

**PRELIMINARY GEOTECHNICAL REPORT
DESIGN-BUILD GEOTECHNICAL STUDY
RECONSTRUCTION OF I-440
I-440 BRIDGE OVER I-65
PROJECT NO. 19014-1169-04
PIN NO. 125325.00
DAVIDSON COUNTY**

Introduction

The Tennessee Department of Transportation (TDOT) is planning to widen Interstate 440 (I-440) for the referenced design-build project. The project is located in Davidson County, Tennessee. The preliminary bridge plans indicate the overall bridge length is approximately 1028 feet, beginning at approximate Station 244+58 and ending at approximate Station 355+45. The current configuration includes 6 spans supported by 5 piers ranging in height of approximately 54 feet to 77 feet. This report addresses preliminary geotechnical site investigation for the bridge foundation. Based on the preliminary data the scope of the widening project is to widen I-440 on inside of two existing bridges. The information presented herein is based on the geology, topography, and the information collected during subsurface exploration. This preliminary report is intended to aid the design build teams in the development of an appropriate scope for designing the geotechnical aspect of the project.

Geology, Soils, and Site Conditions

The project is located in Central Tennessee within the Central Basin Physiographical Region. The topography of the project vicinity is characterized as undulating. The geologic map of the area indicates that the project is underlain by bedrock representing the Bigby-Cannon Limestone and Hermitage Formation. The Bigby-Cannon Formation is considered to be medium to light gray, coarse-grained, medium-bedded limestone with occasional shale partings and brown-gray phosphate pellets and cryptograined to medium-gray. Hermitage Formation is a medium to dark blue-gray, thin bedded to laminated, sandy and argillaceous limestone with shale, nodular shaly limestone, and phosphatic calcarenite. The residuum resulting from the in-place weathering of the Hermitage Formation typically consists of a yellow-brown clay soil.

Surface and Subsurface Investigation

A subsurface exploration was completed by the Geotechnical Engineering Section (GES) and sub-contractor American Engineering, Inc. The purpose of the subsurface exploration was to explore and characterize the subsurface soil and underlying limestone bedrock conditions to provide the design build teams with a better understanding of the subsurface condition at the foundation locations. The summary and the results of geotechnical drilling and lab testing performed on the samples obtained are attached in the appendix at this report.

The subsurface exploration originally consisted of 5 test boring, however due to access issues, only 4 test boings were completed. The borings were proposed between the existing piers. Rock coring was performed at each boring locations to evaluate bedrock conditions. The test borings generally encountered surface materials consisting of topsoil ranging depths up to 2.5 feet. Beneath the topsoil the subsurface profile consists of moist brown to gray lean clay. The borings depth ranges from 17.5 to 63.5 feet, below ground surface. Table 1 provides a summary of the stations, offsets, elevations, and depths of the borings for the bridge exploration. See appendix for boing layout.

Table 1 Boring Summary

Hole No.	Surface Elevation (msl)	Soil Depth (ft.)	Auger Refusal Elevation (msl)	Length of Rock Core (ft.)	Total Depth (ft.)	Bottom of Hole Elevation (msl)
BR-1	489.6	0.2	0.2	25	25.2	464.4
BR-2	485	0.1	0.1	15	15.1	469.9
BR-3	485	2.3	2.5	14.8	17.3	467.7
BR-4	No drilling performed.					
BR-5	535	17.5	17.5	46	63.5	471.5

Total of 8 samples were taken back to the laboratory for unconfined compressive strength tests. Table 2 summarizes the laboratory results.

Table 2 Rock Compressive Strength Data

Boring No.	Depth of Sample (ft.)	Approximate Elevation (msl)	Compressive Strength (psi)
BR-1	18.2	471	7,520
BR-1	18.8	466	10,549
BR-2	9.8	475	10,888
BR-2	15	470	8,598
BR-3	11	474	11,777
BR-3	15	470	4,504
BR-5	55	480	9,085
BR-5	62	473	12,166

Discussion

This report and the attached information should be sufficient information for the design-build teams to determine what amount of additional geotechnical information would be required to help complete the geotechnical aspects of this project. Based on the geotechnical exploration it is suggested that piers 1 through 5 be supported either by spread footings placed on competent rock or by drilled shafts.

If spread footings are consider as an option, approximately of 9 to 17 feet of excavation, to the approximate elevation of 473 to 489 feet, will be required to reach competent rock. Due to proximately to the existing railroad tracks and ramps, we were not able to drill in this location. Therefore, the rock elevation for this pier was approximated by plotting the rock elevations at the other boring locations and interpolating the rock line. Table 3 provides a summary of the approximately bearing elevation for spread footings.

Table 3 Approximately Bearing Elevation for Spread Footing

Pier No.	Approx. Bearing Elevation (msl)
1	473
2	477
3	477
4	489
5	481

If drilled shafts are consider as options, the top of the rock socket shall be located no higher than elevation shown on Table 4 and extend to the final depth as required by AASHTO guidelines. The final end bearing elevations for drilled shafts shall be determined during construction. For each shaft, at least 1 core hole shall be pre-drilled in order to verify the appropriate end bearing elevation and conditions for shaft installation, this hole shall extend at least 10 feet below the estimated end bearing elevation. See TDOT Special Provision 625 for details on drilled shaft installation and procedures.

Table 4 Approximately Top of Rock Socket

Pier No.	Top of Rock Socket Elevation (msl)
1	473
2	478
3	477
4	489
5	481

It shall be noted that advance geotechnical investigation will be required prior to final design and more laboratory testing will be required to design and reconstruct the piers foundation for the bridge project.

If you have any questions, comments, and/or concerns, please contact the Geotechnical Engineering Section.

A handwritten signature in black ink, appearing to read "Besmir", followed by the date "9-21-2017" written vertically.

Besmir Zenelaku, E.I.
Transportation Project Specialist



Travis W. Smith, P.E.
CE Manager 1

APPENDIX A

Boring Logs

CLIENT TDOT

PROJECT NAME I-440

PROJECT NUMBER 216-137

PROJECT LOCATION Nashville, TN

DATE STARTED 8/28/17

COMPLETED 8/28/17

GROUND ELEVATION 489.6 ft

DRILLER Adam Thompson

GROUND WATER LEVELS:

DRILLING METHOD HSA/ Diamond impregnated coring bit

AT TIME OF DRILLING ---

LOGGED BY Jackson Daugherty

CHECKED BY Dennis Mitchell

AT END OF DRILLING ---

NOTES

AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N-VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			REMARKS
								LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0		TOPSOIL (2.5")									
5		LIMESTONE, dark to light gray, thinly to thickly bedded, hard, fossiliferous, containing brachiopods, highly fractured, with clay seams intermittent	RC 1	50 (0)							Highly fractured with clay seams from 0.2' to 10.2'
10			RC 2	60 (8)							
15			RC 3	2 (0)							Clay filled void from 10.2' to 16.0'
20		LIMESTONE, dark to light gray, thinly to thickly bedded, moderately hard, some weathered clay seams	RC 4	80 (40)							
25			RC 5	86 (60)							

Refusal at 0.2 feet.
Bottom of borehole at 25.2 feet.

GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 9/19/17 09:01 - T:\GEOTECH SUPPORT\TDOT\REGION 3 ON-CALL SERVICES 2016-2020\1-440\GEOTECH\LAB TESTING\1-440.GPJ

CLIENT TDOT

PROJECT NAME I-440

PROJECT NUMBER 216-137

PROJECT LOCATION Nashville, TN

DATE STARTED 8/31/17

COMPLETED 8/31/17

GROUND ELEVATION 485.3 ft

DRILLER Adam Thompson

GROUND WATER LEVELS:

DRILLING METHOD HSA/ Diamond impregnated coring bit

AT TIME OF DRILLING ---

LOGGED BY Jackson Daugherty

CHECKED BY Dennis Mitchell

AT END OF DRILLING ---

NOTES

AFTER DRILLING ---

[illegible]

Refusal at 0.1 feet.
Bottom of borehole at 15.1 feet.

**AMERICAN ENGINEERS, INC.**

PROFESSIONAL ENGINEERING

65 Aberdeen Drive
Glasgow, KY 42141
(270) 651-7220**BR-3**

PAGE 1 OF 1

CLIENT TDOTPROJECT NAME I-440PROJECT NUMBER 216-137PROJECT LOCATION Nashville, TNDATE STARTED 9/7/17 COMPLETED 9/7/17GROUND ELEVATION 485 ftDRILLER Adam Thompson

GROUND WATER LEVELS:

DRILLING METHOD HSA/ Diamond impregnated coring bitAT TIME OF DRILLING ---LOGGED BY Nathaniel Blackburn CHECKED BY Dennis MitchellAT END OF DRILLING ---NOTES ---AFTER DRILLING ---

GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 9/19/17 09:01 - T:\GEOTECH SUPPORT\TDOT\REGION 3 ON-CALL SERVICES 2016-2020\I-440\GEOTECH\LAB TESTING\I-440.GPJ

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N-VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			REMARKS
								LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0		CONCRETE (10.75")									
		CRUSHED STONE BASE (3.5")									
		LIMESTONE, medium to light gray, thinly bedded, fractured	SPT 1	125	11-30-16	N/A					SPT sample driven to 3.0 feet likely due to sloping rock or boulder
			RC 2	70 (24)	(46)						
5											
			RC 3	100 (40)							
10											
			RC 4	100 (80)							
15											

Refusal at 2.3 feet.
Bottom of borehole at 17.3 feet.

**AMERICAN ENGINEERS, INC.**

PROFESSIONAL ENGINEERING

65 Aberdeen Drive
Glasgow, KY 42141
(270) 651-7220**BR-5**

PAGE 1 OF 2

CLIENT TDOTPROJECT NAME I-440PROJECT NUMBER 216-137PROJECT LOCATION Nashville, TNDATE STARTED 9/11/17COMPLETED 9/13/17GROUND ELEVATION 535 ftDRILLER Adam Thompson

GROUND WATER LEVELS:

DRILLING METHOD HSA/ Diamond impregnated coring bitAT TIME OF DRILLING ---LOGGED BY Jacob CowanCHECKED BY Dennis MitchellAT END OF DRILLING ---

NOTES

AFTER DRILLING ---

GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 9/19/17 09:01 - T:\GEOTECH SUPPORT\TDOT\REGION 3 ON-CALL SERVICES 2016-2020\I-440\GEOTECH\LAB TESTING\I-440.GPJ

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N-VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			REMARKS
								LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0		TOPSOIL (26.5")									
		(CL) lean CLAY with some gravel, light brown, moist, very stiff to soft	SPT 1	73	3-8-9 (17)	4.5+					
5			SPT 2	67	4-4-3 (7)	1.75					
			SPT 3	33	4-5-11 (16)	1.5					
10			SPT 4	47	1-3-4 (7)	1.25					
15			SPT 5	0	1-2-1 (3)	N/A					
20		LIMESTONE, gray, medium grained, laminated to thinly bedded, hard, weathered, boulder fill	RC 6	33 (0)							
			RC 7	46 (28)							Clay seam from 20.5' to 20.8' Clay seam from 21.4' to 21.7'
25			RC 8	10 (0)							
30			RC 9	38 (24)							
35											

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PROJECT LOCATION Nashville, TN

GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 9/19/17 09:01 - T:\GEOTECH SUPPORT\TDOT\REGION 3 ON-CALL SERVICES 2016-2020\1-440\GEOTECH\LAB TESTING\1-440.GPJ

Refusal at 17.5 feet.
Bottom of borehole at 63.5 feet.

8/11/17
Box 1 of 2
217-216
101-110111
01241/B-2

0.2'

10.2'

15.2'

5.2'

20.2'

25.2'

TDOT
I 440
BR-1

TDOT
I-440
BR 2

BR 2

5.1

10.1

15.1

216-137
TDOT

DOT
2440
Boring BR-1
Box 1 of 1

216-137

TDOT I-440

BR-3

Box 1 of 1

2.3'

12.3'

7.3'

17.3

TDOT 440
216-137

TDOT I-440
BR-4



455

505

605

635

555

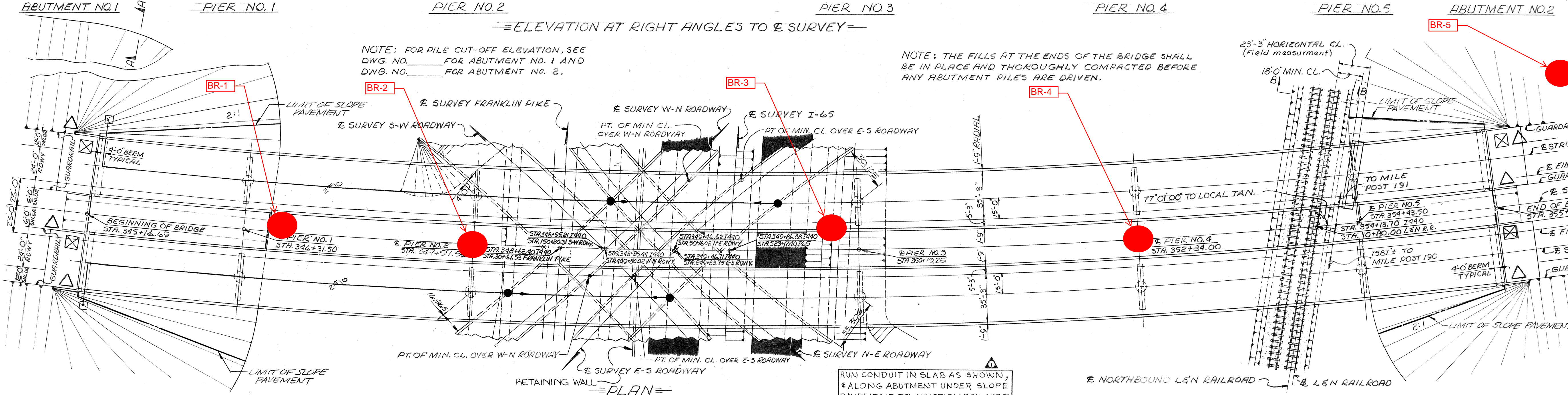
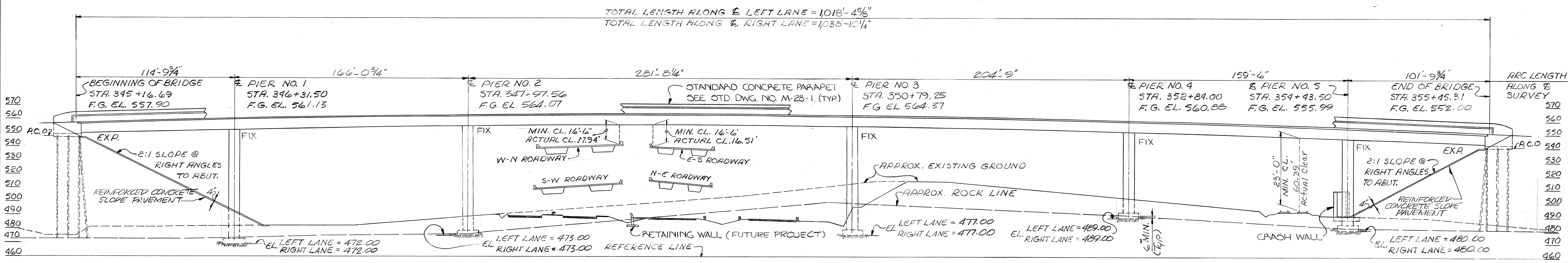


APPENDIX B

Boring Layout

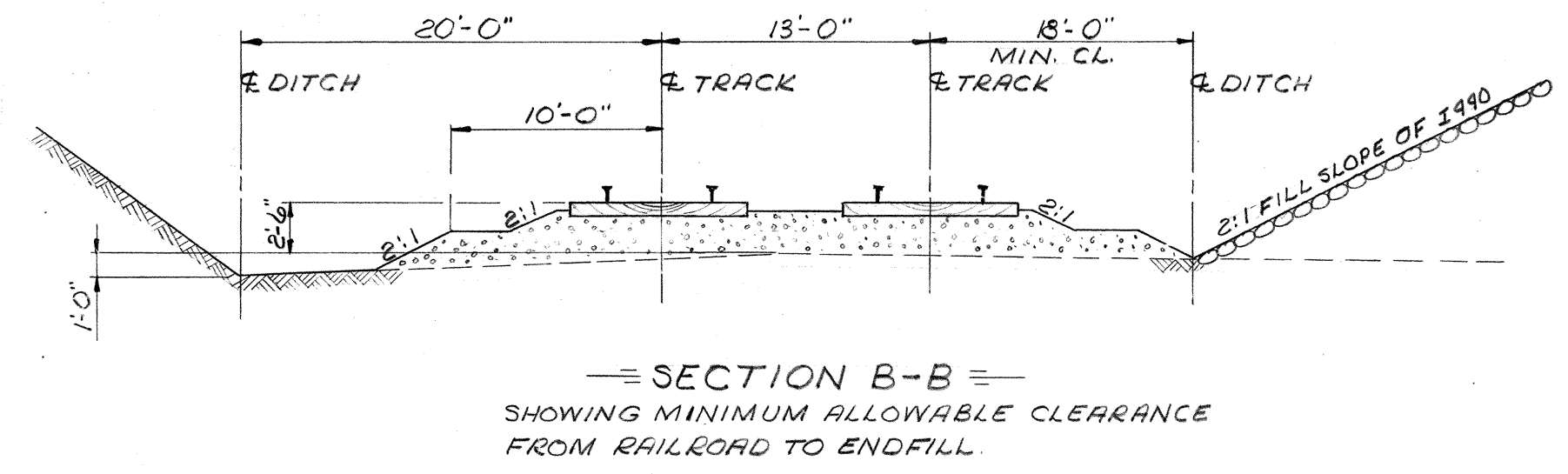
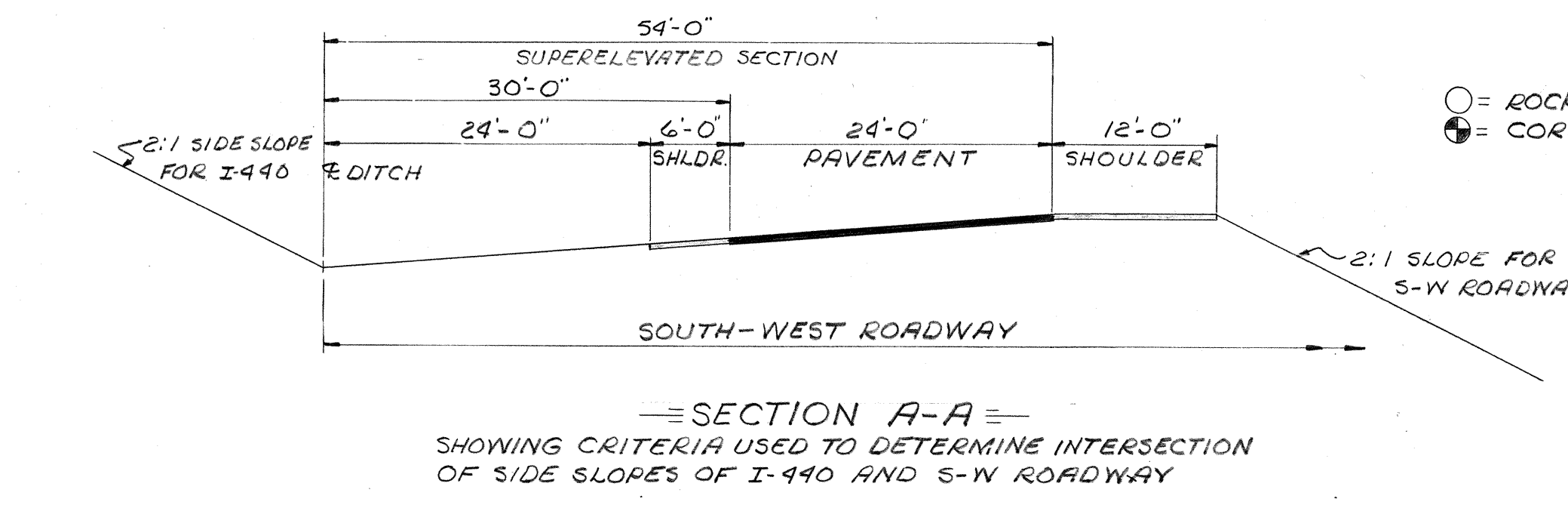
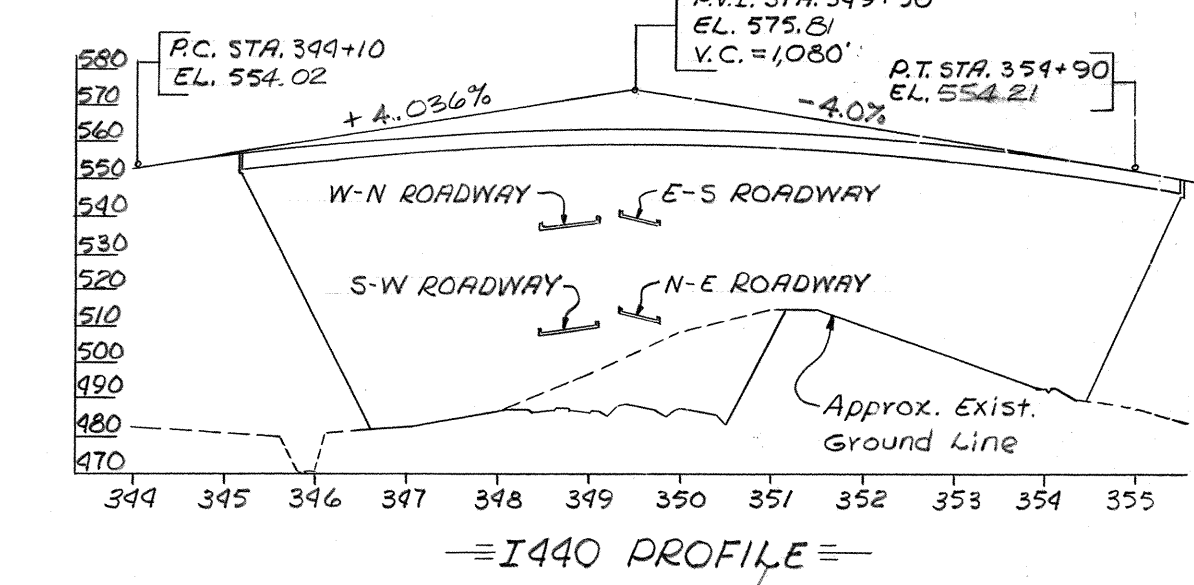
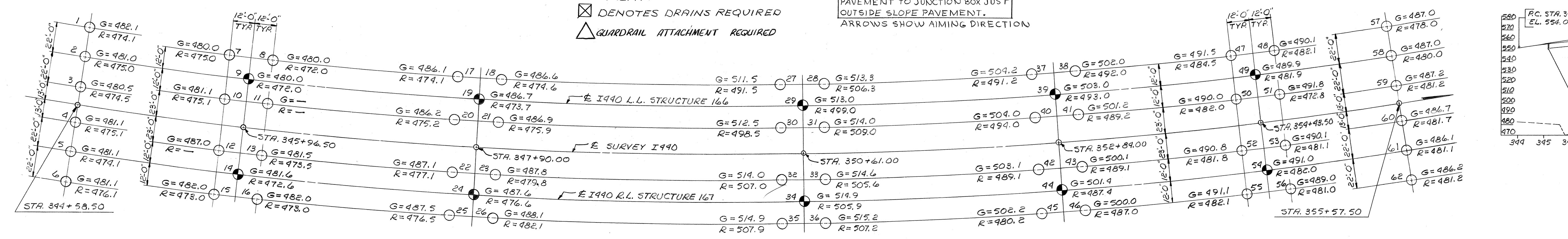
CONSTRUCTION NO. 19015-3113-44					
FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
3	TENN.	I-440-4(48)211	1982		

REVISIONS				
NO.	DATE	BY	BRIEF DESCRIPTION	
1	1/4/83	C.M.H.	LIGHTING	



I-440 CURVE DATA

P.I. STA. 349+65.28
 $\Delta c = 27^{\circ} 04' 43.5''$ LT
 $Dc = 1^{\circ} 30'$
 $T = 919.81'$
 $Lc = 1805.25'$
 $E = 109.19'$
 $R = 3819.72'$
 $S.E. = 0.036\%$
 $C.C.N. = 632,161.47'$
 $E = 1,770,791.96'$
P.C. STA. 340+45.47
 $N = 628,343.20'$
 $E = 1,770,636.96'$



2-42'-0" ROADWAYS

STATE OF TENNESSEE
DEPARTMENT OF HIGHWAYS
NASHVILLE

LAYOUT OF BRIDGE NO. 166 & 167
I440-I65 DIRECTIONAL INTERCHANGE
4 LEVEL GRADE SEPARATION
I440 STRUCTURES
DAVIDSON COUNTY
1982

CORRECT: *Clifton L. Loveall*
BRIDGE ENGINEER

APPROVED: *David Evans*
STATE HIGHWAY ENGINEER

M-15-93

DESIGNED BY C.M. HILES DATE 1981
DRAWN BY M.D. DATE MAY 1981
CHECKED BY C.M. HILES DATE 198