATE: 8-14-15

DEPTH TO WATER
IN BORING: Dry

DATE: 8/14/2015



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

LOG OF BORING NO. W22

CA0601: I-30 Widening - Wall DD
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx Sta 394+50, 120 ft Lt (Ramp 5)

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT							- No. 200 %
						0.2	0.4	0.6	0.8	1.0	1.2	1.4	
			SURF. EL: 307±										
			Dense to very dense tan and reddish tan fine sand w/fine to coarse gravel and some crushed stone (fill)	51									
			Stiff gray, reddish tan and tan silty clay w/numerous shale fragments and sandstone fragments (fill)	11									
5			Firm to stiff tan and olive gray clay, slightly blocky w/occasional silt partings and calcareous inclusions and trace fine gravel	10									91
			Stiff tan fine sandy clay w/occasional fine sand partings	19									
10			Firm to stiff tan and olive gray clay, slightly blocky w/occasional fine sand partings and calcareous inclusions	10									
			Stiff reddish tan and gray silty clay, slightly sandy w/some fine gravel, quartz fragments, ferrous stains and nodules and occasional fine sand pockets	20									
			Moderately hard brown, gray and tan weathered shale w/close sandstone seams and silty clay seams	50/8"									
20			Moderately hard gray, reddish tan and dark gray weathered shale										
25				50/3"									
COMPLETION DEPTH: 25.0 ft				DEPTH TO WATER				DATE: 8/13/2015					
DATE: 8-13-15				IN BORING: Dry									

LGBNEW 15-019 WALL DD.GPJ 5-25-16



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

LOG OF BORING NO. W23

CA0601: I-30 Widening - Wall DD
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx Sta 393+20, 90 ft Lt (Ramp 5)

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT										- No. 200 %
						0.2 0.4 0.6 0.8 1.0 1.2 1.4										
						PLASTIC LIMIT WATER CONTENT LIQUID LIMIT										
SURF. EL: 319±						10	20	30	40	50	60	70				
			Medium dense tan and reddish brown fine sand w/some fine gravel and trace crushed stone, slightly clayey (fill)	25												
			Firm reddish brown and dark gray silty clay and shale fragments (fill)	9												
5			Firm tan and olive gray clay w/occasional silt partings and organics	8										94		
			Firm to stiff tan and dark gray silty clay w/shale fragments and some organic stains and inclusions	10												
10			Stiff gray, tan and reddish tan silty clay w/occasional clay seams and quartz fragments and some highly weathered shale seams and shale fragments (completely weathered shale)	18												
			Low hardness to moderately hard tan, reddish tan and light gray highly weathered shale w/occasional silty clay seams	50/6"												
15																
			Moderately hard reddish tan, dark gray and gray weathered shale w/medium close sandstone partings, flat bedded	50/3"												
20																
			Moderately hard to hard dark gray shale w/medium close sandstone partings	50/1"												
25																
COMPLETION DEPTH: 25.0 ft																
DATE: 8-17-15																
DEPTH TO WATER																
IN BORING: Dry																
DATE: 8/17/2015																

LGBNEW 15-019 WALL DD.GPJ 5-25-16



CA0601: I-30 Widening - Wall DD
Saline County, Arkansas

LOCATION: Approx Sta 392+70, 80 ft Lt (Ramp 5)

_GBNEW 15-019_WALL DD.GPJ 5-25-16

DATE: 8/17/2015



CA0601: I-30 Widening - Wall DD
Saline County, Arkansas

LOCATION: Approx Sta 393+65, 75 ft Rt

_GBNEW 15-019_WALL DD.GPJ 5-6-16

DATE: 9/29/2015



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

LOG OF BORING NO. W26

CA0601: I-30 Widening - Wall DD
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx Sta 394+30, 50 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT							- No. 200 %
						0.2	0.4	0.6	0.8	1.0	1.2	1.4	
			SURF. EL: 322±										
			6 inches: Loose brown silt w/some crushed stone and organics (fill)	36									
			Dense tan and reddish tan silty fine sand w/trace organics (fill)										
			Stiff gray, tan and reddish tan silty clay w/shale and sandstone fragments and occasional clay seams (fill)	16									28
5			- soft with more clay seams and trace crushed stone below 4 ft	6									
			Soft tan, light gray and olive gray clay w/occasional organic inclusions and calcareous inclusions	6									94
			- with more organic inclusions and occasional calcite inclusions and limestone fragments below 8 ft										
10			- limestone layer at 10.5 ft	50/6"									
			Very soft tan and olive gray clay, slightly silty, calcareous w/occasional limestone fragments	0/WHO									63
15			- auger refusal at 17 ft in limestone										
20													
25													

COMPLETION DEPTH: 17.0 ft
DATE: 8-19-15

DEPTH TO WATER
IN BORING: Dry

DATE: 8/19/2015



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

LOG OF BORING NO. W26A

CA0601: I-30 Widening - Wall DD
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx Sta 394+45, 50 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT							- No. 200 %
						0.2	0.4	0.6	0.8	1.0	1.2	1.4	
			SURF. EL: 321±			PLASTIC LIMIT WATER CONTENT LIQUID LIMIT +-----+-----+ 10 20 30 40 50 60 70							
5			Soft tan, reddish tan and gray silty clay, slightly sandy w/shale fragments and occasional clay lamin	6									
10			Firm to stiff tan, gray and olive gray clay w/occasional shale fragments and calcite inclusions - with some decayed organics at 10 ft	13									
15			Stiff tan and olive gray clay, slightly silty, calcareous w/occasional limestone fragments	12									
20			- auger refusal at 17.5 ft in limestone										
25													

COMPLETION DEPTH: 17.5 ft
DATE: 8-19-15

DEPTH TO WATER
IN BORING: Dry

DATE: 8/19/2015



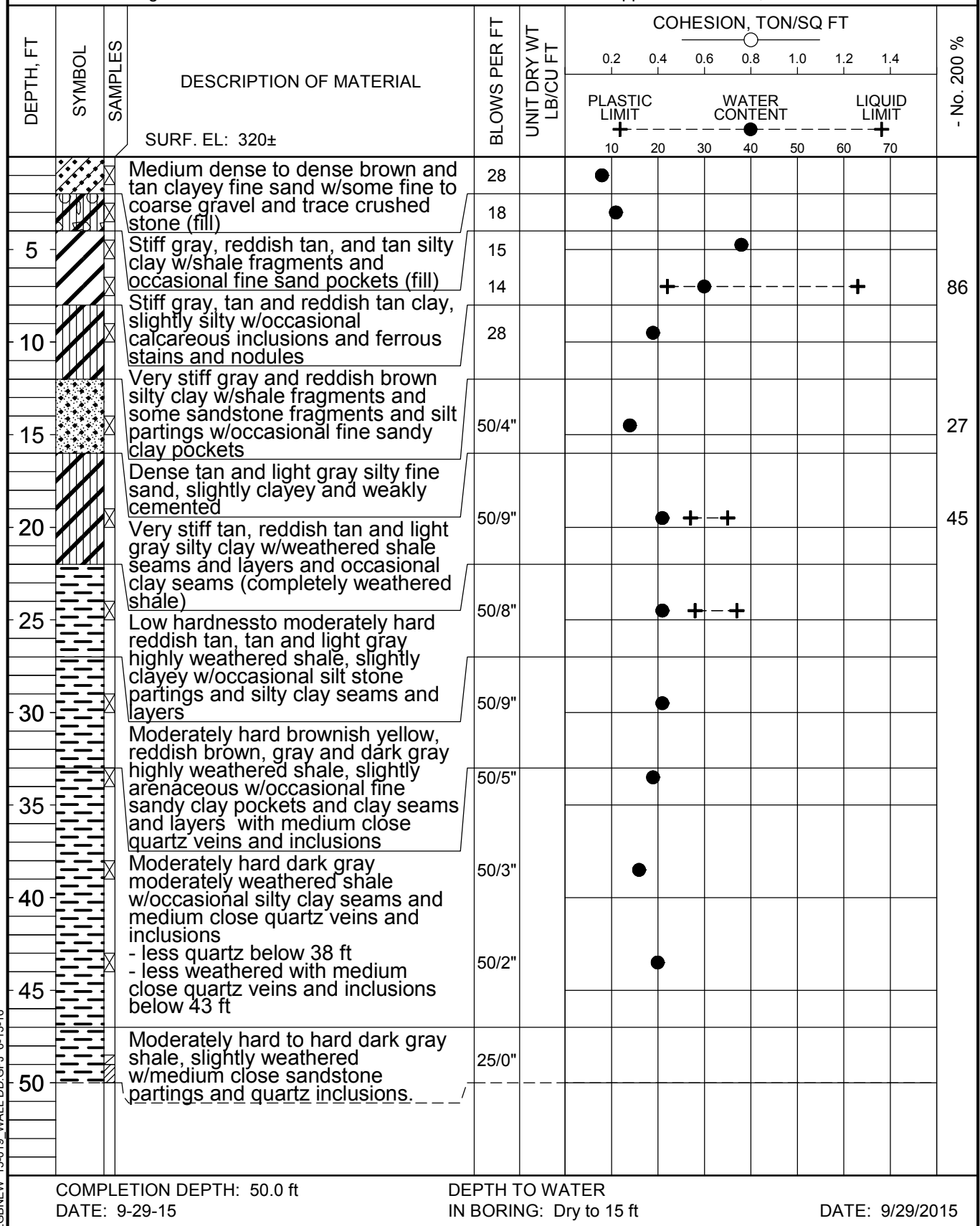
**Grubbs, Hoskyn,
Barton & Wyatt, Inc.**
Consulting Engineers

LOG OF BORING NO. W26B

CA0601: I-30 Widening - Wall DD
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx Sta 394+45, 70 ft Rt



LGBNEW 15-019 WALL DD.GPJ 6-13-16

ATTACHMENT 8



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

LOG OF BORING NO. W27

CA0601: I-30 Widening - Wall EE
Saline County, Arkansas

TYPE: Auger

LOCATION: Approx Sta 399+20, 142 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT			- No. 200 %				
						0.2	0.4	0.6		0.8	1.0	1.2	1.4
SURF. EL: 294±						PLASTIC LIMIT WATER CONTENT LIQUID LIMIT							
						10	20	30	40	50	60	70	
1			Very stiff gray, tan and reddish tan silty clay w/highly weathered shale seams and occasional quartz fragments (completely weathered shale)	28									
2													
3			Moderately hard to hard tan and gray weathered shale	50/0"		●	+	---	+				
4													
- auger refusal at 3.5 ft													
5													
6													
7													
8													
9													

COMPLETION DEPTH: 3.5 ft
DATE: 8-13-15

DEPTH TO WATER
IN BORING: Dry

DATE: 8/13/2015

LGBNEW 15-019 WALL EEGPJ 5-6-16



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

LOG OF BORING NO. S2

CA0601: I-30 over Hwy 67
Saline County, Arkansas

TYPE: Auger to 10 ft /Wash

LOCATION: Approx Sta 396+65, 60 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT						- No. 200 %	% Recovery	% RQD
						0.2	0.4	0.6	0.8	1.0	1.2	1.4		
			SURF. EL: 291±											
			2 inches: Asphalt Concrete	16										
			Stiff gray, tan and reddish brown fine sandy clay w/some fine to coarse gravel (fill)	12										
5			- firm brown silty clay at 4 to 6 ft	7									49	
			- very stiff fine sandy clay below 6 ft	26										
10			Very stiff tan, reddish tan and gray silty clay w/some weathered shale seams and occasional quartz fragments	27									30	
			- stiff with occasional quartz cobbles below 13 ft	21										
15														
20				21										
25			Moderately hard light gray and dark gray weathered shale w/medium close siltstone partings and sandstone partings and occasional calcareous inclusions	50/5"										
			- with quartz veins and inclusions at 23 to 24 ft											
30			Moderately hard to hard light gray and dark gray shale w/medium close siltstone partings and sandstone partings	50/1"										
			- with occasional pyrite inclusions below 30 ft											
35				50/1"										
			- arenaceous shale layer with calcareous mudstone inclusions at 35.5 - 36.5 ft										17	13
			- with very close interbedded siltstone seams and layers below 36 ft											
COMPLETION DEPTH: 65.0 ft				DEPTH TO WATER				DATE: 10/17/2015						
DATE: 10-17-15				IN BORING: Dry to 10 ft										

RECROD200-2 15-019, S1-S4, I-30 OVER HWY 67, GPJ 5-6-16



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

LOG OF BORING NO. S2

CA0601: I-30 over Hwy 67
Saline County, Arkansas

TYPE: Auger to 10 ft /Wash

LOCATION: Approx Sta 396+65, 60 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT			PLASTIC LIMIT +	WATER CONTENT ●	LIQUID LIMIT +	No. 200 %	% Recovery	% RQD
						0.2	0.4	0.6						
45			- with occasional calcite inclusions below 48 ft	50/1"										
50				50/0"										
55				30/0"										
60				30/0"										
65			NOTE: Set 22 ft casing.	30/0"										
70														
75														

COMPLETION DEPTH: 65.0 ft
DATE: 10-17-15

DEPTH TO WATER
IN BORING: Dry to 10 ft

DATE: 10/17/2015



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

LOG OF BORING NO. S3

CA0601: I-30 over Hwy 67
Saline County, Arkansas

TYPE: Auger to 15 ft /Wash

LOCATION: Approx Sta 398+00, 75 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT							- No. 200 %
						0.2 0.4 0.6 0.8 1.0 1.2 1.4							
						PLASTIC LIMIT +	WATER CONTENT ●					LIQUID LIMIT +	
			SURF. EL: 296±			10	20	30	40	50	60	70	
5			7.5 inches: Asphalt Concrete	50/4"									80
			12 inches: Crushed Stone Base										
			Stiff tan and dark gray silty clay w/shale and sandstone fragments and some quartz fragments (fill) - firm below 4 ft	12 8		●	●						
10			Firm tan and reddish tan silty clay, sandy w/some ferrous stains and nodules, moist - stiff with occasional clay laminations, fine sand pockets and a little fine to coarse gravel below 8 ft	8 19			+	●	+				37
15			Firm brown, tan and reddish tan silty clay w/quartz fragments and some fine to coarse gravel	9				●					37
20			- stiff with more fine quartz fragments and occasional clay laminations below 18 ft	17		●	- -	+					37
25			Firm tan and gray silty clay w/shell fragments and organic stains	8									37
30			Moderately hard light gray and dark gray slightly weathered shale w/close siltstone seams and layers	50/3"		●							37
35			- with close quartz and sandstone partings and occasional calcareous inclusions below 33 ft	50/1"									37
40			Moderately hard to hard light gray and dark gray shale w/medium close sandstone partings and occasional quartz and calcareous inclusions	50/0"									37
				50/0"									
COMPLETION DEPTH: 75.0 ft				DEPTH TO WATER				DATE: 10/17/2015					
DATE: 10-17-15				IN BORING: 13 ft									

LGBNEW 15-019, S1-S4, I-30 OVER HWY 67.GPJ 6-13-16



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

LOG OF BORING NO. S3

CA0601: I-30 over Hwy 67
Saline County, Arkansas

TYPE: Auger to 15 ft /Wash

LOCATION: Approx Sta 398+00, 75 ft Lt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL (continued)	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT			- No. 200 %			
						0.2	0.4	0.6		0.8	1.0	1.2
						PLASTIC LIMIT	WATER CONTENT	LIQUID LIMIT				
						+	●	+				
						10	20	30	40	50	60	70
50			- with less quartz and occasional pyrite inclusions below 53 ft	50/0"								
55				50/0"								
60				50/0"								
65			- with less sandstone and more calcareous inclusions below 63 ft	50/0"								
70				50/0"								
75			NOTE: Set 40 ft casing.	50/0"								
80												
85												

COMPLETION DEPTH: 75.0 ft
DATE: 10-17-15

DEPTH TO WATER
IN BORING: 13 ft

DATE: 10/17/2015



CA0601: I-30 - Roadway Widening
Saline County, Arkansas

LOCATION: Approx Sta 398+95, 120 ft Rt

_GBNEW 15-019.GPJ 5-6-16

ATTACHMENT 9



CA0601: I-30 Widening - Wall FF
Benton, Arkansas

LOCATION: Approx Sta 508+55, 105 ft Lt

_GBNEW 15-019_WALL-FF.GPJ 5-6-16

DATE: 7/23/2015

CA0601: I-30 Widening - Wall FF
Benton, Arkansas

TYPE: Auger

LOCATION: Approx Sta 510+10, 100 ft Lt

[illegible]

COMPLETION DEPTH: 12.0 ft
DATE: 7-23-15

DEPTH TO WATER
IN BORING: Dry

DATE: 7/23/2015

ATTACHMENT 10



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

LOG OF BORING NO. W17

CA0601: I-30 Widening - Wall GG
Benton, Arkansas

TYPE: Auger

LOCATION: Approx Sta 508+70, 100 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT							- No. 200 %
						0.2	0.4	0.6	0.8	1.0	1.2	1.4	
			SURF. EL: 350±										
			5 inches: Loose brown fine sandy silt w/organics (fill)										
			Medium dense tan fine to medium sand w/fine to coarse gravel (fill)	23									
			Stiff reddish brown fine sandy clay w/fine to coarse gravel and trace crushed stone (fill)	37									
5			Dense tan, reddish tan and reddish brown clayey fine to coarse sand w/some fine gravel - more sandy below 4 ft	50/9"									26
			Dense reddish brown clayey fine sand w/fine to coarse gravel - water at 6.5 ft	36									19
10			Dense brownish yellow and reddish brown fine to coarse sand, slightly clayey w/some fine to coarse gravel, moist	50/9"									
15			Moderately hard tan and dark gray weathered shale w/silty clay seams and medium close sandstone partings and seams	50/4"									
				50/2"									
20													
25													
COMPLETION DEPTH: 19.0 ft				DEPTH TO WATER				DATE: 7/22/2015					
DATE: 7-22-15				IN BORING: 6.5 ft									

LGBNEW 15-019 WALL-GG.GPJ 5-6-16



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

LOG OF BORING NO. W18

CA0601: I-30 Widening - Wall GG
Benton, Arkansas

TYPE: Auger

LOCATION: Approx Sta 510+25, 100 ft Rt

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WT LB/CU FT	COHESION, TON/SQ FT							- No. 200 %
						0.2	0.4	0.6	0.8	1.0	1.2	1.4	
			SURF. EL: 348±			PLASTIC LIMIT +			WATER CONTENT ●			LIQUID LIMIT +	
						10	20	30	40	50	60	70	
			5 inches: Crushed Stone Base										
			Very stiff reddish brown fine sandy clay w/some medium to coarse sand and fine to coarse gravel (fill)	32		●							
			Dense brownish yellow and reddish brown clayey fine to medium sand w/some fine to coarse gravel	47		●	+	+					21
			- more gravel below 4 ft	43		●							
5			- water at 6.5 ft	37		●							
				16		●			-NON-PLASTIC-				10
10			Medium dense brownish yellow, gray, reddish tan and tan fine sand, slightly silty w/friable sandstone seams and layers and some shale fragments and occasional sandy clay pockets (completely weathered sandstone)										
			Moderately hard maroon and dark gray highly weathered shale w/some weathered fine-grained sandstone seams and occasional silty clay seams and layers	50/5"		●							
15			- auger refusal at 15 ft	50/5"		●							
20													
25													

COMPLETION DEPTH: 15.0 ft
DATE: 7-22-15

DEPTH TO WATER
IN BORING: 6.5 ft

DATE: 7/22/2015

LGBNEW 15-019 WALL-GG.GPJ 5-6-16

ATTACHMENT 11

SUMMARY of CLASSIFICATION TEST RESULTS

PROJECT: CA0601 - Hwy 70 - Sevier St. (Widening) (S)

LOCATION: Saline County, AR

JOB NUMBER: 15-019

BORING NO.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	ATTERBERG LIMITS			SIEVE ANALYSIS								UNIFIED CLASS.	AASHTO CLASS.
			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PERCENT PASSING									
						2 in.	1 in.	3/4 in.	3/8 in.	#4	#10	#40	#200		
Wall AA															
W1	2.5-3.5	11	32	21	11	---	---	---	---	---	---	---	---	SHALE	
W2	2.5-3.5	11	40	22	18	---	---	---	---	---	---	---	37	GC	A-6
W2	6.5-7	11	28	19	9	---	---	---	---	---	---	---	---	SHALE	
W3	0.5-1.5	12	34	21	13	100	100	87	71	60	48	37	31	GC	A-2-6
W3	9-10	13	37	19	18	---	---	---	---	---	---	---	41	GC	A-6
W4	2.5-3.5	14	35	21	14	---	---	---	---	---	---	---	20	GC	A-2-6
W5	2.5-3.5	24	37	24	13	100	100	100	89	81	70	61	54	CL	A-6
W5	6.5-7.5	16	28	21	7	---	---	---	---	---	---	---	56	CL-ML	A-4
W6	4.5-5.5	18	45	26	19	---	---	---	---	---	---	---	68	CL	A-7-6
W7	0.5-1.5	12	27	18	9	---	---	---	---	---	---	---	30	GC	A-2-4
W7	2.5-3.5	9	27	19	8	---	---	---	---	---	---	---	---	SHALE	

SUMMARY of CLASSIFICATION TEST RESULTS

PROJECT: CA0601 - Hwy 70 - Sevier St. (Widening) (S)

LOCATION: Saline County, AR

JOB NUMBER: 15-019

BORING NO.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	ATTERBERG LIMITS			SIEVE ANALYSIS								UNIFIED CLASS.	AASHTO CLASS.
			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PERCENT PASSING									
						2 in.	1 in.	3/4 in.	3/8 in.	#4	#10	#40	#200		
Wall BB															
W8	0.5-1.5	7	18	16	2	---	---	---	---	---	---	---	16	SM	A-2-4
W8	4.5-5.5	48	94	28	66	---	---	---	---	---	---	---	100	CH	A-7-6
W9	2.5-3.5	48	97	31	66	---	---	---	---	---	---	---	100	CH	A-7-5
W10	4.5-5.5	49	105	34	71	---	---	---	---	---	---	---	98	CH	A-7-5
W11	1-2	31	55	20	35	---	---	---	---	---	---	---	67	CH	A-7-6
W11	9-10	35	90	23	67	---	---	---	---	---	---	---	88	CH	A-7-6
W11	14-15	25	- Non Plastic -			---	---	---	---	---	---	---	37	SM	A-4
W12	1.1-2	40	71	23	48	---	---	---	---	---	---	---	89	CH	A-7-6
W12	9-10	36	68	20	48	---	---	---	---	---	---	---	82	CH	A-7-6
W12	14-15	---	42	20	22	---	---	---	---	---	---	---	---	CL	A-7-6
W13	2.5-3.5	27	50	18	32	---	---	---	---	---	---	---	83	CH	A-7-6
W13	9-10	50	112	33	79	---	---	---	---	---	---	---	100	CH	A-7-5

SUMMARY of CLASSIFICATION TEST RESULTS

PROJECT: CA0601 - Hwy 70 - Sevier St. (Widening) (S)

LOCATION: Saline County, AR

JOB NUMBER: 15-019

BORING NO.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	ATTERBERG LIMITS			SIEVE ANALYSIS								UNIFIED CLASS.	AASHTO CLASS.
			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PERCENT PASSING									
						2 in.	1 in.	3/4 in.	3/8 in.	#4	#10	#40	#200		
Wall CC															
W14	2.5-3.5	21	43	19	24	---	---	---	---	---	---	---	58	CL	A-7-6
W14	6.5-7.5	45	99	28	71	---	---	---	---	---	---	---	93	CH	A-7-6
W15	4.5-5.5	39	68	20	48	---	---	---	---	---	---	---	89	CH	A-7-6
W15	14-15	23	41	15	26	---	---	---	---	---	---	---	68	CL	A-7-6
W16	2.5-3.5	17	37	20	17	---	---	---	---	---	---	---	46	GC	A-6
W16	9-10	36	66	25	41	---	---	---	---	---	---	---	83	CH	A-7-6
W16	19-20	18	40	23	17	---	---	---	---	---	---	---	---	SHALE	
Wall DD															
W21	2.5-3.5	18	34	16	18	---	---	---	---	---	---	---	40	GC	A-6
W21	6.5-7.5	23	40	23	17	---	---	---	---	---	---	---	54	CL	A-6
W22	4.5-5.5	38	91	23	68	---	---	---	---	---	---	---	91	CH	A-7-6
W23	4.5-5.5	34	58	22	36	---	---	---	---	---	---	---	94	CH	A-7-6
W24	4.5-5.5	35	65	20	45	---	---	---	---	---	---	---	83	CH	A-7-6

SUMMARY of CLASSIFICATION TEST RESULTS

PROJECT: CA0601 - Hwy 70 - Sevier St. (Widening) (S)

LOCATION: Saline County, AR

JOB NUMBER: 15-019

BORING NO.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	ATTERBERG LIMITS			SIEVE ANALYSIS								UNIFIED CLASS.	AASHTO CLASS.
			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PERCENT PASSING									
						2 in.	1 in.	3/4 in.	3/8 in.	#4	#10	#40	#200		
Wall DD (continued)															
W25	2.5-3.5	14	40	19	21	---	---	---	---	---	---	---	71	CL	A-6
W25	4.5-5.5	47	99	29	70	---	---	---	---	---	---	---	96	CH	A-7-6
W25	9-10	47	90	26	64	---	---	---	---	---	---	---	90	CH	A-7-6
W26	2.5-3.5	13	34	24	10	---	---	---	---	---	---	---	28	GM	A-2-4
W26	6.5-7.5	45	113	28	85	---	---	---	---	---	---	---	94	CH	A-7-6
W26	14-15	18	50	16	34	---	---	---	---	---	---	---	63	CH	A-7-6
W26B	6.5-7.5	30	63	22	41	---	---	---	---	---	---	---	86	CH	A-7-6
W26B	13.5-14	14	---	---	---	100	100	100	100	97	88	62	27	SM	A-2-4
W26B	19-20	21	35	27	8	---	---	---	---	---	---	---	45	SM	A-4
W26B	23.5-24.5	21	37	28	9	---	---	---	---	---	---	---	---	SHALE	
Wall EE															
W27	2.5-3.5	6	32	16	16	---	---	---	---	---	---	---	---	SHALE	
S2	4.5-5.5	20	42	21	21	---	---	---	---	---	---	---	49	SC	A-6
S2	9-10	14	40	21	19	---	---	---	---	---	---	---	30	GC	A-2-6
S3	6.5-7.5	26	35	19	16	---	---	---	---	---	---	---	80	CL	A-6
S3	19-20	18	31	18	13	---	---	---	---	---	---	---	37	GC	A-6
R17	2.5-3.5	20	40	19	21	100	100	100	100	95	92	88	81	CL	A-6

SUMMARY of CLASSIFICATION TEST RESULTS

PROJECT: CA0601 - Hwy 70 - Sevier St. (Widening) (S)

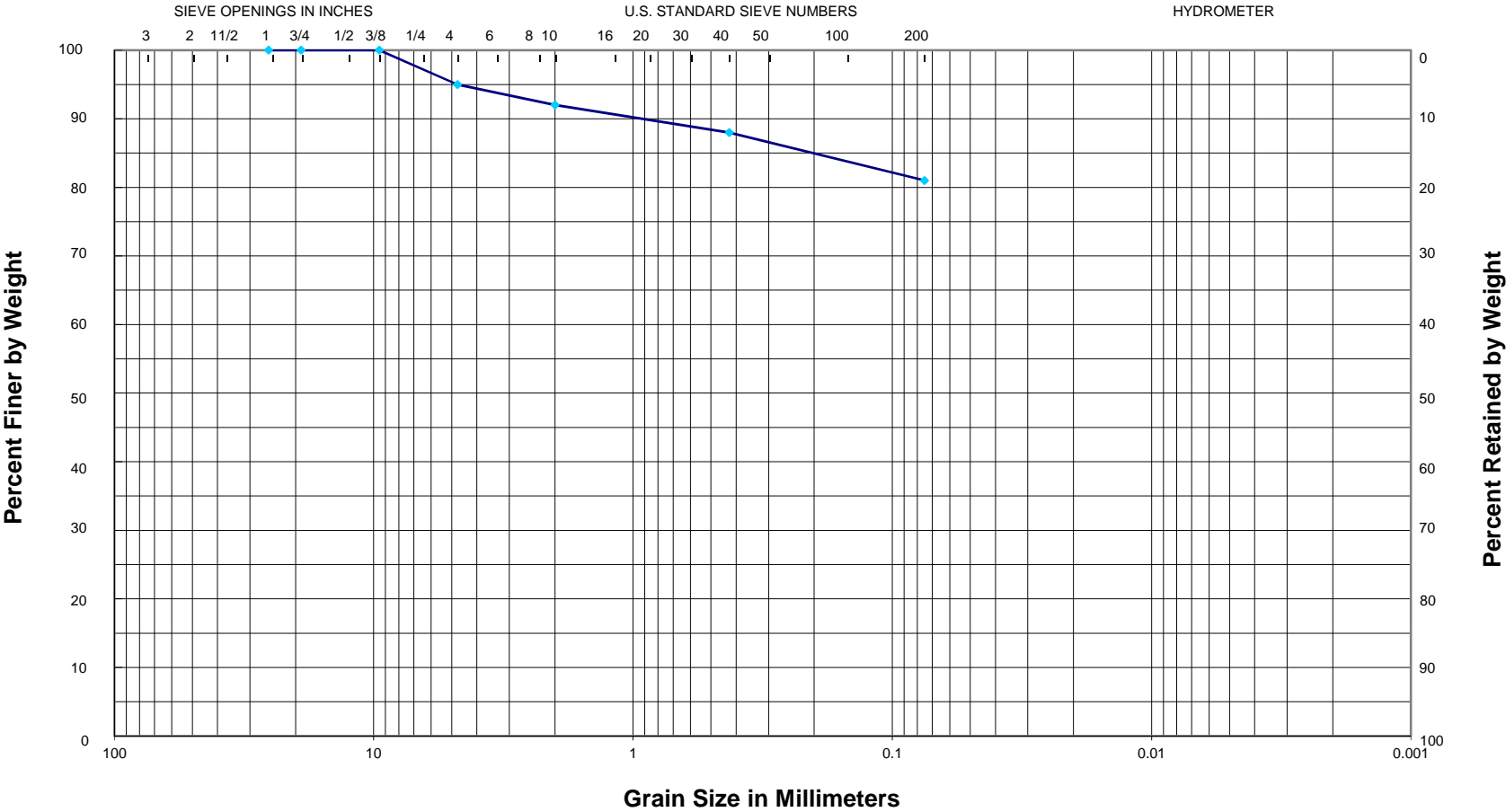
LOCATION: Saline County, AR

JOB NUMBER: 15-019

BORING NO.	SAMPLE DEPTH (ft)	WATER CONTENT (%)	ATTERBERG LIMITS			SIEVE ANALYSIS								UNIFIED CLASS.	AASHTO CLASS.
			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PERCENT PASSING									
						2 in.	1 in.	3/4 in.	3/8 in.	#4	#10	#40	#200		
Wall FF															
W19	2-2.9	7	36	18	18	100	100	100	61	45	36	23	17	GC	A-2-6
W20	4.5-5.5	10	30	18	12	100	100	100	85	74	63	41	28	SC	A-2-6
Wall GG															
W17	4.5-5.5	12	42	21	21	100	100	100	95	75	53	35	26	SC	A-2-7
W17	6.5-7.5	13	23	16	7	---	---	---	---	---	---	---	19	SM-SC	A-2-4
W18	2.5-3.5	11	36	19	17	100	100	100	96	70	49	31	21	SC	A-2-6
W18	9-10	11	- Non Plastic -			---	---	---	---	---	---	---	10	SP-SM	A-2-4

15-019

GRAIN SIZE CURVE

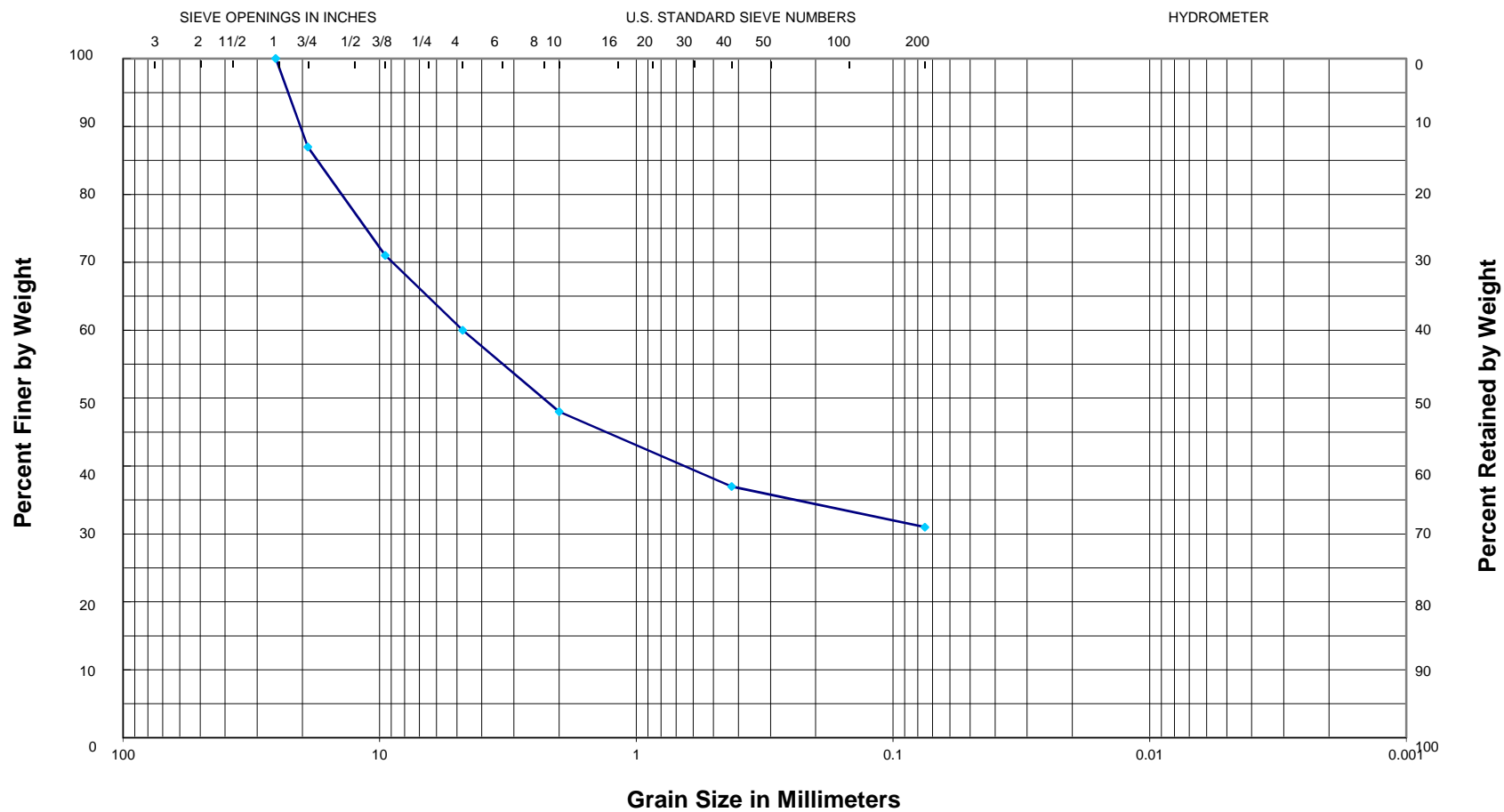


GRAVEL		SAND			SILT	OR	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE			

Sample: R17, 2.5 - 3.5 ft; LL = 40; PL = 19; PI = 21
Description: Gray, tan and reddish tan clay, slightly silty with occasional fine sand partings and some shale and quartz fragments
USCS = CL AASHTO = A-6

15-019

GRAIN SIZE CURVE



GRAVEL		SAND			SILT	OR	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE			

Sample: W3, 0.5 - 1.5 ft; LL = 34; PL = 21; PI = 13

Description: Gray, tan and reddish tan silty clay with shale fragments

USCS = GC AASHTO = A-2-6

15-019

GRAIN SIZE CURVE



GRAVEL		SAND			SILT	OR	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE			

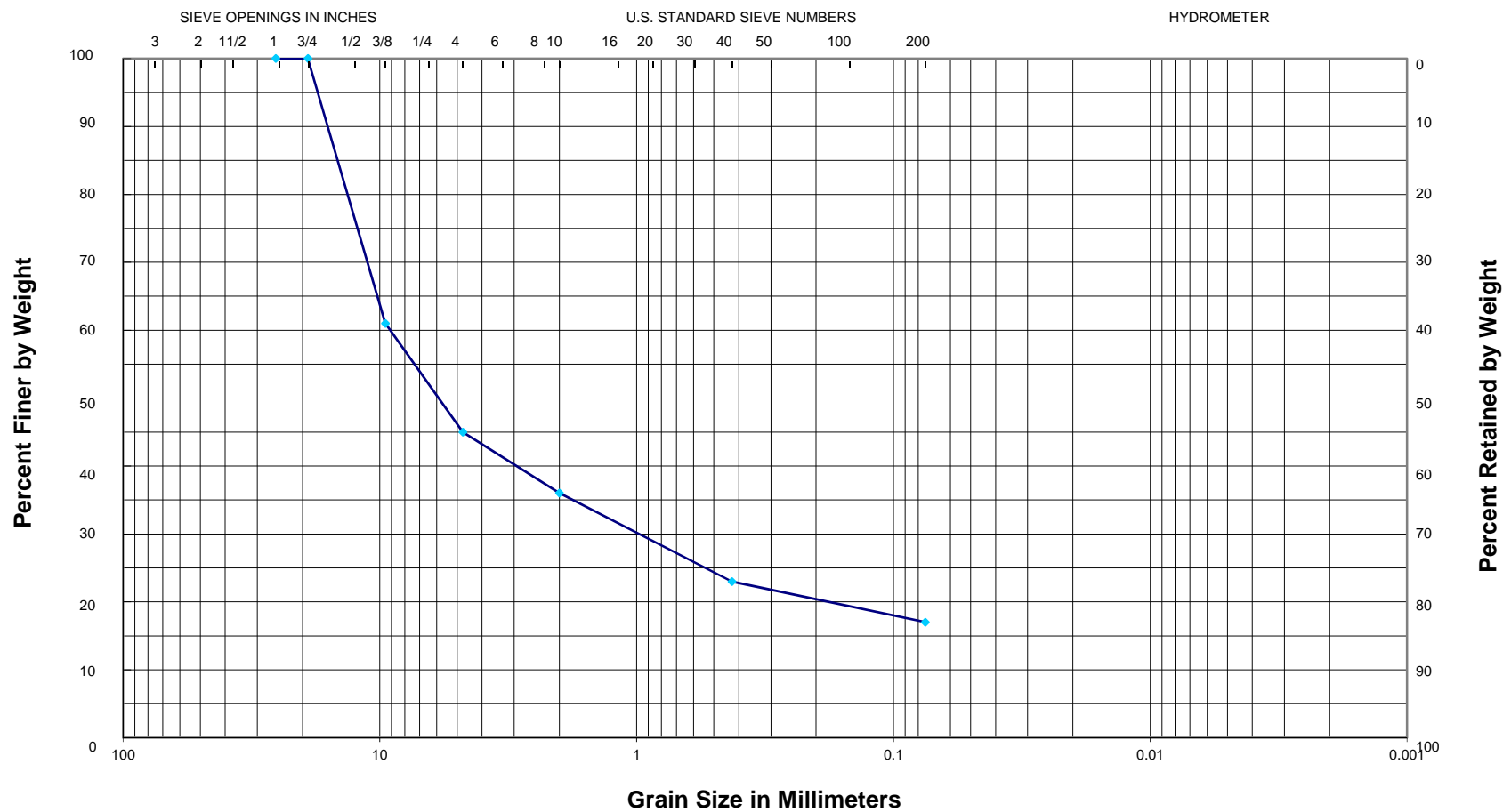
Sample: W5, 2.5 - 3.5 ft; LL = 37; PL = 24; PI = 13

Description: Gray, tan and reddish tan silty clay with shale fragments and trace fine to coarse gravel and occasional fine sandy clay pockets and clay pockets and seams

USCS = CL AASHTO = A-6

15-019

GRAIN SIZE CURVE

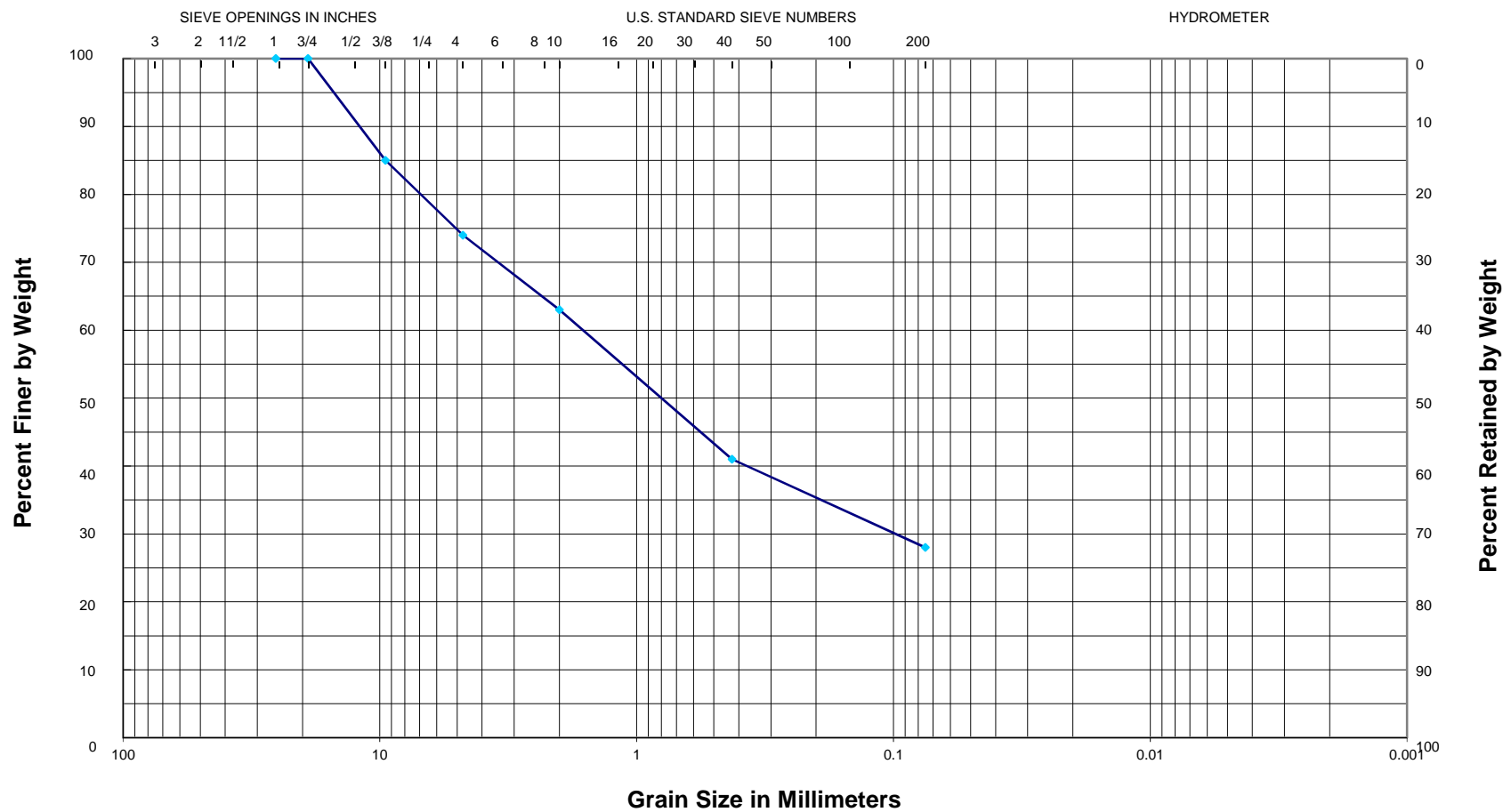


GRAVEL		SAND			SILT	OR	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE			

Sample: W19, 2 - 2.9 ft; LL = 36; PL = 18; PI = 18
 Description: Reddish brown clayey fine to coarse gravel, sandy
USCS = GC AASHTO = A-2-6

15-019

GRAIN SIZE CURVE



GRAVEL		SAND			SILT	OR	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE			

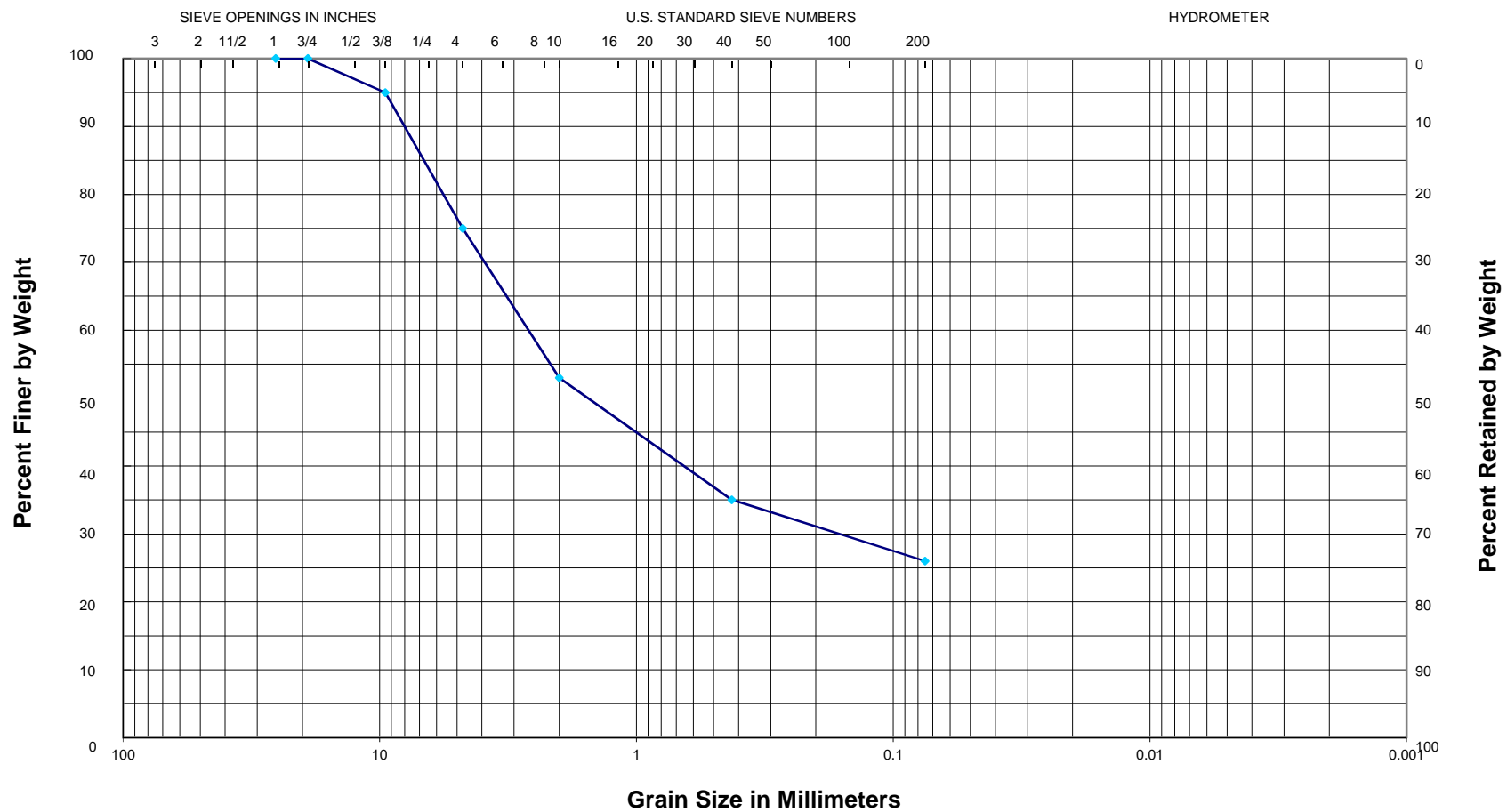
Sample: W20, 4.5 - 5.5 ft; LL = 30; PL = 18; PI = 12

Description: Reddish brown clayey fine to medium sand with some fine to coarse gravel and fine sandy clay pockets

USCS = SC AASHTO = A-2-6

15-019

GRAIN SIZE CURVE



GRAVEL		SAND			SILT	OR	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE			

Sample: W17, 4.5 - 5.5 ft; LL = 42; PL = 21; PI = 21

Description: Reddish tan and reddish brown clayey fine to coarse sand with some fine to coarse gravel

USCS = SC AASHTO = A-2-7

15-019

GRAIN SIZE CURVE



GRAVEL		SAND			SILT	OR	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE			

Sample: W18, 2.5-3.5 ft; LL = 36; PL = 19; PI = 17

Description: Bownish yellow and reddish brown clayey fine to medium sand with some fine to coarse gravel

USCS = SC AASHTO = A-2-6

ATTACHMENT 12

Summary of MSE Wall Recommendations
 PROJECT: AHTD JOB CA0601: I-30 WIDENING (S)
 LOCATION: Saline County, Arkansas
 GHBW JOB NO.: 15-019

Wall	Location	Wall Type	Wall Length, ft	Approx Wall Height, ft	Relevant Borings	Nominal unit bearing resistance, ksf	Estimated reinforcing strap length, ft	Estimated undercut requirements, ft	Bearing Stratum	Nominal Sliding Resistance (Tan δ)	Comments
Wall AA	Sta 6+25 to Sta 8+25	MSE	875	5 to 13	W6	10	8	Minimal	Highly weathered shale	0.45	
Wall AA	Sta 8+25 to Sta 11+20	MSE	875	13 to 15	W5, W4	9.3	0.7H	6	Stiff silty clay	0.35	SM-1 for all fill and backfill
Wall AA	Sta 11+20 to Sta 12+80	MSE	875	11 to 15	W3	9.3	0.7H	7	Very stiff silty clay	0.35	Backfill undercut with SM-1
Wall AA	Sta 12+80 to Sta 15+00	MSE	875	5 to 11	W2, W1	10	8	Minimal	Stiff silty clay	0.32	
Wall DD	Sta 1+79 to Sta 3+50	MSE	±1090	7 to 14	W25, W26	9.3	0.7H, 8 minimum	10	Soft clay and weathered shale	0.35	Backfill undercut with SM-1
Wall DD	Sta 1+79 to Sta 3+50	MSE	±1090	7 to 14	W25, W26	7	0.7H, 8 minimum	RAP	Soft clay and weathered shale	0.5	Rammed aggregate pier alternative
Wall DD	Sta 3+50 to Sta 5+50	MSE	±1090	14 to 32	W26A, W26B	8.1	0.7H	Minimal	Stiff clay	0.32	
Wall DD	Sta 5+50 to Sta 8+20	MSE	±1090	19 to 25	W21	9.3	0.7H	5	Stiff fine sandy clay	0.35	Backfill undercut with SM-1
Wall DD	Sta 8+20 to Sta 10+00	MSE	±1090	12 to 19	W22	9.3	0.7H	3	Stiff fine sandy clay	0.35	Backfill undercut with SM-1
Wall DD	Sta 10+00 to Sta 11+30	MSE	±1090	8 to 12	W23	9.3	8	4	Stiff silty clay	0.35	Backfill undercut with SM-1
Wall DD	Sta 11+30 to Sta 12+67	MSE	±1090	4 to 8	W24	9.3	8	2	Stiff fine sandy clay	0.35	Backfill undercut with SM-1

Wall	Location	Wall Type	Wall Length, ft	Approx Wall Height, ft	Relevant Borings	Nominal unit bearing resistance, ksf	Estimated reinforcing strap length, ft	Estimated undercut requirements, ft	Bearing Stratum	Nominal Sliding Resistance (Tan δ)	Comments
Wall EE	Sta 0+33 to Sta 0+78	MSE	±540	2 to 11	W27	11	8	Minimal	Very stiff silty clay	0.4	
Wall EE	Sta 0+78 to Sta 1+10	MSE	±540	11 to 18	W27	11	0.7H	Minimal	Very stiff silty clay	0.4	
Wall EE	Sta 1+10 to Sta 4+85	MSE	±540	13 to 21	S2, S3, R17	9.3	0.7H	6	Stiff to very stiff silty clay	0.35	SM-1 for all fill and undercut backfill
Wall EE	Sta 4+85 to Sta 5+71	MSE	±540	2 to 13	R17	9.3	8	6	Stiff silty clay	0.35	SM-1 for all fill and undercut backfill
Wall FF	Sta 0+34 to Sta 0+73	MSE	±165	2 to 13	W19	20	8	Minimal	Dense clayey fine gravel	0.45	
Wall FF	Sta 0+73 to Sta 1+62	MSE	±165	13 to 17	W19, W20	20	0.7H	Minimal	Dense clayey fine gravel and dense clayey fine to medium sand	0.4	
Wall FF	Sta 1+62 to Sta 1+99	MSE	±165	2 to 13	W20	17	8	Minimal	Dense clayey fine to medium sand	0.4	
Wall GG	Sta 0+34 to Sta 0+77	MSE	±170	2 to 12	W18	19	8	Minimal	Dense clayey fine to medium sand	0.4	
Wall GG	Sta 0+77 to Sta 1+65	MSE	±170	11 to 17	W17, W18	19	0.7H	Minimal	Dense clayey fine to coarse sand	0.4	
Wall GG	Sta 1+65 to Sta 2+00	MSE	±170	2 to 11	W17	19	8	Minimal	Dense clayey fine to coarse sand	0.4	

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. Undercuts required to develop suitable bearing should be backfilled with selected material (AHTD Standard Specifications Section 302, SM-1), or an approved alternate. Undercuts should extend at least 5 ft outside the reinforced zone to the extent possible.

ATTACHMENT 13

Summary of Soil Nail Wall Recommendations

PROJECT: AHTD JOB CA0601: I-30 WIDENING (S)

LOCATION: Saline County, Arkansas

GHBW JOB NO.: 15-019

Wall	Location	Wall Type	Wall Length, ft	Approx Wall Height, ft	Relevant Borings	Nominal unit bearing resistance, ksf	Bearing Stratum	Preliminary Anchor Length, ft	Preliminary Anchor Spacing, ft
Wall BB	Sta 5+20 to Sta 6+70	Soil nail wall	940	6 to 11	W8	11	Stiff clay	20	4Hx4V
Wall BB	Sta 6+70 to Sta 9+70	Soil nail wall	940	11 to 14	W9, W10	11	Stiff to very stiff silty clay and clay	20	3Hx4V
Wall BB	Sta 9+70 to Sta 11+00	Soil nail wall	940	9 to 12	W11	12	Very stiff clay	20	4Hx4V
Wall BB	Sta 11+00 to Sta 12+70	Soil nail wall	940	8 to 10	W12	4.5	Firm clay	20	3Hx4V
Wall BB	Sta 12+70 to Sta 14+60	Soil nail wall	940	6 to 12	W13	10	Stiff clay	20	4Hx4V
Wall CC	Sta 1+00 to Sta 2+49	Soil nail wall	640	6 to 13	W14	15	Weathered shale	20	4Hx4V
Wall CC	Sta 2+49 to Sta 3+90	Soil nail wall	640	13 to 19	W14	15	Weathered shale	28	4Hx4V
Wall CC	Sta 3+90 to Sta 6+15	Soil nail wall	640	19 to 22	W15, W16	15	Very stiff silty clay and weathered shale	31	3Hx4V
Wall CC	Sta 6+15 to Sta 6+63	Soil nail wall	640	12 to 19	W16	15	Very stiff silty clay and weathered shale	28	4Hx4V
Wall CC	Sta 6+63 to Sta 7+40	Soil nail wall	640	2 to 12	W26B	15	Very stiff silty clay and weathered shale	20	4Hx4V

Note: Anchor length is an estimate only. The Designer must select the length for use in final design.

ATTACHMENT 14

SOIL NAIL WALL

ARKANSAS HIGHWAY AND TRANSPORTATION DEPARTMENT

SPECIAL PROVISION

JOB NO. CA0601

SOIL NAIL WALL

DESCRIPTION: This work consists of designing and constructing permanent soil nail retaining wall at the location and elevation as shown on the plans. The Contractor shall furnish all labor, plans, drawings, design calculations and all other material and equipment required to design and construct the soil nail wall as shown on the plans and as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The work shall include excavating in staged lifts in accordance with the approved Contractor's plan; detailing the drilling of the soil nail drill holes to the diameter and length required to develop the specified capacity; grouting the nails; providing and installing the specified drainage features; providing and installing bearing plates, washers, nuts, and other required miscellaneous materials; and constructing the Pneumatically Placed Concrete (Shotcrete) temporary facing and constructing the final structural facing.

PREQUALIFICATION OF SOIL NAIL WALL CONTRACTOR: The Contractor or subcontractor responsible for the work covered under this provision, the Soil nail wall contractor, must have a minimum of five (5) years experience in soil nail installation including at least five (5) projects similar in nature and scope to this project and shall provide satisfactory evidence of experience. A brief description of each project including the location, start and completion dates, and a reference shall be included for each project listed. As a minimum, the reference shall include an individual's name, affiliation with the project, and current phone number. Also, the Engineer responsible for designing the soil nail wall must have a minimum of five (5) years experience in soil nail design including at least five (5) projects similar in nature and scope to this project and shall provide satisfactory evidence of experience. The Engineer must be licensed in the state of Arkansas as Professional Engineer.

In addition, the onsite supervisors for both the soil nail and shotcrete installation, drill rig operators, shotcrete nozzle operators and testing supervisors assigned to this project by the Soil nail wall contractor must have experience in that position on a minimum of three (3) projects within the last three (3) years which are similar in nature to this project. The personnel list shall contain a summary of each individual's experience and contain enough information for the Engineer to assess the individual's qualifications. Requirements for technician certification and laboratory qualifications need to be satisfied according to the Department's Manual of Field Sampling and Testing Procedures.

SOIL NAIL WALL

This information shall be submitted 60 calendar days prior to start of any soil nail construction, and the Engineer shall approve or reject the Soil nail wall contractor and personnel list within 15 calendar days of receipt of the complete submittal. All costs associated with incomplete or unacceptable submittals shall be borne by the Contractor, and no adjustment in Contract Time shall result. Any changes to previously approved subcontractors or personnel must be in writing and shall include the required information for verification of qualifications. The Engineer may suspend work if the Contractor utilizes non-approved personnel in the listed positions. All costs associated with the uses of non-approved personnel shall be borne by the Contractor, and no adjustment in Contract Time shall result from the suspension.

SOIL NAIL WALL DESIGN REQUIREMENTS

Design the soil nail walls including the final structural facing using the Allowable Stress Design (ASD) method, also known as Service Load Method (SLD), as outlined in FHWA Geotechnical Engineering Circular No. 7 "Soil Nail Walls". Provide minimum recommended factor of safety as listed in section 5.9 and Class I corrosion protection requirements according to the Appendix C of the circular. Also list or show the design shear strength parameters, Seismic design coefficient, type of wall facing, easements, and right-of-ways on the working drawings.

SUBMITTALS:

- A. The Contractor is responsible for providing the necessary geotechnical investigation if available geotechnical information is not adequate for design. The investigation shall provide sampling and testing information for design requirements.
- B. The Contractor is responsible for providing the necessary survey and alignment control during the excavation for each lift, locating drill holes and verifying limits of wall installation. Contractor shall submit complete design calculations and working drawings to the Engineer for review and approval at least 60 calendar days before starting soil nail work. Include all details, dimensions, quantities, ground profiles and cross-sections necessary to construct the wall. Verify the limits of the wall and ground survey data before preparing the drawings. The drawings and calculations shall be signed and sealed by a Professional Engineer registered in the State of Arkansas. The submittal shall include the following:
 - 1. The start date and proposed detailed wall construction sequence.
 - 2. Soil/rock design shear strength parameters and external surcharge loads used in the design.
 - 3. Corrosion protections.
 - 4. Drilling and grouting methods and equipment, including the drill hole diameter, soil nail length, proposed to meet the performance requirements specified herein and any variation of these along the wall alignment. Include casing methods if their use is anticipated.

SOIL NAIL WALL

5. Nail grout mix design, including compressive strength test results (per AASHTO T106/ASTM C109) supplied by a qualified independent testing lab verifying the specified minimum 3-day and 28-day grout compressive strengths. Previous test results for the same grout mix completed within one year of the start of grouting may be submitted for verification of the required compressive strengths.
 6. Nail grout placement procedures and equipment.
 7. Soil nail testing methods and equipment setup.
 8. Identification number and certified calibration records for each test jack and pressure gauge and load cell to be used. Jack and pressure gauge shall be calibrated as a unit. Calibration records shall include the date tested, the device identification number, and the calibration test results and shall be certified for an accuracy of at least 2 percent of the applied certification loads by a qualified independent testing laboratory within 90 days prior to submittal.
 9. Design calculations, detail drawings and quantities for final structural facing.
 10. Manufacturer Certificates of Compliance for the soil nail ultimate strength, nail bar steel, nuts, bolts, washers, Portland cement, centralizers, bearing plates, epoxy coating, encapsulation and any other materials used in the soil nail wall.
 11. Description of proposed equipment for mixing and applying shotcrete. Include the manufacturer instructions, recommendations, literature, performance, and test data.
 12. Proposed shotcrete mix design with mix proportions.
 13. Representative samples of shotcrete material, if requested by the Engineer.
 14. Results of all shotcrete preconstruction testing.
 15. Proposed method for applying and curing shotcrete.
 16. Other information necessary to verify compliance with ACI 506.2 for shotcrete installation
 17. Certification that shotcrete conforms to the standards specified herein.
 18. Fiber samples, if used, with supplier or manufacturer recommendations for use.
- C. The Engineer shall approve or reject the Contractor's working drawings within 30 working days after the submission. Approval of the Construction Plan does not relieve the Contractor of his responsibility for the successful completion of the work.

PRE-CONSTRUCTION MEETING: A pre-construction meeting shall be scheduled by the Engineer to be held after receipt of the complete soil nail working drawings and Soil nail wall contactor, the soil nail design engineer qualification submittals. The Engineer; the Contractor, including their Superintendent; the Soil nail wall contactor, including the listed onsite supervisor; and the engineer who designed the soil nails shall attend. Attendance is mandatory. All other parties to be involved with the design, fabrication, construction, stressing, or testing the soil nail components may be represented. The meeting will be conducted to clarify the requirements of the work, to coordinate the construction schedule and activities, and to identify the contractual relationships and the delineation of responsibilities amongst the parties involved.

SOIL NAIL WALL

FINAL SUBMITTAL: Within 30 days after completion of work covered by these provisions; the Contractor shall submit revised as-built drawings and information documenting all changes to the soil nails during construction. The revised soil nail schedule shall include the as-built soil nail length. All design calculations, material test results, material certifications, not previously submitted shall also be included.

MATERIALS: Materials used shall conform to designated specifications and be within their manufacturers' design range of use for this application. All materials should be from QPL list or are subject to acceptance/verification testing per the Manual of Field Sampling and Testing Procedures. Materials delivered to the site shall be new and without defect and shall be handled and stored in accordance with their manufacturers' recommendations and in a manner that no damage to the components due to movement or exposure to the elements occurs. Unacceptable, defective, or damaged materials shall be removed from the site and replaced with new at no additional cost to the Department.

A. Soil Nails

1. Nail Solid Bar. AASHTO M31/ASTM A615, Grade 420 (60) or 520 (75), ASTM A 722 for Grade 1035 (150). Deformed bar, continuous without splices or welds, new, straight, undamaged, bare, or epoxy-coated, or encapsulated as shown on the working drawings. Threaded, a minimum of 150 mm (6 in.) on the wall anchorage end, to allow proper attachment of bearing plate and nut. Threading may be continuous spiral deformed ribbing provided by the bar deformations (continuous thread bars) or may be cut into a reinforcing bar. If threads are cut into a reinforcing bar, provide the next-larger bar number designation from that is shown on the working drawings, at no additional cost. The use of self-drilling nail bars (also known as hollow, self-grouting or pressure-grouted nail bars) will not be allowed.
2. Bar Coupler. Bar couplers shall develop the full ultimate tensile strength of the bar as certified by the manufacturer.
3. Fusion Bonded Epoxy Coating. AASHTO M284, ASTM A 775. Minimum 0.4 mm (0.016 in.) thickness electrostatically applied. Bend test requirements are waived. Coating at the wall anchorage end of epoxy-coated bars may be omitted over the length provided for threading the nut against the bearing plate.
4. Encapsulation. Minimum 1-mm (0.04-in.) thick, corrugated, HDPE tube conforming to AASHTO M252 or corrugated PVC tube conforming to ASTM D1784, Class 13464-B.

B. Soil Nail Appurtenances

1. Centralizer. Manufactured from Schedule 40 PVC pipe or tube, steel, or other material not detrimental to the nail steel (wood shall not be used); securely attached to the nail bar; sized to position the nail bar within 25 mm (1 in.) of the center of the drill hole; sized to allow tremie pipe insertion to the bottom of the drill hole; and sized to allow grout to freely flow up the drill hole.
2. Nail Grout. Neat cement or sand/cement mixture with a minimum 3-day compressive strength of 10.5 MPa (1,500 psi) and a minimum 28-day compressive strength of 21 MPa (3,000 psi), per AASHTO T106/ASTM C109.

SOIL NAIL WALL

3. Fine Aggregate shall conform to the applicable requirements of Subsection 802.02b of the Standard Specifications for Highway Construction..
 4. Portland Cement shall conform to the applicable requirements of Subsection 802.02a of the Standard Specifications for Highway Construction.
 5. Admixtures shall conform the applicable requirements of Subsection 802.02e of the Standard Specifications for Highway Construction. Admixtures that control bleed, improve flowability, reduce water content, and retard set may be used in the grout subject to review and acceptance by the Engineer. Accelerators are not permitted. Expansive admixtures may only be used in grout used for filling sealed encapsulations. Admixtures shall be compatible with the grout and mixed in accordance with the manufacturer's recommendations.
 6. Film Protection. Polyethylene film per ASTM C171-03.
- C. Bearing Plates, Nuts, and Welded Stud Shear Connectors.
1. Bearing Plates. AASHTO M270/ASTM 709 Grade 36 Minimum.
 2. Nuts. ASTM A563, grade B, hexagonal, fitted with beveled washer or spherical seat to provide uniform bearing.
 3. Shear Connectors. Subsection 807.08 of the Standard Specifications.
- D. Welded Wire Fabric. AASHTO M55/ASTM A185 or A497.
- F. Geocomposite Sheet Drain. Refer to the Department's Qualified Product List (QPL) for approved drainage systems or approved equal.
- G. Underdrain and Perforated Pipe. Design according to Standard Specification Section 611 and Standard drawing no. PU-1.
- H. Shotcrete. Submit for approval, all materials, methods, and control procedures for this work according to this special provision.
- A. Use standard specification items for the following:
1. Air-entraining admixture (wet mix only)
 2. Chemical admixtures (wet mix only)
 3. Concrete coloring agents
 4. Curing material
 5. Hydraulic cement
 6. Pozzolans
 7. Reinforcing steel
- B. Shotcrete Aggregate
- Fine aggregate shall conform to the applicable sections of Standard Specification Section 802.02(b).
- I. Reinforcing Steel. Submit all order lists and bending diagrams, fabricate reinforcing steel, ship and protect material, place, fasten, and splice reinforcing steel according to Standard Specification Section 804.
- J. Structural Concrete. Design concrete mixture, store, handle, batch, and mix material and deliver concrete, provide quality control, and construct concrete facing according to Standard Specification Section 802. Use class "S" concrete for concrete facing with a 28 day compressive strength of 3500 psi.

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STORAGE AND HANDLING

Store and handle soil nail bars in a manner to avoid damage or corrosion. Replace bars exhibiting abrasions, cuts, welds, weld splatter, corrosion, or pitting. Repair or replace any bars exhibiting damage to encapsulation or epoxy coating. Repaired epoxy coating areas shall have a minimum 0.012-in. thick coating.

EXCAVATION

A. The height of exposed unsupported final excavation face cut shall not exceed the vertical nail spacing plus the required reinforcing lap or the short-term stand-up height of the ground, whichever is less. Complete excavation to the final wall excavation line and apply shotcrete in the same work shift, unless otherwise approved by the Engineer. Application of the shotcrete may be delayed up to 24 hours if the contractor can demonstrate that the delay will not adversely affect the excavation face stability.

B. Excavation of the next-lower lift shall not proceed until nail installation, reinforced shotcrete placement, attachment of bearing plates and nuts, and nail testing have been completed and accepted in the current lift. Nail grout and shotcrete shall have cured for at least 72 hours or attained at least their specified 3-day compressive strength before excavating the next underlying lift.

NAIL INSTALLATION

A. Provide nail length and drill hole diameter necessary to develop the load capacity to satisfy the acceptance criteria for the design load required, but not less than the lengths shown in the working drawings. Drill holes for the soil nails at the locations, elevations, orientations, and lengths shown on the working drawings. Select drilling equipment and methods suitable for the ground conditions and in accordance with the approved installation methods submitted by the Contractor. The use of drilling muds or other fluids to remove cuttings will not be allowed. If caving ground is encountered, use approved cased drilling methods to support the sides of the drill holes. Provide nail bars as shown in the working drawings. Provide centralizers sized to position the bar within 1 in. of the center of the drill hole. Position centralizers as shown on the Plans so that their maximum center-to-center spacing does not exceed 8 ft. Also locate centralizers within 1.5 ft from the top and bottom of the drill hole.

GROUTING

A. Grout the drill hole after installation of the nail bar and within 2 hours of completion of drilling. Inject the grout at the lowest point of each drill hole through a grout tube or casing. Keep the outlet end of the conduit delivering grout below the surface of the grout as the conduit is withdrawn to prevent the creation of voids. Completely fill the drill hole in one continuous operation. Cold joints in the grout column are not allowed except at the top of the test bond length of proof tested production nails.

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B. Test nail grout according to AASHTO T106/ASTM C109 at a frequency of one test per mix design and a minimum of one test for every 50 cy of grout placed. Provide grout cube test results to the Engineer within 24 hours of testing. Grout testing shall be conducted by a lab already preapproved by Materials division for conducting these types of testing.

NAIL TESTING

A. Perform both verification and proof testing of designated test nails. Perform verification tests on sacrificial test nails at locations shown on the working drawings. Perform proof tests on production nails at locations selected by the Engineer. Testing of any nail shall not be performed until the nail grout and shotcrete facing have cured for at least 72 hours or attained at least their specified 3-day compressive strength.

B. Testing equipment shall include 2 dial gauges, dial gauge support, jack and pressure gauge, electronic load cell, and a reaction frame. The testing setup and equipment shall need to be preapproved thru the submittal process. The pressure gauge shall be graduated in 75 psi increments or less. Measure the nail head movement with a minimum of 2 dial gauges capable of measuring to 0.001 in.

VERIFICATION TESTING OF SACRIFICIAL NAILS

A. Perform verification testing prior to installation of production nails to confirm the appropriateness of the Contractor's drilling and installation methods, and verify the required nail pullout resistance.

B. Verification test nails shall have both bonded and unbonded lengths. Along the unbonded length, the nail bar is not grouted. The unbonded length of the test nails shall be at least 3 ft. The bonded length of the soil nail during verification tests, LBVT, shall be at least 10 ft but not longer than a maximum length, LBVT max, such that the nail load does not exceed 90 percent of the nail bar tensile allowable load during the verification test. Therefore, the following requirements shall be met:

$$L_{BVT} \leq \begin{cases} 10\text{ft} \\ L_{BVT\text{max}} \end{cases}$$

The length $L_{BVT\text{max}}$ is defined as:

$$L_{BVT\text{max}} = \frac{C_{RT} * A_t * f_Y}{Q_{ALL} * FS_{Tver}}$$

where,

C_{RT} = Reduction coefficient. Use $C_{RT} = 0.9$ for Grade 60 and 75 bars.

If Grade 150 bars are allowed in the job, use $C_{RT} = 0.8$;

A_t = Nail bar cross-sectional area;

f_Y = Nail bar yield tensile strength;

Q_{ALL} = Allowable pullout resistance per unit length ($Q_{ALL} = Q_u/FS_P$), as specified in working drawings; and FS_{Tver} = Factor of safety against tensile failure during verification tests (use 2.5 or, preferably, 3).

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The maximum bonded length shall be preferably based on production nail maximum bar grade. Provide larger bar sizes, if required, to meet the 10-ft minimum test bonded length requirement at no additional cost.

The Design Test Load (DTL) shall be determined as follows:

$$DTL = LBVT * QALL$$

DTL shall be calculated based on as-built bonded lengths

C. Perform verification tests by incrementally loading the verification test nails to failure or a maximum test load of 300 percent of the DTL in accordance with the following loading schedule. Record the soil nail movements at each load increment.

Verification of Test Loading Schedule

The alignment load (AL) should be the minimum load required to align the testing

Load	Hold Time
0.05 DTL max.(AL)	1 minute
0.25 DTL	10 minutes
0.50 DTL	10 minutes
0.75 DTL	10 minutes
1.00 DTL	10 minutes
1.25 DTL	10 minutes
1.50 DTL (Creep Test)	60 minutes
1.75 DTL	10 minutes
2.00 DTL	10 minutes
2.50 DTL	10 minutes max.
3.0 DTL or Failure	10 minutes max.
0.05 DTL max. (AL)	1 minute (record permanent set)

apparatus and should not exceed 5 percent of the DTL. Dial gauges should be set to “zero” after the alignment load has been applied. Following application of the maximum load (3.0 DTL) reduce the load to the alignment load (0.05 DTL maximum) and record the permanent set.

D. Hold each load increment for at least 10 minutes. Monitor the verification test nail for creep at the 1.50 DTL load increment. Measure and record nail movements during the creep portion of the test in increments of 1 minute, 2, 3, 5, 6, 10, 20, 30, 50, and 60 minutes. Maintain the load during the creep test within 2 percent of the intended load by use of the load cell.

PROOF TESTING OF PRODUCTION NAILS

A. Perform successful proof testing on 5 percent of the production soil nails in each nail row or a minimum of 1 per row. The Engineer shall determine the locations and number of proof tests prior to nail installation in each row. Production proof test nails shall have

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both bonded and temporary unbonded lengths. The temporary unbonded length of the test nail shall be at least 3 ft. The bonded length of the soil nail during proof production tests, LBPT, shall be the least of 10 ft and a maximum length, LBPT max, such that the nail load does not exceed 90 percent of an allowable value of the nail bar tensile load during the proof production test. Therefore, the following requirements shall be met:

$$L_{BPT} \leq \begin{cases} 10\text{ft} \\ L_{BPT\text{max}} \end{cases}$$

The length $L_{BPT\text{max}}$ is defined as:

$$L_{BPT\text{max}} = \frac{C_R * A_t * f_Y}{Q_{ALL} * FS_{T\text{proof}}}$$

C_{RT} = Reduction coefficient. Use 0.9 for Grade 60 and 75 bars.

If Grade 150 bars are allowed in the job, use $C_{RT} = 0.8$;

A_t = Nail bar cross-sectional area;

f_Y = Nail bar yield tensile strength;

Q_{ALL} = Allowable pullout resistance per unit length ($Q_{ALL} = Q_u/FS_P$), as specified in working drawings; and

$FS_{T\text{proof}}$ = Factor of safety against tensile failure during proof production tests (use 1.5).

The maximum bonded length shall be based on production nail maximum bar grade. Production proof test nails shorter than 12 ft in length may be constructed with less than the minimum 10-ft bond length.

The Design Test Load (DTL) shall be determined as follows:

$$DTL = L_{BPT} * Q_{ALL}$$

DTL shall be calculated based on as-built bonded lengths.

B. Perform proof tests by incrementally loading the proof test nail to 150 percent of the DTL in accordance with the following loading schedule. Record the soil nail movements at each load increment.

Proof Test Loading Schedule.

The alignment load (AL) should be the minimum load required to align the testing

Load	Hold Time
0.05 DTL max. (AL)	Until Movement Stabilizes
0.25 DTL	Until Movement Stabilizes
0.50 DTL	Until Movement Stabilizes
0.75 DTL	Until Movement Stabilizes
1.00 DTL	Until Movement Stabilizes
1.25 DTL	Until Movement Stabilizes
1.50 DTL (Max. Test Load)	Creep Test (see below)

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apparatus and should not exceed 5 percent of the DTL. Dial gauges should be set to “zero” after the alignment load has been applied.

C. The creep period shall start as soon as the maximum test load (1.50 DTL) is applied and the nail movement shall be measured and recorded at 1 minute, 2, 3, 5, 6, and 10 minutes. Where the nail movement between 1 minute and 10 minutes exceeds 0.04 in., maintain the maximum test load for an additional 50 minutes and record movements at 20 minutes, 30, 50, and 60 minutes. Maintain all load increments within 5 percent of the intended load.

TEST NAIL ACCEPTANCE CRITERIA

A. A test nail shall be considered acceptable when all of the following criteria are met:

1. For verification tests, the total creep movement is less than 0.08 in. between the 6- and 60-minute readings and the creep rate is linear or decreasing throughout the creep test load hold period.
2. For proof tests, the total creep movement is less than 0.04 in. during the 10-minute readings or the total creep movement is less than 2 mm 0.08 in. during the 60-minute readings and the creep rate is linear or decreasing throughout the creep test load hold period
3. For verification and proof tests, the total measured movement at the maximum test load exceeds 80 percent of the theoretical elastic elongation of the test nail unbonded length.
4. A pullout failure does not occur at 3.0 DTL under verification testing and 1.5 DTL test load under proof testing. Pullout failure is defined as the inability to further increase the test load while there is continued pullout movement of the test nail. Record the pullout failure load as part of the test data.

B. Maintaining stability of the temporary unbonded test length for subsequent grouting is the Contractor's responsibility. If the unbonded test length of production proof test nails cannot be satisfactorily grouted subsequent to testing; the proof test nail shall become sacrificial and shall be replaced with an additional production nail installed at no additional cost to the owner.

TEST NAIL REJECTION

If a test nail does not satisfy the acceptance criterion:

- 1 For verification test nails, the Engineer will evaluate the results of each verification test. Installation methods that do not satisfy the nail testing requirements shall be rejected. The Contractor shall propose alternative methods and install replacement verification test nails. Replacement test nails shall be installed and tested at no additional cost.
- 2 For proof test nails, the Engineer may require the Contractor to replace some or all of the installed production nails between a failed proof test nail and the adjacent

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passing proof test nail. Alternatively, the Engineer may require the installation and testing of additional proof test nails to verify that adjacent previously installed production nails have sufficient load carrying capacity. Installation and testing of additional proof test nails or installation of additional or modified nails as a result of proof test nail failure(s) will be at no additional cost.

WALL DRAINAGE NETWORK

Install and secure all elements of the wall drainage network as shown on the working drawings. The drainage network shall consist of installing geocomposite drain strips, PVC connection pipes, and wall footing drains as shown in the working drawing drawings.

Exclusive of the wall footing drains, all elements of the drainage network shall be installed prior to shotcreting.

1. Geocomposite Drain Strips. Install geocomposite drain strips centered between the columns of nails as shown on the Plans. The drain strips shall be at least 24 in. wide and placed with the geotextile side against the ground. Secure the strips to the excavation face and prevent shotcrete from contaminating the geotextile. Drain strips will be vertically continuous. Make splices with a 12 in. minimum overlap such that the flow of water is not impeded. Install drain plate and connector pipe at base of each strip. Repair damage to the geocomposite drain strip, which may interrupt the flow of water.
2. Footing Drains. Install footing drains at the bottom of each wall as shown on the working drawings. The drainage geotextile shall envelope the footing drain aggregate and pipe and conform to the dimensions of the trench. Overlap the drainage geotextile on top of the drainage aggregate as shown on the Plans. Replace or repair damaged or defective drainage geotextile.

SHOTCRETE FACING

A. Provide construction shotcrete facing in accordance with this special provision. Where shotcrete is used to complete the top ungrouted zone of the nail drill hole near the face, position the nozzle into the mouth of the drill hole to completely fill the void

- 1 Final Face Finish. Shotcrete finish shall be either an undisturbed gun finish as applied from the nozzle or a rod, broom, wood float, rubber float, steel trowel or rough screeded finish as shown on the working drawings.

- 2 Attachment of Nail Head Bearing Plate and Nut. Attach a bearing plate, washers, and nut to each nail head as shown on the working drawings. While the shotcrete construction facing is still plastic and before its initial set, uniformly seat the plate on the shotcrete by hand-wrench tightening the nut. Where uniform contact between the plate and the shotcrete cannot be provided, set the plate in a bed of grout. After grout has set for 24 hours, hand-wrench tighten the nut. Ensure bearing plates with headed studs are located within the tolerances shown on the working drawings.

- 3 Shotcrete Facing Tolerances. Construction tolerances for the shotcrete facing

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from plan location and plan dimensions are as follows:

Horizontal location of welded wire mesh; reinforcing bars, and headed studs:	0.4 in.
Location of headed studs on bearing plate:	¼ in.
Spacing between reinforcing bars:	1 in.
Reinforcing lap, from specified dimension:	1 in.
Complete thickness of shotcrete:	
If troweled or screeded:	0.6 in.
If left as shot:	1.2 in.
Planeness of finish face surface-gap under 3-m (10-ft) straightedge:	
If troweled or screeded:	0.6 in.
If left as shot:	1.2 in.
Nail head bearing plate deviation from parallel to wall face:	10 degrees

SHOTCRETE REINFORCING FIBERS

A. Contractor may elect to use reinforcing deformed steel or fibrillated polypropylene fibers conforming to ASTM C 1116. The use of reinforcing fibers shall be pre-approved by the Engineer.

SHOTCRETE CONSTRUCTION

GENERAL

- A. Conform to the following:
1. ACI 506R Guide to Shotcrete.
 2. ACI 506.1 State of the Art Report on Fiber Reinforced Shotcrete.
 3. ACI 506.2 Specifications for Proportioning Application of Shotcrete.
 4. AASHTO C 311 Method for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Concrete.
 5. Requirements for technician certification and laboratory qualifications are contained in the Department's Manual of Field Sampling and Testing Procedures.

SHOTCRETE EQUIPMENT

- A. Water Supply System. For dry mix, provide a water storage tank at the job site. Provide a positive displacement pump with a regulating valve that is accurately controlled to provide water in the pressures and volumes recommended by the delivery machine manufacturer.
- B. Mixing. Use equipment capable of handling and applying shotcrete containing the specified maximum size aggregate and admixtures. Provide an air hose and blowpipe to clear dust and rebound during shotcrete application.
- C. Air Supply System. Use an air supply system capable of supplying the delivery machine and hose with air at the pressures and volumes recommended by the machine manufacturer. Do not use air supply systems that deliver oil-contaminated air or are incapable of maintaining constant pressure.

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D. Delivery Machine. Use a delivery machine capable of supplying material to the delivery hose at a uniform rate. The ejection from the nozzle must adhere to the treated surface with minimum rebound and maximum density when the nozzle is held in the range of 3 to 6 ft from the target surface.

SHOTCRETE COMPOSITION (SHOTCRETE MIX DESIGN)

A. Design and produce shotcrete mixtures conforming to Table 1 for the type of shotcrete specified. Use the amount of water required to produce shotcrete of suitable strength, consistency, quality, and uniformity with the minimum amount of rebound. Use the same material types and sources as submitted with the mix design in the field trials and production work.

1. Fibers. If fibers are required, add them to the mix in the proportions recommended by the manufacturer.

2. Hydration stabilizing admixtures. Hydration stabilizing admixtures may be used to extend the allowable delivery time for shotcrete. Dosage is based on the time needed to delay the initial set of the shotcrete for delivery and discharge on the job. Design shall include discharge time limit in the dosage submittal. Dosage required to stabilize shotcrete shall be determined using job site material and field trial mixtures. The extended-set admixture shall control the hydration of all cement minerals and gypsum. The maximum allowable design discharge time is 3.50 hours.

3. If a hydration-stabilizing admixture is approved for use in the concrete mix, concrete shall be delivered and placed within the approved design discharge time limit. An approved and compatible hydration activator may be used at the discharge site to insure proper placement and testing.

4. Dosage and type of extended-set admixture shall be included with proposed mix design. When requested, the admixture manufacturer shall provide the service of a qualified person to assist in establishing the proper dose of extended-set admixture and make dosage adjustments required to meet changing job site conditions

Table 1: Composition of Shotcrete

Type of Shotcrete Process	Minimum Cement Content		Maximum W/C(1) Ratio	Air Content Range (%)	Minimum 28-Day Compressive Strength(3)	
	(kg/m ³)	(lb/cy ³)			(MPa)	(psi)
Wet	325	550	0.55	NA	28	150
Dry	325	550	0.50	NA	28	150
Wet (w/EA)	325	550	0.45	5 min	28	150
Dry (w/EA)	325	550	0.45	5 min.	28	150

Notes:

(1) W/C = Water/Cement (by weight).

(2) EA = Entrained Air.

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(3) According to AASHTO T 22.

SHOTCRETE PRECONSTRUCTION TESTING

Conduct preconstruction shotcrete field trials before starting shotcrete production. Allow the Engineer the opportunity to witness all phases of the preconstruction testing.

1. Field Trials: Construct wood forms at least 6-in. thick by 3 ft by 3 ft in size. Have each proposed nozzle operator make test panels on two vertical wood forms. Cure the test panels according to AASHTO T 23, without immersing the panels.
2. Coring: Drill six 3-in. diameter cores from each test panel according to AASHTO T 24. Trim the ends of the cores according to AASHTO T 24 to make cylinders at least 3-in. long.
3. Compressive Strength Testing: Soak the cylinders in water for 40 hours immediately before testing. Test three cylinders from each test panel three days after field trial and test the remaining three cylinders 28 days after the field trial. Perform tests according to AASHTO T 22. All specified strength requirements shall be satisfied before the shotcrete mix design will be considered for acceptance.
4. Mix Design Acceptance: The Engineer will accept or reject the shotcrete mix design based on the results of the preconstruction field trials and testing. Before approving any changes to a previously accepted mix design, the Engineer may require additional preconstruction testing at no additional cost to the agency.

SURFACE PREPARATION AND APPLICATION OF SHOTCRETE

A. Surface Preparation - Clean loose material, mud, rebound, and other foreign matter from all surfaces to receive shotcrete. Remove curing compound on previously placed shotcrete surfaces by sandblasting. Install approved depth gages to indicate the thickness of the shotcrete layers. Install depth gages on 6-ft centers longitudinally and transversely with no less than two gauges per increment of surface area to receive the shotcrete. Moisten all surfaces.

B. Weather Limitations - Place shotcrete when the ambient temperature is 41°F(5°C) or higher. Do not perform shotcrete operations during high winds and heavy rains.

C. Shotcrete Application

1. Do not apply shotcrete to frozen surfaces.
2. Use acceptable nozzle operators who have fabricated acceptable test panels.
3. Apply shotcrete within 45 minutes of adding cement to the mixture. Apply shotcrete at a mix temperature between 50°F (10°C) and 86°F (30°C).
4. Direct the shotcrete at right angles to the receiving surface except when shooting ground reinforcing bars. Apply shotcrete in a circular fashion to build up the required

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layer thickness. Apply shotcrete in a steady uninterrupted flow. If the flow becomes intermittent, direct the flow away from the work area until it becomes steady.

5. Make the surface of each shotcrete layer uniform and free of sags, drips, or runs.
6. Limit the layer thickness of each shotcrete application to 2 in. Thicker applications may be approved if the contractor can demonstrate that no sloughing or sagging is occurring. If additional thickness is required, broom or scarify the applied surface and allow the layer to harden. Dampen the surface before applying an additional layer.
7. Remove laitance, loose material, and rebound. Promptly remove rebound from the work area.
8. Taper construction joints to a thin edge over a distance of at least 1 ft. Wet the joint surface before placing additional shotcrete on the joint. Do not use square construction joint.

D. Production Summary - Prepare and submit a summary of shotcrete production application for each shift. Furnish the summary to the Engineer within 24 hours. Include the following information in the report:

1. Quantity and location of shotcrete applied including sketches.
2. Observations of success or problems of equipment operation, application, final product conditions, and any other relevant issues during production and application.
3. Description of placement equipment.
4. Batch number(s) if applicable.

SHOTCRETE QUALITY CONTROL RECORDS

A. Submit field quality control test reports within two working days of performing the tests. Include the following information in the reports:

1. Sample identification including mix design and test panel number and orientation.
2. Date and time of sample preparation including name of persons preparing samples, curing conditions and sample dimensions.
3. Date, time, and type of test.
4. Complete test results including load and deformation data during testing, sketch of sample before and after testing, and any unusual occurrences observed.
5. Names and signature of person performing the test.
6. Location of steel reinforcement, if used, covered by shotcrete.
7. Name of nozzle operator

SHOTCRETE PROTECTION AND CURING

A. Protect and cure the surface according to Standard Specification Section 802. Clear curing compound shall be used as an interim cure for intermediate shotcrete surfaces. Apply curing compound to the final exposed shotcrete surface according to Standard Specification Section 802.17. Protect and maintain shotcrete at a temperature above 41°F (5°C) until shotcrete has achieved a minimum strength of 750 psi.

SHOTCRETE ACCEPTANCE

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A. Material for concrete will be evaluated by visual inspection of the work, conformance testing and by certification for materials manufactured off-site. Compressive strength will be evaluated by conformance testing using Table 1 for specification limits. See Table 2 for minimum sampling and testing requirements and acceptance quality category.

Table 2: Sampling and Testing of Shotcrete.

Material or Product	Property or Characteristic	Category	Test Methods or Specifications	Frequency ⁽⁴⁾	Sampling Point
	Air content	–	AASHTO T 152	1 per load ⁽¹⁾	Truck, mixer or agitator ⁽²⁾
Shotcrete	Unit mass	–	AASHTO T 121	1 per load ⁽¹⁾	Truck, mixer or agitator ⁽²⁾
	Compressive strength	II	AASHTO T 22	1 set per 33 cy, but not less than 1 set each day ⁽³⁾	Production test panels ⁽³⁾

Notes:

(1) When continuous mixing is used sample every 10 cy.

(2) Sample according to AASHTO T 141.

(3) Prepare production test panels according to procedures listed in section shotcrete preconstruction testing. Obtain two 3-in. diameter core specimens from each panel according to AASHTO T 24. A single compressive strength test result is the average result from two 3-in. diameter core specimens from the same test panel tested according to AASHTO T 22 at 28 days.

(4) Engineer shall conduct verification testing at a rate of one (1) per four (4) performed by the Contractor or a minimum of one (1) per job.

BACKFILLING BEHIND WALL FACING UPPER CANTILEVER

A. Compact backfill within 3 ft behind the wall facing upper cantilever using light mechanical tampers.

B. Backfill shall be relatively free draining granular material meeting the minimum requirements of Selected Material Class SM-1 in Section 302 of the Standard Specifications for Highway Construction, edition 2003.

ACCEPTANCE

Material for the soil nail retaining wall will be accepted based on the manufacturer production certification and from quality control and acceptance sampling and testing results as well as verification testing results. Construction of the soil nail retaining wall will be accepted based on conformance with the plans, specifications and this special provision.

METHOD OF MEASUREMENT: Soil nail walls will be measured by the square foot of front surface area between two foot below the proposed ground at the face of the wall and the top of the wall.

BASIS OF PAYMENT: Soil nail walls completed, accepted and measured as provided above will be paid for at the contract unit price bid per square foot, which price shall

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include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, including design, preparing working drawings, testing, all concrete, reinforcing steel, pneumatically placed concrete (shotcrete), expansion and construction joints, wall drainage materials, drilling, nail reinforcement, grout, test nails, geotechnical investigation, pipe underdrains; for performing mix designs and quality control and acceptance sampling and testing; and for doing all the work involved in installing the soil nails, design and installing the final facing wall complete in place, as shown on the working drawings and as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

The Contractor shall comply with applicable Federal, State, and local laws governing safety in accordance with Subsection 107.01(b) in any and all excavation and/or shoring operations. Contractor has the option of using a cut slope and/or shoring to maintain stability of the cut. Any shoring, and/or additional excavation, and subsequent backfill beyond the vertical cut line behind the pneumatically placed concrete will not be paid separately.

Payment will be made under:

Pay Item**Pay Unit**

Soil Nail Wall

Square Foot

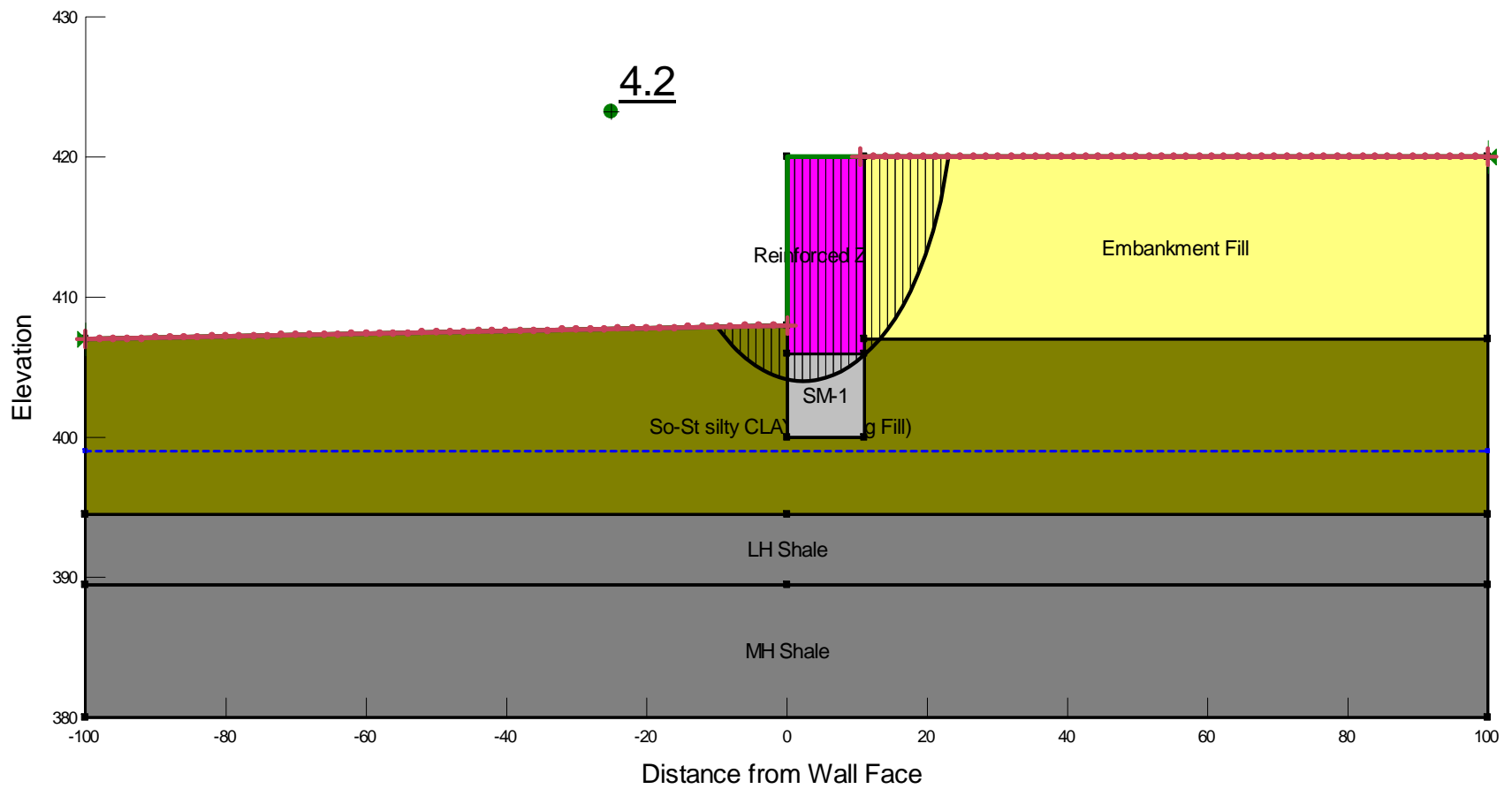
ATTACHMENT 15

Summary of Stability Analysis Results
MSE Wall AA @ Sta 11+20
AHTD Job No. CA 0601 – HWY 70 – Sevier St. (Widening)(S)

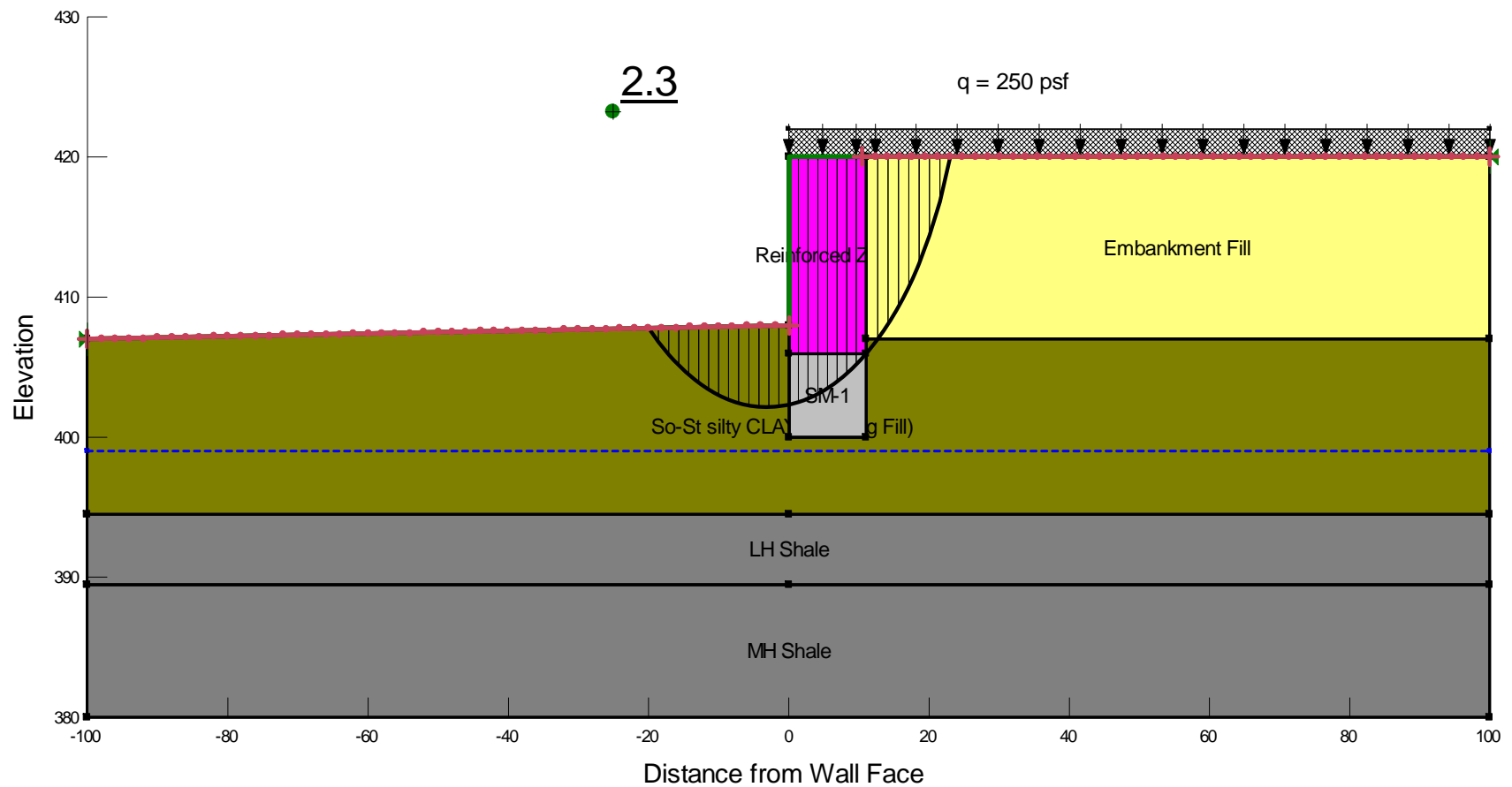
Design Loading Condition	Calculated Minimum Factor of Safety
End of Construction	4.2
Long Term	2.3
Seismic ($k_h = 0.5A_s = 0.07$)	2.0

Summary of Soil Strength Parameters

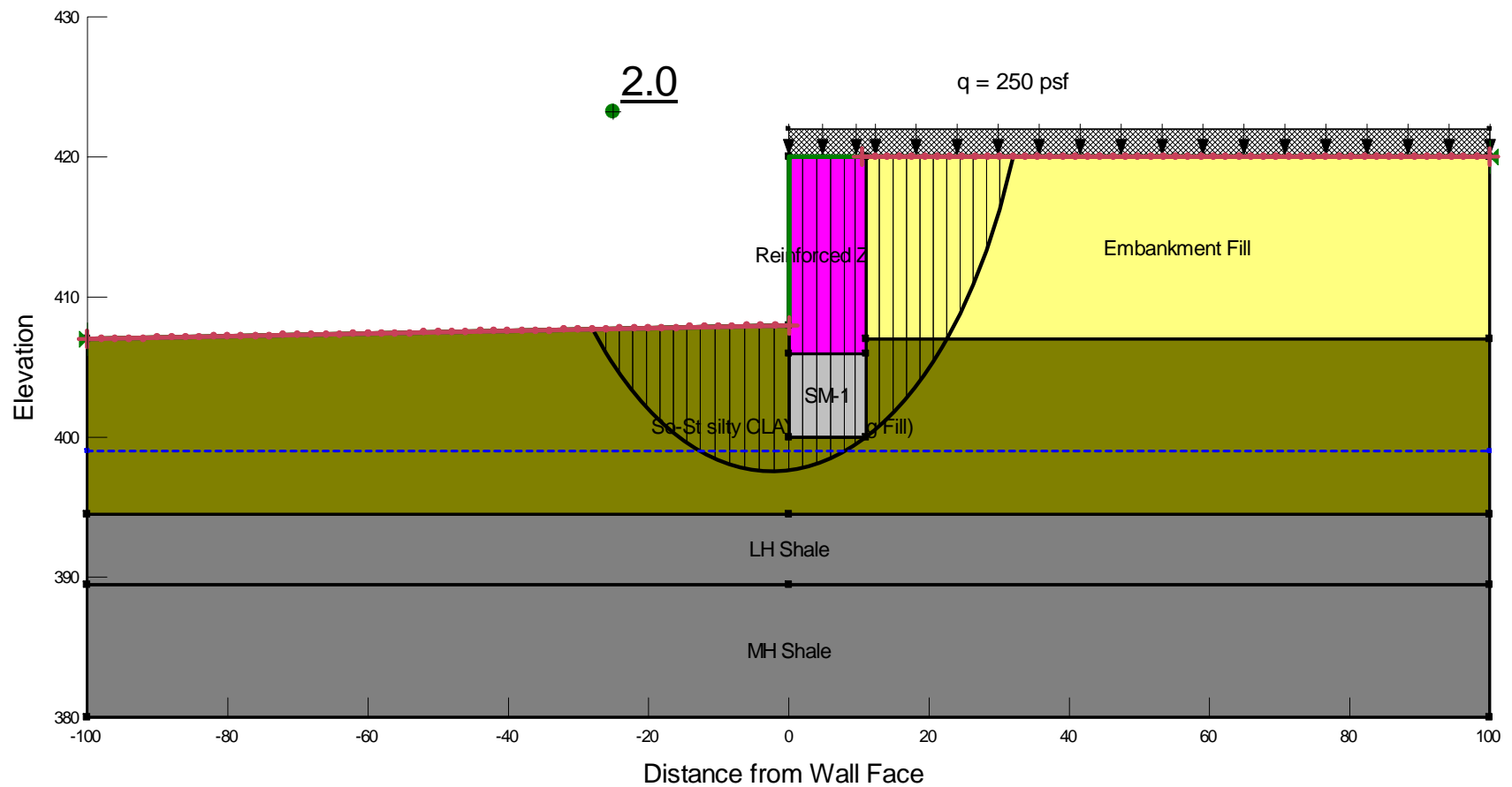
Soil Description	Total Unit Weight (γ) pcf	Undrained Shear Strength (s_u) psf	Effective Cohesion (c') psf	Effective Friction Angle (ϕ') deg
Embankment Fill	125	750	750	0
SM-1	125	0	0	32
Soft to Stiff silty Clay (Existing Fill)	120	1500	200	20
Low Hardness Shale	135	2000	500	20
Moderately Hard Shale	135	4000	1000	20



Results of Stability Analyses – End of Construction Condition
 MSE Wall AA @ Sta 11+20
 AHTD Job No. CA0601 – HWY 70 – Sevier St. (Widening)(S)



Results of Stability Analyses – Long Term Condition
MSE Wall AA @ Sta 11+20
AHTD Job No. CA0601 – HWY 70 – Sevier St. (Widening)(S)



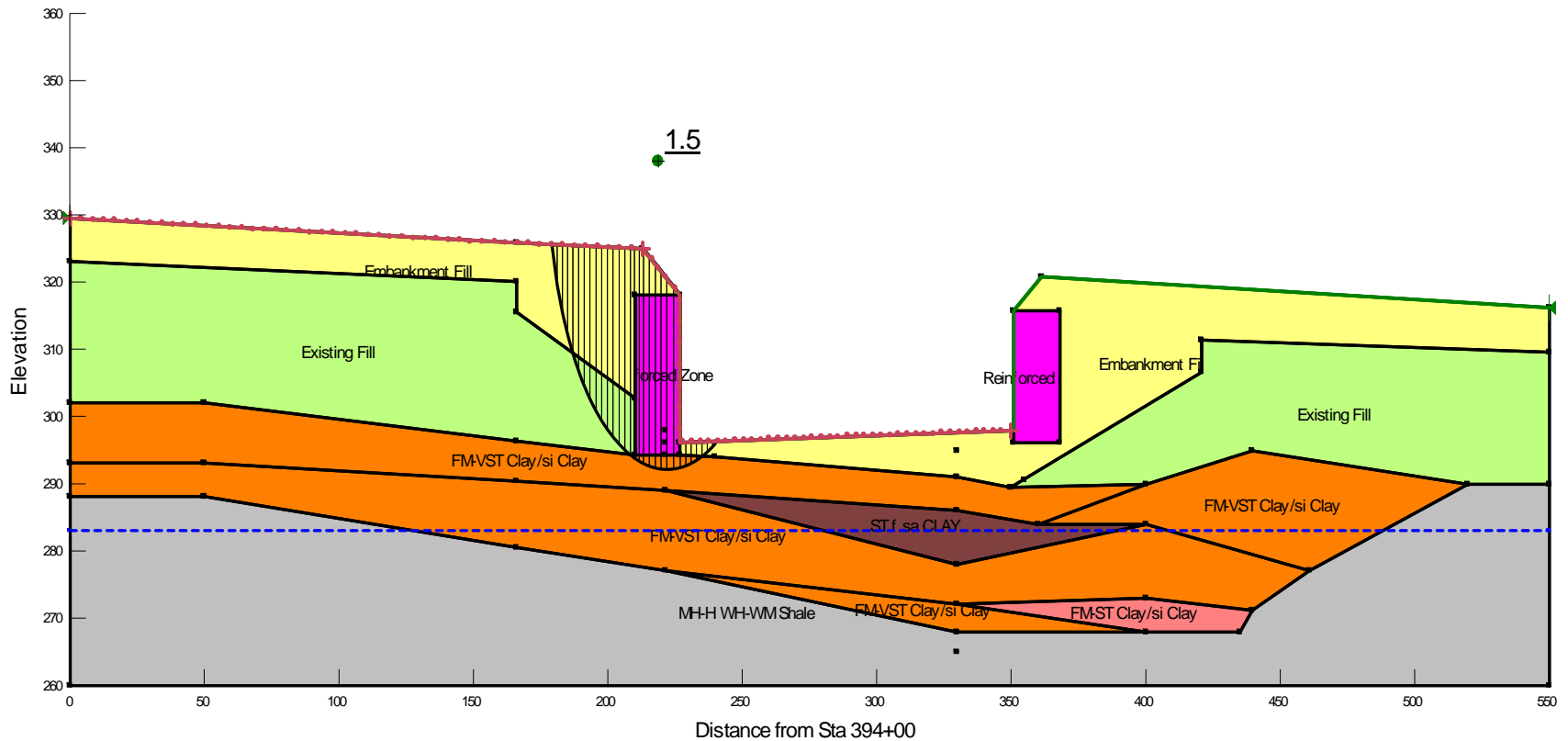
Results of Stability Analyses – Seismic Condition ($k_h = 0.5A_s = 0.07$)
MSE Wall AA @ Sta 11+20
AHTD Job No. CA0601 – HWY 70 – Sevier St. (Widening)(S)

Summary of Stability Analysis Results
2H:1V End Slope with MSE Wall DD @ West Bridge Abutment
I-30 over Highway 67
AHTD Job No. CA 0601 – HWY 70 – Sevier St. (Widening)(S)

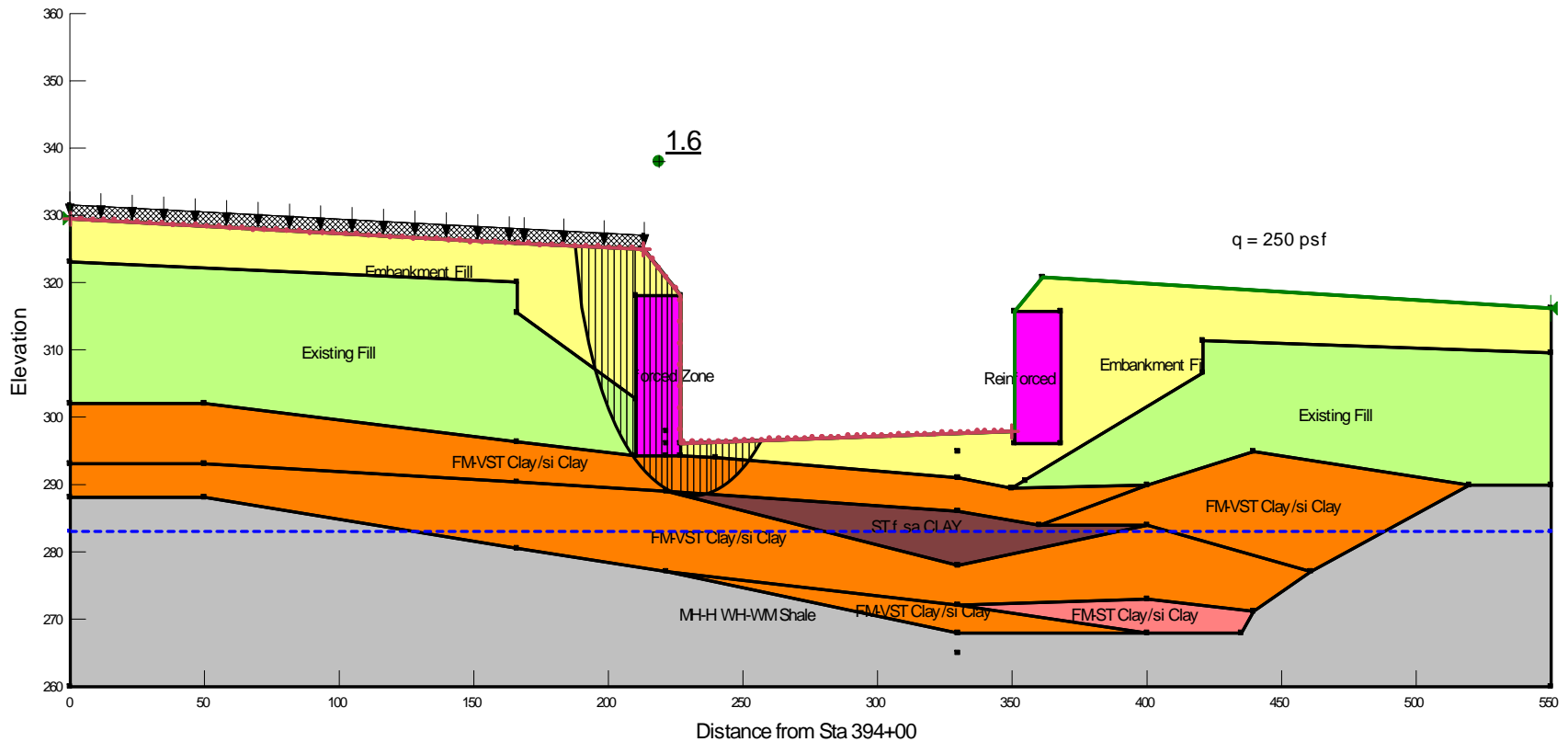
Bridge End	Design Loading Condition	Calculated Minimum Factor of Safety
Bent 1 (West Abutment)	End of Construction	1.5
	Long Term	1.6
	Seismic ($k_h = 0.5A_s = 0.07$)	1.5

Summary of Soil Strength Parameters

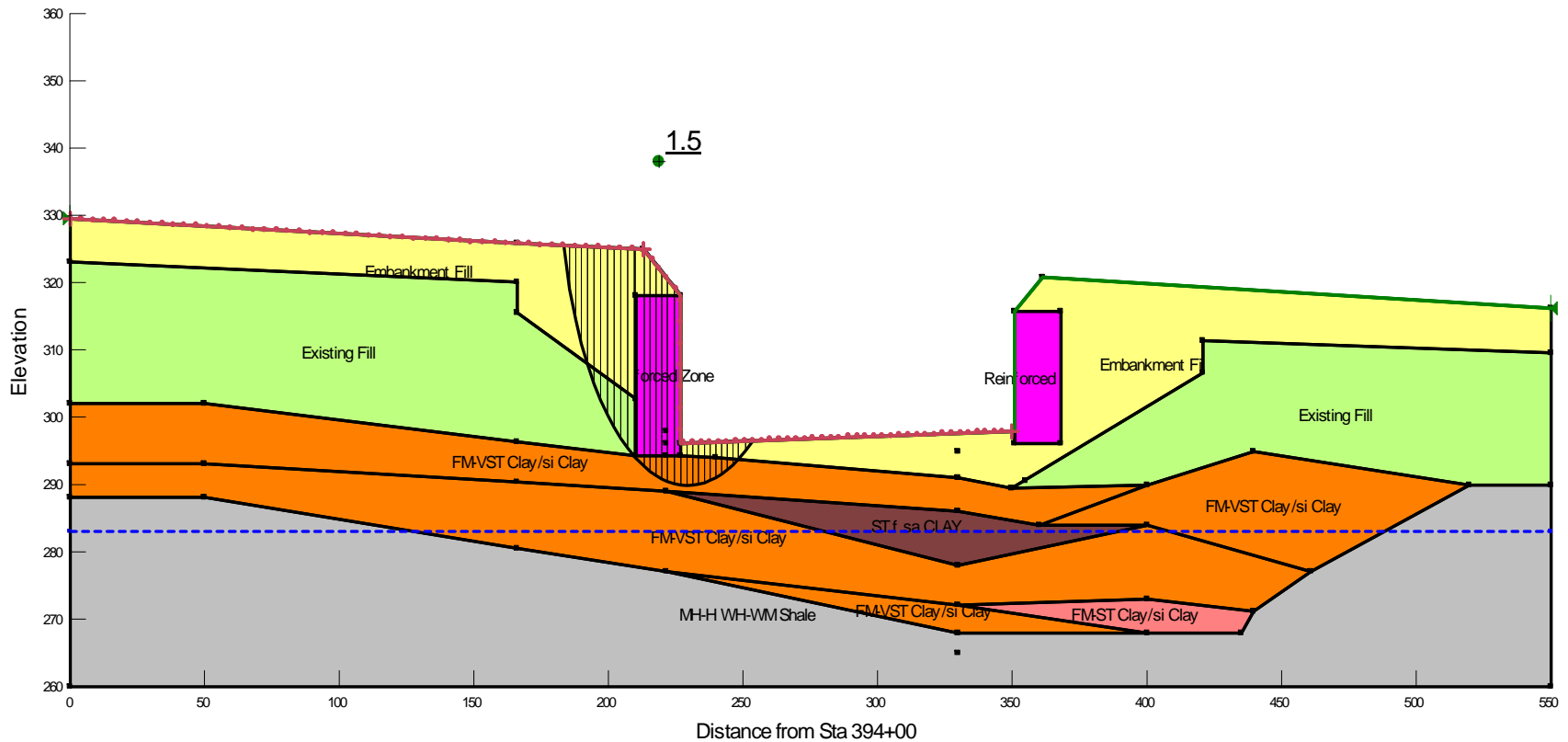
Soil Description	Total Unit Weight (γ) pcf	Undrained Shear Strength (s_u) psf	Effective Cohesion (c') psf	Effective Friction Angle (ϕ') deg
Embankment Fill	125	750	750	0
Existing Fill	120	1000	200	25
Firm to Very Stiff Clay/silty Clay	115	1125	200	25
Stiff fine sandy Clay	125	2000	300	20
Firm to Stiff Clay/silty Clay	118	1250	250	15
Moderately Hard to Hard Moderately to Highly Weathered Shale	135	4000	1000	20



Results of Stability Analyses – End of Construction Condition
 2H:1V End Slope with MSE Wall DD @ West Abutment
 Cross Section @ Center Line Bridge
 I-30 over Highway 67
 AHTD Job No. CA0601 – HWY 70 – Sevier St. (Widening)(S)



Results of Stability Analyses – Long Term Condition
 2H:1V End Slope with MSE Wall DD @ West Abutment
 Cross Section @ Center Line Bridge
 I-30 over Highway 67
 AHTD Job No. CA0601 – HWY 70 – Sevier St. (Widening)(S)



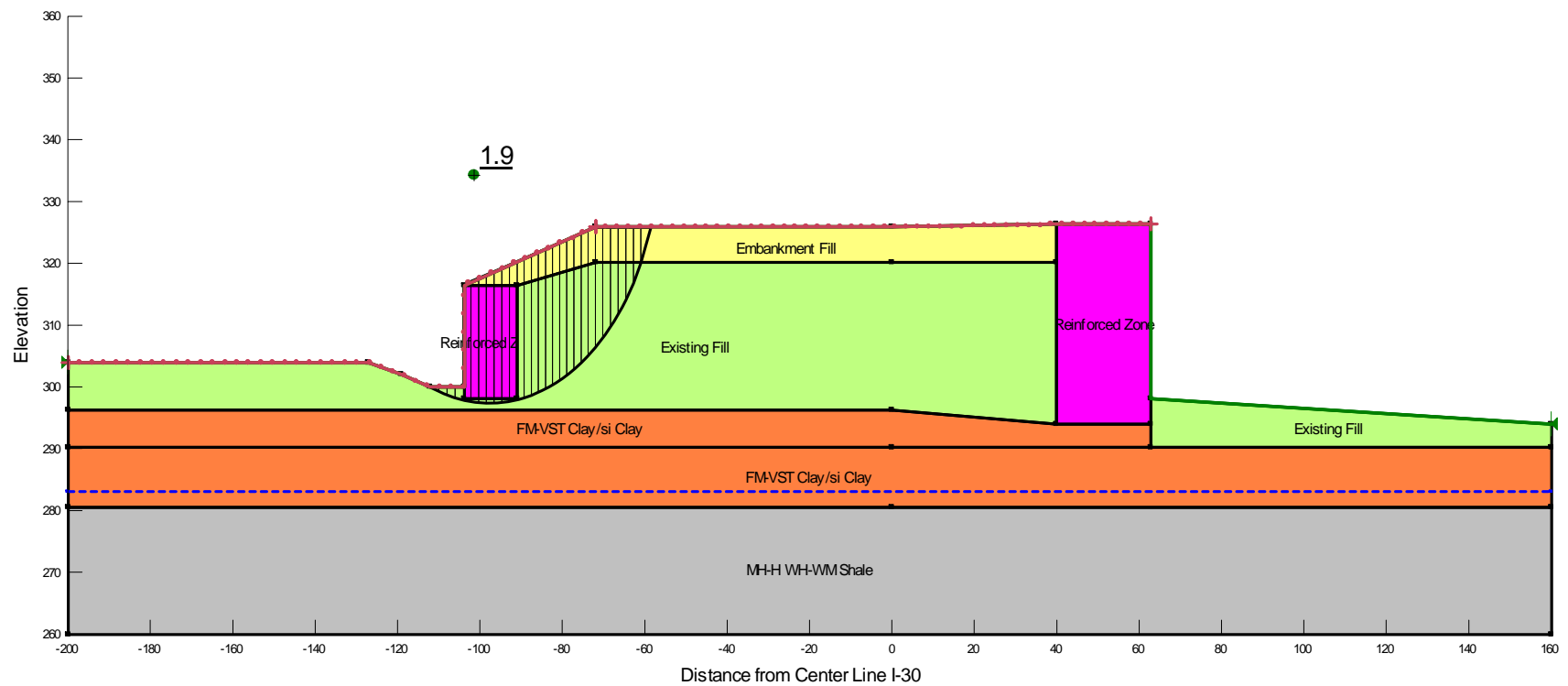
Results of Stability Analyses – Seismic Condition ($k_h = 0.5A_s = 0.07$)
 2H:1V End Slope with MSE Wall DD @ West Abutment
 Cross Section @ Center Line Bridge
 I-30 over Highway 67
 AHTD Job No. CA0601 – HWY 70 – Sevier St. (Widening)(S)

Summary of Stability Analysis Results
3H:1V Side Slopes with MSE Wall DD @ West Bridge Abutment
I-30 over Highway 67
AHTD Job No. CA 0601 – HWY 70 – Sevier St. (Widening)(S)

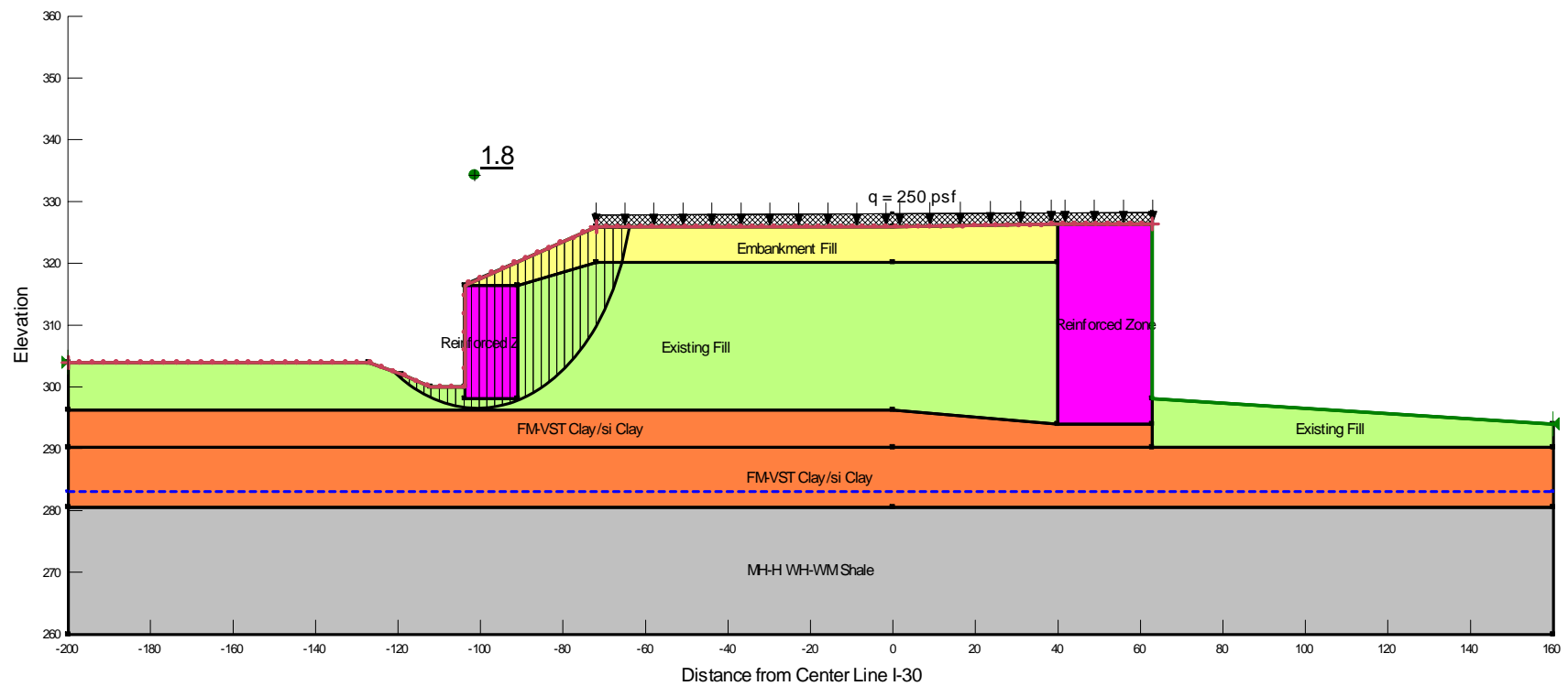
Embankment Side	Design Loading Condition	Calculated Minimum Factor of Safety
North (Left)	End of Construction	1.9
	Long Term	1.8
	Seismic ($k_h = 0.5A_s = 0.07$)	1.7
South (Right)	End of Construction	1.6
	Long Term	1.7
	Seismic ($k_h = 0.5A_s = 0.07$)	1.6

Summary of Soil Strength Parameters

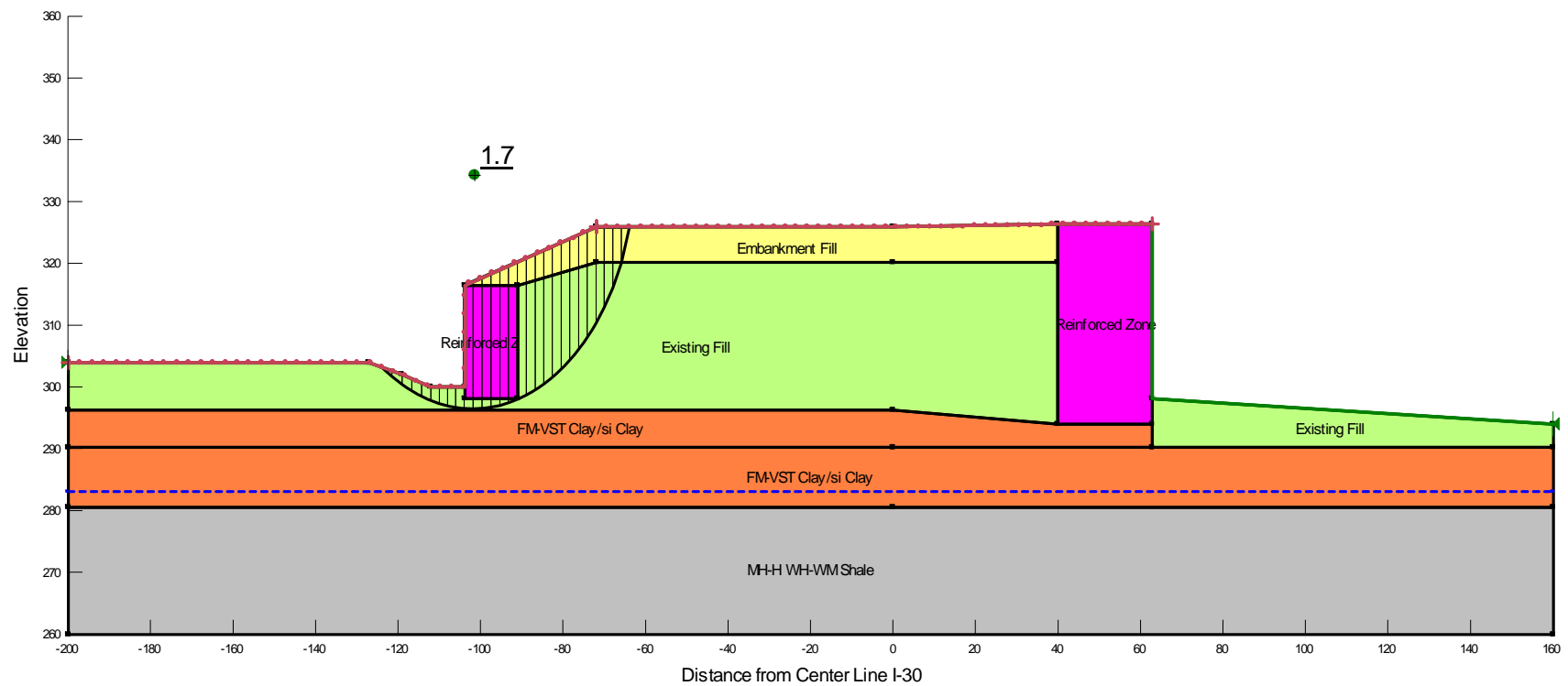
Soil Description	Total Unit Weight (γ) pcf	Undrained Shear Strength (s_u) psf	Effective Cohesion (c') psf	Effective Friction Angle (ϕ') deg
Embankment Fill	125	750	750	0
Existing Fill	120	1000	200	25
Firm to Very Stiff Clay/silty Clay	115	1125	200	25
Moderately Hard to Hard Moderately to Highly Weathered Shale	135	4000	1000	20



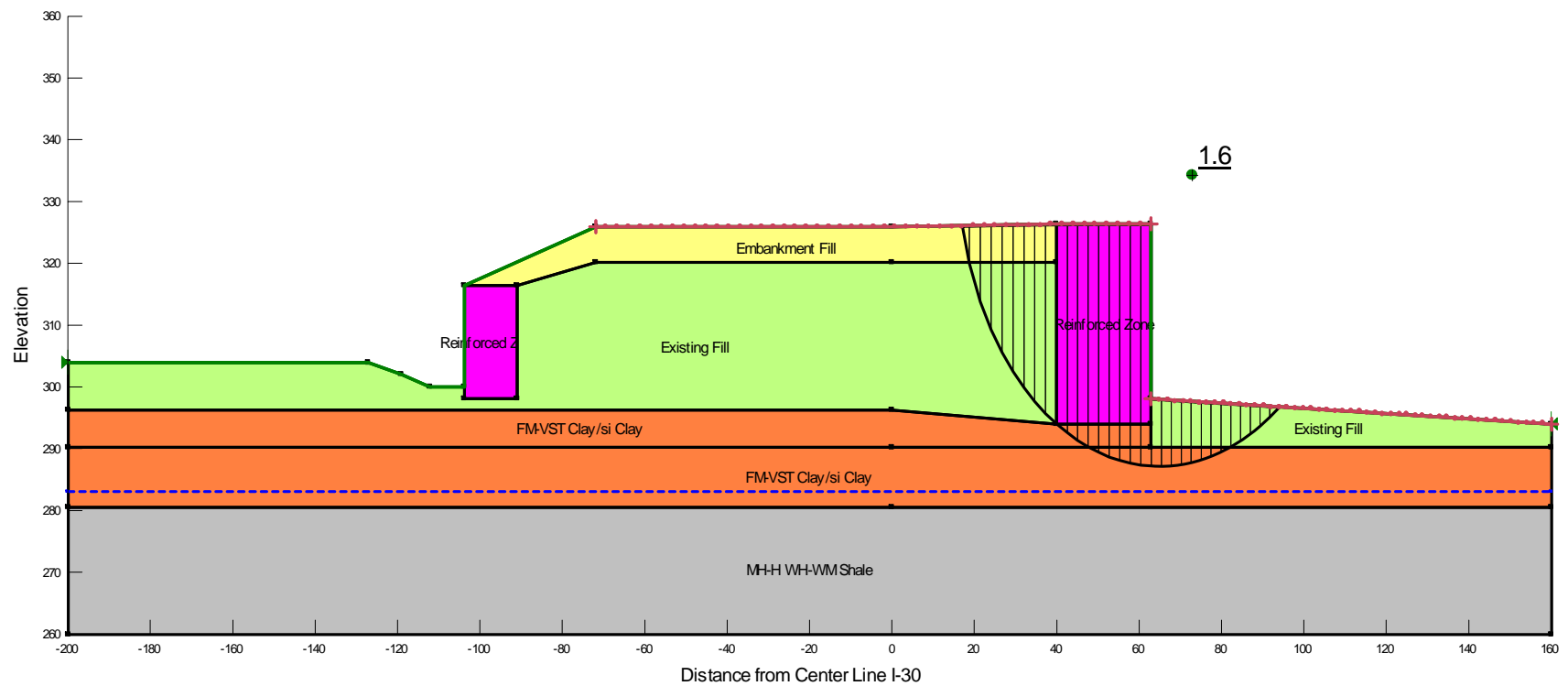
Results of Stability Analyses – End of Construction Condition
 North (Left) Side Slope with MSE Wall DD @ West Bridge Abutment
 Cross Section @ Sta 395+66
 I-30 over Highway 67
 AHTD Job No. CA0601 – HWY 70 – Sevier St. (Widening)(S)



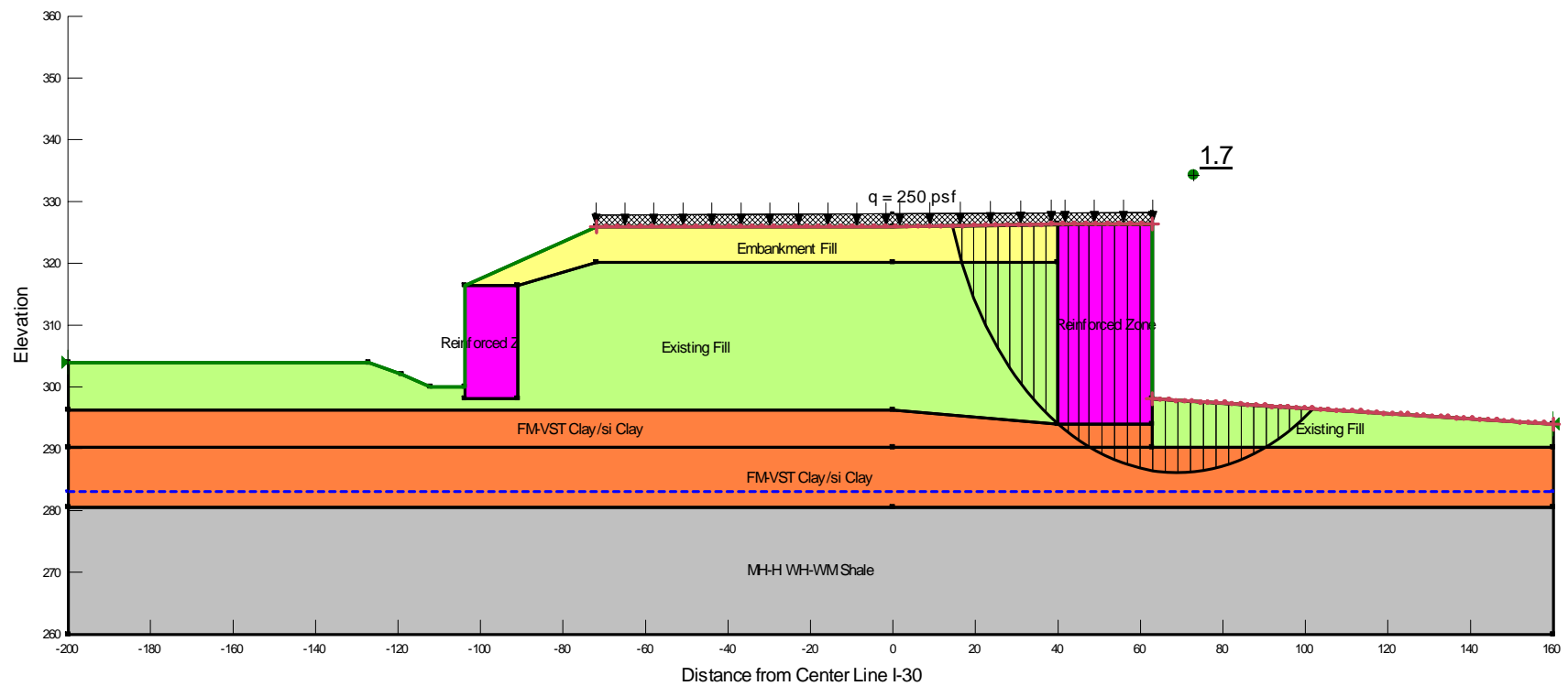
Results of Stability Analyses – Long Term Condition
 North (Left) Side Slope with MSE Wall DD @ West Bridge Abutment
 Cross Section @ Sta 395+66
 I-30 over Highway 67
 AHTD Job No. CA0601 – HWY 70 – Sevier St. (Widening)(S)



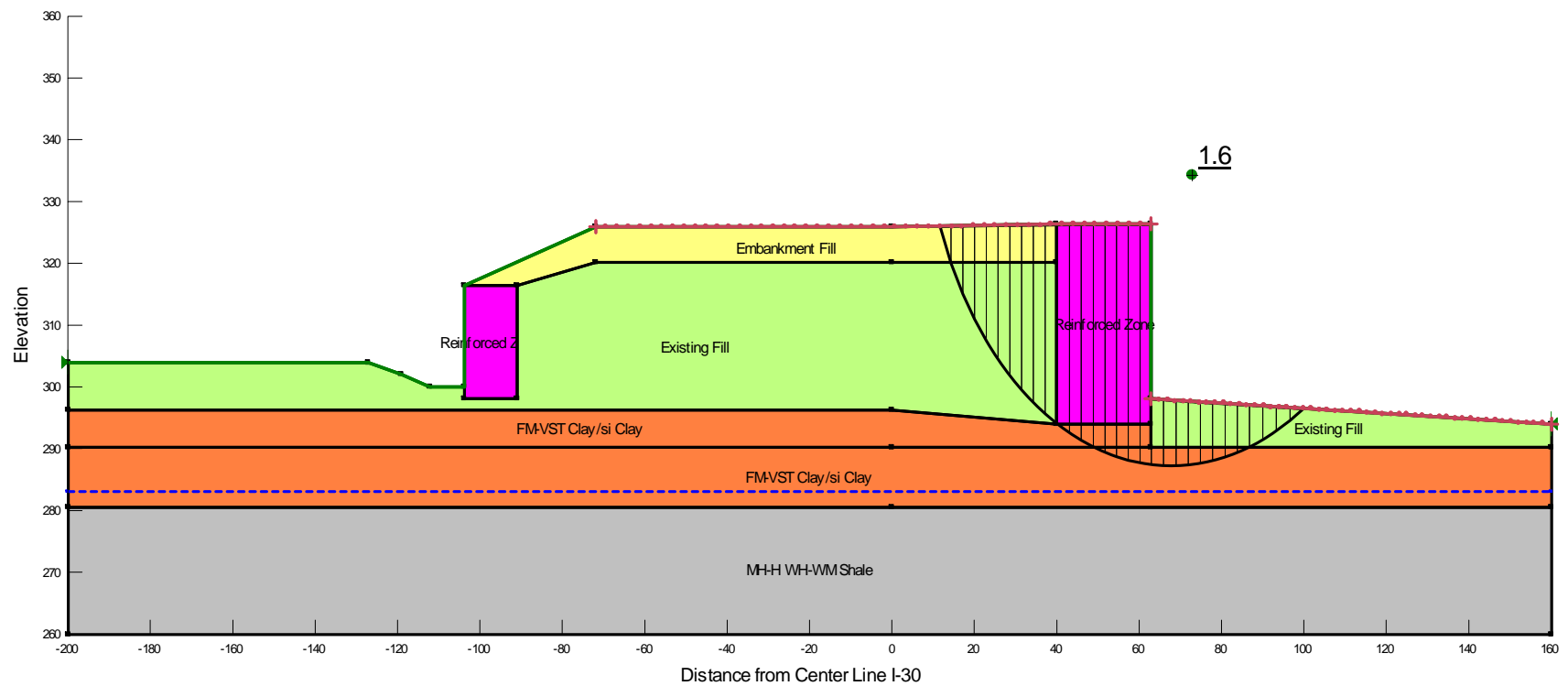
Results of Stability Analyses – Seismic Condition ($k_h = 0.5A_s = 0.07$)
 North (Left) Side Slope with MSE Wall DD @ West Bridge Abutment
 Cross Section @ Sta 395+66
 I-30 over Highway 67
 AHTD Job No. CA0601 – HWY 70 – Sevier St. (Widening)(S)



Results of Stability Analyses – End of Construction Condition
 South (Right) Side Slope with MSE Wall DD @ West Bridge Abutment
 Cross Section @ Sta 395+66
 I-30 over Highway 67
 AHTD Job No. CA0601 – HWY 70 – Sevier St. (Widening)(S)



Results of Stability Analyses – Long Term Condition
 South (Right) Side Slope with MSE Wall DD @ West Bridge Abutment
 Cross Section @ Sta 395+66
 I-30 over Highway 67
 AHTD Job No. CA0601 – HWY 70 – Sevier St. (Widening)(S)



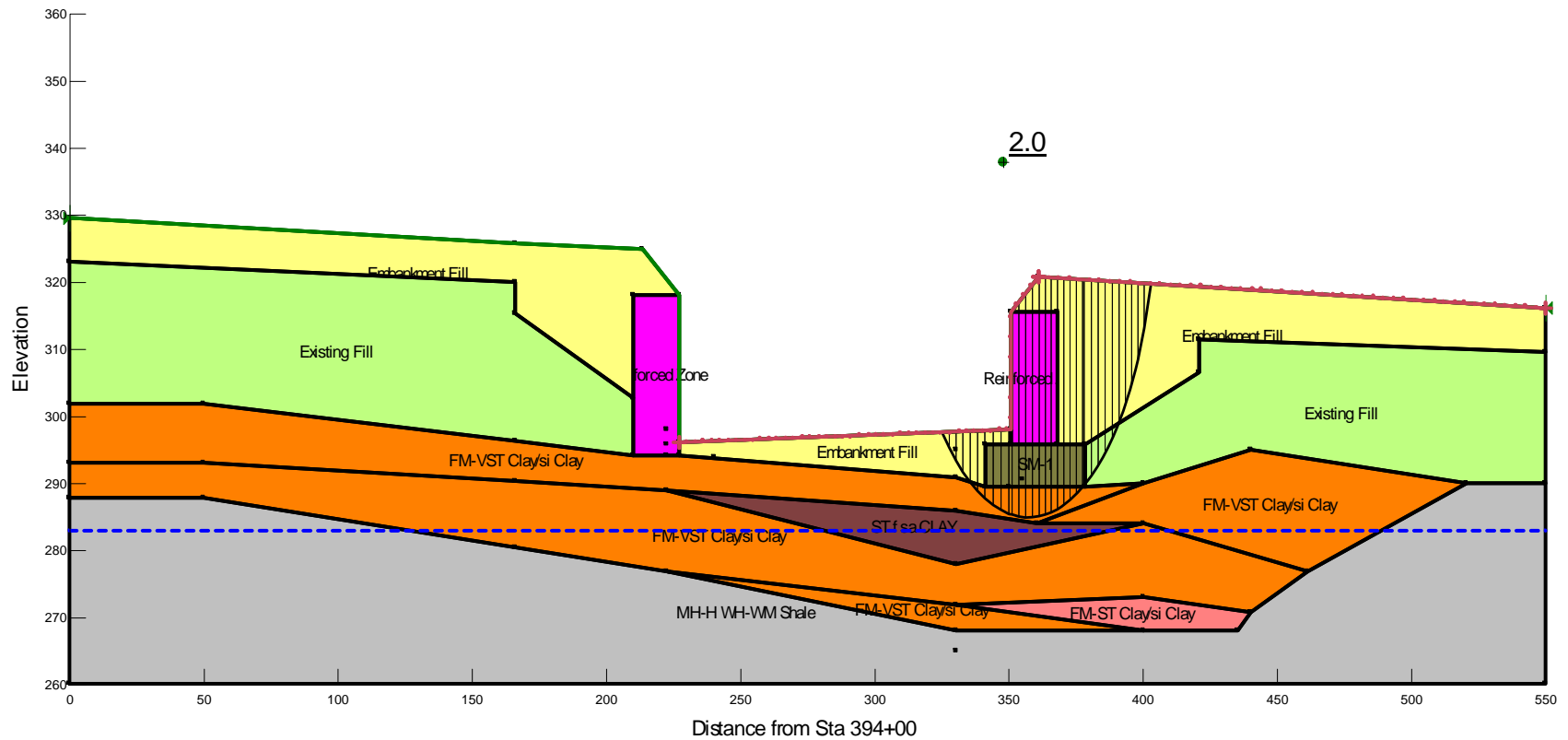
Results of Stability Analyses – Seismic Condition ($k_h = 0.5A_s = 0.07$)
 South (Right) Side Slope with MSE Wall DD @ West Bridge Abutment
 Cross Section @ Sta 395+66
 I-30 over Highway 67
 AHTD Job No. CA0601 – HWY 70 – Sevier St. (Widening)(S)

Summary of Stability Analysis Results
2H:1V End Slope with MSE Wall EE@ East Bridge Abutment
I-30 over Highway 67
AHTD Job No. CA 0601 – HWY 70 – Sevier St. (Widening)(S)

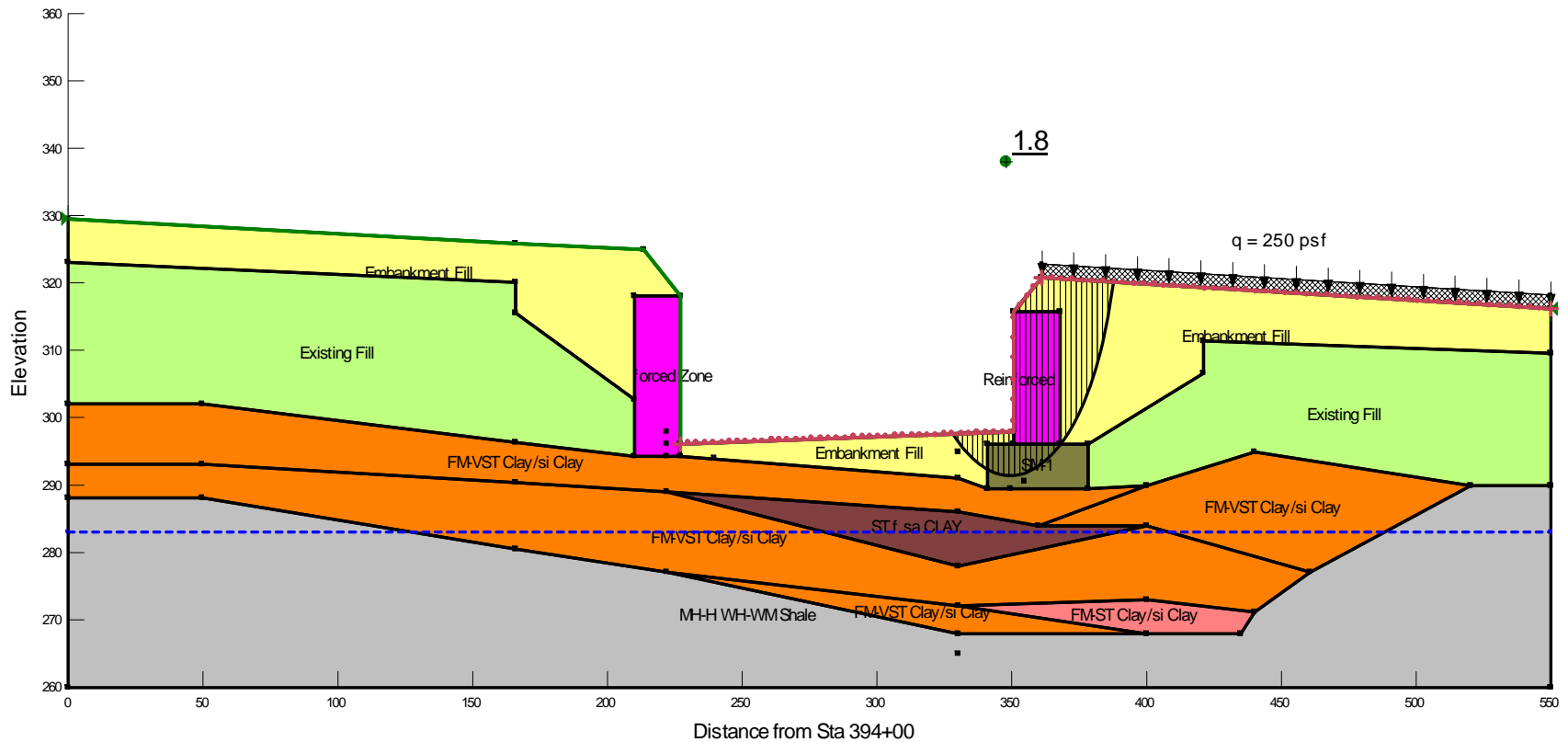
Bridge End	Design Loading Condition	Calculated Minimum Factor of Safety
Bent 2 (East Abutment)	End of Construction	2.0
	Long Term	1.8
	Seismic ($k_h = 0.5A_s = 0.07$)	1.8

Summary of Soil Strength Parameters

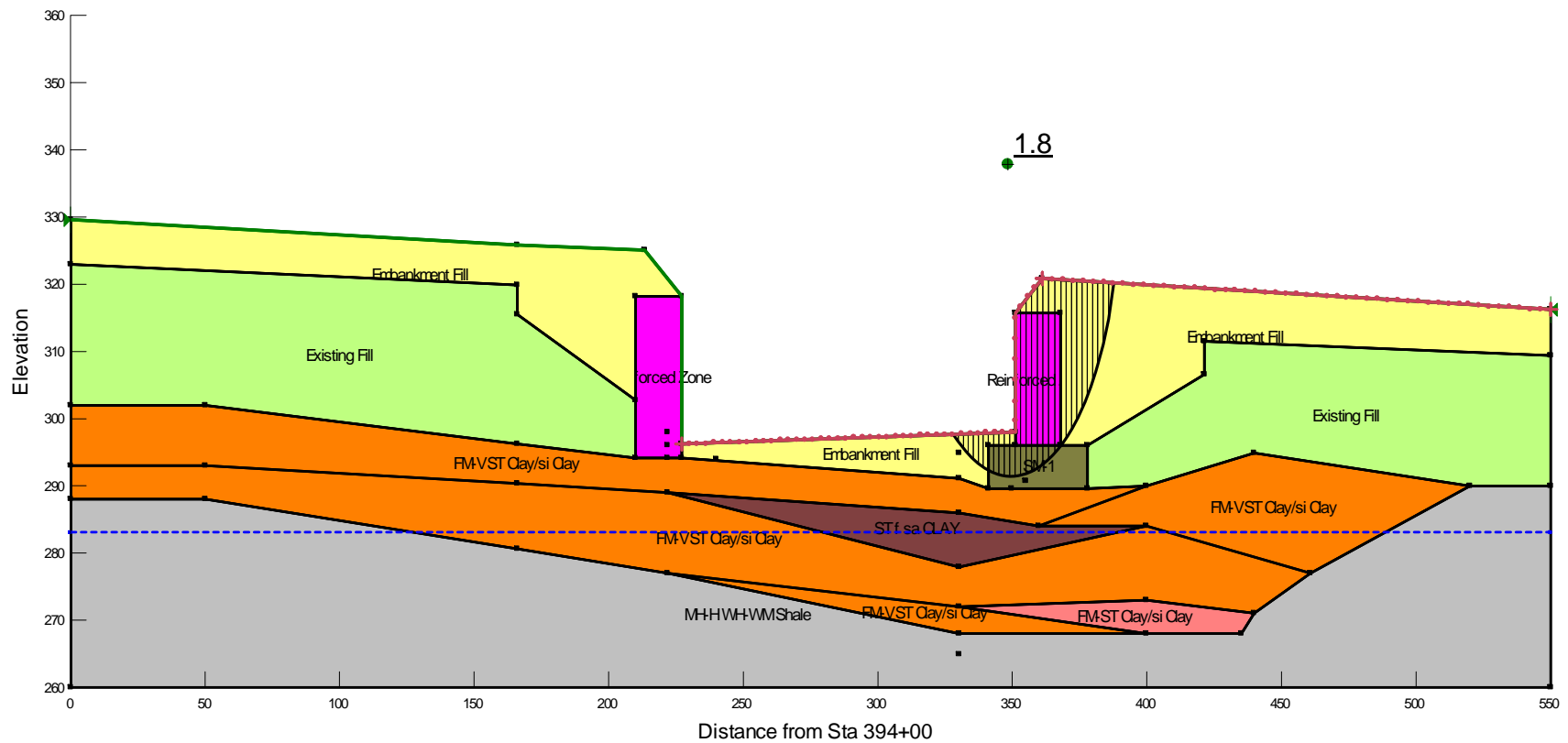
Soil Description	Total Unit Weight (γ) pcf	Undrained Shear Strength (s_u) psf	Effective Cohesion (c') psf	Effective Friction Angle (ϕ') deg
Embankment Fill	125	750	750	0
SM-1	125	0	0	32
Existing Fill	120	1000	200	25
Firm to Very Stiff Clay/silty Clay	115	1125	200	25
Stiff fine sandy Clay	125	2000	300	20
Firm to Stiff Clay/silty Clay	118	1250	250	15
Moderately Hard to Hard Moderately to Highly Weathered Shale	135	4000	1000	20



Results of Stability Analyses – End of Construction Condition
 2H:1V End Slope with MSE Wall EE @ East Abutment
 Cross Section @ Center Line Bridge
 I-30 over Highway 67
 AHTD Job No. CA0601 – HWY 70 – Sevier St. (Widening)(S)



Results of Stability Analyses – Long Term Condition
 2H:1V End Slope with MSE Wall EE @ East Abutment
 Cross Section @ Center Line Bridge
 I-30 over Highway 67
 AHTD Job No. CA0601 – HWY 70 – Sevier St. (Widening)(S)



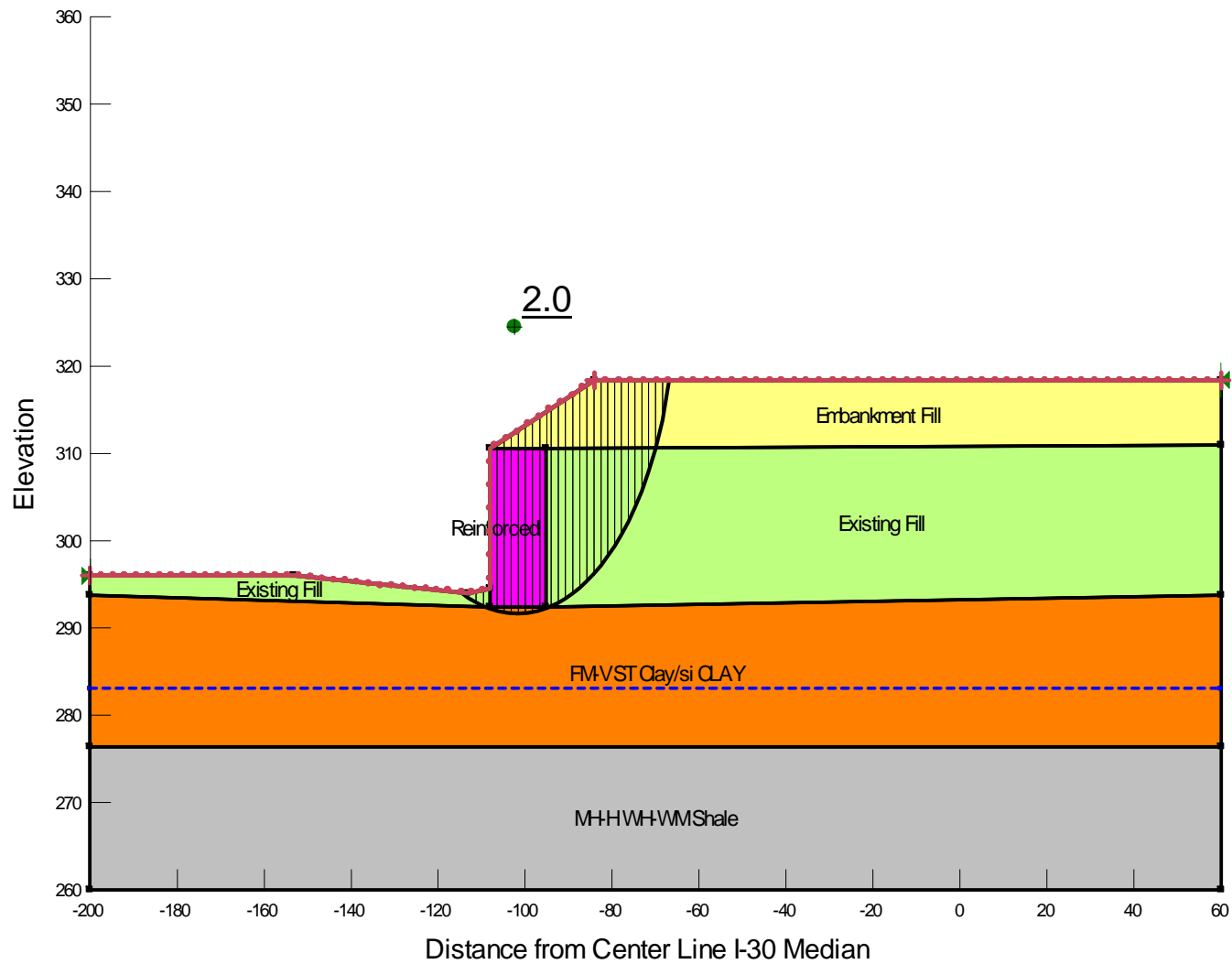
Results of Stability Analyses – Seismic Condition ($k_h = 0.5A_s = 0.07$)
 2H:1V End Slope with MSE Wall EE @ East Abutment
 Cross Section @ Center Line Bridge
 I-30 over Highway 67
 AHTD Job No. CA0601 – HWY 70 – Sevier St. (Widening)(S)

Summary of Stability Analysis Results
3H:1V Side Slopes with MSE Wall EE @ East Bridge Abutment
I-30 over Highway 67
AHTD Job No. CA 0601 – HWY 70 – Sevier St. (Widening)(S)

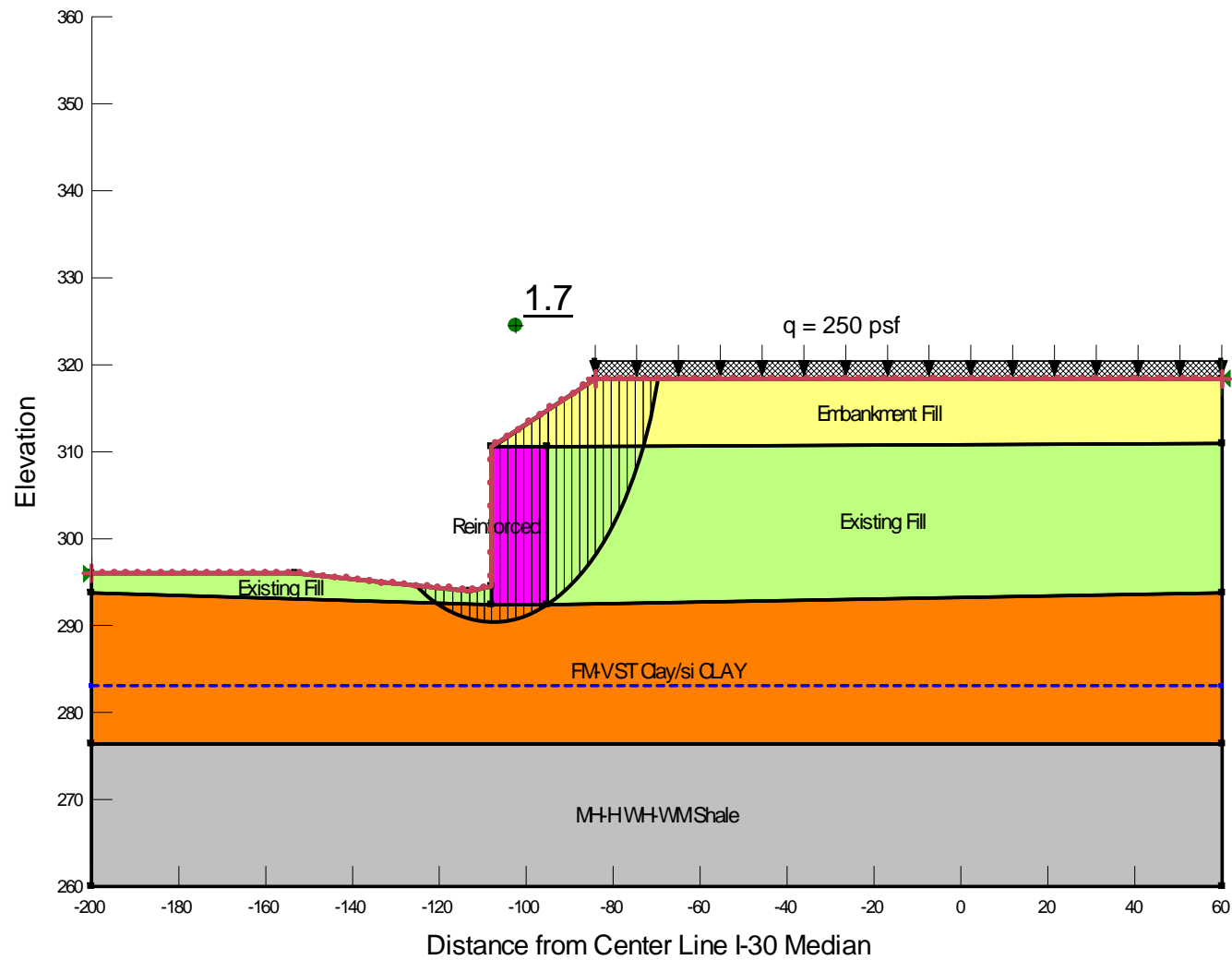
Embankment Side	Design Loading Condition	Calculated Minimum Factor of Safety
North (Left)	End of Construction	2.0
	Long Term	1.7
	Seismic ($k_h = 0.5A_s = 0.07$)	1.6
South (Right)	End of Construction	1.6
	Long Term	1.5
	Seismic ($k_h = 0.5A_s = 0.07$)	1.5

Summary of Soil Strength Parameters

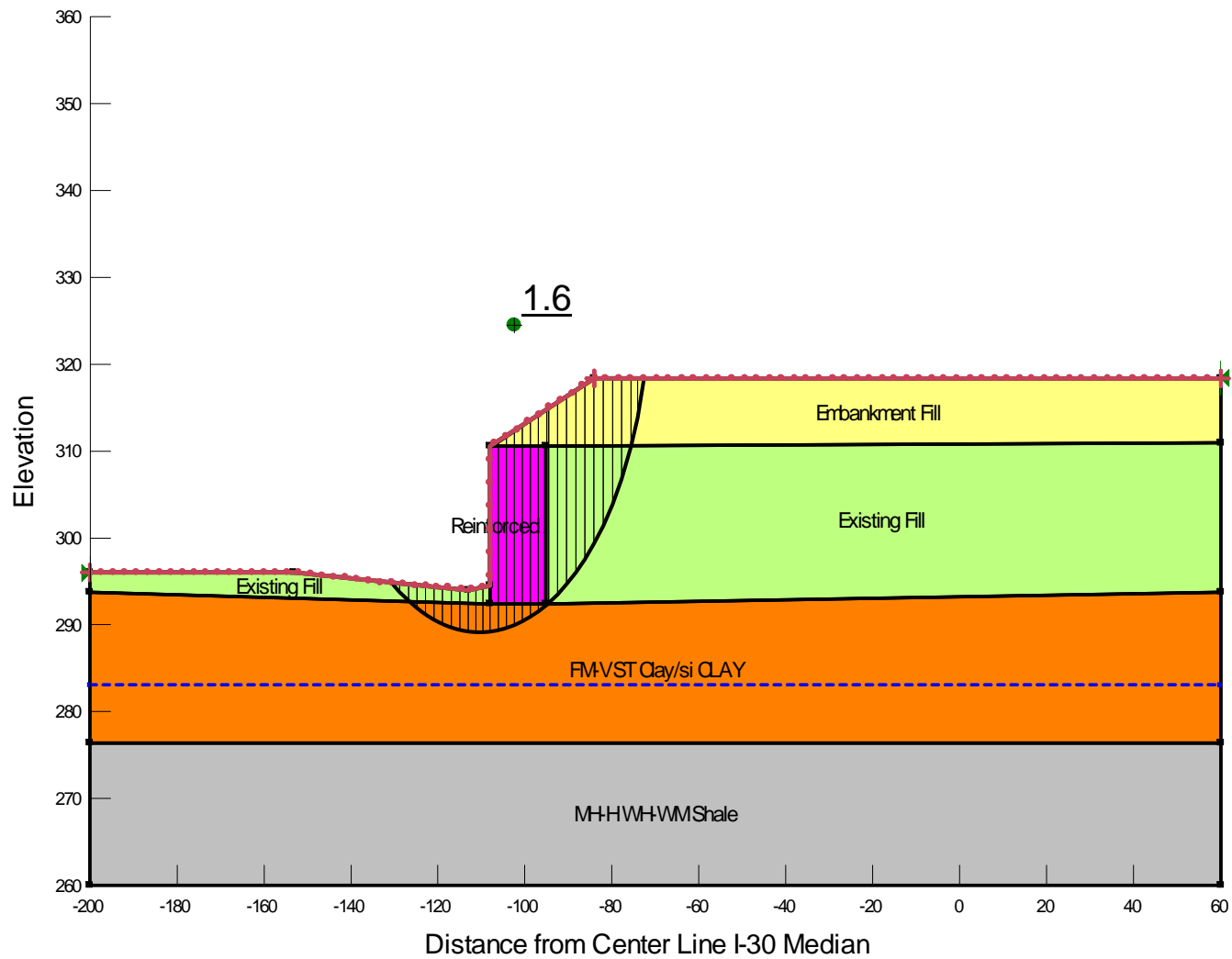
Soil Description	Total Unit Weight (γ) pcf	Undrained Shear Strength (s_u) psf	Effective Cohesion (c') psf	Effective Friction Angle (ϕ') deg
Embankment Fill	125	750	750	0
Existing Fill	120	1000	200	25
Firm to Very Stiff Clay/silty Clay	115	1125	200	25
Stiff fine sandy Clay	125	2000	300	20
Moderately Hard to Hard Moderately to Highly Weathered Shale	135	4000	1000	20



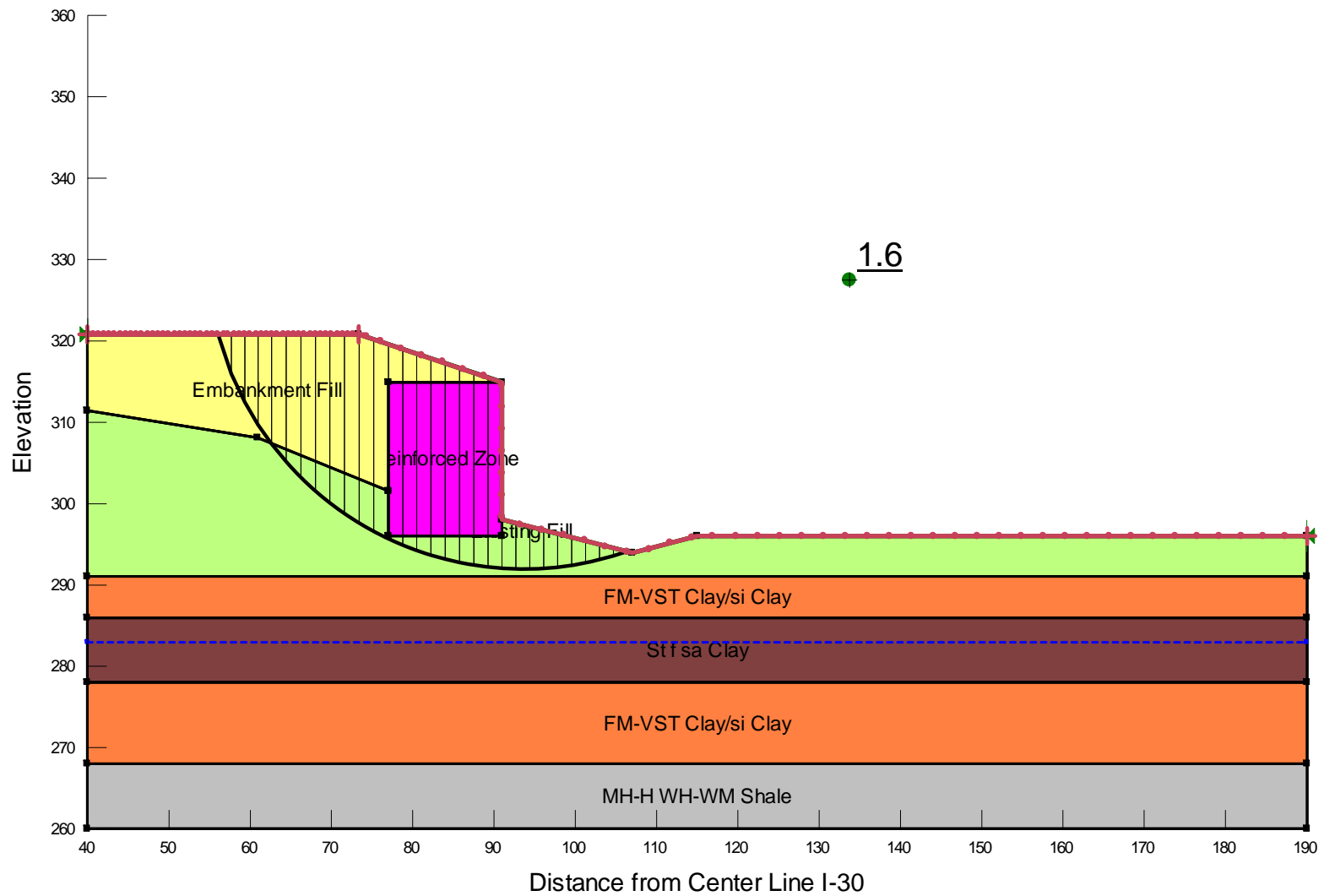
Results of Stability Analyses – End of Construction Condition
 North (Left) Side Slope with MSE Wall EE @ East Bridge Abutment
 Cross Section @ Sta 398+59
 I-30 over Highway 67
 AHTD Job No. CA0601 – HWY 70 – Sevier St. (Widening)(S)



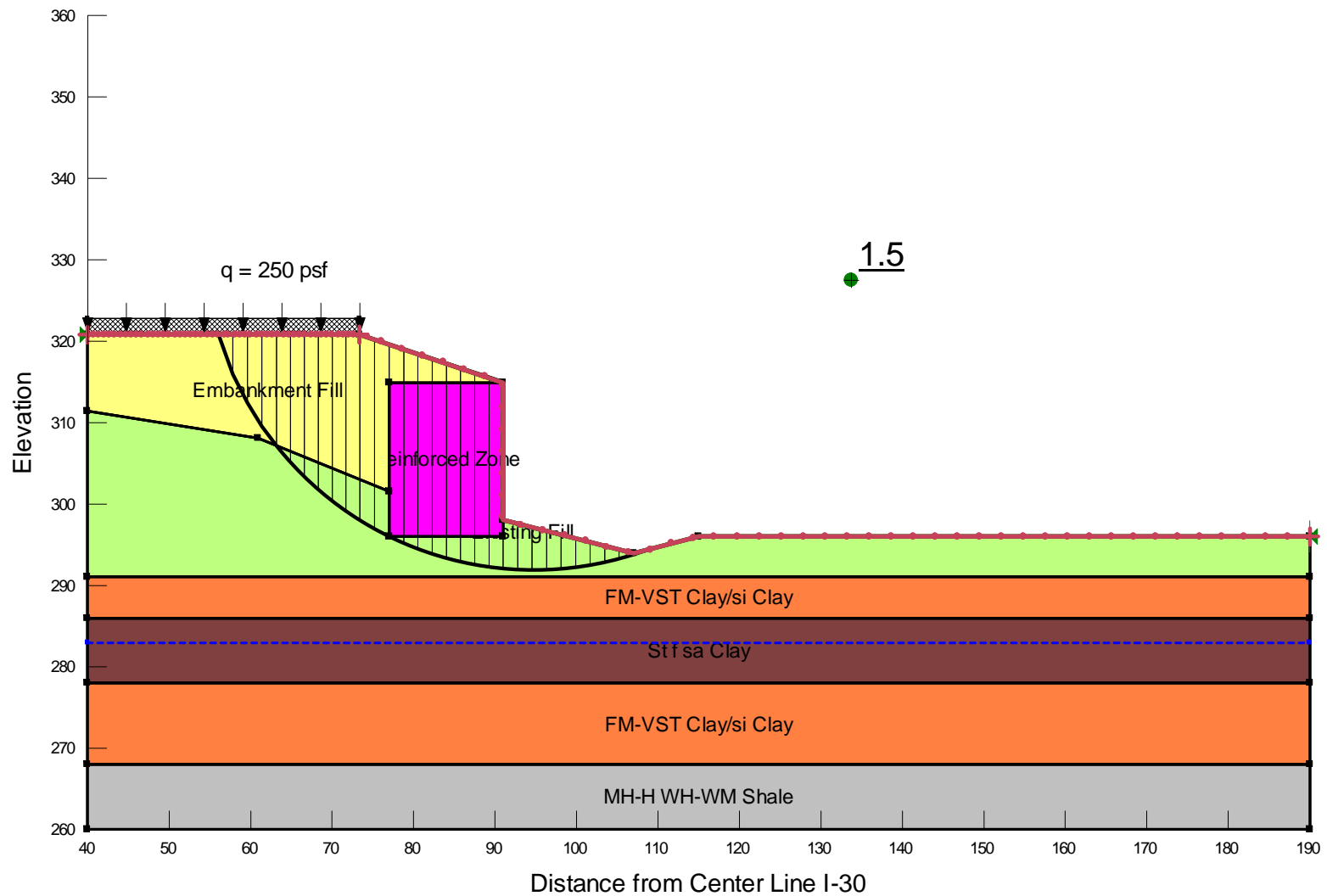
Results of Stability Analyses – Long Term Condition
 North (Left) Side Slope with MSE Wall EE @ East Bridge Abutment
 Cross Section @ Sta 398+59
 I-30 over Highway 67
 AHTD Job No. CA0601 – HWY 70 – Sevier St. (Widening)(S)



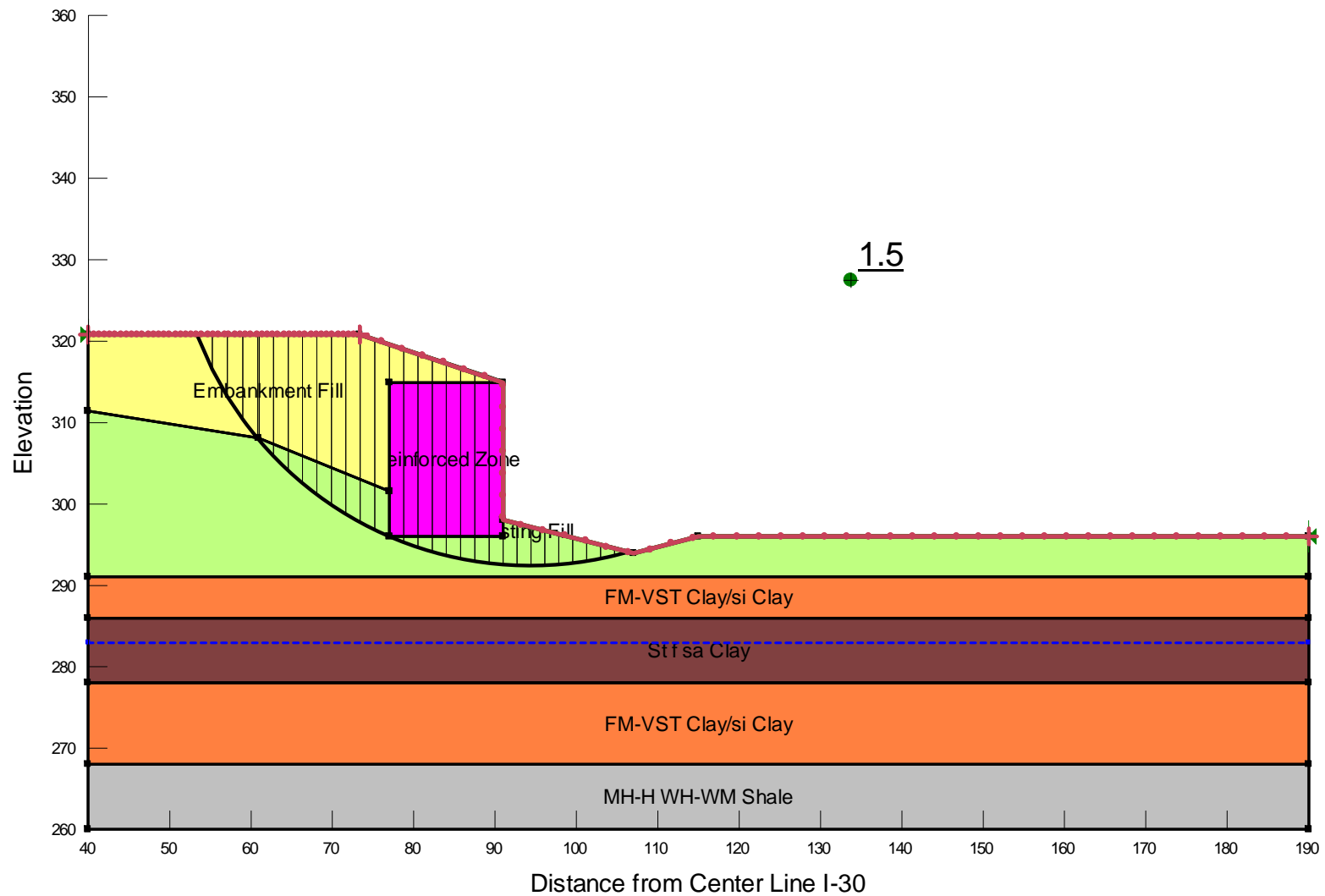
Results of Stability Analyses – Seismic Condition ($k_h = 0.5A_s = 0.07$)
 North (Left) Side Slope with MSE Wall EE @ East Bridge Abutment
 Cross Section @ Sta 398+59
 I-30 over Highway 67
 AHTD Job No. CA0601 – HWY 70 – Sevier St. (Widening)(S)



Results of Stability Analyses – End of Construction Condition
 South (Right) Side Slope with MSE Wall EE @ East Bridge Abutment
 Cross Section @ Sta 397+31
 I-30 over Highway 67
 AHTD Job No. CA0601 – HWY 70 – Sevier St. (Widening)(S)



Results of Stability Analyses – Long Term Condition
 South (Right) Side Slope with MSE Wall EE @ East Bridge Abutment
 Cross Section @ Sta 397+31
 I-30 over Highway 67
 AHTD Job No. CA0601 – HWY 70 – Sevier St. (Widening)(S)



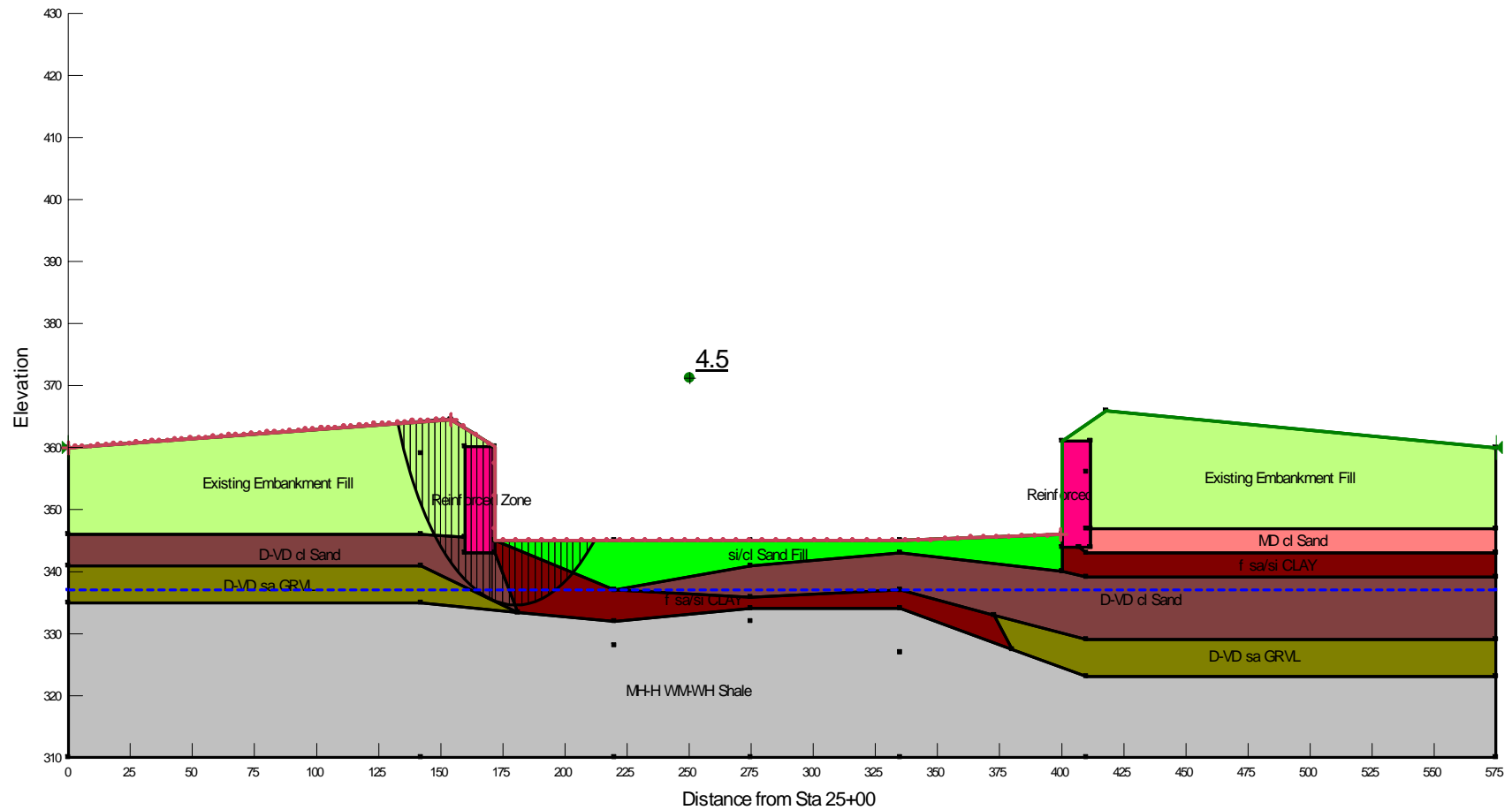
Results of Stability Analyses – Seismic Condition ($k_h = 0.5A_s = 0.07$)
 South (Right) Side Slope with MSE Wall EE @ East Bridge Abutment
 Cross Section @ Sta 397+31
 I-30 over Highway 67
 AHTD Job No. CA0601 – HWY 70 – Sevier St. (Widening)(S)

Summary of Stability Analysis Results
2H:1V End Slope with MSE Wall FF @ North Bridge Abutment
South Street over I-30
AHTD Job No. CA 0601 – HWY 70 – Sevier St. (Widening)(S)

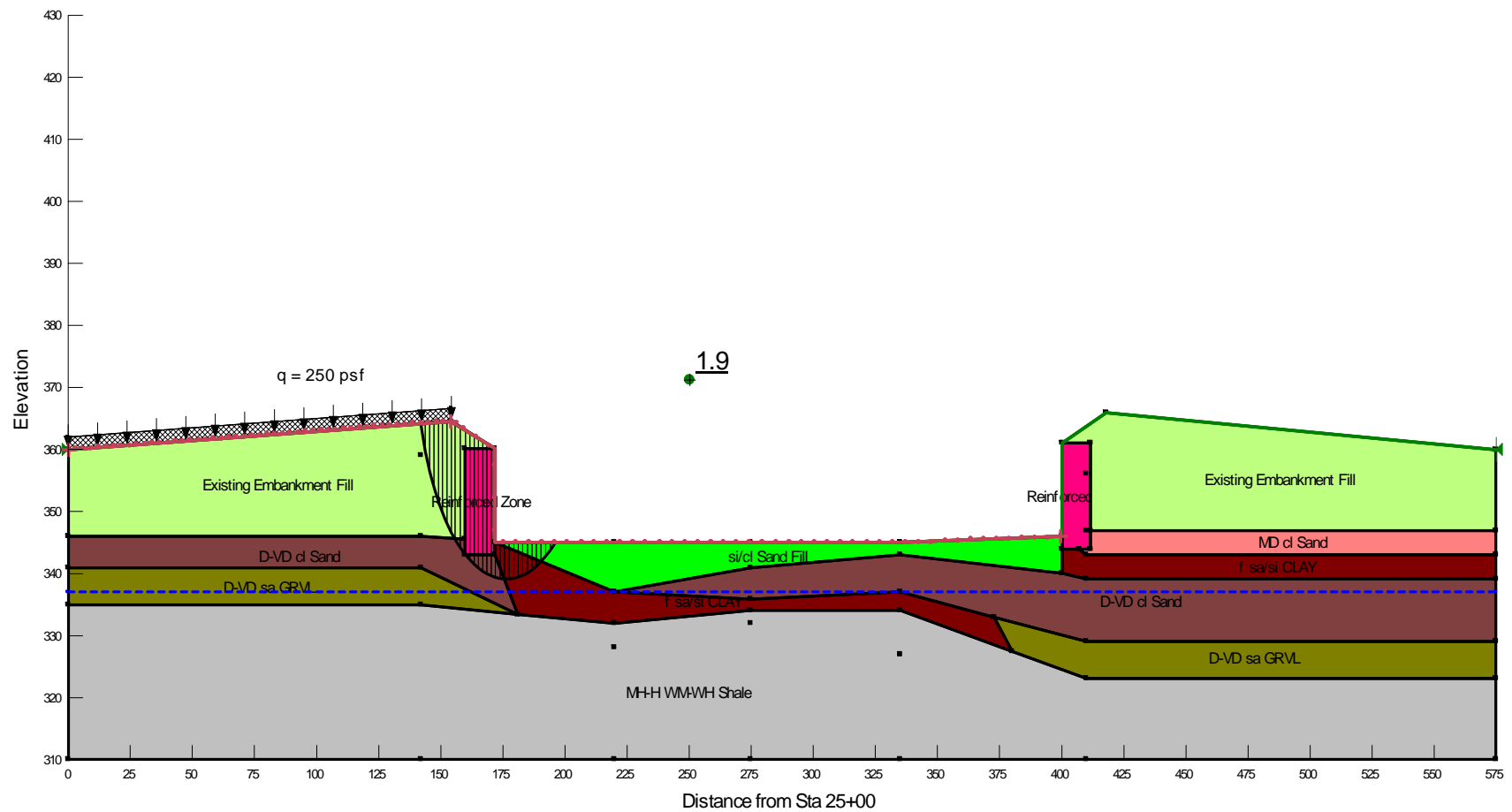
Bridge End	Design Loading Condition	Calculated Minimum Factor of Safety
Bent 1 (North Abutment)	End of Construction	4.5
	Long Term	1.9
	Seismic ($k_h = 0.5A_s = 0.07$)	1.8

Summary of Soil Strength Parameters

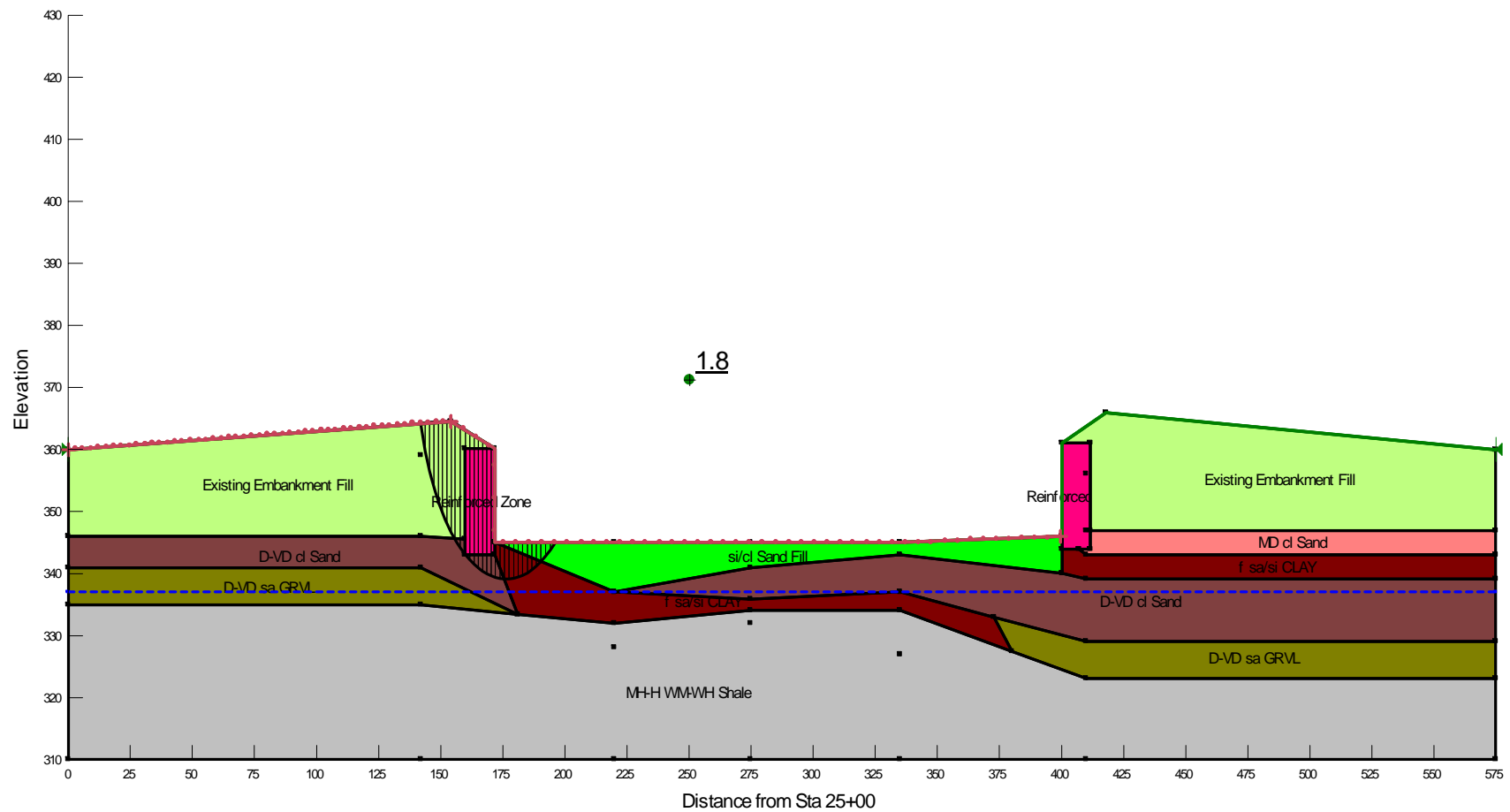
Soil Description	Total Unit Weight (γ) pcf	Undrained Shear Strength (s_u) psf	Effective Cohesion (c') psf	Effective Friction Angle (ϕ') deg
Existing Embankment Fill	110	2500	250	25
Dense to Very Dense clayey Sand	125	0	0	35
Dense to Very Dense sandy Gravel	130	0	0	40
Silty/Clayey Sand Fill	125	0	0	34
Fine sandy/silty Clay	111	1125	200	20
Medium Dense clayey Sand	120	0	0	33
Moderately Hard to Hard Moderately to Highly Weathered Shale	135	4000	1000	20



Results of Stability Analyses – End of Construction Condition
 2H:1V End Slope with MSE Wall FF @ North Abutment
 Cross Section @ Center Line Bridge
 South Street over I-30
 AHTD Job No. CA0601 – HWY 70 – Sevier St. (Widening)(S)



Results of Stability Analyses – Long Term Condition
 2H:1V End Slope with MSE Wall FF @ North Abutment
 Cross Section @ Center Line Bridge
 South Street over I-30
 AHTD Job No. CA0601 – HWY 70 – Sevier St. (Widening)(S)



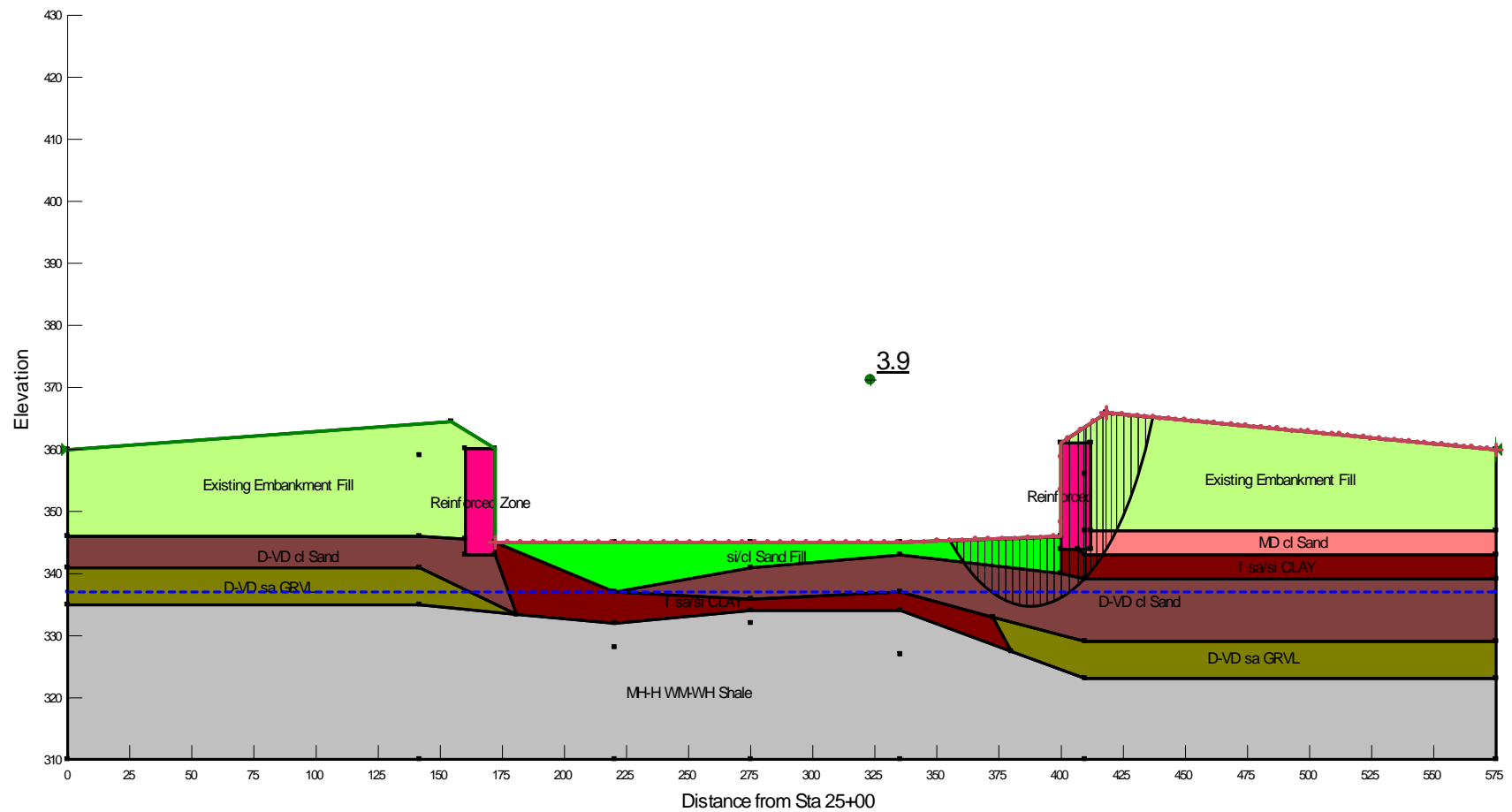
Results of Stability Analyses – Seismic Condition ($k_h = 0.5A_s = 0.07$)
 2H:1V End Slope with MSE Wall FF @ North Abutment
 Cross Section @ Center Line Bridge
 South Street over I-30
 AHTD Job No. CA0601 – HWY 70 – Sevier St. (Widening)(S)

Summary of Stability Analysis Results
2H:1V End Slope with MSE Wall GG @ South Bridge Abutment
South Street over I-30
AHTD Job No. CA 0601 – HWY 70 – Sevier St. (Widening)(S)

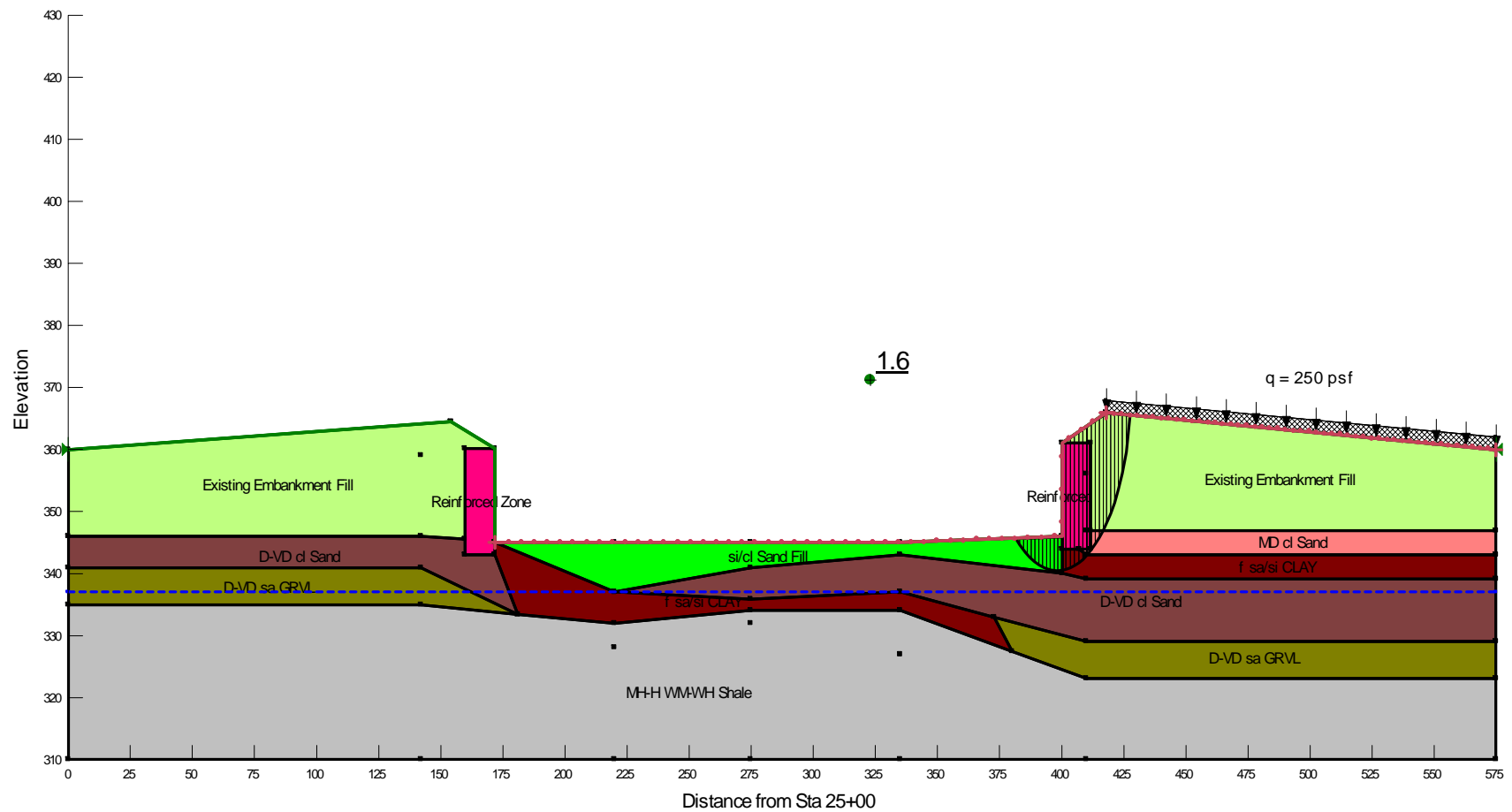
Bridge End	Design Loading Condition	Calculated Minimum Factor of Safety
Bent 5 (South Abutment)	End of Construction	3.9
	Long Term	1.6
	Seismic ($k_h = 0.5A_s = 0.07$)	1.5

Summary of Soil Strength Parameters

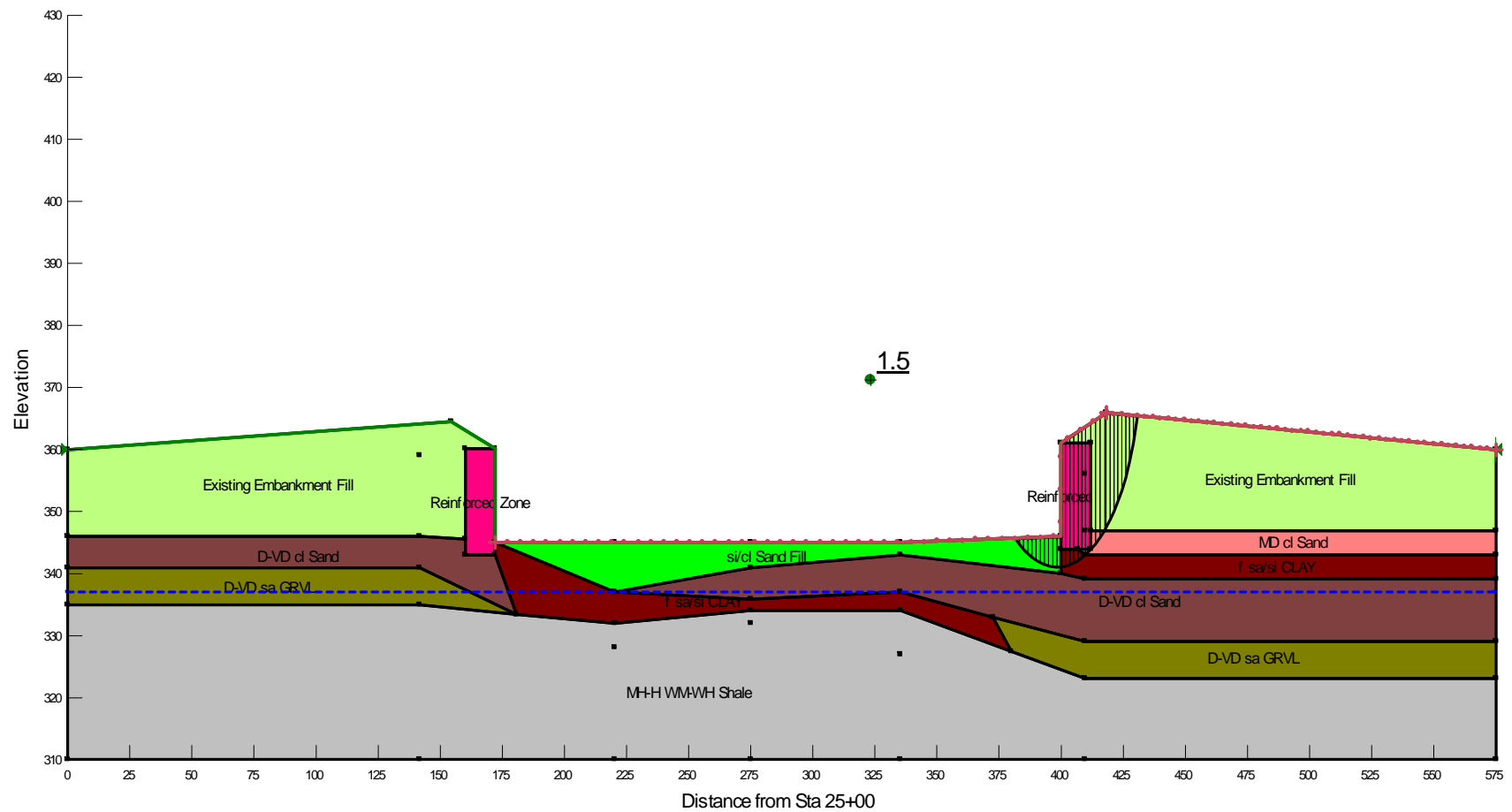
Soil Description	Total Unit Weight (γ) pcf	Undrained Shear Strength (s_u) psf	Effective Cohesion (c') psf	Effective Friction Angle (ϕ') deg
Existing Embankment Fill	110	2500	250	25
Dense to Very Dense clayey Sand	125	0	0	35
Dense to Very Dense sandy Gravel	130	0	0	40
Silty/Clayey Sand Fill	125	0	0	34
Fine sandy/silty Clay	111	1125	200	20
Medium Dense clayey Sand	120	0	0	33
Moderately Hard to Hard Moderately to Highly Weathered Shale	135	4000	1000	20



Results of Stability Analyses – End of Construction Condition
 2H:1V End Slope with MSE Wall GG @ South Abutment
 Cross Section @ Center Line Bridge
 South Street over I-30
 AHTD Job No. CA0601 – HWY 70 – Sevier St. (Widening)(S)



Results of Stability Analyses – Long Term Condition
 2H:1V End Slope with MSE Wall GG @ South Abutment
 Cross Section @ Center Line Bridge
 South Street over I-30
 AHTD Job No. CA0601 – HWY 70 – Sevier St. (Widening)(S)



Results of Stability Analyses – Seismic Condition ($k_h = 0.5A_s = 0.07$)
 2H:1V End Slope with MSE Wall GG @ South Abutment
 Cross Section @ Center Line Bridge
 South Street over I-30
 AHTD Job No. CA0601 – HWY 70 – Sevier St. (Widening)(S)

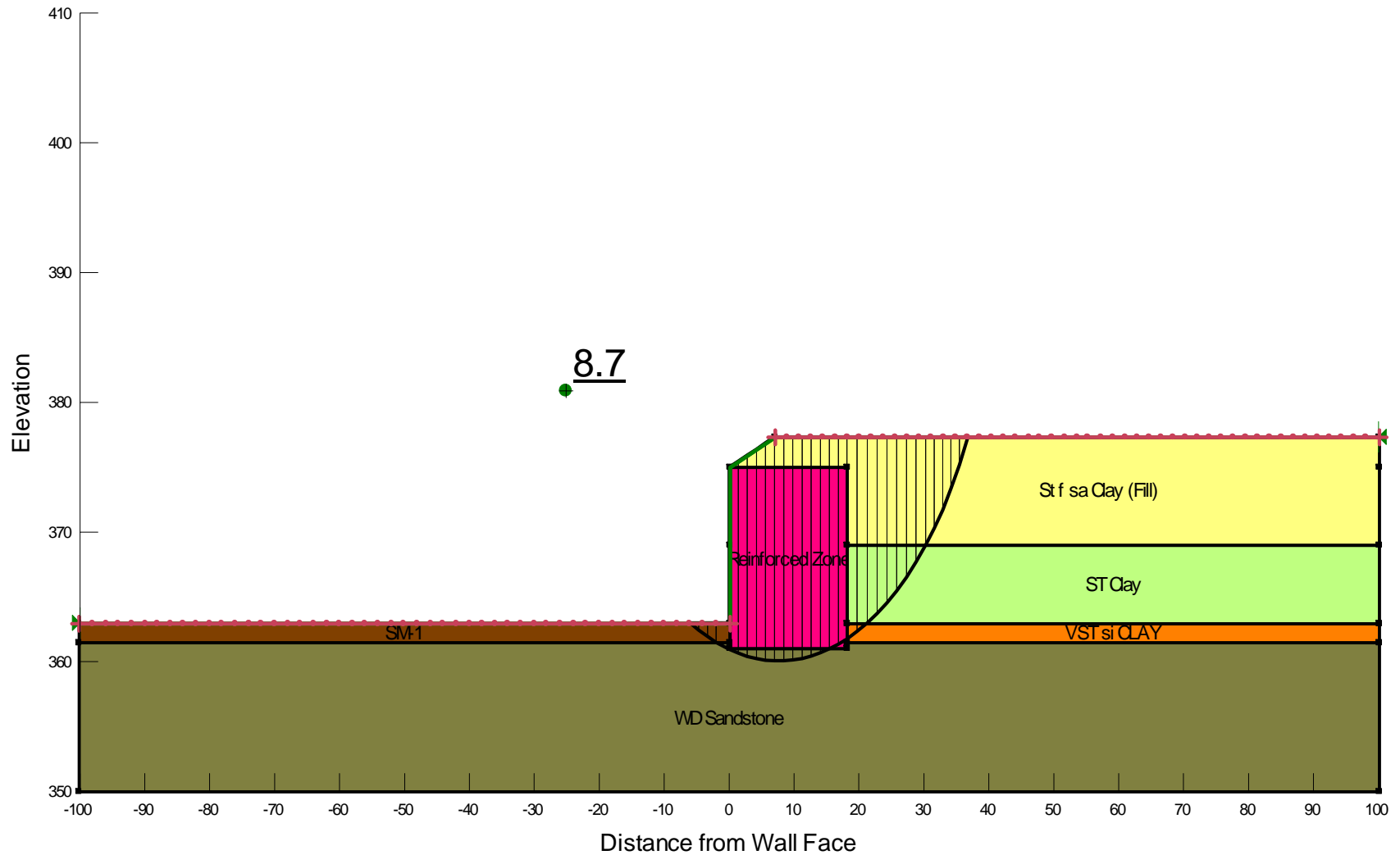
ATTACHMENT 16

Summary of Stability Analysis Results
Soil Nail Wall BB @ Sta 08+42
AHTD Job No. CA 0601 – HWY 70 – Sevier St. (Widening)(S)

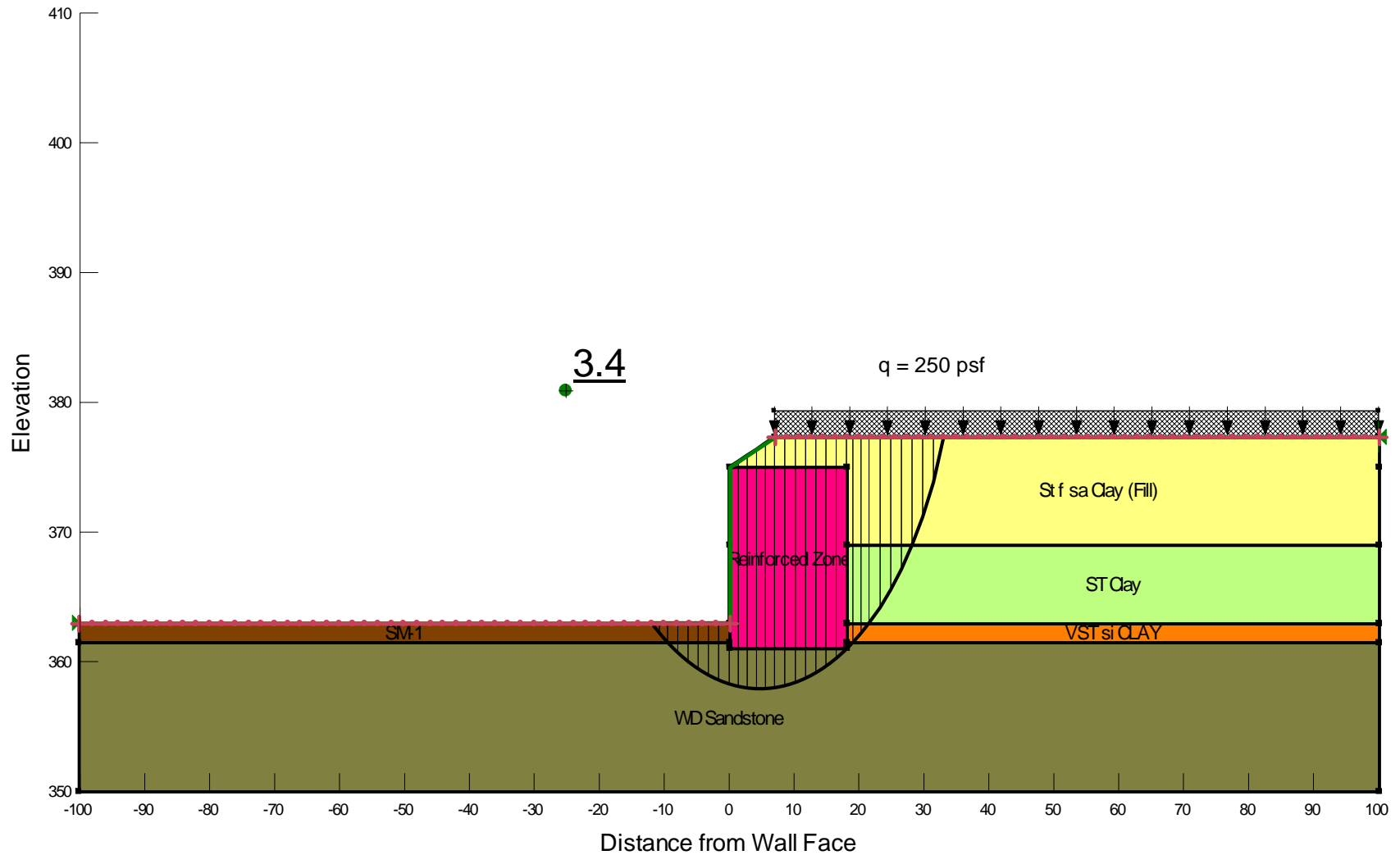
Design Loading Condition	Calculated Minimum Factor of Safety
End of Construction	8.7
Long Term	3.4
Seismic ($k_h = 0.5A_s = 0.07$)	2.9

Summary of Soil Strength Parameters

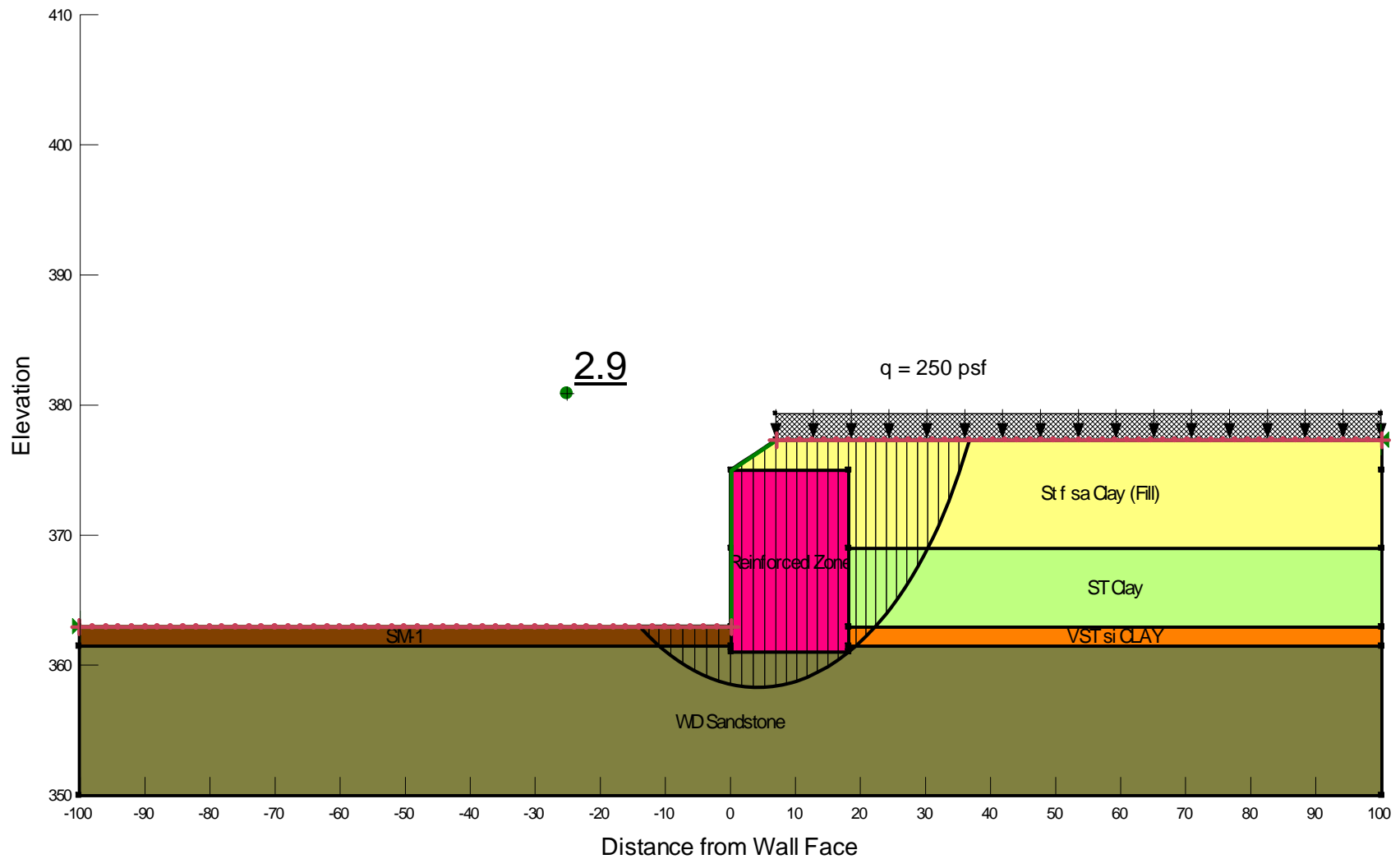
Soil Description	Total Unit Weight (γ) pcf	Undrained Shear Strength (s_u) psf	Effective Cohesion (c') psf	Effective Friction Angle (ϕ') deg
Stiff fine sandy Clay (Fill)	125	750	750	0
Stiff Clay	115	1000	200	20
Very Stiff silty Clay	125	2500	200	20
SM-1	125	0	0	32
Weathered Sandstone	140	4000	1000	20



Results of Stability Analyses – End of Construction Condition
 Soil Nail Wall BB @ Sta 08+42
 AHTD Job No. CA0601 – HWY 70 – Sevier St. (Widening)(S)



Results of Stability Analyses – Long Term Condition
 Soil Nail Wall BB @ Sta 08+42
 AHTD Job No. CA0601 – HWY 70 – Sevier St. (Widening)(S)



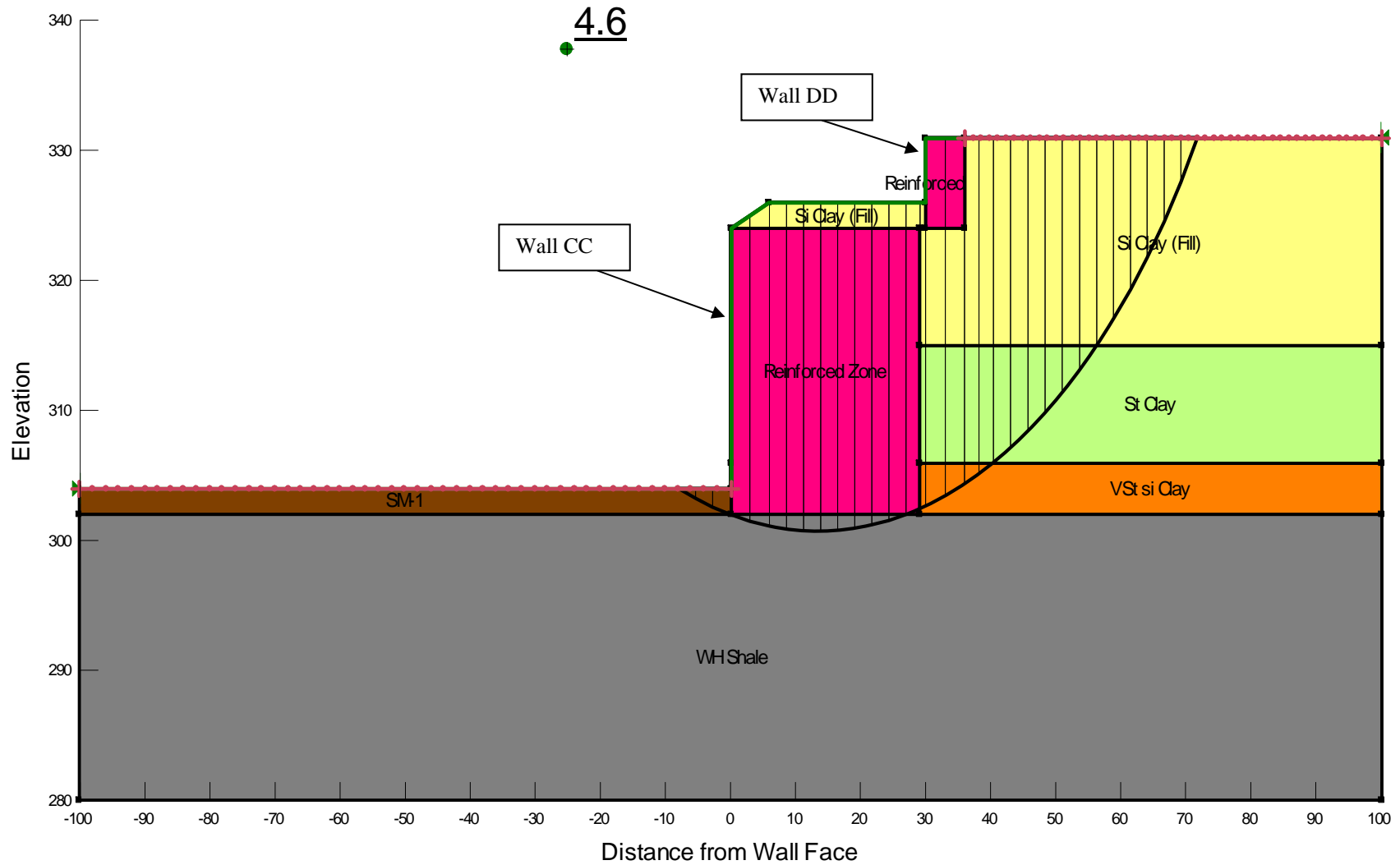
Results of Stability Analyses – Seismic Condition ($k_h = 0.5A_S = 0.07$)
 Soil Nail Wall BB @ Sta 08+42
 AHTD Job No. CA0601 – HWY 70 – Sevier St. (Widening)(S)

Summary of Stability Analysis Results
Soil Nail Wall CC @ Sta 05+27
AHTD Job No. CA 0601 – HWY 70 – Sevier St. (Widening)(S)

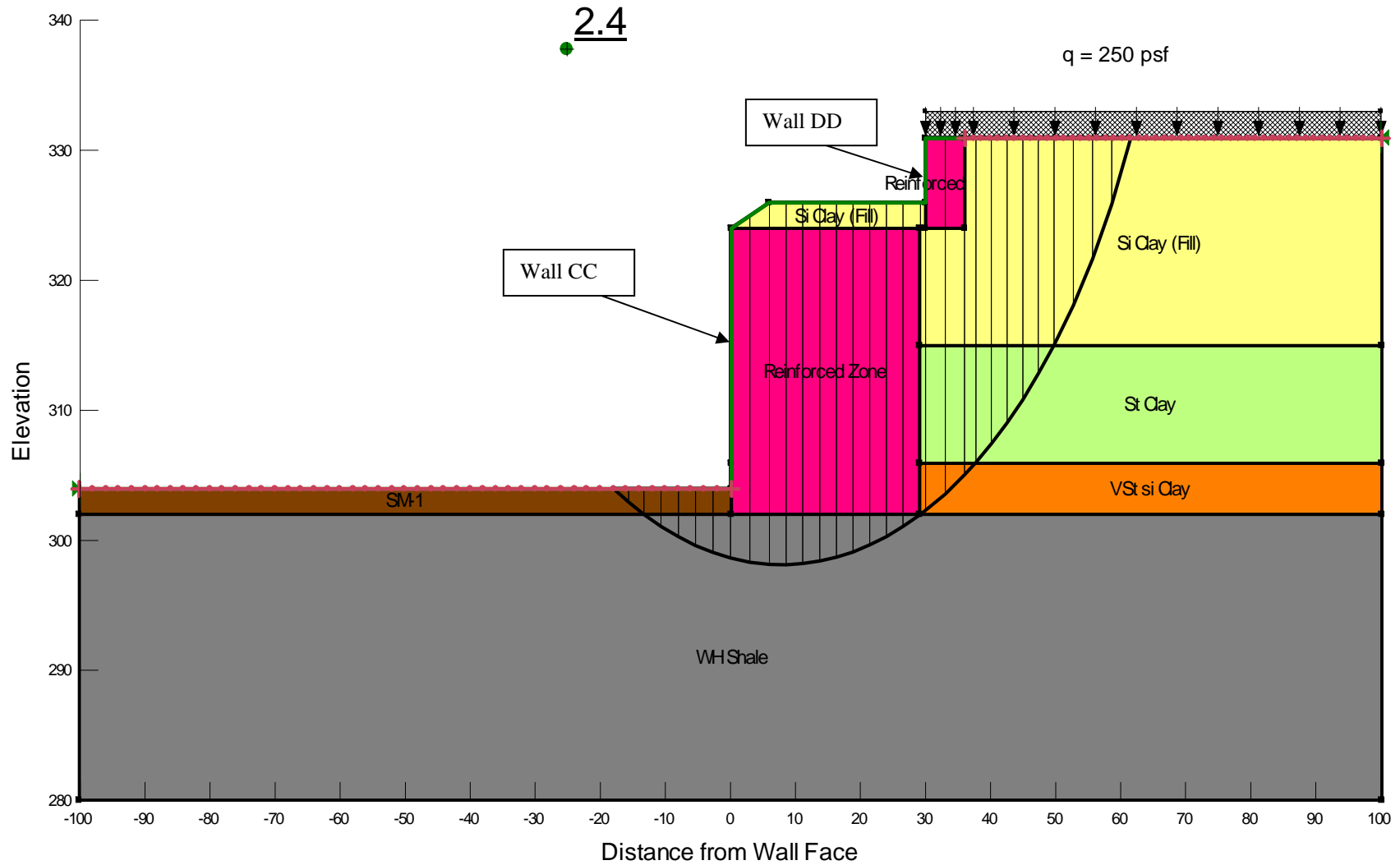
Design Loading Condition	Calculated Minimum Factor of Safety
End of Construction	4.6
Long Term	2.4
Seismic ($k_h = 0.5A_s = 0.07$)	2.0

Summary of Soil Strength Parameters

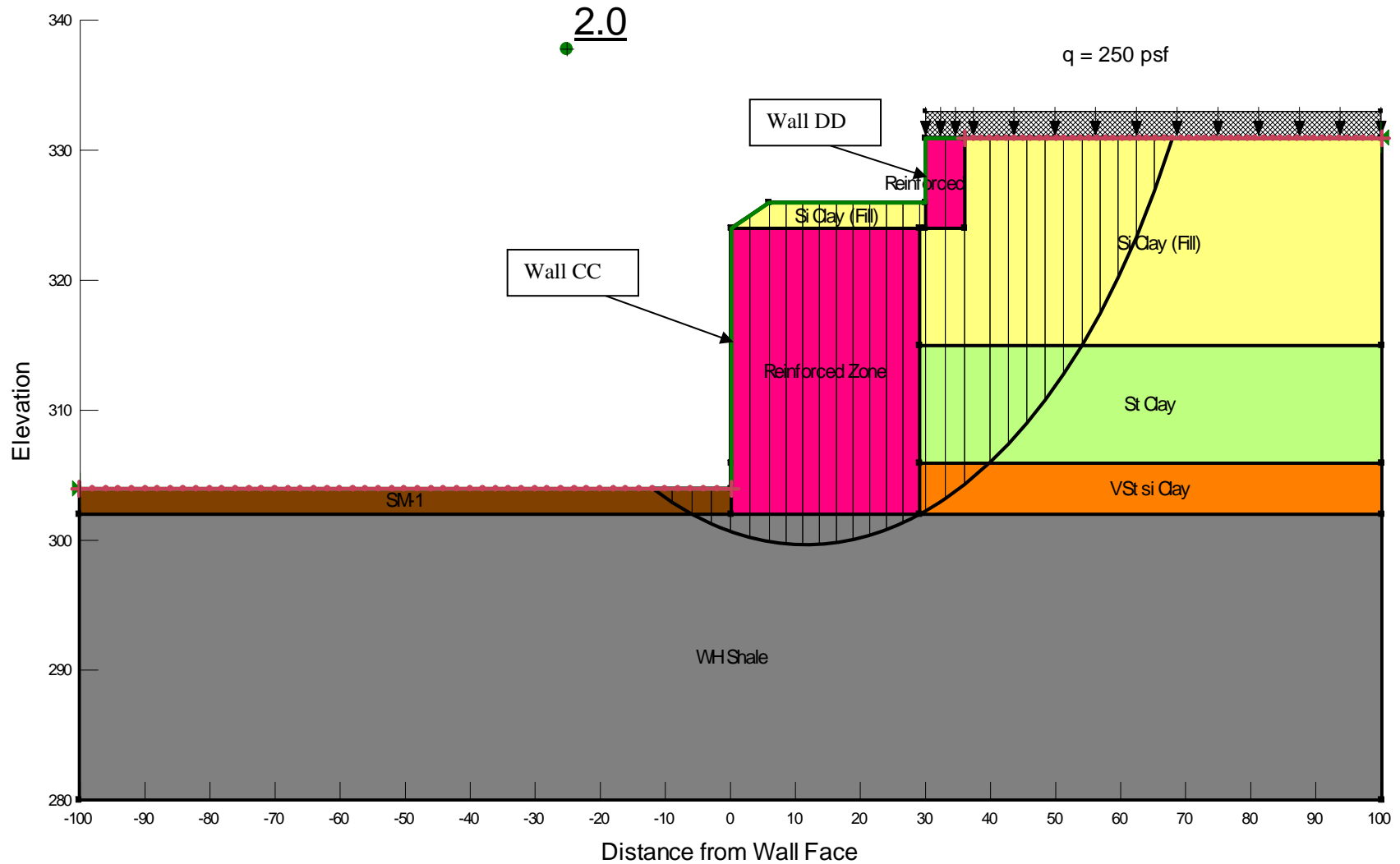
Soil Description	Total Unit Weight (γ) pcf	Undrained Shear Strength (s_u) psf	Effective Cohesion (c') psf	Effective Friction Angle (ϕ') deg
Silty Clay (Fill)	125	750	750	0
Stiff Clay	115	1250	200	20
Very Stiff silty Clay	125	3000	200	20
SM-1	125	0	0	32
Weathered Shale	135	4000	1000	20



Results of Stability Analyses – End of Construction Condition
 Soil Nail Wall CC @ Sta 05+27
 AHTD Job No. CA0601 – HWY 70 – Sevier St. (Widening)(S)



Results of Stability Analyses – Long Term Condition
 Soil Nail Wall CC @ Sta 05+27
 AHTD Job No. CA0601 – HWY 70 – Sevier St. (Widening)(S)



Results of Stability Analyses – Seismic Condition ($k_h = 0.5A_s = 0.07$)
 Soil Nail Wall CC @ Sta 05+27
 AHTD Job No. CA0601 – HWY 70 – Sevier St. (Widening)(S)