BRIDGE HYDRAULIC ANALYSIS/
DESIGN STUDY
FOR
THE PROPOSED CONSTRUCTION
OF

BRIDGE REPLACEMENT ON US 301 SB OVER FOUR HOLE SWAMP

FILE NO.: 38.040308 **PIN:** 40308

ORANGEBURG COUNTY, SOUTH CAROLINA

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Reviewed by: G. Randall Mungo, PE, RPG 3 Hydraulic Engineer

September 19, 2014

Not for Construction

BRIDGE HYDRAULIC ANALYSIS/DESIGN STUDY
US 301 SB BRIDGE OVER FOUR WHOLE SWAMP
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GENERAL SUPPORTING INFORMATION

A. GENERAL NARRATIVE

This bridge hydraulic analysis/design study was prepared for the bridge replacement project for US 301 South Bound over the Four Hole Swamp in Orangeburg County, South Carolina. The location is just over eleven miles from the city of Orangeburg, South Carolina. SCDOT maintenance has rated the bridge to be deficient. The existing bridge was last rebuilt around 1950.

The Four Hole Swamp bridge is proposed for replacement in the same alignment as the current bridge. The completion of this project would increase road safety. The purpose of this study is to analyze and design a replacement structure that meets SCDOT guidelines and requirements for the hydraulic design of bridges. This study included bridge hydraulics, bridge scour, and the impacts of the proposed project on water surface elevations of the Four Hole Swamp floodplain.

The project consists of about a third mile of roadway and bridge construction. Improvements to the road embankments will include raising the roadway elevation to meet the new finish grade for the bridge and widening of the road. The surrounding area is primarily rural area comprised of woods and swamps. A vicinity map showing the project area is included as Figure 1. This map was obtained from the Mapping and Graphics Division of the SCDOT.

The hydraulic and stormwater management design study was conducted according to the requirements presented in the 2009 document "SCDOT Requirements for Hydraulic Design Studies." Information used in this study was obtained from the SCDOT roadway plans, USGS 7.5 minute quadrangle maps, Soil Conservation Service soil survey and aerial photography, a field investigation, and other sources.

B. TOPOGRAPHIC MAPS

Three types of topographic data were used for this project. SCDOT topographic survey was used for area within the survey's boundaries. United States Geological Survey (USGS) topographic map, with a scale of 1 inch = 2,000 feet and a contour interval of 10 feet, was used for offsite drainage. The project area is on the quadrant sheet Indian Branch. The proposed location of the improvement is shown in Figure 2. Any discrepancies in topographic data are due to errors and omissions from the entity that developed the survey.

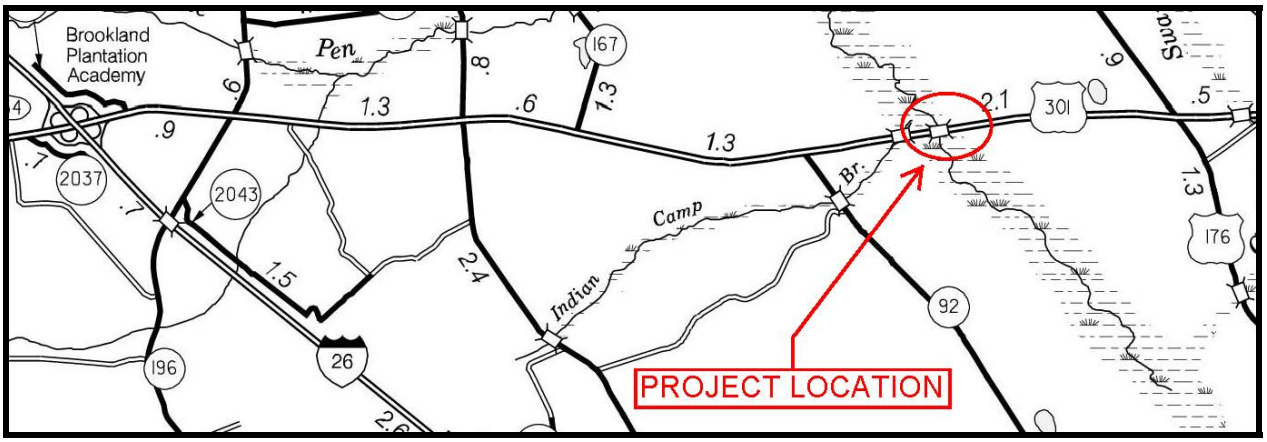


Figure 1: Vicinity Map (SCDOT)

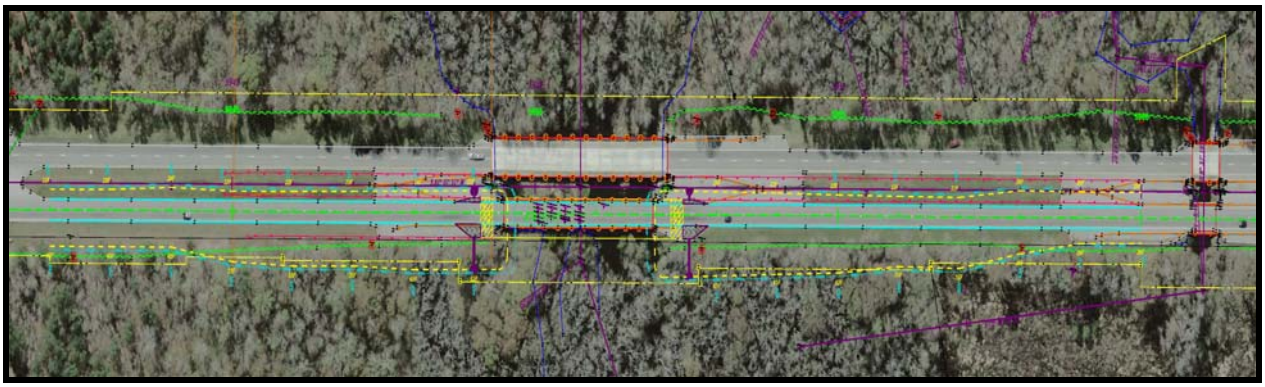


Figure 2: Map of the Site and Vicinity

C. SOILS CONDITIONS

The topsoil located around the project site is described in Table 1. The soil map came from the Soil Surveys of Orangeburg County, South Carolina from the Natural Resource Conservation Service (NRCS) and it is found in Appendix D. The soils were found to be fine soils. Soil conditions for design of the sedimentation and erosion controls will be based on coarse soils found in the Lower Coastal Plain of South Carolina In addition, information for soil boring at the existing bridge are included in the appendix.

Table 1: Soils At and Near Project

SOIL SERIES	HSG	DEPTHS (in)	K	D15 (mm)	1.4	1	0.063	0.044	0.038 (%)	0.004	0.003	0.001	Coarse/Fine
MOUZON	(D)	0-11	0.2	0.01	100	89	62.5	40.1	39.1	5	3.1	0	Fine
		11-31	0.2	0.01	100	83	45.3	34.3	34.3	7.7	5.2	0	Fine
		31-46	0.2	0.01	100	83	43.9	28	28	6.7	4.6	0	Fine
		46-72	0.15	0.04	100	86	53.4	15.4	15.4	3.7	2.5	0	Coarse

D. LAND USE / FUTURE DEVELOPMENT

The current landuse connected to the project site is mostly rural with forest and swamps. Due to the watershed distance from major cities and towns, it is doubtful that there would be a significant change in land use in the near term.

E. FLOODWAY DATA

The proposed project is located on the *Flood Insurance Rate Map for Lexington County, South Carolina Number 45075C0410C*. All of the project area is classified by FEMA as Zone AE with Base Flood Elevations and Unshaded Zone X (areas outside of the 0.2% annual chance floodplain). The map and BFE table are in Appendix E.

F. HYDROLOGIC DESIGN DATA

In accordance with SCDOT requirements, the analysis of the natural, current, and proposed conditions was carried out using a 50-year design storm. Because the drainage area is over 0.1 square miles in size, the USGS regression equations found in USGS SIR 2009-5156 were used to calculate the flow rates for this study. The size of the determined drainage area was 136 square miles. The Log Person Type III was not used since the USGS does not have a gauge on this part of the creek. The results from this study are attached in Appendix A. Additional detailed are in the hydraulic analysis section of this report.

BRIDGE HYDRAULIC ANALYSIS

A. PROJECT BOUNDARIES

This project includes more than 0.34 miles of improvements at the US 301 SB Bridge over Four Hole Swamp. The project boundaries are approximately 730 ft. North and 775 ft. South of the Bridge. Slopes in the project area are mild. The approach used by the project engineer was to rework and improve the present flow paths of the stormwater to meet the needs of the desired improvement to the roadways.

B. BACKGROUND

This bridge hydraulic design study presents the hydraulic analysis and design for the proposed bridge replacement project for the South Bound lanes of US 301 in Orangeburg County, South Carolina. The study investigated the bridge hydraulics, bridge scour, and the impacts of the proposed project on water surface elevations of the Four Hole Swamp floodplain. This project will keep same alignment as the current bridge. A field inspection was made on January 9, 2013.

C. SCOPE OF WORK

Tasks completed for this study included performing the bridge hydraulic analysis for the current and proposed bridges using the Hydrologic Engineering Center River Analysis System software, HEC-RAS (Version 4.1). The analysis and design follows the guidelines presented in *SCDOT Requirements for Hydraulic Design Studies*, dated May 26, 2009. Establishment of the final grades for the roadway and bridge approaches were made by using the proposed bridge pier, span, and abutment configurations provided by the bridge design department as the basis of the hydraulic design analysis. The existing bridge is a 220 ft eleven span bridge (all 22') will be replaced with a new 294 ft seven span (44'-44'-44'-44'-44'-44'-30'). The Proposed Bridge has approximately the same length the North Bound Bridge and a higher low cord to meet SCDOT guidelines. In addition, the Proposed bridge will be set on H-piles like the existing structure.

A scour analysis was carried out by computing the pier, abutment and contraction scour for the 1- and 0.2-percent-annual-chance floods. Procedures used to calculate scour followed the guidelines provided in United States Geological Survey (USGS) *publications Clear-Water Abutment and Contraction Scour in the Coastal Plain and Piedmont Province of South Carolina, Development and Evaluation of Clear-Water Pier and Contraction Scour Envelope Curves in the Coastal Plain and Piedmont Provinces of South Carolina, Development and Evaluation of Live-Bed Pier and Contraction Scour Envelope Curves in the Coastal Plain and Piedmont Provinces of South Carolina*, and *Modifications of Selected South Carolina Bridge-Scour Envelope Curves*. In addition, the Federal Highway Administration (FHWA) publications *Hydraulic Engineering Circular No. 18 (HEC-18): Evaluating Scour at Bridges and Hydraulic Engineering Circular No. 20 (HEC-20): Stream Stability at Highway Structures* were used as needed.

D. FLOODPLAIN ANALYSIS

The bridge configuration is described in the Bridge Hydrology Datasheet included in this document in Appendix C. The HEC-RAS computer software was used to develop water surface model for the natural conditions, existing bridge, and the proposed replacement bridge

configurations. Two different analysis were done: 1) SCDOT Hydraulic Design and 2) FEMA Floodplain Compliance.

1. SCDOT HYDRARULIC DESIGN

The purpose of this model and analysis was to meet SCDOT's design guidelines for Bridge Hydraulics. This analysis set the minimum bridge freeboard and to keep the Proposed Bridge's backwater less than 1 foot. The results of the comparison of the natural conditions, existing bridge, and proposed replacement bridge configuration water surface elevations are presented in Table 2. As the data shows, the proposed bridge led to an increase in backwater between the Natural and Proposed models of less than 1 foot. The total discharges for the Four Hole Swamp at US 301 are shown in Table 3. The box culvert was included in the model.

Summaries of the hydraulic modeling (HEC-RAS) are presented in this document for the natural conditions, existing bridge, and proposed bridge configurations for the 2-, 1- and 0.2-percent-annual-chance floods can be found in Appendix D through F.

Table 2: 100 Year Water Surface Elevation Comparision for Four Hole Swamp at US 301 in Orangeburg County

Cross Section	100-YEAR WATER SURFACE ELEVATION IN FEET (NGVD)			
	Natural Conditions	Existing Conditions	Proposed Conditions	Change
-800	118.14	119.42	119.06	0.92
-850	118.13	119.41	119.05	0.92
-900	118.12	119.41	119.04	0.92
-913	118.12	119.40	119.03	0.91
Bridge				
-1100	118.07	118.22	118.22	0.15
-1150	118.06	118.20	118.20	0.14
-1200	118.04	118.17	118.17	0.13

Table 3: Discharges For Four Hole Swamp At U S301in Orangeburg County

Event	50	100	500
Discharge	5890	7040	9640

2. FEMA COMPLIANCE

The purpose of this analysis was to meet FEMS's standards for a Zone AE with Base Flood Elevations. A model for existing conditions used to set the official base flood elevations for FEMA was provided by SCDNR's State NFIP Coordinator. The model was modified to contain the Proposed Bridge.

Summaries of the hydraulic modeling (HEC-RAS) are presented in this document for the existing bridge and proposed bridge configurations for the 1-percent-annual-chance floods can be found in Appendix K. The change in water surface elevation at the FIS cross sections is contained in Table 3. No increase in water surface elevation is created by the proposed bridge. The No Rise Certification is located in Appendix K.

Table 3: 100 Year Water Surface Elevation Comparision for Four Hole Swamp at US 301 in Orangeburg Count

Stream Station	100-YEAR WATER SURFACE ELEVATION IN FEET (NGVD 88)		
	FEMA Existing Conditions	Proposed Conditions	Change
146196	120.2	120.2	0.0
145196	119.8	119.8	0.0
144079	119.3	119.3	0.0
142488	118.5	118.5	0.0
141196	118.1	118.1	0.0
139981	117.8	117.8	0.0
138150	117.2	117.2	0.0
137985	Bridge	Bridge	
137863	117.0	117.0	0.0
137196	116.8	116.8	0.0
136196	116.5	116.5	0.0
135196	116.2	116.2	0.0
134196	115.9	115.9	0.0
133196	115.5	115.5	0.0
132196	115.1	115.1	0.0

E. SCOUR ANALYSIS

The scour analysis was conducted on US 301 SB proposed brdge. USGS Scour Regression Equations was the basis for the 100-Yr Scour Profile. In addtion, HEC-18 was used to obtain the 500-Yr multiplier for the Regression Equation results. Soil boring were used to find the D_{50} to determine the type of scour occurring at the bridge. Results of the scour analysis are in Table 4.

It was determined that clear water scour was occurring at the bridge. Due to the bridge being located in a swamp with no defined channel live-bed scour does not occur at this crossing. Calculations related to determining the type of scour of in Appendix G.

USGS Regression equations, outlined in multiple publications, were used to obtain the 100-Yr abutment, contraction, and pier scour values. USGS guidance on the interaction of abutment and pier scour and pier and contraction scour was followed. Abutment scour depths were affected by the amount contraction caused by the bridge on the floodplain. The large contraction length the embankment lengths effect by the 100-Yr event. In addition, this was the main effect on the contraction scour depth. Pier scour depths were related to the pier diameter. Calculations and additional information is in Appendix G.

Table 4: Scour Depths for Proposed US 301 SB Bridge

SCOUR STUDY RESULTS									
County	Orangeburg								
Road	US 301								
Waterbody	Four Hole Swamp								
ABUTMENT SCOUR									
Left Abutment			Right Abutment						
100-YR Scour	14.9	FT	100-YR Scour	15.6	FT				
500-YR Scour	19.0	FT	500-YR Scour	19.5	FT				
CONTRACTION SCOUR									
100-YR Scour	4.8	FT							
500-YR Scour	6.4	FT							
PIER SCOUR									
Left Over Bank			Channel			Right Over Bank			
100-YR Scour	6.5	FT	100-YR Scour	6.5	FT	100-YR Scour	6.5	FT	
500-YR Scour	7.1	FT	500-YR Scour	7.1	FT	500-YR Scour	7.1	FT	

F. CONCLUSIONS

The proposed bridge must meet SCDOT guidelines for hydraulic design. To this end, the proposed bridge must have a low chord elevation of 2 feet higher than the 50 year flood, not have a back water effect on the waterbody of greater than 1 foot for the 50 year and 100 year flood, and designed to be scour resistant. These guidelines were used to make recommendations for the proposed bridge. The studies and analysis of the proposed bridge were carried out according to proper and accepted methods and in accordance with SCDOT standards and guidelines. All of the results are in preceding table and in the appendixes.

The results of the analysis set the minimum low cord at 120.00 feet for the proposed bridge. This would meet the stated guidelines. The proposed bridge has a length of 294 feet with 6 spans of 44 feet and one of 30 feet. As proposed, the new bridge will have a minimum finished grade of 122.30 feet.

The bridge, as design and proposed, would cause backwater for the 50 year and 100 year flood of 0.77 feet and 0.90 feet respectively. With flow velocity in the bridge opening for the proposed 50 year and 100 year floods of 2.93 fps and 3.24 fps.

The proposed bridge was analyzed for contraction, pier, and abutment scour. USGS Regression Equations and HEC-18 multipliers were used to perform the study with design events of the 100 and 500 year flood. The analysis showed that the largest scour potential was at the abutments. Pier and contraction scour had similar potential. Based on these result the pier foundation many need to vary based on the location of the pier. In addition, Rip Rap will be place in accordance with SCDOT guidelines and procedures.

REFERENCES

Arneson, L. A., Zevenbergen, L. W., Lagasse, P. E. and Clopper, P. E. (2012). *Hydraulic Engineering Circular No. 18: Evaluating Scour At Bridges*. 5th ed. Publication No. FHWA NIF-12-003 HEC –18. Federal Highway Administration. Washington, DC.

Benedict, S. T. (2003). *USGS Water-Resources Investigations Report 03-4064: Clear-Water Abutment and Contraction Scour in the Coastal Plan and Piedmont Provinces of South Carolina, 1996-99*. Columbia, South Carolina

Benedict, S. T. and Caldwell, A. W. (2005). *Development and Evaluation of Clear-Water Pier and Contraction Scour Envelope Curves in the Coastal Plain and Piedmont Provinces of South Carolina*. United States Geological Survey Scientific Investigations Report 2005-5289.

Benedict, S. T. and Caldwell, A. W. (2009). *Development and Evaluation of Live-Bed Pier- and Contraction-Scour Envelope Curves in the Coastal Plain and Piedmont Provinces of South Carolina*. United States Geological Survey Scientific Investigations Report 2009-5099.

Benedict, S. T. and Caldwell, A. W. (2012). *Modification of Selected South Carolina Bridge-Scour Envelope Curves*. United States Geological Survey Scientific Investigations Report 2012-5029.

Feaster, T. D. Gotvald, A. J., and Weaver J. C. (2009). *USGS Scientific Investigations Report 2009-5156: Magnitude and Frequency of Rural Floods in the Southeastern United States, 2006: Volume 3, South Carolina*. Columbia, South Carolina.

Federal Emergency Management Agency. (2014). *Flood Insurance Study: Orangeburg County, South Carolina and Incorporated Areas Volume 1 (45075CV001A).* Federal Emergency Management Agency. Washington D. C.

Lagasse, P. E., Zevenbergen, L. W., Spitz, W. J., and Arneson, L. A. (2012). *Hydraulic Engineering Circular No. 20: Stream Stability At Highway Structures*. 4rd ed. Publication No. FHWA NIF-12-004 HEC –20. Federal Highway Administration. Washington, DC.

South Carolina Department Of Transportation ed. (2009). *South Carolina Department of Transportation: Requirements for Hydraulic Studies*. South Carolina Department of Transportation Hydrology Department. Columbia, South Carolina.

APPENDIX A

HYDRAULIC CALCULATIONS

This spreadsheet computes the 50-, 20-, 10-, 4-, 2-, 1-, 0.5-, and 0.2-percent chance exceedance flows for an ungaged site in Georgia, South Carolina, and North Carolina. The spreasheet also includes the 95-percent prediction intervals, the minus and plus standard error of prediction intervals, and the average standard error of prediction. To use the spreadsheet, enter requested information in the yellow cells below.

Enter a site-description name: Test site anywhere in GA, SC, or NC

Enter the explanatory variables:

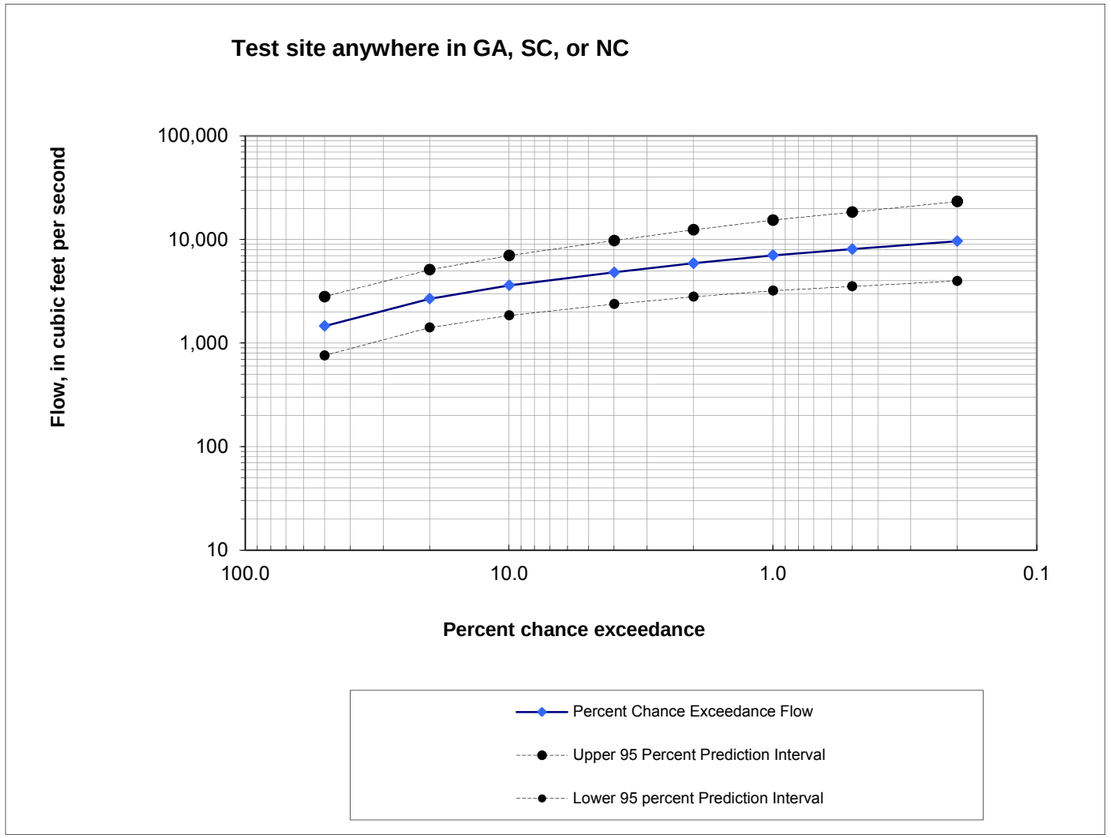
Drainage area, in square miles	136.0171363
Percent of basin in Hydrologic Region 1	0
Percent of basin in Hydrologic Region 2	0
Percent of basin in Hydrologic Region 3	0
Percent of basin in Hydrologic Region 4	100
Percent of basin in Hydrologic Region 5	0

Applicable range of draingage area is 1 to 9,000 square miles.
Hydrologic Region 1 corresponds to the USEPA Level III Ridge and Valley and Piedmont ecoregions
Hydrologic Region 2 corresponds to the USEPA Level III Blue Ridge ecoregion
Hydrologic Region 3 corresponds to the USEPA Level IV Sand Hills ecoregion
Hydrologic Region 4 corresponds to the USEPA Level III Southeastern, Middle Atlantic Coastal, and Southern Coastal Plain ecoregions
Hydrologic Region 5 corresponds to the lower portion of the USEPA Level IV Tifton Uplands ecoregion.

Sum of region percentages	100

Drainage area check
DRAINAGE AREA WITHIN APPLICABLE LIMITS.

Percent chance exceedance	Percent chance exceedance flow, in ft^3/s	Lower 95 percent prediction interval flow, in ft^3/s	Upper 95 percent prediction interval flow, in ft^3/s	$-S_{P,i}$ (percent)	$+S_{P,i}$ (percent)	Average $S_{p,i}$ (percent)
50	1,460	759	2,810	-28.4	39.6	34.3
20	2,680	1,410	5,110	-28.1	39.0	33.8
10	3,600	1,850	7,000	-28.8	40.4	34.9
4	4,820	2,380	9,770	-30.3	43.4	37.3
2	5,890	2,800	12,400	-31.6	46.2	39.4
1	7,040	3,210	15,400	-33.0	49.2	41.7
0.5	8,070	3,530	18,400	-34.4	52.4	44.1
0.2	9,640	3,980	23,300	-36.3	56.9	47.5



APPENDIX B

SOIL DATA

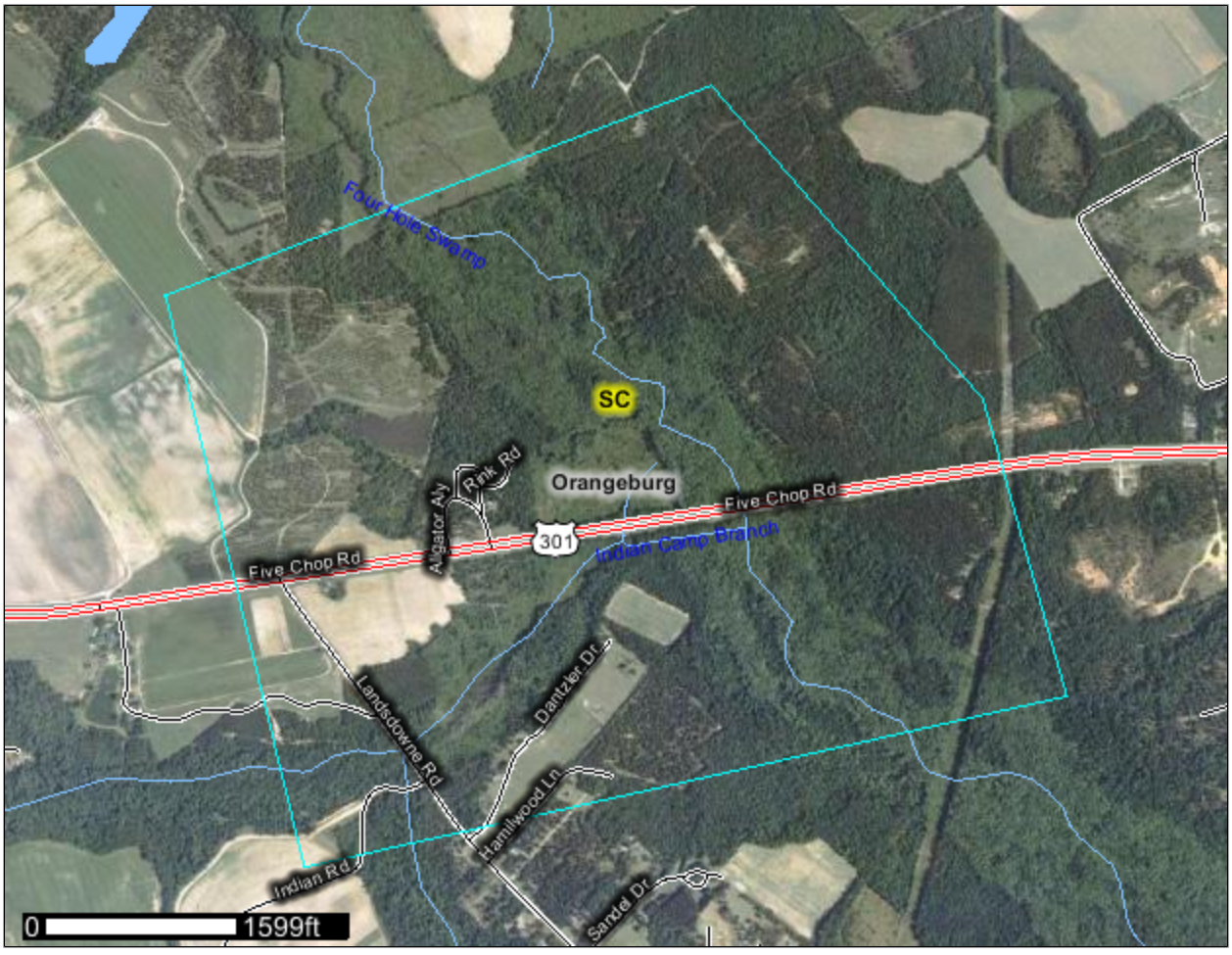
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

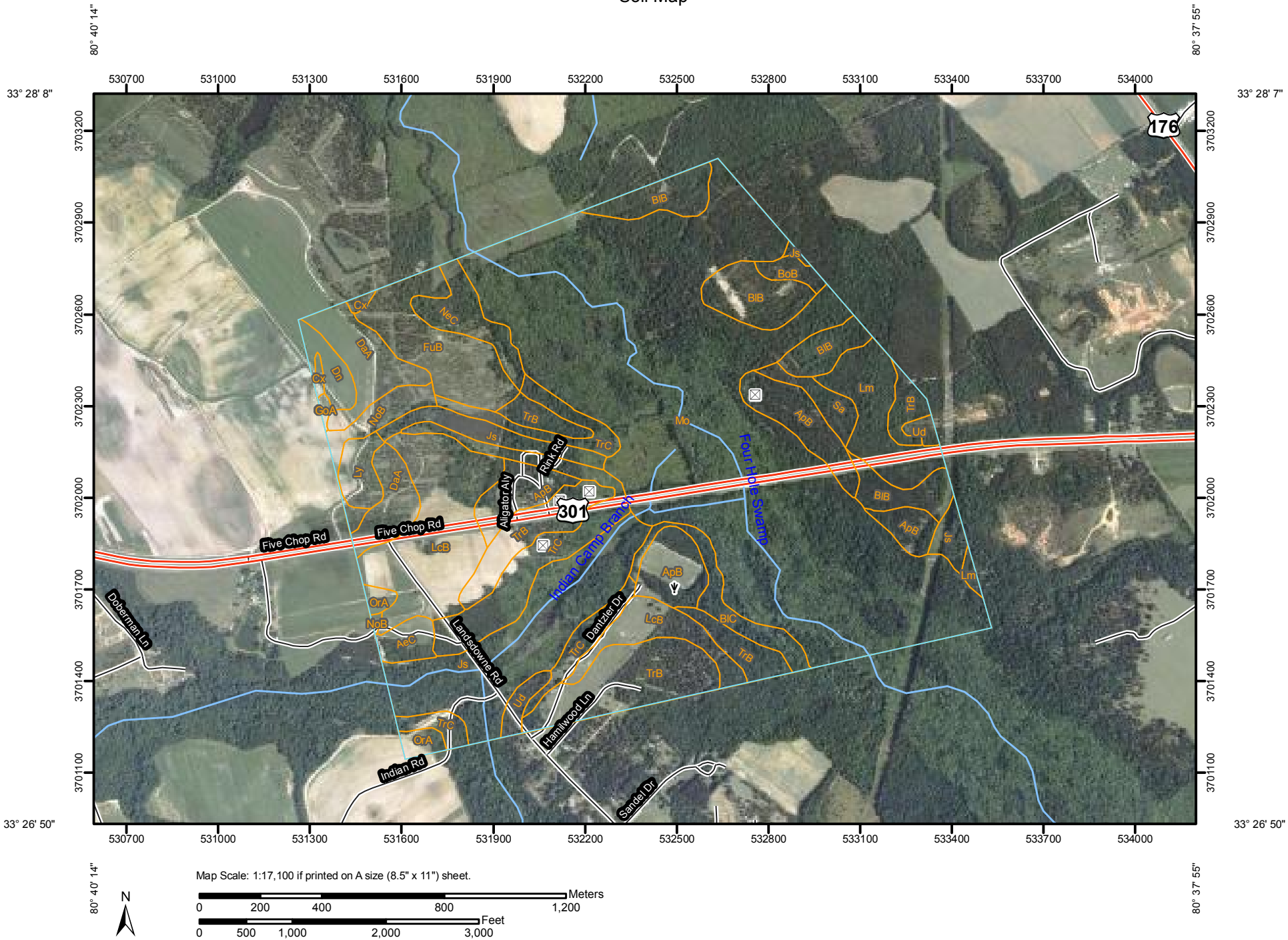
A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Orangeburg County, South Carolina



November 27, 2012

Custom Soil Resource Report
Soil Map



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features
- Gully
- Short Steep Slope
- Other

Political Features
- Cities

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:17,100 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 17N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Orangeburg County, South Carolina
Survey Area Data: Version 9, Oct 5, 2011

Date(s) aerial images were photographed: 6/11/2006

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Orangeburg County, South Carolina (SC075)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
AeC	Ailey sand, 6 to 10 percent slopes	5.6	0.8%
ApB	Alpin sand, 0 to 6 percent slopes	40.2	5.6%
BlB	Blanton sand, 0 to 6 percent slopes	38.5	5.3%
BlC	Blanton sand, 6 to 10 percent slopes	10.8	1.5%
BoB	Bonneau sand, 0 to 4 percent slopes	3.5	0.5%
Cx	Coxville sandy loam	1.6	0.2%
DaA	Dothan loamy sand, 0 to 2 percent slopes	26.0	3.6%
Dn	Dunbar sandy loam	6.0	0.8%
FuB	Fuquay sand, 0 to 6 percent slopes	26.0	3.6%
GoA	Goldsboro sandy loam, 0 to 2 percent slopes	0.7	0.1%
Js	Johnston sandy loam	65.2	9.0%
LcB	Lucy loamy sand, 0 to 6 percent slopes	54.6	7.6%
Lm	Lumbee loamy sand	21.7	3.0%
Ly	Lynchburg fine sandy loam	6.8	0.9%
Mo	Mouzon fine sandy loam	272.7	37.8%
NeC	Neeses loamy sand, 6 to 10 percent slopes	11.8	1.6%
NoB	Noboco loamy sand, 2 to 6 percent slopes	9.1	1.3%
OrA	Orangeburg loamy sand, 0 to 2 percent slopes	4.7	0.6%
Sa	Stallings loamy sand	6.0	0.8%
TrB	Troup sand, 0 to 6 percent slopes	57.4	8.0%
TrC	Troup sand, 6 to 10 percent slopes	46.8	6.5%
Ud	Udorthents, loamy	5.4	0.7%
Totals for Area of Interest		**721.2**	**100.0%**

Geotechnical Data Report

August 22, 2014

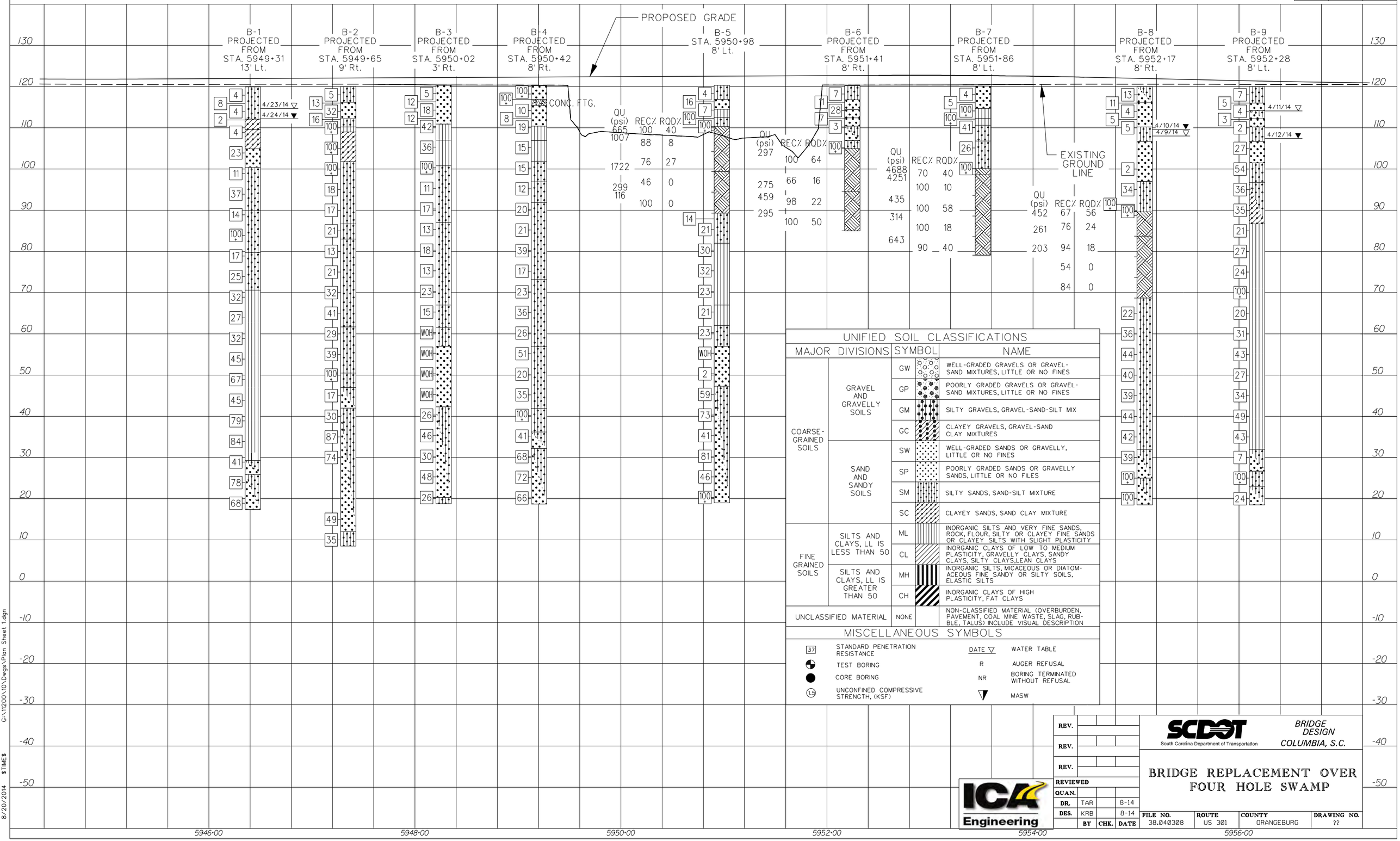
US 301 Bridge Replacement over Four Hole Swamp
Orangeburg County, South Carolina

Prepared For:

SCDOT
South Carolina
Department of Transportation

submitted by
ICA Engineering

PIN	SHEET NO.	TOTAL SHEETS
40308 BR01	??	??



UNIFIED SOIL CLASSIFICATIONS

MAJOR DIVISIONS		SYMBOL	NAME
COARSE-GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	WELL-GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GP	POORLY GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIX
		GC	CLAYEY GRAVELS, GRAVEL-SAND CLAY MIXTURES
	SAND AND SANDY SOILS	SW	WELL-GRADED SANDS OR GRAVELLY, LITTLE OR NO FINES
		SP	POORLY GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FILES
		SM	SILTY SANDS, SAND-SILT MIXTURE
		SC	CLAYEY SANDS, SAND CLAY MIXTURE
FINE GRAINED SOILS	SILTS AND CLAYS, LL IS LESS THAN 50	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
		CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
	SILTS AND CLAYS, LL IS GREATER THAN 50	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
		CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
UNCLASSIFIED MATERIAL		NONE	NON-CLASSIFIED MATERIAL (OVERBURDEN, PAVEMENT, COAL MINE WASTE, SLAG, RUBBLE, TALUS) INCLUDE VISUAL DESCRIPTION

MISCELLANEOUS SYMBOLS

37	STANDARD PENETRATION RESISTANCE	DATE ▽	WATER TABLE
	TEST BORING	R	AUGER REFUSAL
	CORE BORING	NR	BORING TERMINATED WITHOUT REFUSAL
1.5	UNCONFINED COMPRESSIVE STRENGTH, (KSF)		MASW

REV.			
REV.			
REV.			
REVIEWED			
QUAN.			
DR.	TAR		8-14
DES.	KRB		8-14
	BY	CHK.	DATE

ICA Engineering

SCDOT South Carolina Department of Transportation

BRIDGE DESIGN COLUMBIA, S.C.

BRIDGE REPLACEMENT OVER FOUR HOLE SWAMP

FILE NO.	ROUTE	COUNTY	DRAWING NO.
38.040308	US 301	ORANGEBURG	??

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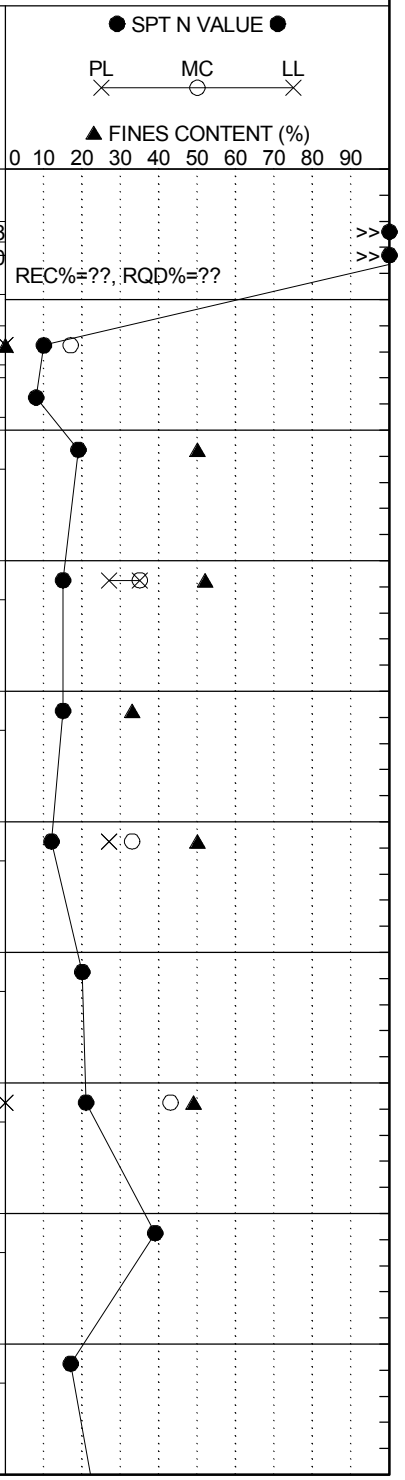
8/20/2014 $TIME$

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-4	**Boring Location:**	5950+42	**Offset:**	8' Rt.	**Alignment:**	US 301
Elev.:	120.2 ft	**Latitude:**	33.45754	**Longitude:**	80.64764	**Date Started:**	4/5/2014
Total Depth:	101.5 ft	**Soil Depth:**	101.5 ft	**Core Depth:**	ft	**Date Completed:**	4/6/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 45C	**Drill Method:**	RW/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NA	**Driller:**	M. Morgan	**Groundwater:**	**TOB** NA	**24HR**	NA

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	0.0	Mudline							
115.2		Roadway Embankment: Loose to very dense, wet, gray & white, sub-angular, weakly reactive, strongly cemented, med. to cse. grain, poorly graded SAND (SP/A-1-b). LL=NP, PL=NP, PI=NP, NMC=17.2, %#200=0.1		2.0	SS-1	1	50/0.3		50/0.3
				3.3	SS-2	50/0.0			50/0.0
				3.3	NQ-1				
				6.0	SS-3	2	7	3	10
				8.0	SS-4	4	3	5	8
110.2	9.8	Santee Formation: Very stiff, moist, gray & green, sub-angular, strongly reactive, sub-angular, f. grain, sandy SILT (ML/A-4). LL=NA, PL=NA, PI=NA, NMC=NA, %#200=50.2		10.0	SS-5	7	8	11	19
105.2	13.3			15.0	SS-6	4	6	9	15
100.2	18.3	Stiff, moist, gray & green, sub-angular, strongly reactive, f. grain, sandy SILT, (ML/A-4). LL=35, PL=27, PI=8, NMC=34.8, %#200=52.4		20.0	SS-7	7	6	9	15
95.2	23.3	Medium dense, moist, gray & green, sub-angular, strongly reactive, f. grain, silty SAND with gravel (SM/A-2-4). LL=NA, PL=NA, PI=NA, NMC=NA, %#200=32.8		25.0	SS-8	3	5	7	12
90.2	28.3	Medium dense, moist, gray & green, sub-angular, strongly reactive, f. grain, silty SAND (SM/A-4). LL=27, PL=27, PI=NP, NMC=33.2, %#200=49.8		30.0	SS-9	6	9	11	20
85.2		Medium dense to dense, moist, tan & gray, sub-angular, strongly reactive, f. grain, silty SAND (SM/A-4). LL=NP, PL=NP, PI=NP, NMC=43.4, %#200=49.4		35.0	SS-10	6	7	14	21
80.2				40.0	SS-11	21	17	22	39
75.2				45.0	SS-12	4	7	10	17
	47.0	Medium dense to dense, moist, gray, tan & green, strongly reactive, f. to cse. grain, silty SAND (SM/A-4).		50.0					



LEGEND

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SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-4	**Boring Location:**	5950+42	**Offset:**	8' Rt.	**Alignment:**	US 301
Elev.:	120.2 ft	**Latitude:**	33.45754	**Longitude:**	80.64764	**Date Started:**	4/5/2014
Total Depth:	101.5 ft	**Soil Depth:**	101.5 ft	**Core Depth:**	ft	**Date Completed:**	4/6/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 45C	**Drill Method:**	RW/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NA	**Driller:**	M. Morgan	**Groundwater:**	**TOB** NA	**24HR**	NA

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
65.2		LL=37, PL=34, PI=3, NMC=36.0, %#200=42.6		55.0	SS-13	8	10	13	23
					SS-14	12	15	21	36
60.2				60.0	SS-15	10	12	14	26
	63.3	Medium dense to very dense, moist, gray, tan & green, strongly reactive, weakly cemented areas, f. grain, silty SAND (SM/A-2-4).							
55.2		LL=36, PL=33, PI=3, NMC=33.4, %#200=33.5		65.0	SS-16	16	18	33	51
50.2				70.0	SS-17	6	7	13	20
45.2				75.0	SS-18	14	16	19	35
	78.3	Very dense, moist, gray, tan & green, weakly to strongly cemented, f. grain, silty SAND (SM/A-2-4).							
40.2		LL=33, PL=30, PI=3, NMC=22.7, %#200=27.3		80.0	SS-19	23	38	50/0.2	88/0.7
	84.0	Congaree Formation:							
35.2		Dense, moist, dark green, gray & tan, sub-angular, strongly reactive, f. to med. grain, poorly graded SAND with silt (SP-SM/A-1-b).		85.0	SS-20	15	16	25	41
	88.0								
30.2		Very dense, wet, gray & green, sub-angular, non to weakly reactive, med. to cse. grain, well-graded SAND with silt (SW-SM/A-1-b).		90.0	SS-21	20	28	48	68
25.2				95.0	SS-22	17	32	40	72
				100.0					

SPT N VALUE ● PL × MC ○ LL × ▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90

Continued Next Page

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-4	**Boring Location:**	5950+42	**Offset:**	8' Rt.	**Alignment:**	US 301
Elev.:	120.2 ft	**Latitude:**	33.45754	**Longitude:**	80.64764	**Date Started:**	4/5/2014
Total Depth:	101.5 ft	**Soil Depth:**	101.5 ft	**Core Depth:**	ft	**Date Completed:**	4/6/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 45C	**Drill Method:**	RW/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NA	**Driller:**	M. Morgan	**Groundwater:**	**TOB** NA	**24HR**	NA

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
	101.5				SS-23	16	31	35	66
		No Casing Refusal & Boring Terminated @ 101.5' (Elev. 18.7).							
15.2		Bridge deck to mudline 12.3'.							
10.2									
5.2									
0.2									
-4.8									
-9.8									
-14.8									
-19.8									
-24.8									

● SPT N VALUE ●

PL MC LL

▲ FINES CONTENT (%)

0 10 20 30 40 50 60 70 80 90

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC_DOT BRIDGE OVER FOUR HOLE SWAMP.GPJ SC_DOT.GDT 8/21/14

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-5	**Boring Location:**	5950+98	**Offset:**	8' Lt.	**Alignment:**	US 301
Elev.:	120.3 ft	**Latitude:**	33.45747	**Longitude:**	80.64781	**Date Started:**	4/12/2014
Total Depth:	101.3 ft	**Soil Depth:**	80.3 ft	**Core Depth:**	21 ft	**Date Completed:**	4/13/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 45C	**Drill Method:**	RW/RC/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NQ2	**Driller:**	M. Morgan	**Groundwater:**	**TOB** NA	**24HR**	NA

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	SPT N VALUE / PL MC LL / FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90
	0.0	Mudline								
		Alluvium:								
		Very loose, wet, gray & tan, sub-angular, non-reactive, med. to cse. grain, silty SAND (SM/A-2-4).		2.0						
	3.4				SS-1	2	1	3	4	
				4.0						
115.3	5.8	Medium dense, wet, gray & tan, sub-angular, non-reactive, med. to cse. grain, well-graded SAND (SW/A-1-b).			SS-2	8	8	8	16	
				6.0						
	7.8	LL=NP, PL=NP, PI=NP, NMC=16.8, %#200=3.8			SS-3	3	3	4	7	
				8.0						
					SS-4	10	50/0.3		50/0.3	>>
110.3	10.0			10.0	SS-5	50/0.0			50/0.0	>>
		Firm, moist, green, gray & tan, non-reactive, f. grain, sandy SILT (ML/A-4).		10.0	NQ-1					REC%=100, RQD%=40
		LL=NA, PL=NA, PI=NA, NMC=NA, %#200=59.9		11.0	NQ-2					REC%=88, RQD%=8
105.3										
		Santee Formation:		16.0	NQ-3					REC%=76, RQD%=27
		Very dense, moist, green & gray, strongly reactive, mod. to strongly cemented, f. grain, silty SAND (SM/A-4).								
100.3	20.9	LL=NA, PL=NA, PI=NA, NMC=NA, %#200=47.8		21.0	NQ-4					REC%=46, RQD%=0
		Casing Refusal @ 10.0'. Begin coring in Calcareous Sandstone.								
95.3		Tan, lt. green, lt. gray, black-dk. brown, v.f. to scat. med. grain, thinly to thickly bedded, quartz-calcite-phosphate, mod. to highly weathered, v. weak to weak, friable in parts-seams low hardness, VC discontinuity spacing, seams calcarenite, fossiliferous (frags. & mega shells).		26.0	NQ-5					REC%=100, RQD%=0
90.3	31.0	med. strong 10.6'-11.0', 19.0'-20.0' & 20.5'-20.9'; 33+ 0° B, T-MW, No, Wa-lr, SR		32.4	SS-6	4	4	10	14	
85.3				35.0	SS-7	7	7	14	21	
	38.3	Calcarenite: Tan-gray, v.f. to f. grain, v. thinly to thinly bedded, calcite-quartz, mod. to highly weathered, v. weak to weak, friable, VC discontinuity spacing, pods of calcareous sandstone, fossiliferous (frags. & trc. mega shells).		40.0	SS-8	10	13	17	30	
80.3		1 90° J, T, No, Pl, Slk; 49+ 0° B, T-MW, No, Wa-lr, SR								
75.3		End Coring @ 31.0'. Return to Casing and Sample.		45.0	SS-9	8	12	20	32	
		Medium dense, moist, green & gray, strongly reactive, f. grain, silty SAND (SM/A-4).								
		LL=NP, PL=NP, PI=NP, NMC=36.4,		50.0						

LEGEND

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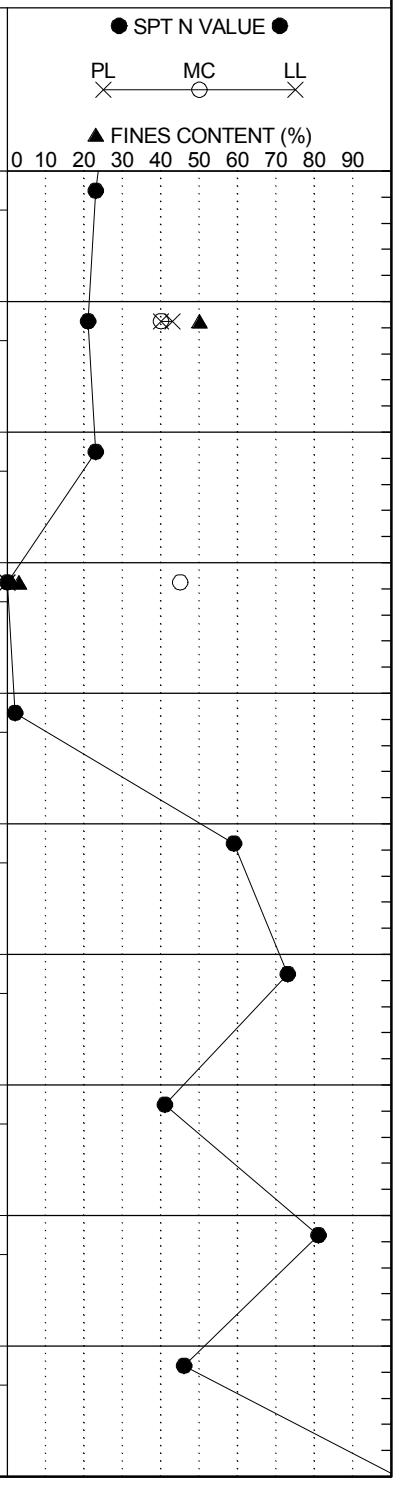
SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-5	**Boring Location:**	5950+98	**Offset:**	8' Lt.	**Alignment:**	US 301
Elev.:	120.3 ft	**Latitude:**	33.45747	**Longitude:**	80.64781	**Date Started:**	4/12/2014
Total Depth:	101.3 ft	**Soil Depth:**	80.3 ft	**Core Depth:**	21 ft	**Date Completed:**	4/13/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 45C	**Drill Method:**	RW/RC/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NQ2	**Driller:**	M. Morgan	**Groundwater:**	**TOB** NA	**24HR**	NA

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value
		%#200=41.2						
	53.3	Very stiff to hard, moist, green & gray, strongly reactive, f. grain, sandy SILT (ML/A-7-5).						
65.3		LL=45, PL=33, PI=12, NMC=37.0, %#200=52.3	55.0	SS-11	5	10	11	21
	58.3	Very stiff, moist, green & gray, strongly reactive, f. grain, sandy SILT (ML/A-5).						
60.3		LL=43, PL=40, PI=3, NMC=39.6, %#200=50.1	60.0	SS-12	9	11	12	23
	63.3	Medium dense, wet, dark green & gray, strongly reactive, f. grain, silty SAND (SM/A-2-4).						
55.3		Congaree Formation:	65.0	SS-13	0	0	0	0
50.3		Very loose, wet, dark green, tan & black, non to weakly reactive, cse. grain, well-graded SAND (SW/A-1-b).	70.0	SS-14	0	0	2	2
		LL=NP, PL=NP, PI=NP, NMC=45.4, %#200=2.6						
	73.0							
45.3		Dense to very dense, moist, gray, sub-angular, non-reactive, f. to med. grain, well-graded SAND with silt (SW-SM/A-1-b).	75.0	SS-15	13	24	35	59
40.3			80.0	SS-16	23	35	38	73
35.3			85.0	SS-17	10	18	23	41
30.3			90.0	SS-18	31	41	40	81
25.3			95.0	SS-19	7	13	33	46
			100.0					



LEGEND

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SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-5	**Boring Location:**	5950+98	**Offset:**	8' Lt.	**Alignment:**	US 301
Elev.:	120.3 ft	**Latitude:**	33.45747	**Longitude:**	80.64781	**Date Started:**	4/12/2014
Total Depth:	101.3 ft	**Soil Depth:**	80.3 ft	**Core Depth:**	21 ft	**Date Completed:**	4/13/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 45C	**Drill Method:**	RW/RC/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NQ2	**Driller:**	M. Morgan	**Groundwater:**	**TOB** NA	**24HR**	NA

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	SPT N VALUE / PL MC LL / FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90
	101.3				SS-20	15	42	50/0.3	92/0.8	>>
		No Casing Refusal & Boring Terminated @ 101.3' (Elev. 19.0).								
15.3		Bridge deck to mudline 14.8'.								
10.3										
5.3										
0.3										
-4.7										
-9.7										
-14.7										
-19.7										
-24.7										

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC_DOT BRIDGE OVER FOUR HOLE SWAMP.GPJ SC_DOT.GDT 8/21/14

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-6	**Boring Location:**	5951+41	**Offset:**	8' Rt.	**Alignment:**	US 301
Elev.:	120.2 ft	**Latitude:**	33.4575	**Longitude:**	80.64796	**Date Started:**	4/6/2014
Total Depth:	35.2 ft	**Soil Depth:**	15.2 ft	**Core Depth:**	20 ft	**Date Completed:**	4/8/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 45C	**Drill Method:**	RW/RC/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NQ2	**Driller:**	M. Morgan	**Groundwater:**	**TOB** NA	**24HR**	NA

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6"	2nd 6"	3rd 6"	N Value	SPT N VALUE / PL MC LL / FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90
	0.0	Mudline								
		Alluvium: Loose, wet, brown, tan & gray, sub-angular, weakly reactive, med. to cse. grain, silty SAND (SM/A-2-4).		2.0	SS-1	3	4	3	7	
115.2	3.4			4.0	SS-2	3	5	6	11	
	5.8	Medium dense, wet, brown, tan & gray, sub-angular, non-reactive, med. to cse. grain, poorly graded SAND (SP/A-1-b). LL=NA, PL=NA, PI=NA, NMC=12.7, %#200=1.6		6.0	SS-3	8	11	17	28	
110.2	7.8			8.0	SS-4	0	3	4	7	
	9.8			10.0	SS-5	1	1	2	3	
	13.3	Medium dense, wet, brown, tan & gray, sub-angular, non-reactive, med. to cse. grain, poorly graded SAND (SP/A-1-b). LL=NP, PL=NP, PI=NP, NMC=14.0, %#200=4.0		15.0	SS-6	50/0.2			50/0.2	>>
105.2	15.2			15.2	NQ-1					REC%=100, RQD%=64
		Loose, wet, brown, tan & gray, sub-angular, non-reactive, med. to cse. grain, poorly graded SAND (SP/A-1-b). LL=NP, PL=NP, PI=NP, NMC=17.0, %#200=2.1		20.2	NQ-2					REC%=66, RQD%=16
100.2										
		Very loose, wet, gray & brown, sub-angular, non-reactive, med. to cse. grain, poorly graded SAND with silt (SP-SM/A-2-4). LL=NA, PL=NA, PI=NA, NMC=NA, %#200=8.8		25.2	NQ-3					REC%=98, RQD%=22
95.2	25.6									
		Very dense, wet, gray & green, sub-angular, weakly reactive, med. to cse. grain, silty SAND (SM/A-4).		30.2	NQ-4					REC%=100, RQD%=50
90.2		Casing Refusal @ 15.2'. Begin coring in Calcareous Sandstone. Santee Formation:								
85.2	35.2	Gray-tan, tan-lt. green, scat. black-dk. brown, f. to med. grain w/scat. cse. frags., thinly to thickly bedded, quartz-calcite-phosphate, mod. to highly weathered w/seams completely weathered, v. weak to weak, friable in parts-seams low hardness, VC discontinuity spacing, seams calcarenite, fossiliferous (frags. & mega shells), vugular texture. 23 0°-10° B, T-MW, No, Pl-Wa, SR								
80.2										
75.2		Calcarenite: Tan-gray, lt. green, v.f. to f. grain, thickly bedded, calcite-quartz, mod. weathered w/highly weathered seams, v. weak to weak, friable w/seams low hardness, VC discontinuity spacing, pods of calcareous								

Continued Next Page

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SCDOT Soil Test Boring Log

File No.:	38.040308	**Project No. (PIN):**	BR38(019)	**County:**	Orangeburg	**Eng./Geo.:**	R. DeLost
Site Description:	Bridge Replacement over Four Hole Swamp					**Route:**	US 301
Boring No.:	B-6	**Boring Location:**	5951+41	**Offset:**	8' Rt.	**Alignment:**	US 301
Elev.:	120.2 ft	**Latitude:**	33.4575	**Longitude:**	80.64796	**Date Started:**	4/6/2014
Total Depth:	35.2 ft	**Soil Depth:**	15.2 ft	**Core Depth:**	20 ft	**Date Completed:**	4/8/2014
Bore Hole Diameter (in):	4	**Sampler Configuration**		**Liner Required:**	Y (N)	**Liner Used:**	Y (N)
Drill Machine:	CME 45C	**Drill Method:**	RW/RC/DC	**Hammer Type:**	Automatic	**Energy Ratio:**	79%
Core Size:	NQ2	**Driller:**	M. Morgan	**Groundwater:**	**TOB** NA	**24HR**	NA

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample No./Type	1st 6" / 2nd 6" / 3rd 6"	N Value	● SPT N VALUE ● PL MC LL ▲ FINES CONTENT (%) 0 10 20 30 40 50 60 70 80 90
		sandstone, fossiliferous (frags. & trc. mega shells). med. strong 25.6'-26.5'; 27+ 0° B, T-MW, No, Pl-Ir, SR						
65.2		Boring Terminated @ 35.2' (Elev. 85.0).						
		Bridge deck to mudline 12.4'.						
60.2								
55.2								
50.2								
45.2								
40.2								
35.2								
30.2								
25.2								

LEGEND

SAMPLER TYPE		DRILLING METHOD	
SS - Split Spoon	NQ - Rock Core, 1-7/8"	HSA - Hollow Stem Auger	RW - Rotary Wash
ST - Shelby Tube	CU - Cuttings	CFA - Continuous Flight Augers	RC - Rock Core
AWG - Rock Core, 1-1/8"	CT - Continuous Tube	DC - Driving Casing	

SC_DOT BRIDGE OVER FOUR HOLE SWAMP.GPJ SC_DOT.GDT 8/21/14

Appendix Section IV
Laboratory Testing

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Gray Poorly Graded Sand

Sample No. : SS-3
Sample Loc. : Boring No. B-4
Sample Depth : 6.0' to 7.5'
Date Tested : 07/21/14
Date Reported : 07/24/14

AASHTO T27 :

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	100.0
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	93.4
1/4		6.3	mm	
No.4		4.75	mm	92.3
No.6		3.35	mm	
No.10		2	mm	83.5

AASHTO T88

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	7.2
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	0.1
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 1.0132 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 17.2
Liquid Limit (AASHTO T89) : NP
Plastic Limit (AASHTO T90) : NP
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-1-b (0)
ASTM Classification: D2487 : SP

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 16.5
Coarse Sand (-No.10 + No.40) : 76.3
Fine Sand (-No.40 + No.200) : 7.1
Silt + Clay (-No.200) : 0.1

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 7.7
Coarse Sand (-No.4 + No.10) : 8.8
Medium Sand (-No.10 + No.40) : 76.3
Fine Sand (-No.40 + No.200) : 7.1
Silt + Clay (-No.200) : 0.1

Approved By : J.S.

Soil No. 25

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Gray & Green Sandy Silt

Sample No. : SS-5
Sample Loc. : Boring No. B-4
Sample Depth : 10.0' to 11.5'
Date Tested : 07/15/14
Date Reported : 07/22/14

AASHTO T27 :

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	100.0
1/4		6.3	mm	
No.4		4.75	mm	98.9
No.6		3.35	mm	
No.10		2	mm	96.3

AASHTO T88

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	87.1
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	50.2
No.270		0.053	mm	
Hyd. Rd.	# 1	0.0324	mm	43.5
Hyd. Rd.	# 2	0.0208	mm	39.7
Hyd. Rd.	# 3	0.0121	mm	36.0
Hyd. Rd.	# 4	0.0087	mm	33.1
Hyd. Rd.	# 5	0.0063	mm	27.1
Hyd. Rd.	# 6	0.0032	mm	16.7
Hyd. Rd.	# 7	0.0014	mm	9.4

D_{50} = 0.0731 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : NA
Liquid Limit (AASHTO T89) : NA
Plastic Limit (AASHTO T90) : NA
Plasticity Index : NA
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : 2.714
AASHTO Classification: M145 : A-4 (0) *
ASTM Classification: D2487 : ML *
* Visual Classification

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 3.7
Coarse Sand (-No.10 + No.40) : 9.2
Fine Sand (-No.40 + No.200) : 36.9
Silt (-No.200 + 0.002mm) : 37.5
Clay (-0.002mm + 0.001mm) : 4.4
Colloids (-0.001mm) : 8.3

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 1.1
Coarse Sand (-No.4 + No.10) : 2.6
Medium Sand (-No.10 + No.40) : 9.2
Fine Sand (-No.40 + No.200) : 36.9
Silt (-No.200 + 0.005mm) : 26.6
Clay (-0.005mm + 0.001mm) : 15.3
Colloids (-0.001mm) : 8.3

Approved By : J.S.

Soil No. 26

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Gray & Green Sandy Silt

Sample No. : SS-6
Sample Loc. : Boring No. B-4
Sample Depth : 15.0' to 16.5'
Date Tested : 07/15/14
Date Reported : 07/22/14

AASHTO T27 :

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	100.0

AASHTO T88

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	92.0
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	52.4
No.270		0.053	mm	
Hyd. Rd.	# 1	0.0326	mm	45.0
Hyd. Rd.	# 2	0.0209	mm	41.0
Hyd. Rd.	# 3	0.0122	mm	37.0
Hyd. Rd.	# 4	0.0088	mm	32.9
Hyd. Rd.	# 5	0.0063	mm	28.8
Hyd. Rd.	# 6	0.0032	mm	17.0
Hyd. Rd.	# 7	0.0014	mm	9.2

D_{50} = 0.0573 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 34.8
Liquid Limit (AASHTO T89) : 35
Plastic Limit (AASHTO T90) : 27
Plasticity Index : 8
Liquidity Index : 0.94
Activity : 0.63
Sp. Gr. (AASHTO T100) : 2.718
AASHTO Classification: M145 : A-4 (2)
ASTM Classification: D2487 : ML

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 0.0
Coarse Sand (-No.10 + No.40) : 8.0
Fine Sand (-No.40 + No.200) : 39.6
Silt (-No.200 + 0.002mm) : 39.6
Clay (-0.002mm + 0.001mm) : 4.6
Colloids (-0.001mm) : 8.2

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 0.0
Medium Sand (-No.10 + No.40) : 8.0
Fine Sand (-No.40 + No.200) : 39.6
Silt (-No.200 + 0.005mm) : 27.6
Clay (-0.005mm + 0.001mm) : 16.7
Colloids (-0.001mm) : 8.2

Approved By : J.S.

Soil No. 27

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Gray & Green Silty Sand with Gravel

Sample No. : SS-7
Sample Loc. : Boring No. B-4
Sample Depth : 20.0' to 21.5'
Date Tested : 07/15/14
Date Reported : 07/22/14

AASHTO T27 :

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	100.0
3/4	in.	19	mm	97.4
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	90.2
1/4		6.3	mm	
No.4		4.75	mm	85.0
No.6		3.35	mm	
No.10		2	mm	80.0

AASHTO T88

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	61.7
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	32.8
No.270		0.053	mm	
Hyd. Rd.	# 1	0.0335	mm	29.5
Hyd. Rd.	# 2	0.0213	mm	27.9
Hyd. Rd.	# 3	0.0125	mm	23.2
Hyd. Rd.	# 4	0.0090	mm	20.1
Hyd. Rd.	# 5	0.0064	mm	16.0
Hyd. Rd.	# 6	0.0033	mm	8.1
Hyd. Rd.	# 7	0.0014	mm	3.0

D_{50} = 0.2106 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : NA
Liquid Limit (AASHTO T89) : NA
Plastic Limit (AASHTO T90) : NA
Plasticity Index : NA
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : 2.711
AASHTO Classification: M145 : A-2-4 (0) *
ASTM Classification: D2487 : SM *
* Visual Classification

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 20.0
Coarse Sand (-No.10 + No.40) : 18.3
Fine Sand (-No.40 + No.200) : 28.9
Silt (-No.200 + 0.002mm) : 27.6
Clay (-0.002mm + 0.001mm) : 2.6
Colloids (-0.001mm) : 2.6

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 2.6
Fine Gravel (-3/4in. + No.4) : 12.4
Coarse Sand (-No.4 + No.10) : 5.0
Medium Sand (-No.10 + No.40) : 18.3
Fine Sand (-No.40 + No.200) : 28.9
Silt (-No.200 + 0.005mm) : 19.7
Clay (-0.005mm + 0.001mm) : 10.5
Colloids (-0.001mm) : 2.6

Approved By : J.S.

Soil No. 28

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Gray & Green Silty Sand

Sample No. : SS-8
Sample Loc. : Boring No. B-4
Sample Depth : 25.0' to 26.5'
Date Tested : 07/15/14
Date Reported : 07/22/14

AASHTO T27 :

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	99.8

AASHTO T88

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	88.0
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	49.8
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.0757 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 33.2
Liquid Limit (AASHTO T89) : 27
Plastic Limit (AASHTO T90) : 27
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-4 (0)
ASTM Classification: D2487 : SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 0.2
Coarse Sand (-No.10 + No.40) : 11.8
Fine Sand (-No.40 + No.200) : 38.2
Silt + Clay (-No.200) : 49.8

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 0.2
Medium Sand (-No.10 + No.40) : 11.8
Fine Sand (-No.40 + No.200) : 38.2
Silt + Clay (-No.200) : 49.8

Approved By : J.S.

Soil No. 29

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Gray Silty Sand

Sample No. : SS-10
Sample Loc. : Boring No. B-4
Sample Depth : 35.0' to 36.5'
Date Tested : 07/21/14
Date Reported : 07/24/14

AASHTO T27 :

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	100.0
1/4		6.3	mm	
No.4		4.75	mm	98.2
No.6		3.35	mm	
No.10		2	mm	91.7

AASHTO T88

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	80.0
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	49.4
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.0776 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 43.4
Liquid Limit (AASHTO T89) : NP
Plastic Limit (AASHTO T90) : NP
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-4 (0)
ASTM Classification: D2487 : SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 8.3
Coarse Sand (-No.10 + No.40) : 11.7
Fine Sand (-No.40 + No.200) : 30.6
Silt + Clay (-No.200) : 49.4

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 1.8
Coarse Sand (-No.4 + No.10) : 6.5
Medium Sand (-No.10 + No.40) : 11.7
Fine Sand (-No.40 + No.200) : 30.6
Silt + Clay (-No.200) : 49.4

Approved By : J.S.

Soil No. 30

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Gray, Tan & Green Silty Sand

Sample No. : SS-13
Sample Loc. : Boring No. B-4
Sample Depth : 50.0' to 51.5'
Date Tested : 07/19/14
Date Reported : 07/23/14

AASHTO T27 :

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	100.0

AASHTO T88

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	83.6
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	42.6
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.1026 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 36
Liquid Limit (AASHTO T89) : 37
Plastic Limit (AASHTO T90) : 34
Plasticity Index : 3
Liquidity Index : 0.76
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-4 (0)
ASTM Classification: D2487 : SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 0.0
Coarse Sand (-No.10 + No.40) : 16.4
Fine Sand (-No.40 + No.200) : 41.0
Silt + Clay (-No.200) : 42.6

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 0.0
Medium Sand (-No.10 + No.40) : 16.4
Fine Sand (-No.40 + No.200) : 41.0
Silt + Clay (-No.200) : 42.6

Approved By : J.S.

Soil No. 31

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Gray, Tan & Green Silty Sand

Sample No. : SS-16
Sample Loc. : Boring No. B-4
Sample Depth : 65.0' to 66.5'
Date Tested : 07/15/14
Date Reported : 07/22/14

AASHTO T27 :

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	99.3

AASHTO T88

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	82.6
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	33.5
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.1343 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 33.4
Liquid Limit (AASHTO T89) : 36
Plastic Limit (AASHTO T90) : 33
Plasticity Index : 3
Liquidity Index : 0.17
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-2-4 (0)
ASTM Classification: D2487 : SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 0.7
Coarse Sand (-No.10 + No.40) : 16.7
Fine Sand (-No.40 + No.200) : 49.1
Silt + Clay (-No.200) : 33.5

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 0.7
Medium Sand (-No.10 + No.40) : 16.7
Fine Sand (-No.40 + No.200) : 49.1
Silt + Clay (-No.200) : 33.5

Approved By : J.S.

Soil No. 32

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Gray, Tan & Green Silty Sand

Sample No. : SS-19
Sample Loc. : Boring No. B-4
Sample Depth : 80.0' to 81.2'
Date Tested : 07/19/14
Date Reported : 07/23/14

AASHTO T27 :

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	99.9

AASHTO T88

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	68.1
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	27.3
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.1969 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 22.7
Liquid Limit (AASHTO T89) : 33
Plastic Limit (AASHTO T90) : 30
Plasticity Index : 3
Liquidity Index : -2.43
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-2-4 (0)
ASTM Classification: D2487 : SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 0.1
Coarse Sand (-No.10 + No.40) : 31.8
Fine Sand (-No.40 + No.200) : 40.8
Silt + Clay (-No.200) : 27.3

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 0.1
Medium Sand (-No.10 + No.40) : 31.8
Fine Sand (-No.40 + No.200) : 40.8
Silt + Clay (-No.200) : 27.3

Approved By : J.S.

Soil No. 33

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Gray & Tan Well-Graded Sand

Sample No. : SS-2
Sample Loc. : Boring No. B-5
Sample Depth : 4.0' to 5.5'
Date Tested : 07/15/14
Date Reported : 07/22/14

AASHTO T27 :

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	100.0
1/4		6.3	mm	
No.4		4.75	mm	96.9
No.6		3.35	mm	
No.10		2	mm	85.4

AASHTO T88

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	29.2
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	3.8
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.7539 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 16.8
Liquid Limit (AASHTO T89) : NP
Plastic Limit (AASHTO T90) : NP
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-1-b (0)
ASTM Classification: D2487 : SW

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 14.6
Coarse Sand (-No.10 + No.40) : 56.2
Fine Sand (-No.40 + No.200) : 25.4
Silt + Clay (-No.200) : 3.8

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 3.1
Coarse Sand (-No.4 + No.10) : 11.5
Medium Sand (-No.10 + No.40) : 56.2
Fine Sand (-No.40 + No.200) : 25.4
Silt + Clay (-No.200) : 3.8

Approved By : J.S.

Soil No. 34

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Green, Gray & Tan Sandy Silt

Sample No. : SS-3
Sample Loc. : Boring No. B-5
Sample Depth : 6.0' to 7.5'
Date Tested : 07/15/14
Date Reported : 07/22/14

AASHTO T27 :

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	99.9

AASHTO T88

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	96.1
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	59.9
No.270		0.053	mm	
Hyd. Rd.	# 1	0.0316	mm	52.8
Hyd. Rd.	# 2	0.0204	mm	47.9
Hyd. Rd.	# 3	0.0119	mm	44.1
Hyd. Rd.	# 4	0.0085	mm	40.2
Hyd. Rd.	# 5	0.0062	mm	33.4
Hyd. Rd.	# 6	0.0031	mm	20.5
Hyd. Rd.	# 7	0.0014	mm	10.6

D_{50} = 0.0246 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : NA
Liquid Limit (AASHTO T89) : NA
Plastic Limit (AASHTO T90) : NA
Plasticity Index : NA
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : 2.728
AASHTO Classification: M145 : A-4 (0) *
ASTM Classification: D2487 : ML *
* Visual Classification

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 0.1
Coarse Sand (-No.10 + No.40) : 3.8
Fine Sand (-No.40 + No.200) : 36.2
Silt (-No.200 + 0.002mm) : 44.7
Clay (-0.002mm + 0.001mm) : 5.8
Colloids (-0.001mm) : 9.4

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 0.1
Medium Sand (-No.10 + No.40) : 3.8
Fine Sand (-No.40 + No.200) : 36.2
Silt (-No.200 + 0.005mm) : 30.6
Clay (-0.005mm + 0.001mm) : 19.9
Colloids (-0.001mm) : 9.4

Approved By : J.S.

Soil No. 35

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Green & Gray Silty Sand

Sample No. : SS-4
Sample Loc. : Boring No. B-5
Sample Depth : 8.0' to 9.5'
Date Tested : 07/16/14
Date Reported : 07/22/14

AASHTO T27 :

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	100.0
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	97.9
1/4		6.3	mm	
No.4		4.75	mm	95.7
No.6		3.35	mm	
No.10		2	mm	93.4

AASHTO T88

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	82.4
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	47.8
No.270		0.053	mm	
Hyd. Rd.	# 1	0.0327	mm	39.4
Hyd. Rd.	# 2	0.0210	mm	35.8
Hyd. Rd.	# 3	0.0123	mm	31.2
Hyd. Rd.	# 4	0.0088	mm	27.5
Hyd. Rd.	# 5	0.0064	mm	20.0
Hyd. Rd.	# 6	0.0032	mm	12.2
Hyd. Rd.	# 7	0.0014	mm	7.0

D_{50} = 0.0837 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : NA
Liquid Limit (AASHTO T89) : NA
Plastic Limit (AASHTO T90) : NA
Plasticity Index : NA
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : 2.716
AASHTO Classification: M145 : A-4 (0) *
ASTM Classification: D2487 : SM *
* Visual Classification

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 6.6
Coarse Sand (-No.10 + No.40) : 11.0
Fine Sand (-No.40 + No.200) : 34.6
Silt (-No.200 + 0.002mm) : 38.5
Clay (-0.002mm + 0.001mm) : 3.1
Colloids (-0.001mm) : 6.2

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 4.3
Coarse Sand (-No.4 + No.10) : 2.3
Medium Sand (-No.10 + No.40) : 11.0
Fine Sand (-No.40 + No.200) : 34.6
Silt (-No.200 + 0.005mm) : 30.6
Clay (-0.005mm + 0.001mm) : 11.0
Colloids (-0.001mm) : 6.2

Approved By : J.S.

Soil No. 36

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Green & Gray Silty Sand

Sample No. : SS-6
Sample Loc. : Boring No. B-5
Sample Depth : 32.4' to 33.9'
Date Tested : 07/21/14
Date Reported : 07/24/14

AASHTO T27 :

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	99.8

AASHTO T88

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	83.6
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	41.2
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.1075 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 36.4
Liquid Limit (AASHTO T89) : NP
Plastic Limit (AASHTO T90) : NP
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-4 (0)
ASTM Classification: D2487 : SM

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 0.2
Coarse Sand (-No.10 + No.40) : 16.2
Fine Sand (-No.40 + No.200) : 42.4
Silt + Clay (-No.200) : 41.2

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 0.2
Medium Sand (-No.10 + No.40) : 16.2
Fine Sand (-No.40 + No.200) : 42.4
Silt + Clay (-No.200) : 41.2

Approved By : J.S.

Soil No. 37

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Green & Gray Sandy Silt

Sample No. : SS-9
Sample Loc. : Boring No. B-5
Sample Depth : 45.0' to 46.5'
Date Tested : 07/21/14
Date Reported : 07/24/14

AASHTO T27 :

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	99.9

AASHTO T88

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	82.9
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	52.3
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.0561 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 37
Liquid Limit (AASHTO T89) : 45
Plastic Limit (AASHTO T90) : 33
Plasticity Index : 12
Liquidity Index : 0.31
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-7-5 (5)
ASTM Classification: D2487 : ML

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 0.1
Coarse Sand (-No.10 + No.40) : 17.0
Fine Sand (-No.40 + No.200) : 30.6
Silt + Clay (-No.200) : 52.3

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 0.1
Medium Sand (-No.10 + No.40) : 17.0
Fine Sand (-No.40 + No.200) : 30.6
Silt + Clay (-No.200) : 52.3

Approved By : J.S.

Soil No. 38

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Green & Gray Sandy Silt

Sample No. : SS-11
Sample Loc. : Boring No. B-5
Sample Depth : 55.0' to 56.5'
Date Tested : 07/21/14
Date Reported : 07/24/14

AASHTO T27 :

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	100.0

AASHTO T88

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	84.1
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	50.1
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.074 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 39.6
Liquid Limit (AASHTO T89) : 43
Plastic Limit (AASHTO T90) : 40
Plasticity Index : 3
Liquidity Index : -0.19
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-5 (1)
ASTM Classification: D2487 : ML

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 0.0
Coarse Sand (-No.10 + No.40) : 15.9
Fine Sand (-No.40 + No.200) : 34.0
Silt + Clay (-No.200) : 50.1

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 0.0
Medium Sand (-No.10 + No.40) : 15.9
Fine Sand (-No.40 + No.200) : 34.0
Silt + Clay (-No.200) : 50.1

Approved By : J.S.

Soil No. 39

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Dark Green, Tan & Black Well-Graded Sand

Sample No. : SS-13
Sample Loc. : Boring No. B-5
Sample Depth : 65.0' to 66.5'
Date Tested : 07/21/14
Date Reported : 07/24/14

AASHTO T27 :

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	100.0
1/4		6.3	mm	
No.4		4.75	mm	99.7
No.6		3.35	mm	
No.10		2	mm	85.2

AASHTO T88

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	23.5
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	2.6
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.8266 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 45.4
Liquid Limit (AASHTO T89) : NP
Plastic Limit (AASHTO T90) : NP
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-1-b (0)
ASTM Classification: D2487 : SW

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 14.8
Coarse Sand (-No.10 + No.40) : 61.7
Fine Sand (-No.40 + No.200) : 20.9
Silt + Clay (-No.200) : 2.6

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.3
Coarse Sand (-No.4 + No.10) : 14.5
Medium Sand (-No.10 + No.40) : 61.7
Fine Sand (-No.40 + No.200) : 20.9
Silt + Clay (-No.200) : 2.6

Approved By : J.S.

Soil No. 40

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Brown, Tan & Gray Poorly Graded Sand

Sample No. : SS-2
Sample Loc. : Boring No. B-6
Sample Depth : 4.0' to 5.5'
Date Tested : 07/22/14
Date Reported : 07/25/14

AASHTO T27 :

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	88.2

AASHTO T88

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	11.9
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	1.6
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.921 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 12.7
Liquid Limit (AASHTO T89) : NA
Plastic Limit (AASHTO T90) : NA
Plasticity Index : NA
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-1-b (0)
ASTM Classification: D2487 : SP

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 11.8
Coarse Sand (-No.10 + No.40) : 76.3
Fine Sand (-No.40 + No.200) : 10.3
Silt + Clay (-No.200) : 1.6

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 11.8
Medium Sand (-No.10 + No.40) : 76.3
Fine Sand (-No.40 + No.200) : 10.3
Silt + Clay (-No.200) : 1.6

Approved By : J.S.

Soil No. 41

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Brown, Tan & Gray Poorly Graded Sand

Sample No. : SS-3
Sample Loc. : Boring No. B-6
Sample Depth : 6.0' to 7.5'
Date Tested : 07/21/14
Date Reported : 07/24/14

AASHTO T27 :

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	
1/4		6.3	mm	
No.4		4.75	mm	100.0
No.6		3.35	mm	
No.10		2	mm	97.8

AASHTO T88

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	43.7
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	4.0
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.509 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 14
Liquid Limit (AASHTO T89) : NP
Plastic Limit (AASHTO T90) : NP
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-1-b (0)
ASTM Classification: D2487 : SP

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 2.2
Coarse Sand (-No.10 + No.40) : 54.1
Fine Sand (-No.40 + No.200) : 39.7
Silt + Clay (-No.200) : 4.0

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.0
Coarse Sand (-No.4 + No.10) : 2.2
Medium Sand (-No.10 + No.40) : 54.1
Fine Sand (-No.40 + No.200) : 39.7
Silt + Clay (-No.200) : 4.0

Approved By : J.S.

Soil No. 42

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Brown, Tan & Gray Poorly Graded Sand

Sample No. : SS-4
Sample Loc. : Boring No. B-6
Sample Depth : 8.0' to 9.5'
Date Tested : 07/21/14
Date Reported : 07/24/14

AASHTO T27 :

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	100.0
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	97.5
1/4		6.3	mm	
No.4		4.75	mm	96.7
No.6		3.35	mm	
No.10		2	mm	92.2

AASHTO T88

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	37.7
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	2.1
No.270		0.053	mm	
Hyd. Rd.	# 1		mm	
Hyd. Rd.	# 2		mm	
Hyd. Rd.	# 3		mm	
Hyd. Rd.	# 4		mm	
Hyd. Rd.	# 5		mm	
Hyd. Rd.	# 6		mm	
Hyd. Rd.	# 7		mm	

D_{50} = 0.6028 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : 17
Liquid Limit (AASHTO T89) : NP
Plastic Limit (AASHTO T90) : NP
Plasticity Index : NP
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : NA
AASHTO Classification: M145 : A-1-b (0)
ASTM Classification: D2487 : SP

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 7.8
Coarse Sand (-No.10 + No.40) : 54.5
Fine Sand (-No.40 + No.200) : 35.6
Silt + Clay (-No.200) : 2.1

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 3.3
Coarse Sand (-No.4 + No.10) : 4.5
Medium Sand (-No.10 + No.40) : 54.5
Fine Sand (-No.40 + No.200) : 35.6
Silt + Clay (-No.200) : 2.1

Approved By : J.S.

Soil No. 43

SOIL CLASSIFICATION

Project Name : Bridge Replacement over Four Hole Swamp
Project No. : 11200-10
Project County : Orangeburg
Project State : South Carolina
Laboratory No. : 11200-10
Submitted By : ICA Engineering
Soil Type : Gray & Brown Poorly Graded Sand with Silt

Sample No. : SS-5
Sample Loc. : Boring No. B-6
Sample Depth : 10.0' to 11.5'
Date Tested : 07/17/14
Date Reported : 07/24/14

AASHTO T27 :

				% Passing
4	in.	101.6	mm	
3.5	in.	88.9	mm	
3	in.	76.2	mm	
2.5	in.	63.5	mm	
2	in.	50.8	mm	
1 3/4	in.	45	mm	
1 1/2	in.	38.1	mm	
1 1/4	in.	31.5	mm	
1	in.	25	mm	
3/4	in.	19	mm	
1/2	in.	12.5	mm	
3/8	in.	9.5	mm	100.0
1/4		6.3	mm	
No.4		4.75	mm	99.6
No.6		3.35	mm	
No.10		2	mm	99.2

AASHTO T88

				% Passing
No.16		1.18	mm	
No.30		0.6	mm	
No.40		0.425	mm	86.4
No.50		0.3	mm	
No.60		0.25	mm	
No.80		0.18	mm	
No.100		0.15	mm	
No.200		0.075	mm	8.8
No.270		0.053	mm	
Hyd. Rd.	# 1	0.0377	mm	4.8
Hyd. Rd.	# 2	0.0238	mm	4.8
Hyd. Rd.	# 3	0.0137	mm	3.9
Hyd. Rd.	# 4	0.0097	mm	3.8
Hyd. Rd.	# 5	0.0069	mm	3.8
Hyd. Rd.	# 6	0.0034	mm	3.6
Hyd. Rd.	# 7	0.0014	mm	2.9

D_{50} = 0.1884 mm

CBR : NA
Dry Dens. : NA
Opt. Moist. : NA

Natural Moisture (%) (AASHTO T265) : NA
Liquid Limit (AASHTO T89) : NA
Plastic Limit (AASHTO T90) : NA
Plasticity Index : NA
Liquidity Index : NA
Activity : NA
Sp. Gr. (AASHTO T100) : 2.672
AASHTO Classification: M145 : A-2-4 (0) *
ASTM Classification: D2487 : SP-SM *
* Visual Classification

AASHTO Composition of Total Sample: M145
Gravel (3in. + No.10) : 0.8
Coarse Sand (-No.10 + No.40) : 12.8
Fine Sand (-No.40 + No.200) : 77.6
Silt (-No.200 + 0.002mm) : 5.6
Clay (-0.002mm + 0.001mm) : 0.7
Colloids (-0.001mm) : 2.5

ASTM Composition of Total Sample: D2487
Coarse Gravel (3in. + 3/4in.) : 0.0
Fine Gravel (-3/4in. + No.4) : 0.4
Coarse Sand (-No.4 + No.10) : 0.4
Medium Sand (-No.10 + No.40) : 12.8
Fine Sand (-No.40 + No.200) : 77.6
Silt (-No.200 + 0.005mm) : 5.1
Clay (-0.005mm + 0.001mm) : 1.2
Colloids (-0.001mm) : 2.5

Approved By : J.S.

Soil No. 44

2550 Irvin Cobb Drive
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APPENDIX C

BRIDGE DATASHEET

REV. 11/2005

Date: 9/9/2014

Memorandum to: Road Design Group Coordinator Ansel Stuck
Bridge Design Squad/Team Leader Terry Koon

From: Hydraulic Design Squad/Engineer Mungo

Subject: Hydrology Data for Bridge Over Four Hole Swamp

County: Orangeburg Rd/Rte.: US 301 Const. Pin: 40308
Structure No.: 3820030130800
Bridge Length: 294 ft. Bridge Roadway Width: 44 ft.
Beg. Station: 5949+30 End Station: 5952+24 Skew Angle: N/A °
Bridge Span Configuration: 44'-44'-44'-44'-44'-44'-30'
Bridge Span Type: Flat Slab

Min. F. G. Elev.: 122.30 ft. Min. Low Steel: 120.00 ft.
End Fill Slope: 2 Riprap Req'd: Yes X To Elevation: 119.00 ft.
No
Comments: Location of piers are critical for Hydraulic Efficiency.
New Bridge length and spans are limited by downstream US 301 NB Bridge.

Historical Highwater Elev. = 124.08 FT in 1928 (123.09 FT NAVD 88)

50 Year H. W. Elev. = 118.33 including 0.79 ft. Backwater
100 Year H. W. Elev. = 119.04 including 0.92 ft. Backwater

HYDROLOGY DATA:

D. A. = 136 sq. mi. = 87051 ac.
Q50 = 5890 cfs
Vel. = 2.94 ft/sec
50 Year W.S. Elev = 118.15 ft.
Q_{100} = 7040 cfs
$Vel._{100}$ = 3.25 ft/sec
100 Year W.S. Elev = 118.83 ft.

2 Year W.S. Elev = 114.54 ft.

OVERTOPPING FLOOD:

Q = 9640 cfs
Probability = N/A

cc: Program Manager Michelle Shepherd
Environmental Engineer: Randy Williamson

APPENDIX D

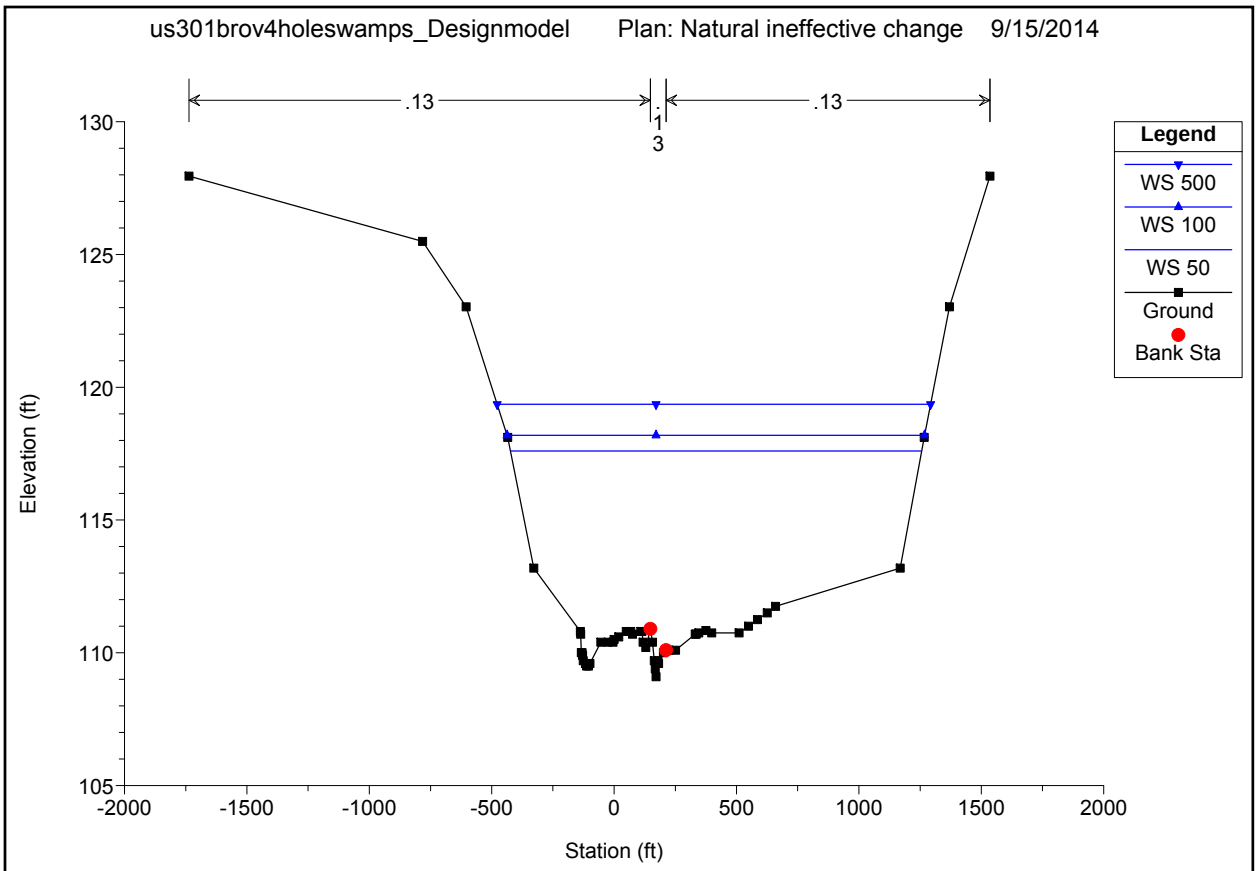
NATURAL CONDITIONS
HEC-RAS MODEL SUMMARY

HEC-RAS Plan: Natural ineffect Locations: User Defined

River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
4 Hole Swamp	4 Hole Swamp	-600	50	5890.00	109.10	117.60		117.61	0.000272	0.74	9687.17	1679.95	0.05
4 Hole Swamp	4 Hole Swamp	-600	100	7040.00	109.10	118.19		118.20	0.000287	0.79	10682.19	1705.49	0.05
4 Hole Swamp	4 Hole Swamp	-600	500	9640.00	109.10	119.36		119.37	0.000317	0.91	12711.99	1770.37	0.05
4 Hole Swamp	4 Hole Swamp	-650	50	5890.00	108.80	117.59		117.59	0.000262	0.71	9856.59	1709.65	0.05
4 Hole Swamp	4 Hole Swamp	-650	100	7040.00	108.80	118.18		118.18	0.000276	0.77	10867.89	1735.14	0.05
4 Hole Swamp	4 Hole Swamp	-650	500	9640.00	108.80	119.34		119.35	0.000305	0.88	12930.33	1800.92	0.05
4 Hole Swamp	4 Hole Swamp	-700	50	5890.00	108.60	117.58		117.58	0.000245	0.71	10127.18	1739.76	0.04
4 Hole Swamp	4 Hole Swamp	-700	100	7040.00	108.60	118.16		118.17	0.000258	0.77	11154.92	1764.92	0.05
4 Hole Swamp	4 Hole Swamp	-700	500	9640.00	108.60	119.33		119.34	0.000287	0.88	13251.06	1833.23	0.05
4 Hole Swamp	4 Hole Swamp	-750	50	5890.00	108.10	117.57		117.57	0.000216	0.71	10628.23	1789.60	0.04
4 Hole Swamp	4 Hole Swamp	-750	100	7040.00	108.10	118.15		118.16	0.000230	0.76	11684.13	1814.96	0.04
4 Hole Swamp	4 Hole Swamp	-750	500	9640.00	108.10	119.32		119.32	0.000258	0.87	13837.93	1886.38	0.05
4 Hole Swamp	4 Hole Swamp	-800	50	5890.00	107.60	117.56		117.56	0.000201	0.72	11026.33	1855.45	0.04
4 Hole Swamp	4 Hole Swamp	-800	100	7040.00	107.60	118.14		118.15	0.000214	0.77	12120.19	1882.49	0.04
4 Hole Swamp	4 Hole Swamp	-800	500	9640.00	107.60	119.30		119.31	0.000241	0.88	14355.99	1964.10	0.05
4 Hole Swamp	4 Hole Swamp	-850	50	5890.00	106.20	117.55		117.55	0.000200	0.69	11194.52	1923.96	0.04
4 Hole Swamp	4 Hole Swamp	-850	100	7040.00	106.20	118.13		118.14	0.000211	0.74	12328.42	1954.32	0.04
4 Hole Swamp	4 Hole Swamp	-850	500	9640.00	106.20	119.29		119.30	0.000236	0.84	14645.51	2036.38	0.05
4 Hole Swamp	4 Hole Swamp	-900	50	5890.00	106.70	117.54		117.54	0.000196	0.71	11366.85	1973.25	0.04
4 Hole Swamp	4 Hole Swamp	-900	100	7040.00	106.70	118.12		118.13	0.000207	0.76	12529.31	2004.84	0.04
4 Hole Swamp	4 Hole Swamp	-900	500	9640.00	106.70	119.28		119.29	0.000231	0.86	14907.88	2094.07	0.05
4 Hole Swamp	4 Hole Swamp	-913	50	5890.00	106.80	117.53		117.54	0.000180	0.62	12352.57	2291.69	0.04
4 Hole Swamp	4 Hole Swamp	-913	100	7040.00	106.80	118.12		118.12	0.000185	0.66	13699.70	2318.46	0.04
4 Hole Swamp	4 Hole Swamp	-913	500	9640.00	106.80	119.28		119.28	0.000202	0.74	16468.19	2453.22	0.04
4 Hole Swamp	4 Hole Swamp	-1100	50	5890.00	107.80	117.49		117.49	0.000224	0.65	11826.80	2457.53	0.04
4 Hole Swamp	4 Hole Swamp	-1100	100	7040.00	107.80	118.07		118.08	0.000230	0.69	13285.04	2535.94	0.04
4 Hole Swamp	4 Hole Swamp	-1100	500	9640.00	107.80	119.23		119.23	0.000229	0.75	16263.75	2603.48	0.04
4 Hole Swamp	4 Hole Swamp	-1150	50	5890.00	108.50	117.47		117.48	0.000247	0.69	10375.25	1868.43	0.04
4 Hole Swamp	4 Hole Swamp	-1150	100	7040.00	108.50	118.06		118.06	0.000257	0.74	11470.05	1893.23	0.05
4 Hole Swamp	4 Hole Swamp	-1150	500	9640.00	108.50	119.21		119.22	0.000284	0.85	13718.40	1997.14	0.05
4 Hole Swamp	4 Hole Swamp	-1200	50	5890.00	109.50	117.46		117.47	0.000309	0.77	9072.57	1587.72	0.05
4 Hole Swamp	4 Hole Swamp	-1200	100	7040.00	109.50	118.04		118.05	0.000325	0.83	10001.98	1611.17	0.05
4 Hole Swamp	4 Hole Swamp	-1200	500	9640.00	109.50	119.19		119.20	0.000370	0.96	11928.24	1731.44	0.06
4 Hole Swamp	4 Hole Swamp	-1250	50	5890.00	108.70	117.44		117.45	0.000325	0.81	9001.00	1602.70	0.05
4 Hole Swamp	4 Hole Swamp	-1250	100	7040.00	108.70	118.02		118.03	0.000341	0.87	9937.80	1626.08	0.05

HEC-RAS Plan: Natural ineffect Locations: User Defined (Continued)

River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
4 Hole Swamp	4 Hole Swamp	-1250	500	9640.00	108.70	119.18		119.19	0.000387	1.01	11882.00	1755.83	0.06
4 Hole Swamp	4 Hole Swamp	-1300	50	5890.00	108.60	117.43		117.43	0.000323	0.76	9044.17	1622.01	0.05
4 Hole Swamp	4 Hole Swamp	-1300	100	7040.00	108.60	118.01		118.01	0.000338	0.82	9991.14	1646.10	0.05
4 Hole Swamp	4 Hole Swamp	-1300	500	9640.00	108.60	119.16		119.17	0.000383	0.96	11956.18	1780.15	0.06
4 Hole Swamp	4 Hole Swamp	-1350	50	5890.00	109.10	117.41		117.42	0.000330	0.77	9084.78	1663.73	0.05
4 Hole Swamp	4 Hole Swamp	-1350	100	7040.00	109.10	117.99		118.00	0.000344	0.82	10056.21	1692.78	0.05
4 Hole Swamp	4 Hole Swamp	-1350	500	9640.00	109.10	119.14		119.15	0.000383	0.95	12068.98	1822.50	0.06
4 Hole Swamp	4 Hole Swamp	-1400	50	5890.00	109.10	117.40		117.40	0.000315	0.74	9340.50	1726.69	0.05
4 Hole Swamp	4 Hole Swamp	-1400	100	7040.00	109.10	117.97		117.98	0.000328	0.80	10348.54	1760.11	0.05
4 Hole Swamp	4 Hole Swamp	-1400	500	9640.00	109.10	119.12		119.13	0.000362	0.92	12431.37	1881.87	0.05
4 Hole Swamp	4 Hole Swamp	-1450	50	5890.00	109.10	117.38		117.39	0.000284	0.71	9734.92	1773.17	0.05
4 Hole Swamp	4 Hole Swamp	-1450	100	7040.00	109.10	117.96		117.96	0.000297	0.76	10768.42	1805.54	0.05
4 Hole Swamp	4 Hole Swamp	-1450	500	9640.00	109.10	119.10		119.11	0.000330	0.88	12897.28	1922.31	0.05
4 Hole Swamp	4 Hole Swamp	-1500	50	5890.00	109.10	117.37		117.37	0.000262	0.72	10056.66	1813.36	0.05
4 Hole Swamp	4 Hole Swamp	-1500	100	7040.00	109.10	117.94		117.95	0.000275	0.78	11111.94	1844.70	0.05
4 Hole Swamp	4 Hole Swamp	-1500	500	9640.00	109.10	119.09		119.10	0.000308	0.89	13280.58	1958.34	0.05
4 Hole Swamp	4 Hole Swamp	-1550	50	5890.00	109.10	117.35		117.36	0.000249	0.66	10329.77	1869.18	0.04
4 Hole Swamp	4 Hole Swamp	-1550	100	7040.00	109.10	117.93		117.94	0.000261	0.71	11417.04	1903.69	0.05
4 Hole Swamp	4 Hole Swamp	-1550	500	9640.00	109.10	119.07		119.08	0.000290	0.83	13647.75	2011.70	0.05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Legend
WS 500
WS 100
WS 50
Ground
Bank Sta
Elevation (ft)
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-1500
-1000
-500
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1500
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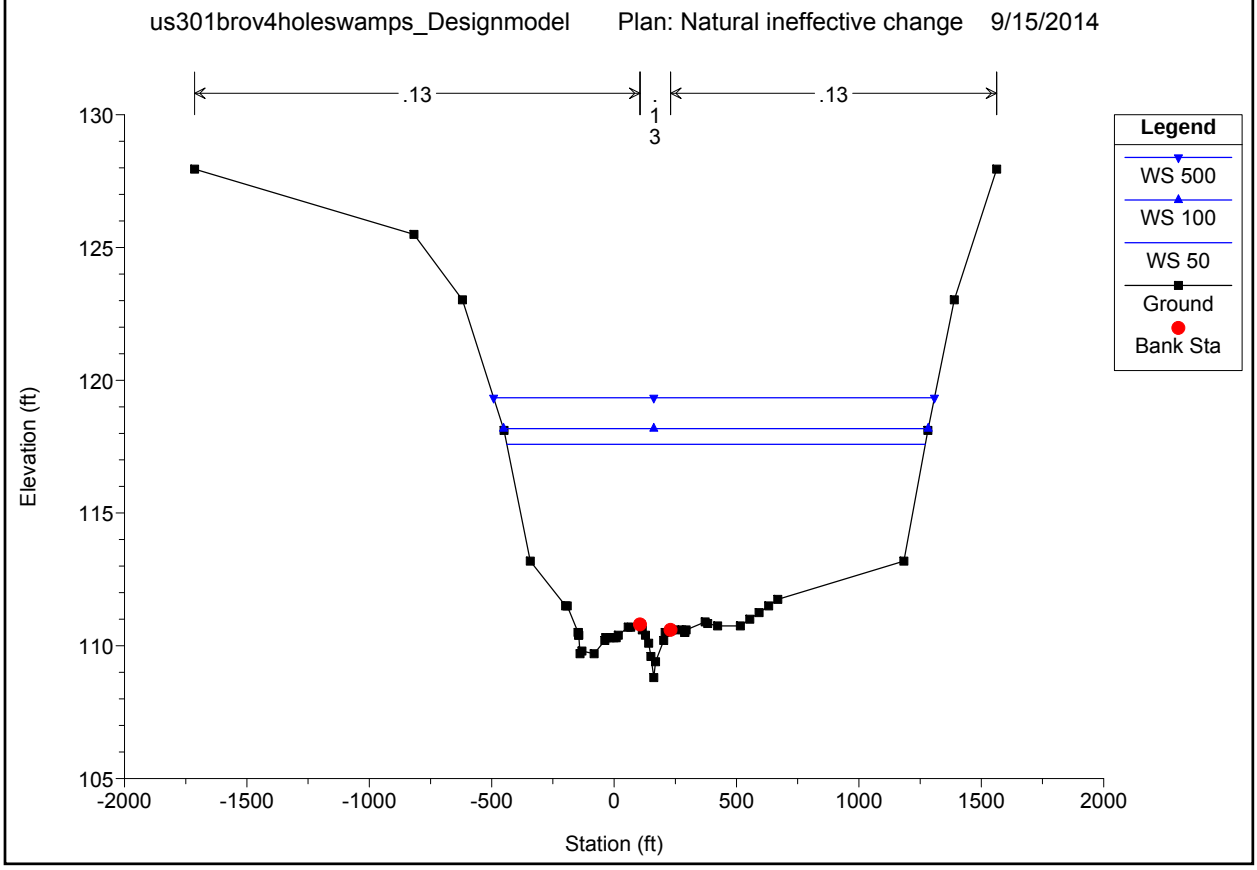
Station (ft)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Legend
WS 500
WS 100
WS 50
Ground
Bank Sta
Elevation (ft)
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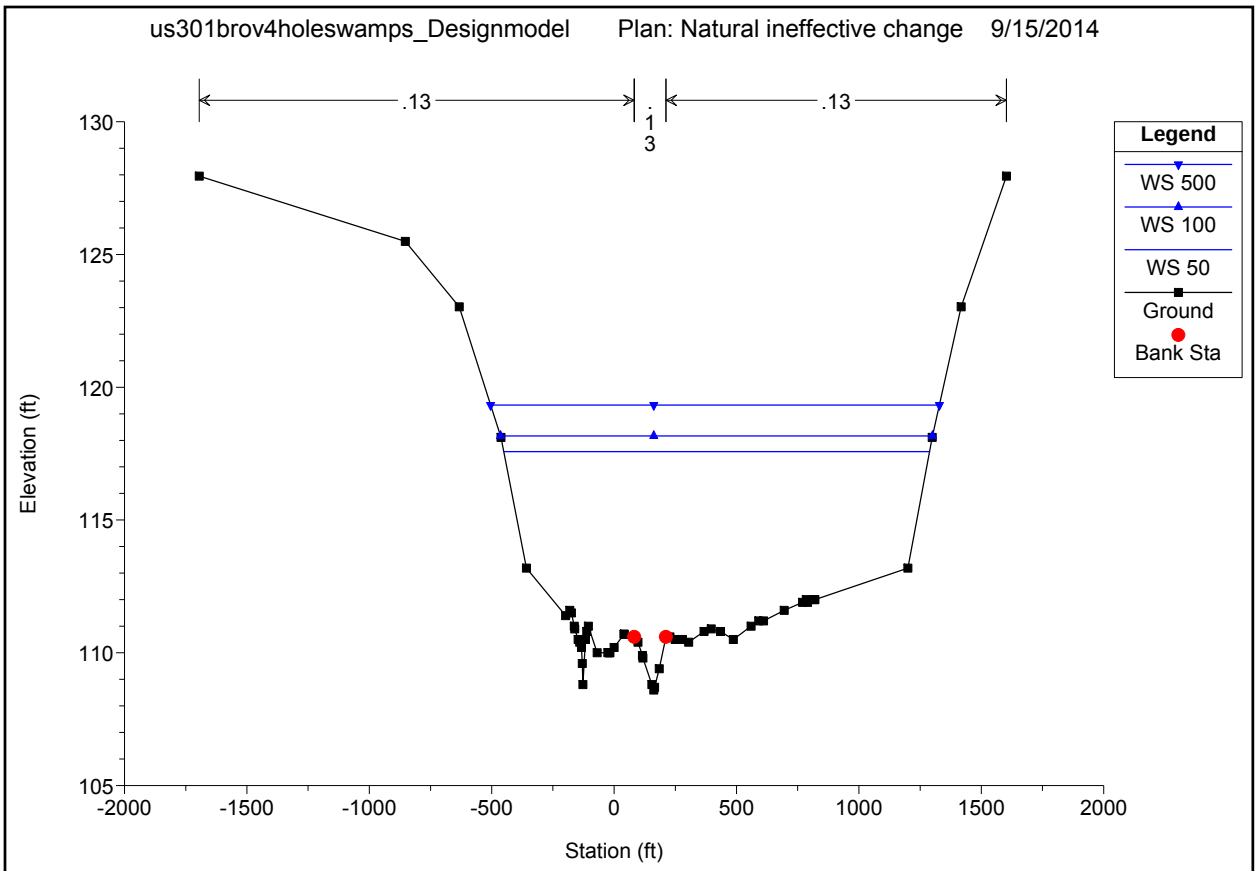
Station (ft)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Legend
WS 500
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WS 50
Ground
Bank Sta
Elevation (ft)
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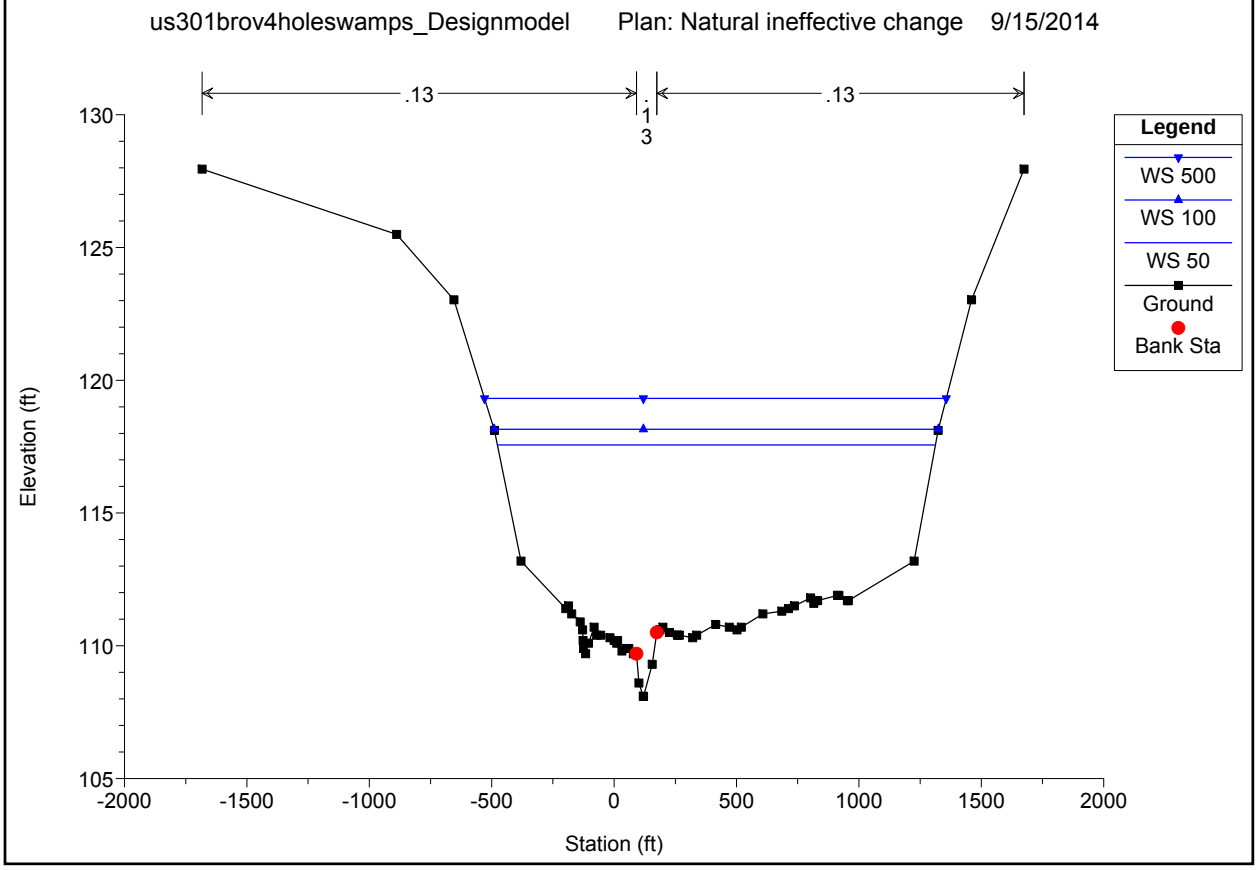
Station (ft)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WS 100
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Ground
Bank Sta
Elevation (ft)
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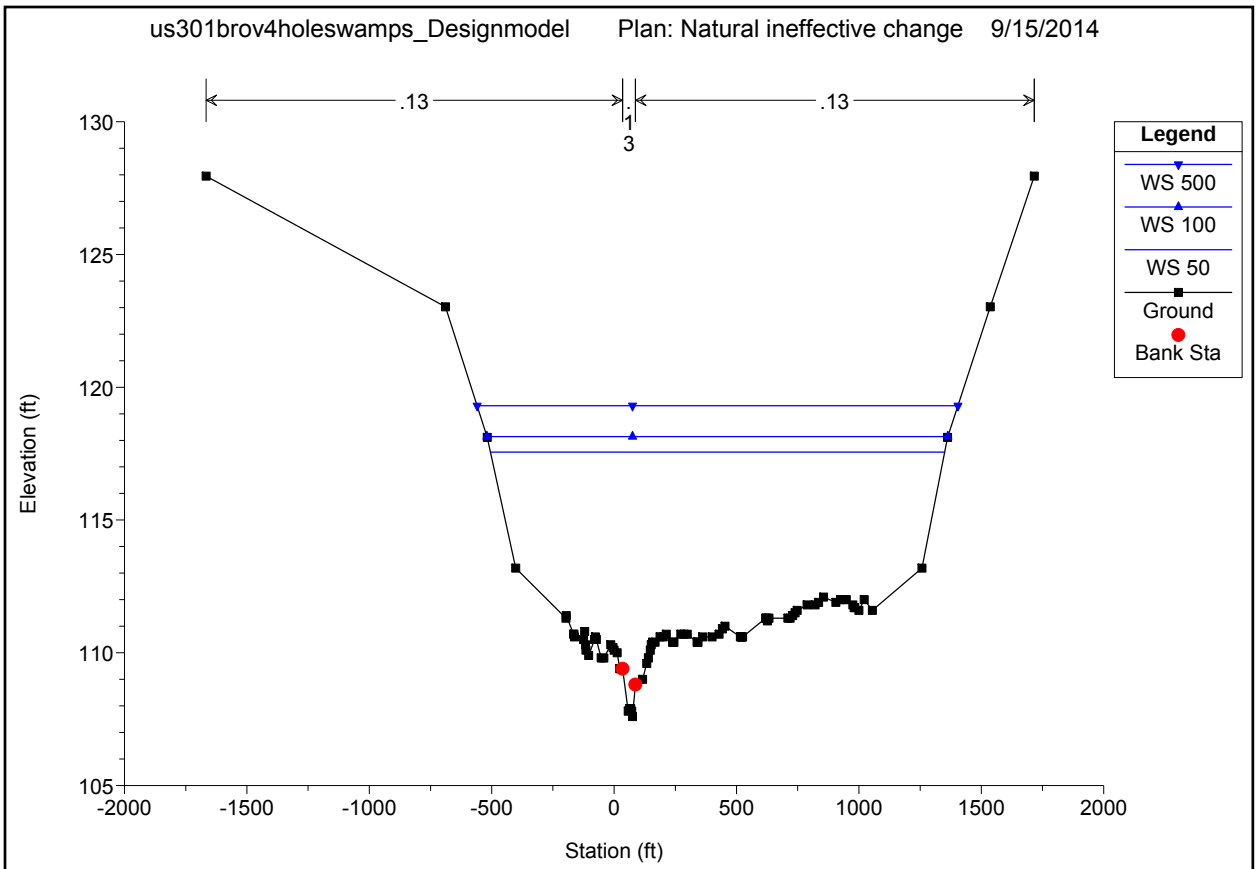
Station (ft)


us301brov4holeswamps_Designmodel
Plan: Natural ineffective change
9/15/2014
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Legend
WS 500
WS 100
WS 50
Ground
Bank Sta
Elevation (ft)
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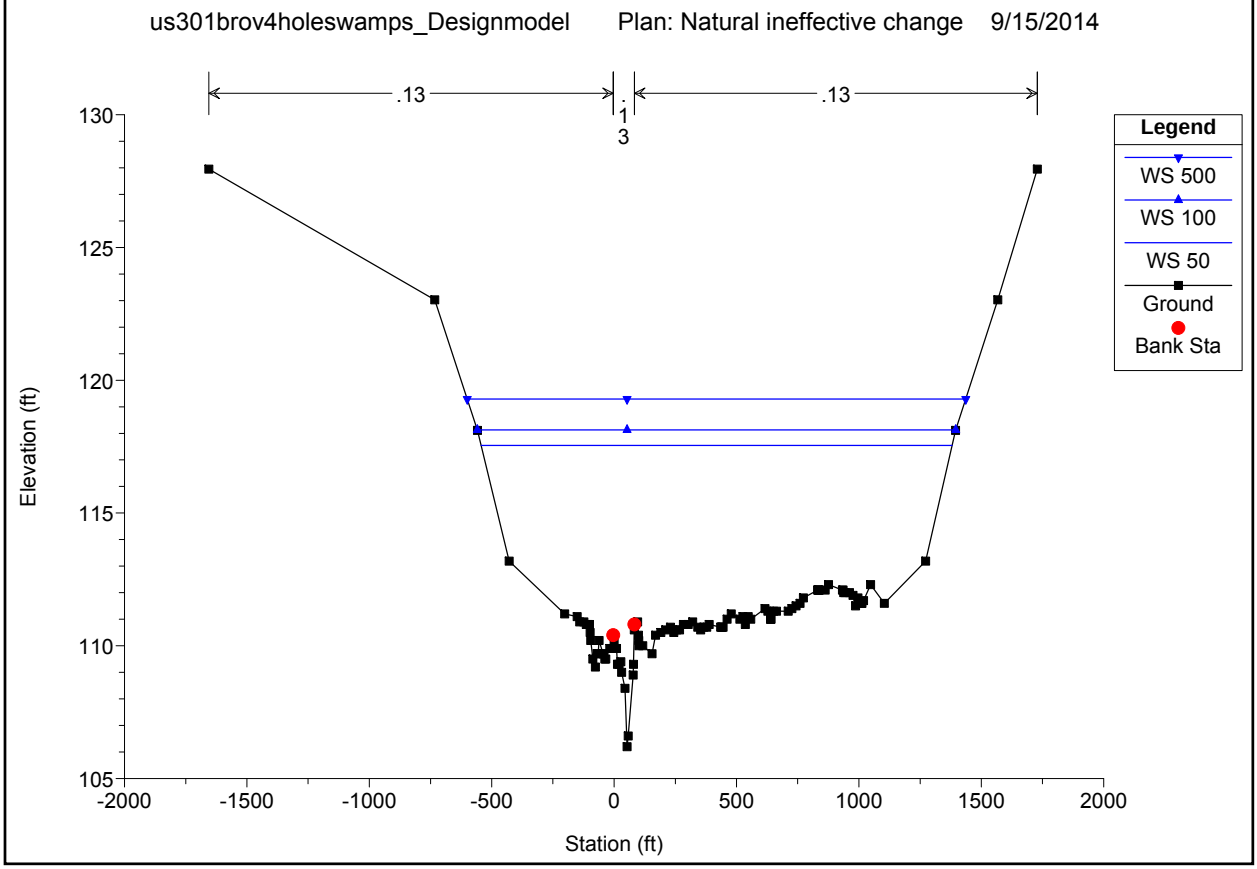
Station (ft)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Plan: Natural ineffective change
9/15/2014
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Legend
WS 500
WS 100
WS 50
Ground
Bank Sta
Elevation (ft)
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120
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110
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-2000
-1500
-1000
-500
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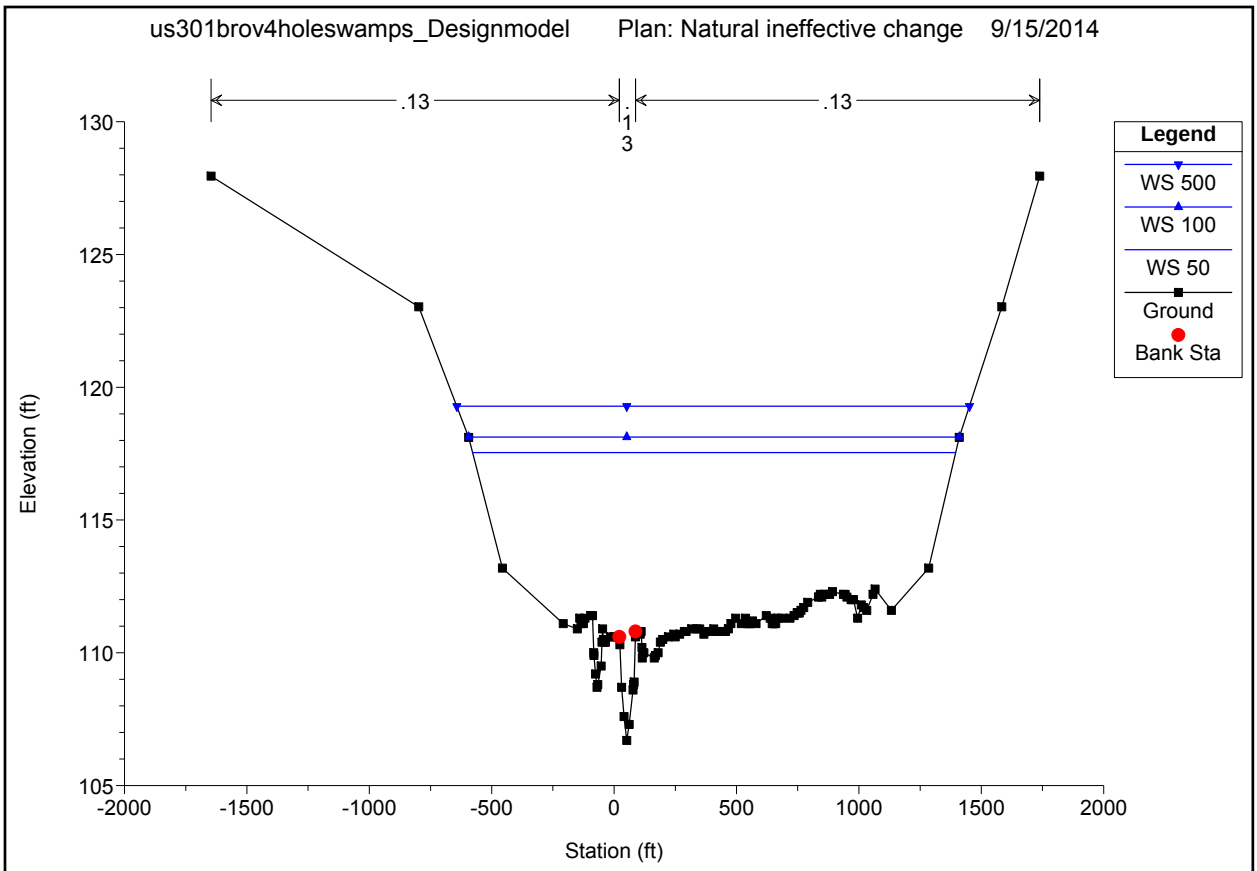
2000
Station (ft)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Legend
WS 500
WS 100
WS 50
Ground
Bank Sta
Elevation (ft)
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-2000
-1500
-1000
-500
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1500
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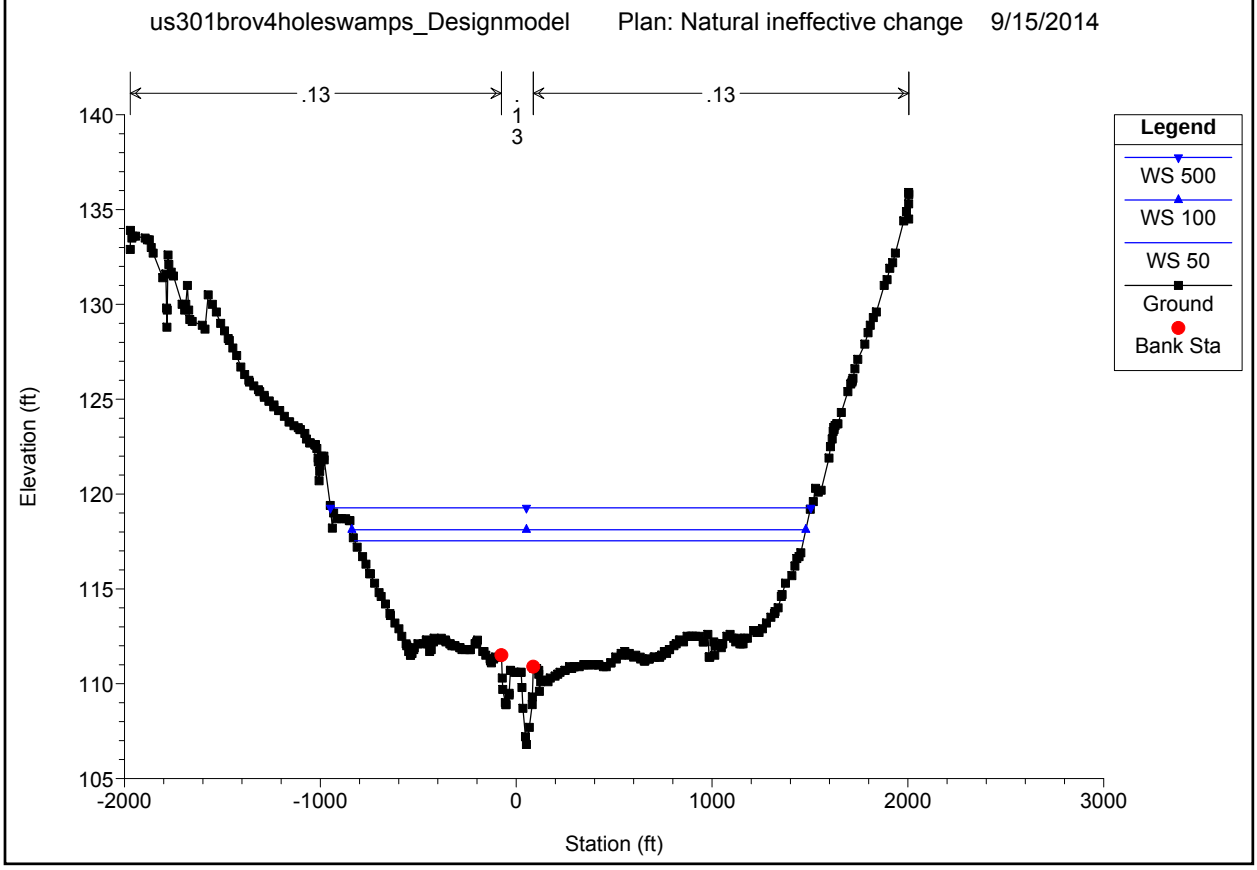
Station (ft)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Plan: Natural ineffective change
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Legend
WS 500
WS 100
WS 50
Ground
Bank Sta
Elevation (ft)
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130
125
120
115
110
105
-2000
-1000
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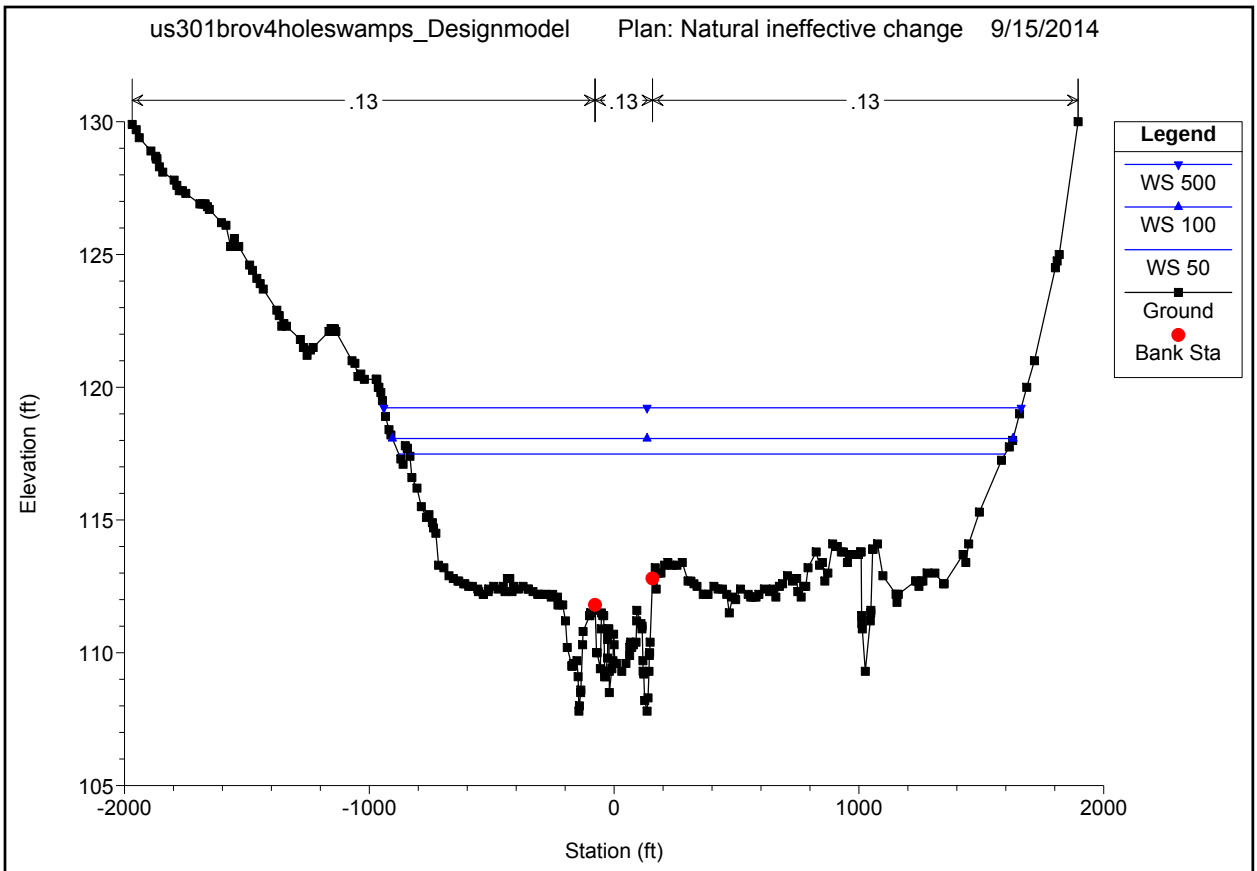
1000
2000
3000
Station (ft)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Legend
WS 500
WS 100
WS 50
Ground
Bank Sta
Elevation (ft)
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-2000
-1000
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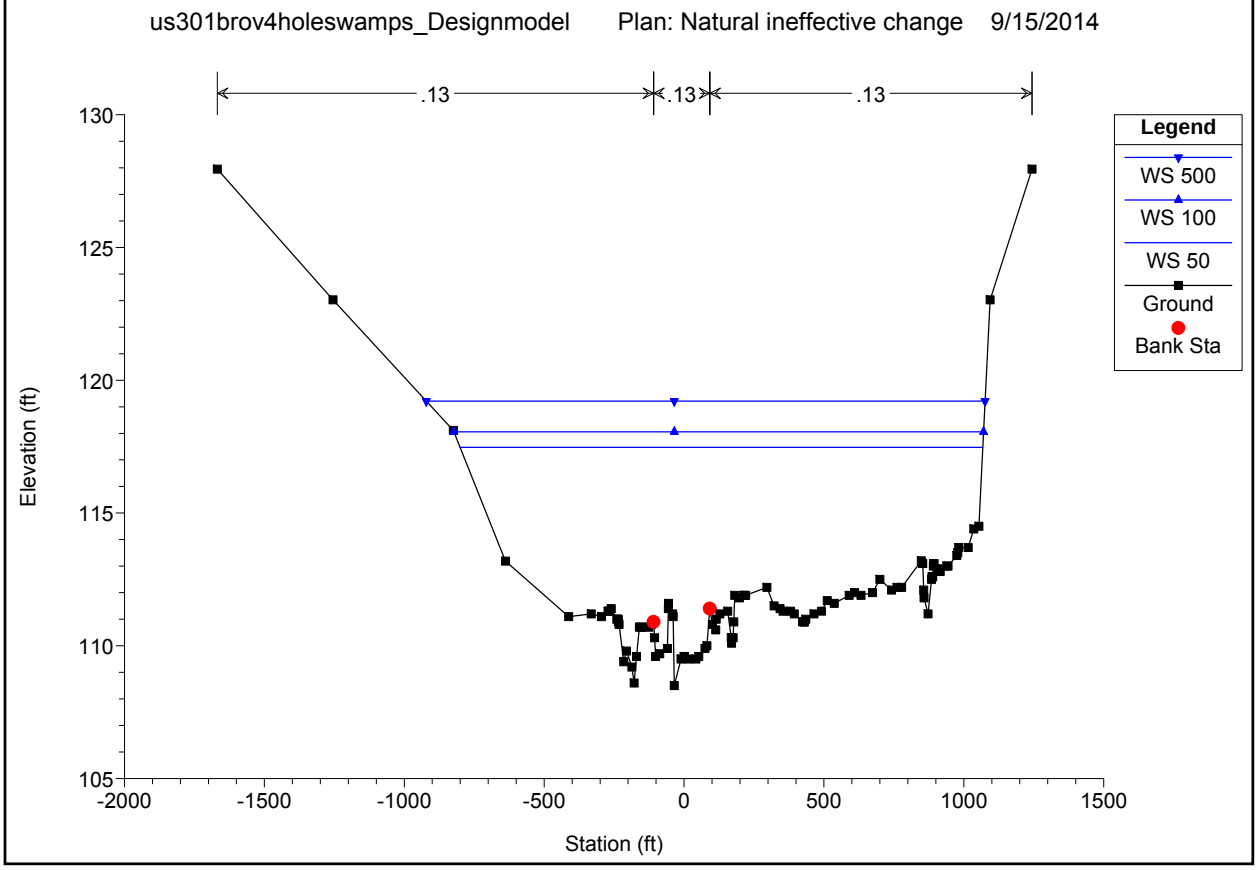
1000
2000
Station (ft)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WS 500
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Ground
Bank Sta
Elevation (ft)
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-2000
-1500
-1000
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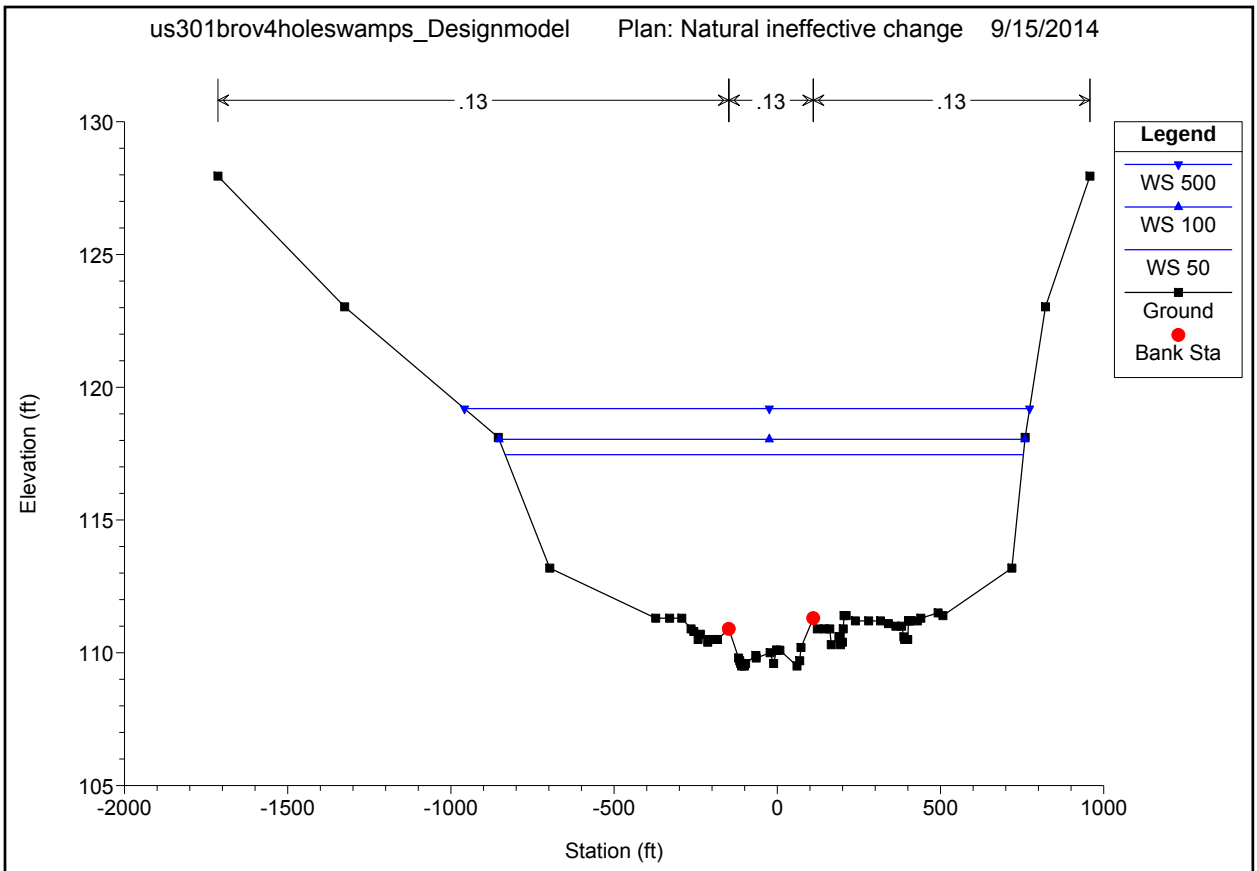
Station (ft)


us301brov4holeswamps_Designmodel Plan: Natural ineffective change 9/15/2014
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WS 500
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Bank Sta
Elevation (ft)
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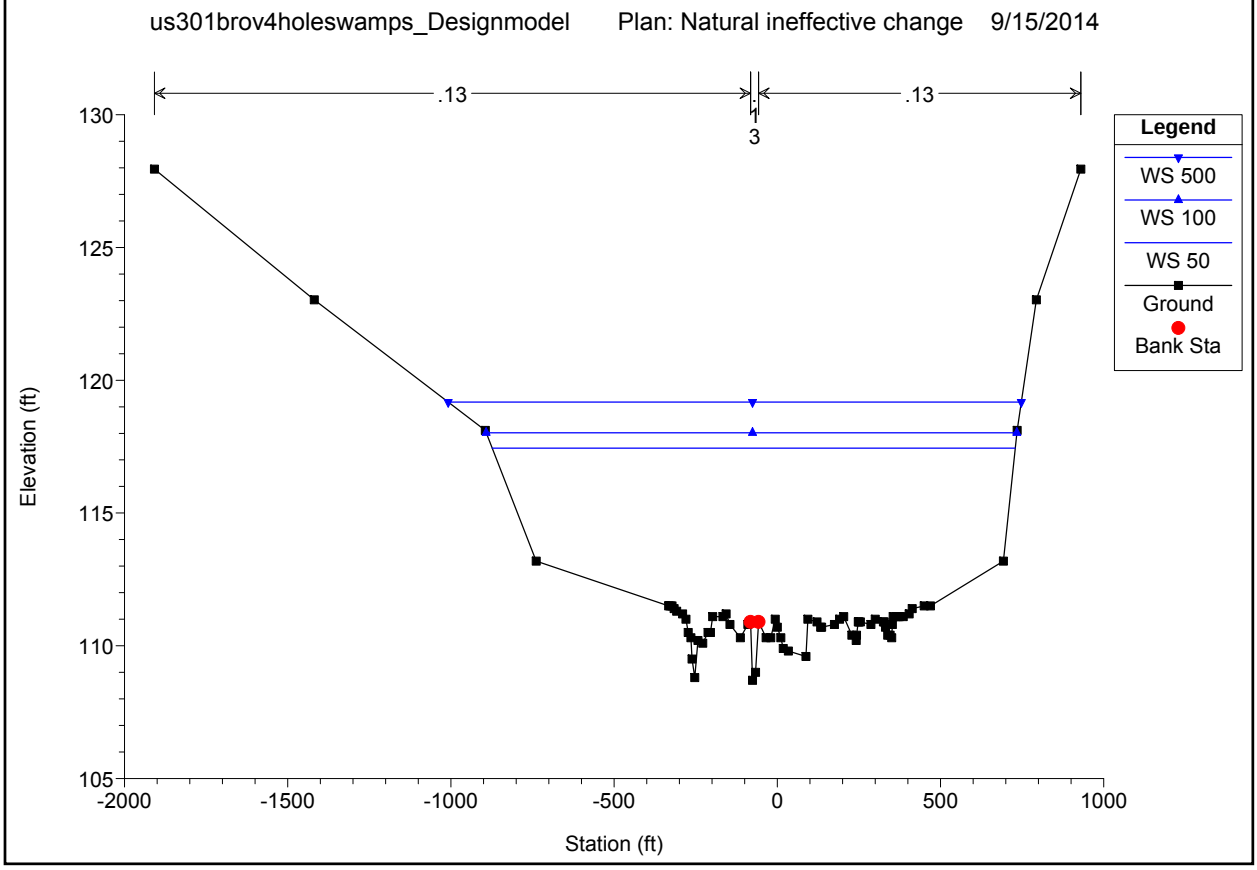
Station (ft)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WS 500
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Bank Sta
Elevation (ft)
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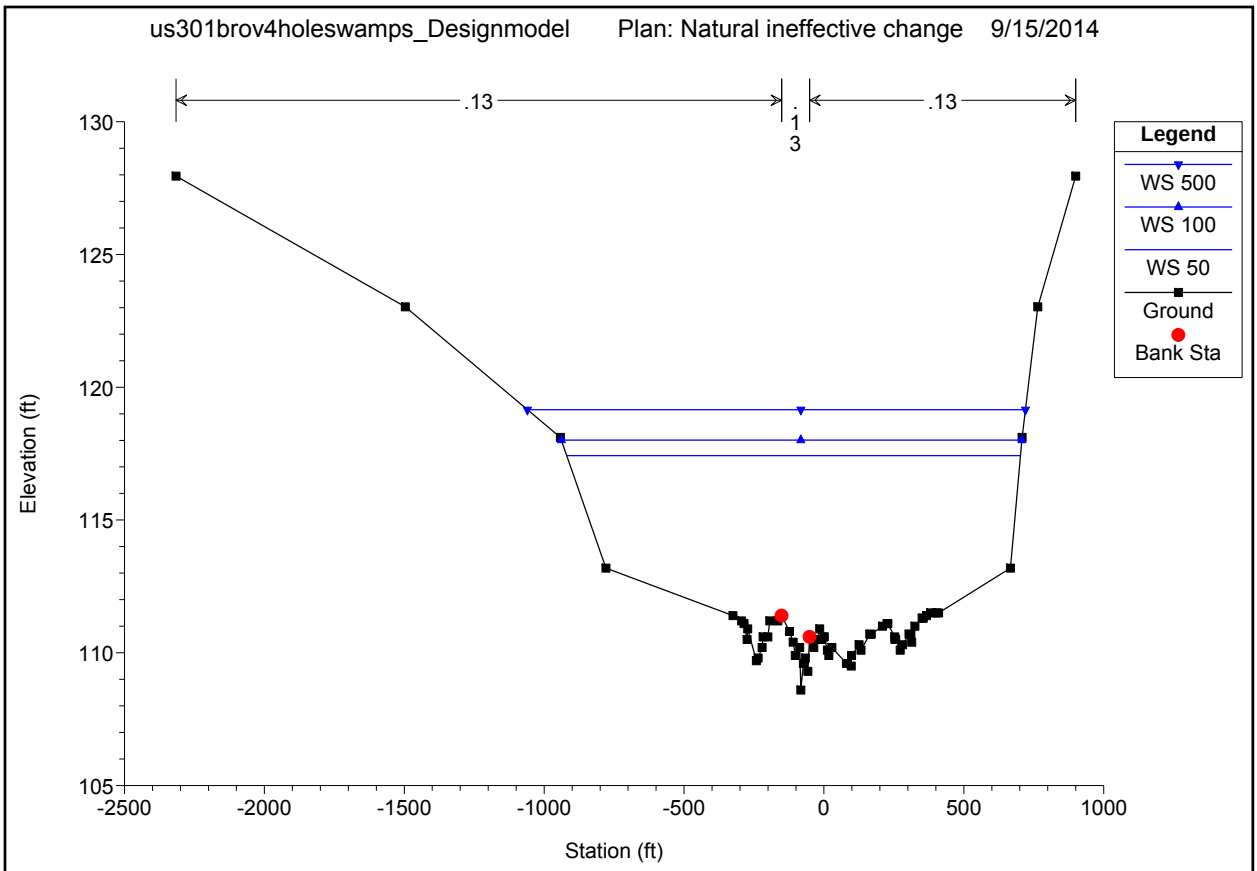
Station (ft)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Ground
Bank Sta
Elevation (ft)
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-2000
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-1000
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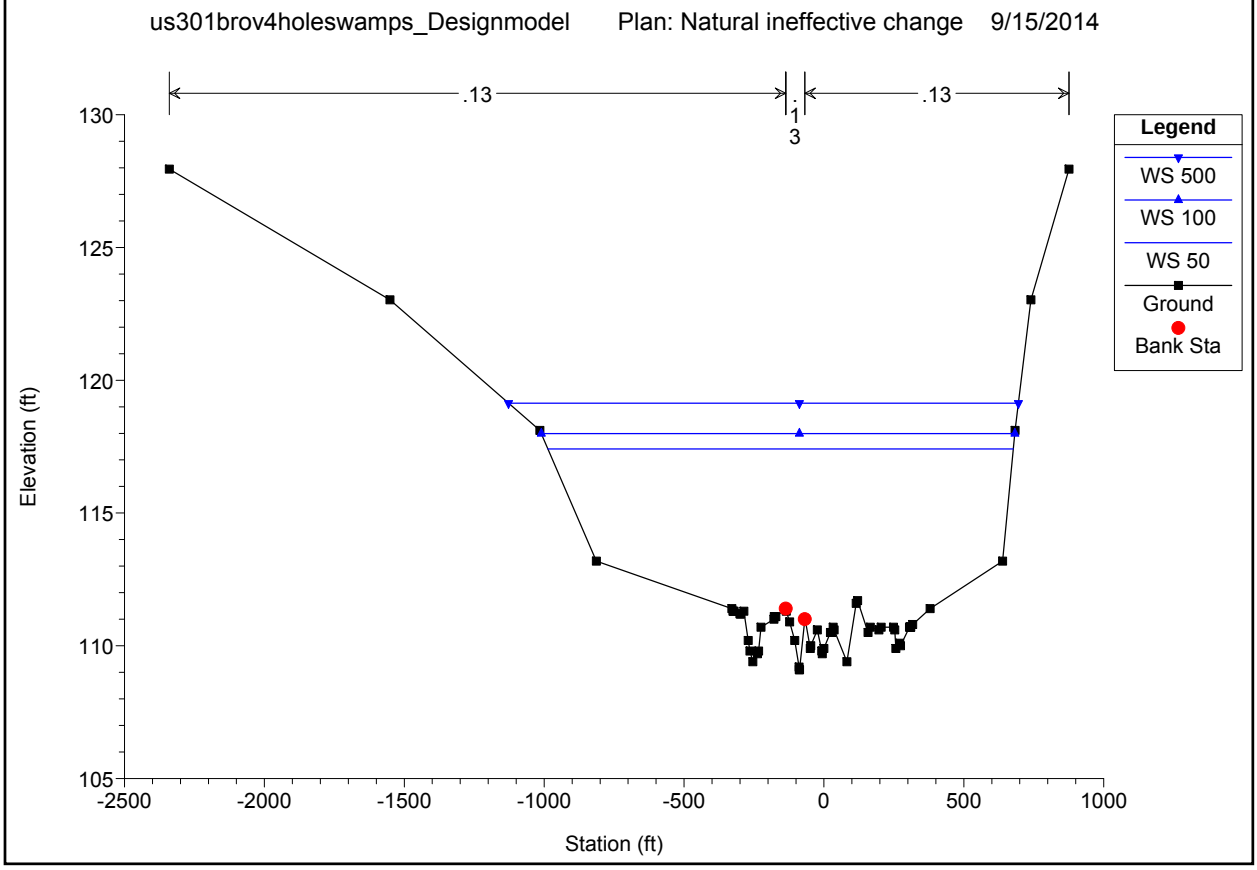
Station (ft)


us301brov4holeswamps_Designmodel Plan: Natural ineffective change 9/15/2014
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WS 500
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Ground
Bank Sta
Elevation (ft)
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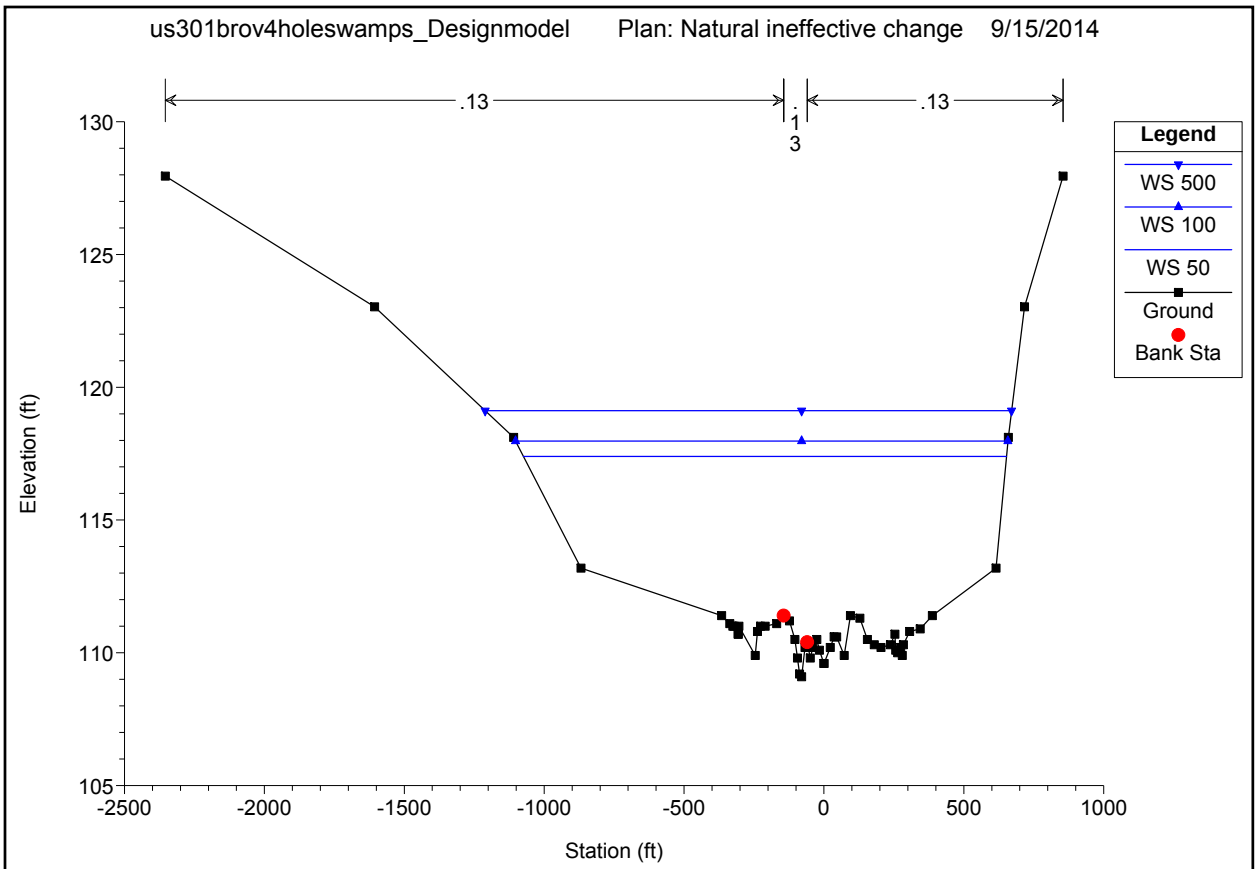
Station (ft)


us301brov4holeswamps_Designmodel Plan: Natural ineffective change 9/15/2014
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Legend
WS 500
WS 100
WS 50
Ground
Bank Sta
Elevation (ft)
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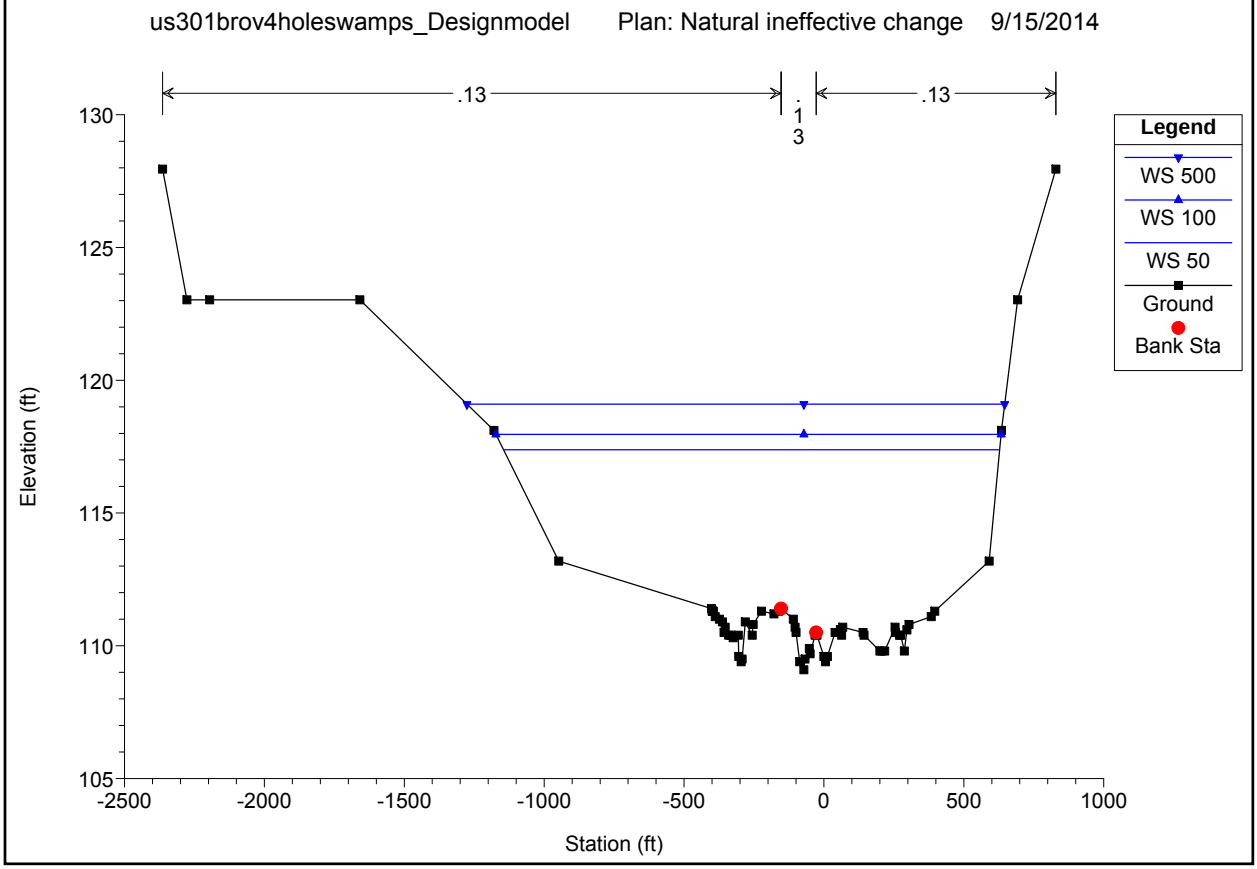
Station (ft)


us301brov4holeswamps_Designmodel Plan: Natural ineffective change 9/15/2014
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Legend
WS 500
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WS 50
Ground
Bank Sta
Elevation (ft)
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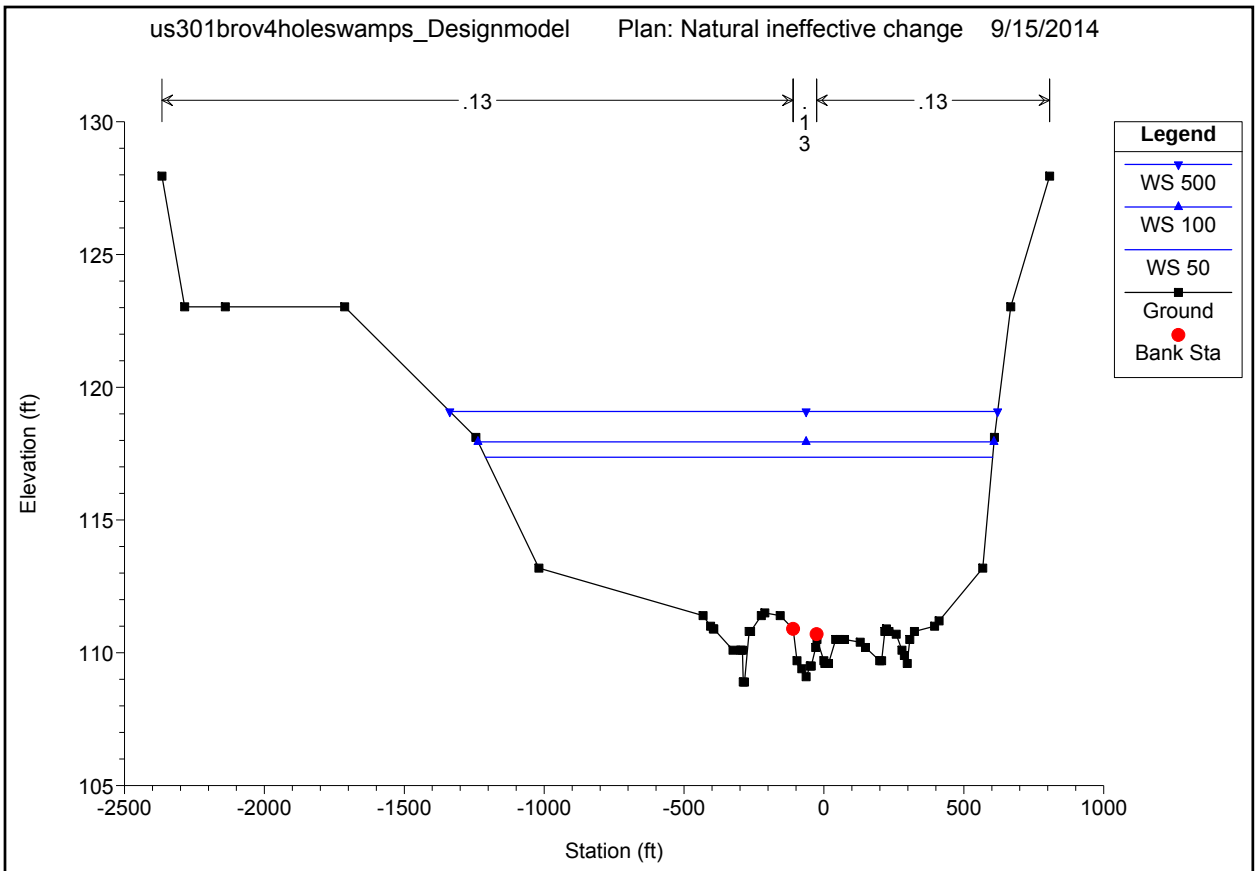
Station (ft)


us301brov4holeswamps_Designmodel Plan: Natural ineffective change 9/15/2014
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Legend
WS 500
WS 100
WS 50
Ground
Bank Sta
Elevation (ft)
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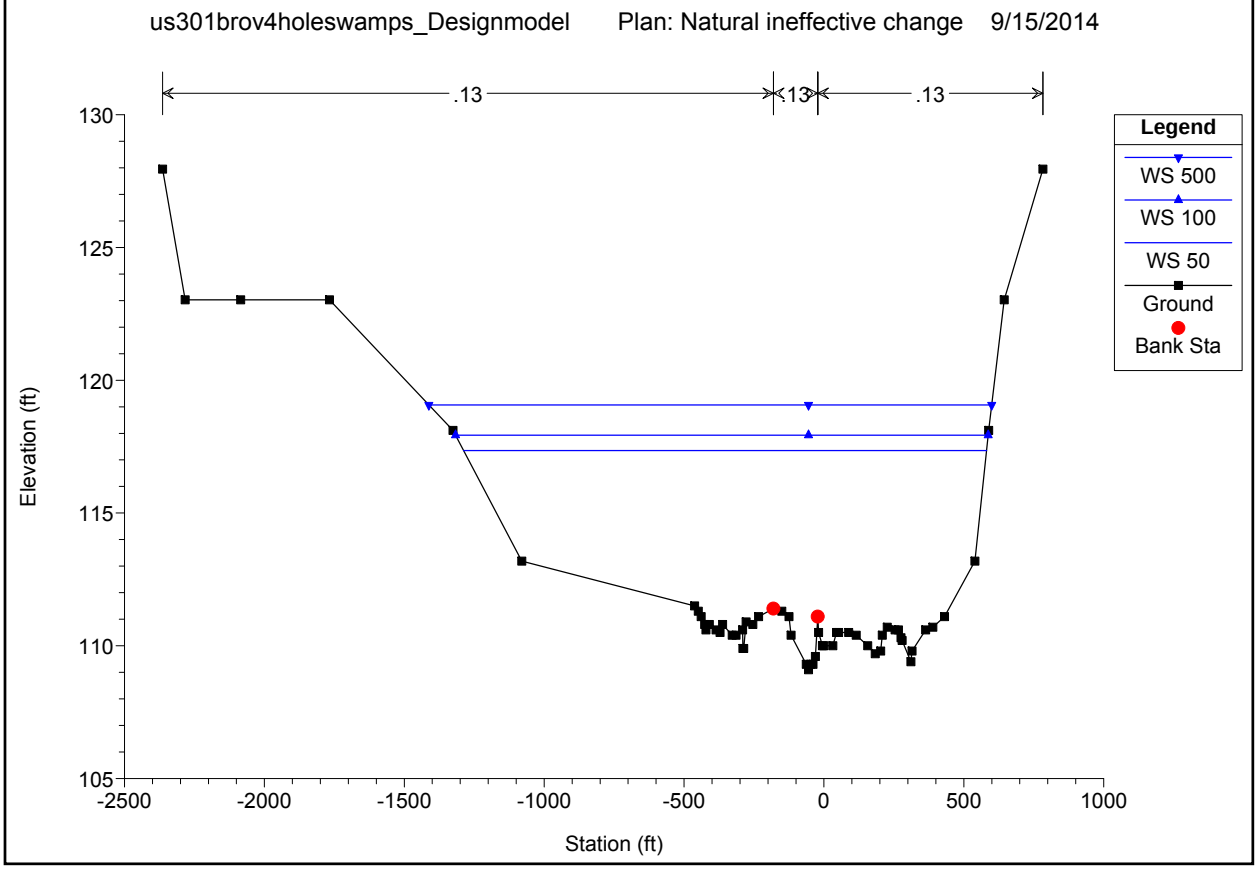
Station (ft)


us301brov4holeswamps_Designmodel Plan: Natural ineffective change 9/15/2014
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Legend
WS 500
WS 100
WS 50
Ground
Bank Sta
Elevation (ft)
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120
115
110
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-2500
-2000
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-500
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500
1000
Station (ft)

APPENDIX E

EXISTING BRIDGE

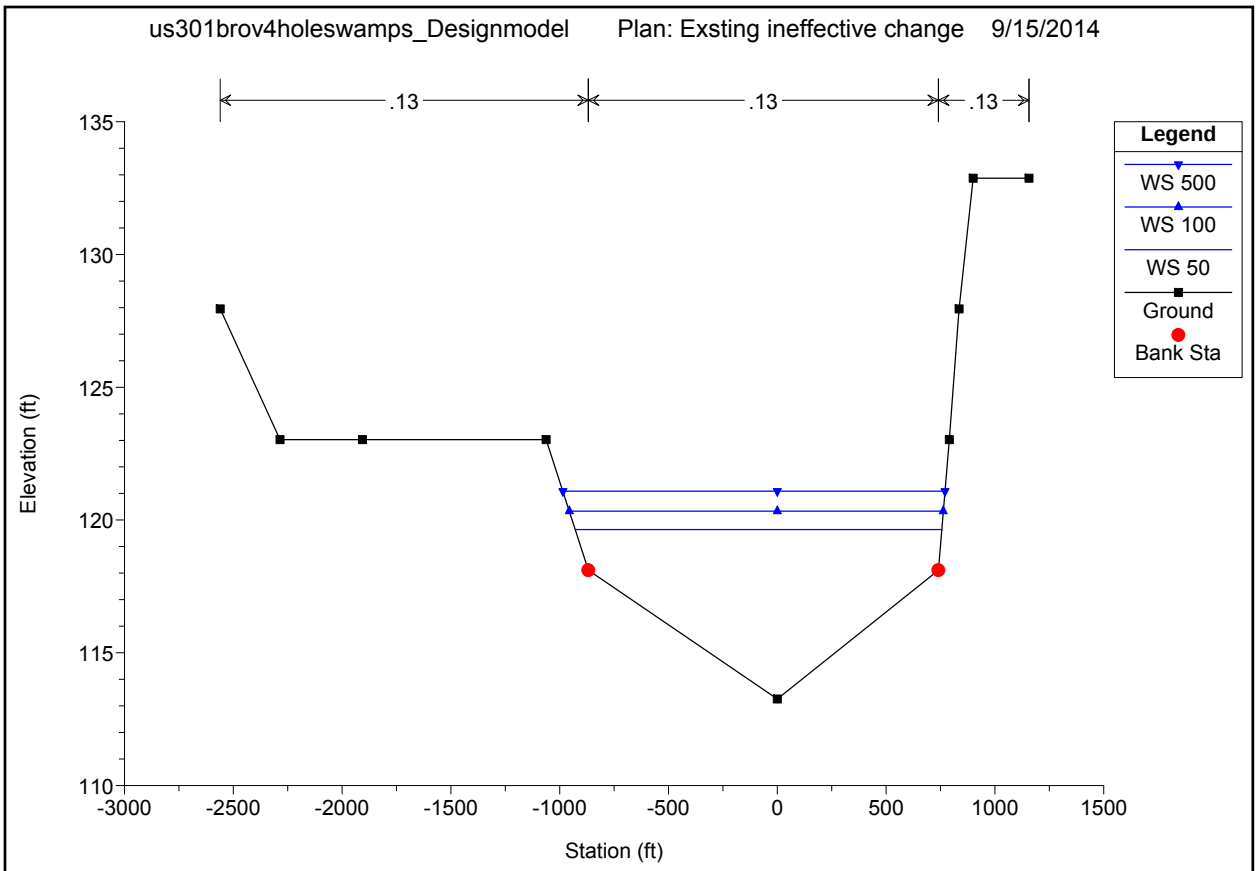
HEC-RAS MODEL SUMMARY

HEC-RAS Plan: Exsiting ineffec Locations: User Defined

River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
4 Hole Swamp	4 Hole Swamp	-600	50	5890.00	109.10	118.52	111.86	118.52	0.000166	0.80	11241.29	1723.61	0.05
4 Hole Swamp	4 Hole Swamp	-600	100	7040.00	109.10	119.45	112.04	119.45	0.000155	0.83	12862.37	1775.40	0.05
4 Hole Swamp	4 Hole Swamp	-600	500	9640.00	109.10	120.00	112.39	120.01	0.000231	1.06	13843.55	1806.30	0.06
4 Hole Swamp	4 Hole Swamp	-650	50	5890.00	108.80	118.51	111.82	118.51	0.000152	0.76	11421.92	1753.87	0.05
4 Hole Swamp	4 Hole Swamp	-650	100	7040.00	108.80	119.44	112.01	119.45	0.000143	0.79	13042.76	1806.47	0.05
4 Hole Swamp	4 Hole Swamp	-650	500	9640.00	108.80	119.99	112.36	120.00	0.000215	1.01	14016.75	1837.62	0.06
4 Hole Swamp	4 Hole Swamp	-700	50	5890.00	108.60	118.50	111.60	118.51	0.000141	0.76	11621.44	1784.74	0.04
4 Hole Swamp	4 Hole Swamp	-700	100	7040.00	108.60	119.43	111.99	119.44	0.000134	0.79	13232.27	1839.45	0.04
4 Hole Swamp	4 Hole Swamp	-700	500	9640.00	108.60	119.98	112.38	119.99	0.000203	1.00	14193.90	1871.64	0.06
4 Hole Swamp	4 Hole Swamp	-750	50	5890.00	108.10	118.49	111.96	118.50	0.000131	0.77	11978.88	1836.02	0.04
4 Hole Swamp	4 Hole Swamp	-750	100	7040.00	108.10	119.43	112.11	119.43	0.000126	0.80	13597.31	1893.31	0.04
4 Hole Swamp	4 Hole Swamp	-750	500	9640.00	108.10	119.97	112.38	119.98	0.000191	1.02	14557.02	1926.81	0.05
4 Hole Swamp	4 Hole Swamp	-800	50	5890.00	107.60	118.49	111.94	118.49	0.000134	0.81	11790.23	1906.87	0.04
4 Hole Swamp	4 Hole Swamp	-800	100	7040.00	107.60	119.42	112.01	119.43	0.000130	0.84	13364.17	1972.42	0.04
4 Hole Swamp	4 Hole Swamp	-800	500	9640.00	107.60	119.96	112.43	119.97	0.000197	1.07	14292.20	2010.49	0.06
4 Hole Swamp	4 Hole Swamp	-850	50	5890.00	106.20	118.48	111.98	118.49	0.000134	0.78	11575.93	1979.11	0.04
4 Hole Swamp	4 Hole Swamp	-850	100	7040.00	106.20	119.41	112.18	119.42	0.000128	0.81	13072.03	2045.11	0.04
4 Hole Swamp	4 Hole Swamp	-850	500	9640.00	106.20	119.95	112.52	119.96	0.000194	1.04	13935.03	2083.18	0.05
4 Hole Swamp	4 Hole Swamp	-900	50	5890.00	106.70	118.48	112.14	118.48	0.000148	0.85	10863.73	2031.90	0.05
4 Hole Swamp	4 Hole Swamp	-900	100	7040.00	106.70	119.41	112.28	119.42	0.000143	0.89	12235.74	2103.70	0.05
4 Hole Swamp	4 Hole Swamp	-900	500	9640.00	106.70	119.95	112.63	119.95	0.000218	1.13	13023.02	2144.91	0.06
4 Hole Swamp	4 Hole Swamp	-913	50	5890.00	106.80	118.47	112.14	118.48	0.000206	0.92	8940.34	2337.36	0.05
4 Hole Swamp	4 Hole Swamp	-913	100	7040.00	106.80	119.40	112.30	119.41	0.000199	0.97	10073.57	2459.34	0.05
4 Hole Swamp	4 Hole Swamp	-913	500	9640.00	106.80	119.93	112.44	119.95	0.000304	1.24	10718.24	2479.26	0.07
4 Hole Swamp	4 Hole Swamp	-967		Mult Open									
4 Hole Swamp	4 Hole Swamp	-1100	50	5890.00	107.80	117.62	112.39	117.64	0.000473	1.24	6772.38	2478.53	0.08
4 Hole Swamp	4 Hole Swamp	-1100	100	7040.00	107.80	118.22	112.78	118.24	0.000488	1.32	7498.11	2546.59	0.08
4 Hole Swamp	4 Hole Swamp	-1100	500	9640.00	107.80	119.40	113.25	119.42	0.000521	1.50	8933.21	2611.92	0.09
4 Hole Swamp	4 Hole Swamp	-1150	50	5890.00	108.50	117.60	112.39	117.61	0.000373	1.12	7469.95	1873.91	0.07
4 Hole Swamp	4 Hole Swamp	-1150	100	7040.00	108.50	118.20	112.47	118.21	0.000393	1.21	8216.06	1903.65	0.07
4 Hole Swamp	4 Hole Swamp	-1150	500	9640.00	108.50	119.38	112.92	119.39	0.000431	1.38	9696.35	2012.10	0.08
4 Hole Swamp	4 Hole Swamp	-1200	50	5890.00	109.50	117.58	112.11	117.59	0.000469	1.24	6207.28	1592.45	0.08

HEC-RAS Plan: Exsiting ineffec Locations: User Defined (Continued)

River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
4 Hole Swamp	4 Hole Swamp	-1200	100	7040.00	109.50	118.17	112.28	118.19	0.000504	1.35	6784.38	1620.35	0.08
4 Hole Swamp	4 Hole Swamp	-1200	500	9640.00	109.50	119.34	112.63	119.37	0.000575	1.58	7936.92	1747.21	0.09
4 Hole Swamp	4 Hole Swamp	-1250	50	5890.00	108.70	117.55	112.09	117.57	0.000576	1.41	6201.80	1607.06	0.09
4 Hole Swamp	4 Hole Swamp	-1250	100	7040.00	108.70	118.14	112.25	118.16	0.000615	1.53	6782.17	1633.36	0.09
4 Hole Swamp	4 Hole Swamp	-1250	500	9640.00	108.70	119.31	112.57	119.33	0.000696	1.77	7940.64	1771.73	0.10
4 Hole Swamp	4 Hole Swamp	-1300	50	5890.00	108.60	117.52	111.93	117.54	0.000535	1.29	6253.16	1626.01	0.08
4 Hole Swamp	4 Hole Swamp	-1300	100	7040.00	108.60	118.11	112.11	118.13	0.000573	1.40	6835.43	1650.66	0.09
4 Hole Swamp	4 Hole Swamp	-1300	500	9640.00	108.60	119.28	112.46	119.30	0.000650	1.64	7996.90	1794.95	0.10
4 Hole Swamp	4 Hole Swamp	-1350	50	5890.00	109.10	117.50	111.94	117.51	0.000556	1.30	6249.13	1668.01	0.09
4 Hole Swamp	4 Hole Swamp	-1350	100	7040.00	109.10	118.08	112.11	118.10	0.000594	1.42	6834.11	1697.46	0.09
4 Hole Swamp	4 Hole Swamp	-1350	500	9640.00	109.10	119.24	112.46	119.27	0.000671	1.65	8000.98	1835.20	0.10
4 Hole Swamp	4 Hole Swamp	-1400	50	5890.00	109.10	117.47	111.92	117.48	0.000537	1.27	6320.35	1730.97	0.08
4 Hole Swamp	4 Hole Swamp	-1400	100	7040.00	109.10	118.05	112.08	118.07	0.000574	1.38	6908.40	1764.78	0.09
4 Hole Swamp	4 Hole Swamp	-1400	500	9640.00	109.10	119.21	112.41	119.23	0.000651	1.62	8081.23	1892.12	0.10
4 Hole Swamp	4 Hole Swamp	-1450	50	5890.00	109.10	117.44	111.78	117.46	0.000484	1.21	6490.29	1776.72	0.08
4 Hole Swamp	4 Hole Swamp	-1450	100	7040.00	109.10	118.03	111.94	118.04	0.000521	1.32	7081.46	1809.40	0.08
4 Hole Swamp	4 Hole Swamp	-1450	500	9640.00	109.10	119.18	112.26	119.20	0.000596	1.55	8260.21	1930.70	0.09
4 Hole Swamp	4 Hole Swamp	-1500	50	5890.00	109.10	117.42	111.81	117.43	0.000464	1.25	6636.22	1816.26	0.08
4 Hole Swamp	4 Hole Swamp	-1500	100	7040.00	109.10	118.00	111.96	118.02	0.000502	1.37	7230.17	1847.83	0.08
4 Hole Swamp	4 Hole Swamp	-1500	500	9640.00	109.10	119.15	112.26	119.17	0.000578	1.60	8414.07	1965.15	0.09
4 Hole Swamp	4 Hole Swamp	-1550	50	5890.00	109.10	117.40	111.62	117.41	0.000425	1.13	6768.28	1871.82	0.07
4 Hole Swamp	4 Hole Swamp	-1550	100	7040.00	109.10	117.98	111.77	117.99	0.000462	1.24	7367.16	1906.51	0.08
4 Hole Swamp	4 Hole Swamp	-1550	500	9640.00	109.10	119.12	112.07	119.14	0.000534	1.46	8561.05	2016.83	0.09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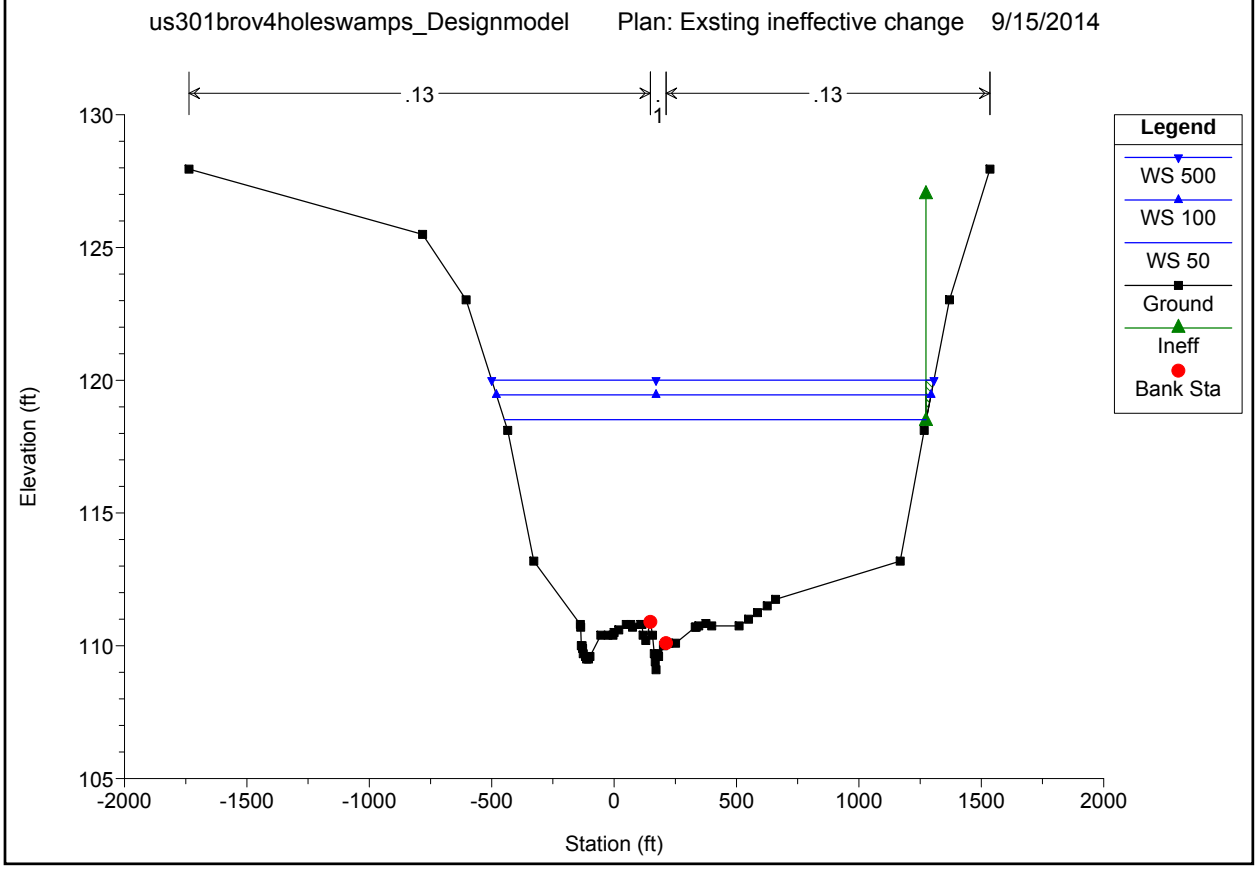
Station (ft)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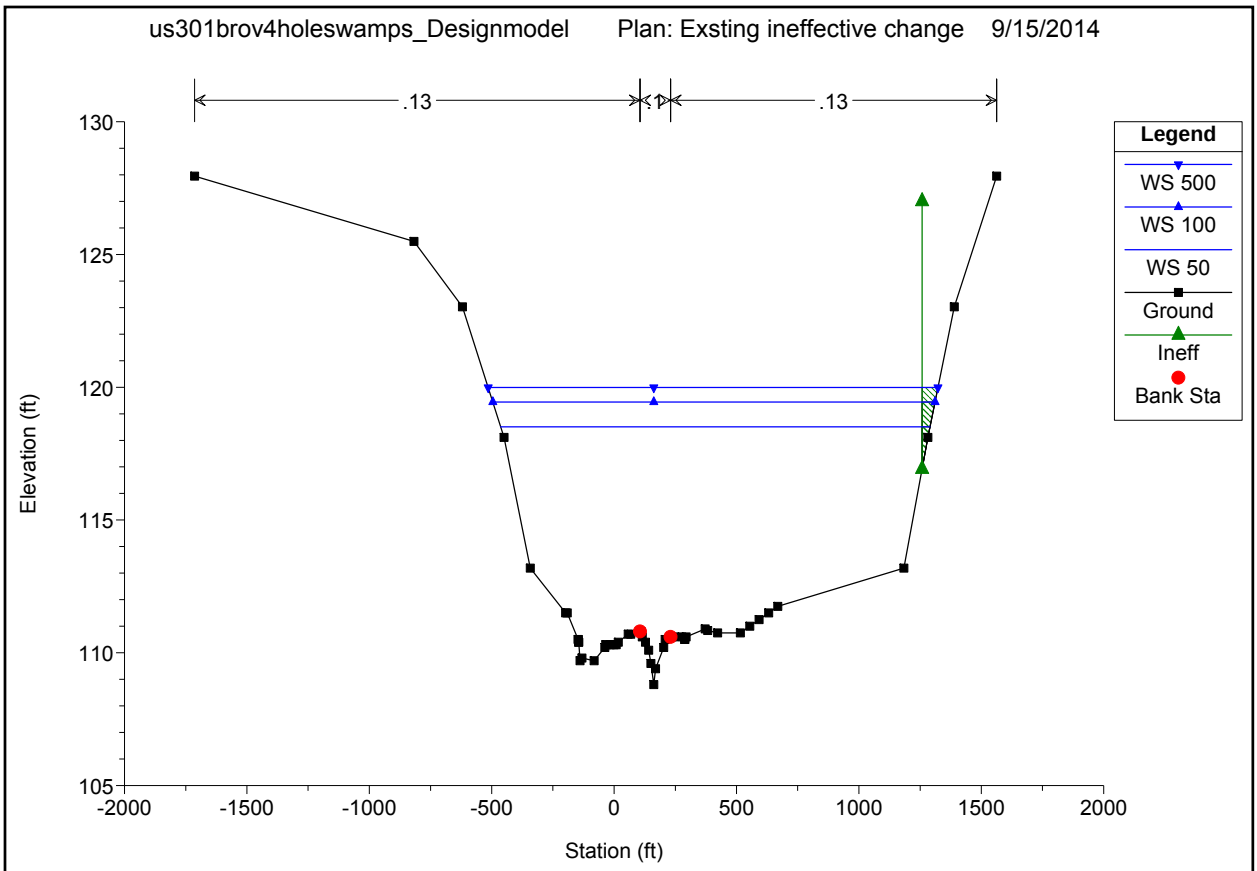
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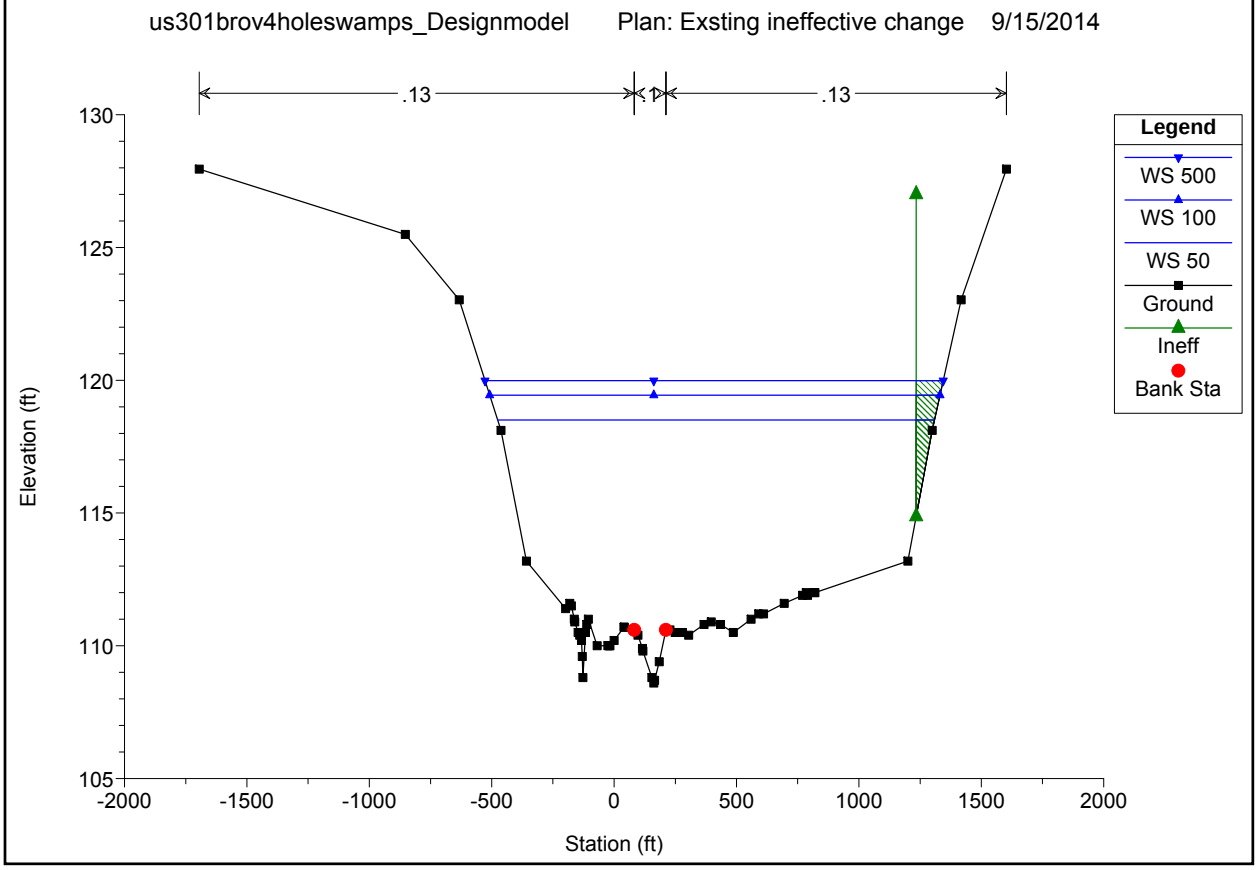
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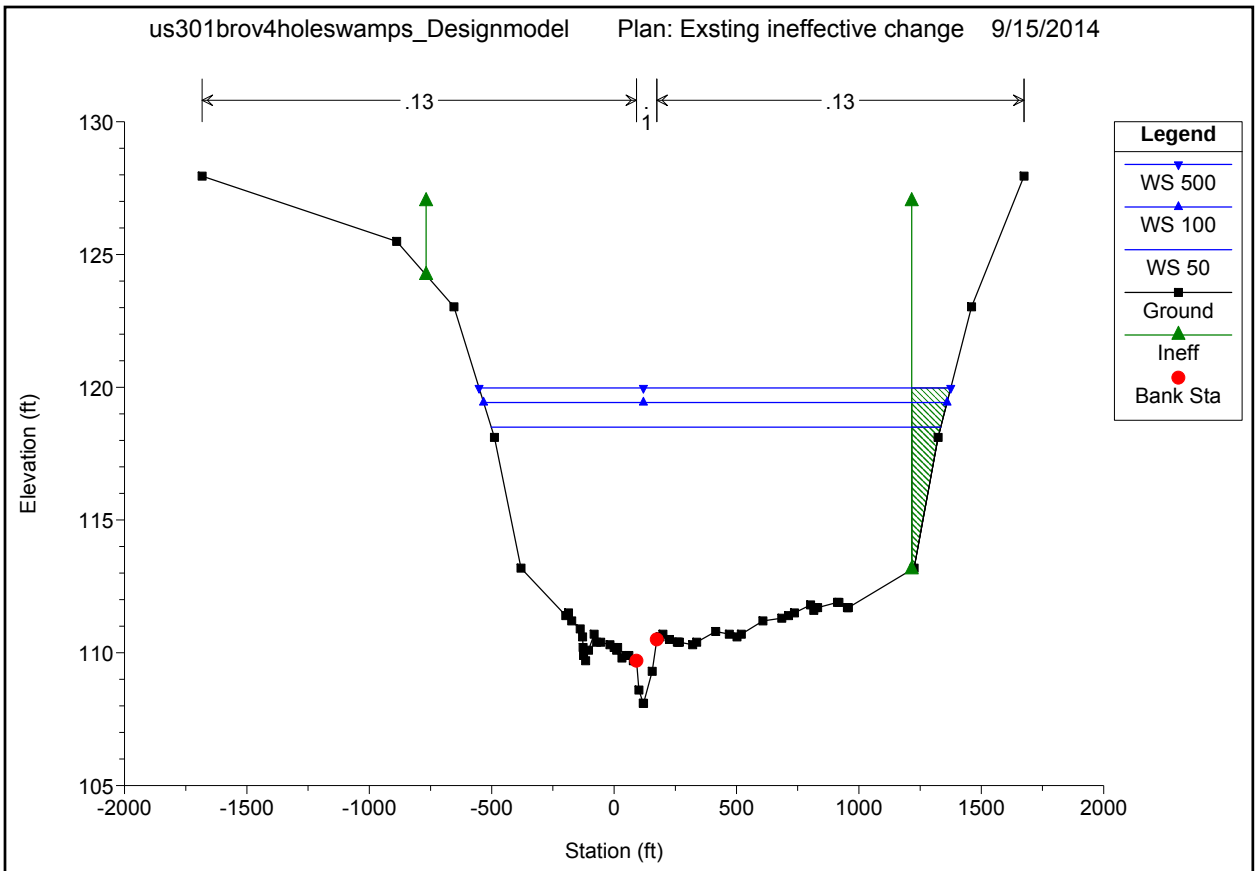
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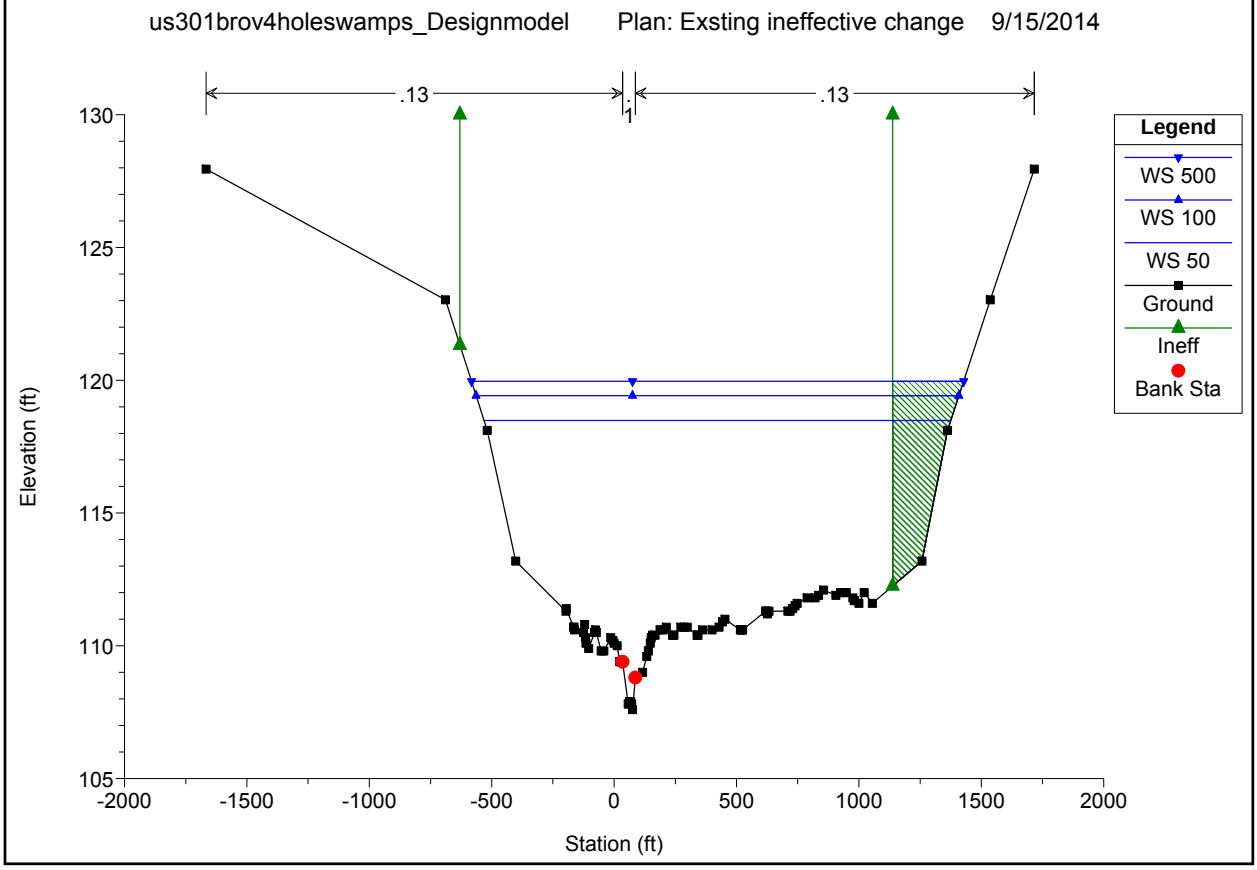
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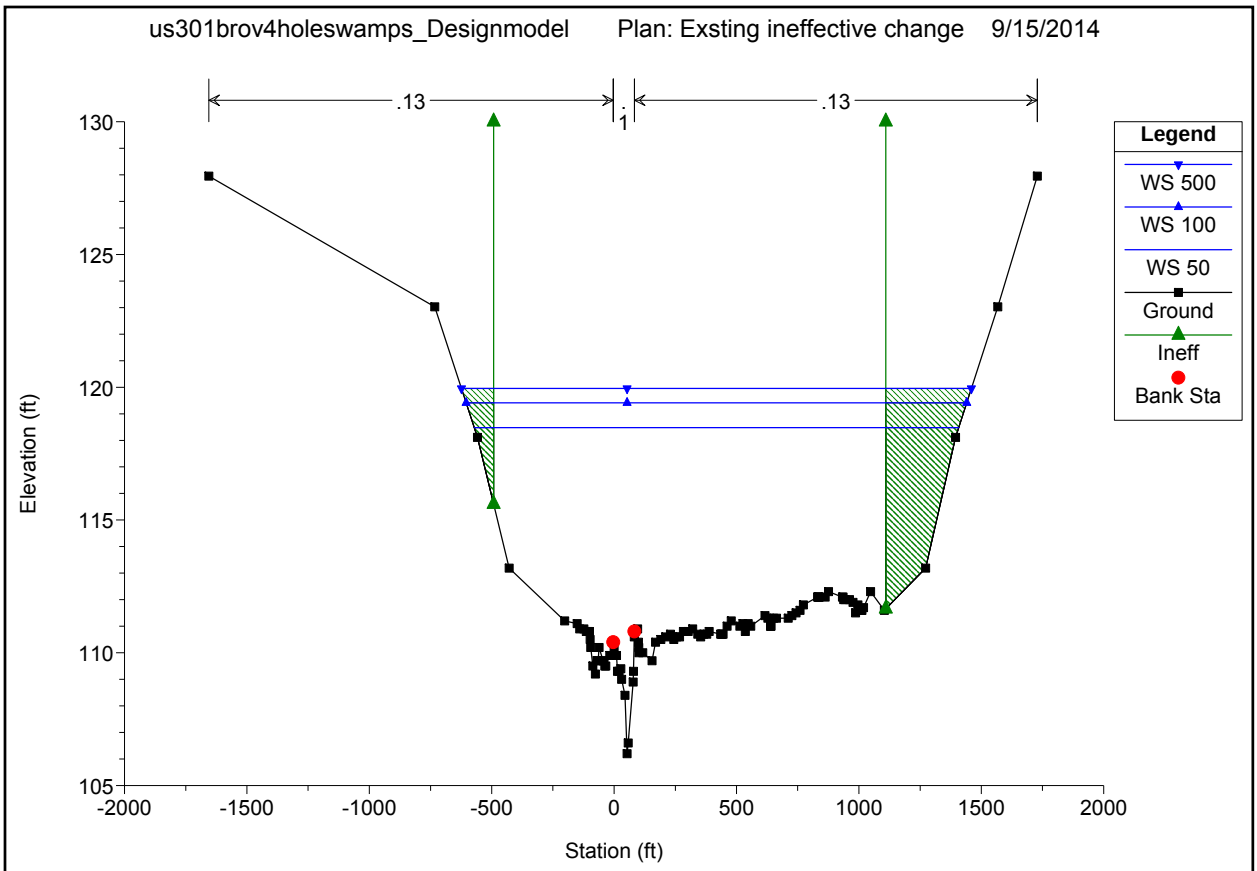
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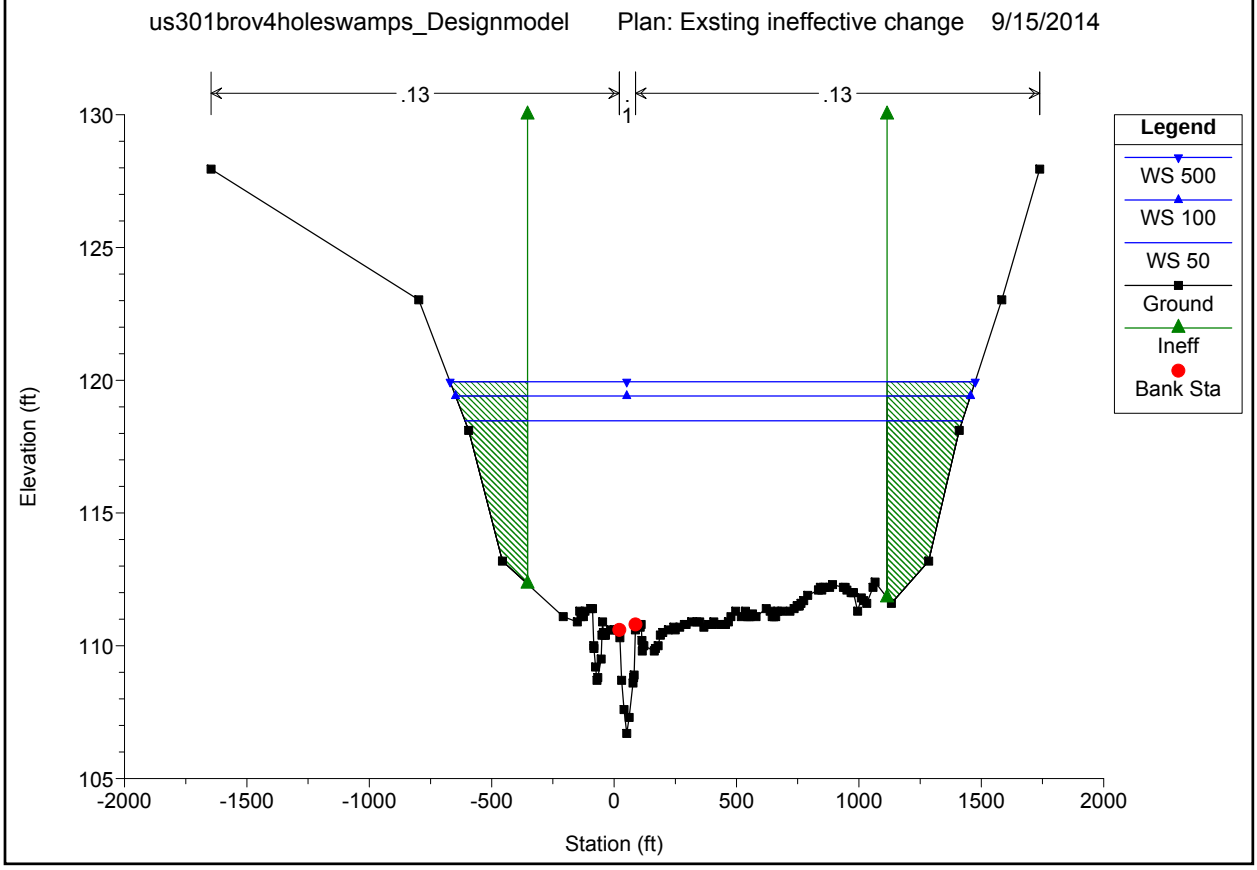
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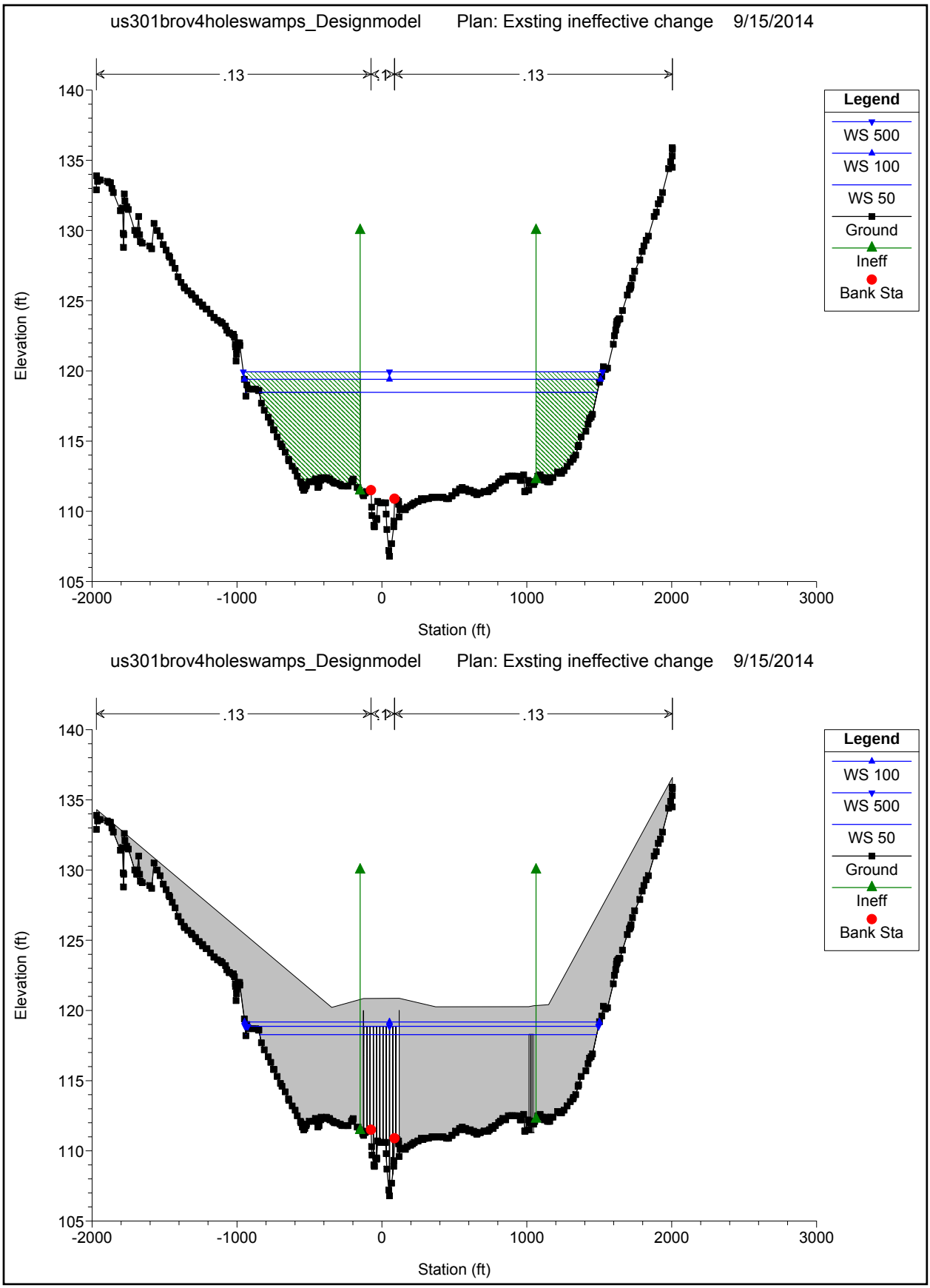
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us301brov4holeswamps_Designmodel Plan: Exsting ineffective change 9/15/2014
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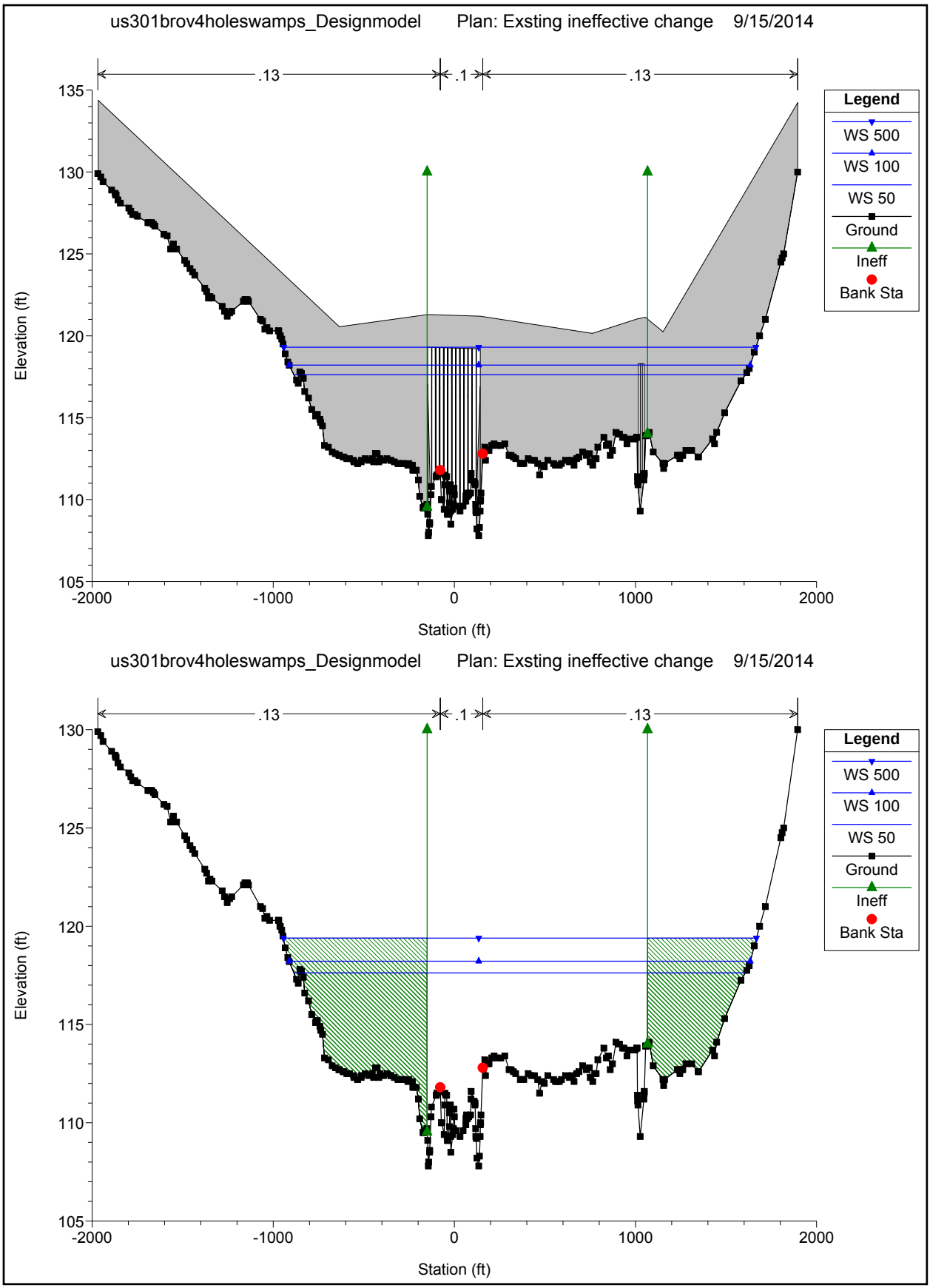
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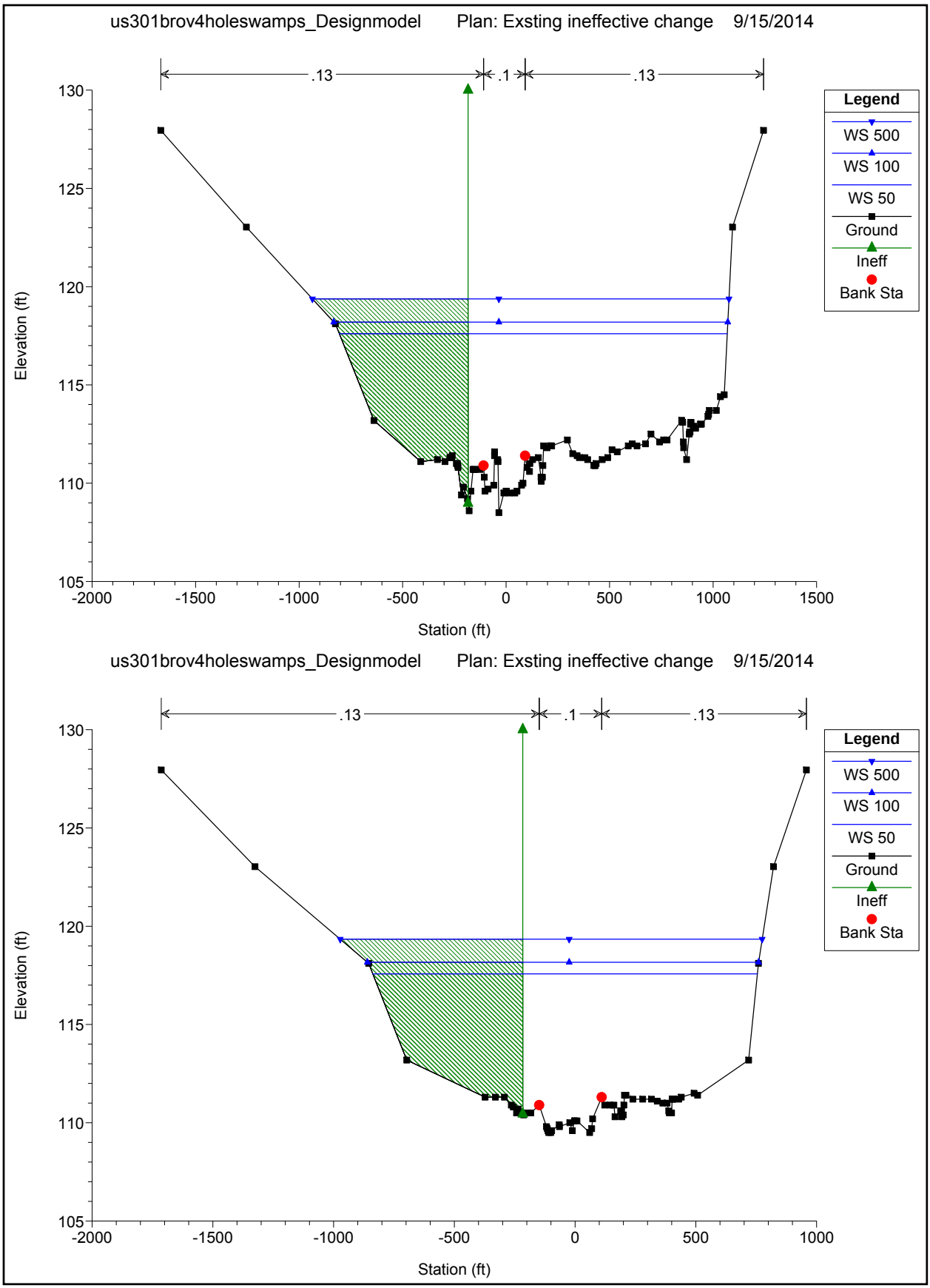
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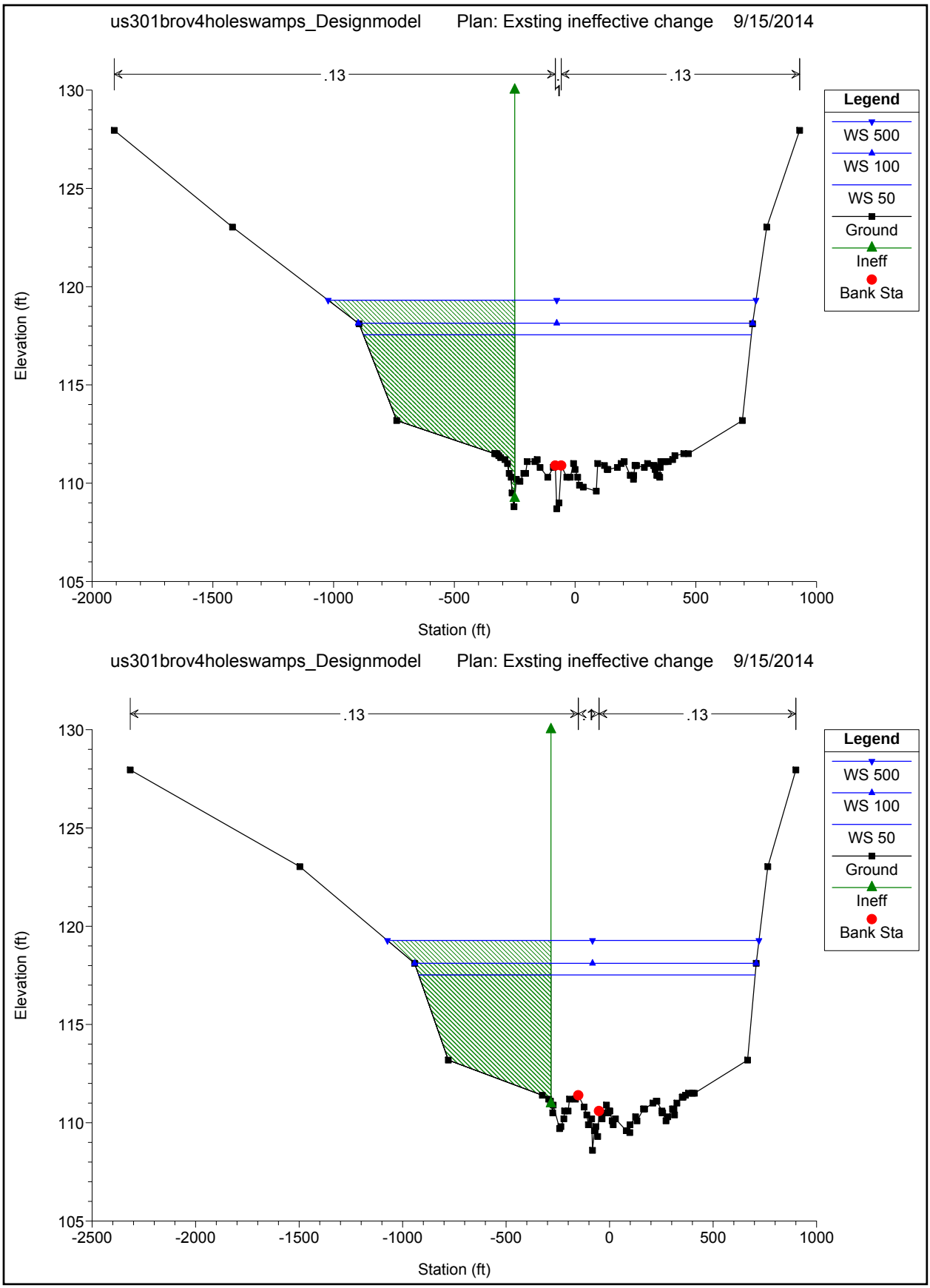
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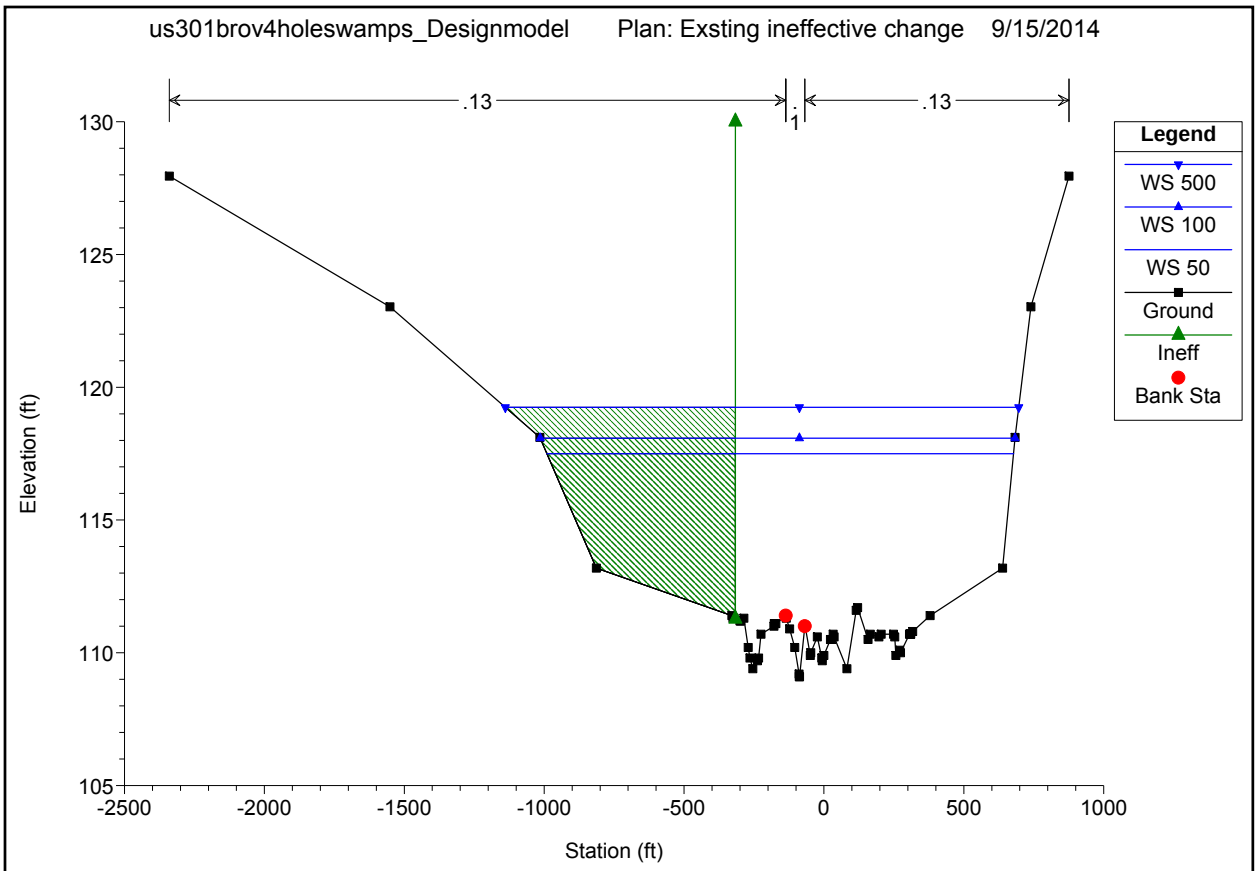
Station (ft)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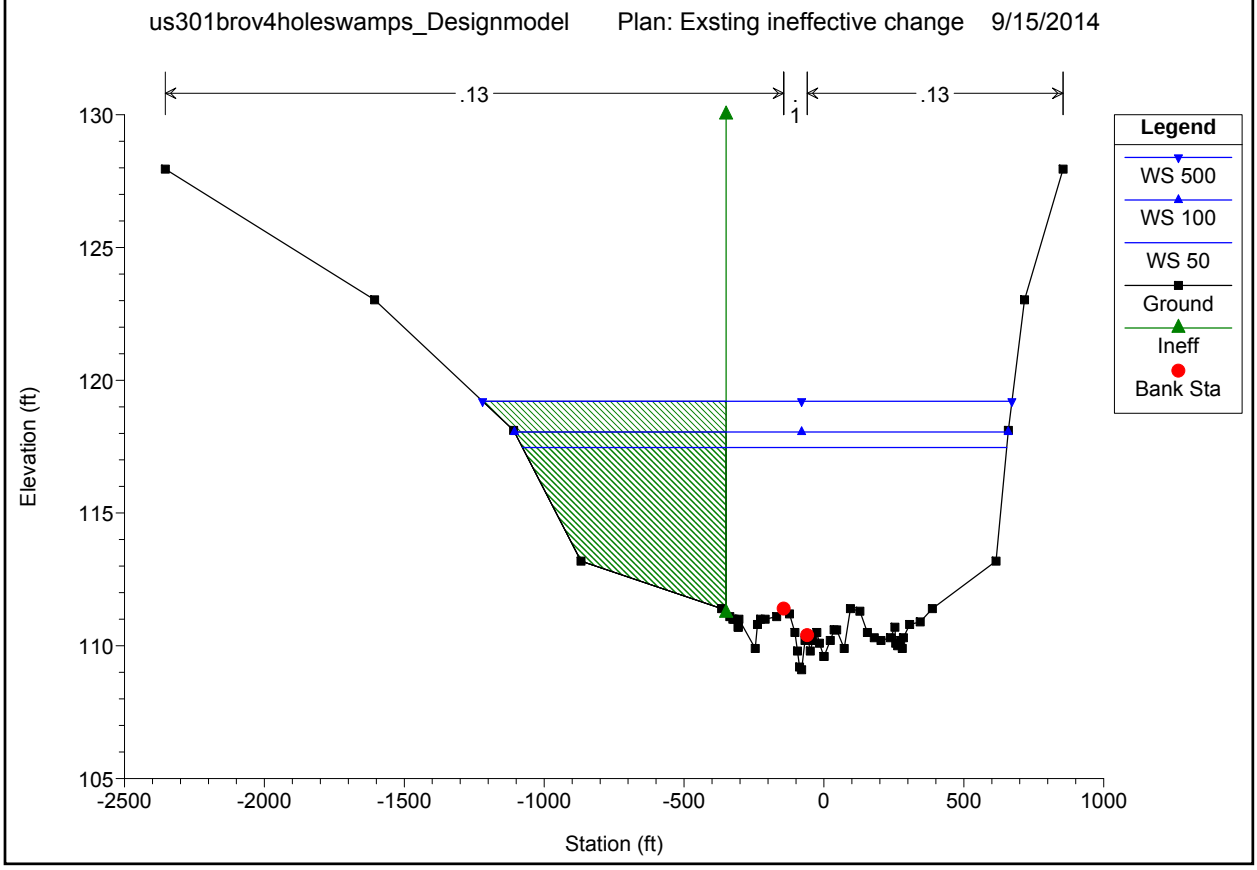
Station (ft)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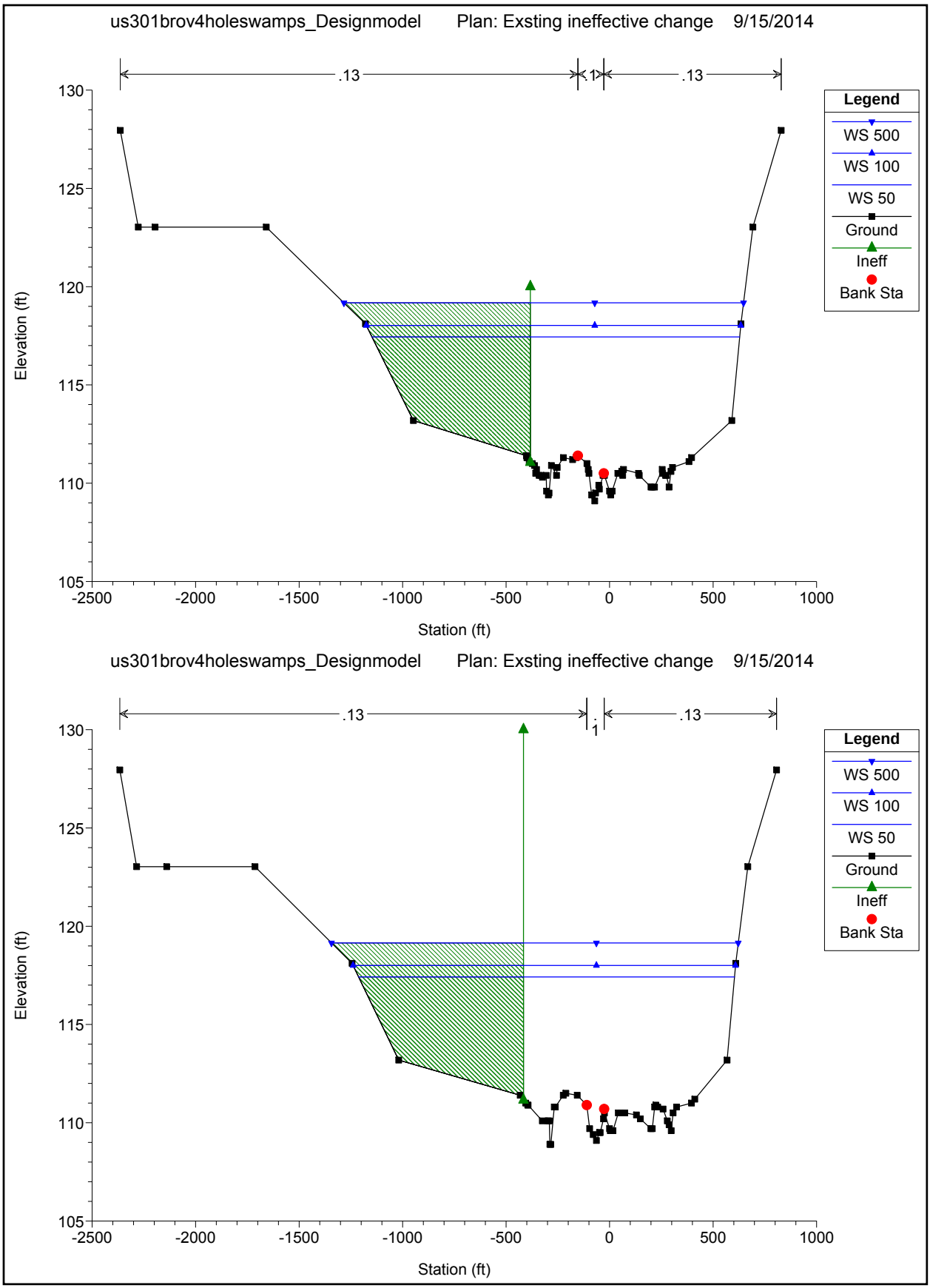
Station (ft)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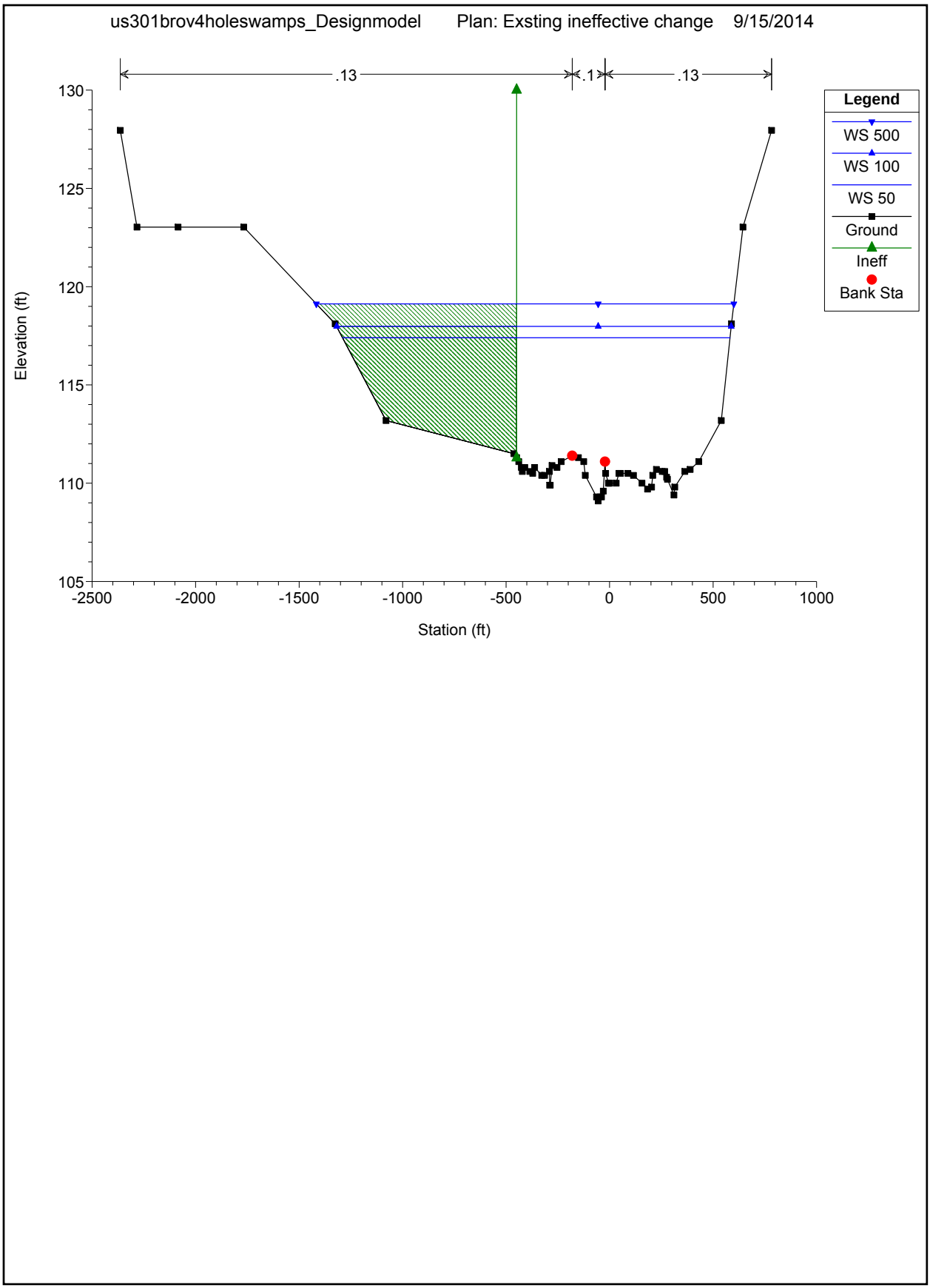
Station (ft)


us301brov4holeswamps_Designmodel
Plan: Exsting ineffective change
9/15/2014
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WS 500
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Ground
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Bank Sta
Elevation (ft)
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Station (ft)

APPENDIX F

PROPOSED BRIDGE

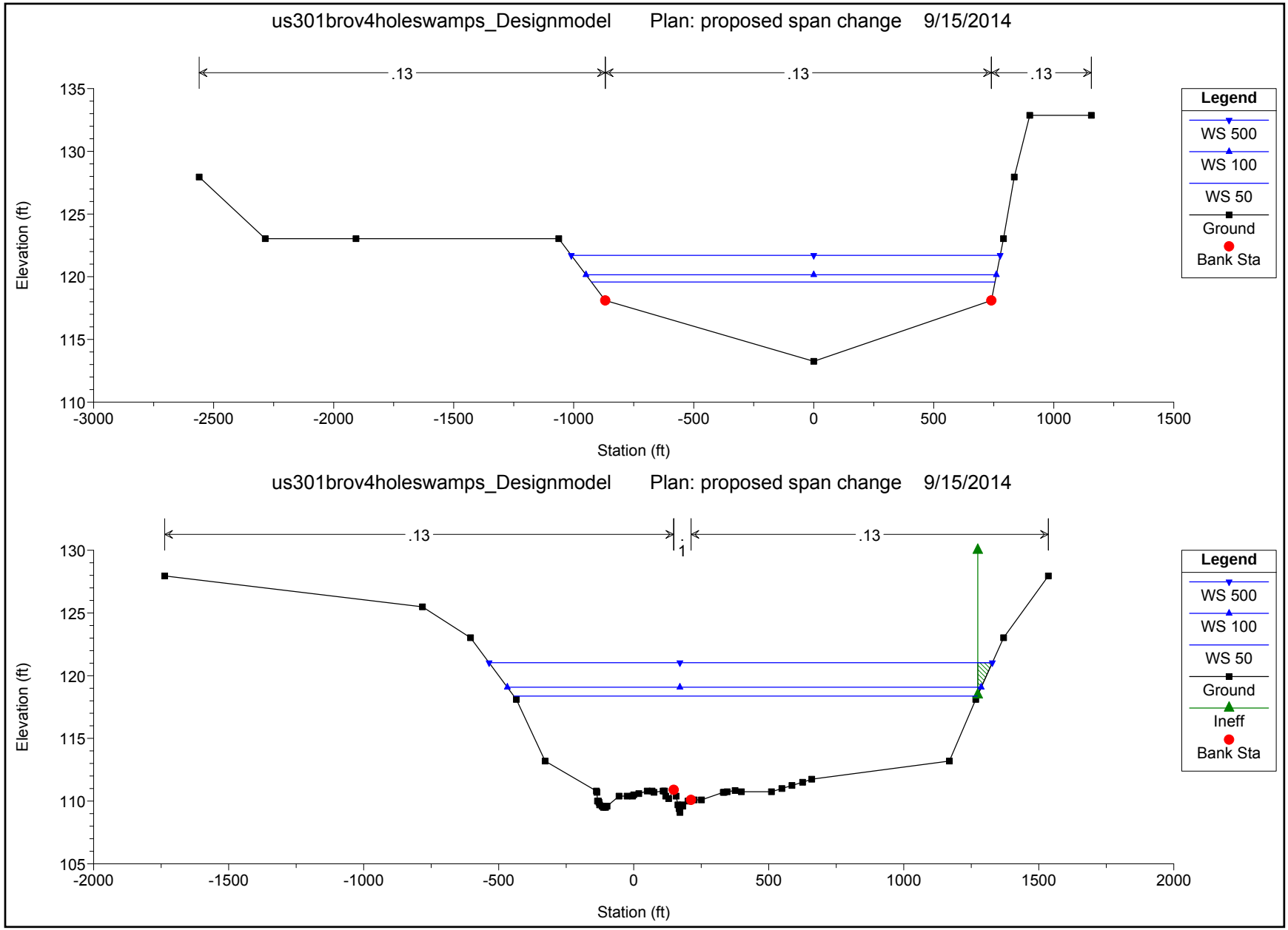
HEC-RAS MODEL SUMMARY

HEC-RAS Plan: prospan Locations: User Defined

River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
4 Hole Swamp	4 Hole Swamp	-600	50	5890.00	109.10	118.37	111.86	118.38	0.000178	0.82	10991.58	1715.54	0.05
4 Hole Swamp	4 Hole Swamp	-600	100	7040.00	109.10	119.08	112.04	119.09	0.000182	0.88	12223.10	1755.09	0.05
4 Hole Swamp	4 Hole Swamp	-600	500	9640.00	109.10	121.03	112.39	121.04	0.000156	0.93	15686.24	1863.43	0.05
4 Hole Swamp	4 Hole Swamp	-650	50	5890.00	108.80	118.36	111.82	118.37	0.000163	0.78	11171.31	1745.65	0.05
4 Hole Swamp	4 Hole Swamp	-650	100	7040.00	108.80	119.07	112.01	119.08	0.000168	0.83	12401.69	1785.78	0.05
4 Hole Swamp	4 Hole Swamp	-650	500	9640.00	108.80	121.03	112.36	121.03	0.000146	0.89	15864.54	1895.81	0.05
4 Hole Swamp	4 Hole Swamp	-700	50	5890.00	108.60	118.35	111.60	118.36	0.000151	0.77	11371.62	1776.16	0.05
4 Hole Swamp	4 Hole Swamp	-700	100	7040.00	108.60	119.07	111.60	119.07	0.000157	0.83	12593.38	1817.87	0.05
4 Hole Swamp	4 Hole Swamp	-700	500	9640.00	108.60	121.02	112.38	121.02	0.000139	0.89	16035.82	1932.34	0.05
4 Hole Swamp	4 Hole Swamp	-750	50	5890.00	108.10	118.35	111.79	118.35	0.000140	0.78	11727.08	1827.01	0.04
4 Hole Swamp	4 Hole Swamp	-750	100	7040.00	108.10	119.06	112.11	119.06	0.000147	0.84	12953.91	1870.66	0.05
4 Hole Swamp	4 Hole Swamp	-750	500	9640.00	108.10	121.01	112.38	121.02	0.000131	0.89	16410.54	1990.53	0.05
4 Hole Swamp	4 Hole Swamp	-800	50	5890.00	107.60	118.34	111.94	118.34	0.000144	0.83	11544.80	1896.53	0.05
4 Hole Swamp	4 Hole Swamp	-800	100	7040.00	107.60	119.05	112.01	119.06	0.000151	0.89	12736.60	1946.43	0.05
4 Hole Swamp	4 Hole Swamp	-800	500	9640.00	107.60	121.01	112.43	121.01	0.000136	0.95	16102.87	2083.60	0.05
4 Hole Swamp	4 Hole Swamp	-850	50	5890.00	106.20	118.33	111.98	118.34	0.000143	0.80	11392.43	1968.67	0.05
4 Hole Swamp	4 Hole Swamp	-850	100	7040.00	106.20	119.04	112.18	119.05	0.000149	0.86	12546.94	2018.88	0.05
4 Hole Swamp	4 Hole Swamp	-850	500	9640.00	106.20	121.00	112.52	121.00	0.000133	0.91	15722.96	2157.00	0.05
4 Hole Swamp	4 Hole Swamp	-900	50	5890.00	106.70	118.33	112.14	118.33	0.000155	0.86	10782.83	2020.53	0.05
4 Hole Swamp	4 Hole Swamp	-900	100	7040.00	106.70	119.04	112.28	119.04	0.000163	0.92	11842.35	2075.12	0.05
4 Hole Swamp	4 Hole Swamp	-900	500	9640.00	106.70	120.99	112.64	121.00	0.000147	0.98	14758.89	2225.40	0.05
4 Hole Swamp	4 Hole Swamp	-913	50	5890.00	106.80	118.32	112.14	118.33	0.000217	0.94	8834.28	2328.77	0.06
4 Hole Swamp	4 Hole Swamp	-913	100	7040.00	106.80	119.03	112.30	119.04	0.000228	1.01	9702.73	2444.37	0.06
4 Hole Swamp	4 Hole Swamp	-913	500	9640.00	106.80	120.98	112.44	120.99	0.000207	1.09	12095.91	2548.31	0.06
4 Hole Swamp	4 Hole Swamp	-967		Mult Open									
4 Hole Swamp	4 Hole Swamp	-1100	50	5890.00	107.80	117.62	112.39	117.64	0.000473	1.24	6772.46	2478.54	0.08
4 Hole Swamp	4 Hole Swamp	-1100	100	7040.00	107.80	118.22	112.78	118.24	0.000488	1.32	7498.93	2546.63	0.08
4 Hole Swamp	4 Hole Swamp	-1100	500	9640.00	107.80	119.40	113.25	119.42	0.000521	1.50	8935.36	2612.01	0.09
4 Hole Swamp	4 Hole Swamp	-1150	50	5890.00	108.50	117.60	112.39	117.61	0.000373	1.12	7470.03	1873.91	0.07
4 Hole Swamp	4 Hole Swamp	-1150	100	7040.00	108.50	118.20	112.47	118.21	0.000392	1.21	8216.93	1903.72	0.07
4 Hole Swamp	4 Hole Swamp	-1150	500	9640.00	108.50	119.38	112.92	119.39	0.000431	1.38	9698.59	2012.26	0.08
4 Hole Swamp	4 Hole Swamp	-1200	50	5890.00	109.50	117.58	112.11	117.59	0.000469	1.24	6207.34	1592.45	0.08

HEC-RAS Plan: prospan Locations: User Defined (Continued)

River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
4 Hole Swamp	4 Hole Swamp	-1200	100	7040.00	109.50	118.17	112.28	118.19	0.000504	1.35	6785.07	1620.42	0.08
4 Hole Swamp	4 Hole Swamp	-1200	500	9640.00	109.50	119.34	112.63	119.37	0.000575	1.58	7938.72	1747.41	0.09
4 Hole Swamp	4 Hole Swamp	-1250	50	5890.00	108.70	117.55	112.09	117.57	0.000576	1.41	6201.86	1607.06	0.09
4 Hole Swamp	4 Hole Swamp	-1250	100	7040.00	108.70	118.14	112.25	118.16	0.000615	1.53	6782.88	1633.45	0.09
4 Hole Swamp	4 Hole Swamp	-1250	500	9640.00	108.70	119.31	112.57	119.34	0.000696	1.77	7942.48	1771.95	0.10
4 Hole Swamp	4 Hole Swamp	-1300	50	5890.00	108.60	117.52	111.93	117.54	0.000535	1.29	6253.22	1626.02	0.08
4 Hole Swamp	4 Hole Swamp	-1300	100	7040.00	108.60	118.11	112.11	118.13	0.000573	1.40	6836.16	1650.75	0.09
4 Hole Swamp	4 Hole Swamp	-1300	500	9640.00	108.60	119.28	112.46	119.30	0.000649	1.64	7998.78	1795.18	0.10
4 Hole Swamp	4 Hole Swamp	-1350	50	5890.00	109.10	117.50	111.94	117.51	0.000556	1.30	6249.19	1668.01	0.09
4 Hole Swamp	4 Hole Swamp	-1350	100	7040.00	109.10	118.08	112.11	118.10	0.000594	1.42	6834.86	1697.50	0.09
4 Hole Swamp	4 Hole Swamp	-1350	500	9640.00	109.10	119.24	112.46	119.27	0.000670	1.65	8002.89	1835.43	0.10
4 Hole Swamp	4 Hole Swamp	-1400	50	5890.00	109.10	117.47	111.92	117.48	0.000537	1.27	6320.41	1730.98	0.08
4 Hole Swamp	4 Hole Swamp	-1400	100	7040.00	109.10	118.05	112.08	118.07	0.000574	1.38	6909.17	1764.82	0.09
4 Hole Swamp	4 Hole Swamp	-1400	500	9640.00	109.10	119.21	112.41	119.23	0.000650	1.62	8083.20	1892.33	0.10
4 Hole Swamp	4 Hole Swamp	-1450	50	5890.00	109.10	117.44	111.78	117.46	0.000484	1.21	6490.35	1776.73	0.08
4 Hole Swamp	4 Hole Swamp	-1450	100	7040.00	109.10	118.03	111.94	118.04	0.000521	1.32	7082.24	1809.45	0.08
4 Hole Swamp	4 Hole Swamp	-1450	500	9640.00	109.10	119.18	112.26	119.20	0.000596	1.55	8262.22	1930.91	0.09
4 Hole Swamp	4 Hole Swamp	-1500	50	5890.00	109.10	117.42	111.81	117.43	0.000464	1.25	6636.29	1816.26	0.08
4 Hole Swamp	4 Hole Swamp	-1500	100	7040.00	109.10	118.00	111.96	118.02	0.000501	1.37	7230.96	1847.88	0.08
4 Hole Swamp	4 Hole Swamp	-1500	500	9640.00	109.10	119.15	112.26	119.17	0.000578	1.60	8416.11	1965.36	0.09
4 Hole Swamp	4 Hole Swamp	-1550	50	5890.00	109.10	117.40	111.62	117.41	0.000425	1.13	6768.35	1871.82	0.07
4 Hole Swamp	4 Hole Swamp	-1550	100	7040.00	109.10	117.98	111.77	117.99	0.000462	1.24	7367.96	1906.56	0.08
4 Hole Swamp	4 Hole Swamp	-1550	500	9640.00	109.10	119.12	112.07	119.15	0.000534	1.46	8563.13	2017.03	0.09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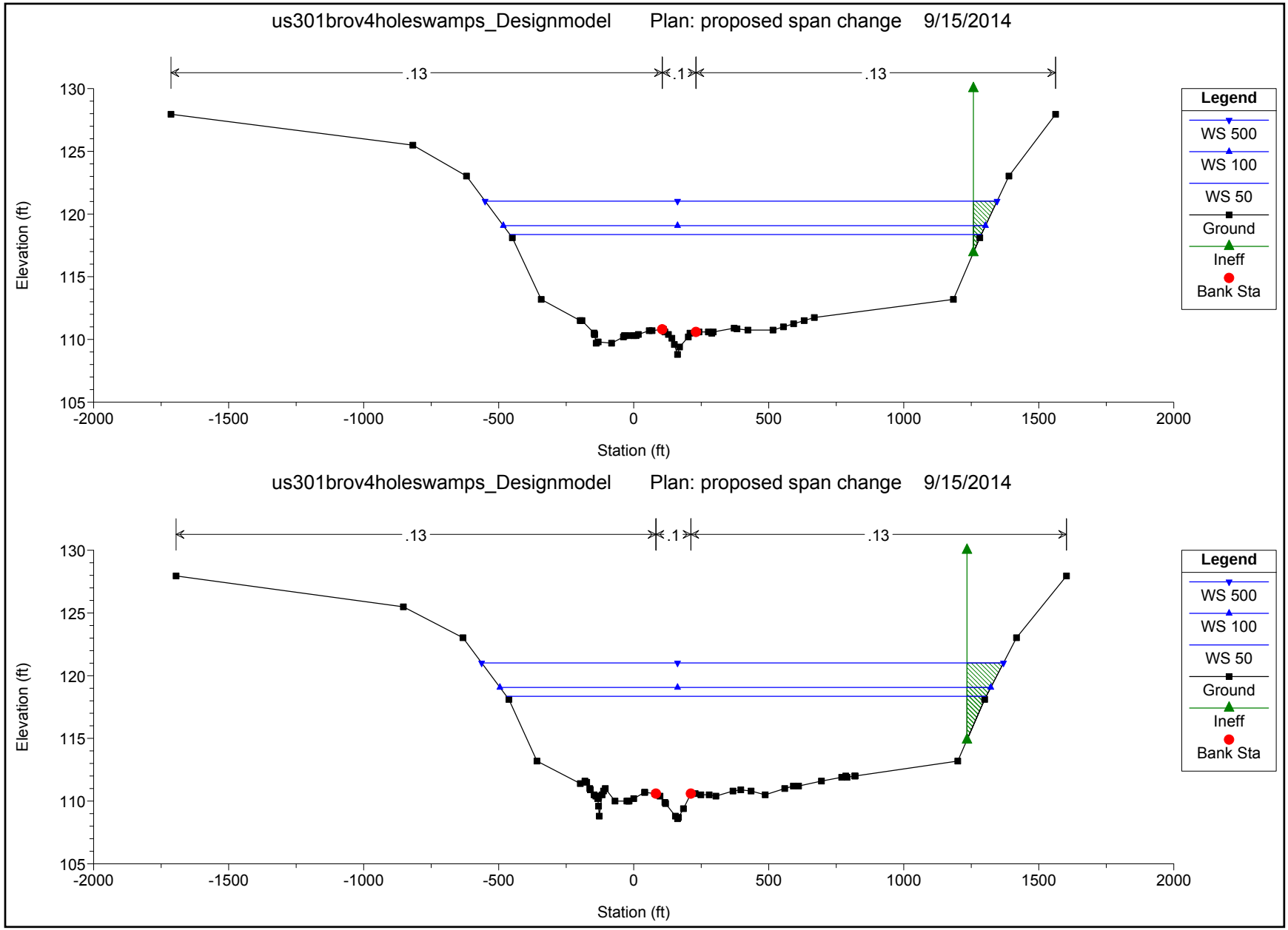
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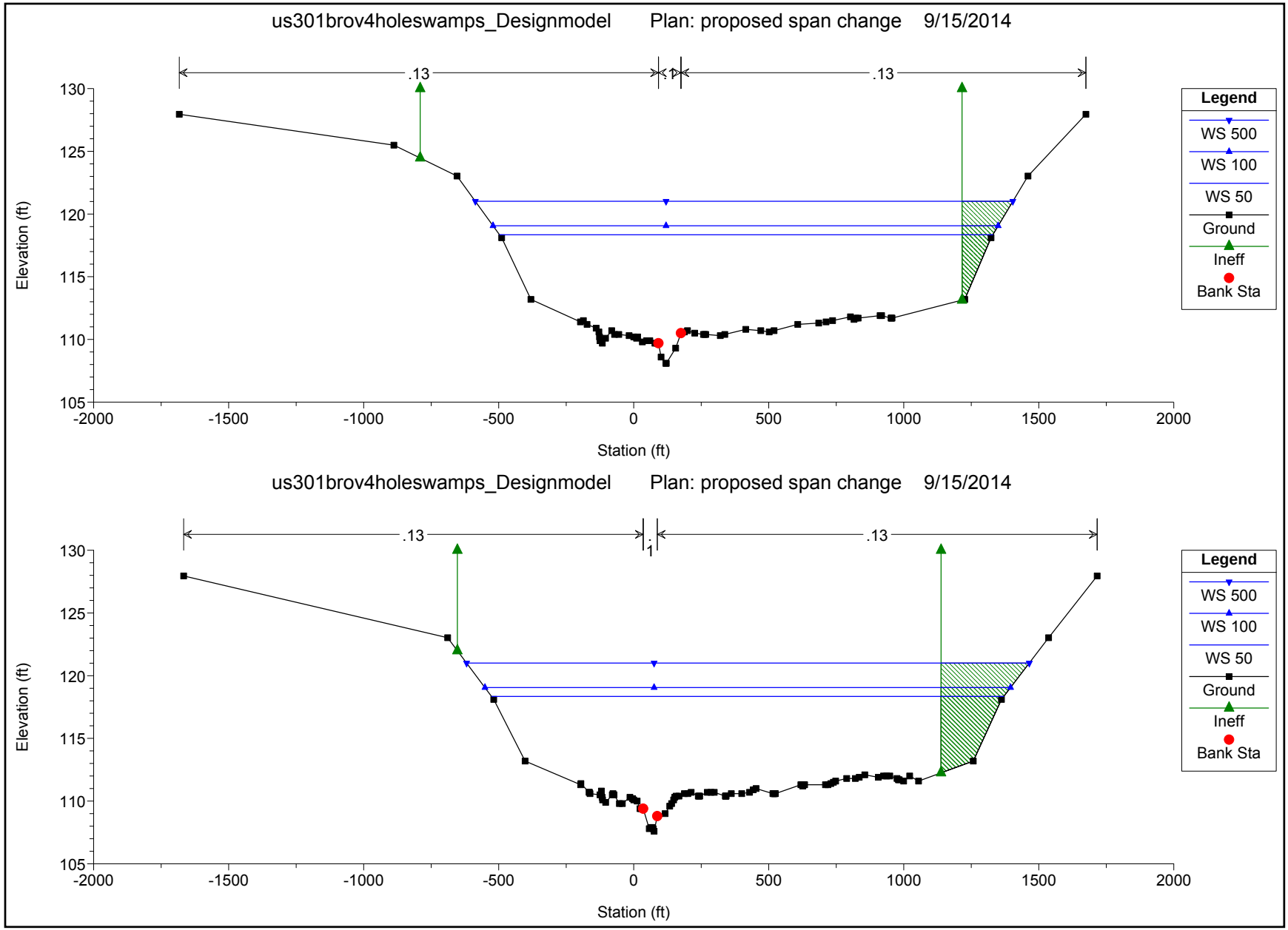
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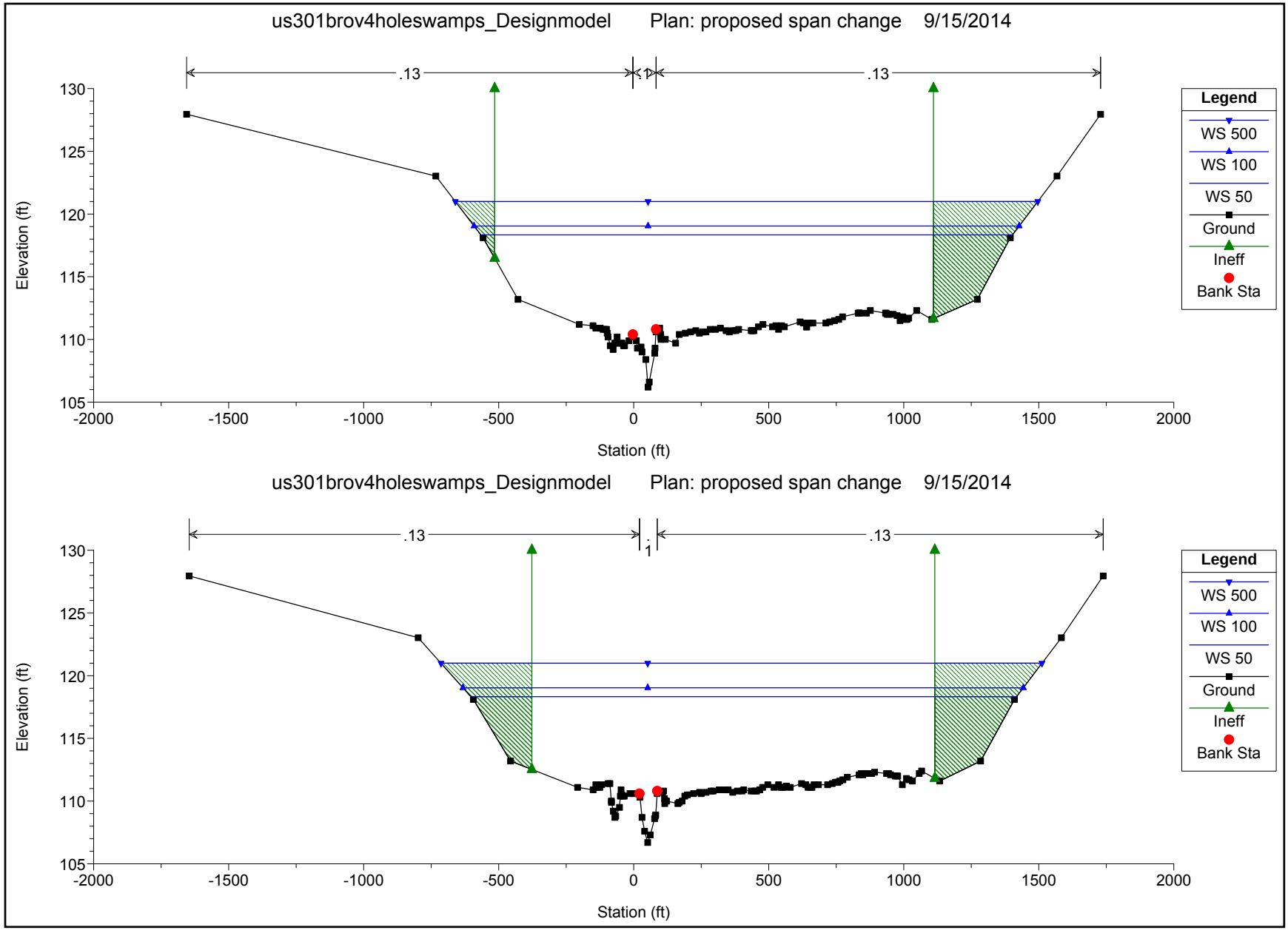
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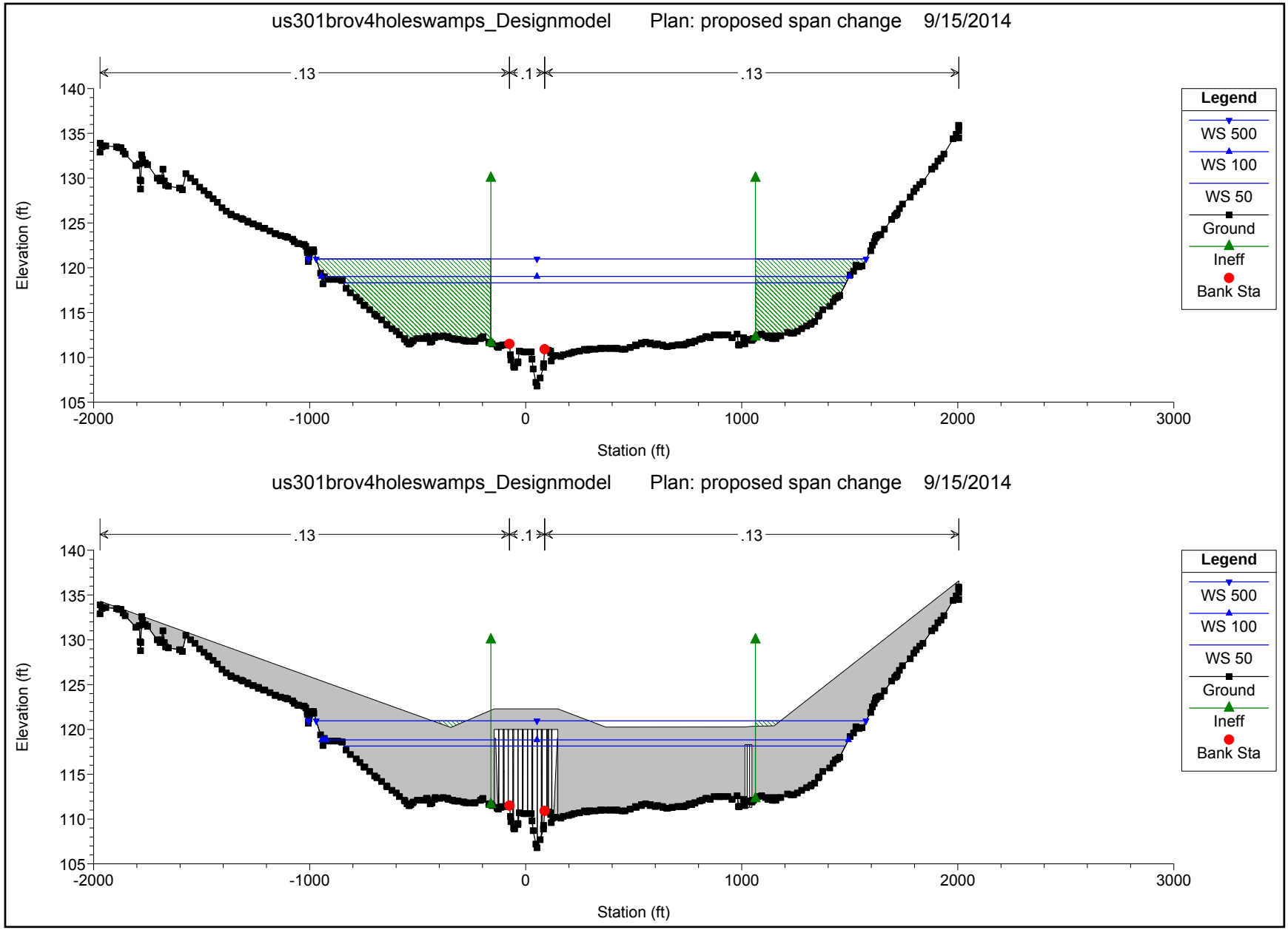
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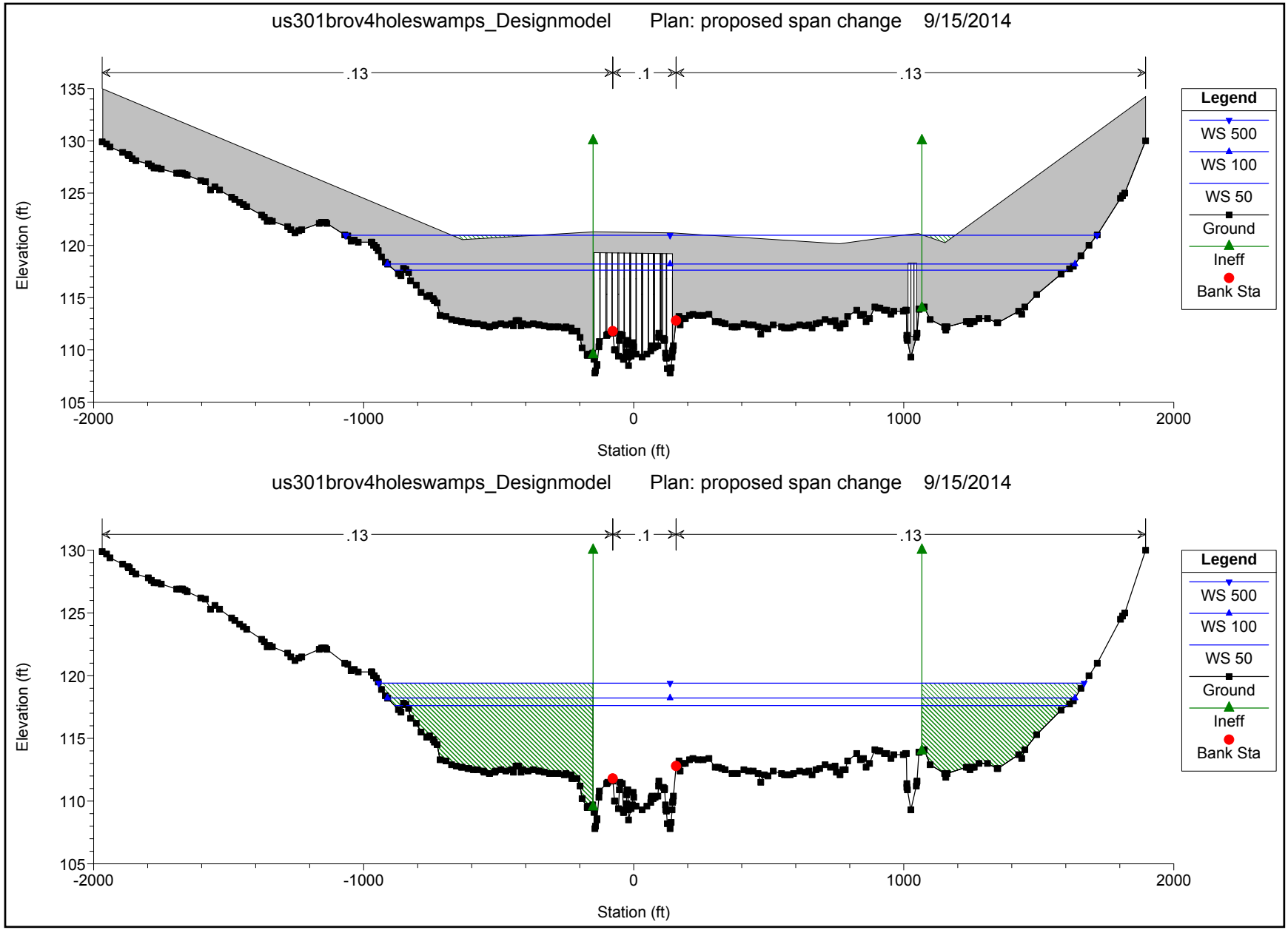
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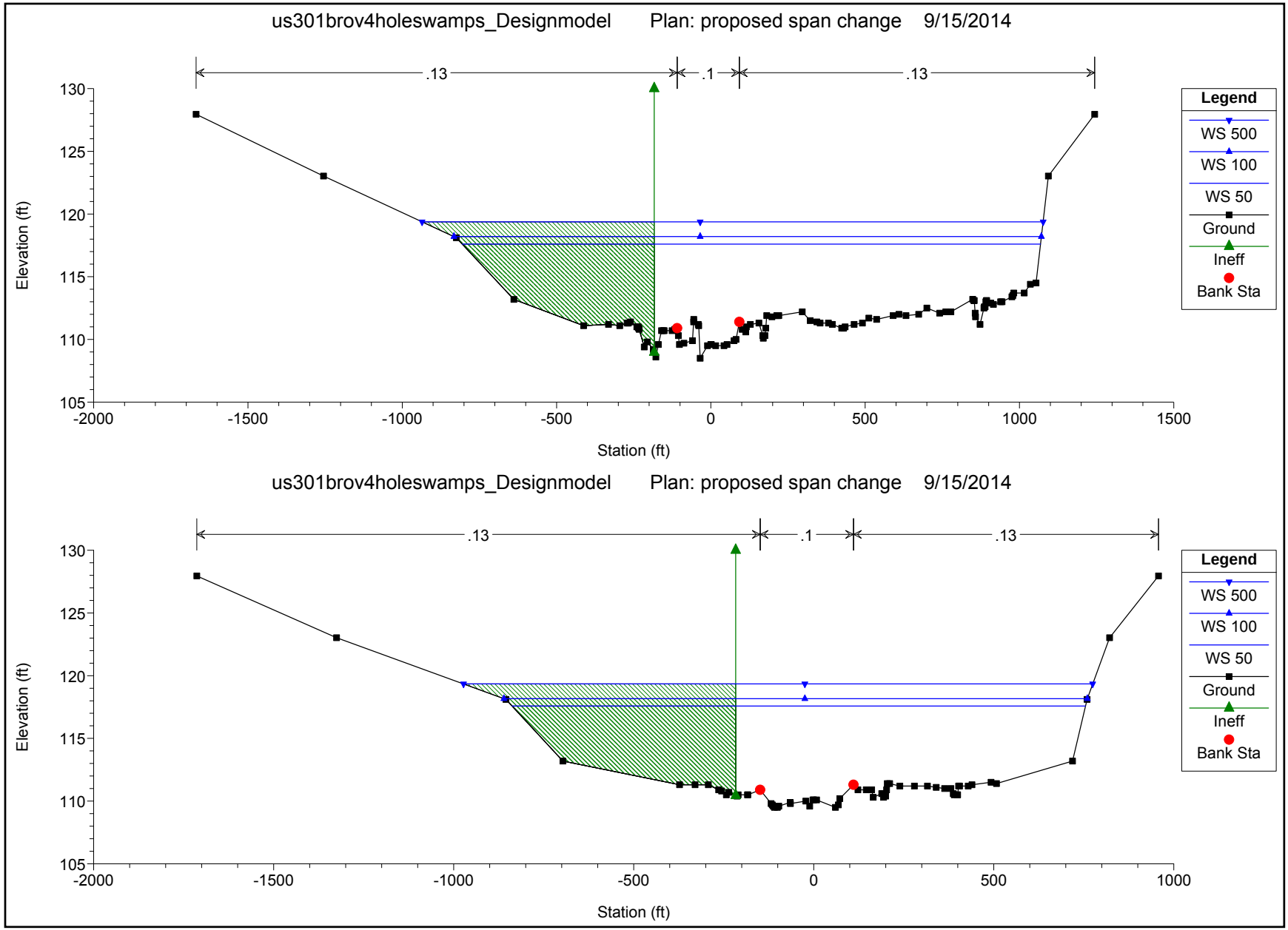
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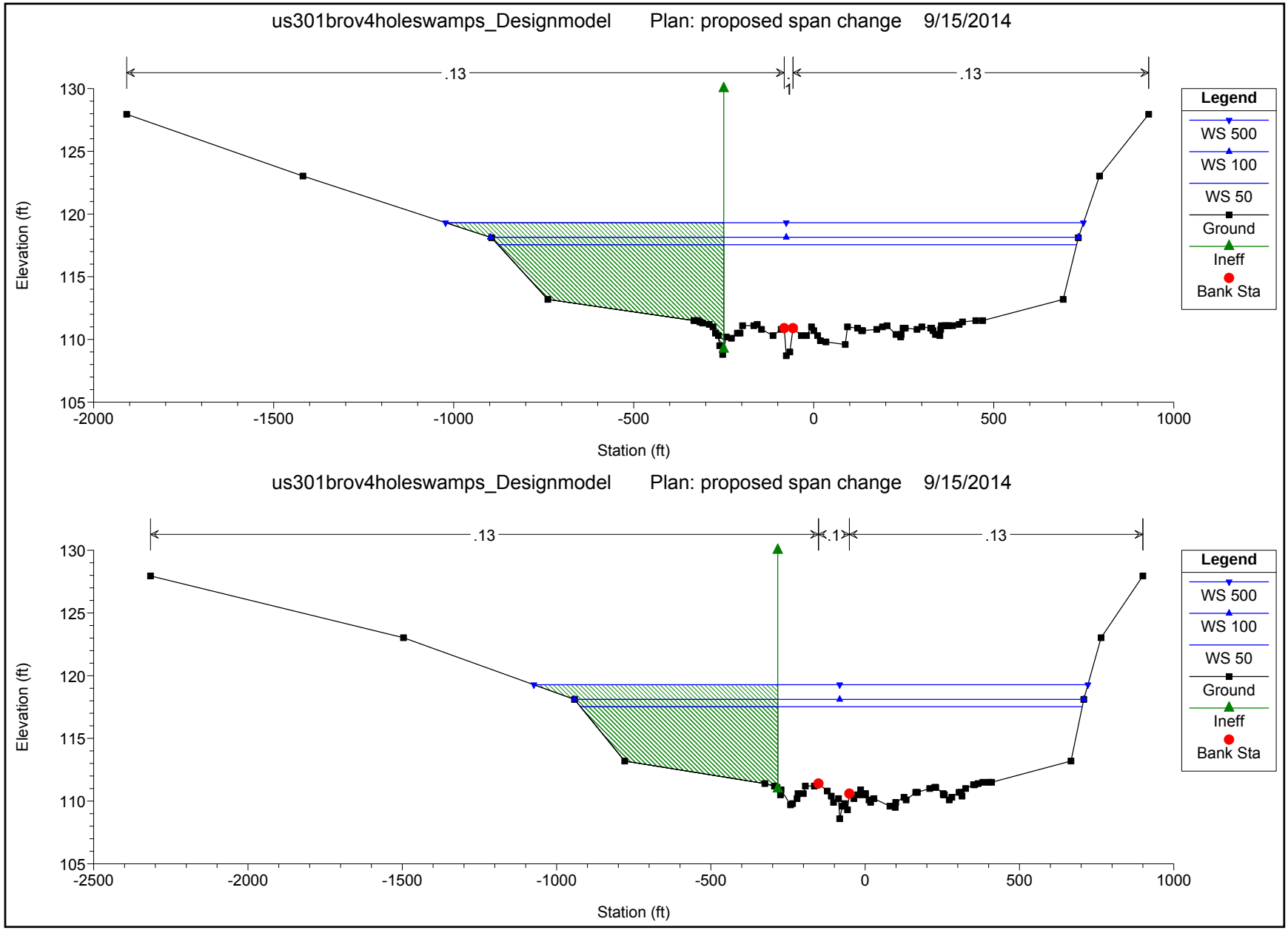
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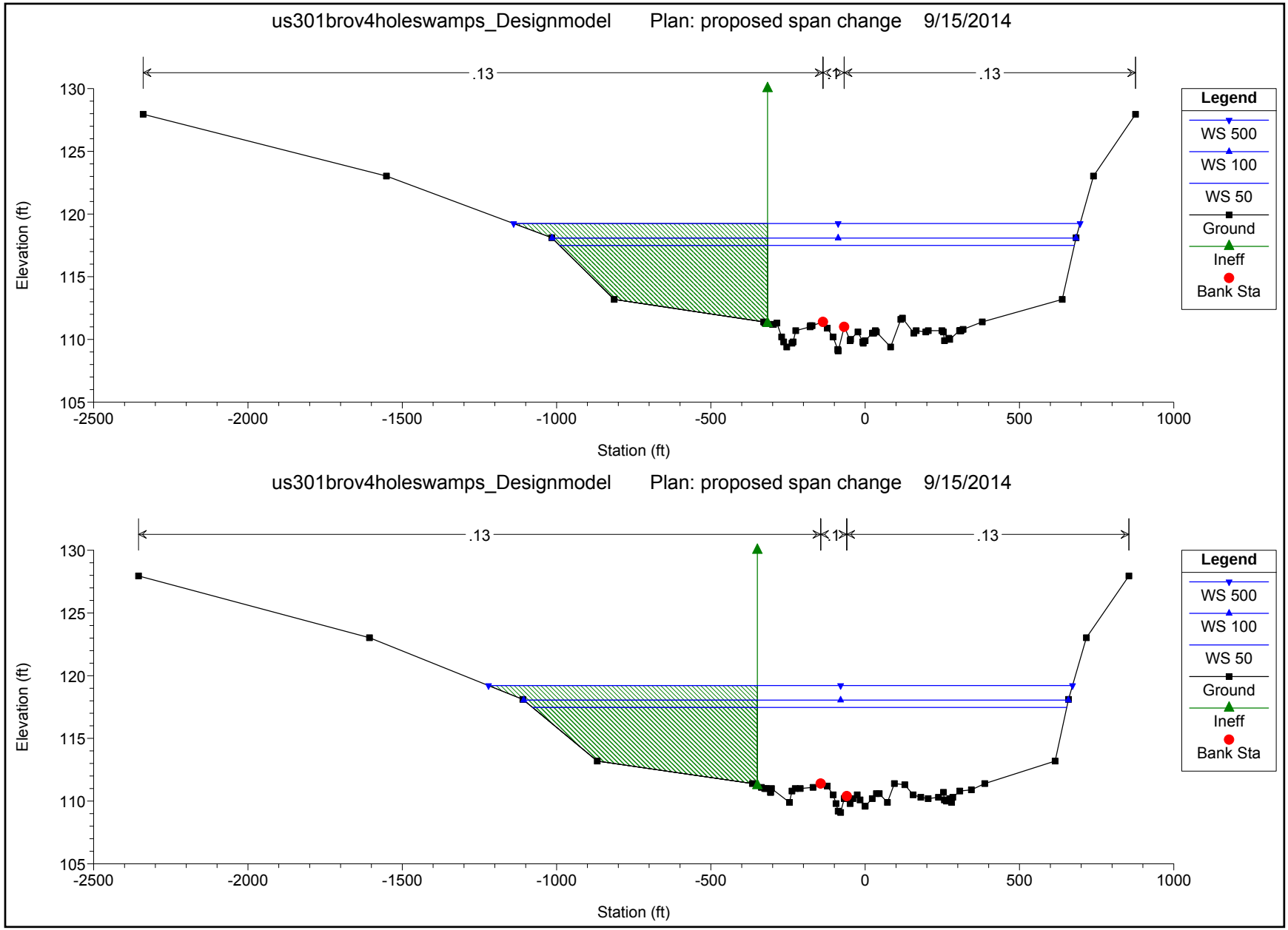
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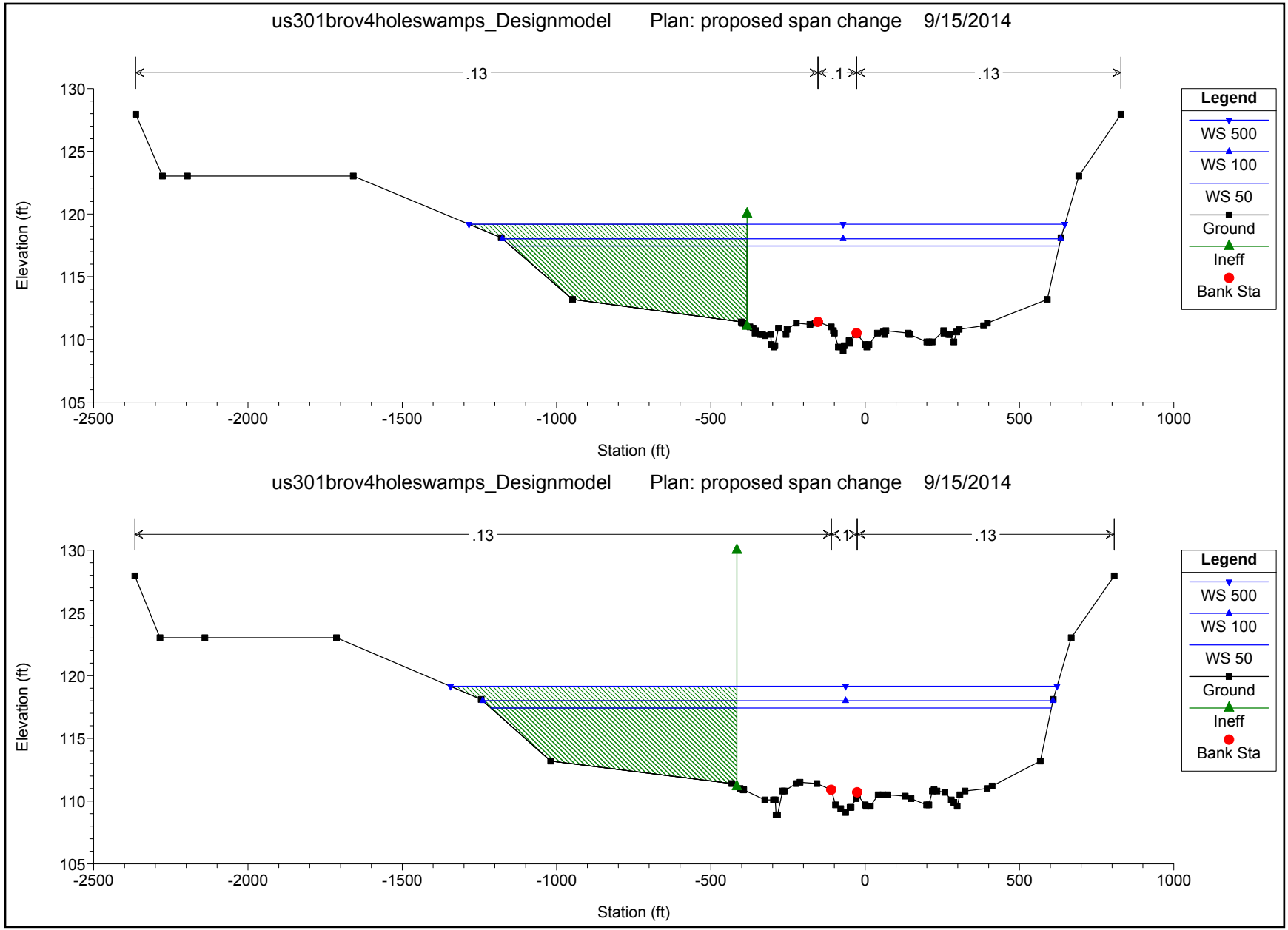
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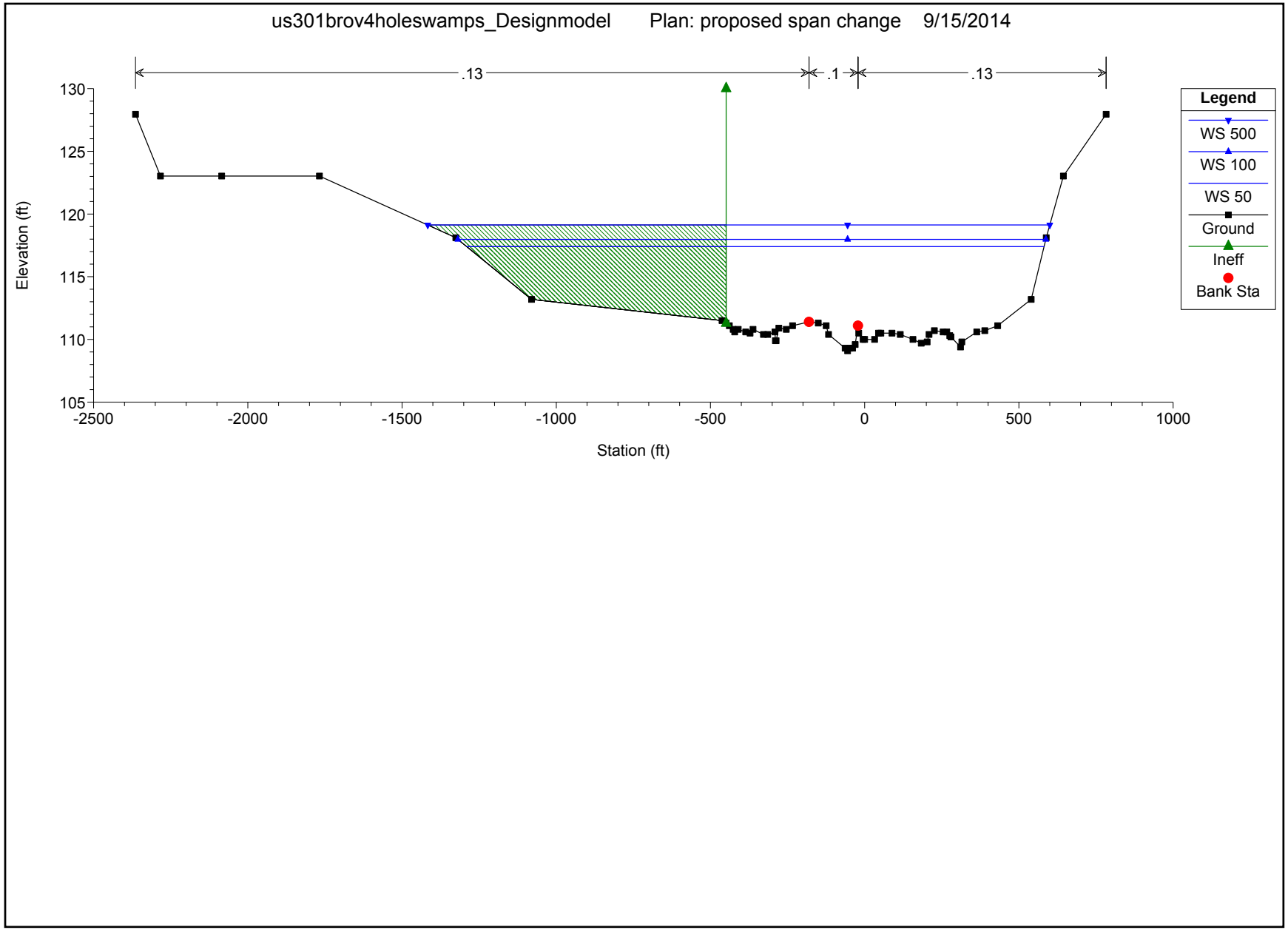
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APPENDIX G

BRIDGE SCOUR REPORT

HEC-RAS MODEL SUMMARY

SCOUR STUDY RESULTS

County	Orangeburg
Road	US 301
Waterbody	Four Hole Swamp

ABUTMENT SCOUR

Left Abutment			Right Abutment		
100-YR Scour	14.9	FT	100-YR Scour	15.6	FT
500-YR Scour	19.0	FT	500-YR Scour	19.5	FT

CONTRACTION SCOUR

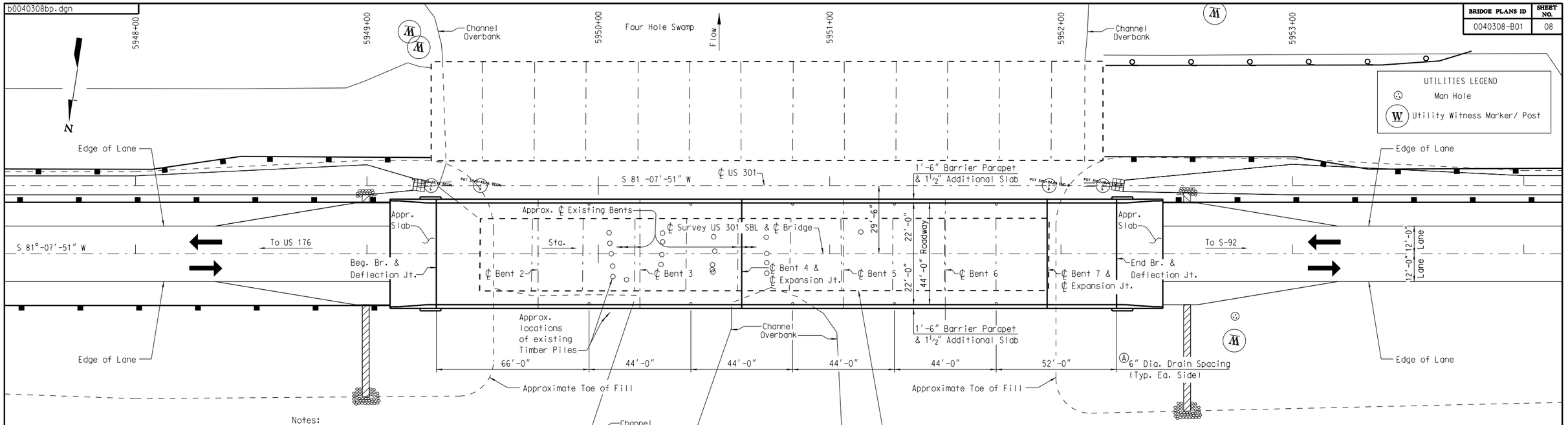
100-YR Scour	4.8	FT
500-YR Scour	6.4	FT

PIER SCOUR

Left Over Bank			Channel			Right Over Bank		
100-YR Scour	6.5	FT	100-YR Scour	6.5	FT	100-YR Scour	6.5	FT
500-YR Scour	7.1	FT	500-YR Scour	7.1	FT	500-YR Scour	7.1	FT

b0040308bp.dgn

BRIDGE PLANS ID	SHEET NO.
0040308-B01	08



Notes:

Ⓐ Shift drains to miss deck reinforcing steel.

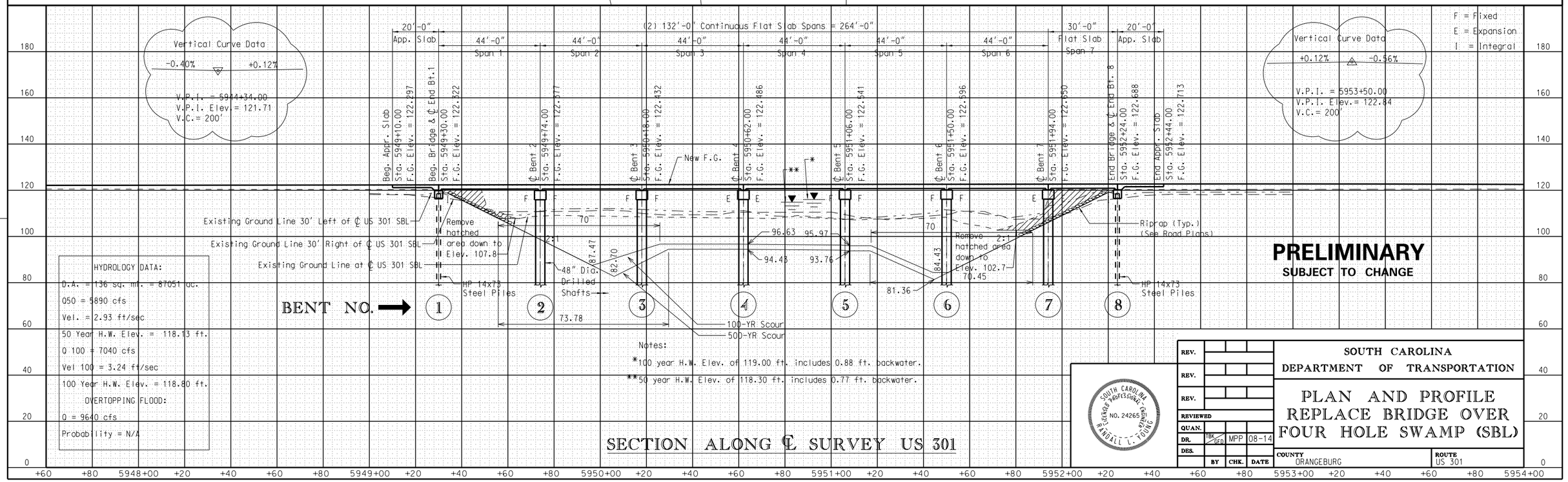
For additional information on utilities, see Road Plans.

B.M. # 3 - Nail in base of 18" Gum
Offset = 102.55' Left of Sta. = 5948+70.93
US 301 Elev. 113.24000
N=591011.00280 E=2107638.81947

Existing 247.0' x 29.0' Reinforced Concrete and Structural Steel Bridge to be removed and disposed of by the Bridge Contractor in accordance with Section 202.4.2 of the Standard Specifications. Include all costs in the lump sum price bid for "Removal and Disposal of Existing Bridge".

B.M. # 4 - Railroad spike in base of 40" live Oak
Offset = 87.37' Right of Sta. = 5958+88.06
US 301 Elev. 114.60500
N=591041.83020 E=2106604.57383

PLAN



HYDROLOGY DATA:
D.A. = 136 sq. mi. = 87051 ac.
Q50 = 5890 cfs
Vel. = 2.93 ft/sec
50 Year H.W. Elev. = 118.13 ft.
Q 100 = 7040 cfs
Vel 100 = 3.24 ft/sec
100 Year H.W. Elev. = 118.80 ft.
OVERTOPPING FLOOD:
Q = 9640 cfs
Probability = N/A

Notes:
*100 year H.W. Elev. of 119.00 ft. includes 0.88 ft. backwater.
**50 year H.W. Elev. of 118.30 ft. includes 0.77 ft. backwater.

SECTION ALONG ℄ SURVEY US 301

PRELIMINARY
SUBJECT TO CHANGE

SOUTH CAROLINA REGISTERED PROFESSIONAL ENGINEER NO. 24265 RANDALL L. YOUNG

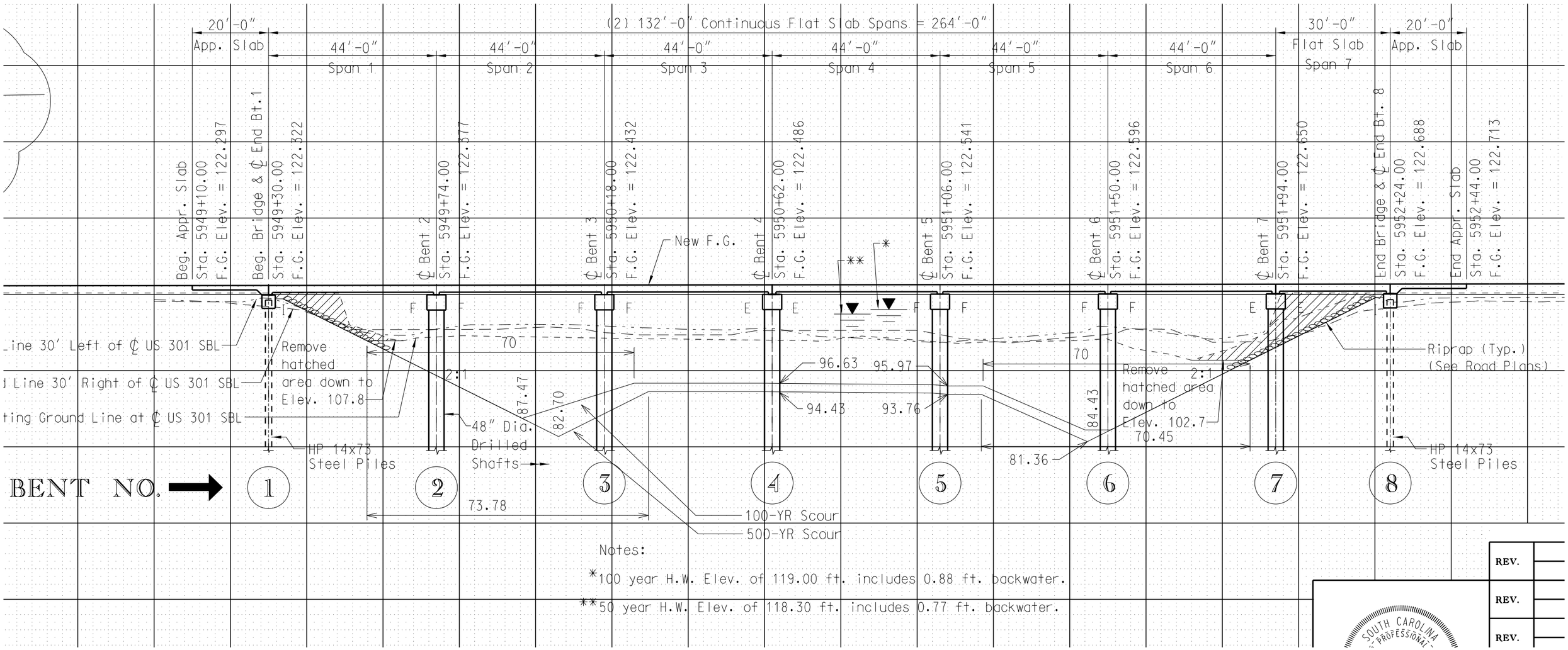
REV.				
REV.				
REV.				
REVIEWED				
QUAN.				
DR.	TBK GFD	MPP	08-14	
DES.				
	BY	CHK.	DATE	

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION

PLAN AND PROFILE
REPLACE BRIDGE OVER
FOUR HOLE SWAMP (SBL)

COUNTY ORANGEBURG
ROUTE US 301

$$DATE$$
Border Sheet 6/08



Notes:

*100 year H.W. Elev. of 119.00 ft. includes 0.88 ft. backwater.

**50 year H.W. Elev. of 118.30 ft. includes 0.77 ft. backwater.

REV.	
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REV.	

SOUTH CAROLINA

USGS Scour Regression Equations Calculations

Abutment Scour 100 YR

1. Selection of Equations and Calculations
   a. Left Abutment
      a. Bridge in Coastal Plain and 100-Yr Flow Embankment Length is > 426 FT and < 7440 FT; Use Eq 13b
      b. $y_s = 14.4 + 0.00131 * (L - 426)$
      c. $y_s = 14.4 + 0.00131 * (805.35 - 426)$
      d. $y_s =$ 14.9 FT

   b. Right Abutment
      a. Bridge in Coastal Plain and 100-Yr Flow Embankment Length is > 426 FT and < 7440 FT; Use Eq 13b
      b. $y_s = 14.4 + 0.00131 * (L - 426)$
      c. $y_s = 14.4 + 0.00131 * (1365.36 - 426)$
      d. $y_s =$ 15.6 FT

Contraction Scour 100 YR

2. Calculations
   a. $y_s = -6m^2 + 10m + 0.6$
   b. $y_s = -6\left(1 - \frac{b}{B}\right)^2 + 0.6$
   c. $y_s = -6\left(1 - \frac{254}{1754}\right)^2 + 0.6$
   d. $y_s =$ 4.8 FT

Pier Scour 100 YR

3. Calculations
   a. $y_s = 1.5b + .05$
   b. $y_s = 1.5 * 4 + .05$
   c. $y_s = 6.5\ FT$

HEC-18 Scour Calculations

Abutment Scour 100 YR

1. Selection of Equations and Calculations
   a. Left Abutment
      a. $\frac{L}{Y1} = \frac{805FT}{7.68FT} = 105 > 25$ Use HIRE Equation
      b. $y_s = 4\ Fr^{0.33}\ \frac{K_1}{0.55} K_2 y_1$
      c. $y_s = 4\ (0.04^{0.33}) \frac{0.55}{0.55} 1(7.71FT)$
      d. $y_s =$ 10.7 FT

   b. Right Abutment
      a. $\frac{L}{Y1} = \frac{1365FT}{8.68FT} = 157 > 25$ Use HIRE Equation
      b. $y_s = 4\ Fr^{0.33}\ \frac{K_1}{0.55} K_2 y_1$
      c. $y_s = 4\ (0.04^{0.33}) \frac{0.55}{0.55} 1(8.70FT)$
      d. $y_s =$ 12.0 FT

Abutment Scour 500 YR

2. Calculations
   a. Left Abutment
      a. $y_s = 4\ Fr^{0.33}\ \frac{K_1}{0.55} K_2 y_1$
      b. $y_s = 4\ (0.04^{0.33}) \frac{0.55}{0.55} 1(9.82FT)$
      c. $y_s =$ 13.6FT

b. Right Abutment

a. $y_s = 4\ Fr^{0.33}\ \frac{K_1}{0.55} K_2 y_1$

b. $y_s = 4\ (0.04^{0.33})\ \frac{0.55}{0.55} 1(10.84FT)$

c. $y_s =$ 15.0 FT

Contraction Scour 100 YR

3. Calculations
   a. Left Over Bank
      a. $y_s = \left[\frac{K_u Q^2}{D_m^{2/3} W^2}\right]^{3/7} - y_o$
      b. $y_s = \left[\frac{0.0077\ (802.32)^2}{(.025*0.00328*1.25)^{2/3} 50.71^2}\right]^{3/7} - 7.71$
      c. $y_s = 10.6\ FT$
   b. Channel
      a. $y_s = \left[\frac{K_u Q^2}{D_m^{2/3} W^2}\right]^{3/7} - y_o$
      b. $y_s = \left[\frac{0.0077\ (4263.41)^2}{(.025*0.00328*1.25)^{2/3} 162.9^2}\right]^{3/7} - 12.03$
      c. $y_s = 16.1\ FT$
   c. Right Overbank
      a. $y_s = \left[\frac{K_u Q^2}{D_m^{2/3} W^2}\right]^{3/7} - y_o$
      b. $y_s = \left[\frac{0.0077\ (730.33)^2}{(.025*0.00328*1.25)^{2/3} 40.55^2}\right]^{3/7} - 8.70$
      c. $y_s = 11.7\ FT$

Contraction Scour 500 YR

4. Calculations

   a. Left Over Bank

      a. $y_s = \left[\frac{K_u Q^2}{D_m^{2/3} W^2}\right]^{3/7} - y_o$

      b. $y_s = \left[\frac{0.0077\ (1098.56)^2}{(.025*0.00328*1.25)^{2/3} 50.71^2}\right]^{3/7} - 9.82$

      c. $y_s = 14.1\ FT$

   b. Channel

      a. $y_s = \left[\frac{K_u Q^2}{D_m^{2/3} W^2}\right]^{3/7} - y_o$

      b. $y_s = \left[\frac{0.0077\ (5635.16)^2}{(.025*0.00328*1.25)^{2/3} 162.9^2}\right]^{3/7} - 14.17$

      c. $y_s = 21.6\ FT$

   c. Right Overbank

      a. $y_s = \left[\frac{K_u Q^2}{D_m^{2/3} W^2}\right]^{3/7} - y_o$

      b. $y_s = \left[\frac{0.0077\ (1011.85)^2}{(.025*0.00328*1.25)^{2/3} 40.55^2}\right]^{3/7} - 10.84$

      c. $y_s = 16.2\ FT$

Pier Scour 100 YR

5. Calculations
   a. $y_s = y_1 2K_1K_2K_3 \left[\frac{a}{y_1}\right]^{0.65} Fr_1^{0.43}$
   b. $y_s = 12.03 * 2 * 1 * 1 * 1.1 * \left[\frac{4}{12.03}\right] \quad 0.17^{0.43}$
   c. $y_s = 6.0\ FT$

Pier Scour 500 YR

6. Calculations
   a. $y_s = y_1 2K_1K_2K_3 \left[\frac{a}{y_1}\right]^{0.65} Fr_1^{0.43}$
   b. $y_s = 14.17 * 2 * 1 * 1 * 1.1 * \left[\frac{4}{14.71}\right] \quad 0.18^{0.43}$
   c. $y_s = 6.6\ FT$

APPENDIX H

PLANS FOR EXISTING BRIDGE

FED. AID PROJ. NO.	FED. ROAD DIST. NO.	STATE	COUNTY	DOCKET NO.	ROUTE NO.	SHEET NO.	TOTAL SHEETS
	14	S.C.	Orangeburg	38.340	US 301	1-A	11

SOUTH CAROLINA STATE HIGHWAY DEPARTMENT

FINAL CONSTRUCTION PLANS

BRIDGE

OVER FOUR HOLES SWAMP

DOCKET NO. 38.340 F.A.PROJ. NO. _____

COUNTY ORANGEBURG

ON RT. US 301 BETWEEN ORANGEBURG AND SANTEE

CONTRACTOR McMEEKIN CONSTRUCTION CO.

TYPE OF BRIDGE AND CULVERT REINFORCED CONCRETE

INDEX

SHEET NO.	DESCRIPTION
1-A	TITLE SHEET
1-8	PLANS
9-11	RECAPITULATION SHEETS

PROGRESS DATA

CONTRACT AWARDED SEPTEMBER 15 1949

WORK BEGAN OCTOBER 18 1949

PROJECT ACCEPTED FEBRUARY 10 1950

BRIDGE ENGINEER W.J. GOODING, JR.

BRIDGE FIELD ENGINEER _____

RESIDENT ENGINEER SALVADOR LaTORRE

NOTES TO RESIDENT ENGINEER:

Notes on recapitulation sheets should be read carefully and complied with in full. The Resident Engineer should personally check the plans against the following list:—

	RES. ENG'R. CHECK	COL'A. OFFICE CHECK
1. Ink drawings and computations of all excavation, showing division of Dry, Wet and Rock excavation		
2. Ink drawings on translucent paper of pile bents or foundation piles and pile record, so arranged that the location of each pile, its length, penetration and bearing capacity is shown		
3. Ink drawings on translucent paper of all changes from plans, with computations of changes in Quantities		
4. Summary of Quantities		
5. Cement record to substantiate adjustments		
6. P.R. 47 - 2 copies (Federal Aid Project only)		
7. Force Account Claims and bills (if necessary)		
8. Adjustment of cement cost due to variation in yield (5 copies)		
9. Cement Invoices accompanying adjustments		
10. Freight Bills and Register		
11. Overrun and Underrun sheets (2 copies)		
12. Property Releases (if necessary)		
13. Estimate (5 copies)		
14. Statement of the amount to be deducted due to overtime		
15. Letter of Transmittal		
16. Final Roadway Profile		
17. Tie between S.C.H.D. Datum and Mean Sea Level		

Overruns and Underruns are to be explained in such a manner as to leave no doubts as to the reasons.

Following data to be inked on front of each note book:— Docket Number (as shown by original plans), Book Number, Contents, Contractor, Resident Engineer, Date Completed, Type of Bridge.

THE FINAL NOTE BOOKS, PROPERLY MARKED AND DESCRIBED, SUBMITTED HEREWITH AS A PART OF THESE FINAL CONSTRUCTION PLANS ARE AS FOLLOWS:—

BOOK NO. 1 Original Pile Notes

BOOK NO. 2 Original Survey Notes

BOOK NO. _____

BOOK NO. _____

BOOK NO. _____

DIARY _____

DATA CORRECT _____ RESIDENT ENGINEER — 2-13-50 DATE

PLANS AND QUANTITIES CHKD. _____ BRIDGE ESTIMATE ENGINEER — 2-15-50 DATE

EXAMINED _____ ASSISTANT BRIDGE ENGINEER — 3/8/50 DATE

SOURCE OF SUPPLY OF MATERIAL

ITEM	MANUFACTURER	ADDRESS
SAND	SOUTHEASTERN	DIXIANA, S.C.
CRUSHED STONE	WESTON & BROOKER	DIXIANA, S.C.
GRAVEL		
CEMENT	UNIVERSAL ATLAS CEMENT CO.	LEEDS, ALA.
REINF. STEEL	OWENS STEEL CO.	COLUMBIA, S.C.
STRUCT. STEEL		
TREATED TIMBER	KOPPERS CO.	CHARLESTON, S.C.
STEEL H PILING	BROUGHT FROM CONTRACTOR'S STOCK	
TR. STRUCT. TIMBER		
HARDWARE		
EXPANSION PLATES		
PAINT		
WATERPROOFING		
HANDRAIL (STEEL)		

TABLE OF OVERRUNS AND UNDERRUNS

ITEM	UNIT	PLAN QUANTITIES	RES. ENGINEER QUANTITIES	PAY QUANTITIES COL'A. OFFICE	OVERRUN	UNDERRUN	EXPLANATION
EXCAVATION							
DRY EXCAVATION	C.Y.						
WET "	C.Y.						
ROCK "	C.Y.						
WET AND DRY EXCAV.	C.Y.						
CEMENT							
CLASS "A A" CONCRETE	C.Y.		178.03			-19	
CLASS "A" CONCRETE	C.Y.	178.22 ✓	178.22 ✓				
REINFORCING STEEL							
REINFORCING STEEL	LBS.	29,974 ✓	29,965 ✓			9 ✓	Omitted 4 c-Bars in Cap Extensions to match old structure ✓
STRUCTURAL TIMBER							
TREATED STRUCT. TIMBER	M.B.M.						
UNTREATED STRUCT. TIMBER	M.B.M.						
HARDWARE							
HARDWARE	LBS.						
STRUCTURAL STEEL							
STRUCTURAL STEEL	LBS.						
STEEL SUPERSTRUCTURE	L. SUM						
PILING							
UNTREATED TIMBER PILING	L.F.						
CREOSOTED " "	L.F.	288 ✓	271.8 ✓			16.2	All Necessary ✓
CUT-OFF C.T. PILING @ 40 %	L.F.		18.5 ✓		18.5		Not Estimated "
CUT-OFF C.T. PILING @ 25 %	L.F.		0.0 ✓				
IN. PRE-CAST R.C. PILING	L.F.						
IN. PRE-CAST R.C. PILING	L.F.						
STEEL H PILING (10 IN. 42 LBS.)	L.F.	440 ✓	495.32 ✓		55.32 ✓		Necessary to obtain required bearing ✓
12"x5" PRE-CAST CONC. SHEET PILING	L.F.	256 ✓	256 ✓				
PAINTING							
FIELD PAINTING STRUCTURAL STEEL	L.SUM						
HANDRAIL							
METAL HANDRAIL	L.F.						
PIPE "	L.F.						
TIMBER "	L.F.						
OTHER ITEMS			74.0			74.0	
PRE-CAST CONCR. TILE SL. DRAINS	L.F.	80 ✓	73.83			6.17	All Necessary ✓
REMOVAL OF DESIGNATED PORTIONS OF EXISTING ABUTMENTS AND SUPERSTRUCTURE AND NECESSARY DRILLING AND CHIPPING	L.S.	Necessary ✓	Necessary ✓				Letter 12-8-49
ENCASING EXISTING BENT COLUMNS	Each	6 ✓	3 ✓			3 ✓	All Necessary ✓
RIP RAP	Tons	0 ✓	47.6 ✓		47.6 ✓		See Supplemental Agreement dated 12-12-49
EXCESS CREOSOTE OIL IN PILES	LBS.	0	544 ✓		544 ✓		Provided for in Special Provisions ✓

FED. ROAD DIV. NO.	STATE	COUNTY	DOCKET NO.	PROJECT NO.	ROUTE NO.	SHEET NO.	TOTAL SHEETS
3	S.C.	Orangeburg	38.340		301	1	8

INDEX OF SHEETS

1 Title
2 Culvert P & P.
3 " Widening Details.
4 Flared Curb and Gutter.
5 Slope Drains.
6 Bridge P & P.
7 Abutment & Bent Extension Sheet.
8 Superstructure Details.

SOUTH CAROLINA
STATE HIGHWAY DEPARTMENT
COLUMBIA

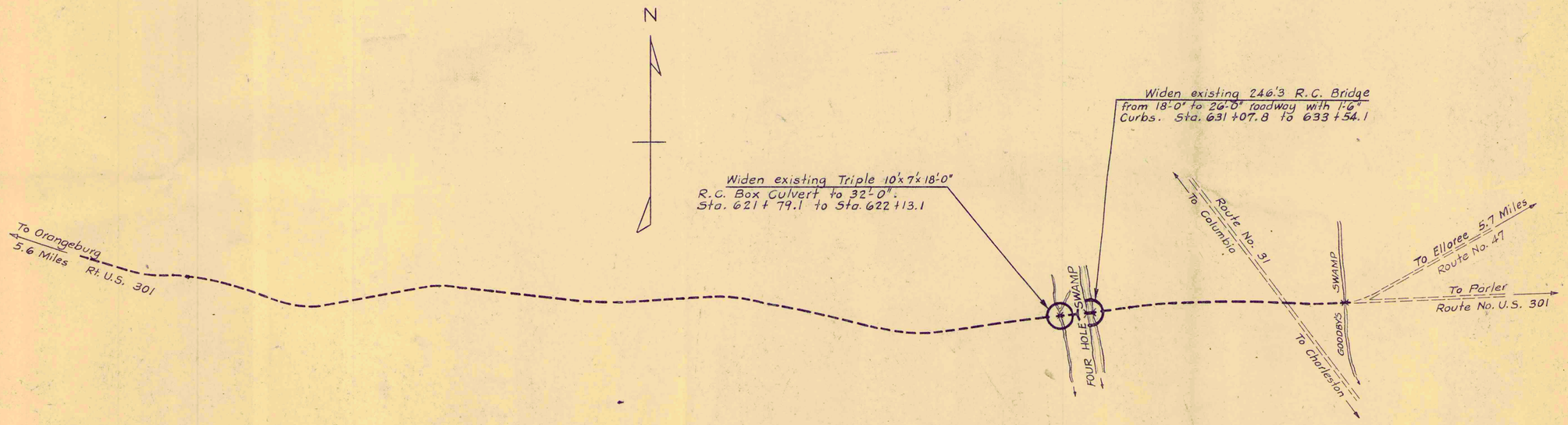
PLAN AND PROFILE OF PROPOSED STATE HIGHWAY

DOCKET NO. 38.340
ROUTE NO. U.S. 301
ORANGEBURG COUNTY

WIDENING CULVERT AND BRIDGE IN
FOUR HOLE SWAMP

SUMMARY OF ESTIMATED QUANTITIES

Item	Quantity	
Cement Concrete (Class "A")	178.22	C.Y.
Reinforcing Steel	29,974	Lbs.
Creosoted Timber Piling	288	L.F.
Pre-cast Concrete Sheet Piling (5"x12")	256	L.F.
Steel H-Piling - 10" @ 42#	440	L.F.
Pre-cast Concrete Tile Slope Drains	80	L.F.
Removal of designated Portions of existing Abutments and Superstructures and necessary drilling and chipping	Necessary	L.S.
Encasing Existing Bent Columns	6	Ea.



CONVENTIONAL SIGNS

State Line		Trolley Poles	
County Line		Power Poles	
City or Town Limits		Telephone or Telegraph Poles	
Property Line		Marsh	
Fence	x x	Trees	
Retaining Wall		Brush	
Existing Road		Stumps	
℄ and R.O.W. Lines of		Buildings	
Proposed Road		Bridge	
Railroad		Concrete Box Culvert	
Levee or Embankment		Pipe Culvert	
Guard Rail		Drop Inlet and Culvert	
Point of Intersection (P. I.)	△	Hub on Center Line	

LEGEND

PROPOSED PROJECT
OTHER ROADS

LAYOUT

Scale: 1 inch = 2000 feet

Net Length of Roadway	0.000	Miles
Net Length of Bridges	0.053	Miles
Net Length of Project	0.053	Miles
Length of Exceptions	0.000	Miles
Gross Length of Project	0.053	Miles

Note: All workmanship and material on this project to conform with South Carolina State Highway Department Standard Specifications for Highway Construction dated March 15th 1939, as approved by the Administrator, Federal Works Agency.

APPROVED

S. H. Pearman
STATE HIGHWAY ENGINEER
8/2/49

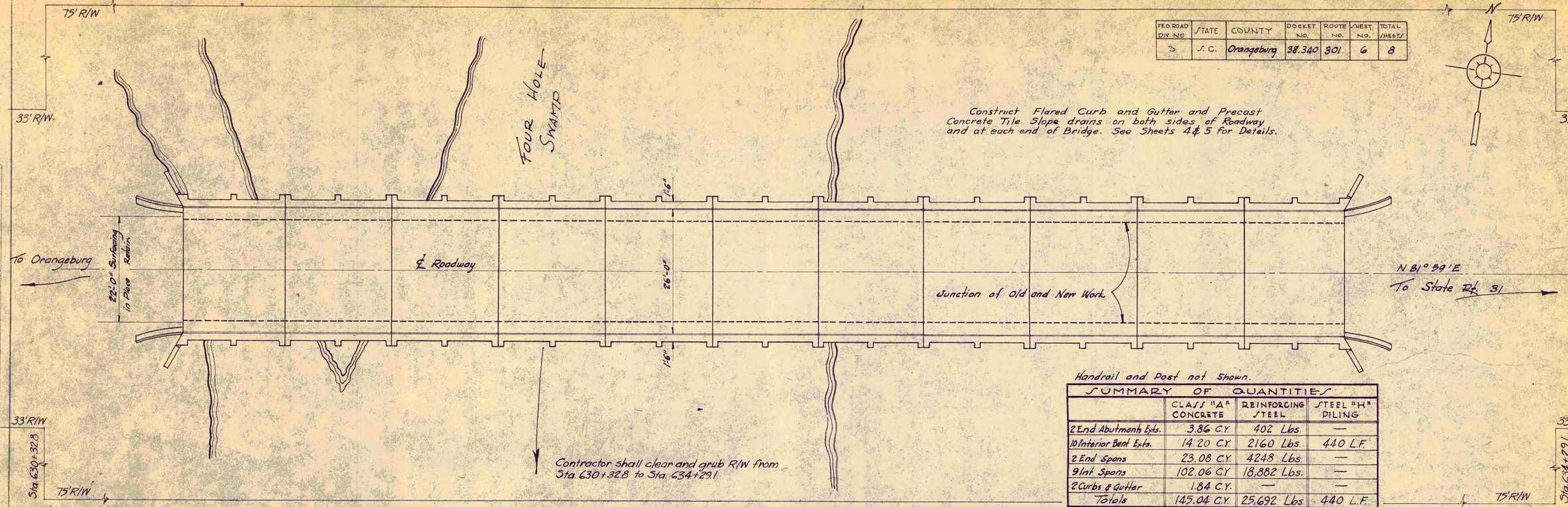
RECOMMENDED FOR APPROVAL

DISTRICT ENGINEER
PUBLIC ROADS ADMINISTRATION
FEDERAL WORKS AGENCY

APPROVED

DIVISION ENGINEER
PUBLIC ROADS ADMINISTRATION
FEDERAL WORKS AGENCY

FED. ROAD DIV. NO.	STATE	COUNTY	DOCKET NO.	ROUTE NO.	SHEET NO.	TOTAL SHEETS
3	S. C.	Orangeburg	38.340	301	6	8



SUMMARY OF QUANTITIES

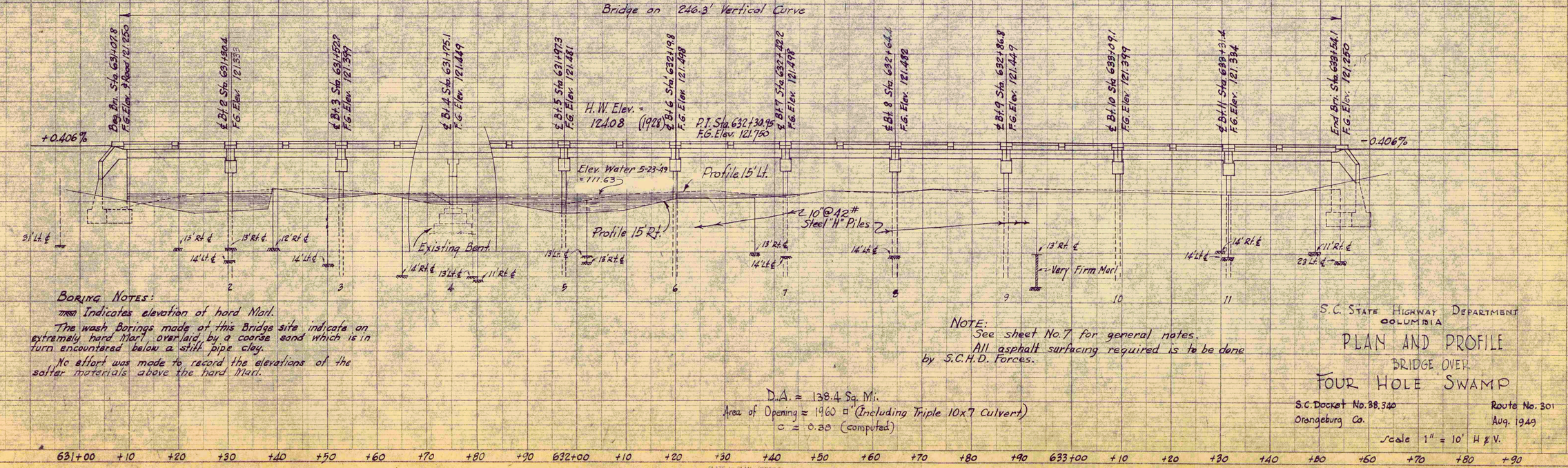
	CLASS "A" CONCRETE	REINFORCING STEEL	STEEL "H" PILING
2 End Abutments Exts.	3.86 C.Y.	402 Lbs.	—
10 Interior Bent Exts.	14.20 C.Y.	2160 Lbs.	440 L.F.
2 End Spans	23.08 C.Y.	4248 Lbs.	—
9 Int Spans	102.06 C.Y.	18,882 Lbs.	—
2 Curbs & Gutter	1.84 C.Y.	—	—
Totals	145.04 C.Y.	25,692 Lbs.	440 L.F.

B.M. No 45: X Mark on N.W. corner of Abutment opp. Sta 631+08 - Elev. 121.054

B.M. No 46: ⊙ Mark on D.S. Sidewalk 22" from end of Span 5. Elev. 122.101

B.M. No. 3: ⊙ Mark on U.S. corner of N.E. Abutment Elev. 120.492

B.M. No 4: Nail in side at 10" Persimmon 40'-Lt. Sta 634+40 - Elev. 116.630



BORING NOTES:

Indicates elevation of hard Marl.

The wash Borings made at this Bridge site indicate an extremely hard Marl overlaid by a coarse sand which is in turn encountered below a stiff pipe clay.

No effort was made to record the elevations of the softer materials above the hard Marl.

NOTE:
See sheet No. 7 for general notes.
All asphalt surfacing required is to be done by S.C.H.D. Forces.

D.A. = 138.4 Sq. Mi.
Area of Opening = 1960 □' (Including Triple 10x7 Culvert)
C = 0.38 (computed)

S. C. STATE HIGHWAY DEPARTMENT
COLUMBIA

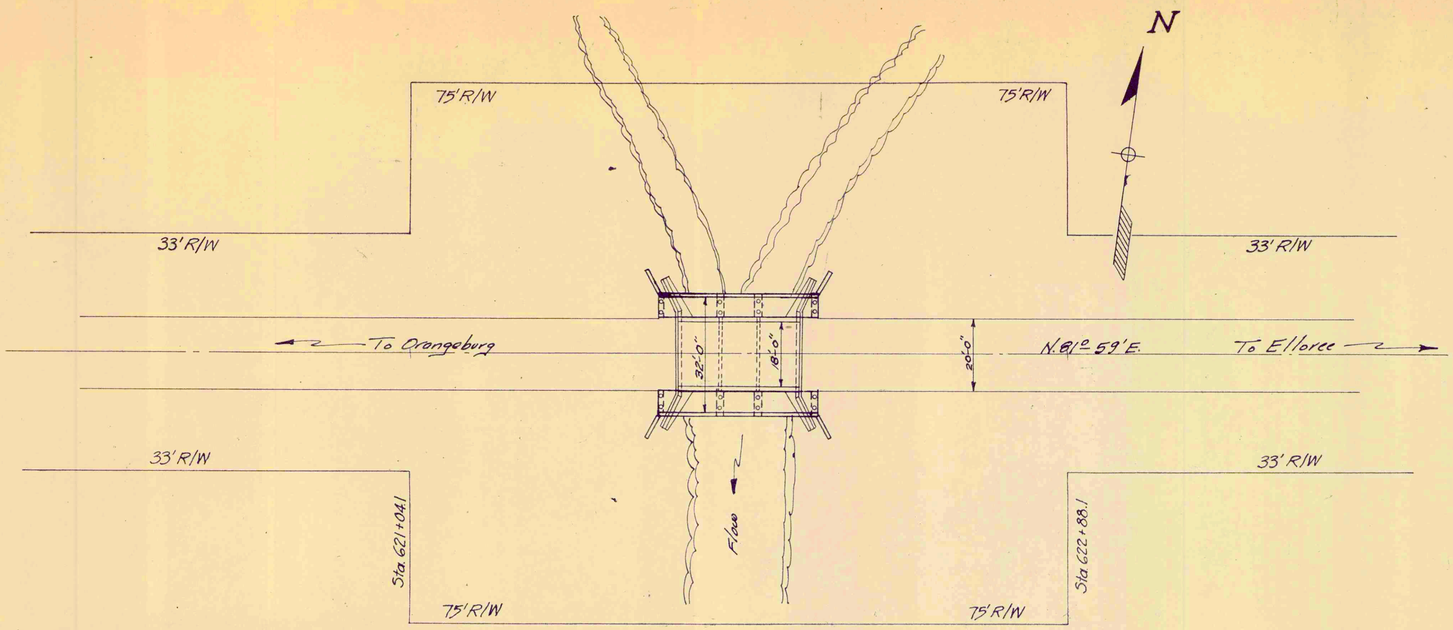
PLAN AND PROFILE
BRIDGE OVER
FOUR HOLE SWAMP

S.C. Docket No. 38.340 — Route No. 301
Orangeburg Co. — Aug. 1949
Scale 1" = 10' H & V.

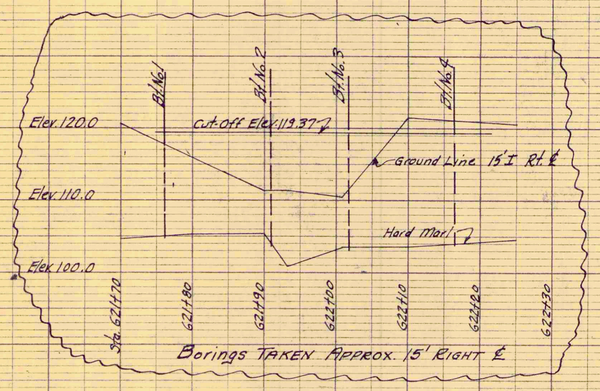
PLATE 1 — PLAN—PROFILE

FED. ROAD DIV. NO.	STATE	COUNTY	DOCKET NO.	PROJECT NO.	ROUTE NO.	SHEET NO.	TOTAL SHEETS
3	S. C.	ORANGEBURG	38.340		US 301	2	8

PLAN — SURVEYED — PLOTTED — LOCATION CHECKED — R. W. A. NOTED — STRUCTURE NOTATIONS CHECKED — NOTE BOOK — NO. — BY — DATE



Contractor shall clear and grub R/W for Sta. 621+04.1 to Sta. 622+88.1.



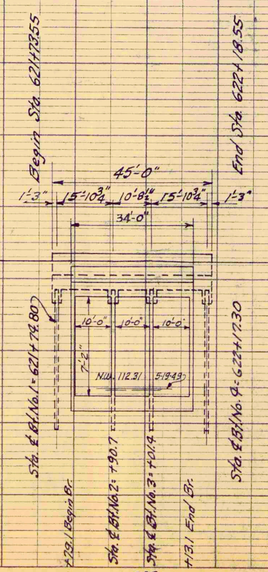
NOTE:
Wash borings made at this location indicate an extremely hard marl over-laid in spots by a Firm Marl, which in turn is encountered below a stiff grey pipe clay or sand. No effort was made to record the elevations of the softer materials.

Worked Up By: G.H.B. 8-49
Checked By: W.B.B. 8-49

B.M. #4
Cross on S.W. Corner of Bridge opp. Sta. 621+79
Elev. = 120.903 Orig. Plan Elev. = 121.33

B.M. #1
@ Mark on U.S. Corner N.E. Abutment Elev. = 120.162

B.M. #4? Nail in Head of N.W. Wing Culvert Elev. = 120.373



Present Elev. ℄ of Roadway

S. C. STATE HIGHWAY DEPARTMENT
COLUMBIA

PLAN AND PROFILE
FOR TRIPLE CULVERT IN
FOUR HOLE SWAMP
STATION 621+96

DOCKET No. 38340 ROUTE No. 301
COUNTY: ORANGEBURG DATE: 8-49

PROFILE — SURVEYED — PLOTTED — LOCATION CHECKED — R. W. A. NOTED — STRUCTURE NOTATIONS CHECKED — NOTE BOOK — NO. — BY — DATE

619 +50 620 +50 621 +50 622 +50 623 +50 624 +50 625

APPENDIX I

BRIDGE MAINTENANCE REPORT

Bridge ID

(008) Bridge ID	3820030130800	**Asset ID**	1753

On Route

County	ORANGEBURG	**Route Type**	US Route	**Route**	301	**Auxiliary**	Main Line
MilePoint	28.03	**(005E) Direction**	3-SOUTH				

(002) District	7-District 7	**(006) Crossing Name**	FOUR HOLE SWAMP
(312) In District	7-District 7	**(007) Facility**	US 301
(311) Maint Co.	ORANGEBURG	**(009) Location**	8MI W OF SANTEE
(004) City/Town			
(022) Owner	1-SCDOT	**(013) INVRTE/SUBRTE**	00US00301000
(021 Custodian	1-SCDOT	**(012) Base Hwy Ntwk**	1-INVENTORY ROUTE IS ON THE BASE NETWORK
(102) Direction	1-1-WAY TRAFFIC	**(105) Fed Lands Hwy**	0-NOT APPLICABLE
(100) Strahnet	0-NOT A STRAHNET HIGHWAY		
(016) Lat	33 **Deg** 27 **Min** 27 **Sec**	**(104) NHS**	1-NHS
(017) Lon	80 **Deg** 38 **Min** 55 **Sec**	**(026) Functional Class**	2-Rural -- Principal Arterial - Other
(019) Bypass	1 **Miles**	**(029) ADT**	5050 ☐ **Override**
(020) Toll	3-ON FREE ROAD	**(030) Year of ADT**	2011
(301) Road	2-US ROUTE	**(114) Future ADT**	8787 ☐ **Override**
(313) Skid	44	**(115) Year of Future ADT**	2031
Border Bridge		**(109) % Truck Traffic**	6
(099) Structure		**(110) Nat Network**	1-YES
(98A) State		**(101) Parallel**	L-THE LEFT STRUCTURE OF PARALLEL BRIDGES.
(98B) % Respon		**(103) Temporary**	

Underpass

County	ORANGEBURG	**Route Type**	US Route	**Route**	301	**Auxiliary**	Main Line
MilePoint	28.03	**Direction**	3-SOUTH	**Bridge ID**	3820030130800	**Asset ID**	1753

Under Route

County		**Route Type**		**Route**		**Auxiliary**	
MilePoint		**(005E) Direction**	0-NOT APPLICABLE				

(102) Traffic Direction		**(104) NHS**		
(006) Crossing Name		**(026) Functional Class**		
(109) % Truck Traffic		**(029) ADT**	0	☐ **Override**
(012) Base Highway Network	0-INVENTORY ROUTE IS NOT ON THE BASE NETWORK	**(030) Year of ADT**		
(013) LRS INVRTE/SUBRTE		**(114) Future ADT**	0	☐ **Override**
(105) Federal Lands Highway	0-NOT APPLICABLE	**(115) Year of Future ADT**		
(110) National Network				
(100) Strahnet Highway				

Insp. Gen.

County	ORANGEBURG	**Route Type**	US Route	**Route**	301	**Auxiliary**	Main Line
MilePoint	28.03	**Direction**	3-SOUTH	**Bridge ID**	3820030130800	**Asset ID**	1753

(090) Inspection Date	1/1/2012	**Type Structure**	
(027) Year Built	1950	**(43A) Main Orig Super**	1-CONCRETE
(106) Year Recon	0	**Main Orig Type**	4-TEE BEAM
(031) Design Load	2-H 15	**Main Orig Sub**	1-CONCRETE
(032) Appr Rdway	40 **FT**	**(43B) Main Rec Super**	
(033) Bridge Median	1-OPEN MEDIAN	**Main Rec Type**	
(034) Skew	0 **Deg**	**Main Rec Sub**	
(035) Flared	0-NO FLARE	**(44A) Appr Orig Super**	0-OTHER OR NOT APPLICABLE
(36A) Railings	1-MEETS CURRENTLY ACCEPTABLE STANDARDS.	**Appr Orig Type**	00-OTHER OR NOT APPLICABLE
(36B) Transitions	1-MEETS CURRENTLY ACCEPTABLE STANDARDS.	**Appr Orig Sub**	0-OTHER OR NOT APPLICABLE
(36C) Appr Guard	1-MEETS CURRENTLY ACCEPTABLE STANDARDS.	**(44B) Appr Rec Super**	
(36D) Appr Guard End	1-MEETS CURRENTLY ACCEPTABLE STANDARDS.	**Appr Rec Type**	
(037) History	4-HISTORICAL SIGNIFICANCE IS NOT DETERMINABLE	**Appr Rec Sub**	
(041) Post Status	A-OPEN, NO RESTRICTION		
(045) # Main Spans	11	**(107) Deck Struct**	1-CONCRETE CAST-IN-PLACE
(046) # Appr Spans	0	**(108A) Wear Surf Type**	6-BITUMINOUS
(048) Max Span Lgth	22 **FT**	**(108B) Membrane Type**	8-UNKNOWN
(308) Appr Span Lgth	0 **FT**	**(108C) Deck Prot Type**	8-UNKNOWN
(049) Struct Length	247 **FT**	**(404) Maint Bridge**	0-No

Insp. Geom.

County	ORANGEBURG	**Route Type**	US Route	**Route**	301	**Auxiliary**	Main Line
MilePoint	28.03	**Direction**	3-SOUTH	**Bridge ID**	3820030130800	**Asset ID**	1753

(038) Navigational Control	0-NO NAVIGATION CONTROL ON WATERWAY			**(42A) Type Service - On**	1-HIGHWAY		
(039) Navig Vert Clearance	0	**FT**		**(42B) Type Service - Under**	5-WATERWAY		
(040) Navig Horz Clearance	0	**FT**		**(28A) # Lanes - On**	2	**(417) Bridge Wt. Classification**	A30
(111) Navig Pier Protect				**(28B) # Lanes - Under**	0		
(10A) Greatest Min Over	99	**FT** 99 **IN**		**Horizontal Clearances**			
Underclearances				**(47A) Horz Clear Right**	26	**FT**	
(10B) Greatest Min Right	99	**FT** 99 **IN**		**(47B) Horz Clear Left**	0	**FT**	
(10C) Greatest Min Left	99	**FT** 99 **IN**		**(47UA) Horz Clear Right (U)**	0	**FT**	
(54A) Min Vert Clear Ref	N-FEATURE NOT A HIGHWAY OR RAILROAD			**(47UB) Horz Clear Left (U)**	0	**FT**	
(54B) Min Vert Clear Right	0	**FT** 0 **IN**		**Widths**			
(54C) Min Vert Clear Left	0	**FT** 0 **IN**		**(50A) Sidewalk Width Right**	0	**FT**	
(55A) Min Lat Clear Ref	N-FEATURE NOT A HIGHWAY OR RAILROAD			**(50B) Sidewalk Width**	0	**FT**	

(55B) Min Lat Clear Right	99.9	FT		Left (051) Curb to Curb Width		26	FT
(056) Min Lat Clear Left	0	FT		(052) Deck Width Out-Out		29	FT
				(053) Vert Clearance Above Deck	99	FT	99 IN

Insp. Cond .

County	ORANGEBURG	**Route Type**	US Route	**Route**	301	**Auxiliary**	Main Line
MilePoint	28.03	**Direction**	3-SOUTH	**Bridge ID**	3820030130800	**Asset ID**	1753

Condition Ratings

(058) Deck	5-FAIR CONDITION	**(063) Oper Rate Method**	2-ALLOWABLE STRESS (AS)
(059) SuperStr	4-POOR CONDITION	**(064) Oper Rate Tons**	36
(060) SubStruct	4-POOR CONDITION	**(065) Inv Rate Method**	2-ALLOWABLE STRESS (AS)
(061) Channel	5-BANK PROTECTION IS BEING ERODED.	**(066) Inv Rate Tons**	27
(062) Culvert	N-NOT APPLICABLE.		

Inspection Data

	Frequency	Date				
			(113) Sour Critical	3-BRIDGE IS SCOUR CRITICAL; FOUNDATIONS UNSTABLE		
(93A) Fracture Critical Insp	N-N		**(091) Inspection Frequency**	24	**(415) Critical Route**	
(93B) Underwater Insp	N-N		**(411) Load Rating**		**(416) Evac Route**	
(93C) Special Insp	N-N		**(319) Last Paint Date**		**(417) Bridge Weight Classification**	A30-A30

Appraisal Rating

(067) Struct Eval	4-MEETS MINIMUM TOLERABLE LIMITS TO BE LEFT AS IS	**(400) Functionally Obsolete**	1-Yes
(068) Deck Geom	2-INTOLERABLE; REQUIRES HIGH PRIORITY OF REPLACEMENT	**(401) Structurally Deficient**	1-Yes
(069) Underclear	N-NOT APPLICABLE	**(402) Substandard**	1-Yes
(070) Posting	5-EQUAL TO OR ABOVE LEGAL LOADS	**(403) Sufficiency Rating**	44.4
(071) Waterway Adq	6-EQUAL TO PRESENT MINIMUM CRITERIA		
(072) Appr Rswy Align	7-BETTER THAN PRESENT MINIMUM CRITERIA		

Sufficiency Rating

Security

		(409) Bridge Security Class	
Seismic		**(412) Security Risk**	
(407) Seismic Status		**(413) Security Mitigation**	
(408) Seismic Level		**(414) Mitigation Type**	

Route Data

County	ORANGEBURG	**Route Type**	US Route	**Route**	301	**Auxiliary**	Main Line
MilePoint	28.03	**Direction**	3-SOUTH	**Bridge ID**	3820030130800	**Asset ID**	1753

ON Routes

County	Route Type	Route	Auxiliary	(05E) Direction	MilePoint	Dominant/Subordinate
ORANGEBURG	US Route	301	Main Line	3-SOUTH	28.030	D

UNDER Routes

County	Route Type	Route	Auxiliary	(05E) Direction	MilePoint

APPENDIX J

BRIDGE WORKSHEET

HYDRAULIC DESIGN
AND
RISK ASSESSMENT FOR
BRIDGE/BRIDGE REPLACEMENT OVER
Four Hole Swamp
ROUTE/ROAD NUMBER US 301
FILE NO. 38.040308 PROJECT NO. ##########)
Orangeburg COUNTY, SOUTH CAROLINA

January 9, 2013

Prepared By T. Patrick Knight
Checked/Reviewed By G. Randall Mungo

_____
Signed and Sealed

PROJECT DESCRIPTION

County: Orangeburg File No.: 38.04308 Project No.: #######
Charge Code: 38Q100BR38019.2220
Project Engineer: Kevin Gant Road Squad: J. Sease

COMPARATIVE DATA

By T. Patrick Knight Date January 9, 2013 Checked G. Randall Mungo Date

ROUTE/ROAD NO.	US 301 SB	US 301 NB		
DIST. FROM NEW BR. (MI.)	0	0.01		
DRAINAGE AREA (SQ. MI.)	136.02	136.02		
ZONE	Coastal Plain	Coastal Plain		
Q10	3600	3600		
Q25	4820	4820		
Q50	5890	5890		
Q100	7040	7040		
Q500	9640	9640		
BRIDGE LENGTH (FT.)	245.8	290.4		
AVG. F. G. (FT.)	120.86	121.25		
VELOCITY (FT./SEC.)	N/A	8.1		
HIGH WATER ELEV. (FT.)	124.08	124.08		
HIGH WATER DATE	1928	1928		
HIGH WATER DEPTH	N/A	N/A		
NORMAL WATER ELEV. (FT.)	111.63	111.8		
NORMAL WATER DATE	5/23/49	9/20/67		
NORMAL WATER DEPTH	N/A	N/A		
FILE/DOCKET/PROJ. NO.	38.240	38.632		
LOCATION OF PLANS	Plan Library	Plan Library		
DATUM/DATUM TIE	121.054	124.11		
FLOODWAY MAP	A	A		

SITE INSPECTION

County: Orangeburg Date: Wensday January 9, 2013 Pin: 40308
Stream: Four Hole Swamp Rt./Rd. No.: US 301
By: Randall Mungo and Thomas Knight

Note: All references to left and right are looking in the direction of flow.

EXISTING BRIDGE

Length 245.8 ft Width 31.3 Ft. Max. Span Length 22.33 FT.
Alignment Tangent/Curved Bridge skewed Yes/No Angle
End Abutment Type Vertical
Riprap on Fills? Some (US Right Corner) Condition Okay
Superstructure Type Flat Slab
Substructure Type Piles
Utilities Present Yes/No Describe Buried Fiber Optic on US; Water, Gas, Telecommunications on DS of DS BR
Debris accumulation on bridge, percent channel blocked horizontal 0
Percent channel blocked vertical 0
Hydraulic Problems? Yes/No Describe Controlled by DS BR

Draw Sketch of Bridge and Stream Below
(Show north arrow and direction of flow)

See Attached Scoping Information

SITE CHARACTERISTICS

General Topography Rural Area

Stream Type (circle one) Straight, Braided, or Meandering

Are Channel banks Stable? Yes/No If No Describe _____

Are there any Hydraulic Controls Up Stream or Down Stream? Yes/No Describe Bridge for North Bound Lanes

Soil type Sandy Loam Exposed Rock Yes/No If so, give description and location

Describe potential for drift Low

Give description and location of any structures or other property that could be damaged by backwater None

Describe any other features that might effect or be effected by the hydraulic performance of the proposed bridge None

MANNINGS "n" VALUES FOR CHANNEL

Channel n = (nb + n1 + n2 + n3 + n4) m

nb -- Base n for soil

Earth	.020
Rock Cut	.025
Fine Gravel	.024
Course Gravel	.028

n1 -- Degree of Irregularity

Smooth	.000
Minor	.001-.005
Moderate	.006-.010
Severe	.011-.020

n2 -- Variations of Channel Cross Sections

Gradual	.000
Alternating	
Occasionally	.001-.005
Frequently	.010-.015

n3 -- Relative Effect of Obstructions

Negligible	.000-.004
Minor	.010-.015
Appreciable	.020-.030
Severe	.040-.060

n4 -- Vegetation

Low	.002-.010
Medium	.010-.025
High	.025-.050
Very High	.050-.100

m -- Degree of Meandering

Minor	1.00
Appreciable	1.15
Severe	1.30

FIELD OBSERVATIONS FOR CHANNEL

Channel Depth	nb	n1	n2	n3	n4	m	Computed n
US	.02	.005	0.005	0.01	0.047	1.15	0.100
DS	.02	.005	0.005	0.01	0.047	1.15	0.100

MANNINGS "n" FOR OVER BANK AREAS

Over Bank n = nb + n1 + n3 + n4

nb -- Base n for soil

Earth	.020
Rock Cut	.025
Fine Gravel	.024
Course Gravel	.028

n1 -- Degree of Irregularity

Smooth	.000
Minor	.001-.005
Moderate	.006-.010
Severe	.011-.020

n3 -- Effect of Obstructions

Negligible	.000-.004
Minor	.005-.019
Appreciable	.020-.030

n4 -- Amount of Vegetation

Small	.001-.010
Medium	.011-.025
Large	.025-Very Large

FIELD OBSERVATIONS FOR OVER BANK AREAS

Location	Depth	nb	n1	n3	n4	Computed n
US		0.02	0.01	0.03	.07	.13
Near Culvert US		0.02	0.01	0.023	.07	.13
L DS		0.02	0.01	0.023	.07	.13
R DS		0.02	0.01	0.023	.07	.13

COMPARATIVE BRIDGE SITE INSPECTION FORM

County: Orangeburg Rt/Rd No.: US 301

Stream: Four hole Swamp Measured bridge length 290.4

Maximum span length 22.33 ft Superstructure type Flat Slab

Substructure type Piles End Abutement type Spill Through

Rip-rap present? yes Condition Okay

Stream type (circle one) Straight, Braided, Meander, Anabranched. Alluvial/Rock

Any visible signs of scour problems (describe) No

Are banks stable (describe) Yes

Debris blockage, percent of channel blocked horizontally 0

vertically 0 Describe other signs of debris

Any other problems

Draw sketch & indicate problem areas. On sketch indicate location of woods, fields, and other land uses in the vicinity of bridge. Show north arrow and direction of flow

See Attached Scooping Information

RISK ASSESSMENT

Risk assessment involves the risk in dealing with the hazards associated with flood waters and the economic cost of protection against those risks. The objective is to arrive at an acceptable level of protection while minimizing the cost. Only the design decisions controlled by hydraulic design criteria are evaluated. The procedure is to work through the following questions. The path through the questions will lead to the appropriate result.

In this procedure the maximum flood is defined as the 500 year flood or overtopping flood which ever is smaller.

I. Backwater Damage Major flood damage applies to shopping centers, hospitals, industrial facilities, residential areas, schools, farming operations, etc.

1. Does the maximum flood cause major damage to up stream property?
   Yes_____(Go to 2) No__ __ (Go to 3).

2. Would this damage occur if the road were not there?
   Yes _____(Go to 3) No_____(Perform a limited LTEC analysis to see if the bridge opening should be increased and/or grades raised to minimize the damage potential. Go to II)

3. Was this a bridge replacement and if so, was the bridge opening increased enough to increase the discharge passed through the bridge? Yes___(Go to 4) No___ (Go to II).

4. Does the increased flow cause major damage down stream? Yes_____(Perform a limited LTEC analysis to determine if the bridge opening should be reduced, the flood way redefined, and flood easements purchased upstream or if flood easements should be purchased downstream. Go to II) No_____ (Go to II).

II. Traffic Related Losses

1. Is the overtopping flood greater than the 100 year flood? Yes__ ___ (Go to III)
   No_____ (Go to 2).

2. Does the ADT exceed 50 vehicles per day? Yes_____ (Go to 3) No_____ (Go to III).

3. Does the duration of road closure in days, multiplied by the difference in length in miles between the normal route and the detour exceed 20? Yes_____ (Go to 4)
   No___ (Go to III).

4. Does the annual risk cost for traffic related costs exceed 10% of the estimated annual capital costs? Yes____ (Perform a limited LTEC analysis to compare the cost to raise the grades and if necessary increase the bridge length with the traffic related costs. Go to III.) No _____ (Go to III.)

III. Roadway and/or Structure Repair Costs

1. Is the overtopping flood less than the 100 year flood? Yes_____ (Go to 2) No_____ (Go to 3).

2. Is the overtopping flood less than 0.5 feet over the low point on the roadway and duration no more than 1.0 hour? Yes_____ (Go to 3) No_____ (perform a limited LTEC analysis to determine if the grades should be raised and/or the bridge opening increased or that the repair cost for embankment erosion are less significant. Traffic cost should be included in this evaluation.

3. Is the proposed bridge or culvert structure subject to potential damage due to debris? Yes_____ (Go to 4) No_____ (Go to 5)

4. Perform a limited LTEC analysis to determine if the structure should be modified. (Go to 5)

5. The risk assessment has determined the most economical design for the crossing within the design constraints.

Instructions

The purpose of this document is have a uniform approach to the design process and documentation for bridge design studies. The "bridge" designation includes all culverts having a horizontal dimension normal to the flow direction of 20 feet or greater as well as all bridge structures. Full completion of this procedure will include a risk assessment for the proposed construction.

Each bridge site is unique. Therefore, it is recognized that the procedure outlined below may have to be modified in order to fit the job.

Any hand computations will become a part of the formal report. This does not include scratch work used to develop program data, unless this work is part of the design. All work sheets will be dated and initialed at the top of each page.

1. Copy this file onto your disk file. Fill in the Project description data. Print a copy for a work copy.

2. Obtain a 8 1/2 by 11 inch section of a print of the county map and the USGS topographic map showing the location of the bridge site. Check the Floodway-Flood Plain map files to determine if the site is a floodway. Copy a 8 1/2 by 11 inch portion of the appropriate map showing the site. The maps will follow the project description and comparative data sheet in the report. Maps will be identified as "Figure No. __".

3. Develop comparative data.

a. Delineate drainage area on USGS topographic maps and measure it with a planimeter.

b. Find the Road and Bridge plans for all crossings on the stream for the reach which ranges in drainage area size from half to twice the drainage area of the study site. Record the information on the Comparative Data Sheet.

c. Determine the 10, 25, 50, 100, and 500 year flood discharges for the bridge site. The computations become a part of this document following the maps. It should be noted that the more precise way to refer to the discharges is in terms of probability of occurrence, but the term frequency or "blank" year flood is the more common usage and understanding. Therefore, in this document frequency will be used.

(1) Determine if there are any USGS gages on the stream. If so, analyze the gage data using the Log Pearson Type III procedure. Adjust the results using the procedure described in USGS WRI 82-1, Techniques for Estimating Magnitude and Frequency of Floods in South Carolina

(2) If there is no gage on the stream use the regression equations in WRI 82-1 to compute the discharges.

(3) The Q500 discharge can be computed by the method in "Procedure for Extrapolating a Log-Pearson III Flood Frequency Curve".

(4) If the drainage area consist mainly of Carolina Bays or is very flat and swampy with poorly defined boundaries it may be necessary to perform flood routings to adequately define the discharges. If there are reservoirs or lakes upstream of sufficient size to effect the discharge, a flood routing should also be used. This should be done using the HEC-1 computer program.

(5) If the drainage area has a significant amount of urban development the USGS 7 parameter method should be used.

4. Compute high water profiles for the for discharges determined in the previous step, using the survey data and topographic maps. Use assumed "n" values. The computer program WSPRO should be used for this step.

If the stream is a designated floodway, the computer data used in the floodway study should be obtained and used for this step.

In the data for the computer run, comment cards should be placed at each place where a decision or assumption was made giving an explanation for the decision or assumption. An example would be at the starting slope. A comment card should explain how the slope was set.

Wide flood plains with a sinuous channel or with variations in the flood plane cross-section or roughness which would cause transverse flow to occur, should be analyzed using a finite element two dimensional model.

5. Set preliminary road grades and bridge length based on the computed high-water. Evaluate the hydraulic performance of the proposed bridge using WSPRO. For floodways this step should be done using the floodway computer data base.

a. The first step is to determine the span length necessary for the main channel. This is based on the width of the channel and the potential for debris accumulation on the substructure. Span lengths should be set in multiples of 5.0 feet.

b. Once the main span length is set then the type of superstructure must be determined. If necessary, the Bridge Department may be consulted for this step.

c. The minimum finished grade is then set based on having a minimum of 2.0 feet of freeboard between the design high-water surface and the bottom of the superstructure. For large rivers where the size of the debris may warrant, the freeboard may be as much as 7.0 feet. The Road Design Squad or the Project Engineer should be consulted to see if the finished grade set by the high-water, sight distance, or other road design consideration, controls. This decision should be documented in the narrative part of the study report.

d. Set the location of the ends of the bridge considering the most economical span set up for the bridge. If the road alignment is skewed to the flood plain, the bridge substructure should line up with the direction of flow during the design flood. This will establish the bridge skew angle.

(1) If there are existing roadway fills in place, the toe of fill at the ends of the bridge should not project beyond the existing fill. The one exception is, if there is strong evidence that the existing bridge opening is too long, then the fills may project beyond the existing fills. Considerations in this decision are:

(a) It is extremely difficult to achieve proper compaction of the fill material on short extension of the fill.

(b) Consideration must be given to the view point of the owners of the adjacent property. A reduction in bridge opening might cause them to consider legal action for any flood damages that might occur whether it is due to the reduced bridge opening or not.

(2) A geometric projection of the fill slope should be no closer to the channel than 5.0 feet. For larger rivers this distance should be increased based on engineering judgment. If the stream banks are unstable or it the channel has high velocities, the fills should be moved back to keep them protected from the channel instability. An alternate may be to stabilize the channel banks with riprap.

(3) The velocity of flow through the bridge and the backwater produced by the bridge should be within acceptable limits. If this is not the case, the bridge needs to be lengthened in a trial and error process until acceptable results are obtained.

e. For culverts:

(1) The culvert should be aligned with the flow approaching the culvert so that there is no bend at the upstream end of the culvert. This will reduce the chances for siltation within the culvert.

(2) The width of the culvert should be no wider than the channel.

(3) Analyze using the HY8 or CDS culvert programs.

6. Conduct a field investigation of the proposed bridge site using the forms at the beginning of this document a guide. The purpose of doing the preliminary computations and designs in step 4 and 5 before the field inspection is to have complete familiarity with the available data and to have a good estimate of the proposed bridge length and location prior to the actual field investigation. This will enable the engineer to make better evaluation of the site, be able to better judge the adequacy of the survey data, and see whether the propose bridge will work as planned.

After the on site inspection, complete the site description on page 2. Make any necessary adjustments to computer runs and designs as determined by the field inspection.

7. Perform a risk assessment of the proposed construction using the format which precedes these instructions. When the risk assessment is complete and all design criteria have been met the design is complete.

A listing of the input data and the summary print-outs become part of the final report. Any decisions that are not covered in the risk assessment should be described in a written narrative.

Design Criteria

1. The design discharge for secondary roads is the 25 year discharge. For primary and interstate routes the design discharge is the 50 year discharge.

2. All Flood Plain crossings must meet the Federal Emergency Management Agency (FEMA) regulation requirements. If the stream is a designated floodway, the backwater produced by the bridge plus the rise computed for the floodway cannot exceed 1.0 feet for the 100 year discharge. All other bridge project are limited to a 1.0 foot rise above existing 100 year flood profile. It is the Department's policy to limit the increase to 1.0 feet above the unrestricted or natural 100 year flood profile if practical. If it becomes economically unfeasible or impractical to meet these backwater standards, mitigation measures must be used such as channel modification or the purchase of flood easements.

3. Flow velocities within the bridge opening should be limited so that there will be minimum scour in the overbank portion of the opening.

4. Scour analysis will be performed for all bridges with pile footings in the channel. Scour analysis will be performed for pile type bents in the channel at the recommendation of the Hydraulic Engineer. Note: Spread footings should not be used on stream crossings except on firm rock. The scour analysis should be made for the 2, 5, 10, 25, 50, 100, and 500 year discharges. The footings should be placed below the maximum scour level. For pile bents bearing should be achieved below the depth of maximum scour.

5. If the road is the only evacuation route from an area subject to tidal surges from a hurricane, the grade should be set 1.0 feet above the 100 year high-water elevation including wave action.

6. If the bridge is over one of the major lakes or reservoirs where there is considerable boat traffic the grade should be set so that there is 8.0 feet clearance above the maximum operating pool.

7. To protect the pavement, road subgrades should be 1.0 feet above the design high water level.

8. Riprap will be placed on all end fills to 2.0 feet above the design high-water level except where the velocities are well below the threshold for scour. It should be noted that some of the highest velocities experienced in bridges occurs around the end fills. Past experience in South Carolina has shown that severe erosion occurs during high floods at end fills, frequently undermining the pavement at the end of the bridge and creating a hazardous situation.

9. In wide flood plains where the approach flow outside the bridge is significant, spur dikes will be considered.

1.6.4 Risk Assessment

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION FLOODPLAIN AND RISK ASSESSMENT

Regulation 23 CFR 650 shall apply to all encroachment and to all actions which affect base floodplains, except for repairs made with emergency funds. (See HEC-17) Note: These studies shall be summarized in the environmental review document prepared pursuant to 23 CFR 771.

Project Description:

Replacement of deficient and functional obsolete bridge over Four Hole Swamp on US 301 SB.

A. Narrative Describing Purpose and Need for Project:

a. Relevant Project History:

Original bridge was likely built in the 1920/1930 and widen in 1949.

b. Project Location (attach Location and Project Map):

On Four Hole Swamp in Orangeburg County. (See Design Report)

c. Major Issues and Concerns:

Bridge is effected by downstream bridge on US 301 NB.

B. Are there any floodplain(s) regulated by FEMA located in the project area?

Yes ☐ **No** ☐

C. Will fill be placed within a 100-year floodplain?

Yes ☐ **No** ☐

Page 1 of 5

D. Will the existing profile grade be raised within the floodplain?

Yes ☐ **No** ☐

E. If applicable, please discuss the practicability of alternatives to any longitudinal encroachments.

F. Please include a discussion of the following: commensurate with the significance of the risk or environmental impact for all alternatives containing encroachments and those actions which would support base floodplain development:

i. What are the flood-related risks associated with implementation of the action?

Minimal

ii. What are the impacts on the natural and beneficial floodplain values?

Minimal

iii. Will the bridge entice people to build in floodplains?

Very Doubtful

iv. What measures were used to minimize floodplain impacts associated with the action?

The bridge was lengthen with long spans.

v. Were any measures used to restore and preserve the natural and beneficial floodplain values impacted by the action?

Only areas within the ROW will be effected.

G. Please discuss the practicability of alternatives to any significant encroachments or to support of incompatible floodplain development.

This is a replacement project for the existing bridge. There is not a practical alterative to the replacement.

H. List local, state, and federal water resources and floodplain management agencies consulted to determine if the proposed highway action is consistent with existing watershed and floodplain management programs. Describe any information obtained on development and proposed actions in the affected area. Please include agency documentation.

SCDHEC, SCDNR, and USACOE; Contact the Environmental Section at SCDOT for Documentation.

I. BACKWATER DAMAGE FORM

Major flood damage applies to shopping centers, hospitals, industrial facilities, residential areas, schools, farming operations, etc.

1. *Does the maximum flood cause major damage to upstream property?*

Yes - (Go to 2.) No - (Go to 3.)

2. *Would this damage occur if the road were not there?*

Yes - (Go to 3.)

No - (Perform a limited Least Total Expected Cost (LTEC) (HEC-17) analysis to see if the bridge opening should be increased and/or grades raised to minimize the damage potential. Go to II.)

3. *Was this a bridge replacement? If so, was the bridge opening increased enough to increase the discharge passed through the bridge?*

Yes - (Go to 4.) No - (Go to II.)

4. *Does the increased flow cause major damage downstream?*

Yes - (Perform a limited LTEC analysis to determine if the bridge opening should be reduced, the floodway redefined, and flood easements purchased upstream or if flood easements should be purchased downstream. Go to II.)

No - (Go to II)

II. TRAFFIC RELATED LOSSES

1. *Is the overtopping flood greater than the 100-year flood?*

Yes - (Go to III.) No - (Go to 2.)

2. *Does the ADT exceed 50 vehicles per day?*

Yes - (Go to 3.) No - (Go to III.)

3. *Does the duration of road closure in days, multiplied by the difference in length, in miles between the normal route and the detour, exceed 20?*

Yes - (Go to 4.) No - (Go to III.)

4. *Does the annual risk cost for traffic related costs exceed 10% of the estimated annual capital costs?*

Yes - (Perform a limited LTEC analysis to compare the cost to raise the grades and if necessary increase the bridge length with the traffic related costs. Go to III.)

No - (Go to III.)

III. ROADWAY AND/OR STRUCTURE REPAIR COST

1. *Is the overtopping flood less than the 100-year flood?*

Yes - (Go to 2) No - (Go to 3)

2. *Is the overtopping flood less than 0.5 foot over the low point on the roadway and duration no more than 1.0 hour?*

Yes - (Go to 3)

No - (perform a limited LTEC analysis to determine if the grades should be raised and/or the bridge opening increased or that the repair cost for embankment erosion are less significant. Traffic cost should be included in this evaluation.)

3. *Is the proposed bridge or culvert structure subject to potential damage due to debris?*

Yes - (Go to 4) No - (Go to 5)

4. *Perform a limited LTEC analysis to determine if the structure should be modified. (Go to 5.)*

5. *The risk assessment has determined the most economical design for the crossing within the design constraints.*

Revised 3/16/09

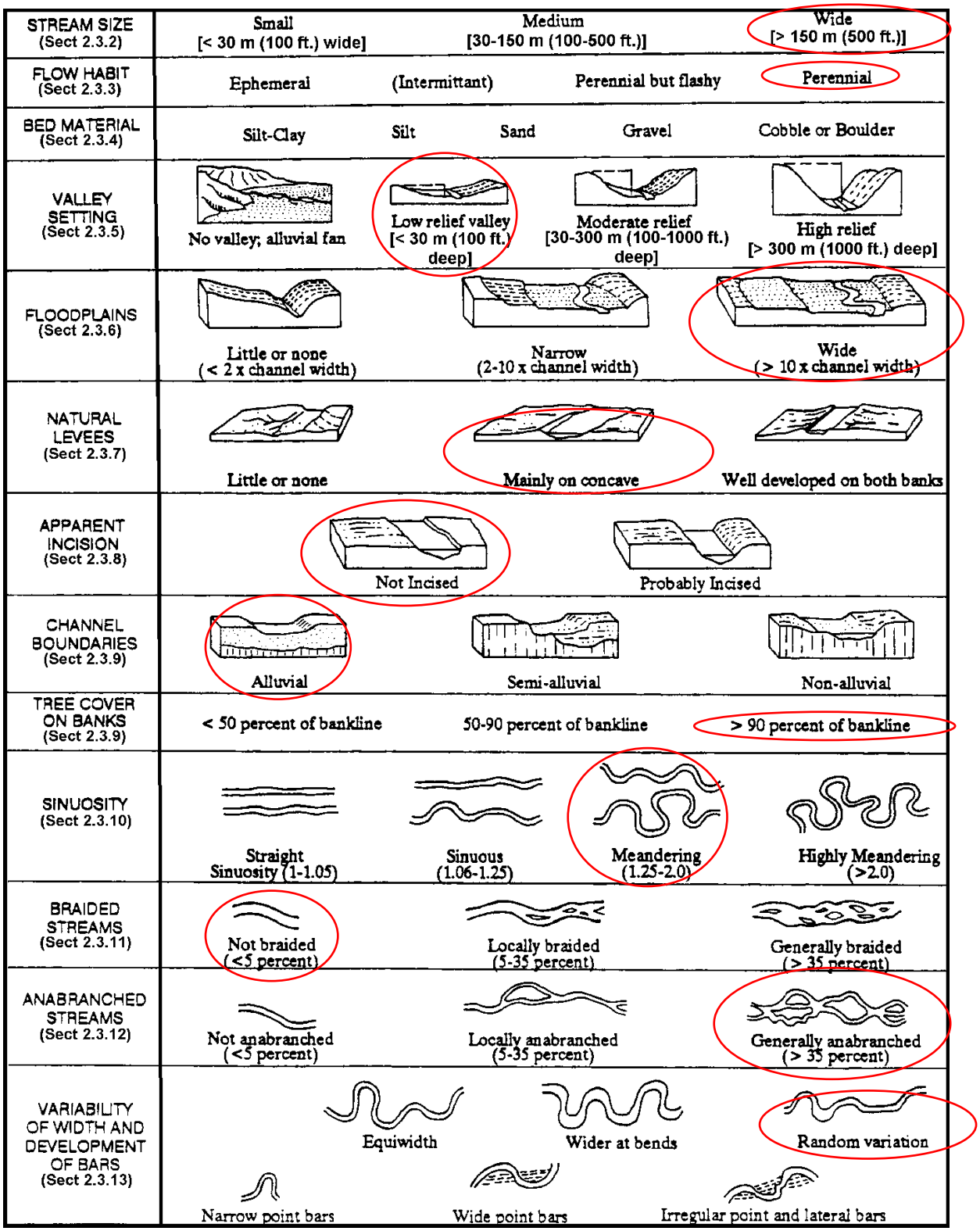


Figure 2.6. Geomorphic factors that affect stream stability (adapted from Brice and Blodgett).[10]

BRIDGE SCOPE AND RISK ASSESSMENT FORM

COUNTY: Orangeburg DATE: 01/16/2014

ROAD #: US 301 STREAM CROSSING: Four Hole Swamp

Purpose & Need for the Project:

Replacement of structurally deficient and functionally obsolete bridge over Four Hole Swamp in on US 301 in Orangeburg County, South Carolina.

I. FEMA Acknowledgement

Is this project located in a regulated FEMA Floodway? ☐ Yes ☑ No

Panel Number: 45075C0410C Effective Date: 01/16/2014 (See Attached)

II. FEMA Floodmap Investigation

FEMA Flood Profile Sheet Number _____ illustrates the existing 100 year flood:

☐ Passes under the existing low chord elevation.
☐ Is in contact with the existing low chord elevation.
☐ Overtops the existing bridge finished grade elevation.

III. No Rise/CLOMR Preliminary Determination

☑ Preliminary assessment indicates this project may be constructed to meet the "No-Rise" requirements. A detailed hydraulic analysis will be performed to verify this assessment.

Justification: The bridge is in a Zone AE with BFEs and the new bridge is designed to meet "No-Rise" Requirements.

☐ Preliminary assessmnet indicates this project may require a CLOMR/LOMR. Impacts will be determined by a detailed hydraulic analysis.

Justification:

BRIDGE SCOPE AND RISK ASSESSMENT FORM

IV. Preliminary Bridge Assessment

A. Locate Existing Plans

a. Bridge Plans ☑ Yes ☐ No File No. 38.340 Sheet No. 6-10 (See Attached)

b. Road Plans ☑ Yes ☐ No File No. 38.618 Sheet No. 38-39 (See Attached)

B. Historical Highwater Data

a. USGS Gage ☐ Yes ☑ No Gage No. _____ Results: _____

b. SCDOT/USGS Documented Highwater Elevations

☑ Yes ☐ No Results: 1928 124.08 (123.09 NAVD 88)

c. Existing Plans ☑ Yes ☐ No See Above

V. Field Review

A. Existing Bridge

Length: 245.8 ft. Width: 31.3 ft. Max. span Length: 22.33 ft.

Alignment: ☑ Tangent ☐ Curved

Bridge Skewed: ☐ Yes ☑ No Angle: _____

End Abutment Type: Vertical Concrete

Riprap on End Fills: ☑ Yes ☐ No Condition: Okay(On RT U/S)

Superstructure Type: Flat Slab

Substructure Type: Piles

Utilities Present: ☑ Yes ☐ No

Describe: Buried Fiber Optic on U/S; Water, Gas, Telecommunications on D/S of BR

Debris Accumulation on Bridge: Percent Blocked Horizontally: 0 %

Percent Blocked Vertically: 0 %

Hydraulic Problems: ☑ Yes ☐ No

Describe: Controlled by D/S BR

BRIDGE SCOPE AND RISK ASSESSMENT FORM

V. Field Review (cont.)

B. Hydraulic Features

a. Scour Present: ☑ Yes ☐ No Location: Low Flow Channels

b. Distance from F.G. to Normal Water Elevation: 9.5 ft.
c. Distance from Low Steel to Normal Water Elev.: 7.5 ft.
d. Distance from F.G. to High Water Elevation: 5.0 ft.
e. Distance from Low Steel to High Water Elev.: 2.0 ft.

f. Channel Banks Stable: ☑ Yes ☐ No
Describe:

g. Soil Type: Mouzon Fine Sandy Loam

h. Exposed Rock: ☐ Yes ☑ No Location:

i. Give Description and Location of any structures or other property that could be damaged due to additional backwater.

None

C. Existing Roadway Geometry

a. Can the existing roadway be closed for an On-Alignment Bridge Replacement
☑ Yes ☐ No
Describe:

Bridge on 4 Lane Section of 301 and D/S BR can be used during construction for traffic in both directions.

If "yes", does the existing vertical and horizontal curves meet the proposed design speed criteria?

Yes

If "No", will the proposed bridge be:
☐ Staged Constructed
☐ Replaced on New Alignment

BRIDGE SCOPE AND RISK ASSESSMENT FORM

VI. Field Review (cont.)

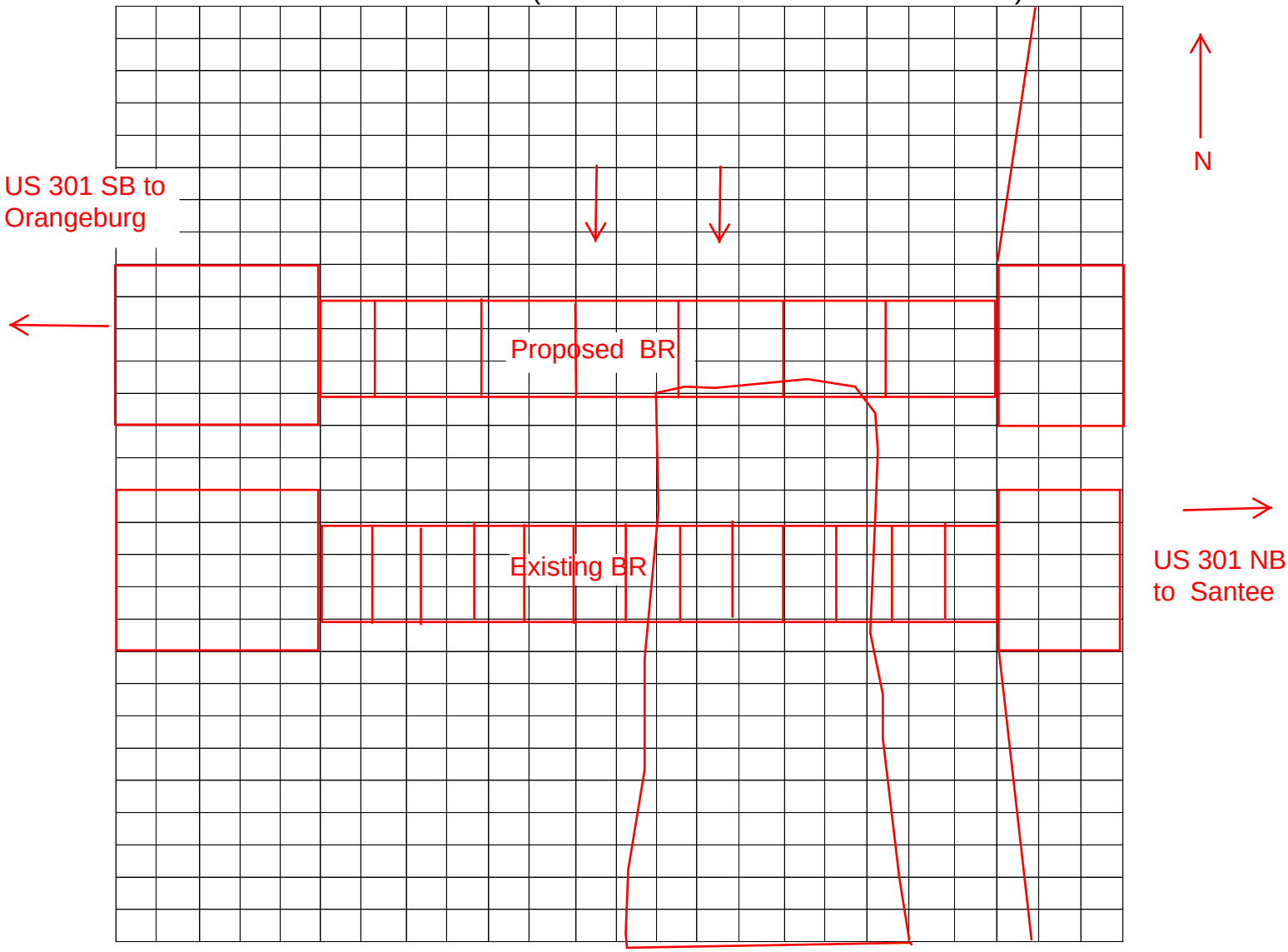
A. Proposed Bridge Recommendation:

Length: 294 ft. Width: 44 ft. Elevation: 122.30 ft.

Span Arangement: 44'-44'-44'-44'-44'-44'-30'

Notes: Location of piers are critical for Hydraulic Efficiency. New Bridge length and spans are limited by downstream US 301 NB Bridge.

BRIDGE SITE DIAGRAM: (Show North Arrow and Direction of Flow)



Performed By: T. P. Knight

BRIDGE SCOPING TRIP

9
10-2
6

DATE: 12/14/2010

COUNTY: Orangeburg

ROAD #: US-301

STREAM CROSSING: Four Hole Swamp

FLOODWAY: Zone A

OLD BRIDGE PLANS: No

NW TO F.G. 9'-6"

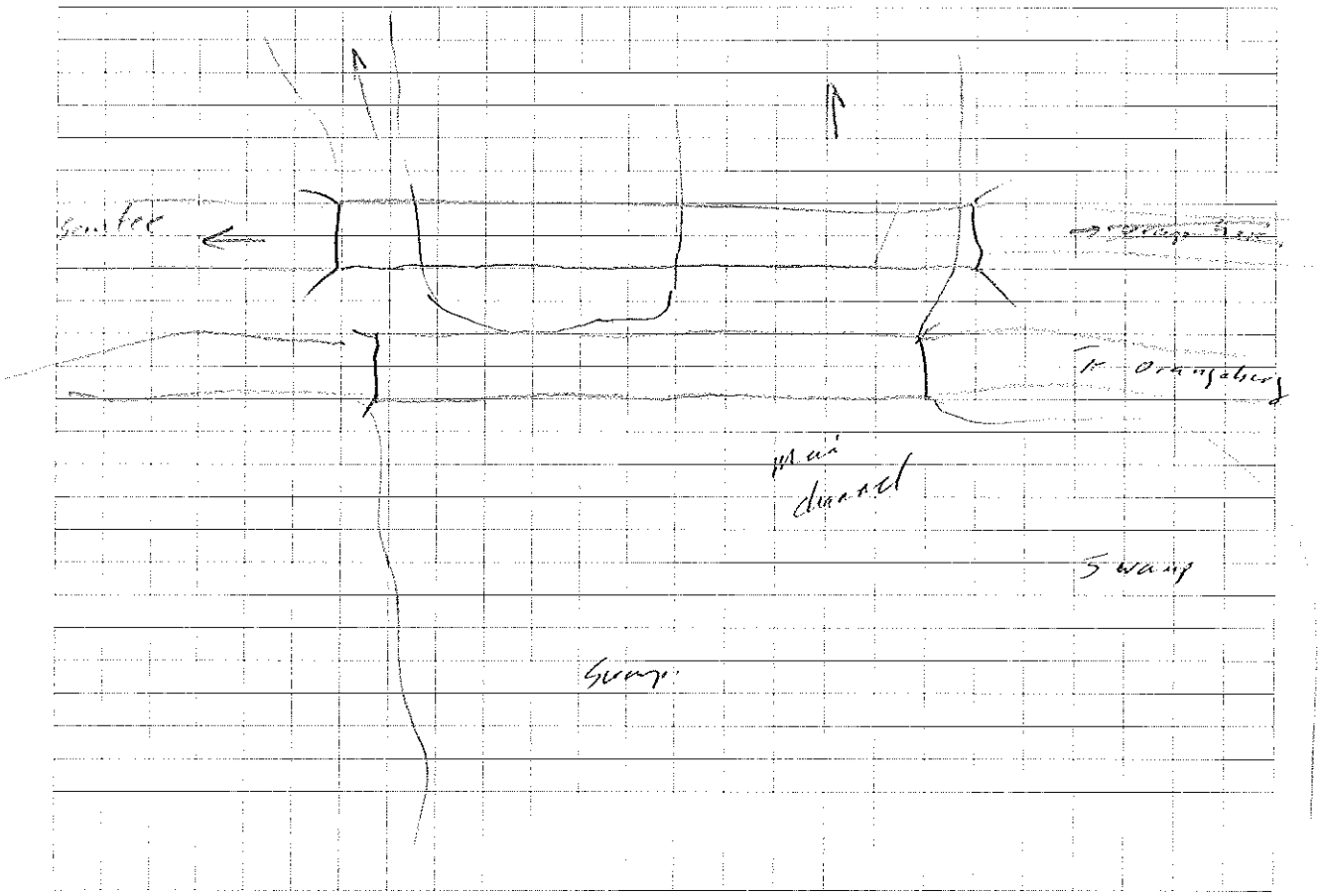
NW TO L.S. 7'-6" ?

WATER DEPTH 3'

HW TO LS 2'

HW TO FG 5'

DIAGRAM:



RECOMMENDATION: Try to match D/S Bridge

SPAN CONFIG.

ELEVATION:

South Carolina
Department of Transportation

MEMORANDUM

TO: Jo Ann Woodrum, District Seven Engineering Administrator
Jim Porth, District Seven Construction Engineer
Ems Baskin, District Seven Traffic Engineer
Brent Dillon, Traffic Projects & Design Engineer
Chris Lacy, Midlands Design Manager
Ansel Stuck, Midlands Road Design Engineer
Terry Koon, Midlands Bridge Design Engineer
Randall Mungo, Midlands Hydrology Engineer
Heather Robbins, NEPA Coordinator
Ed Frierson, NEPA Program Manager
Sean Connolly, Permits Manager

FROM: Bradley S. Reynolds, Midlands Assistant Program Manager

DATE: November 29, 2010

RE: Scoping Meeting
Intersection Improvement of US 601 & S-1099 (Zan St.) & S-25 (Boulevard St.) & US 301 Bridge Replacement over Four Holes Swamp
Orangeburg County

A scoping meeting has been scheduled for **Tuesday, December 14, 2010.** The meeting will begin on site at the Intersection of US 601 & S-1099 (Zan St.) & S-25 (Boulevard St.) in the City of Orangeburg at 9:30am. After that we will be scoping the US 301 Bridge Replacement over Four Holes Swamp. If you are unable to attend please have a representative from your section assigned to attend the meeting. Transportation will be provided from headquarters if you would like to ride with us.

Attached are site maps of the locations for everyone's information. Please let me know if you have questions or would like to discuss further. You may reach me at 803-737-3081.

BSR:pcm
File: PC/BSR

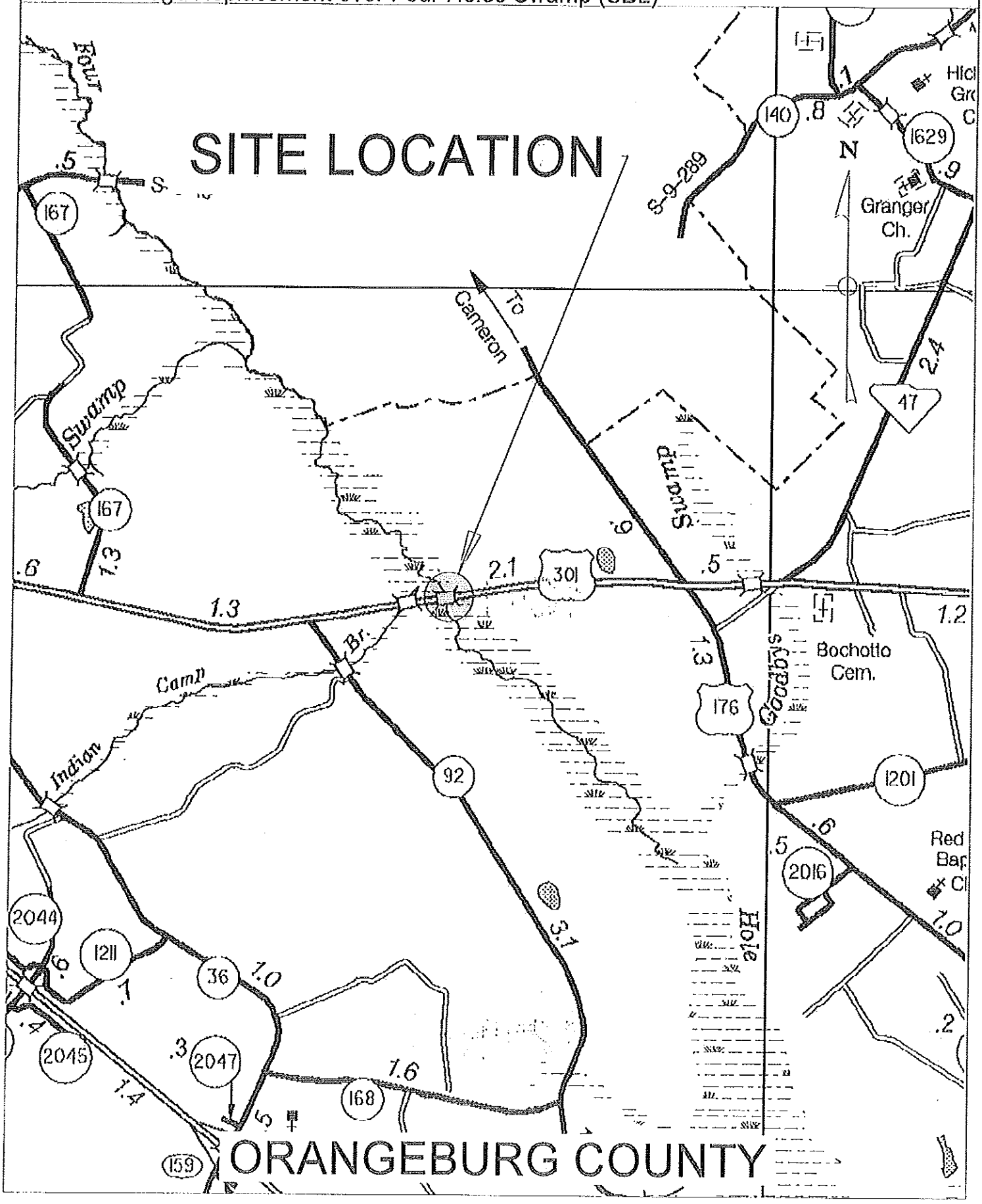
Post Office Box 191
Columbia, South Carolina 29202-0191

Phone: (803) 737-2314
TTY: (803) 737-3870

AN EQUAL OPPORTUNITY
AFFIRMATIVE ACTION EMPLOYER

BRIDGE PIN: 40308

US 301 Bridge Replacement over Four Holes Swamp (SBL)



South Carolina
Department of Transportation

MEMORANDUM

TO: Jo Ann Woodrum, District Seven Engineering Administrator
Jim Porth, District Seven Construction Engineer
Ems Baskin, District Seven Traffic Engineer
Brent Dillon, Traffic Projects & Design Engineer
Chris Lacy, Midlands Design Manager
Ansel Stuck, Midlands Road Design Engineer
Terry Koon, Midlands Bridge Design Engineer
Randall Mungo, Midlands Hydrology Engineer
Heather Robbins, NEPA Coordinator
Ed Frierson, NEPA Program Manager
Sean Connolly, Permits Manager

FROM: Bradley S. Reynolds, Midlands Assistant Program Manager

DATE: November 29, 2010

RE: Scoping Meeting
Intersection Improvement of US 601 & S-1099 (Zan St.) & S-25 (Boulevard St.) & US 301 Bridge Replacement over Four Holes Swamp
Orangeburg County

A scoping meeting has been scheduled for **Tuesday, December 14, 2010.** The meeting will begin on site at the Intersection of US 601 & S-1099 (Zan St.) & S-25 (Boulevard St.) in the City of Orangeburg at 9:30am. After that we will be scoping the US 301 Bridge Replacement over Four Holes Swamp. If you are unable to attend please have a representative from your section assigned to attend the meeting. Transportation will be provided from headquarters if you would like to ride with us.

Attached are site maps of the locations for everyone's information. Please let me know if you have questions or would like to discuss further. You may reach me at 803-737-3081.

BSR:pcm
File: PC/BSR

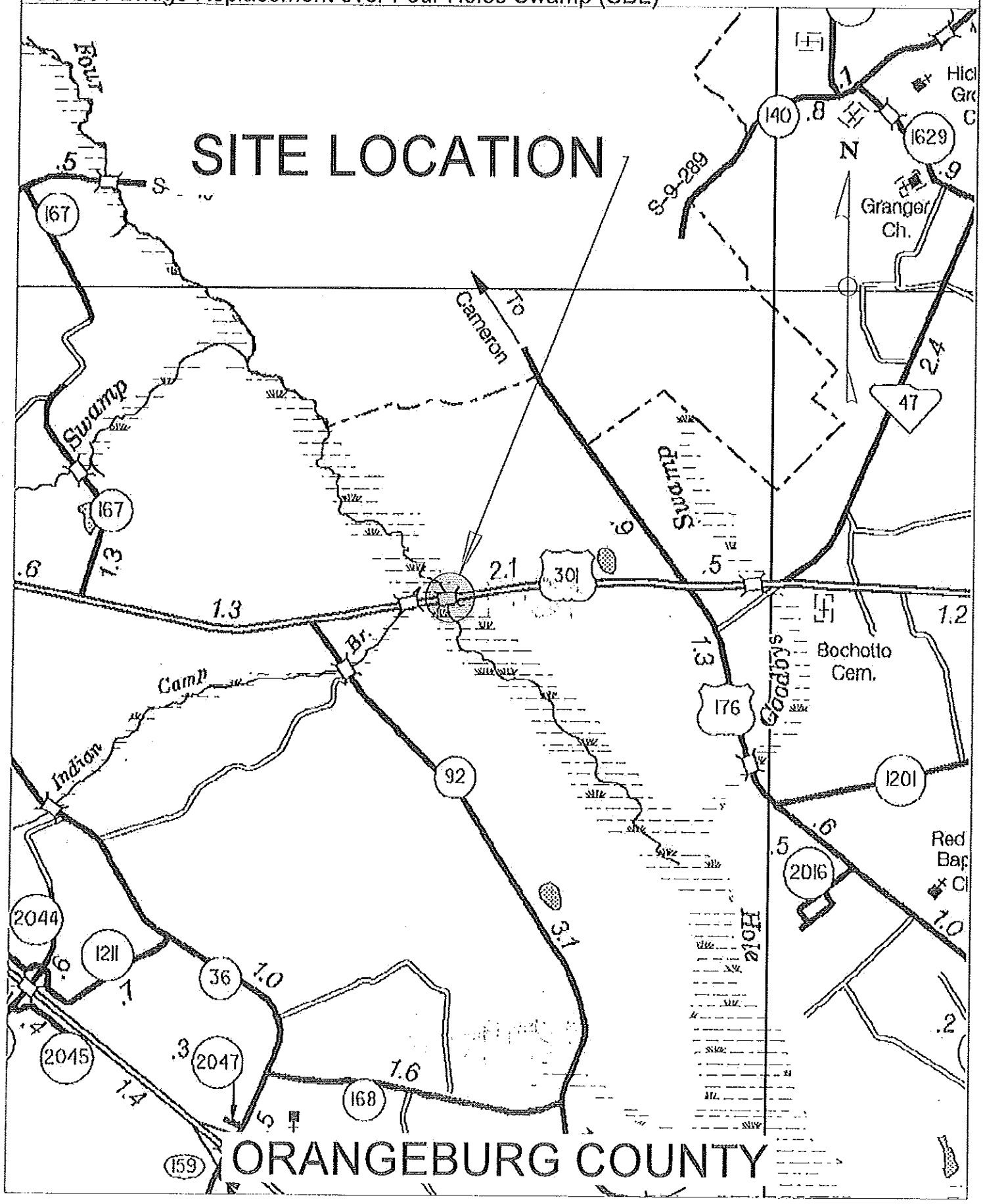
Post Office Box 191
Columbia, South Carolina 29202-0191

Phone: (803) 737-2314
TTY: (803) 737-3870

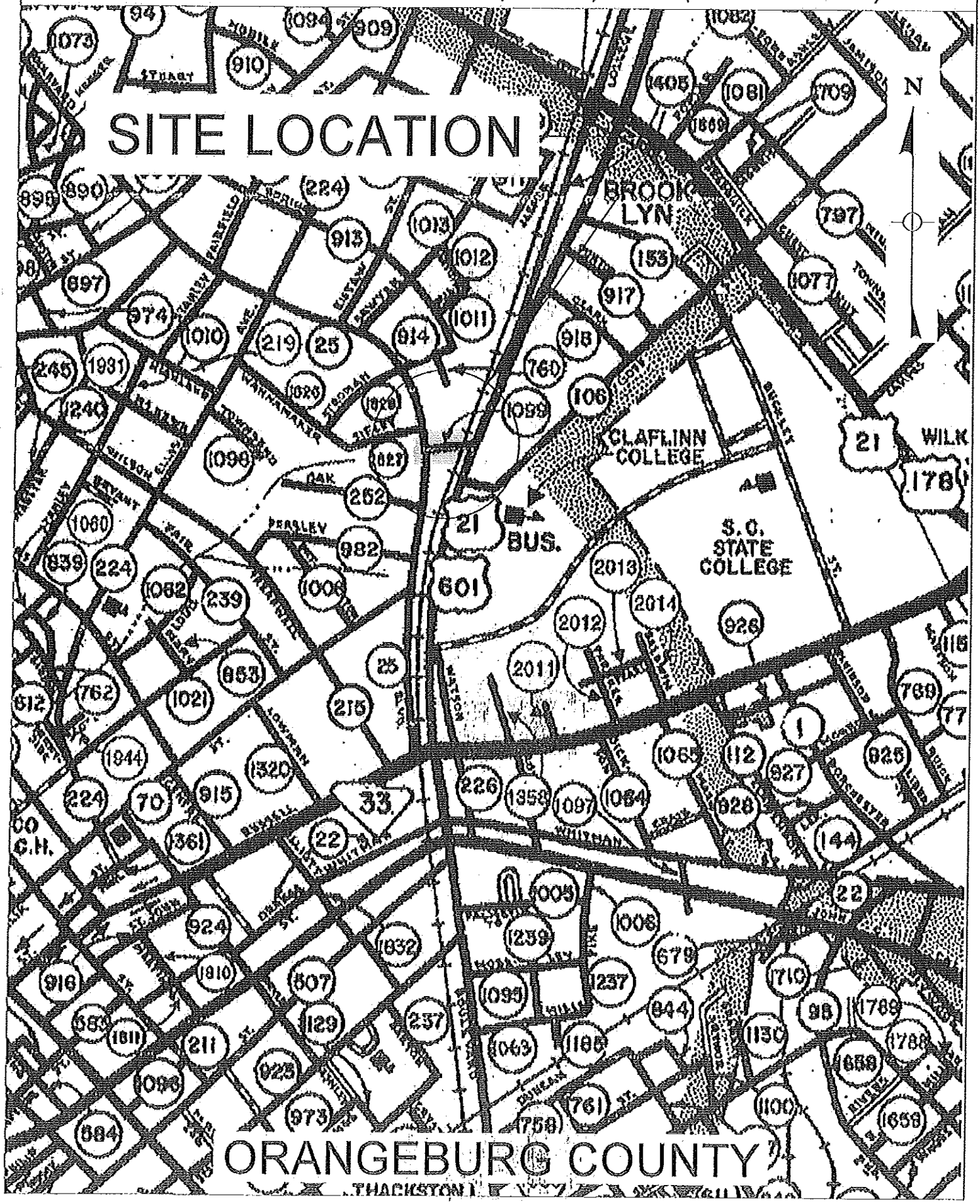
AN EQUAL OPPORTUNITY
AFFIRMATIVE ACTION EMPLOYER

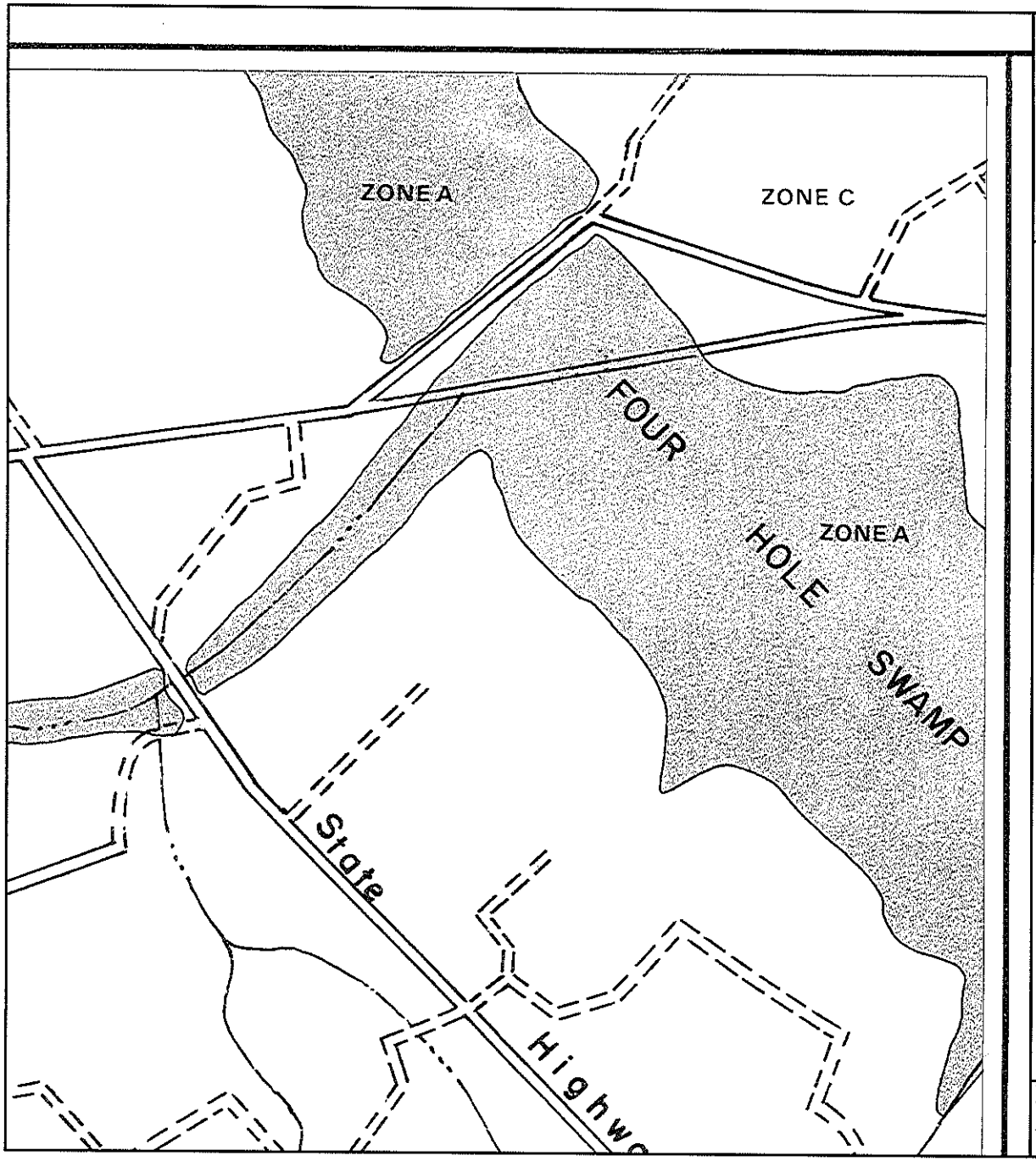
BRIDGE PIN: 40308

US 301 Bridge Replacement over Four Holes Swamp (SBL)



INTERSECTION IMPROV. US 601 & S-1099 (ZAN ST.) & S-25 (BOULEVARD ST.)





N

APPROXIMATE SCALE

1000 0 1000 FEET

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

ORANGEBURG COUNTY, SOUTH CAROLINA

(UNINCORPORATED AREAS)

PANEL 235 OF 385

(SEE MAP INDEX FOR PANELS NOT PRINTED)

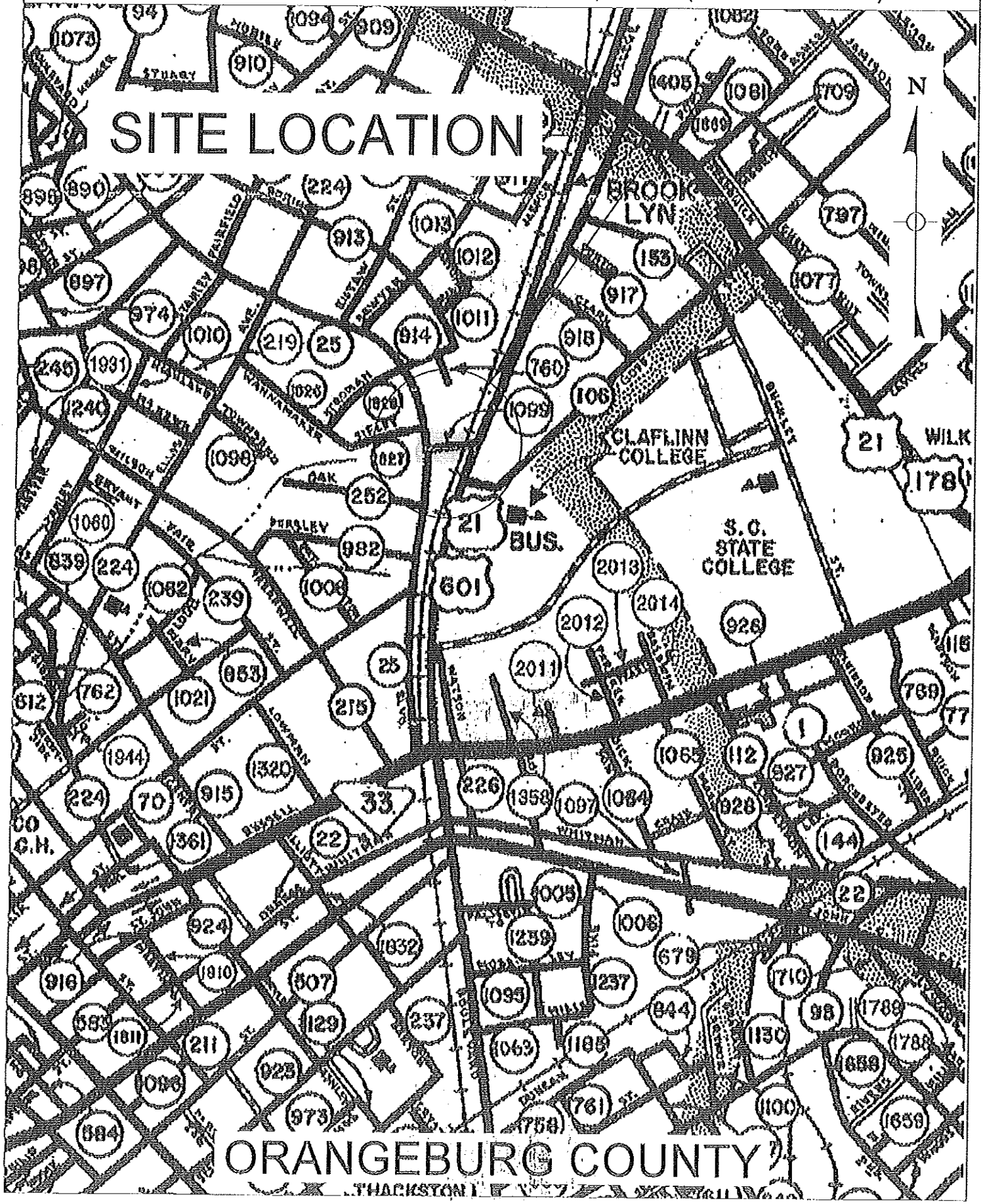
COMMUNITY-PANEL NUMBER
450160 0235 B

EFFECTIVE DATE:
DECEMBER 16, 1980

federal emergency management agency
federal insurance administration

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

INTERSECTION IMPROV. US 601 & S-1099 (ZAN ST.) & S-25 (BOULEVARD ST.)



Mungo, Randall

From: Lacy, Christopher R.
Sent: Monday, November 22, 2010 10:50 AM
To: Mungo, Randall; Stuck, Ansel
Cc: Barker, Julie P.; Sears, Roger D.
Subject: Tentative: US 601 piping

Randall and Ansel,
It looks like this will be a small drainage project that may need new right of way and some grading work.

Please plan to have a member of your staff attend. Thanks.

Chris – I think this is the district's call but it seems like there are some unknowns in regards to ROW. We checked with RME David Brandyburg and he said DOT did not own any ROW in this area. I would imagine to put these pipes in SCDOT will need some permissions if not a permanent easement to cover the pipes which we may need surveys for. Also, there is a road S-1869 that runs about 450' parallel to US 601. Seems to me if we pipe the first 200' on one property we may need to widen or lengthen the ditch for the last 200'. This would also probably require permissions from the property owners. It's hard to know by looking only at the aerials.

Julie

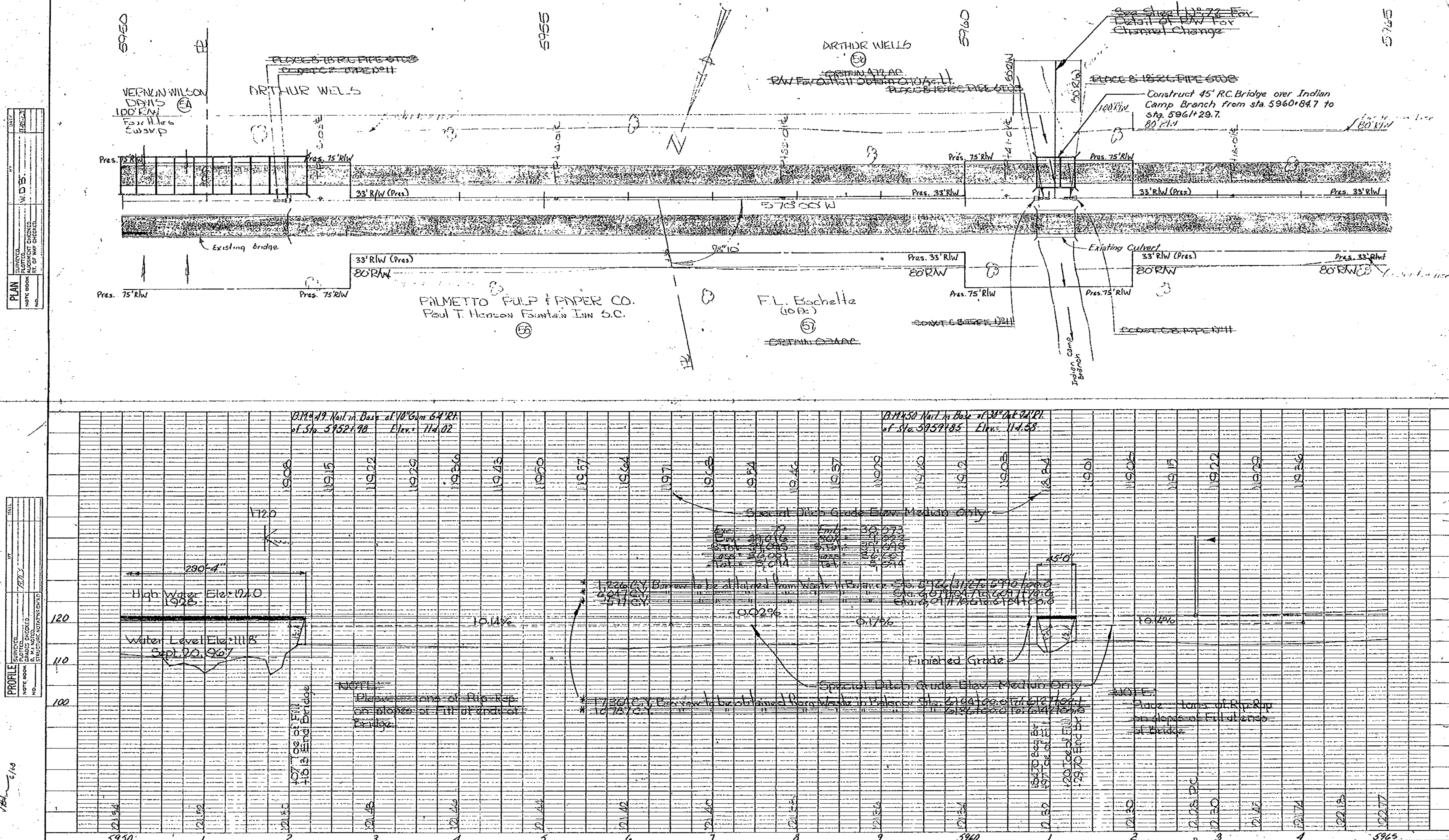
-----Original Appointment-----
From: Lacy, Christopher R.
Sent: Monday, November 22, 2010 10:01 AM
To: Sears, Roger D.; Barker, Julie P.; Porth, Jim A
Subject: Tentative: US 601 piping
When: Tuesday, December 14, 2010 10:30 AM-11:30 AM (GMT-05:00) Eastern Time (US & Canada).
Where: Orangeburg, SC

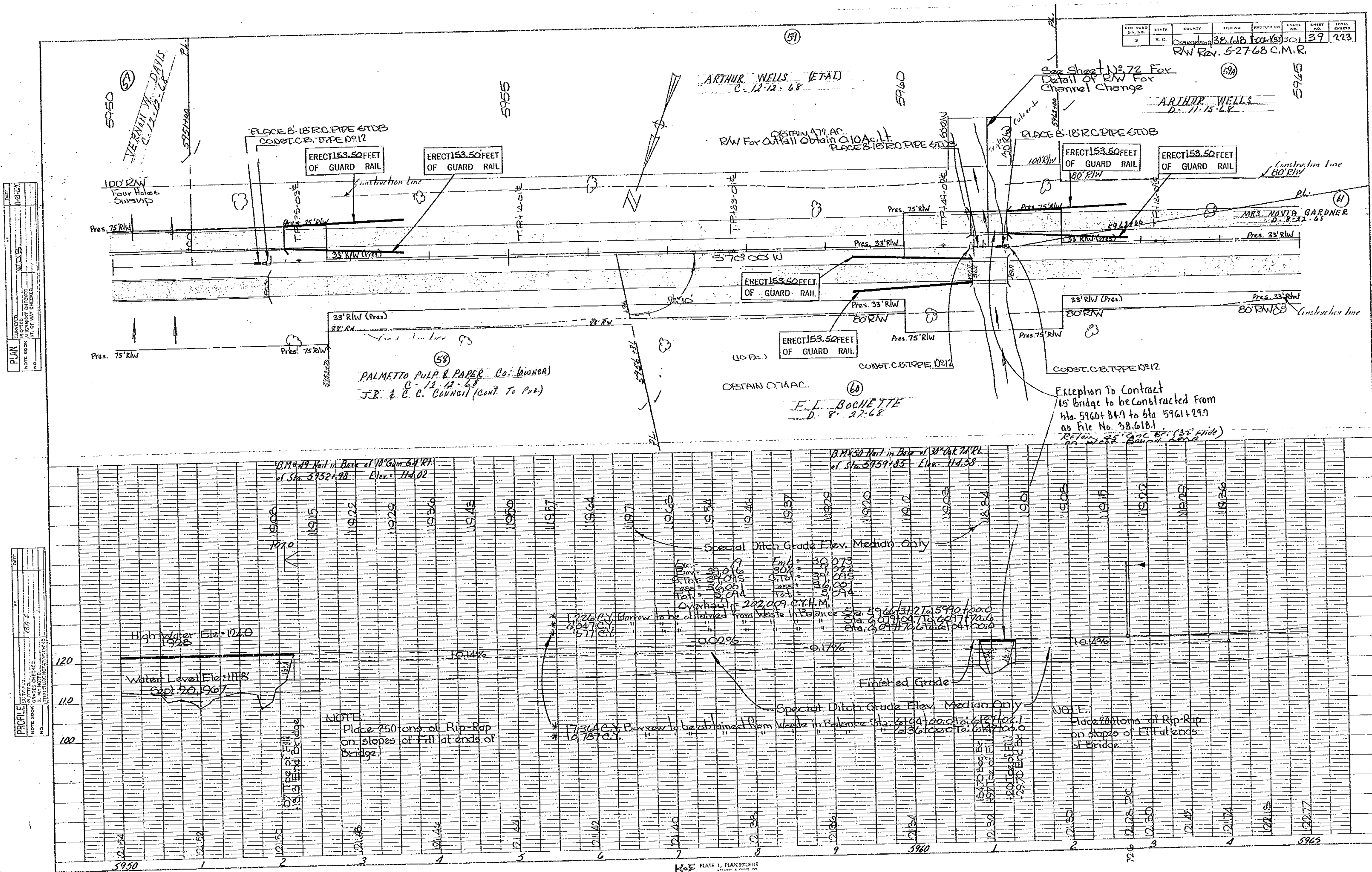
Is a drainage study needed and do plans need to be developed by HQ or will the district complete a set of "strip map" type plans?

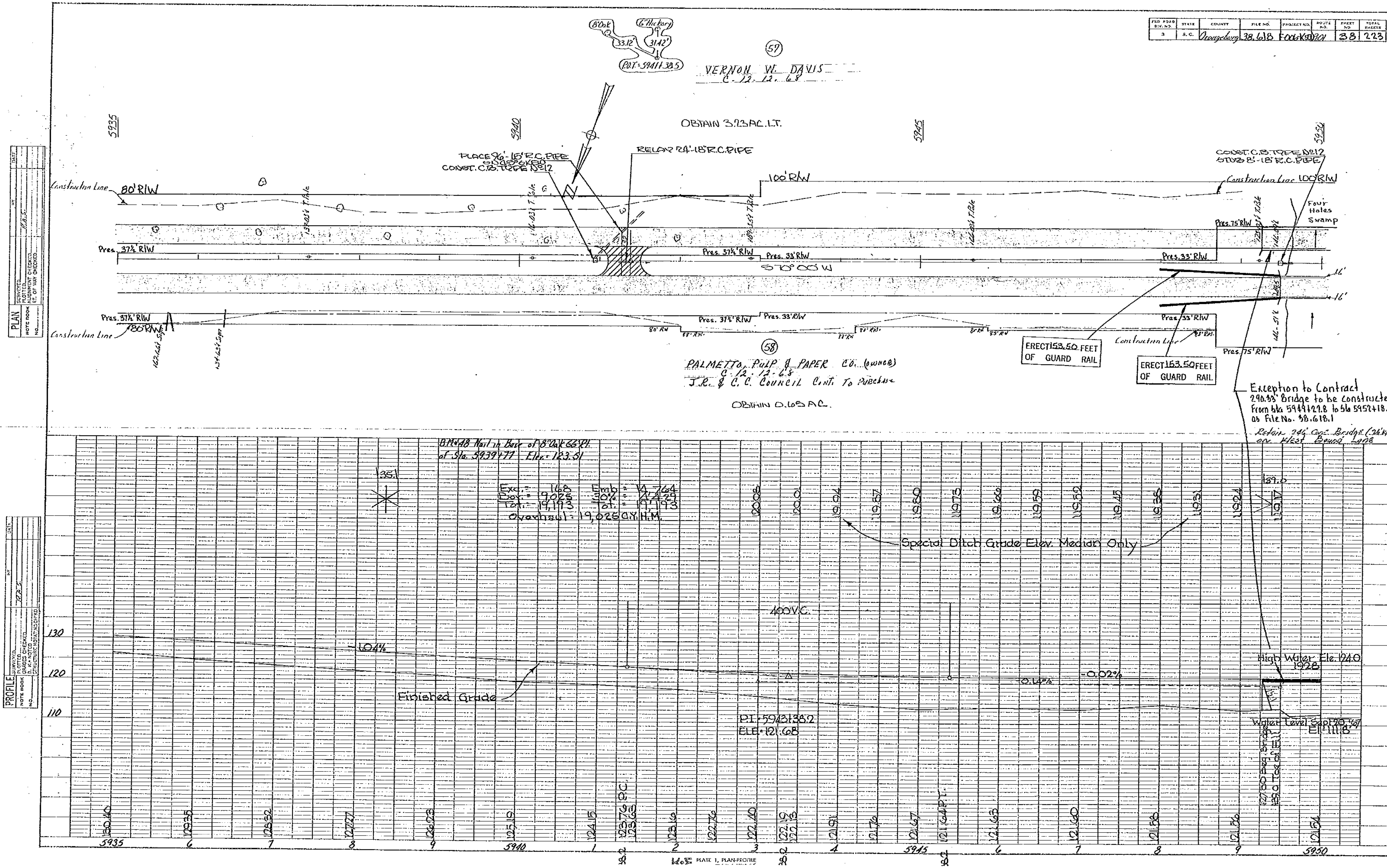
Chris

FED. ROAD DIV. NO.	STATE	COUNTY	FILE NO.	PROJECT NO.	ROUTE NO.	SHEET NO.	TOTAL SHEETS
3	S.C.	Orangeburg	38.632		301	10	25

R/W Rev. 5-27-68 C.M.R.

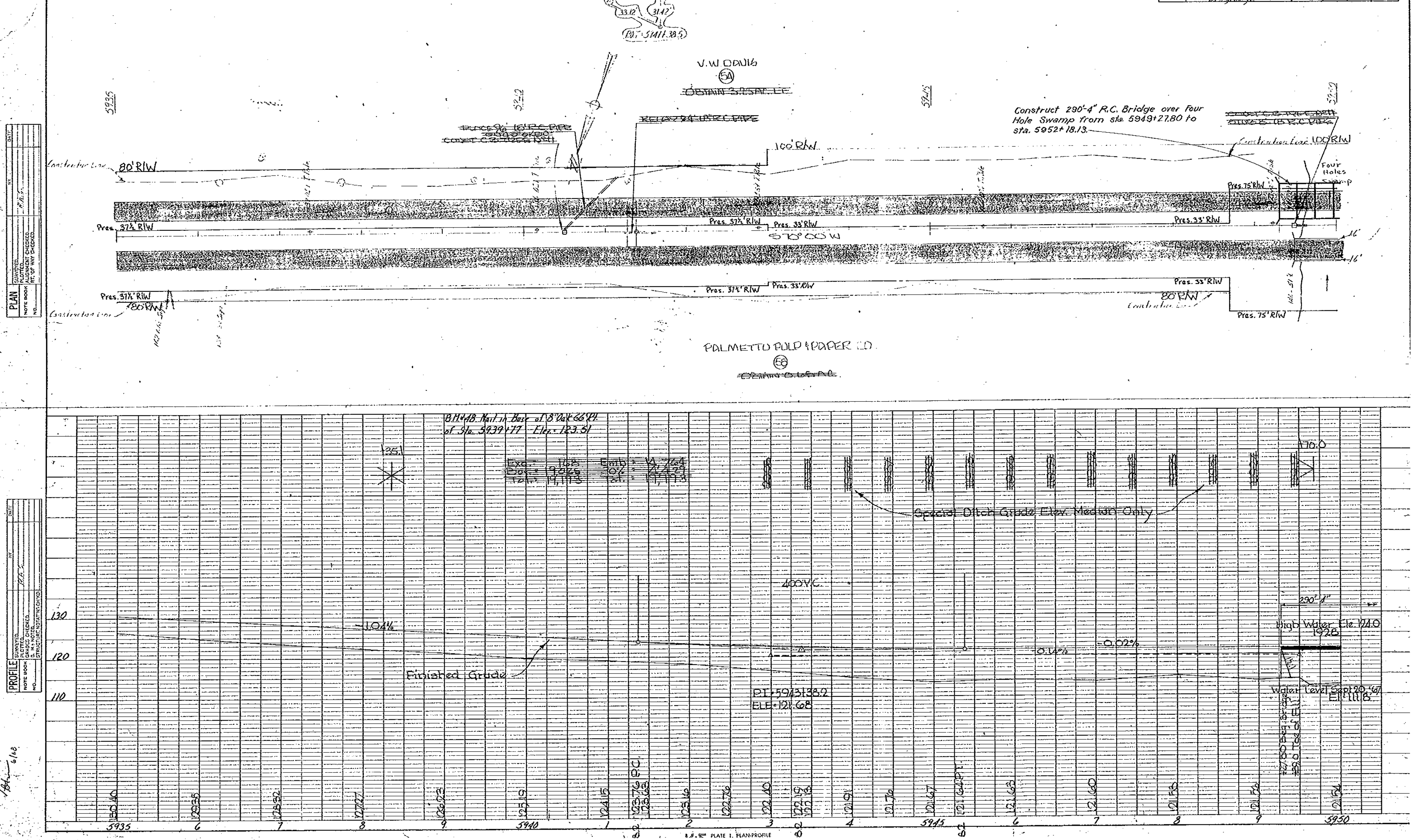



Orangeburg 38.618 301 39 223
R/W Rev. 5-27-68 C.M.R.
ARTHUR WELLS (ETAL) C. 12-12-68
VERNON W. DAVIS C. 12-12-68
See Sheet No. 72 For Detail Of R/W For Channel Change
ARTHUR WELLS D. 11-15-68
PLACE 8-18" R.C. PIPE STUB
CONST. C.B. TYPE No. 12
ERECT 153.50 FEET OF GUARD RAIL
100' R/W
Four Holes Swamp
Construction line
Pres. 75' R/W
33' R/W (Pres.)
R/W For Outfall Obtain 0.10 Ac. Lt.
S 70° 00' W
80' R/W
MRS. NOVIA GARDNER D. 8-22-68
PALMETTO PULP & PAPER Co. (Owner) C. 12-12-68
J.R. & C.C. Council (Cont. To Pur.)
OBTAIN 0.74 AC.
F.L. BOCHETTE D. 8-27-68
Exception To Contract
45' Bridge to be Constructed From Sta. 5960+84.7 to Sta. 5961+29.7 as File No. 38.618.1
B.M. 49 Nail in Base of 10" Gum 64' Rt. of Sta. 5952+98 Elev. 114.02
B.M. 50 Nail in Base of 30" Oak 72' Rt. of Sta. 5959+85 Elev. 114.58
Special Ditch Grade Elev. Median Only
Overhaul = 202,009 C.Y.H.M.
Borrow to be obtained from Waste in Balance Sta. 5966+31.7 To 5990+00.0
High Water Ele. 124.0 1928
Water Level Ele. 111.8 Sept. 20, 1967
+0.14%
-0.02%
-0.17%
+0.40%
Finished Grade
NOTE: Place 250 tons of Rip-Rap on slopes of Fill at ends of Bridge.
NOTE: Place 200 tons of Rip-Rap on slopes of Fill at ends of Bridge.
5950
5955
5960
5965
PLAN
PROFILE

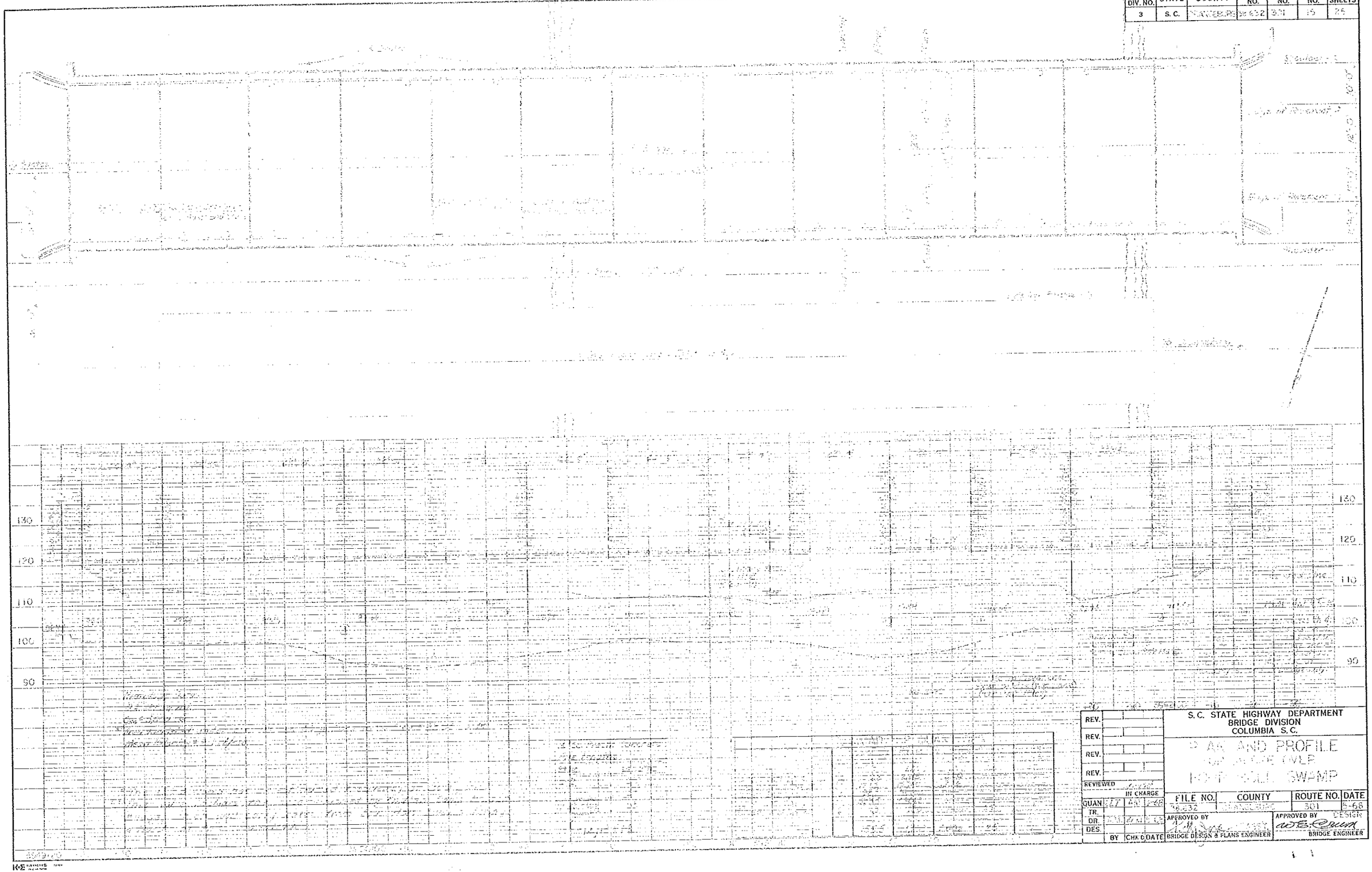


Orangeburg 38.618 F006(K5)301 38 223
VERNON W. DAVIS
C. 12. 12. 68
OBTAIN 3.23 AC. LT.
PLACE 96'-18" R.C. PIPE
CONST. C.B. TYPE No 12
RELAY 24'-18" R.C. PIPE
CONST. C.B. TYPE No 12
STUB 8'-18" R.C. PIPE
Construction Line 80' R/W
100' R/W
Construction Line 100' R/W
Four Holes Swamp
Pres. 37½' R/W
Pres. 33' R/W
Pres. 75' R/W
S 70°00' W
ERECT 153.50 FEET OF GUARD RAIL
ERECT 153.50 FEET OF GUARD RAIL
PALMETTO PULP & PAPER CO. (OWNER)
C. 12. 12. 68
J.R. & C.C. COUNCIL Cont. To Purchase
OBTAIN 0.65 AC.
Exception to Contract
290.33' Bridge to be constructed From Sta. 5949+27.8 to Sta 5952+18.13 as File No. 38.618.1
BM #48 Nail in Base of 8" Oak 66' Rt. of Sta. 5939+77 Elev. 123.51
Exc. = 168 Emb. = 14,764
Bor. = 9,025 30% = 4,429
Tot. = 19,193 Tot. = 19,193
Overhaul: 19,025 C.Y. H.M.
Special Ditch Grade Elev. Median Only
400' V.C.
-1.04%
-0.14%
-0.02%
High Water Ele. 124.0 1928
Finished Grade
P.I. 5943+38.2
ELE. 121.68
Water Level Sept. 20 '67 El. 111.8
130
120
110
5935 6 7 8 9 5940 1 2 3 4 5945 6 7 8 9 5950
PLAN
PROFILE
PLATE 1, PLAN-PROFILE

FED ROAD DIV. NO.	STATE	COUNTY	FILE NO.	PROJECT NO	ROUTE NO.	SHEET NO.	TOTAL SHEETS
3	S.C.	Orangeburg	38.632		301	9	25



FED. RD. DIV. NO.	STATE	COUNTY	FILE NO.	ROUTE NO.	SHEET NO.	TOTAL SHEETS
3	S.C.	[illegible]	38-632	301	15	25



REV.			
REV.			
REV.			
REV.			
REVIEWED		IN CHARGE	
QUAN.			
TR.			
DR.			
DES.			
	BY	CHK'D	DATE

S.C. STATE HIGHWAY DEPARTMENT
BRIDGE DIVISION
COLUMBIA S.C.

PLAN AND PROFILE
OF BRIDGE OVER
HOT ROD SWAMP

FILE NO.	COUNTY	ROUTE NO.	DATE
38-632	[illegible]	301	5-68

APPROVED BY [signature] BRIDGE DESIGN & PLANS ENGINEER

APPROVED BY [signature] DESIGN BRIDGE ENGINEER

APPENDIX K

FEMA COMPLIANCE

FEMA COMPLIANCE STUDY
FOR
THE PROPOSED CONSTRUCTION
OF

REPLACEMENT BRIDGE ON US 301 SOUTH BOUND OVER FOUR HOLE SWAMP

FILE NO.: 38.040308 **PIN NO.: 40308**

ORANGEBURG COUNTY, SOUTH CAROLINA

****
****

Prepared by: Thomas P. Knight, PE

Reviewed by: G. Randall Mungo, PE, RPG 3 Hydraulic Engineer

February 10, 2014

FEMA COMPLIANCE STUDY
US 301 SB AT FOUR HOLE SWAMP

BRIDGE HYDRAULIC ANALYSIS
US 301 SB
REPORT INDEX

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C.	FLOODWAY DATA	3
D.	HYDROLOGIC DESIGN CRITERIA	4
	BRIDGE HYDRAULIC ANALYSIS NARRATIVE	
A.	PROJECT DESCRIPTION	6
B.	SCOPE OF WORK	6
C.	FLOODPLAIN ANALYSIS	6
D.	CONCLUSIONS	7
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C.	PROPOSED BRIDGE - HEC-RAS MODEL SUMMARY	24
D.	NO RISE CERTIFICATION	35

GENERAL SUPPORTING INFORMATION

A. GENERAL NARRATIVE

This bridge hydraulic analysis was prepared for the bridge replacement project over the Four Hole Swamp on US 301 South Bound (SB) Orangeburg County, South Carolina. The location is about a 1.3 miles West of the US 301/US 176 intersection. SCDOT maintenance has rated the bridge to be deficient.

The US 301 SB Bridge is proposed for replacement on the same alignment as the existing bridge. This study's purpose was to investigate bridge hydraulics and the impacts of the proposed project on water surface elevations of the Four Hole Swamp floodplain. The analysis is based on FEMA guidelines and requirements for the hydraulic design of bridges.

The surrounding area is primarily rural area comprised of woods and swamps. A vicinity map showing the project area is included as Figure 1. This map was obtained from the Mapping and Graphics Division of the SCDOT.

The bridge analysis/design study was conducted according to the requirements presented in the 2009 document *SCDOT Requirements for Hydraulic Design Studies*. Study information was obtained from the existing and proposed SCDOT plans, USGS 7.5 minute quadrangle maps, SCDOT land survey, aerial photography, FEMA Bridge Analysis, and other means.

The vertical datum used for this project is the North American Vertical Datum of 1988 (NAVD88). This datum was used for all elevation data contained in the SCDOT land Survey, Flood Insurance Study (FIS), and Federal Insurance Rate Maps (FIRM). All of the results from the HEC-RAS models are based on this datum.

B. TOPOGRAPHIC MAPS

All topographic data was obtain as part of the model used by FEMA to set the office base flood elevation. The model was provided by South Carolina Department of Natural Resources (SCDNR). Any discrepancies in topographic data are due to errors and omissions from the entity that developed the survey.

C. FLOODWAY DATA

The proposed project is located on the *Flood Insurance Rate Map for Orangeburg County, South Carolina Number 45075C0410C* produced by the Federal Emergency Management Agency. The area is in Flood Zone AE. This zone comprises areas of the 100 year flood with the base flood elevation determined at the time of the maps publication. The *Flood Insurance Study for Orangeburg County South Carolina and Incorporated Areas* contained the discharge and base flood elevations for Four Hole Swamp. A copy of this map and data for Crowder Creek are in Appendix A.

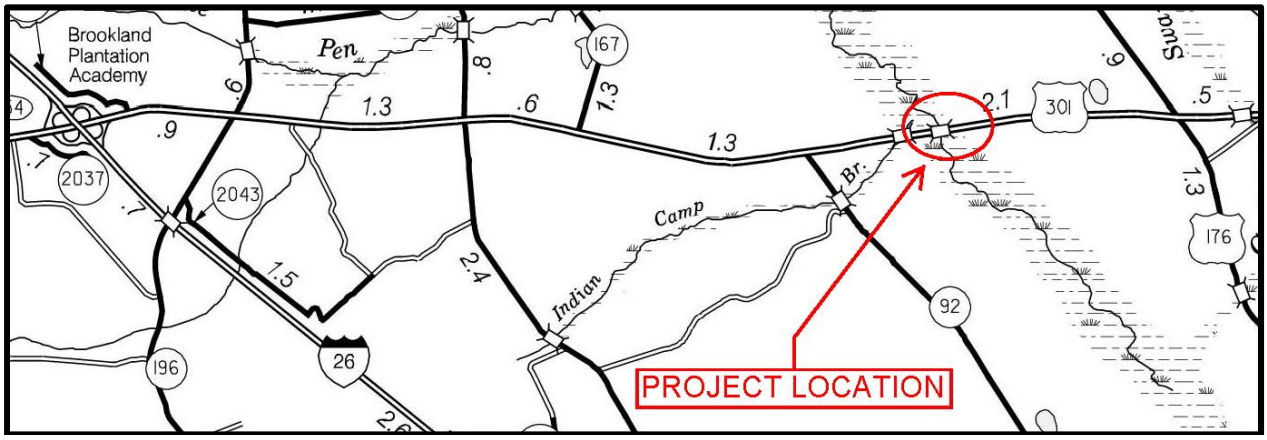


Figure 1: Vicinity Map (SCDOT)

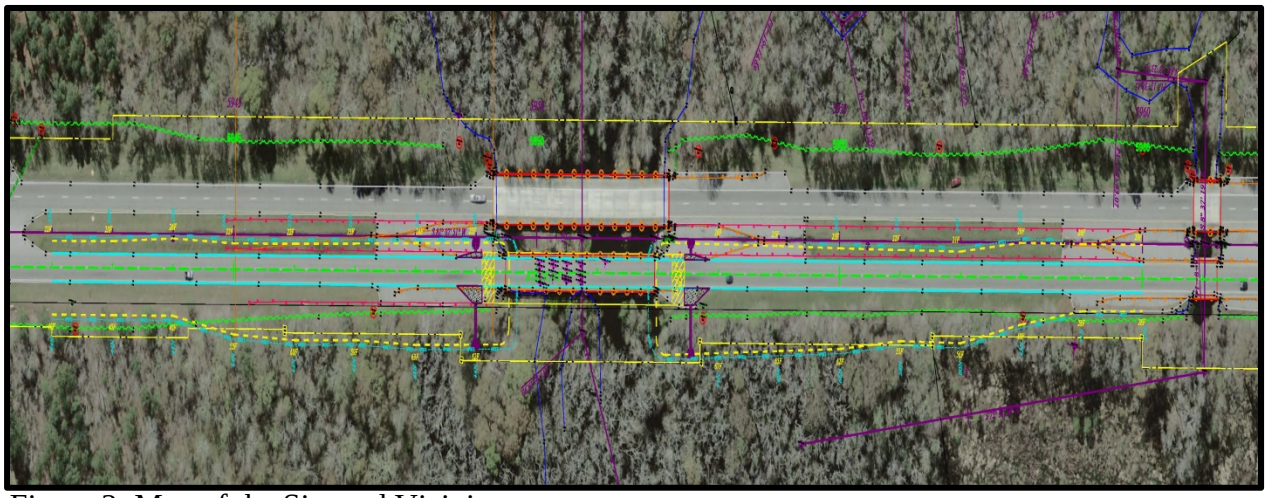


Figure 2: Map of the Site and Vicinity

D. HYDROLOGIC DESIGN DATA

In accordance with SCDOT requirements, the analysis of the current and proposed conditions was performed using information from the *Flood Insurance Study for Orangeburg County*. This included 100-year event discharge and Water Surface Elevations for Four Hole Swamp at US 301 SB. This Information is attached in Appendix A.

BRIDGE HYDRAULIC ANALYSIS

A. PROJECT DESCRIPTION

The bridge on US 301 SB over Four Hole Swamp is located in the southeastern portion of Orangeburg County. The project includes the bridge and a portion of the two approaches to the bridge. This analysis shall demonstrate that the proposed bridge meets the requirements for a "No Rise" certification. The existing a 220 ft eleven span bridge (all 22') will be replaced with a new 294 ft seven span (44'-44'-44'-44'-44'-44'-30'). The Proposed Bridge has approximately the same length the North Bound Bridge and a higher low cord to meet SCDOT guidelines.

B. SCOPE OF WORK

This study included performing the bridge hydraulic analysis for the current and proposed bridges using the Hydrologic Engineering Center River Analysis System software, HEC-RAS (Version 4.1). The analysis was based on FEMA's standards for modeling a Zone AE with Base Flood Elevations. A model for existing conditions used to set the official base flood elevations for FEMA was provided by SCDNR's State NFIP Coordinator. The model was then modified to contain the Proposed Bridge.

C. FLOODPLAIN ANALYSIS

The results of the comparison of the existing bridge and proposed replacement bridge configuration water surface elevations are presented in Table 2. As the data shows, the proposed bridge does not increase the water surface elevation in the FEMA Model. The total discharge for the Four Hole Swamp came from the Federal Insurance Study and is in Appendix B.

The existing bridge model was compiled by FEMA's Consultant for the Map Modernization project. A copy of the base flood elevations for Four Hole Swamp is located in Appendix B.

The proposed bridge model used the reach and other data from the existing model. Information for the new bridge was obtained from the proposed bridge design plans. The new bridge has approximately the same length and pier locations as the US 301 NB Bridge. New piers will be H-pile piers, like the Existing SB Bridge. A copy of the Base Flood Elevations for the proposed Four Hole Swamp model is located in Appendix C.

Summaries of the hydraulic modeling (HEC-RAS) are presented in this document for the existing bridge and proposed bridge configurations for the 1-percent-annual-chance floods can be found in Appendix B and C. The change in water surface elevation at the FIS cross sections is contained in Table 1. No increase in water surface elevation is created by the proposed bridge.

Table 1: 100 Year Water Surface Elevation Comparision for Four Hole Swamp at US 301 in Orangeburg Count

Stream Station	100-YEAR WATER SURFACE ELEVATION IN FEET (NGVD 88)		
	FEMA Existing Conditions	Proposed Conditions	Change
146196	120.2	120.2	0.0
145196	119.8	119.8	0.0
144079	119.3	119.3	0.0
142488	118.5	118.5	0.0
141196	118.1	118.1	0.0
139981	117.8	117.8	0.0
138150	117.2	117.2	0.0
137985	Bridge	Bridge	
137863	117.0	117.0	0.0
137196	116.8	116.8	0.0
136196	116.5	116.5	0.0
135196	116.2	116.2	0.0
134196	115.9	115.9	0.0
133196	115.5	115.5	0.0
132196	115.1	115.1	0.0

D. CONCLUSIONS

The proposed bridge must meet FEMA guidelines for compliance for the AE Zone with Base Flood Elevations. To this end, the Proposed Bridge must have the same 100-Year Water Surface Elevation as the Existing Bridge. All of the results are in preceding table and in the appendixes.

Based on the hydraulic analysis, the proposed bridge will meet the design criteria set by FEMA and SCDOT. As shown in Table 1, the HEC-RAS model indicates that the water surface elevation should not increase by the proposed bridge. Rip Rap will be place in accordance with SCDOT guidelines and procedures. The No Rise Certification is located in Appendix D. If, so desired, SCDOT will provide electronic copies of the hydraulic bridge design and analysis.

REFERENCES

Federal Emergency Management Agency. (2014). *Flood Insurance Study: Orangeburg County, South Carolina and Incorporated Areas Volume 1 (45075CV001A).* Federal Emergency Management Agency. Washington D. C.

Federal Emergency Management Agency. (2014). *Flood Insurance Rate Map for Orangeburg County, South Carolina, Number 45075C0410C.* Federal Emergency Management Agency. Washington D. C.

South Carolina Department Of Transportation. (2009). *South Carolina Department of Transportation: Requirements for Hydraulic Studies*. South Carolina Department of Transportation Hydrology Department. Columbia, South Carolina.

APPENDIX A

FEMA MAP AND BFE

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction, and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures in this jurisdiction.

The **projection** used in the preparation of this map was South Carolina State Plane, FIPSZONE 3900. The **horizontal datum** was NAD83, GRS80 spheroid. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey, SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242**, or visit their website at http://www.ngs.noaa.gov/.

Base map information shown on the Flood Insurance Rate Map (FIRM) was derived from the U.S. Geological Survey (USGS), National Geodetic Survey, Census Bureau, Orangeburg County, SC and South Carolina Office of Research and Statistics. This information was developed at scales of 1"=2000', 1"=1000' and 1"=500'. Users of this FIRM should be aware that minor adjustments may have been made to specific base map features.

This map may reflect more detailed or up to date stream channel configurations than those shown on the previous FIRM. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations and improved topographic data. The profile baselines depicted on this map represent the hydraulic modeling baselines that match the flood profiles and Floodway Data Tables if applicable, in the FIS report. As a result, the profile baselines may deviate significantly from the new base map channel representation and may appear outside of the floodplain.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

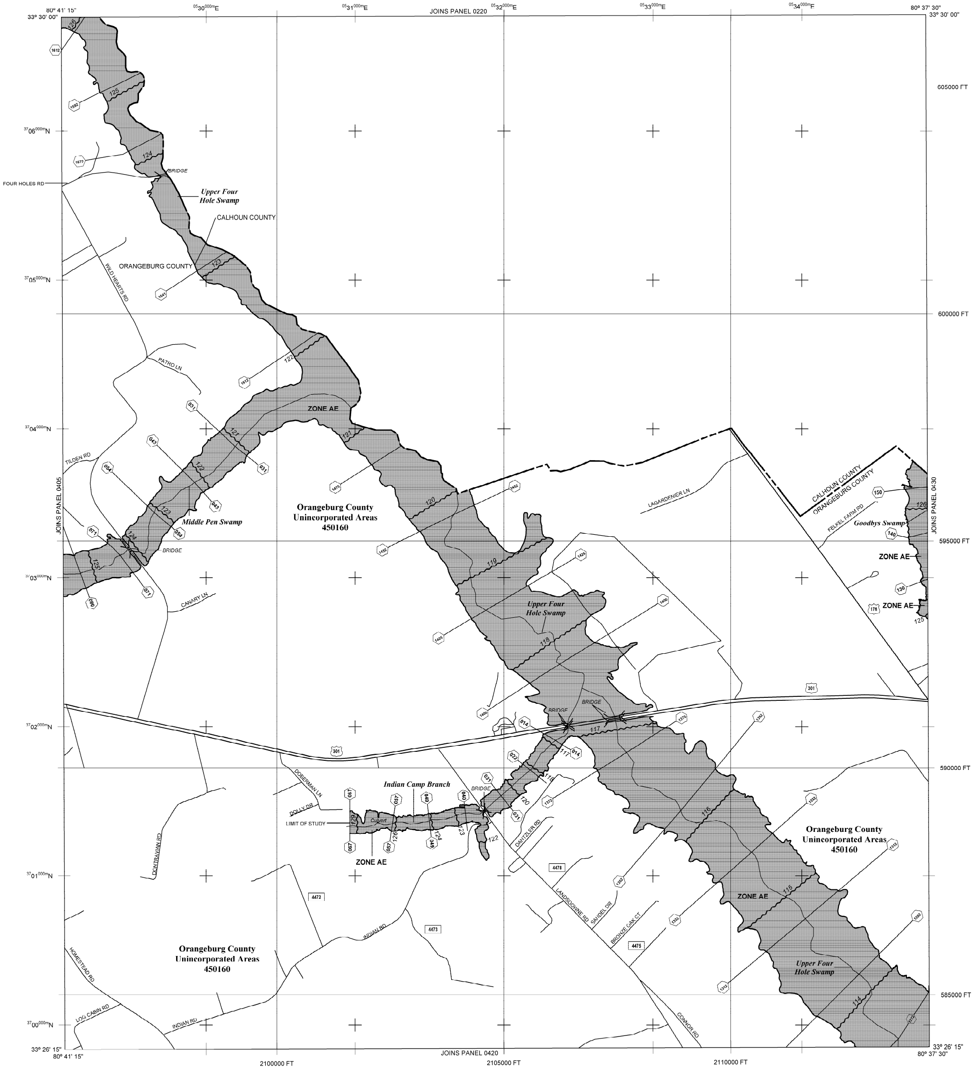
For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have **questions about this map**, how to order products or the National Flood Insurance Program in general, please call the **FEMA Map Information eXchange** at **1-877-FEMA-MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov.

DNR

This digital Flood Insurance Rate Map (FIRM) was produced through a unique cooperative partnership between the State of South Carolina and the Federal Emergency Management Agency (FEMA). The State of South Carolina has implemented a long-term approach of floodplain management to decrease the costs associated with flooding. This is demonstrated by the State's commitment to map floodplain areas at the local level. As a part of this effort, the State of South Carolina has joined in a Cooperating Technical State agreement with FEMA to produce and maintain this digital FIRM.

http://www.dnr.state.sc.us/



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

Floodplain boundary
Floodway boundary
Zone D Boundary
CBRS and OPA Boundary
Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

A — A	Cross section line
23 - - - 23	Transect line
	Culvert, Flume, Penstock or Aqueduct
	Road or Railroad Bridge
	Footbridge
97° 07' 30", 32° 22' 30"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
4276000mE	1000-meter Universal Transverse Mercator grid values, zone 17
600000 FT	5000-foot grid ticks: South Carolina State Plane coordinate system, FIPSZONE 3900, Lambert Conformal Conic Projection
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
• M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index.

EFFECTIVE DATE OF COUNTYWIDE FLOOD
INSURANCE RATE MAP
JANUARY 16, 2014

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'

500 0 1000 2000 FEET
300 0 300 600 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0410C

FIRM

FLOOD INSURANCE RATE MAP

ORANGEBURG COUNTY, SOUTH CAROLINA

AND INCORPORATED AREAS

PANEL 410 OF 760

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
ORANGEBURG COUNTY	450160	0410	C

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
45075C0410C

EFFECTIVE DATE
JANUARY 16, 2014

Federal Emergency Management Agency

Table 7 - Limited Detailed Flood Hazard Data (Continued)

Cross Section[1]	Stream Station[2]	Flood Discharge (cfs)	1% Annual Chance Water-Surface Elevation (feet NAVD 88)
Edisto River Trib 2_1	**(Continued)**		
081	8104	602	114.3
086	8594	602	114.3
091	9144	602	114.4
095	9515	602	114.4
102	10176	602	114.5
110	10984	602	114.8
119	11901	602	115.3
126	12637	511	115.9
128	12823	511	116.1
131	13129	511	116.3
136	13608	511	116.5
Four Hole Swamp			
1172	117,239	14242	59.47
1183	118,294	14242	59.75
1191	119,099	14242	59.95
1198	119,799	14016	60.16
1212	121,191	14016	60.71
1224	122,409	14016	61.27
1234	123,361	14016	61.65
1245	124,513	14016	62.03
1257	125,674	14016	62.43
1270	126,970	14016	62.86
1280	128,018	13943	63.21
1291	129,104	13943	63.51
1300	129,995	13943	63.75
1309	130,950	13943	64.03
1319	131,914	13943	64.31
1329	132,893	13943	64.57
1339	133,860	13943	64.85
1348	134,811	13627	65.14
1356	135,645	13509	65.45
1367	136,672	13509	66.07
1376	137,584	13509	66.50
1387	138,667	13509	66.81
1398	139,801	13509	67.05
1404	140,406	13509	66.53
1410	141,040	13509	73.85
1414	141,443	13509	73.85
1422	142,208	13509	74.52
1431	143,143	13460	74.53
1441	144,138	13460	74.54
1450	144,984	13460	74.55
1459	145,872	13347	74.56
1469	146,912	13347	74.57

[1] This table reflects all modeled Cross-Sections. Some Cross-Sections shown in this table may not appear on map.

[2] Feet above mouth.

[3] Elevation includes backwater effects.

Table 7 - Limited Detailed Flood Hazard Data (Continued)

Cross Section[1]	Stream Station[2]	Flood Discharge (cfs)	1% Annual Chance Water-Surface Elevation (feet NAVD 88)
Four Hole Swamp	**(Continued)**		
1480	147,986	13347	74.59
1490	149,031	13285	74.60
1502	150,247	13285	74.63
1512	151,230	13285	74.66
1522	152,192	13285	74.68
1532	153,175	13285	74.70
1541	154,126	13060	74.73
1551	155,078	13035	74.77
1560	156,015	13035	74.82
1568	156,828	13035	74.87
1577	157,712	13035	74.95
1584	158,438	13035	75.02
1593	159,284	13035	75.14
1605	160,526	13035	75.38
1616	161,583	12683	75.65
1624	162,412	12683	75.96
1635	163,497	12683	76.38
1653	165,283	12657	81.20
1662	166,160	12657	81.22
1671	167,085	12657	81.25
1681	168,054	12657	81.28
1692	169,159	12163	81.33
1701	170,100	12163	81.38
1711	171,134	12163	81.44
1722	172,157	12163	81.50
1732	173,177	12163	81.59
1741	174,117	12163	81.68
1750	174,950	12163	81.78
Four Hole Swamp Trib 1			
018	1800	1414	102.0[3]
022	2190	1414	102.0[3]
026	2602	1414	102.7
032	3150	1414	104.0
037	3653	1414	105.0
041	4050	1414	105.7
045	4510	1414	106.5
050	4967	1288	107.1
053	5348	1288	107.6
059	5873	1288	108.4
063	6300	1288	109.4
068	6750	1288	110.0
072	7200	1288	111.0
077	7650	1288	111.7
081	8100	1288	112.5
086	8550	1288	113.1

[1] This table reflects all modeled Cross-Sections. Some Cross-Sections shown in this table may not appear on map.

[2] Feet above mouth.

[3] Elevation includes backwater effects.

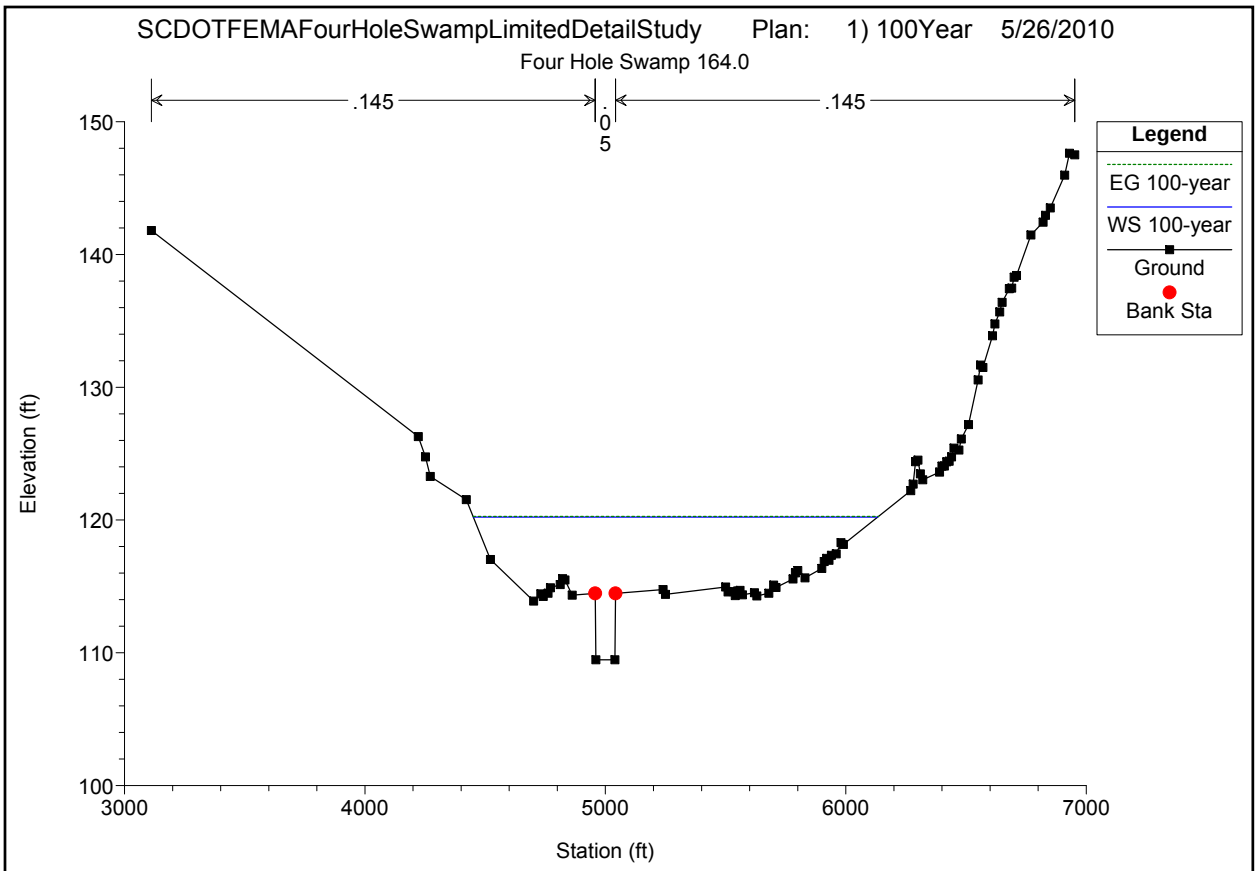
APPENDIX B

EXISTING BRIDGE

HEC-RAS MODEL SUMMARY

HEC-RAS Plan: 100Year River: Four Hole Swamp Reach: Reach-1 Profile: 100-year

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach-1	146196	100-year	6755.00	109.47	120.23		120.27	0.000410	2.77	8312.66	1682.09	0.15
Reach-1	145196	100-year	6755.00	108.81	119.81		119.86	0.000411	2.82	7585.91	1354.35	0.15
Reach-1	144079	100-year	6755.00	108.43	119.29	115.22	119.35	0.000510	3.11	6711.65	1522.66	0.17
Reach-1	142488	100-year	6755.00	107.61	118.54		118.59	0.000443	2.91	7561.76	1452.93	0.16
Reach-1	141196	100-year	6885.00	106.92	118.15	113.69	118.18	0.000236	2.17	11985.29	2634.10	0.11
Reach-1	139981	100-year	6885.00	106.57	117.83		117.86	0.000286	2.39	9610.69	1691.17	0.13
Reach-1	138150	100-year	7050.00	106.25	117.26	109.07	117.34	0.000265	2.36	3139.20	2355.40	0.13
Reach-1	137985		Bridge									
Reach-1	137863	100-year	7050.00	106.15	116.99	108.98	117.08	0.000276	2.38	3147.70	2410.92	0.13
Reach-1	137196	100-year	7050.00	105.75	116.83		116.86	0.000293	2.39	9858.87	1753.52	0.13
Reach-1	136196	100-year	7116.00	105.44	116.52	112.37	116.56	0.000324	2.52	9439.98	1727.10	0.13
Reach-1	135196	100-year	7116.00	105.10	116.21		116.24	0.000309	2.46	9659.79	1733.01	0.13
Reach-1	134196	100-year	7116.00	104.86	115.86		115.90	0.000374	2.69	8938.49	1734.89	0.14
Reach-1	133196	100-year	7116.00	104.58	115.49		115.53	0.000367	2.65	8890.85	1649.17	0.14
Reach-1	132196	100-year	7116.00	104.57	115.13		115.16	0.000360	2.57	9447.08	1845.64	0.14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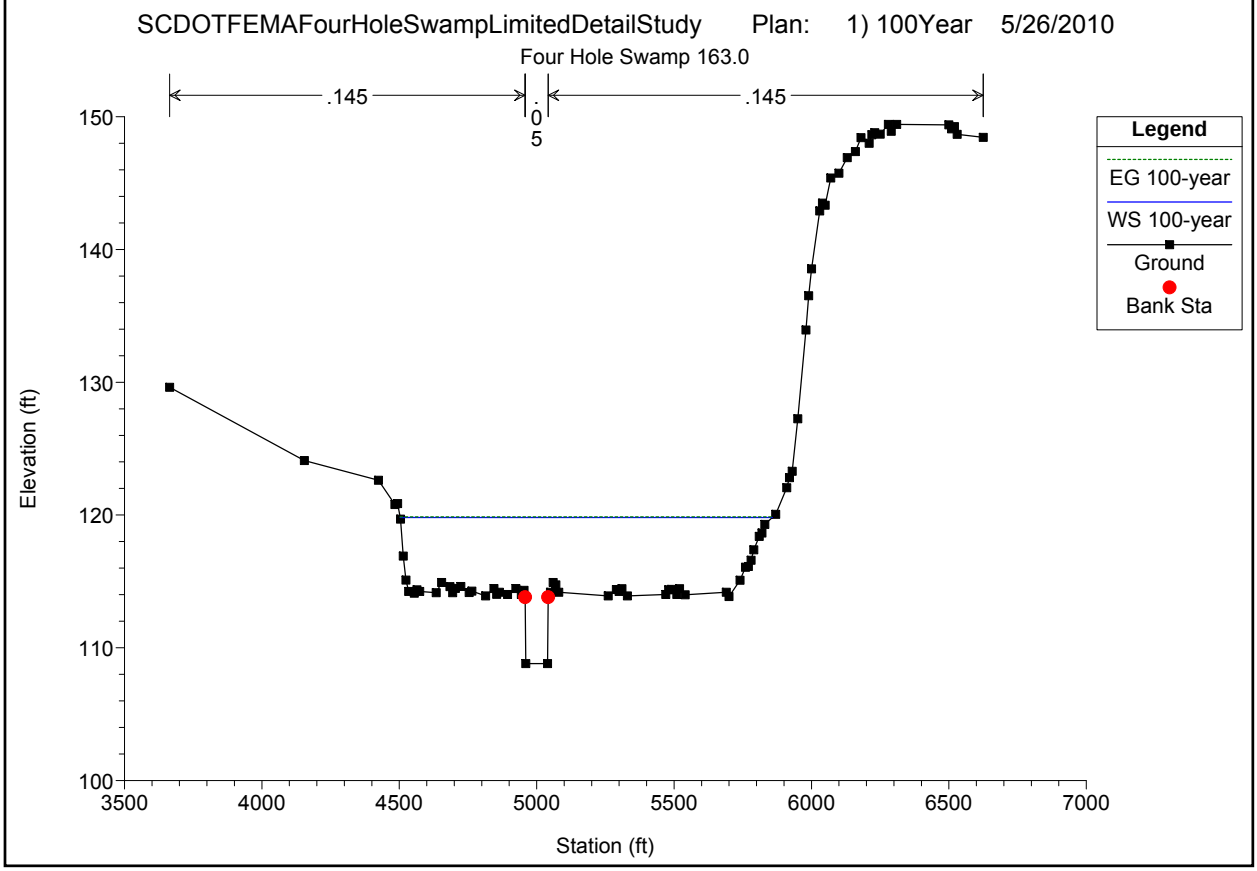
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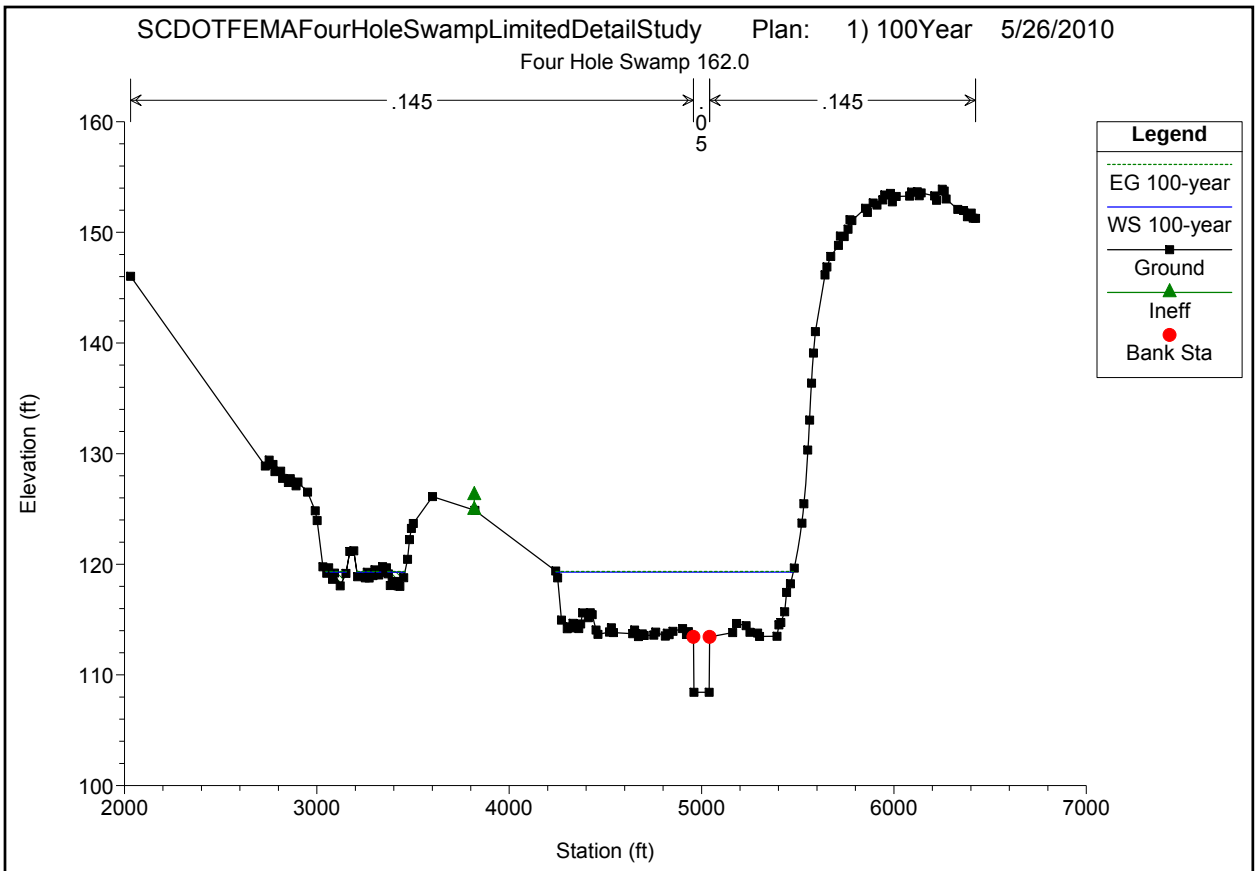
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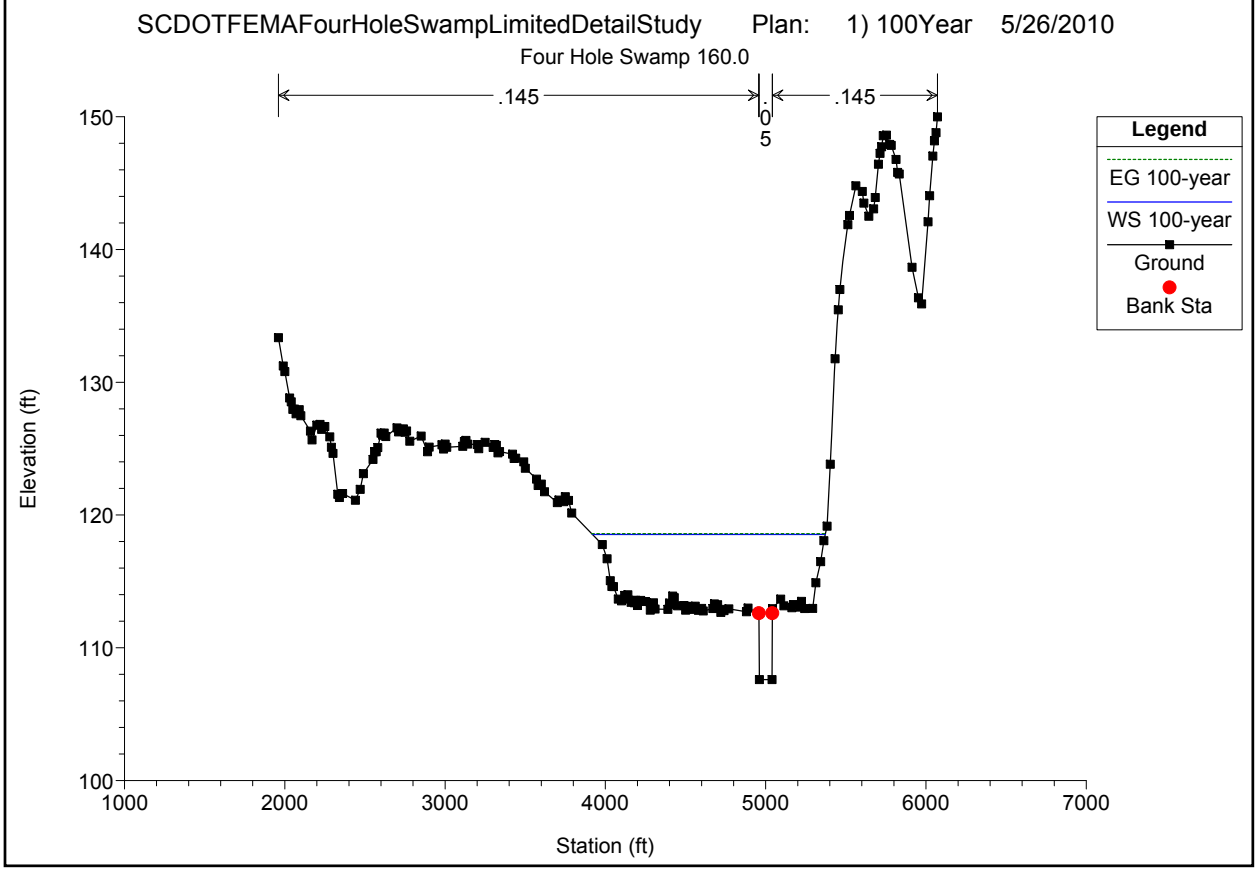
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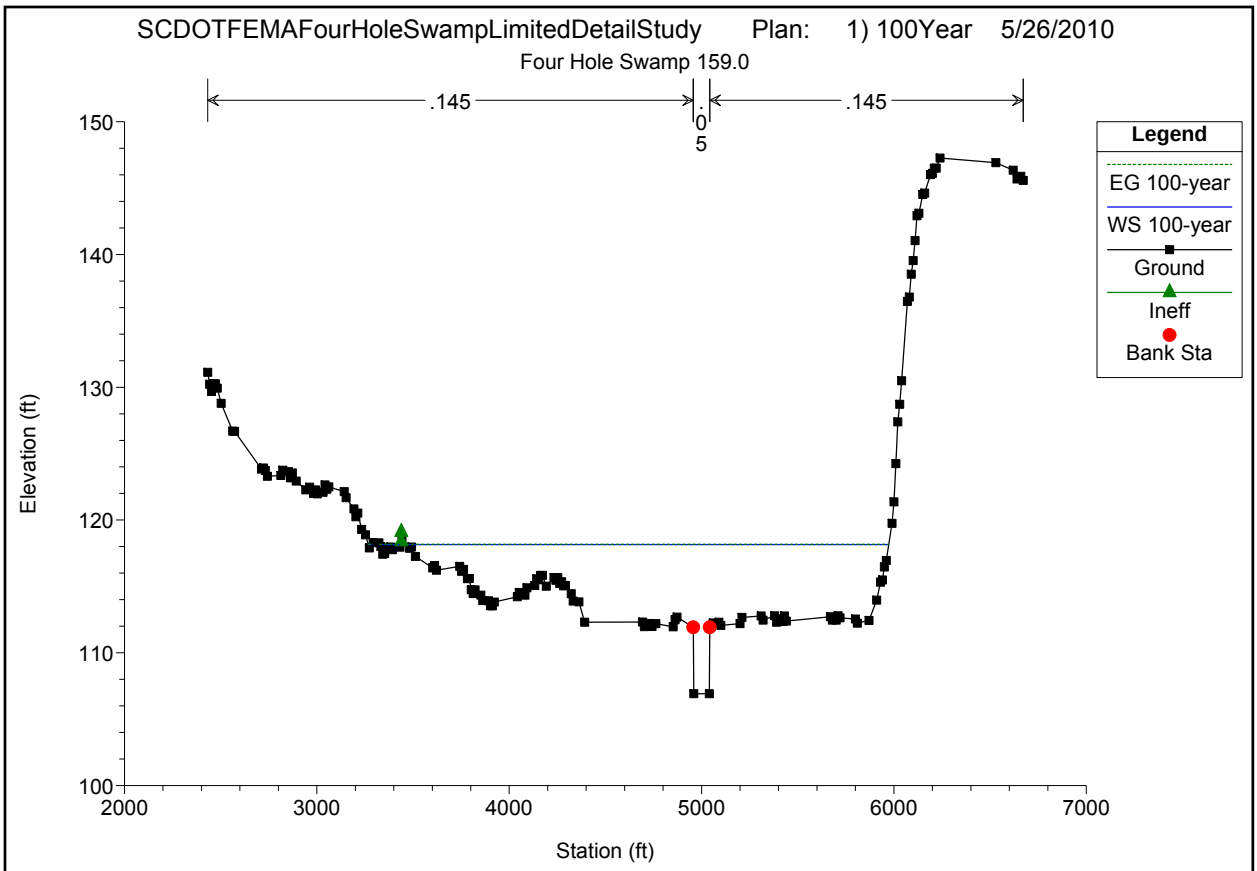
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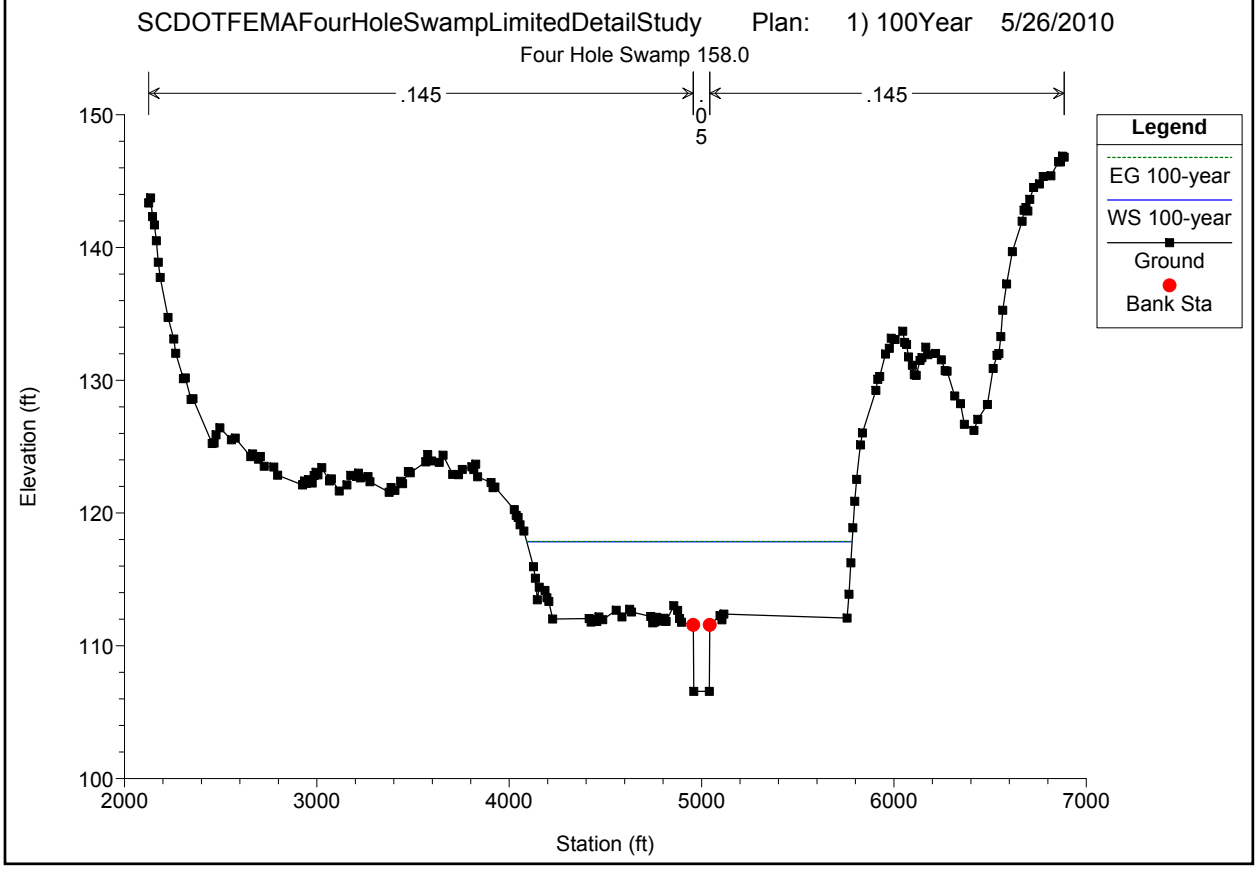
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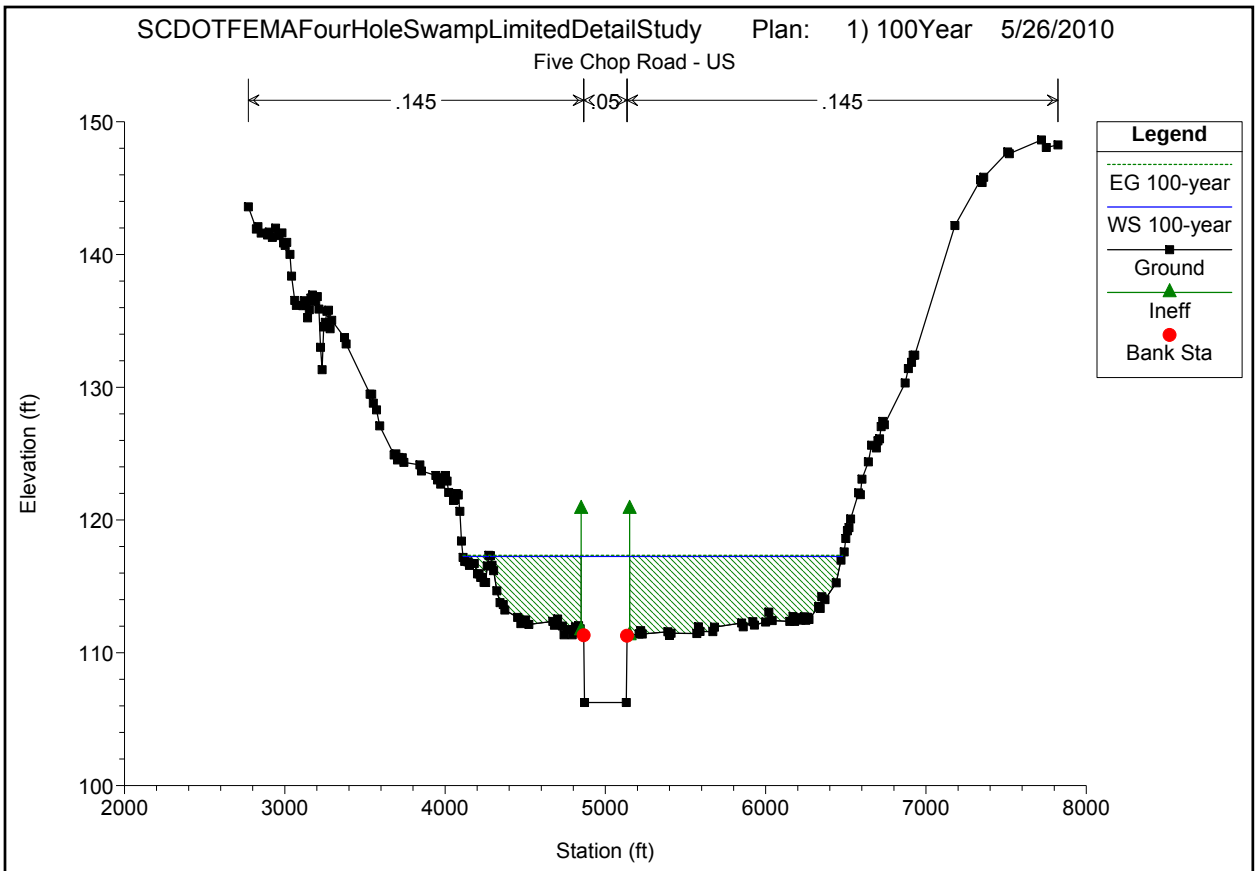
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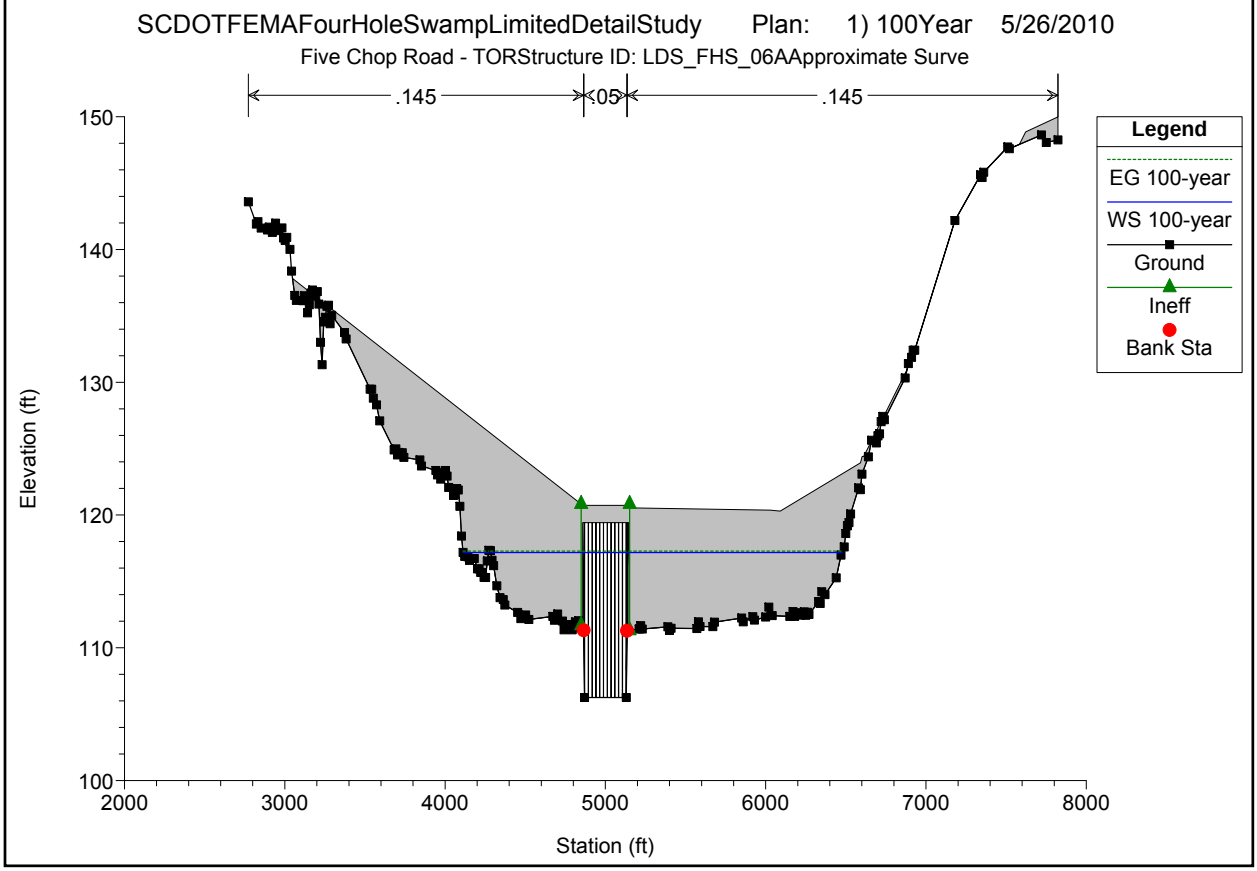
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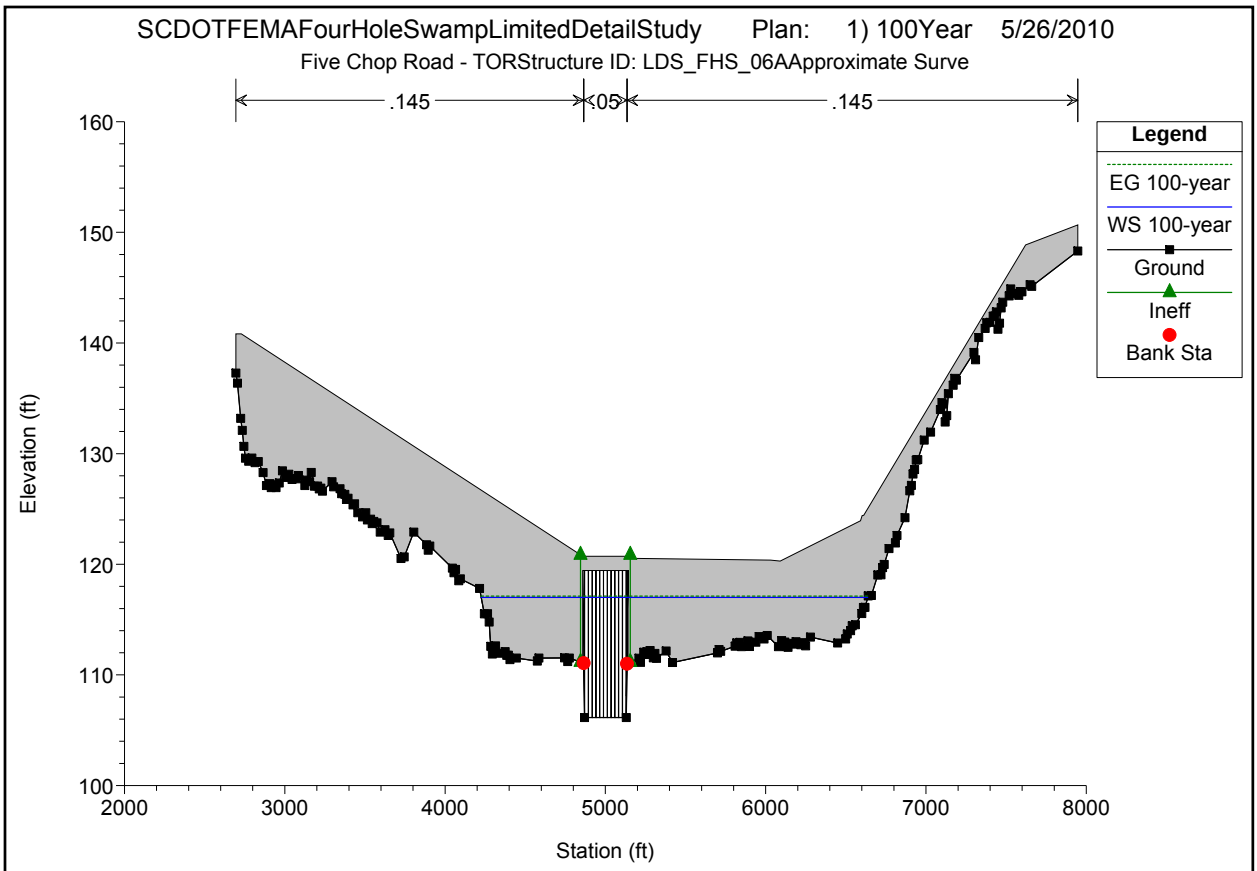
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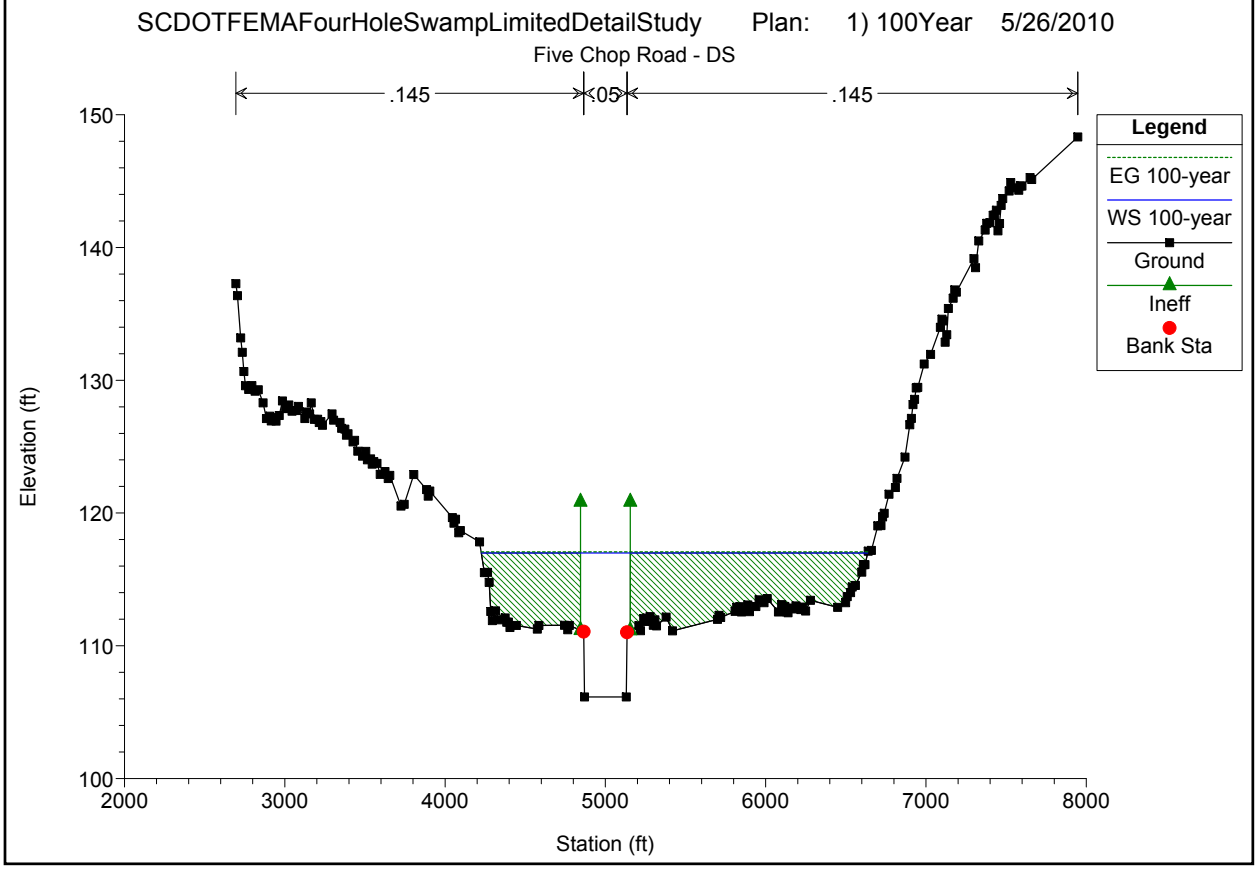
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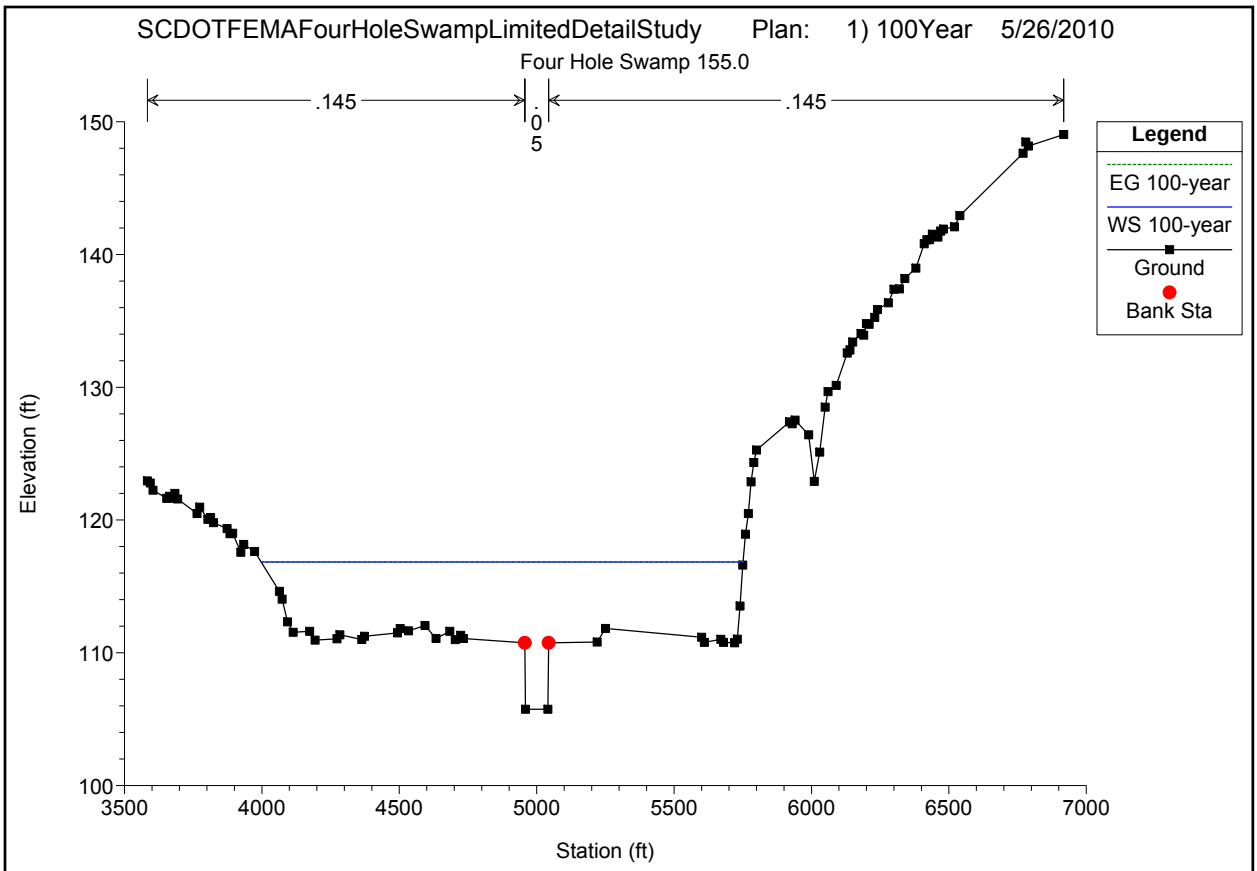
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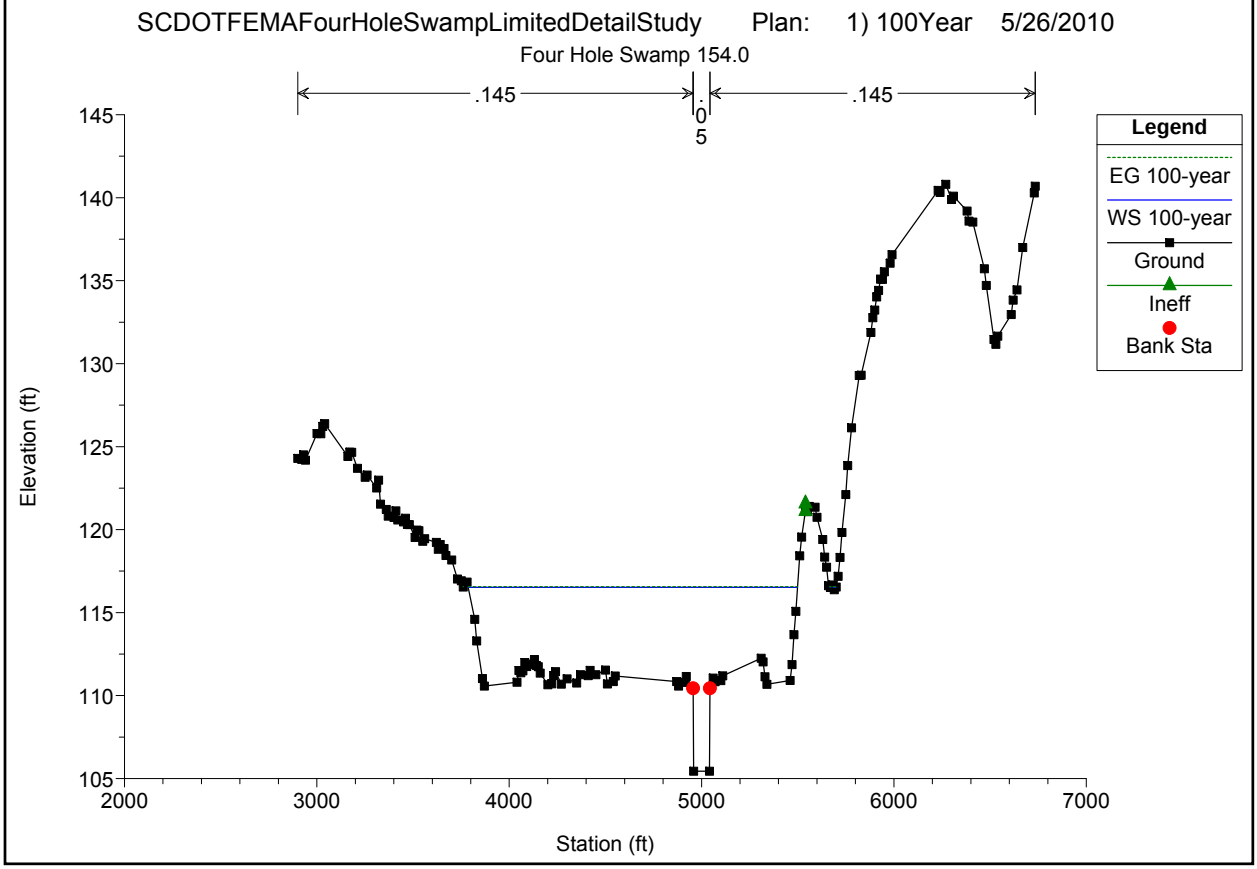
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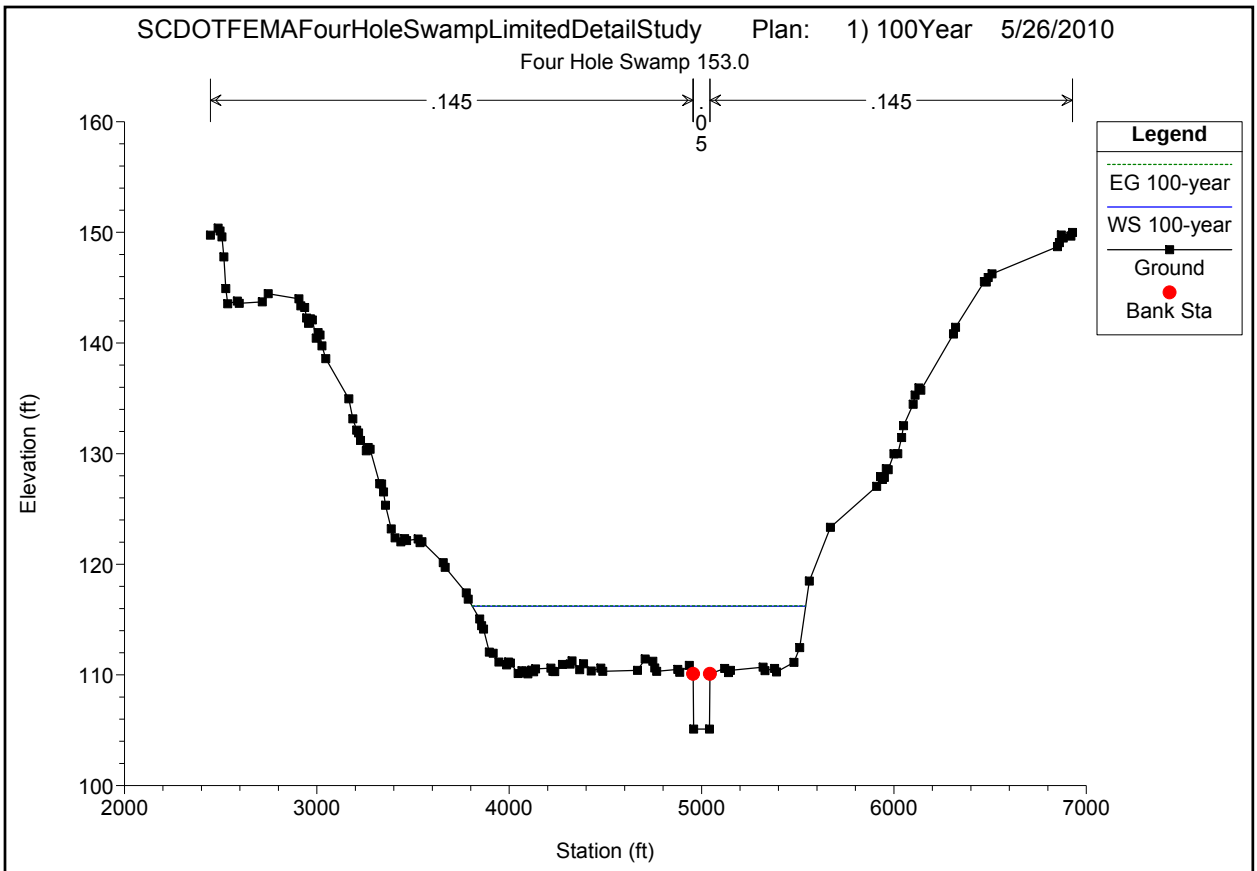
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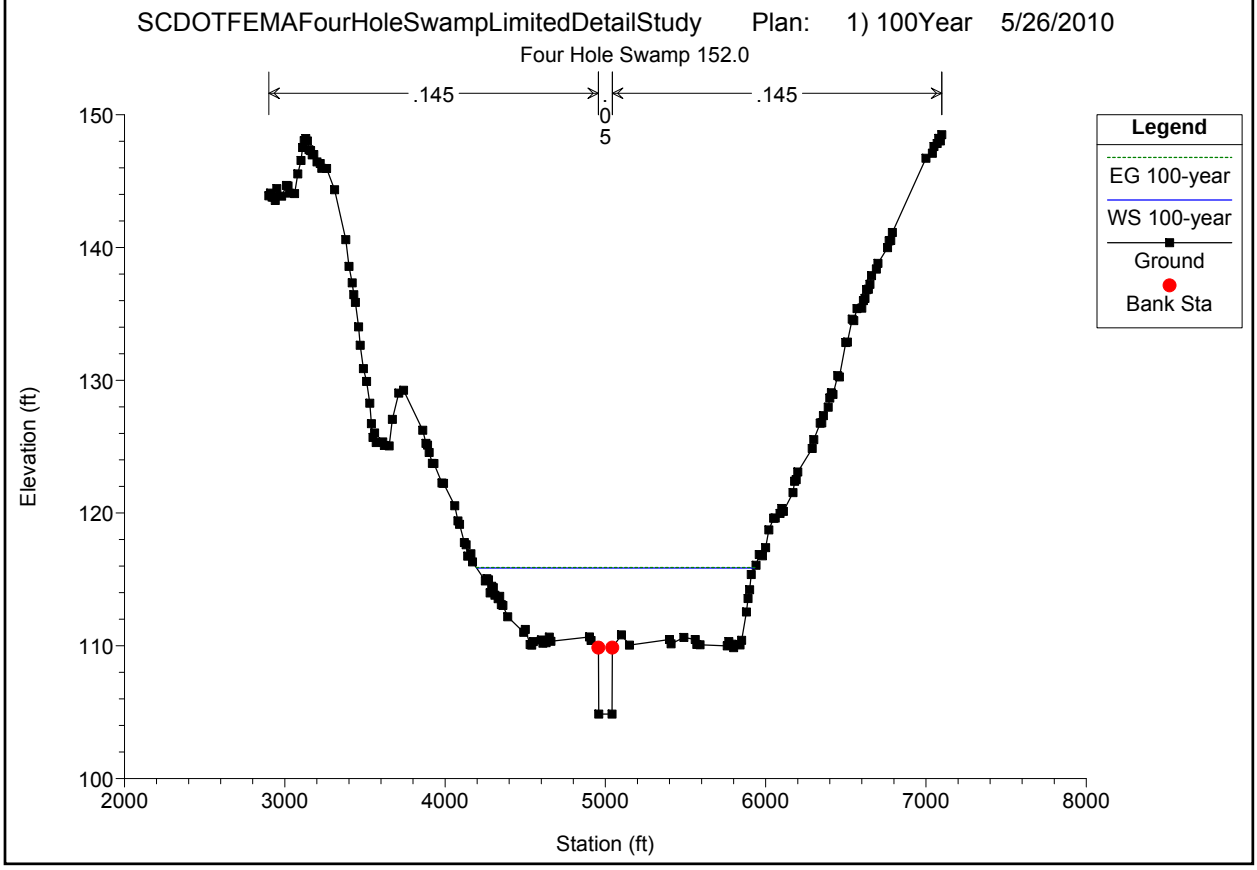
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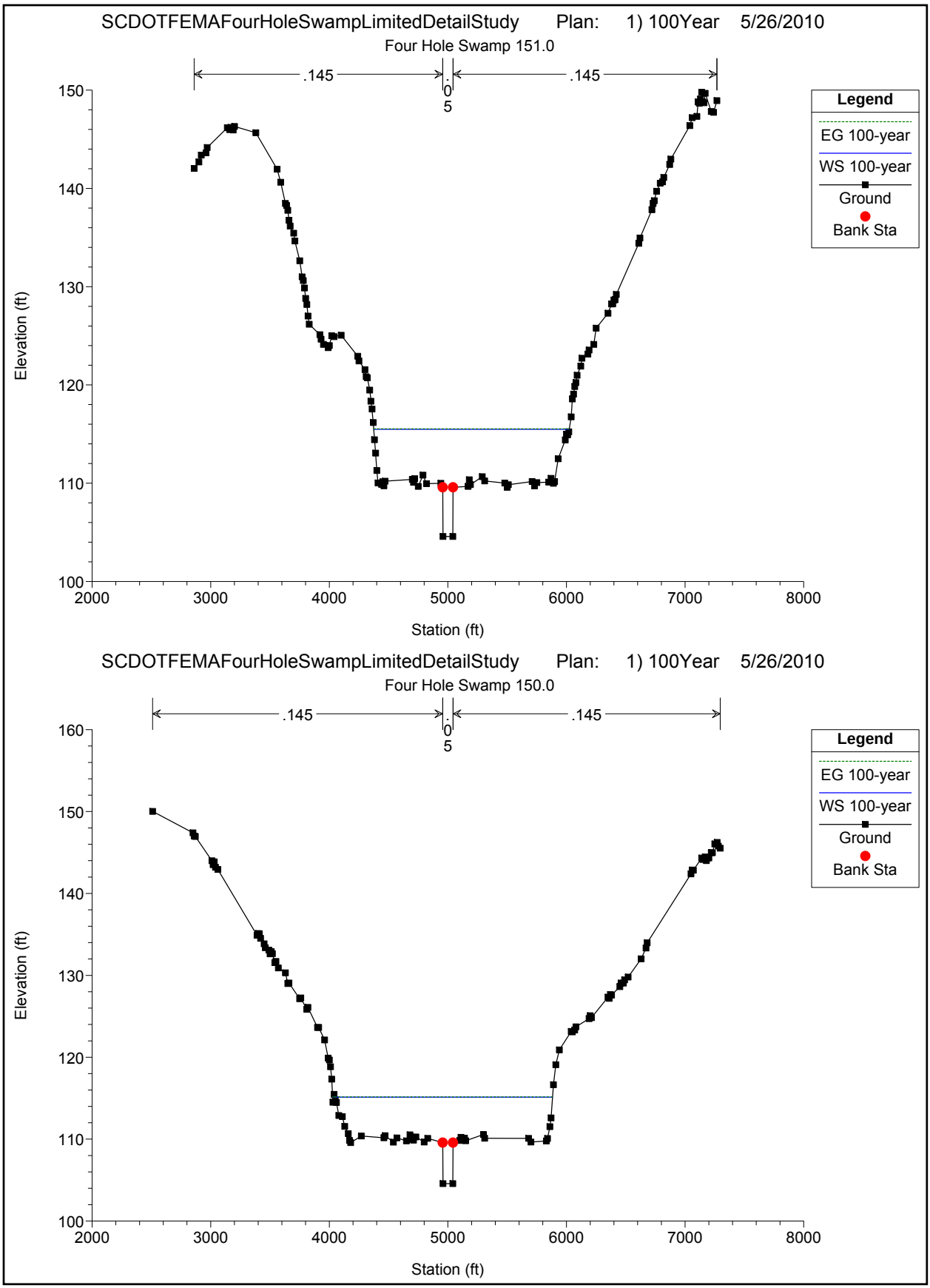
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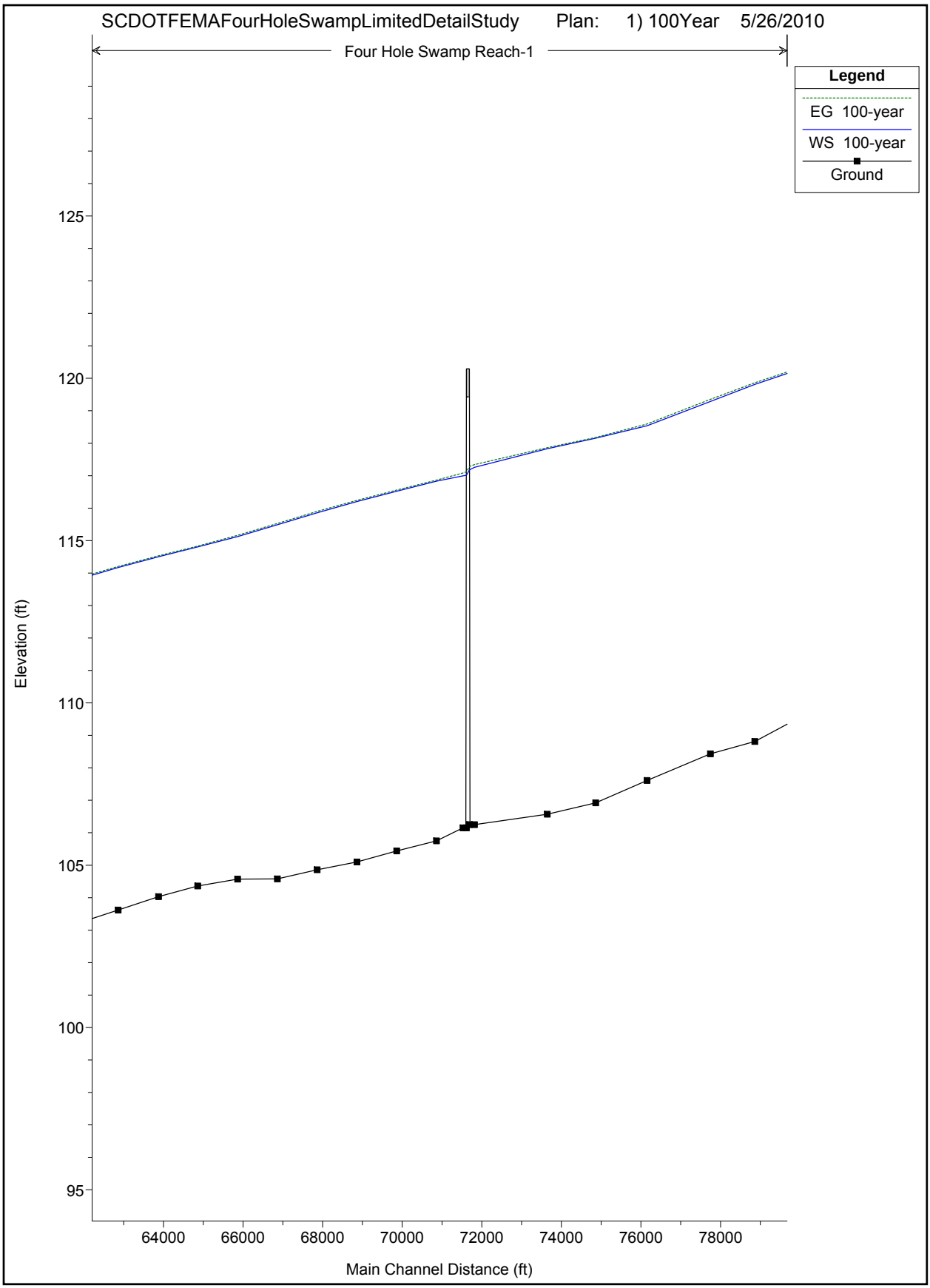


1 in Horiz. = 3569.96 ft 1 in Vert. = 4.378284 ft

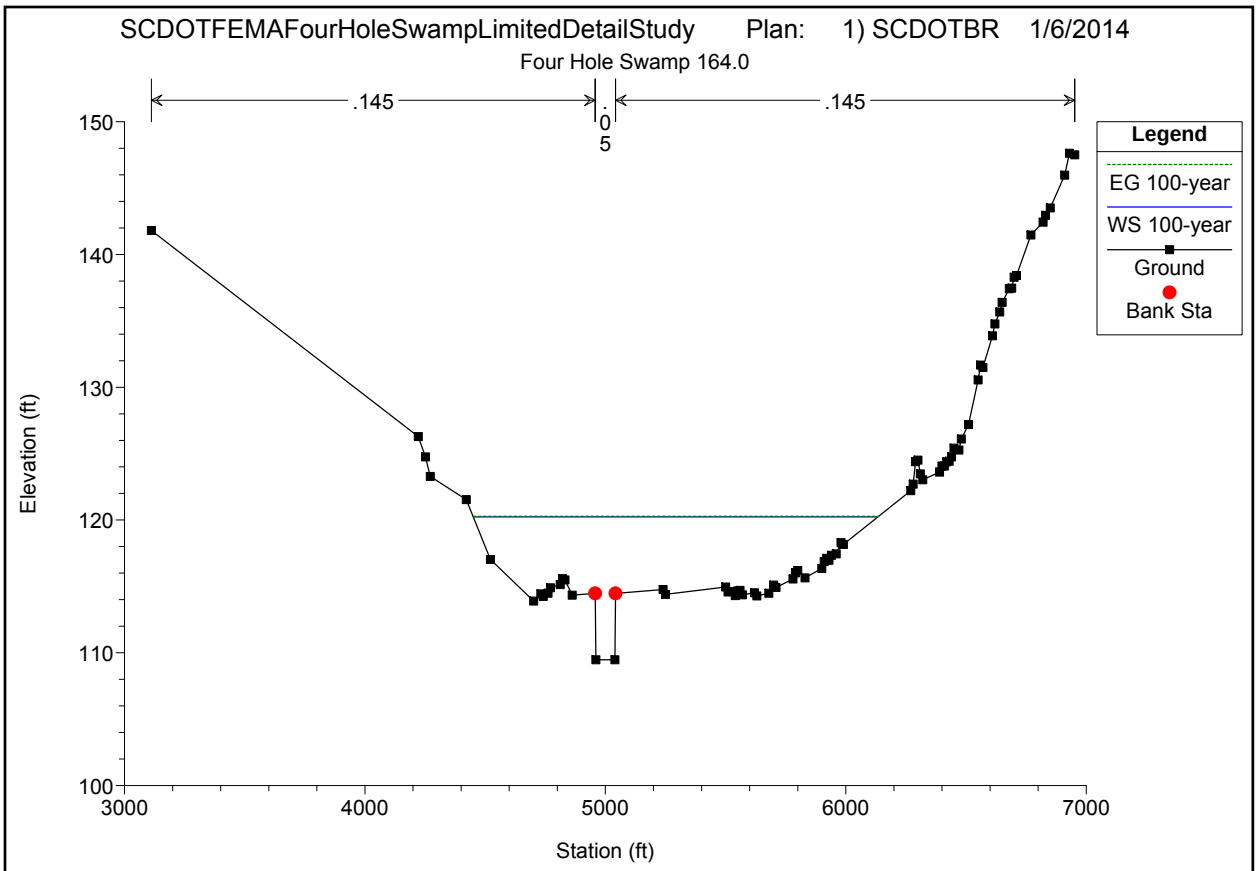
APPENDIX C

PROPOSED BRIDGE

HEC-RAS MODEL SUMMARY

HEC-RAS Plan: SCDOTBR River: Four Hole Swamp Reach: Reach-1 Profile: 100-year

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach-1	146196	100-year	6755.00	109.47	120.23		120.28	0.000409	2.77	8317.84	1682.37	0.15
Reach-1	145196	100-year	6755.00	108.81	119.82		119.87	0.000410	2.81	7591.02	1354.58	0.15
Reach-1	144079	100-year	6755.00	108.43	119.29	115.22	119.36	0.000508	3.11	6717.62	1523.79	0.17
Reach-1	142488	100-year	6755.00	107.61	118.55		118.60	0.000441	2.91	7572.01	1453.63	0.16
Reach-1	141196	100-year	6885.00	106.92	118.16	113.69	118.19	0.000235	2.16	12007.33	2635.79	0.11
Reach-1	139981	100-year	6885.00	106.57	117.84		117.87	0.000285	2.39	9628.42	1691.40	0.13
Reach-1	138150	100-year	7050.00	106.25	117.27	109.07	117.36	0.000264	2.35	3143.10	2356.25	0.13
Reach-1	137985		Bridge									
Reach-1	137863	100-year	7050.00	106.15	116.99	108.98	117.08	0.000276	2.38	3147.71	2410.92	0.13
Reach-1	137196	100-year	7050.00	105.75	116.83		116.86	0.000293	2.39	9858.89	1753.52	0.13
Reach-1	136196	100-year	7116.00	105.44	116.52	112.37	116.56	0.000324	2.52	9440.00	1727.10	0.13
Reach-1	135196	100-year	7116.00	105.10	116.21		116.24	0.000309	2.46	9659.81	1733.01	0.13
Reach-1	134196	100-year	7116.00	104.86	115.86		115.90	0.000374	2.69	8938.50	1734.89	0.14
Reach-1	133196	100-year	7116.00	104.58	115.49		115.53	0.000367	2.65	8890.86	1649.17	0.14
Reach-1	132196	100-year	7116.00	104.57	115.13		115.16	0.000360	2.57	9447.08	1845.64	0.14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Four Hole Swamp 164.0
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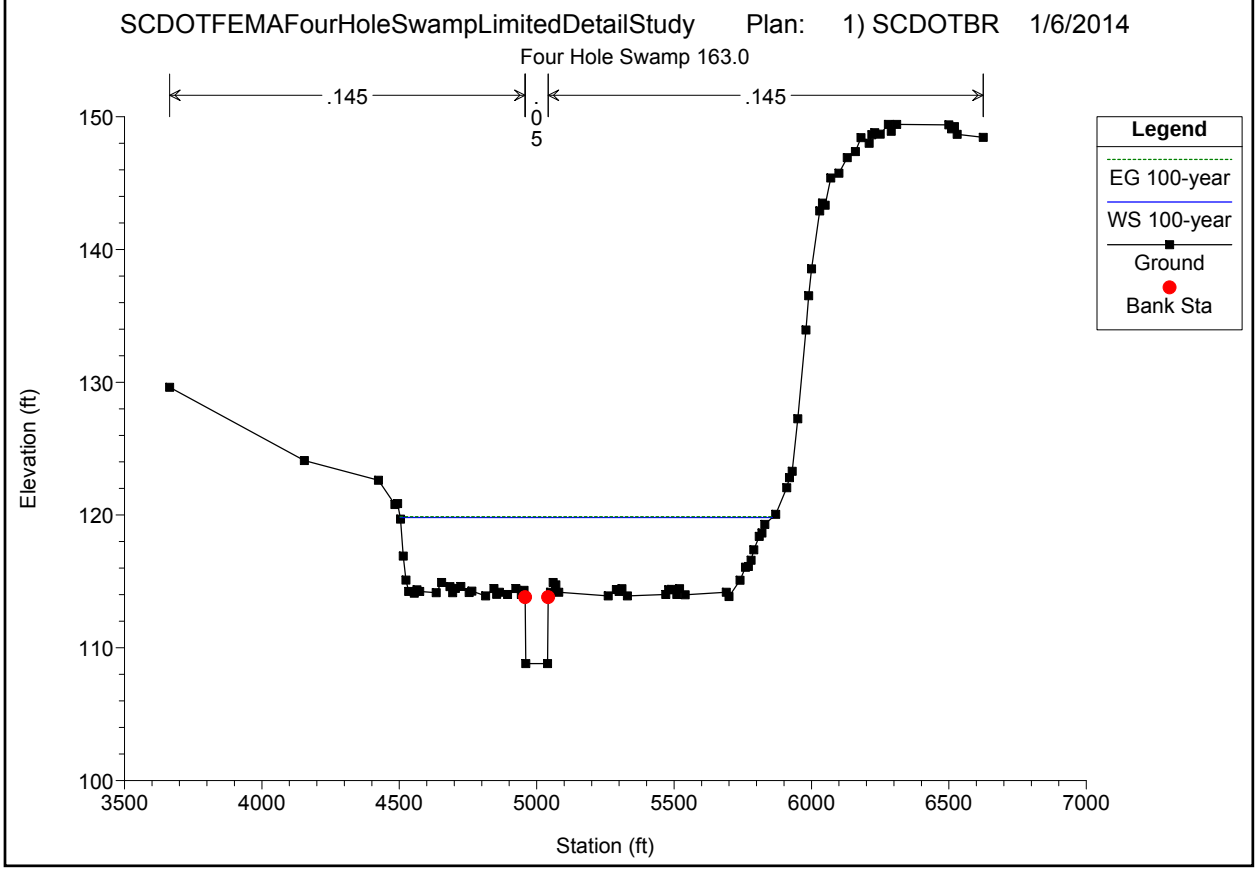
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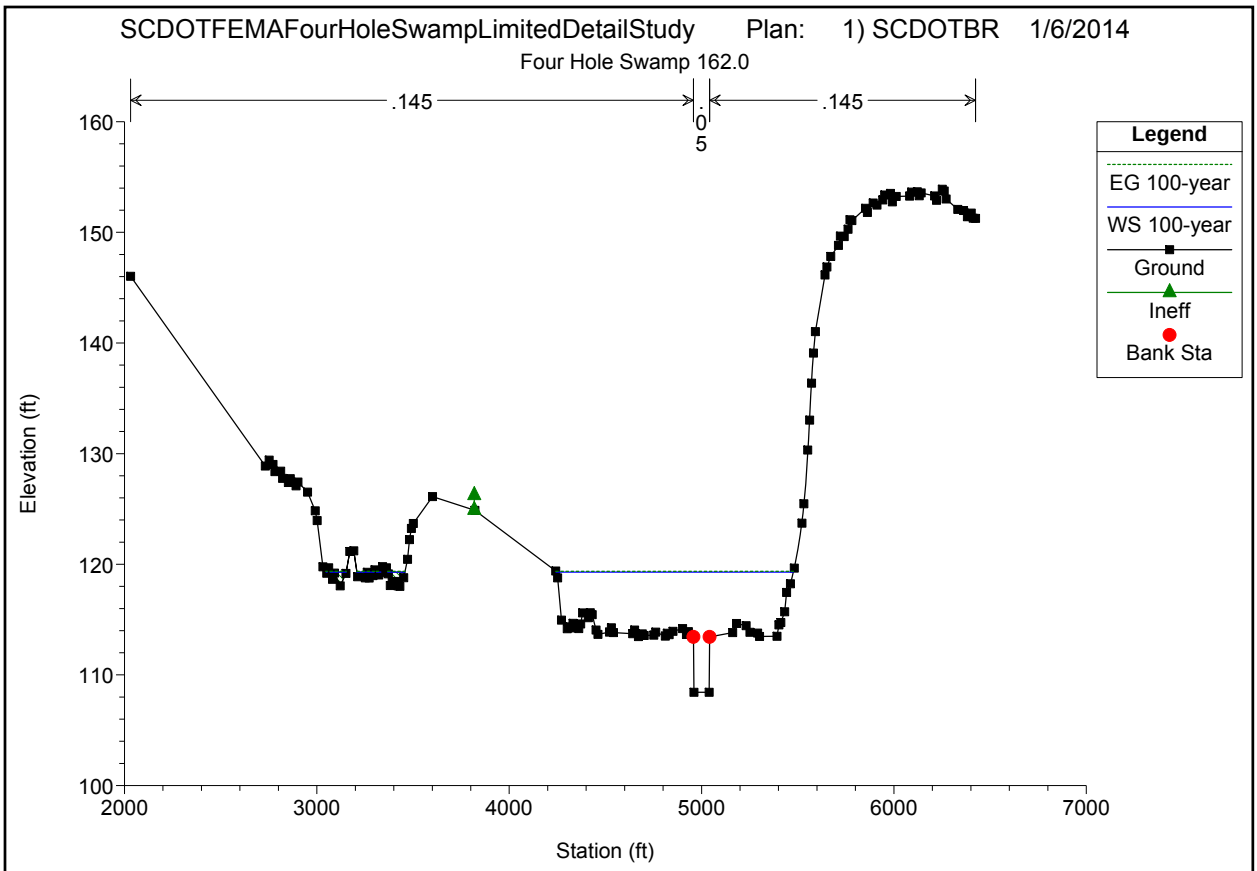
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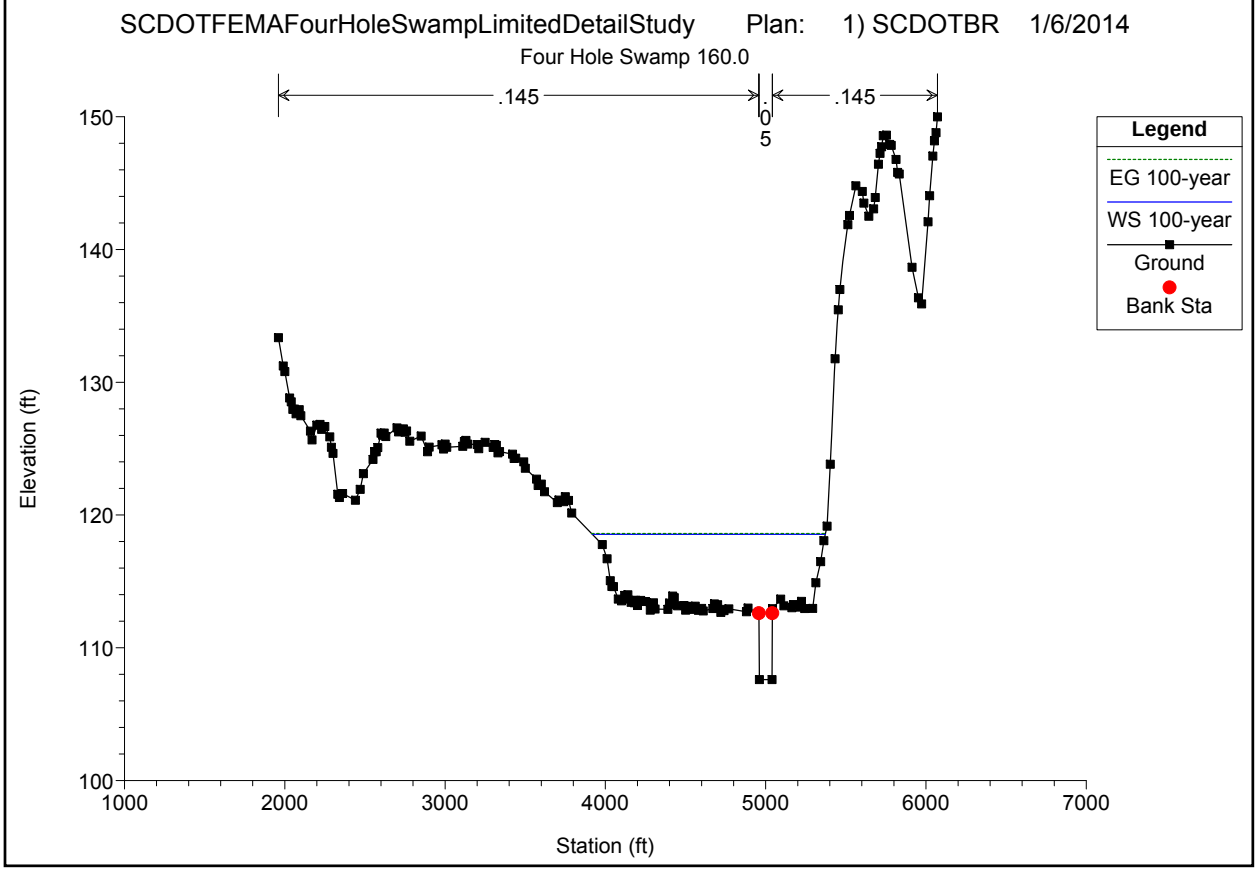
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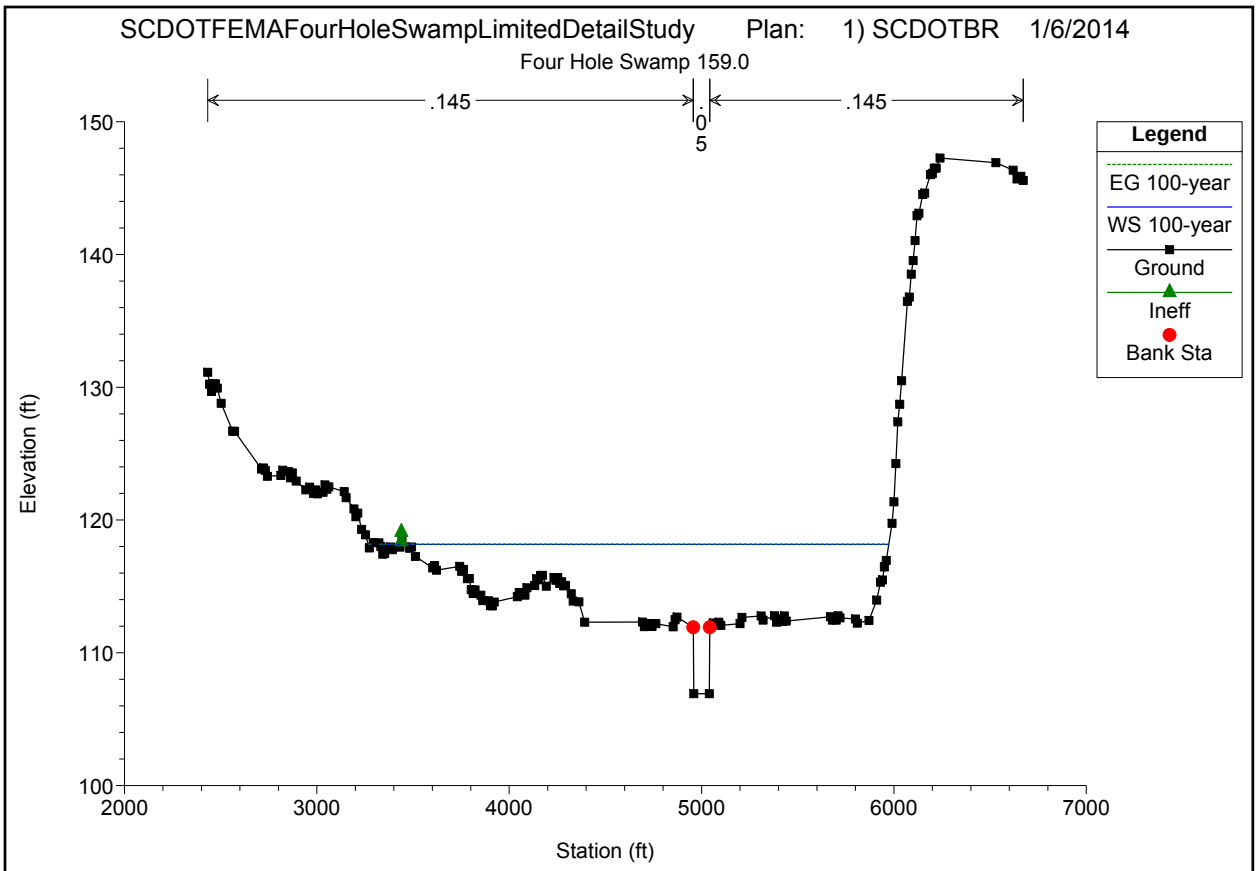
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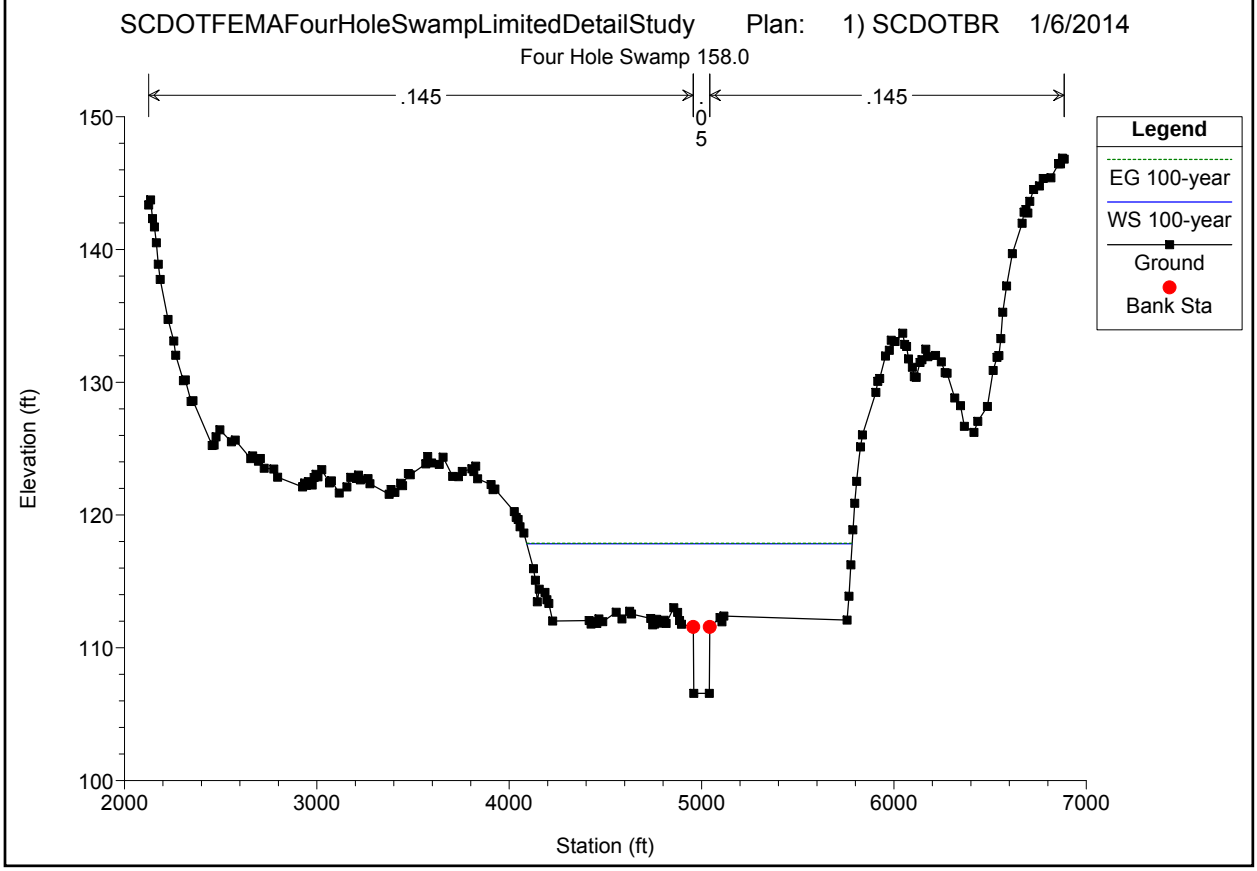
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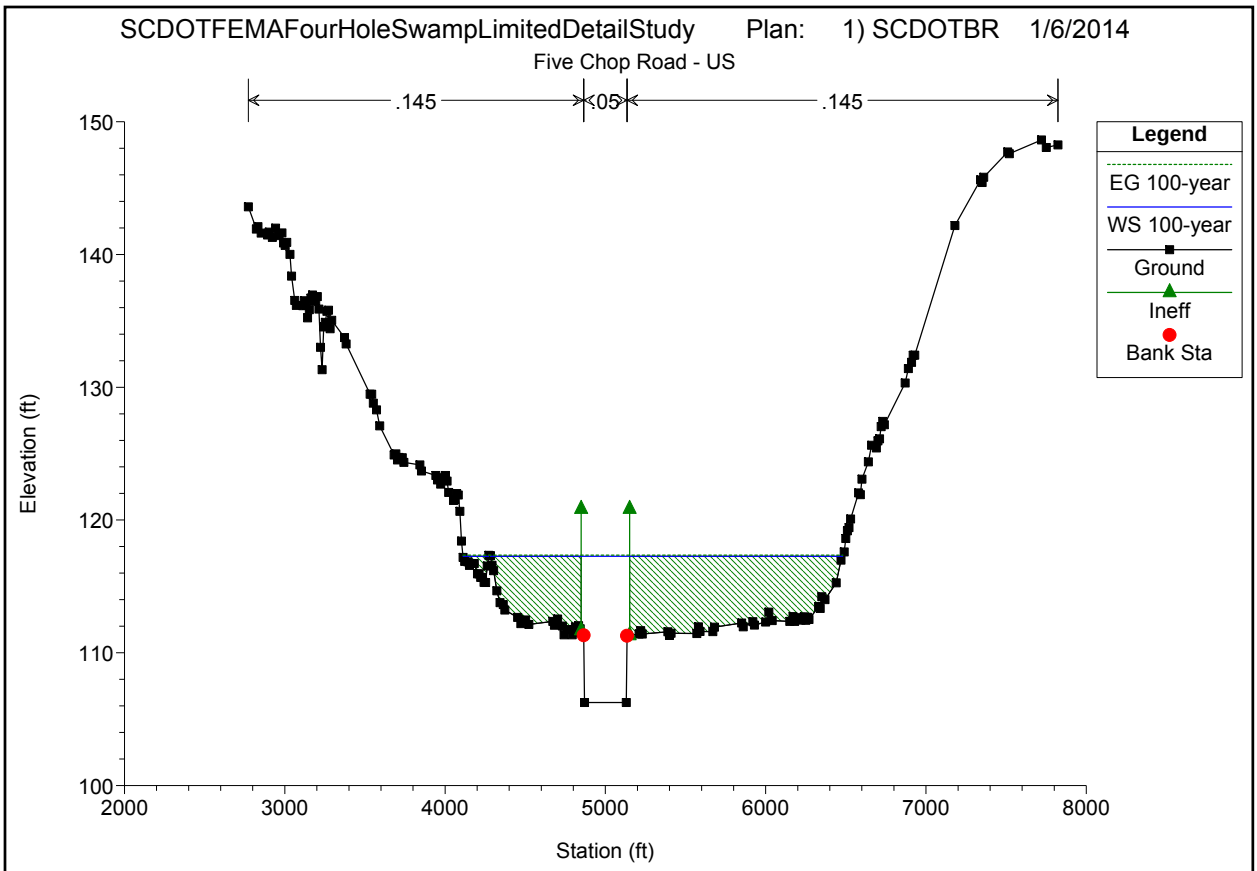
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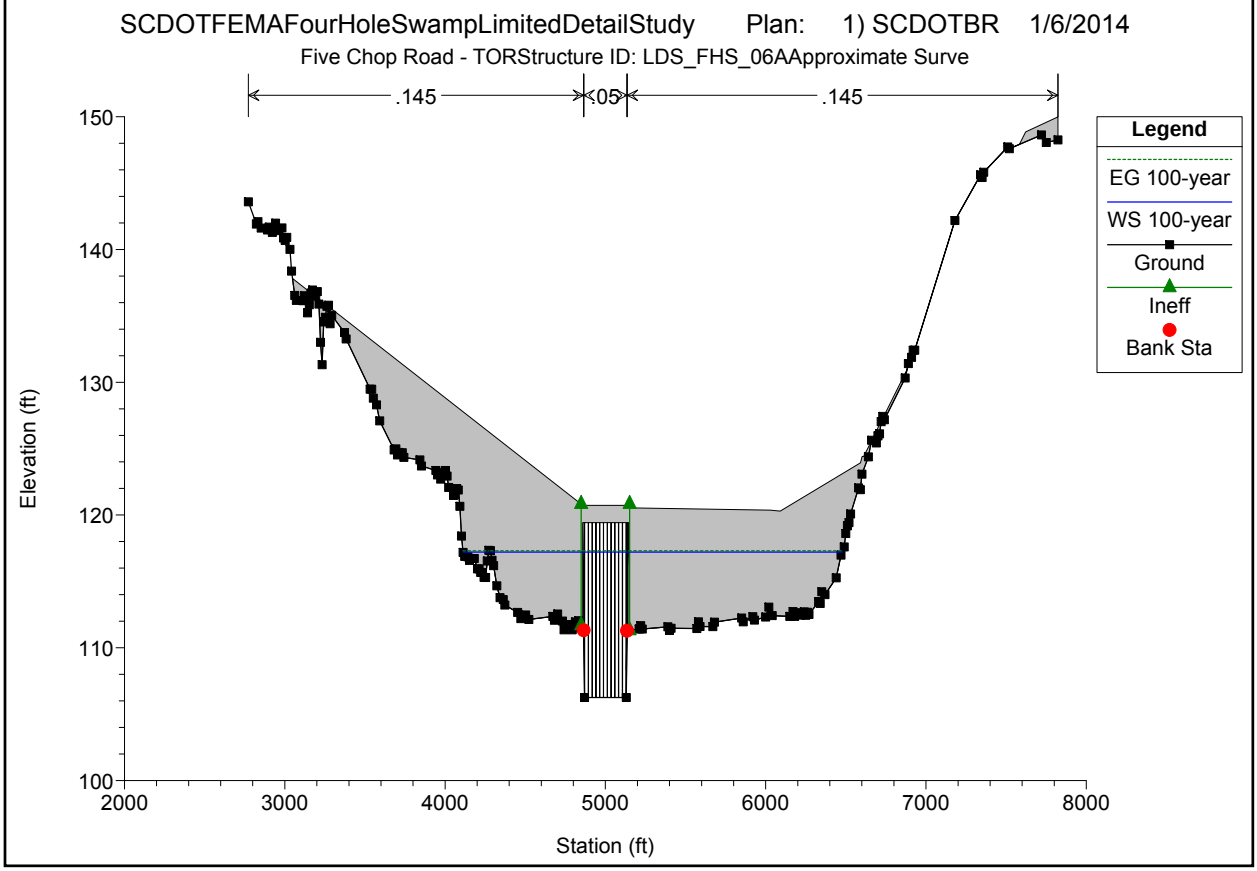
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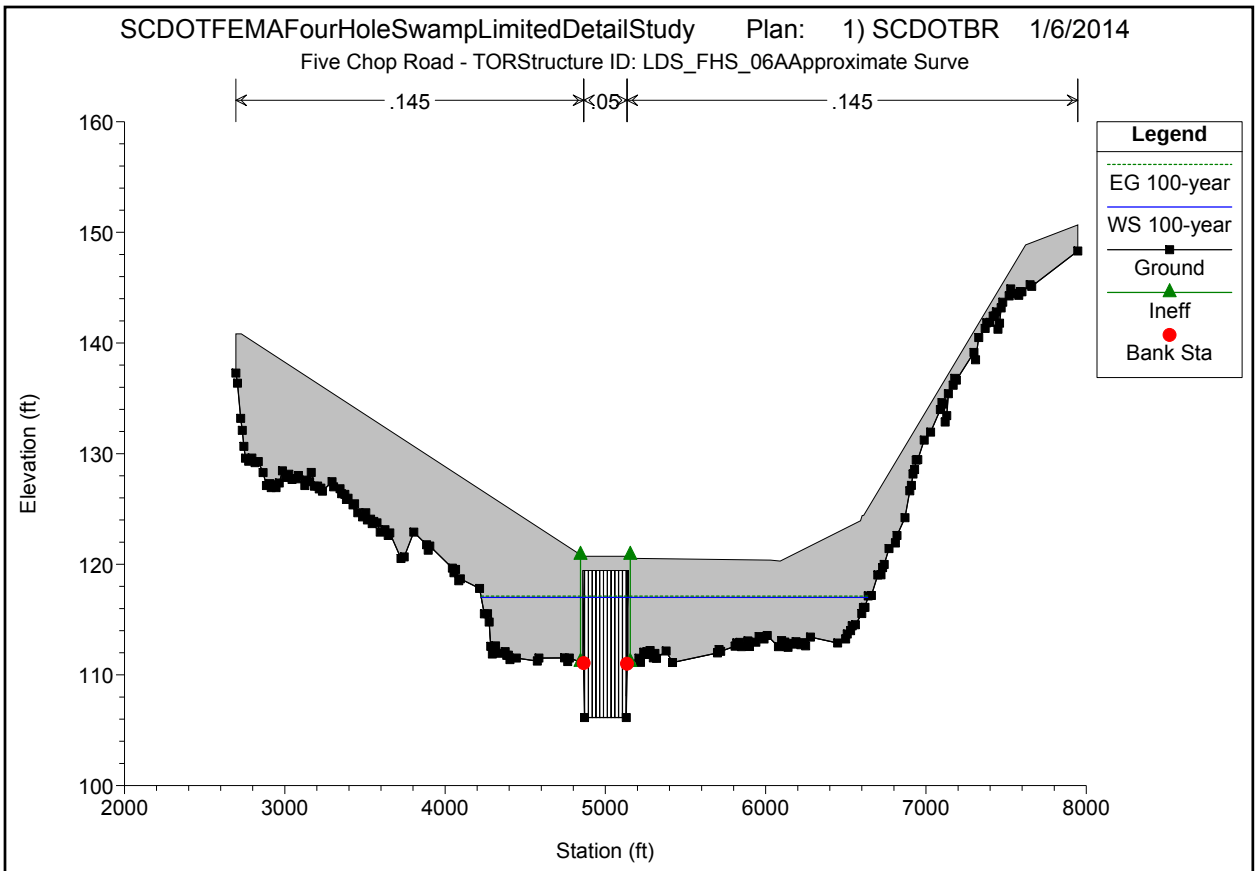
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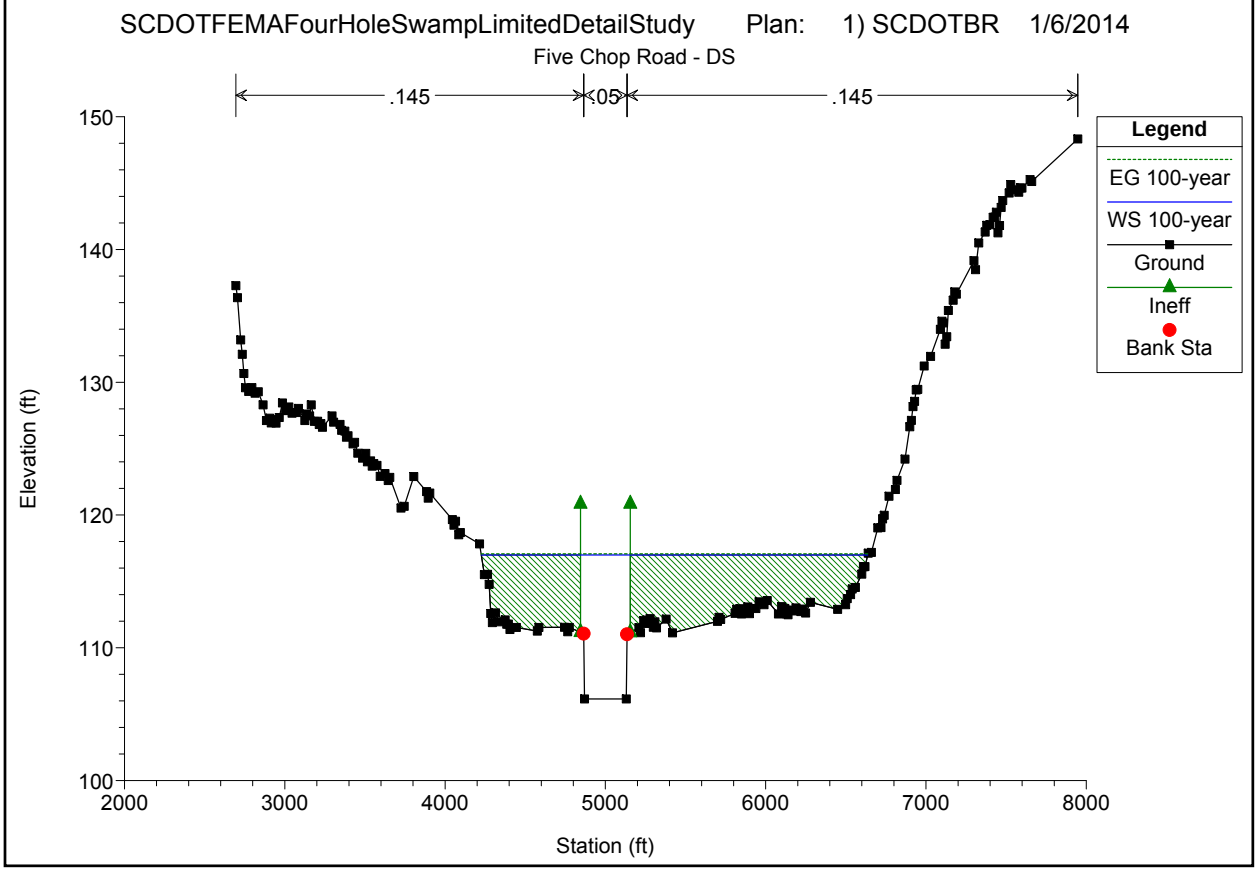
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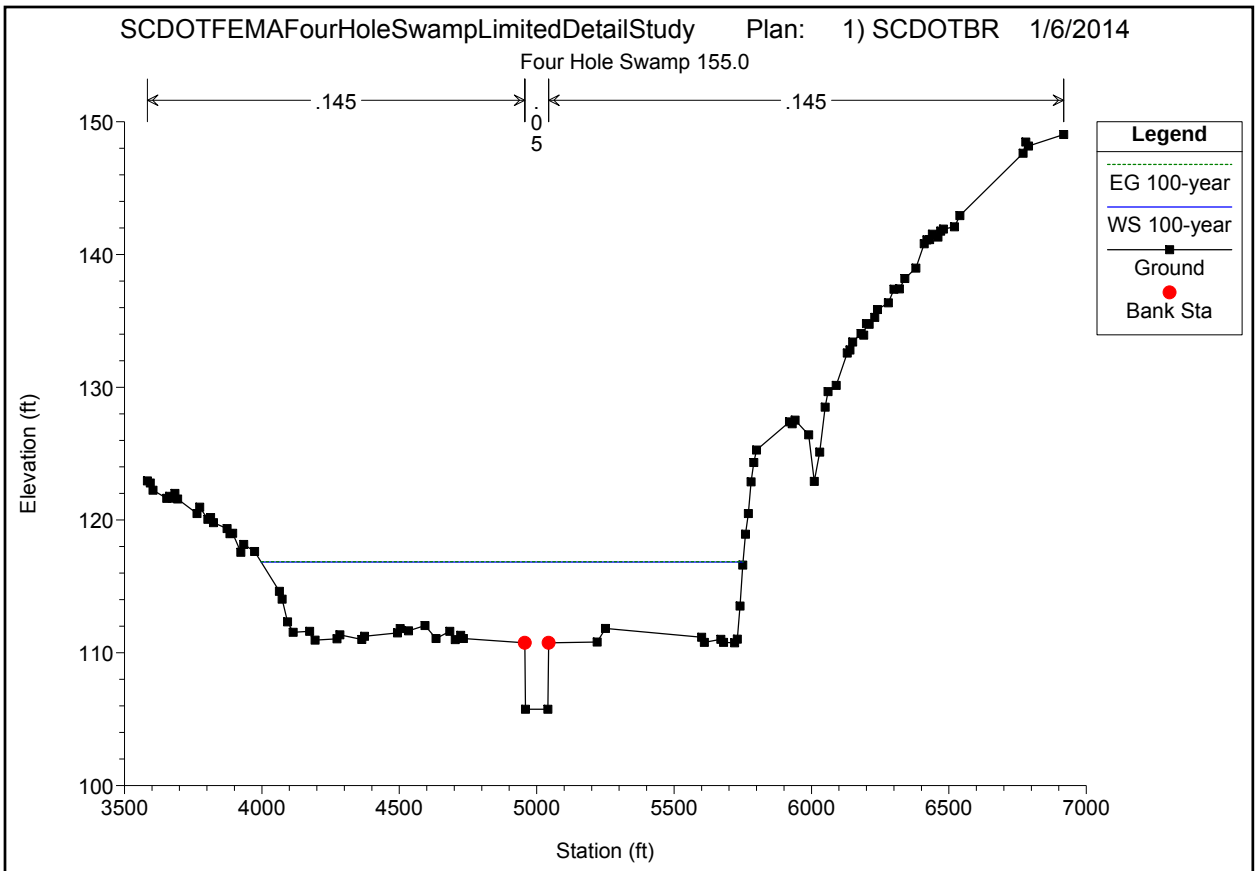
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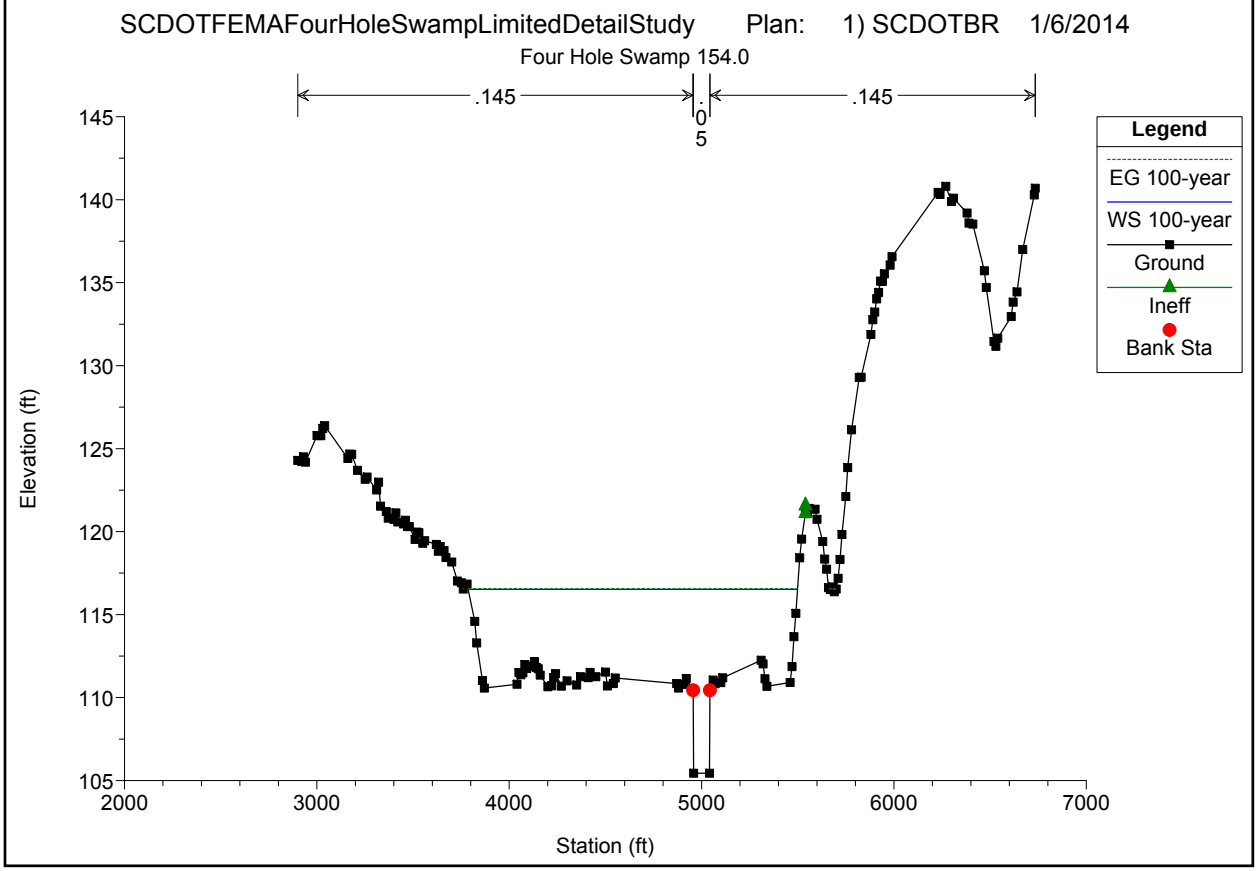
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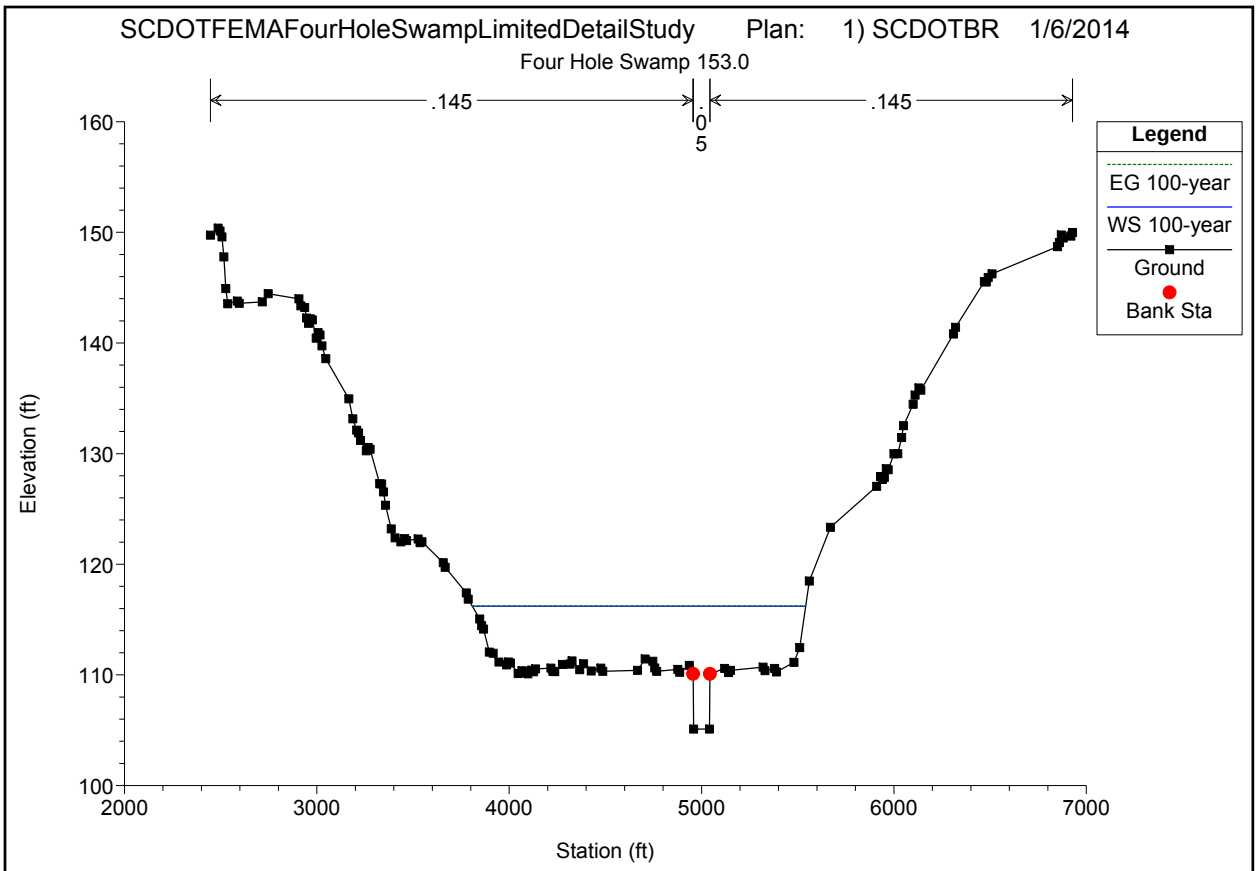
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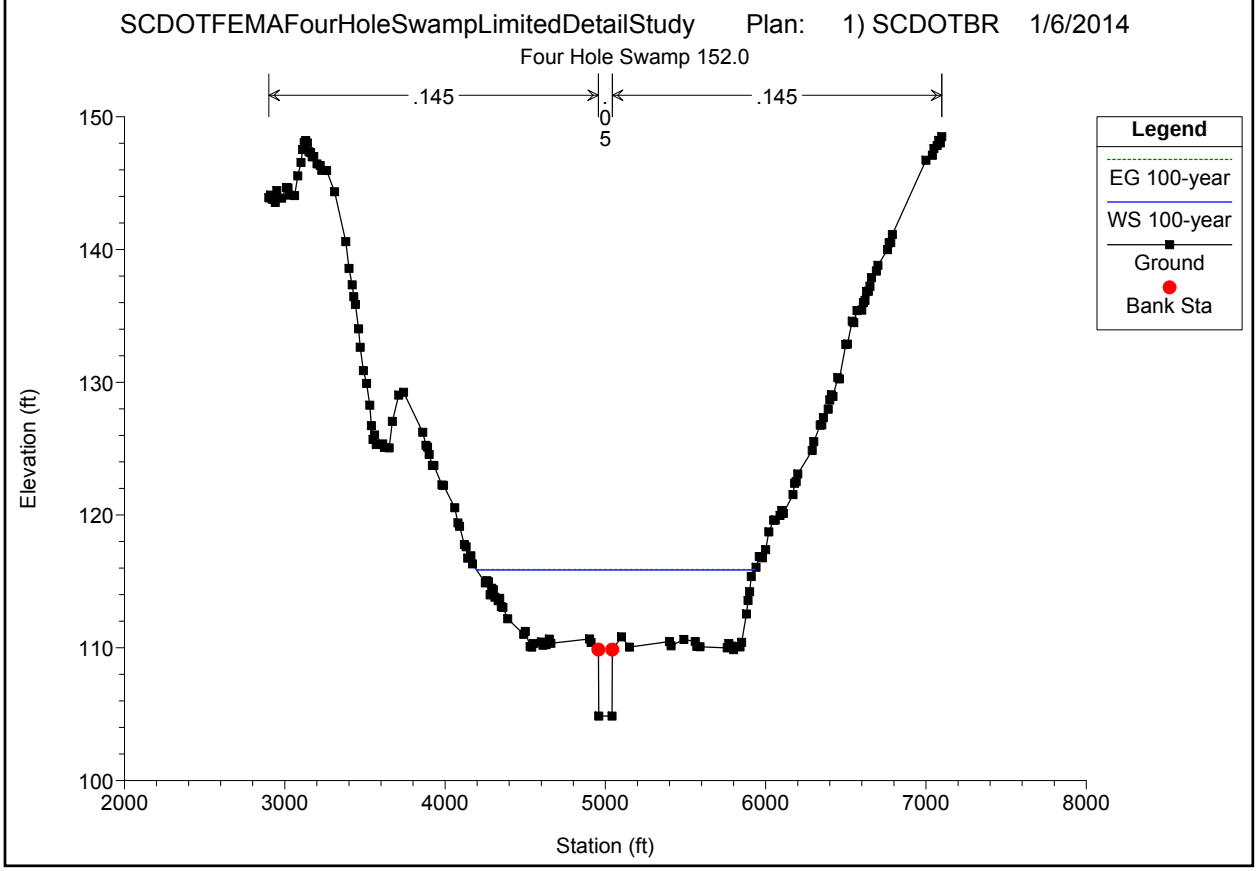
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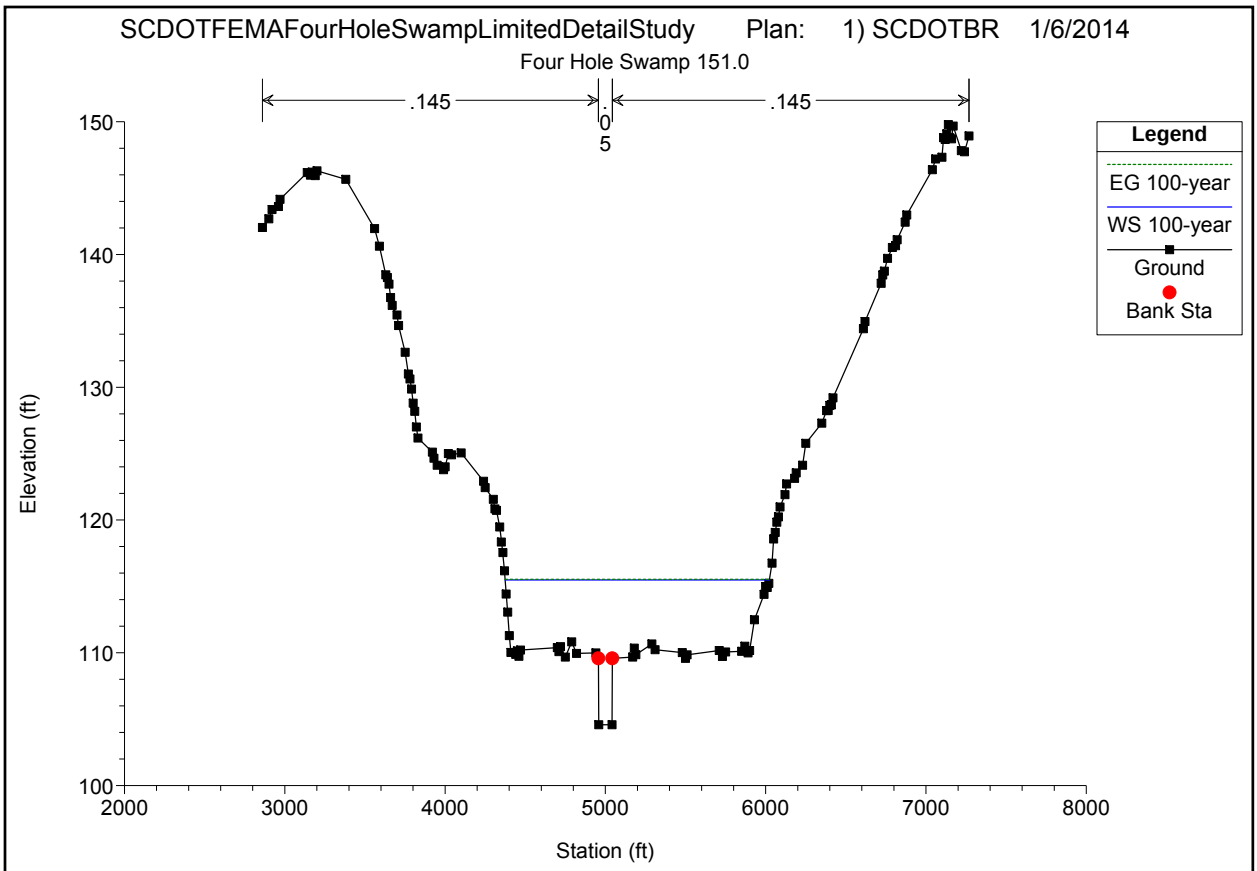
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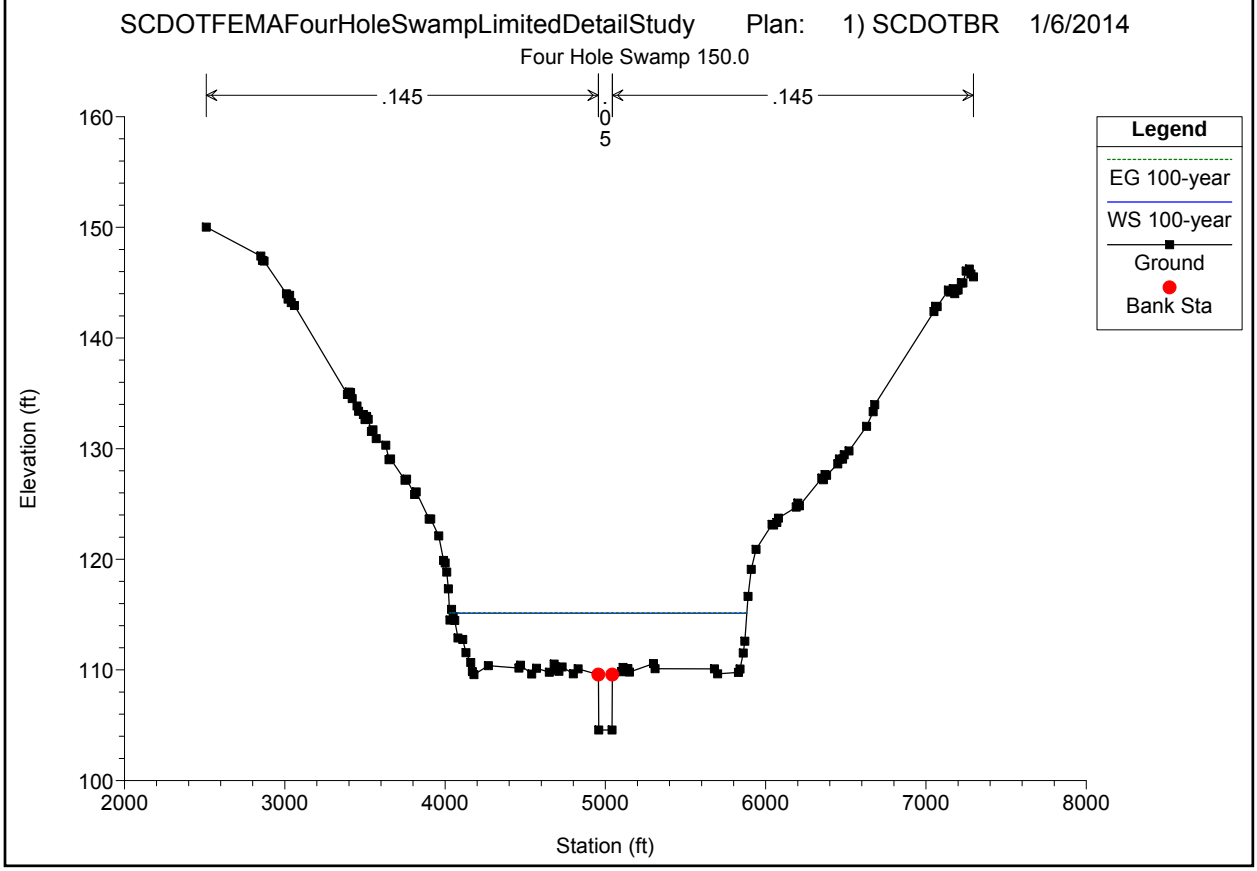
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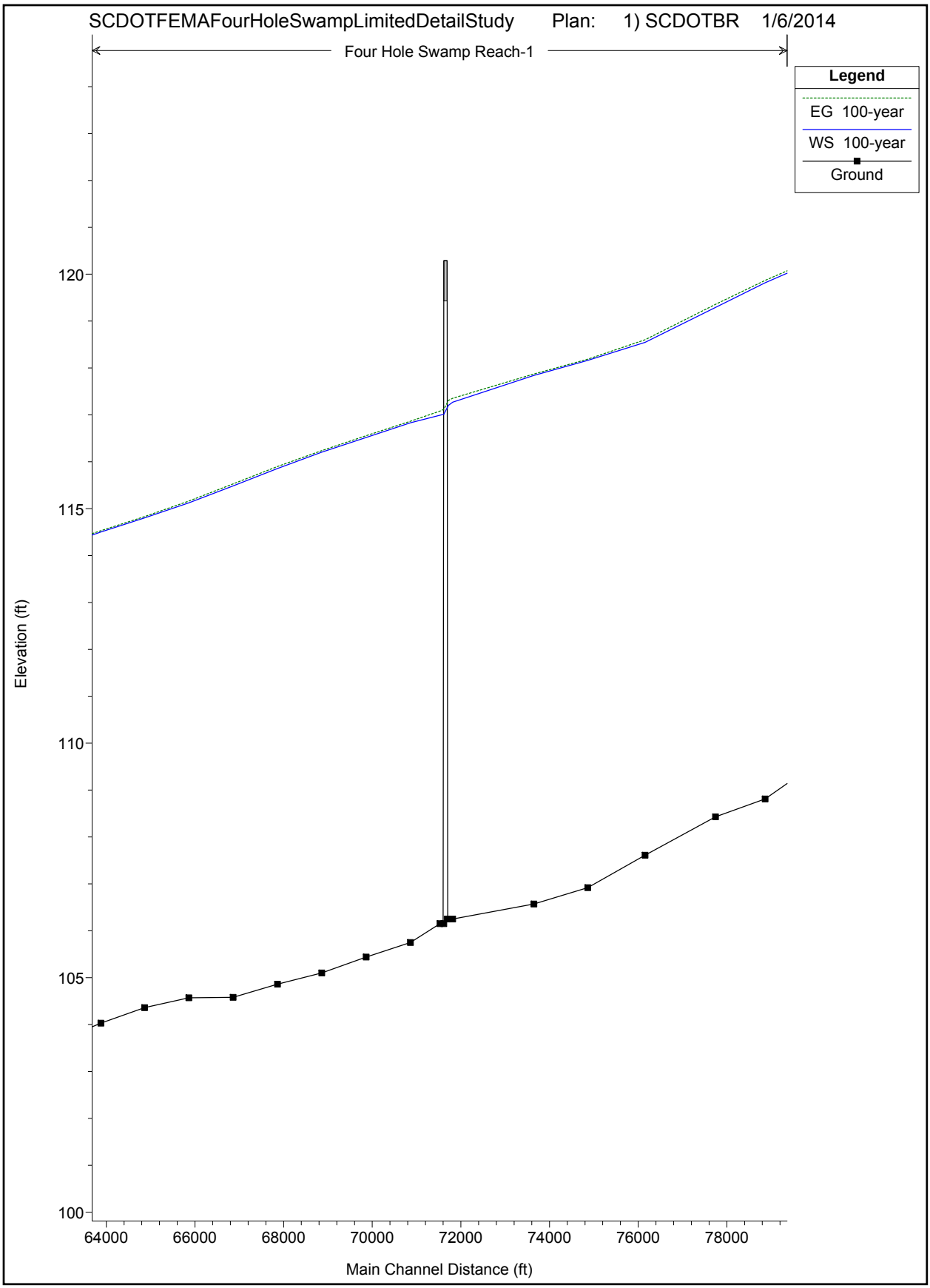

1 in Horiz. = 3204.906 ft 1 in Vert. = 3.030651 ft

APPENDIX K

FEMA COMPLIANCE

COUNTY OF ORANGEBURG

WWW.ORANGEBURGCOUNTY.ORG

Orangeburg
All-America County

February 18, 2014

South Carolina Department of Transportation
Randall Mungo, P.E.
955 Park St.
Columbia SC 29201

Dear Mr. Mungo,
The submitted compliance study and the no-rise certificate for the bridge replacement at 301 SB are acceptable. If you have any additional questions or concerns please let me know.

Sincerely,

Richard Hall
Planning Director

Planning and Land Use Department
PO Drawer 9000, Orangeburg, SC 29116
803-533-6160

ENGINEERING "NO-RISE" CERTIFICATION

This is to certify that I am a duly qualified engineer licensed to practice in the state of South Carolina. It is to further certify that the attached technical data supports the fact that proposed Bridge Replacement At US 301 SB will not increase the Base Flood Elevations
(Name of Development)

(100-year flood), on Four Hole Swamp at published sections in the Flood Insurance Study
(Name of Stream)

for Orangeburg County (45075C), dated January 16, 2014.
(Name of Community & Community ID Number)

And will not increase the Base Flood Elevations (100-year flood) at unpublished cross-sections in the vicinity of the proposed linear development.

Signature George Randall Mungo

Phone Number (803) 737-9872 ***EMAIL*** mungogr@scdot.org

Representing South Carolina Department of Transportation

Address PO Box 191 RM 418

City Columbia ***State*** South Carolina ***Zip Code*** 29202

February 10, 2014
(Date)

SOUTH CAROLINA REGISTERED PROFESSIONAL ENGINEER No. 19843 2-10-14 GEORGE RANDALL MUNGO

George Randall Mungo

Accepted
Richard Hall
2/18/14

Form
Revised 4/01

APPENDIX L

PICTURES

APPENDIX L

PICTURES

Figure K.1: Area Between Upstream and Downstream US 301 Bridges

Figure K.2: US 301 SB Bridge

Figure K.3: Upstream Side of US 301 SB Bridge

Figure K.4: Left Overbank Area

Figure K.5: Area Upstream of Bridge

Figure K.6: Upstream Side of US 301 Bridge

Figure K.7: Right Overbank Area

Figure K.1: Area Between Upstream and Downstream US 301 Bridges

Figure K.2: US 301 SB Bridge

Figure K.3: Upstream Side of US 301 SB Bridge

Figure K.4: Left Overbank Area

Figure K.5: Area Upstream of Bridge

Figure K.6: Upstream Side of US 301 Bridge

Figure K.7: Right Overbank Area