PI NO. 0013994 GORDON COUNTY

SR 136 OVER COOSAWATTEE RIVER & TRIBUTARY

HYDRAULIC AND HYDROLOGICAL STUDY

EXAMINED AND APPROVED:

July 28, 2009
DATE

WILLIAM M. DUVALL, P.E.

STATE BRIDGE ENGINEER

☐ FEMA and Community Coordination Required
☐ Community Coordination Only Required
☒ No FEMA or Community Coordination Required

SECTION 1

HYDRAULIC AND HYDROLOGICAL STUDY

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HYDRAULIC REPORT

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This project involves the replacement of two bridges located on SR 136. Bridge #1 crosses over the Coosawattee River and the bridge #2 crosses the Coosawattee River Tributary approximately 400 feet to the east. The existing 270' long by 26' wide (gutter-to-gutter) bridge over the Coosawattee River will be replaced by a 265' long by 40' wide PSC beam bridge. The existing 150' long by 26' wide bridge over the Coosawattee River Tributary will be replaced by a 150' long by 40' wide PSC beam bridge.

The proposed bridges are located on the same corridor and share the same design parameters. A bridge width of 40 ft. was determined from the Bridge and Structures Design Manual Section 2.9.2.1 for a State Route having a design year ADT greater than 2,000 VPD. The roadway typical section has two 12 ft. travel lanes with 8 ft. shoulders on both sides of the travel way. The design storm is the 50-year storm per the GDOT Drainage Manual for a State Route. The design year ADT is 2,400 VPD and the design speed is 55 mph.

The proposed site is located in Gordon County, Georgia, approximately 5 miles east of Nickelsville. Gordon County participates in the National Flood Insurance Program administered by the Federal Emergency Management Agency (FEMA). A detailed study with regulatory floodways has not been done for this reach of Coosawattee River, so coordination with FEMA or Gordon County will not be required.

Historically, the site was subject to frequent flooding that was verified with preliminary modeling and by talking with local residents. However, in 1977, construction was completed on the Carters Dam and Reregulation Dam located approximately 8 miles

upstream at the mouth of the Coosawattee River. Regulated flows from the dams have greatly reduced the peak flows during storm events and reduced the frequency of flooding in the project area.

Figure 1 – Aerial View of Carters Dam and Lake

Due to the complexity of flows, a 2D modeling approach was taken to calculate hydraulic and hydrologic values. The project site has multiple bridge openings with different skew directions, a junction of flows immediately downstream of the bridges, a wide floodplain upstream, and multiple points of entry for flows to the project site. There is a pipe culvert approximately 100 ft. downstream of the tributary bridge that affects flow through the bridge opening. One-dimensional methods would not adequately model these conditions.

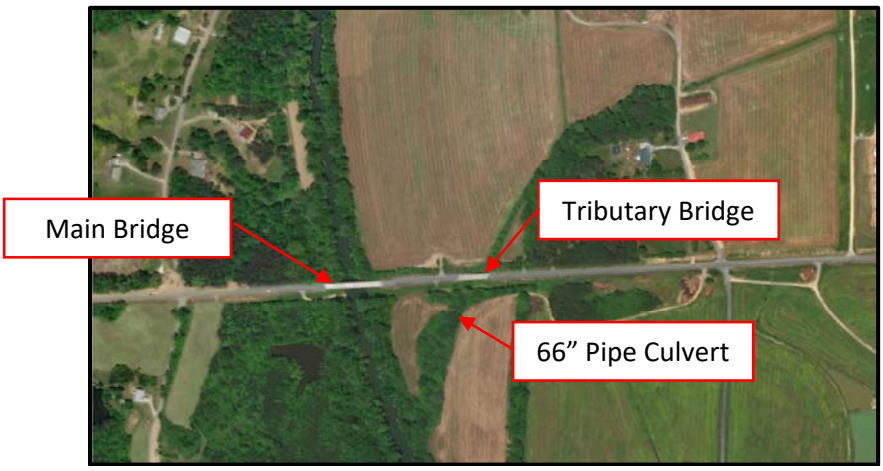

Figure 2 – Aerial view of project showing flow complexity (water flowing top to bottom)

The flood stage elevations, areas of opening, velocities and backwaters for the existing and proposed structures were calculated by using the SRH-2D computer program with SMS 13.0 as the interface. The existing and proposed bridges clear the 50 and 100-year flood stage elevations with no roadway overtopping occurring during either storm. Detailed analysis of the modeling approach will be discussed in section 4 of this report, 'SMS Procedure and Results'.

Bridge #1 (Main Bridge)

The existing main bridge is 270 ft long by 26 ft wide (gutter to gutter). The proposed replacement structure is to be a 265 ft. long by 40 ft. wide (gutter to gutter) PSC beam bridge with stub abutments and is to be located upstream of the existing alignment. The proposed bridge is slightly shorter, but the flow is contained within the channel so the extra length will not be needed. The bents of the proposed bridge are to be built at 80 degrees to the roadway centerline to align with the banks. The skew is required to maintain adequate clearance between the intermediate bents and top of banks. The proposed 265 ft. long bridge was chosen as the minimum length bridge that provides acceptable clearance between the toe of endrolls and the top of banks. The flow is contained within a deep channel, so the proposed span arrangement will mitigate environmental impacts during proposed construction and potential scour risk.

The drainage area of 35 square miles was obtained through multiple steps. First, the USGS StreamStats web application was used to calculate a drainage area of 556 square miles (this value represents the total drainage area if the dams were not in place). Second, the drainage area of 521 square miles that is captured by the dams was subtracted to obtain a final value of 35 square miles. The drainage basin is located entirely in region 1.

Obtaining storm discharges for the main opening was also a multistep process. The 50, 100, and 500-year storm discharges were first determined with the 35 square miles of drainage area using the method in the latest USGS publication, "Magnitude and Frequency of Rural Floods in the Southeastern United States, 2006: Volume 1, Georgia." These flows were subsequently added to the highest regulated flow from the published dam hydrograph to obtain a peak flow for each recurrence interval. The time of concentration for flows coming from the dam and the flows from the watershed area are different, so this method represents a conservative maximum discharge that the bridge would see.

The existing 270 ft. bridge has channel velocities of 6.05 fps for the 50-year flood and 6.28 fps for the 100-year flood. The existing structure creates 0.10 ft. of backwater for the 50-year flood and 0.11 ft. for the 100-year flood. The natural channel velocities for the existing bridge are 5.95 and 6.25 for the 50 and 100 year floods, respectively. The existing bridge is not listed on the Historic Bridge Inventory.

The proposed 265 ft. bridge has channel velocities of 6.24 fps for the 50-year flood and 6.47 fps during the 100-year flood. The 265 ft. bridge creates no backwater during the 50 and 100-year floods. The flow is contained within the channel and there are no bents in the channel so the proposed bridge has negligible effects on the hydraulics. The natural channel velocities for the proposed bridge are 6.24 and 6.47 for the 50 and 100-year floods, respectively. The maximum calculated contraction scour depth for the 100-year storm is 0.49 ft. (see the attached Predicted Scour Report).

Guidebank and riprap calculations were not necessary on the main bridge since all of the flow is contained within the channel. However, type 1 riprap will be used on both endrolls to protect against roadway runoff and unexpectedly high flows released from the

dam. There is no flow in the overbanks at the main bridge, so the riprap apron will not extend from the toe of the endrolls.

Bridge #2 (Tributary Bridge)

The existing tributary bridge is 150 ft long by 26 ft wide (gutter-to-gutter). The proposed replacement structure is to be a 150 ft. long by 40 ft. wide (gutter-to-gutter) PSC beam bridge with stub abutments and is to be located upstream of the existing alignment. The bents of the proposed bridge are to be built at 60 degrees to the roadway centerline to align with the flood flow. The drainage area of 0.7 square miles was obtained using the USGS StreamStats web application. The drainage basin is located entirely in region 1.

The 50, 100 and 500-year storm discharges were determined using the method in the latest USGS publication, "Magnitude and Frequency of Rural Floods in the Southeastern United States, 2006: Volume 1, Georgia."

The existing 150 ft. bridge has channel velocities of 1.33 fps for the 50-year flood and 1.44 fps for the 100-year flood. The existing structure creates 0.11 ft. of backwater for the 50-year flood and 0.13 ft. for the 100-year flood. The natural channel velocities for the existing bridge are 1.33 and 1.42 for the 50 and 100-year floods, respectively. The existing bridge is not listed on the Historic Bridge Inventory.

The proposed 150 ft. long bridge was chosen as the minimum length bridge that provides acceptable clearance between the toe of endrolls and the top of banks. The proposed bridge has channel velocities of 1.34 fps for the 50-year flood and 1.42 fps during the 100-year flood. The proposed velocities are higher than the existing velocities even though the bridge area of opening is increased. This velocity discrepancy is addressed in section 4 of this report, 'SMS Procedure and Results'. The 150 ft. bridge creates 0.05 ft. of

backwater during the 50-year flood and 0.05 ft. of backwater during the 100-year flood. The natural channel velocities for the proposed bridge are 1.15 and 1.20 for the 50 and 100-year floods, respectively. The maximum calculated contraction scour depth for the 100-year storm is 1.25 ft. (see the attached Predicted Scour Report).

Guide bank calculations, performed as prescribed in the FHWA publication HEC No. 23, "Bridge Scour And Stream Instability Countermeasures," indicate that guide banks are not required for the tributary bridge. Calculations for riprap, performed in accordance with the FHWA publication HEC No. 23, "Bridge Scour And Stream Instability Countermeasures," show that Type 3 riprap is sufficient at both endrolls of the tributary bridge. However, per the GDOT Drainage Manual, Type 1 riprap will be used. Additionally, the calculations show that the riprap apron must extend 8 ft. from the toe of the endroll.

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A risk assessment was performed and no risk was determined due to the fact that backwater is improved from the existing conditions for both bridges. There is no potential for property damage or hazard to life to the surrounding development.

Calculations for deck drainage were performed using the method shown in the FHWA publication, HEC No. 21, "Design of Bridge Deck Drainage," and the results indicate that deck drains will be spaced at 10 ft. on both bridges. The site is not located in an MS4 permit area. A culvert was not considered for the main bridge since the drainage area is larger than the 20 square mile limit for culverts. A culvert was not considered for the tributary bridge because a five barrel 10 ft. wide by 12 ft. high box culvert does not provide acceptable backwater and velocity values during high storm events.

SR 136 will be remain open to traffic during the proposed construction. Traffic will be maintained via the existing bridges. The required maps, calculations, computer runs, roadway sheets, and preliminary layouts are included in the following pages.

July 10, 2019

Prepared by: Gary Pierce

Checked by: Susan Beck

HYDRAULIC SITE INSPECTION

PI NO. 0013994 GORDON COUNTY
SR 136 OVER COOSAWATTEE RIVER & TRIBUTARY

A hydraulic site inspection was made at the crossing of SR 136 over Coosawattee River & Tributary on March 20, 2019. The site has one main opening over the Coosawattee River and an opening located to the east over a tributary to the Coosawattee River. A large flat pasture joins the two bridges upstream. A 66" corrugated metal pipe culvert is located approximately 100' downstream of the tributary bridge. The culvert is constructed off GDOT right-of-way and is used by a landowner to access isolated pasture downstream of the bridges. The existing roadway is a paved State Route and is approximately 8 ft above the natural groundline near the bridges. There is residential development around both bridges located outside of the floodplain. An overhead utility line is located approximately 30 ft downstream from the existing bridges and runs parallel to the roadway for the length of the project.

Bridge #1 (Main Bridge)

The existing bridge is a 270 ft long (41'-54'-70'-54'-51' span arrangement) reinforced concrete deck on steel beams. Two intermediate bents in the overbanks consist of steel H-piles with concrete caps and the two intermediate bents in the channel are concrete with concrete web walls between the columns.

The channel is approximately 110 ft wide at its crossing under the bridge. The channel crossing underneath the bridge has a slight skew with no meander upstream or downstream. The channel banks are well defined and are approximately 3 ft high. The channel bed is silty sand based on visible observation. At the time of the site inspection, water was flowing approximately 2.0 ft/sec with an indeterminate depth. There is minor erosion of both banks

underneath the bridge.

The upstream and downstream floodplains are densely wooded with thick undergrowth around the banks. The dense woods extend about 50 ft from the banks and then open into a flat pasture with no obstructions to the east. To the west, the grade rises steeply with residential housing situated at the top well above the high water.

Bridge #2 (Tributary Bridge)

The existing bridge is 150 ft long consisting of five 30' long spans of reinforced concrete "T" beams on concrete caps with steel H-piles.

The channel is approximately 50 ft wide at its crossing under the bridge. The channel crossing underneath the bridge has a 30 degree skew. The channel banks are poorly defined and slowly transition into pasture. The channel bed is silty sand based on visible observation. The water was murky and stagnant at the time of inspection. There is no evidence of erosion around the bridge.

The upstream and downstream floodplains are primarily flat pasture with some lines of dense trees. There is some residential development to the east, but it is also elevated above the high water.

March 20, 2019 Prepared by: Gary M. Pierce

PREDICTED SCOUR REPORT

PI NO. 0013994 GORDON COUNTY
SR 136 OVER COOSAWATTEE RIVER & TRIBUTARY

Theoretical scour depths for the proposed bridges at this site were calculated by using the methods shown in the FHWA publication, HEC No. 18, "Evaluating Scour at Bridges". Contraction scour and local scour were calculated for the 100 and 500 year storms as called for in this publication. The predicted scour depth at each intermediate bent of the proposed bridges will be provided to the Office of Materials Soils Lab and the Bridge Structural Designer for inclusion in the analysis and design of the bridge foundations. Tables and calculations showing these predicted scour depths are included in this study.

June 6, 2019 Prepared by: Gary Pierce

HYDRAULIC TABLE - BRIDGE #1

SR 136 over Coosawattee River & Tributary

50 YEAR STORM	NATURAL (for existing)	EXISTING	NATURAL (for proposed)	PROPOSED
Floodstage (Approach)	645.98	646.08	646.12	646.12
Floodstage (Full Valley)	645.79	645.78	645.80	645.80
Discharge Thru Structure (ft^3/s)	-	9770	-	9770
Discharge Over Road (ft^3/s)	-	0	-	0
Area of Opening (ft^2)	-	1615	-	1566
Velocity Thru Structure (ft/s)	-	6.05	-	6.24
Channel Velocity (ft/s)	5.95	6.05	6.24	6.24
Backwater (ft)	-	0.10	-	0.00

100 YEAR STORM	NATURAL (for existing)	EXISTING	NATURAL (for proposed)	PROPOSED
Floodstage (Approach)	646.53	646.64	646.68	646.68
Floodstage (Full Valley)	646.35	646.33	646.34	646.34
Discharge Thru Structure (ft^3/s)	-	10600	-	10600
Discharge Over Road (ft^3/s)	-	0	-	0
Area of Opening (ft^2)	-	1688	-	1638
Velocity Thru Structure (ft/s)	-	6.28	-	6.47
Channel Velocity (ft/s)	6.25	6.28	6.47	6.47
Backwater (ft)	-	0.11	-	0.00

500 YEAR STORM	NATURAL (for existing)	EXISTING	NATURAL (for proposed)	PROPOSED
Floodstage (Approach)	647.87	648.00	648.01	648.01
Floodstage (Full Valley)	647.68	647.66	647.64	647.64
Discharge Thru Structure (ft^3/s)	-	12710	-	12710
Discharge Over Road (ft^3/s)	-	0	-	0
Area of Opening (ft^2)	-	1877	-	1811
Velocity Thru Structure (ft/s)	-	6.77	-	7.02
Channel Velocity (ft/s)	6.74	6.77	7.02	7.02
Backwater (ft)	-	0.13	-	0.00

Note: The above values represent a 1D cross section extracted from a 2D model

HYDRAULIC TABLE - BRIDGE #2

SR 136 over Coosawattee River & Tributary

50 YEAR STORM	NATURAL (for existing)	EXISTING	NATURAL (for proposed)	PROPOSED
Floodstage (Approach)	650.84	650.95	650.84	650.89
Floodstage (Full Valley)	650.76	650.74	650.77	650.77
Discharge Thru Structure (ft^3/s)	-	494	-	494
Discharge Over Road (ft^3/s)	-	0	-	0
Area of Opening (ft^2)	-	440	-	421
Velocity Thru Structure (ft/s)	-	1.12	-	1.17
Channel Velocity (ft/s)	1.34	1.33	1.15	1.34
Backwater (ft)	-	0.11	-	0.05

100 YEAR STORM	NATURAL (for existing)	EXISTING	NATURAL (for proposed)	PROPOSED
Floodstage (Approach)	651.14	651.27	651.14	651.19
Floodstage (Full Valley)	651.05	651.04	651.07	651.06
Discharge Thru Structure (ft^3/s)	-	581	-	581
Discharge Over Road (ft^3/s)	-	0	-	0
Area of Opening (ft^2)	-	483	-	465
Velocity Thru Structure (ft/s)	-	1.20	-	1.25
Channel Velocity (ft/s)	1.42	1.44	1.20	1.42
Backwater (ft)	-	0.13	-	0.05

500 YEAR STORM	NATURAL (for existing)	EXISTING	NATURAL (for proposed)	PROPOSED
Floodstage (Approach)	651.70	651.88	651.70	651.79
Floodstage (Full Valley)	651.60	651.59	651.62	651.63
Discharge Thru Structure (ft^3/s)	-	790	-	790
Discharge Over Road (ft^3/s)	-	0	-	0
Area of Opening (ft^2)	-	557	-	548
Velocity Thru Structure (ft/s)	-	1.42	-	1.44
Channel Velocity (ft/s)	1.58	1.70	1.34	1.62
Backwater (ft)	-	0.18	-	0.09

Note: The above values represent a 1D cross section extracted from a 2D model

SITE INSPECTION PHOTOS

Upstream Floodplain Near Bridge #1 Showing Development

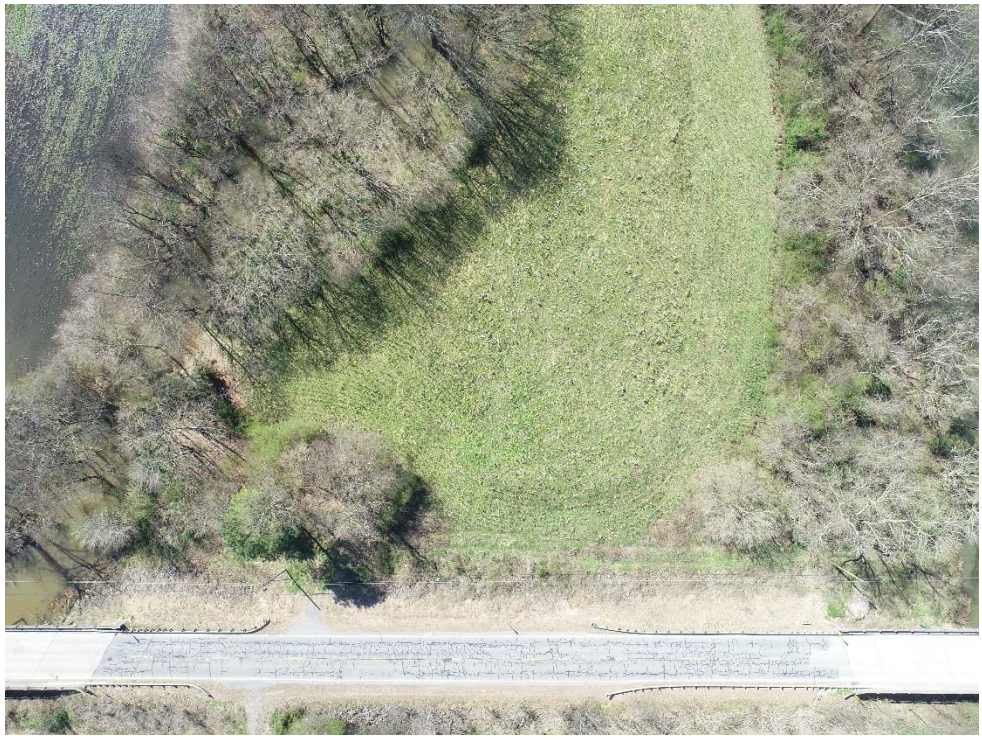
Upstream Floodplain Between Bridges

SITE INSPECTION PHOTOS CONTINUED…

Upstream Floodplain Near Bridge #2 Showing Development

Downstream Channel and Floodplain Near Bridge #1

SITE INSPECTION PHOTOS CONTINUED…



Downstream Floodplain Between Bridges

Downstream Floodplain Near Bridge #2

SITE INSPECTION PHOTOS CONTINUED…

Upstream Face of Bridge #1 Looking at Downstream Channel

Downstream Face of Bridge #1 Looking at Upstream Channel

SITE INSPECTION PHOTOS CONTINUED…

Upstream Face of Bridge #2

Downstream Face of Bridge #2

SITE INSPECTION PHOTOS CONTINUED…

Upstream Channel of Bridge #2

Downstream Channel of Bridge #2

SITE INSPECTION PHOTOS CONTINUED…

Looking East Down Roadway Hovering near Bridge #1

Looking West Down Roadway Hovering Near Bridge #2

SITE INSPECTION PHOTOS CONTINUED…

Aeirial View Showing Both Bridges With Floodplain

Pipe Culvert Upstream of Bridge #2

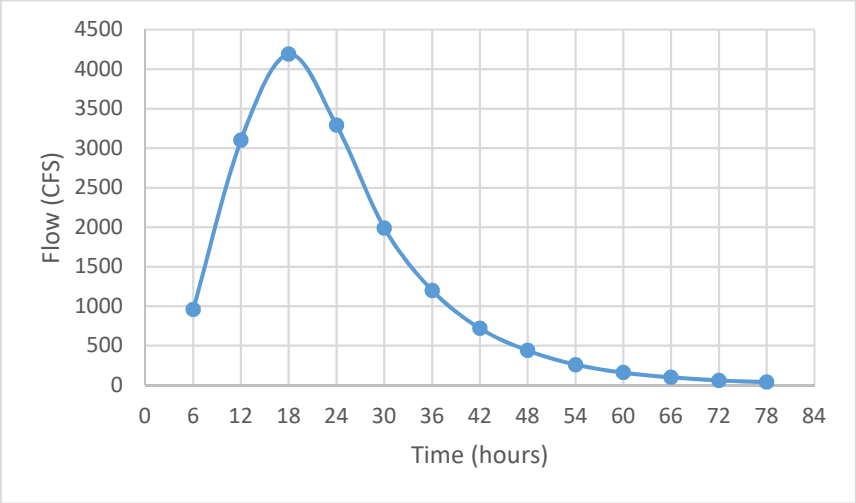
Peak Flow Analysis - Bridge #1

SR 136 over Coosawattee River & Tributary

Latitude: 34.60081
Longitude: -84.77837

6-hour Unit Hydrograph for Carters Reregulation Dam

Time	Flow (cfs)
6	960
12	3100
18	4190
24	3290
30	1990
36	1200
42	720
48	440
54	260
60	160
66	100
72	60
78	40



Peak-Flow Statistics Parameters

Code	Description	Value	Unit
PCTREG1	Area in Region 1	100.0	percent
PCTREG2	Area in Region 2	0	percent
PCTREG3	Area in Region 3	0	percent
PCTREG4	Area in Region 4	0	percent
PCTREG5	Area in Region 5	0	percent

Peak-Flow Statistics Flow Report

Exceedence Interval	Total Flow (cfs)	Maximum Regulated Dam Flow (cfs)	USGS Ungaged Flow (cfs)
50%	5780	4190	1590
20%	6930	4190	2740
10%	7760	4190	3570
4%	8820	4190	4630
2%	9770	4190	5580
1%	10600	4190	6410
0.5%	11430	4190	7240
0.2%	12710	4190	8520

Peak flow for ungaged location calculated using USGS - Guage Application of Methods Tool v1-3.

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: SR 136 over Coosawattee River

Enter the explanatory variables:

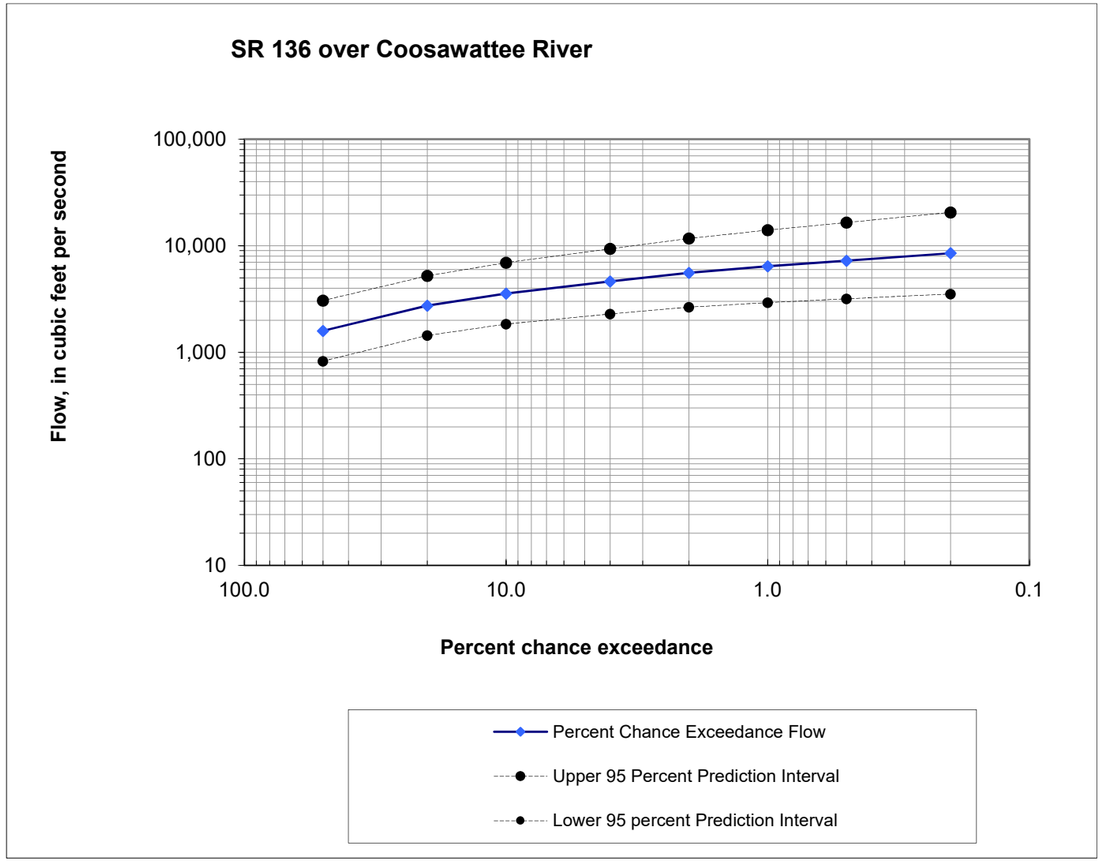
Drainage area, in square miles	35
Percent of basin in Hydrologic Region 1	100
Percent of basin in Hydrologic Region 2	0
Percent of basin in Hydrologic Region 3	0
Percent of basin in Hydrologic Region 4	0
Percent of basin in Hydrologic Region 5	0

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	1,590	827	3,060	-28.4	39.6	34.3
20	2,740	1,440	5,220	-28.0	39.0	33.8
10	3,570	1,840	6,940	-28.7	40.3	34.9
4	4,630	2,290	9,380	-30.2	43.3	37.2
2	5,580	2,650	11,700	-31.6	46.1	39.3
1	6,410	2,930	14,000	-32.9	49.1	41.6
0.5	7,240	3,170	16,500	-34.3	52.3	44.0
0.2	8,520	3,530	20,600	-36.2	56.8	47.4



Peak Flow Analysis - Bridge #2

SR 136 over Coosawattee River & Tributary

USGS - StreamStats Report

Latitude:	34.60090
Longitude:	-84.77641
Time:	5/9/2019
Application Version:	4.3.1

Basic Characteristics

Code	Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.71	square miles
LC06IMP	Percentage of impervious area from NLCD 2006	2.9	percent
LC06DEV	Percentage of land-use from NLCD 2006	12.4	percent
LC06FOREST	Percentage of forest from NLCD 2006	16.1	percent
LC06AGRI	Percent agriculture computed as total of grass	70.7	percent
CSL10_85	Hydraulic slope between points 10% and 85%	35.9	feet per mile

Peak-Flow Statistics Parameters

Code	Description	Value	Unit
PCTREG1	Area in Region 1	100.0	percent
PCTREG2	Area in Region 2	0	percent
PCTREG3	Area in Region 3	0	percent
PCTREG4	Area in Region 4	0	percent
PCTREG5	Area in Region 5	0	percent

Peak-Flow Statistics Flow Report

Exceedence Interval	Flow (cfs)	Average standard error	Lower Interval	Upper Interval
50%	140	31.9	75.6	258
20%	235	25.4	143	387
10%	310	25	192	499
4%	412	27	244	693
2%	494	29.3	281	868
1%	581	32.1	312	1080
0.5%	673	35.1	344	1320
0.2%	790	37.5	387	1610

Peak-Flow Statistics Citations

Gotvald, A.J., Feaster, T.D., and Weaver, J.C.,2009, Magnitude and Frequency of Rural Floods in the Southeastern United States, 2006: Volume 1, Georgia: U.S. Geological Survey Scientific Investigations Report 2009-5043, 120 p.

SECTION 2

SUPPORTING CALCULATIONS

GUIDEBANK AND RIPRAP CALCULATIONS

PREDICTED SCOUR

DECK DRAINAGE

CLEARANCE

GUIDEBANK & RIPRAP - BRIDGE #2

SR 136 over Coosawattee River & Tributary

GUIDE BANK LENGTH

Input Data			Left Bank	Right Bank
	Q_f	Discharge intercepted by the embankment (cfs)	258.28	103.13
	Q_{100}	Discharge in 100 ft of stream (cfs)	219.59	219.59
	b	Length of bridge opening (ft)	150	150
Results				
	Q_f/Q_{100}	Guidebank discharge ratio	1.18	0.47
	V_n	Average velocity through bridge opening (cfs)	1.25	1.25
	L_s	**Projected length of guide bank (ft)**	**≤ 50**	**≤ 50**

Note: A sufficient need for guidebanks, e.g., lengths greater than 150 ft, must be met before being considered for construction.

RIP RAP DESIGN

Input Data		Left Bank	Right Bank
	Set back length (ft)	50.00	15.00
	Average depth of main channel at bridge (ft)	2.36	2.77
	Set back ratio	21.19	5.42
	Discharge at abutment (cfs)	5.82	237.17
	Area at abutment (ft^2)	58.20	228.05
	Characteristic average velocity (ft/s)	0.10	1.04
	Average depth of overbank flow (ft)	2.36	2.77
	Froude number	0.01	0.11
Results			
	Median stone diameter required, D_{50}	0.00	0.02
	Type of riprap required	**TYPE 3**	**TYPE 3**

Note: Type III riprap is sufficient at both endrolls of the proposed bridge however, per the GDOT Drainage Manual, Type I riprap will be used.

The above equations are shown in the FHWA publication HEC No. 23, "Bridge Scour and Stream Instability Countermeasures."

SCOUR CALCULATIONS - BRIDGE #2

SR 136 over Coosawattee River & Tributary

100 YEAR STORM

CONTRACTION SCOUR

Input Parameters	**Left Bank**	**Channel**	**Right Bank**	
Average Depth Upstream of Contraction	2.63	8.30	2.70	ft
D50	0.0005	0.0005	0.0005	ft
Average Velocity Upstream	0.78	1.34	0.80	ft/s
Results of Scour Condition				
Critical velocity	1.04	1.26	1.05	ft/s
Contraction Scour Condition	Clear Water	Live Bed	Clear Water	
Live Bed Input Parameters				
Temperature of Water	-	60.00	-	°F
Slope of Energy Grade Line	-	0.0020	-	ft/ft
Flow in Contracted Section	6.00	334.00	237.00	cfs
Flow Upstream that is Transporting Sediment		210.00		cfs
Width in Contracted Section	25.84	32.26	82.37	ft
Width Upstream	-	18.88	-	ft
Depth Prior to Scour in Contracted Section	2.36	7.29	2.77	ft
Unit Weight of Water	-	62.40	-	lb/ft^3
Unit Weight of Sediment	-	165.00	-	lb/ft^3
Results				
k1	-	0.69	-	
Shear Velocity	-	0.73	-	ft/s
Fall Velocity	-	0.05	-	ft/s
Average Depth in Contracted Section	0.29	8.54	2.53	ft
Scour Depth	**0.00**	**1.25**	**0.00**	**ft**

Scour calculations performed in Hydraulic Toolbox v4.3 with equations shown in the FHWA publication HEC No. 18, "Evaluating Scour at Bridges, Fifth Edition."

SCOUR CALCULATIONS - BRIDGE #2

SR 136 over Coosawattee River & Tributary

500 YEAR STORM

CONTRACTION SCOUR

Input Parameters	**Left Bank**	**Channel**	**Right Bank**	
Average Depth Upstream of Contraction	3.04	8.89	3.09	ft
D50	0.0005	0.0005	0.0005	ft
Average Velocity Upstream	0.92	1.51	0.93	ft/s
Results of Scour Condition				
Critical velocity	1.07	1.28	1.07	ft/s
Contraction Scour Condition	Clear Water	Live Bed	Clear Water	
Live Bed Input Parameters				
Temperature of Water	-	60.00	-	°F
Slope of Energy Grade Line	-	0.0020	-	ft/ft
Flow in Contracted Section	18.00	410.00	357.00	cfs
Flow Upstream that is Transporting Sediment		254.00		cfs
Width in Contracted Section	25.85	32.26	86.12	ft
Width Upstream	-	18.88	-	ft
Depth Prior to Scour in Contracted Section	2.92	7.85	3.2	ft
Unit Weight of Water	-	62.40	-	lb/ft^3
Unit Weight of Sediment	-	165.00	-	lb/ft^3
Results				
k1	-	0.69	-	
Shear Velocity	-	0.76	-	ft/s
Fall Velocity	-	0.05	-	ft/s
Average Depth in Contracted Section	0.75	9.26	3.46	ft
Scour Depth	**0.00**	**1.41**	**0.26**	**ft**

Scour calculations performed in Hydraulic Toolbox v4.3 with equations shown in the FHWA publication HEC No. 18, "Evaluating Scour at Bridges, Fifth Edition."

Geometric Variables

FLAT GRADE	**CONSTANT GRADE**	VERTICAL CURVE

g1	=	**-0.9887**	%	Grade 1, vertical grade before PVI
g2	=	n/a	%	Grade 2, vertical grade after PVI
LVC	=	n/a	ft	Length of vertical curve
PVI	=	n/a	-	Station at PVI
Beg	=	**22+40.00**	-	Station at beginning of bridge
L	=	**265.00**	ft	Length of bridge

Preliminary Data Analysis

Freq	=	**10**	year	Storm frequency -- 10 year per GDOT design manual
Speed	=	**55**	mph	Vehicle design speed
ID	=	**129-0037-0**	-	Existing Bridge Serial Number

Street Hydraulics

W_p	=	**20.000**	ft	Width being drained -- typically half of pavement
T	=	**8.0000**	ft	Design spread
S_x	=	**2.0**	%	Cross-slope of deck
n	=	**0.016**	-	Manning's coefficient -- typically, n = 0.016
C	=	**0.90**	-	Runoff -- typically, C = 0.9 for pavements

Inlet Specifications

CURB INLET	NEENAH	HEC-22	**GDOT**

4 in. Scupper			Grate Details
L	=	0.33	ft	Inlet opening length
W	=	0.33	ft	Inlet opening width
H	=	n/a	ft	Inlet opening height
a	=	n/a	ft	Local Inlet depression

Capacity determined by information found in GDOT drainage manual, capacity in-sump determined by weir/orifice hydraulics.

Design Notes

- Design spread calculated from GDOT Drainage Manual section 12.2.2

Establishment of Rainfall Intensity

Closest station

Ranger

Station Information

Ranger, GA
CARTERS 1 WSW
34.6061^0 LAT
-84.7194^0 LON
740 ft

Station Location

IDF Calculations

t_o	=	**0.70**	min
t_g	=	**4.42**	min
t_c	=	**5.12**	min
t_t	=	**5.08**	min
i	=	**7.78**	in/hr
L_o	=	**408**	ft

Inlet requirement

NO INLETS NEEDED

Rainfall intensity is calculated using intensity-duration-frequency (IDF) curves and methods consistent with GDOT drainage manual. Point precipitation frequency estimates are taken from NOAA Atlas 14 Volume 9 for partial duration time series.

Inlet Spacing on Flat Bridge

P_{INLET}	=	**1.05**	ft	Inlet perimeter
P_{REQ}	=	**3.59**	ft	Required inlet perimeter
L_c	=	**219**	ft	Inlet spacing assuming 100% efficiency
Spacing	=	**63**	ft	Required inlet spacing

Inlet Spacing for Bridge on Grade

	Spacing (ft)	Gutter Flow (cfs)	Efficiency (%)	Bypass (cfs)	Spread (ft)
L_0					
L_1					
L_2					
L_3					
L_4					
L_n					

Flat bridge spacing should be considered for bridges with grades less than 0.03%.

Hydroplaining and Visibility

Hydroplane Depth	=	**0.080 in**	Depth at which hydroplaning can occur
Hydroplain	=	**At Risk**	Risk of hydroplaning at rain intensity
Visibility	=	**Reduced**	Risk of impaired vision due to rain

Hydroplaning and visibility design procedures taken from methods in HEC-22. Methods shown are for constant-slope and flat bridges.

Geometric Variables

FLAT GRADE	**CONSTANT GRADE**	VERTICAL CURVE

g1	=	**0.2653**	%	Grade 1, vertical grade before PVI
g2	=	n/a	%	Grade 2, vertical grade after PVI
LVC	=	n/a	ft	Length of vertical curve
PVI	=	n/a	-	Station at PVI
Beg	=	**29+29.00**	-	Station at beginning of bridge
L	=	**165.00**	ft	Length of bridge

Preliminary Data Analysis

Freq	=	**10**	year	Storm frequency -- 10 year per GDOT design manual
Speed	=	**55**	mph	Vehicle design speed
ID	=	**129-0038-0**	-	Existing Bridge Serial Number

Street Hydraulics

W_p	=	**20.000**	ft	Width being drained -- typically half of pavement
T	=	**8.0000**	ft	Design spread
S_x	=	**2.0**	%	Cross-slope of deck
n	=	**0.016**	-	Manning's coefficient -- typically, n = 0.016
C	=	**0.90**	-	Runoff -- typically, C = 0.9 for pavements

Inlet Specifications

CURB INLET	NEENAH	HEC-22	**GDOT**

4 in. Scupper			Grate Details
L	=	0.33	ft	Inlet opening length
W	=	0.33	ft	Inlet opening width
H	=	n/a	ft	Inlet opening height
a	=	n/a	ft	Local Inlet depression

Capacity determined by information found in GDOT drainage manual, capacity in-sump determined by weir/orifice hydraulics.

Design Notes

- Design spread calculated from GDOT Drainage Manual section 12.2.2

Establishment of Rainfall Intensity

Closest station

Ranger

Station Information

Ranger, GA
CARTERS 1 WSW
34.6061^0 LAT
-84.7194^0 LON
740 ft

Station Location

IDF Calculations

t_o	=	**0.70**	min
t_g	=	**4.42**	min
t_c	=	**5.12**	min
t_t	=	**5.08**	min
i	=	**7.78**	in/hr
L_o	=	**211**	ft

Inlet requirement

NO INLETS NEEDED

Rainfall intensity is calculated using intensity-duration-frequency (IDF) curves and methods consistent with GDOT drainage manual. Point precipitation frequency estimates are taken from NOAA Atlas 14 Volume 9 for partial duration time series.

Inlet Spacing on Flat Bridge

P_{INLET}	=	**1.05**	ft	Inlet perimeter
P_{REQ}	=	**3.59**	ft	Required inlet perimeter
L_c	=	**219**	ft	Inlet spacing assuming 100% efficiency
Spacing	=	**63**	ft	Required inlet spacing

Inlet Spacing for Bridge on Grade

	Spacing (ft)	Gutter Flow (cfs)	Efficiency (%)	Bypass (cfs)	Spread (ft)
L_0					
L_1					
L_2					
L_3					
L_4					
L_n					

Flat bridge spacing should be considered for bridges with grades less than 0.03%.

Hydroplaining and Visibility

Hydroplane Depth	=	**0.080 in**	Depth at which hydroplaning can occur
Hydroplain	=	**At Risk**	Risk of hydroplaning at rain intensity
Visibility	=	**Reduced**	Risk of impaired vision due to rain

Hydroplaning and visibility design procedures taken from methods in HEC-22. Methods shown are for constant-slope and flat bridges.

CLEARANCE CALCULATIONS - BRIDGE #1

SR 136 over Coosawattee River & Tributary

BOTTOM OF BEAM ELEVATION		
PGL at Lowest Point (ft)	671.53	
Bridge Width (ft)	40	
Cross Slope (ft/ft)	0.02	
Depth of Cross Slope	0.40	
Depth of Slab (ft)	1.00	*Includes slab and coping*
Depth of Beam (ft)	6.00	*72" Bulb Tee*
Bottom of Beam Elevation (ft)	664.13	

50 (DESIGN) YEAR STORM FREEBOARD		
Bottom of Beam Elevation (ft)	664.13	
Maximum Floodstage Elevation (ft)	645.80	
Clearance (ft)	18.33	*2 ft. required per GDOT Drainage Manual*

100 YEAR STORM FREEBOARD		
Bottom of Beam Elevation (ft)	664.13	
Maximum Floodstage Elevation (ft)	646.34	
Clearance (ft)	17.79	*1 ft. required per GDOT Drainage Manual*

Freeboard refers to the vertical clearance between the bridge superstructure at its lowest point and the floodstage elevation. See Section 12.1.1 of the GDOT Drainage Manual for more information.

Minimum bottom of beam elevation for proposed bridge shall be no lower than elevation 647.80.

CLEARANCE CALCULATIONS - BRIDGE #2

SR 136 over Coosawattee River & Tributary

BOTTOM OF BEAM ELEVATION		
PGL at Lowest Point (ft)	669.32	
Bridge Width (ft)	40	
Cross Slope (ft/ft)	0.02	
Depth of Cross Slope	0.40	
Depth of Slab (ft)	1.00	*Includes slab and coping*
Depth of Beam (ft)	6.00	*72" Bulb Tee*
Bottom of Beam Elevation (ft)	661.92	

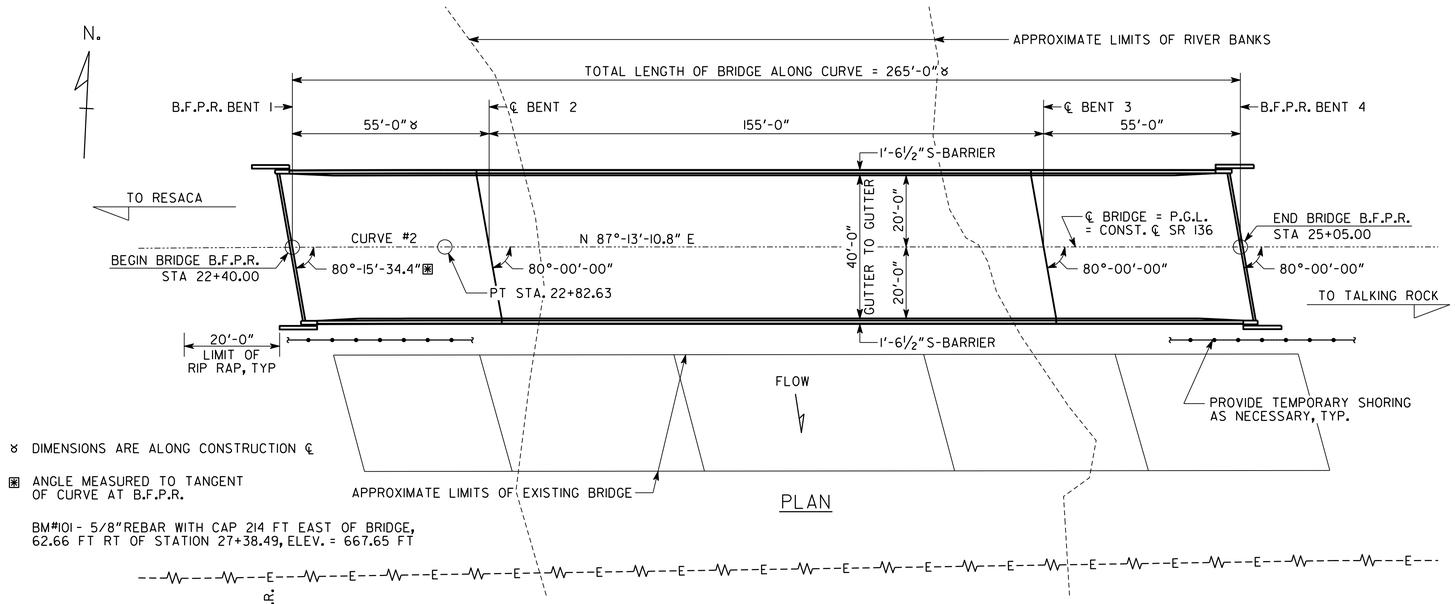
DESIGN STORM FREEBOARD		
Bottom of Beam Elevation (ft)	661.92	
50 Year Floodstage Elevation (ft)	650.77	
Clearance (ft)	11.15	*2 ft. required per GDOT Drainage Manual*

100 YEAR STORM FREEBOARD		
Bottom of Beam Elevation (ft)	661.92	
100 Year Floodstage Elevation (ft)	651.07	
Clearance (ft)	10.85	*1 ft. required per GDOT Drainage Manual*

Freeboard refers to the vertical clearance between the bridge superstructure at its lowest point and the floodstage elevation. See Section 12.1.1 of the GDOT Drainage Manual for more information.

Minimum bottom of beam elevation for proposed bridge shall be no lower than elevation 652.77.

P.I. NO. 0013994

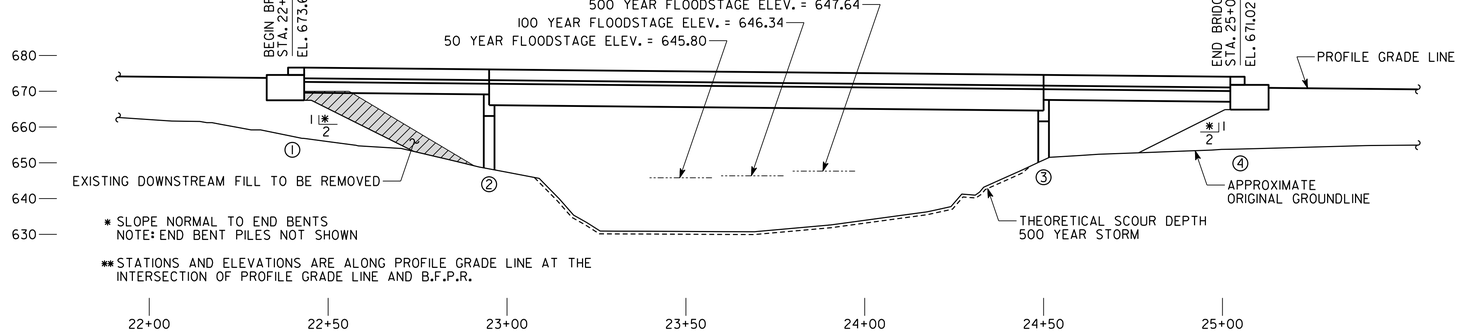


PLAN

ℵ DIMENSIONS ARE ALONG CONSTRUCTION ℄

⊠ ANGLE MEASURED TO TANGENT OF CURVE AT B.F.P.R.

BM#101 - 5/8"REBAR WITH CAP 214 FT EAST OF BRIDGE, 62.66 FT RT OF STATION 27+38.49, ELEV. = 667.65 FT



ELEVATION

CURVE #2
PI STA. = 19+43.09
Δ = 04°-08'-11.9"(RT)
D = 00°-36'-32"
T = 339.84
L = 679.38
R = 9410.00
E = 6.13
SE = NC

PROPOSED HORIZONTAL CURVE DATA

-0.9887%
PVI STA. 16+98.53 EL. 678.99
PVI STA. 27+30.19 EL. 668.79

PROPOSED GRADE DATA

PROPOSED BRIDGE CONSISTS OF

2 - 55'-0" TYPE II PSC BEAM SPANS ---------- SPECIAL DESIGN
1 - 155'-0" BULB TEE, 72", PSC BEAM SPAN ---------- SPECIAL DESIGN
2 - PILE END BENTS ---------- SPECIAL DESIGN
2 - CONCRETE INTERMEDIATE BENTS ---------- SPECIAL DESIGN
24" TYPE I RIP RAP

NOTES

CROSS-SLOPE - THE PROPOSED BRIDGE IS TO BE BUILT ON A NORMAL CROWN OF 2%.
DECK DRAINS - DECK DRAINS TO BE PLACED AT 10 FT SPACING.
BENT LAYOUT - ALL BENTS ARE PARALLEL TO BENT 2.
BEAM ELEVATION - MINIMUM BOTTOM OF BEAM ELEVATION FOR PROPOSED BRIDGE SHALL BE NO LOWER THAN ELEVATION 647.80.
BRIDGE REMOVAL - REMOVE EXISTING BRIDGE. REMOVE EXISTING SUBSTRUCTURE AS PER THE SPECIFICATIONS.
FILL REMOVAL - REMOVE EXISTING ROADWAY FILL BETWEEN STATIONS 22+35 AND 22+90.
TRAFFIC CONTROLS - TRAFFIC TO BE MAINTAINED ON EXISTING BRIDGE DURING PROPOSED CONSTRUCTION.

TRAFFIC DATA

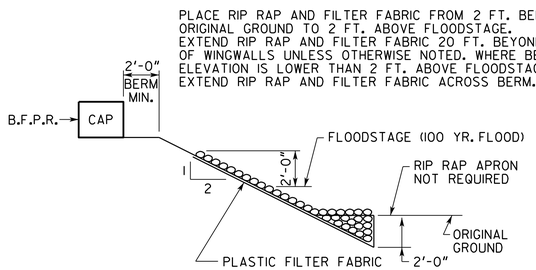
TRAFFIC ---------- ADT = 2,125 (2022)
ADT = 2,400 (2042)
DESIGN SPEED ---------- 55 MPH
TRUCKS ---------- 10 %
DIRECTIONAL ---------- 71 %

DESIGN DATA

SPECIFICATIONS ---------- AASHTO LRFD 7TH EDITION, 2014
DESIGN VEHICLE LIVE LOAD ---------- HL-93
FUTURE PAVING ALLOWANCE ---------- 30 LBS PER SQ FT

EXISTING UTILITIES

OVERHEAD UTILITIES LOCATED 25' DOWNSTREAM OF EXISTING BRIDGE



RIP RAP DETAIL
NO SCALE

BERM ELEVATIONS ⊛	
END BENT	ELEVATIONS
1 LT	667.10
1 RT	667.04
4 LT	664.47
4 RT	664.43

⊛ NOTE: FOR BRIDGE ENDROLL STAKING PURPOSES ONLY

DRAINAGE DATA

DRAINAGE AREA ---------- 521 SQ MILES (UPSTREAM OF CARTER'S DAM)
35 SQ MILES (DOWNSTREAM OF CARTER'S DAM)

FLOOD FREQUENCY	TOTAL DISCHARGE	MEAN VELOCITY	AREA OF OPENING UNDER FLOODSTAGE	BACKWATER
50 YEAR	9,770 CFS	6.24 FPS	1,566 SQ FT	0.00 FT
100 YEAR	10,600 CFS	6.47 FPS	1,638 SQ FT	0.00 FT
500 YEAR	12,710 CFS	7.02 FPS	1,811 SQ FT	0.00 FT

THEORETICAL SCOUR DEPTHS (FT)						
	100 YEAR STORM			500 YEAR STORM		
BENT LOCATION	GENERAL	LOCAL	TOTAL	GENERAL	LOCAL	TOTAL
BENT 2	0.0	0.0	0.0	0.0	0.0	0.0
BENT 3	0.0	0.0	0.0	0.0	0.0	0.0

NOTE: THE 500 YEAR SCOUR IN THE CREEK IS 0.58 FT

BRIDGE SERIAL NO. 129-0037-0
BRIDGE I.D. NO. 129-00136D-018.82E
PROJECT P.I. NO. 0013994
BRIDGE NO. 1

GEORGIA
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION-OFFICE OF BRIDGES AND STRUCTURES

PRELIMINARY LAYOUT
SR 136
OVER COOSAWATTEE RIVER
GORDON COUNTY 0013994

SCALE: 1" = 20'-0"(UNLESS OTHERWISE NOTED) JUNE 2019

DESIGNED GMP | CHECKED STB | REVIEWED SKG/DLC
DRAWN GMP | DESIGN GROUP STB | APPROVED WMD

DRAWING NO. 35-0001
BRIDGE SHEET 1 OF 1

REVISIONS | DATE | BY

1 INCH WHEN PRINTED FULL SIZE

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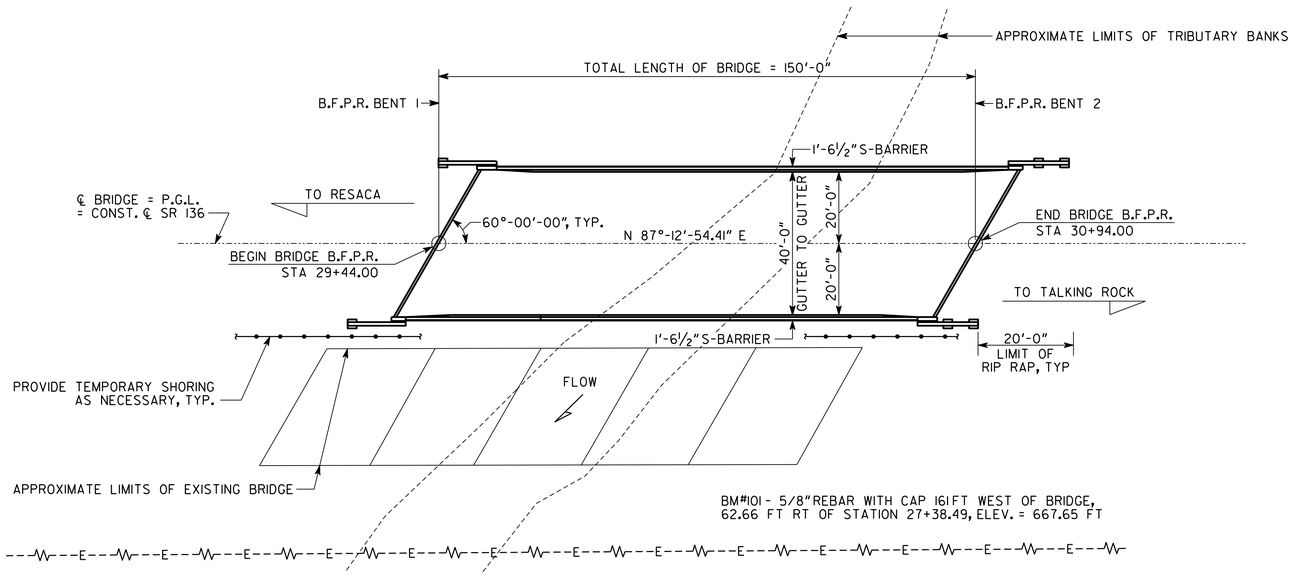
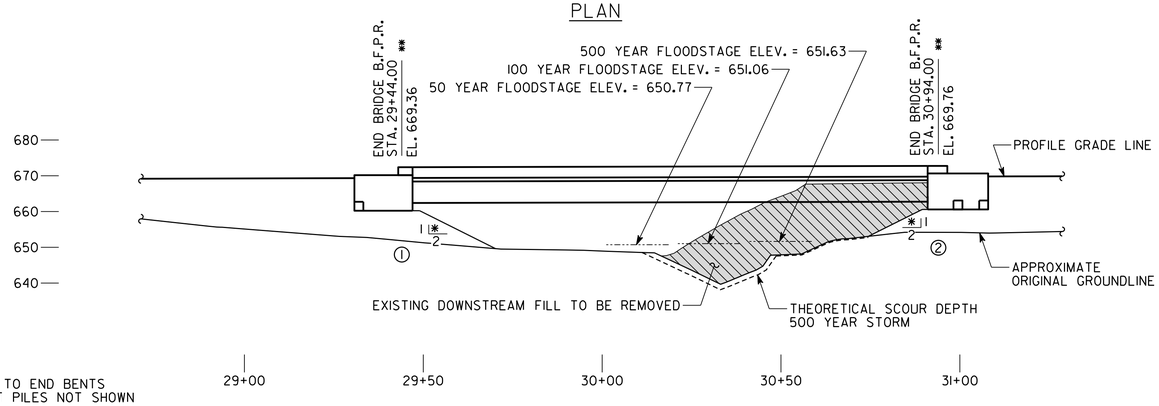
I2433 PM 7/29/2009 01017326

GDOT | P.I. NO. 0013994



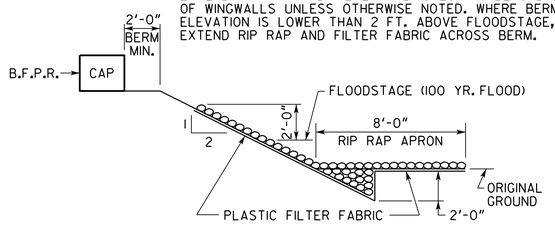
PLAN



ELEVATION

* SLOPE NORMAL TO END BENTS
NOTE: END BENT PILES NOT SHOWN

** STATIONS AND ELEVATIONS ARE ALONG PROFILE GRADE LINE AT THE INTERSECTION OF PROFILE GRADE LINE AND B.F.P.R.

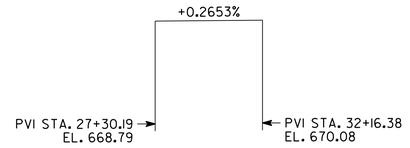


RIP RAP DETAIL

NO SCALE

BERM ELEVATIONS ⊛	
END BENT	ELEVATIONS
1 LT	659.82
1 RT	659.76
2 LT	660.22
2 RT	660.16

⊛ NOTE: FOR BRIDGE ENDROLL STAKING PURPOSES ONLY



PROPOSED GRADE DATA

PROPOSED BRIDGE CONSISTS OF

1 - 150'-0" BULB TEE, 72", PSC BEAM SPAN ---------- SPECIAL DESIGN
2 - PILE END BENTS ---------- SPECIAL DESIGN
24" TYPE I RIP RAP

NOTES

CROSS-SLOPE - THE PROPOSED BRIDGE IS TO BE BUILT ON A NORMAL CROWN OF 2%.
DECK DRAINS - DECK DRAINS TO BE PLACED AT 10 FT SPACING.
BENT LAYOUT - ALL BENTS ARE PARALLEL TO BENT 1.
BEAM ELEVATION - MINIMUM BOTTOM OF BEAM ELEVATION FOR PROPOSED BRIDGE SHALL BE NO LOWER THAN ELEVATION 652.77.
BRIDGE REMOVAL - REMOVE EXISTING BRIDGE. REMOVE EXISTING SUBSTRUCTURE AS PER THE SPECIFICATIONS.
FILL REMOVAL - REMOVE EXISTING ROADWAY FILL BETWEEN STATIONS 30+15 AND 31+10.
TRAFFIC CONTROLS - TRAFFIC TO BE MAINTAINED ON EXISTING BRIDGE DURING PROPOSED CONSTRUCTION.

TRAFFIC DATA

TRAFFIC ---------- ADT = 2,125 (2022)
ADT = 2,400 (2042)
DESIGN SPEED ---------- 55 MPH
TRUCKS ---------- 10 %
DIRECTIONAL ---------- 71 %

DESIGN DATA

SPECIFICATIONS ---------- AASHTO LRFD 7TH EDITION, 2014
DESIGN VEHICLE LIVE LOAD ---------- HL-93
FUTURE PAVING ALLOWANCE ---------- 30 LBS PER SQ FT

EXISTING UTILITIES

OVERHEAD UTILITIES LOCATED 25' DOWNSTREAM OF EXISTING BRIDGE

DRAINAGE DATA

DRAINAGE AREA ---------- 0.7 SQ MILES

FLOOD FREQUENCY	TOTAL DISCHARGE	MEAN VELOCITY	AREA OF OPENING UNDER FLOODSTAGE	BACKWATER
50 YEAR	494 CFS	1.17 FPS	421 SQ FT	0.05 FT
100 YEAR	581 CFS	1.25 FPS	465 SQ FT	0.05 FT
500 YEAR	790 CFS	1.44 FPS	548 SQ FT	0.09 FT

THEORETICAL SCOUR DEPTHS (FT)		
	100 YEAR STORM	500 YEAR STORM
LOCATION	GENERAL	GENERAL
LEFT OVERBANK	0.0	0.0
CHANNEL	1.3	1.4
RIGHT OVERBANK	0.0	0.3

BRIDGE SERIAL NO. 129-0038-0
BRIDGE I.D. NO. 129-00136D-018.82E
PROJECT P.I. NO. 0013994

BRIDGE NO. 2

GEORGIA
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION-OFFICE OF BRIDGES AND STRUCTURES

PRELIMINARY LAYOUT
SR 136
OVER COOSAWATTEE RIVER TRIBUTARY
GORDON COUNTY 0013994

SCALE: 1" = 20'-0" (UNLESS OTHERWISE NOTED) JUNE 2019

DESIGNED GMP | CHECKED STB | REVIEWED SKG/DLC
DRAWN GMP | DESIGN GROUP STB | APPROVED WMD

DRAWING NO. 35-0002
BRIDGE SHEET 1 OF 1

REVISIONS | DATE | BY

1 INCH WHEN PRINTED FULL SIZE

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7/29/2019
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DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA

PLAN AND PROFILE OF PROPOSED
BRIDGE REPLACEMENT
SR 136 AT COOSAWATTEE RIVER

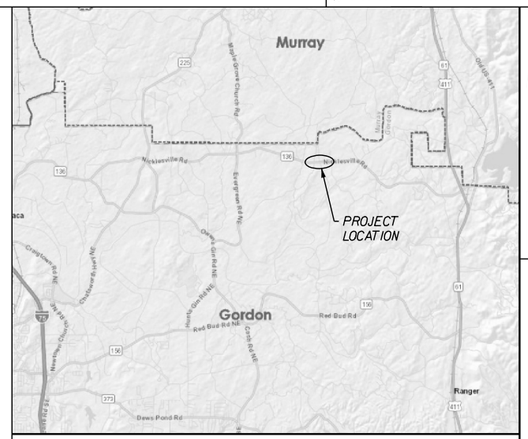
FEDERAL AID PROJECT

GORDON COUNTY

FEDERAL ROUTE * N/A

STATE ROUTE * SR 136

P.I. NO. 0013994



LOCATION SKETCH

DESIGN DATA:	
TRAFFIC A.D.T.:	2,125 (2018)
TRAFFIC A.D.T.:	2,400 (2042)
TRAFFIC D.H.V.:	175/200 (2042)
DIRECTIONAL DIST:	71%/61%
% TRUCKS:	10.0%/9.0%
24 HR.TRUCKS %:	16.5%
SPEED DESIGN:	55 MPH

LOCATION & DESIGN APPROVAL DATE:

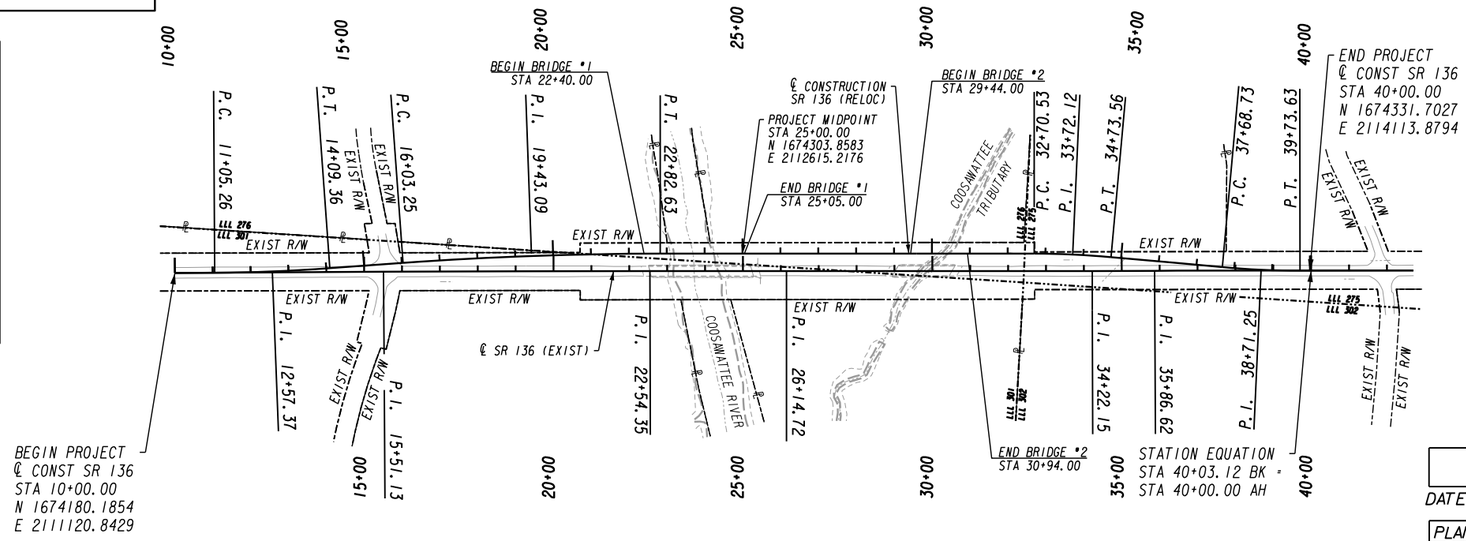
FUNCTIONAL CLASS:
RURAL MAJOR COLLECTOR

THIS PROJECT IS 100% IN GORDON COUNTY AND IS 100% IN CONG.DIST. NO. 14.

PROJECT DESIGNATION: EXEMPT

THIS PROJECT HAS BEEN PREPARED USING THE HORIZONTAL GEORGIA COORDINATE SYSTEM OF 1984 (NAD 1983)/94 WEST ZONE, AND THE NORTH AMERICAN VERTICAL DATUM (NAVD) OF 1988.

NOTE :
ALL REFERENCES IN THIS DOCUMENT, WHICH INCLUDES ALL PAPERS, WRITINGS, DOCUMENTS, DRAWINGS, OR PHOTOGRAPHS USED, OR TO BE USED IN CONNECTION WITH THIS DOCUMENT, TO "STATE HIGHWAY DEPARTMENT OF GEORGIA", "STATE HIGHWAY DEPARTMENT", GEORGIA STATE HIGHWAY DEPARTMENT", "HIGHWAY DEPARTMENT", OR "DEPARTMENT" WHEN THE CONTEXT THEREOF MEANS THE STATE HIGHWAY DEPARTMENT OF GEORGIA, AND SHALL BE DEEMED TO MEAN THE DEPARTMENT OF TRANSPORTATION.



LENGTH OF PROJECT	COUNTY No. / Project No. / MILES
NET LENGTH OF ROADWAY	0.541
NET LENGTH OF BRIDGES	0.079
NET LENGTH OF PROJECT	0.620
NET LENGTH OF EXCEPTIONS	0.000
GROSS LENGTH OF PROJECT	0.620

SCALE IN FEET
0 200 400 800

THE DATA, TOGETHER WITH ALL OTHER INFORMATION SHOWN ON THESE PLANS OR IN ANYWAY INDICATED THEREBY, WHETHER BY DRAWINGS OR NOTES, OR IN ANY OTHER MANNER, ARE BASED UPON FIELD INVESTIGATIONS AND ARE BELIEVED TO BE INDICATIVE OF ACTUAL CONDITIONS. HOWEVER, THE SAME ARE SHOWN AS INFORMATION ONLY, ARE NOT GUARANTEED, AND DO NOT BIND THE DEPARTMENT OF TRANSPORTATION IN ANY WAY. THE ATTENTION OF BIDDER IS SPECIFICALLY DIRECTED TO SUBSECTIONS 102.04, 102.05, AND 104.03 OF THE SPECIFICATIONS.

LONG ENGINEERING
2550 HERITAGE CT. SUITE 250 ATLANTA, GA 30339
TEL 770.951.2495 FAX 770.951.2496 www.longeng.com

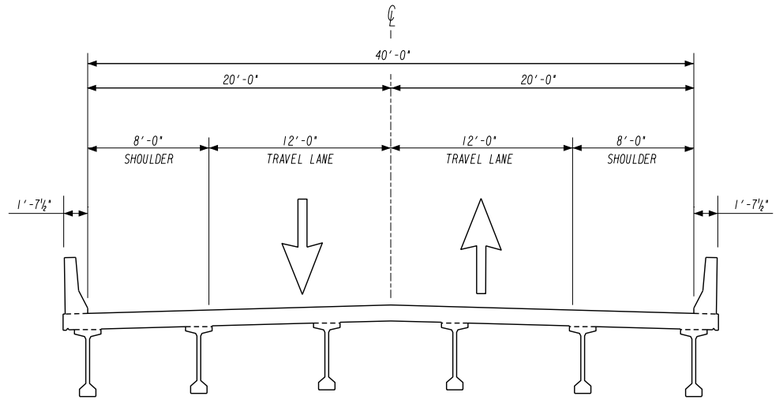
PREPARED BY: DESIGN

RECOMMENDED FOR APPROVAL BY: DESIGN

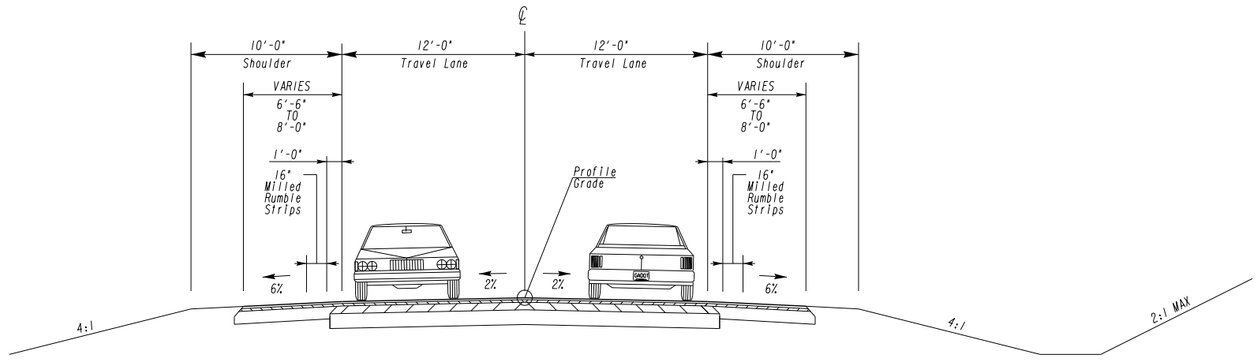
DATE | CHIEF ENGINEER

PLANS COMPLETED - -	
REVISIONS	

DRAWING No. 01-0001



BRIDGE TYPICAL SECTION



ROADWAY TANGENT SECTION

LONG ENGINEERING

NOT TO SCALE

REVISION DATES

TYPICAL SECTIONS

SR 136 AT COOSAWATTEE RIVER

CHECKED:		DATE:		DRAWING No.
BACKCHECKED:		DATE:		
CORRECTED:		DATE:		05-0001
VERIFIED:		DATE:		

N/F
DOUGLAS L RALSTON
& SANDY M RALSTON
PIN: 091 074

N/F
RONALD J. WEAVER
PIN:091 028

LLL 276
LLL 301

BEGIN PROJECT
℄ CONST SR 136 STA 10+00.00
N 1674180.1854
E 2111120.8429

10+00
EXIST R/W
11+00
P.C. 11+05.26
12+00
EXIST R/W
12+00
N 86°52'14.87" E
℄ SR 136 (RELOCATED)
CURVE #1
℄ SR 136 (EXISTING)
P.I. 12+57.37
MATCHLINE STA 13+00
SEE SHEET 13-0002
EXIST R/W
EXIST R/W

CONTROL POINTS						
LABEL	STATION	OFFSET	NORTHING	EASTING	ELEVATION	DESCRIPTION
PT #100	14+99.68	48.78' RT	1674175.0030	2111624.3638	675.379	⅝ REBAR CAPPED
PT #101	27+38.44	62.63' RT	1674252.8693	2112856.4147	667.650	⅝ REBAR CAPPED
PT #102	42+01.60	36.13' LT	1674377.8921	2114316.5667	679.409	⅝ REBAR CAPPED

N/F
RONALD J. WEAVER
PIN:091 028

Curve# 1
PI Sta: 12+57.37
N: 1674194.2345
E: 2111377.8257
DELTA: 03°47'16.0" (LT)
D: 01°14'44.02"
T: 152.11
L: 304.10
R: 4600.00
E: 2.51
e: 2.8%

PROPERTY AND EXISTING R/W LINE
REQUIRED R/W LINE
CONSTRUCTION LIMITS
EASEMENT FOR CONSTR & MAINTENANCE OF SLOPES
EASEMENT FOR CONSTR OF SLOPES
EASEMENT FOR CONSTR OF DRIVES

BEGIN LIMIT OF ACCESS.....BLA
END LIMIT OF ACCESS.....ELA
LIMIT OF ACCESS
REQ'D R/W & LIMIT OF ACCESS
ORANGE BARRIER FENCE
ESA - ENV. SENSITIVE AREA (SEE ERIT TABLE)

LONG ENGINEERING

SCALE IN FEET
0 20 40 80

REVISION DATES

CONSTRUCTION PLAN
SR 136 AT COOSAWATTEE RIVER

CHECKED:		DATE:	
BACKCHECKED:		DATE:	
CORRECTED:		DATE:	
VERIFIED:		DATE:	

DRAWING No. 13-0001

10/23/2015 GPLN

N/F
ANDREW I BOWEN
& CHARITY A BOWEN
PIN: 091 057

N/F
RONALD J. WEAVER
PIN:091 028

LLL 276
LLL 301

P.T. 14+09.36

P.C. 16+03.25

EXIST R/W

WELL HSE.

GRAVEL

DAVIS RD.

℄ SR 136 (RELOCATED)

℄ SR 136 (EXISTING)

CURVE #1

CURVE #2

N 83°04'58.91" E

N 87°05'33.60" E

P.I. 15+51.13

ASPH.

IE:672.45 15"RCP

IE:672.96 15"RCP

NESBIT LOOP

MATCHLINE STA 18+00
SEE SHEET 13-0003

MATCHLINE STA 13+00
SEE SHEET 13-0001

Curve# 1
PI Sta= 12+57.37
N= 1674194.2345
E= 2111377.8257
DELTA= 03°47'16.0" (LT)
D= 01°14'44.02"
T= 152.11
L= 304.10
R= 4600.00
E= 2.51
e= 2.8%

Curve# 2
PI Sta= 19+43.09
N= 1674276.8299
E= 2112058.6667
DELTA= 04°08'11.9" (RT)
D= 00°36'31.97"
T= 339.84
L= 679.38
R= 9410.00
E= 6.13
e= NC

PROPERTY AND EXISTING R/W LINE
REQUIRED R/W LINE
CONSTRUCTION LIMITS
EASEMENT FOR CONSTR & MAINTENANCE OF SLOPES
EASEMENT FOR CONSTR OF SLOPES
EASEMENT FOR CONSTR OF DRIVES

BEGIN LIMIT OF ACCESS.....BLA
END LIMIT OF ACCESS.....ELA
LIMIT OF ACCESS
REQ'D R/W & LIMIT OF ACCESS
ORANGE BARRIER FENCE
ESA - ENV. SENSITIVE AREA (SEE ERIT TABLE)

LONG ENGINEERING

SCALE IN FEET
0 20 40 80

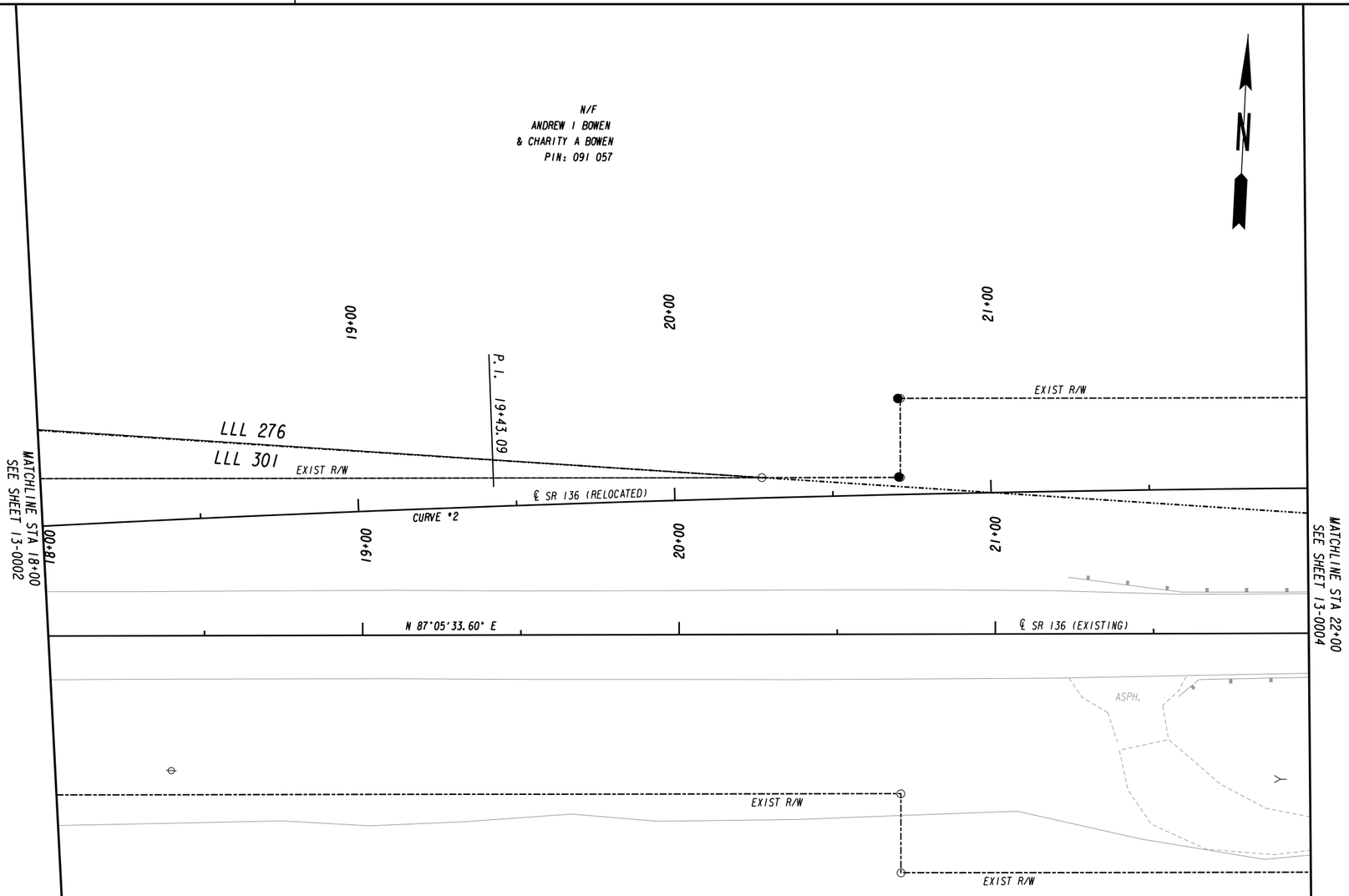
REVISION DATES

CONSTRUCTION PLAN

SR 136 AT COOSAWATTEE RIVER

CHECKED:		DATE:		DRAWING No.
BACKCHECKED:		DATE:		13-0002
CORRECTED:		DATE:		
VERIFIED:		DATE:		

10/23/2015 GPLN



Curve# 2
PI Sta= 19+43.09
N= 1674276.8299
E= 2112058.6667
DELTA= 04°08'11.9" (RT)
D= 00°36'31.97"
T= 339.84
L= 679.38
R= 9410.00
E= 6.13
e= NC

N/F
RONALD J. WEAVER
PIN:091 028

PROPERTY AND EXISTING R/W LINE
REQUIRED R/W LINE
CONSTRUCTION LIMITS
EASEMENT FOR CONSTR & MAINTENANCE OF SLOPES
EASEMENT FOR CONSTR OF SLOPES
EASEMENT FOR CONSTR OF DRIVES

BEGIN LIMIT OF ACCESS.....BLA
END LIMIT OF ACCESS.....ELA
LIMIT OF ACCESS
REQ'D R/W & LIMIT OF ACCESS
ORANGE BARRIER FENCE
ESA - ENV. SENSITIVE AREA (SEE ERIT TABLE)

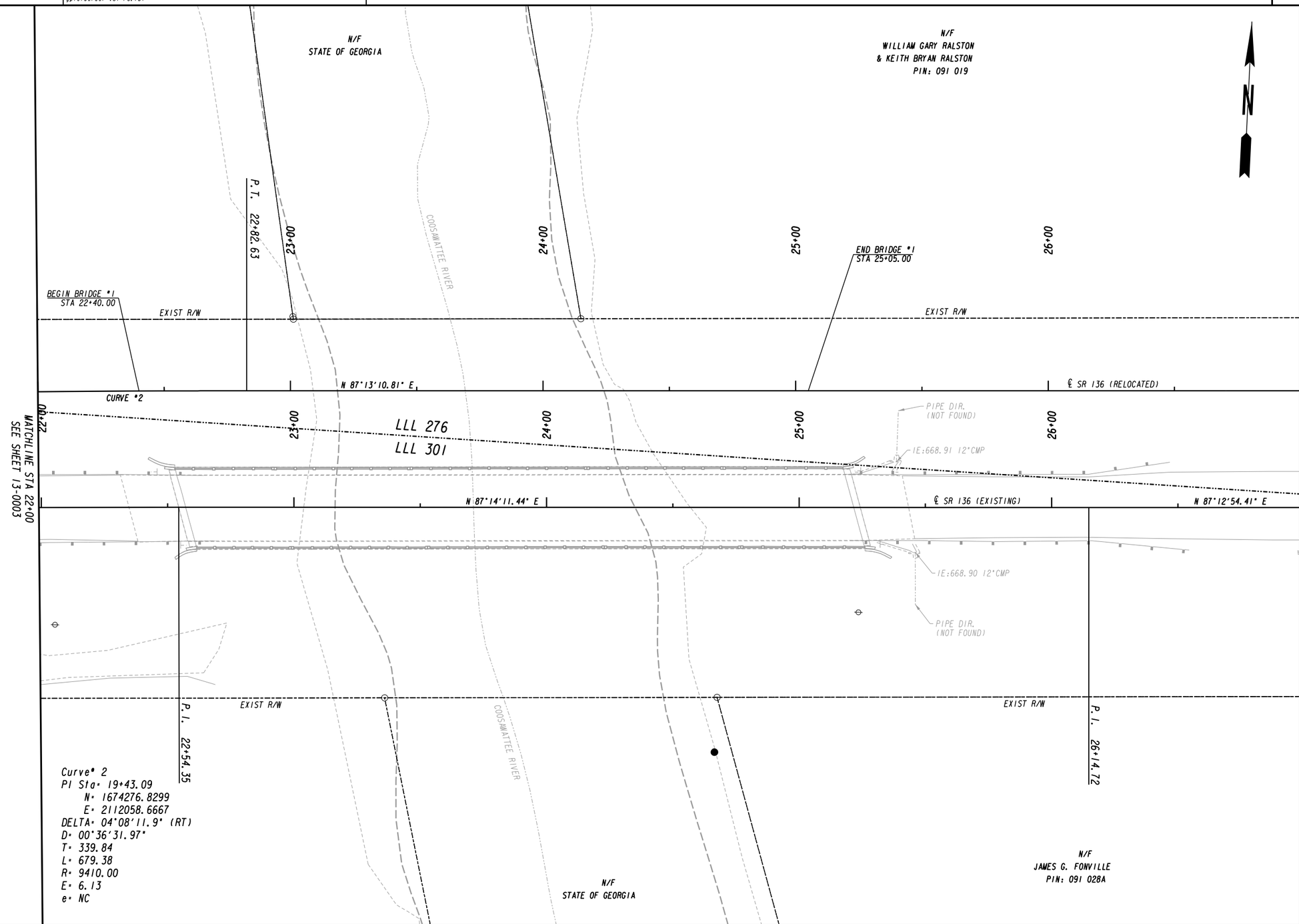
LONG ENGINEERING

SCALE IN FEET
0 20 40 80

REVISION DATES

CONSTRUCTION PLAN
SR 136 AT COOSAWATTEE RIVER

CHECKED:		DATE:		DRAWING No.
BACKCHECKED:		DATE:		13-0003
CORRECTED:		DATE:		
VERIFIED:		DATE:		



PROPERTY AND EXISTING R/W LINE
REQUIRED R/W LINE
CONSTRUCTION LIMITS
EASEMENT FOR CONSTR & MAINTENANCE OF SLOPES
EASEMENT FOR CONSTR OF SLOPES
EASEMENT FOR CONSTR OF DRIVES

BEGIN LIMIT OF ACCESS.....BLA
END LIMIT OF ACCESS.....ELA
LIMIT OF ACCESS
REQ'D R/W & LIMIT OF ACCESS
ORANGE BARRIER FENCE
ESA - ENV. SENSITIVE AREA (SEE ERIT TABLE)

LONG ENGINEERING

SCALE IN FEET
0 20 40 80

REVISION DATES

CONSTRUCTION PLAN

SR 136 AT COOSAWATTEE RIVER

CHECKED:		DATE:		DRAWING No.
BACKCHECKED:		DATE:		13-0004
CORRECTED:		DATE:		
VERIFIED:		DATE:		

10/23/2015 GPLN

N/F
WILLIAM GARY RALSTON
& KEITH BRYAN RALSTON
PIN: 091 019

COOSAWATTEE TRIBUTARY

28+00 29+00 30+00 31+00

BEGIN BRIDGE #2
STA 29+44.00

END BRIDGE #2
STA 30+94.00

EXIST R/W

GATE

℄ SR 136 (RELOCATED)

N 87°13'10.81" E

27+00 28+00 29+00 30+00 31+00

GRAVEL

MATCHLINE STA 27+00
SEE SHEET 13-0004

MATCHLINE STA 32+00
SEE SHEET 13-0006

N 87°12'54.41" E

℄ SR 136 (EXISTING)

ASPH.

LLL 276
LLL 301

COOSAWATTEE TRIBUTARY

EXIST R/W

EXIST R/W

N/F
JAMES G. FONVILLE
PIN: 091 028A

PROPERTY AND EXISTING R/W LINE
REQUIRED R/W LINE
CONSTRUCTION LIMITS
EASEMENT FOR CONSTR & MAINTENANCE OF SLOPES
EASEMENT FOR CONSTR OF SLOPES
EASEMENT FOR CONSTR OF DRIVES

BEGIN LIMIT OF ACCESS.....BLA
END LIMIT OF ACCESS.....ELA
LIMIT OF ACCESS
REQ'D R/W & LIMIT OF ACCESS
ORANGE BARRIER FENCE
ESA - ENV. SENSITIVE AREA (SEE ERIT TABLE)

LONG ENGINEERING

SCALE IN FEET
0 20 40 80

REVISION DATES

CONSTRUCTION PLAN

SR 136 AT COOSAWATTEE RIVER

CHECKED:		DATE:		DRAWING No.
BACKCHECKED:		DATE:		13-0005
CORRECTED:		DATE:		
VERIFIED:		DATE:		

10/23/2015 GPLN

N/F
GLORIA CAROL BURRAGE
PIN:091 022

FIELD WIRE FENCE

P.C. 32+70.53

P.I. 33+72.12

P.T. 34+73.56

32+00 33+00 34+00 35+00 36+00

IE:653.53 18"CMP

GRAVEL

IE:656.76 18"CMP

GATE

IE:668.97 15"RCP

IE:669.56 15" RCP

IE:665.73 24"RCP

EXIST R/W

FIELD WIRE FENCE

EXIST R/W

N 87°13'10.81" E

CURVE #3

℄ SR 136 (RELOCATED)

S 87°36'36.93" E

N 87°12'54.41" E

℄ SR 136 (EXISTING)

N 86°53'28.32" E

N 87°10'19.69" E

MATCHLINE STA 32+00
SEE SHEET 13-0005

MATCHLINE STA 37+00
SEE SHEET 13-0007

LLL 276 LLL 275
LLL 301 LLL 302

IE:660.54 24"RCP

PIPE DIA. (NOT FOUND)

IE:663.91 24"RCP

EXIST R/W

EXIST R/W

EXIST R/W

P.I. 34+22.15

P.I. 35+86.62

LLL 301

LLL 302

GRAVEL

Curve# 3
PI Sta: 33+72.12
N: 1674346.1619
E: 2113486.3061
DELTA: 05°10'12.3" (RT)
D: 02°32'47.32"
T: 101.58
L: 203.03
R: 2250.00
E: 2.29
e: 4.6%

N/F
JAMES G. FONVILLE
PIN: 091 033

N

PROPERTY AND EXISTING R/W LINE
REQUIRED R/W LINE
CONSTRUCTION LIMITS
EASEMENT FOR CONSTR & MAINTENANCE OF SLOPES
EASEMENT FOR CONSTR OF SLOPES
EASEMENT FOR CONSTR OF DRIVES

BEGIN LIMIT OF ACCESS.....BLA
END LIMIT OF ACCESS.....ELA
LIMIT OF ACCESS
REQ'D R/W & LIMIT OF ACCESS
ORANGE BARRIER FENCE
ESA - ENV. SENSITIVE AREA (SEE ERIT TABLE)

LONG ENGINEERING

SCALE IN FEET
0 20 40 80

REVISION DATES

CONSTRUCTION PLAN
SR 136 AT COOSAWATTEE RIVER

CHECKED:		DATE:		DRAWING No.
BACKCHECKED:		DATE:		13-0006
CORRECTED:		DATE:		
VERIFIED:		DATE:		

10/23/2015 GPLN

N/F
GLORIA CAROL BURRAGE
PIN:091 022

N/F
GLORIA CAROL BURRAGE
PIN: 091 023

N/F
WILLIAM GARY RALSTON
& KEITH BRYAN RALSTON
PIN: 091 019A

N

END PROJECT
℄ CONST SR 136 (RELOCATED) STA 40+00.00
N 1674331.7027
E 2114113.8794

EXIST R/W

EXIST R/W

MONTGOMERY BRIDGE RD.

EXIST R/W

42+00

41+00

40+00

39+00

38+00

37+00

FIELD WIRE FENCE

ASPH.

IE:676.19 15"RCP

IE:675.83 15"RCP

P.C. 37+68.73

P.T. 39+73.63

MATCHLINE STA 37+00
SEE SHEET 13-0006

S 87°36'36.93" E

℄ SR 136 (EXISTING)

℄ SR 136 (RELOCATED)

CURVE #4

N 87°10'19.69" E

IE:676.08
15"RCP

ASPH.

IE:675.94 15"RCP

EXIST R/W

EXIST R/W

EXIST R/W

HOOK RD.

GRAVEL

LLL 275
LLL 302

LLL 275
LLL 302

STATION EQUATION
STA 40+03.12 BK =
STA 40+00.00 AH

P.I. 38+71.25

Curve# 4
PI Sta: 38+71.25
N: 1674325.3438
E: 2113985.1447
DELTA: 05°13'03.4" (LT)
D: 02°32'47.32"
T: 102.52
L: 204.89
R: 2250.00
E: 2.33
e: 4.6%

N/F
JAMES G. FONVILLE
PIN: 091 033

PROPERTY AND EXISTING R/W LINE
REQUIRED R/W LINE
CONSTRUCTION LIMITS
EASEMENT FOR CONSTR & MAINTENANCE OF SLOPES
EASEMENT FOR CONSTR OF SLOPES
EASEMENT FOR CONSTR OF DRIVES

BEGIN LIMIT OF ACCESS.....BLA
END LIMIT OF ACCESS.....ELA
LIMIT OF ACCESS
REQ'D R/W & LIMIT OF ACCESS
ORANGE BARRIER FENCE
ESA - ENV. SENSITIVE AREA
(SEE ERIT TABLE)

LONG ENGINEERING

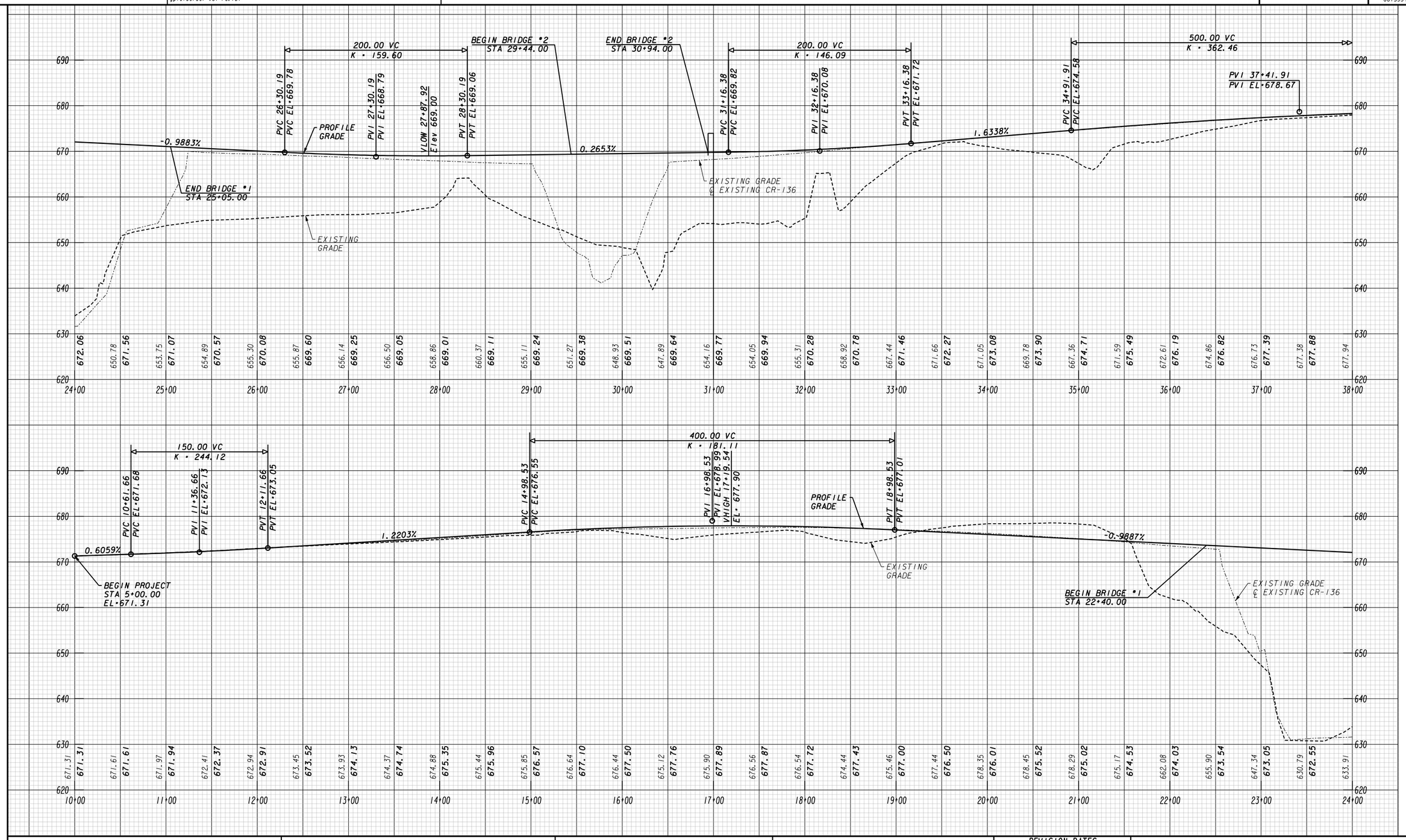
SCALE IN FEET
0 20 40 80

REVISION DATES

CONSTRUCTION PLAN

SR 136 AT COOSAWATTEE RIVER

CHECKED:		DATE:	DRAWING No.
BACKCHECKED:		DATE:	
CORRECTED:		DATE:	13-0007
VERIFIED:		DATE:	



REVISION DATES

SCALE: 1" = 50' HORIZ
1" = 10' VERT

LONG ENGINEERING

MAINLINE PROFILE

SR 136 AT COOSAWATTEE RIVER

CHECKED:		DATE:		DRAWING No.
BACKCHECKED:		DATE:		15-0001
CORRECTED:		DATE:		
VERIFIED:		DATE:		

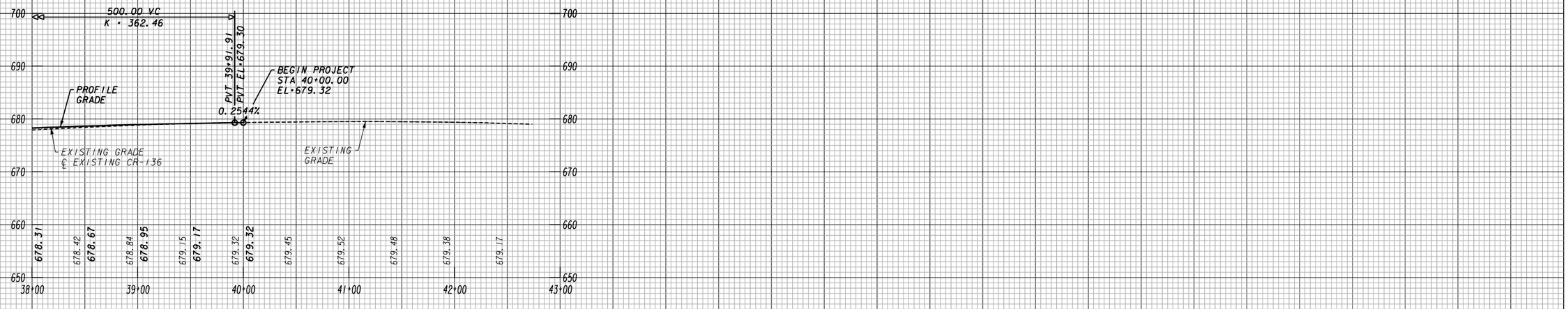
8/2/2019 11:34:35 AM
DennardS

GPLOT-V8
gplotborder-v81-P0.tbl

0013994_15.dgn

GDOT

P. I. No.
0013994



LONG ENGINEERING

SCALE: 1" = 50' HORIZ
1" = 10' VERT

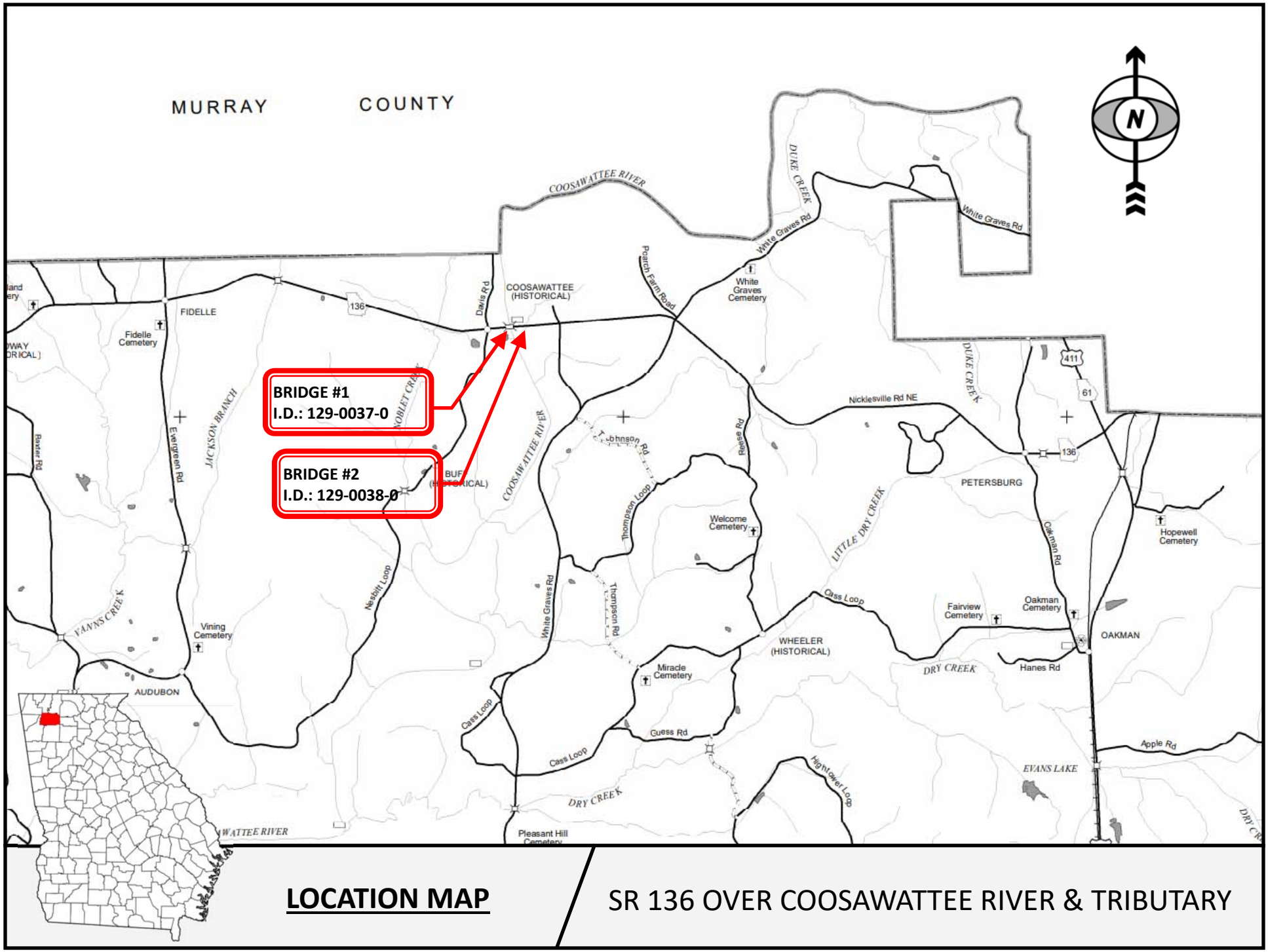
REVISION DATES

MAINLINE PROFILE

SR 136 AT COOSAWATTEE RIVER

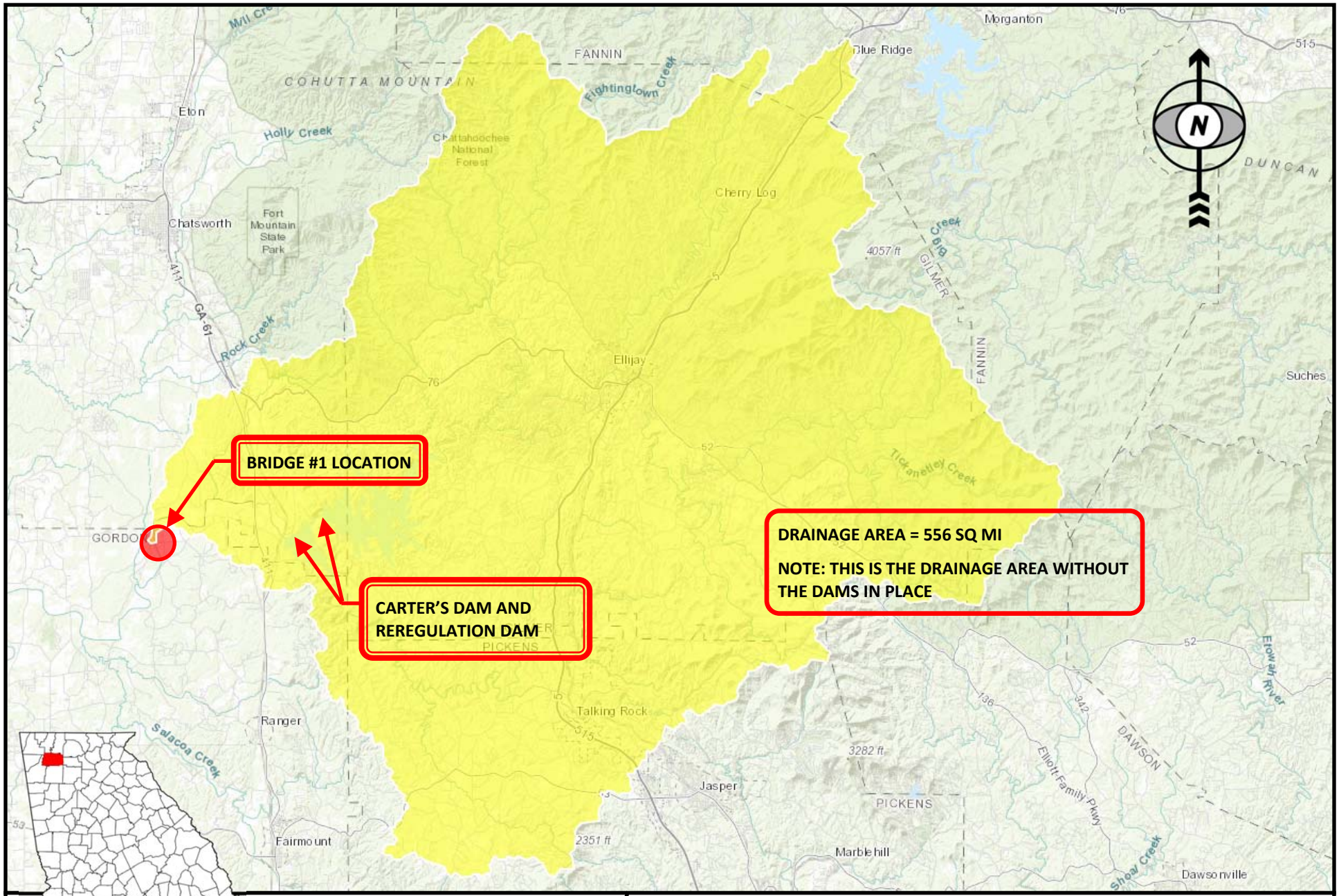
CHECKED:		DATE:		DRAWING No.
BACKCHECKED:		DATE:		15-0002
CORRECTED:		DATE:		
VERIFIED:		DATE:		

10/23/2015 GPLN



LOCATION MAP

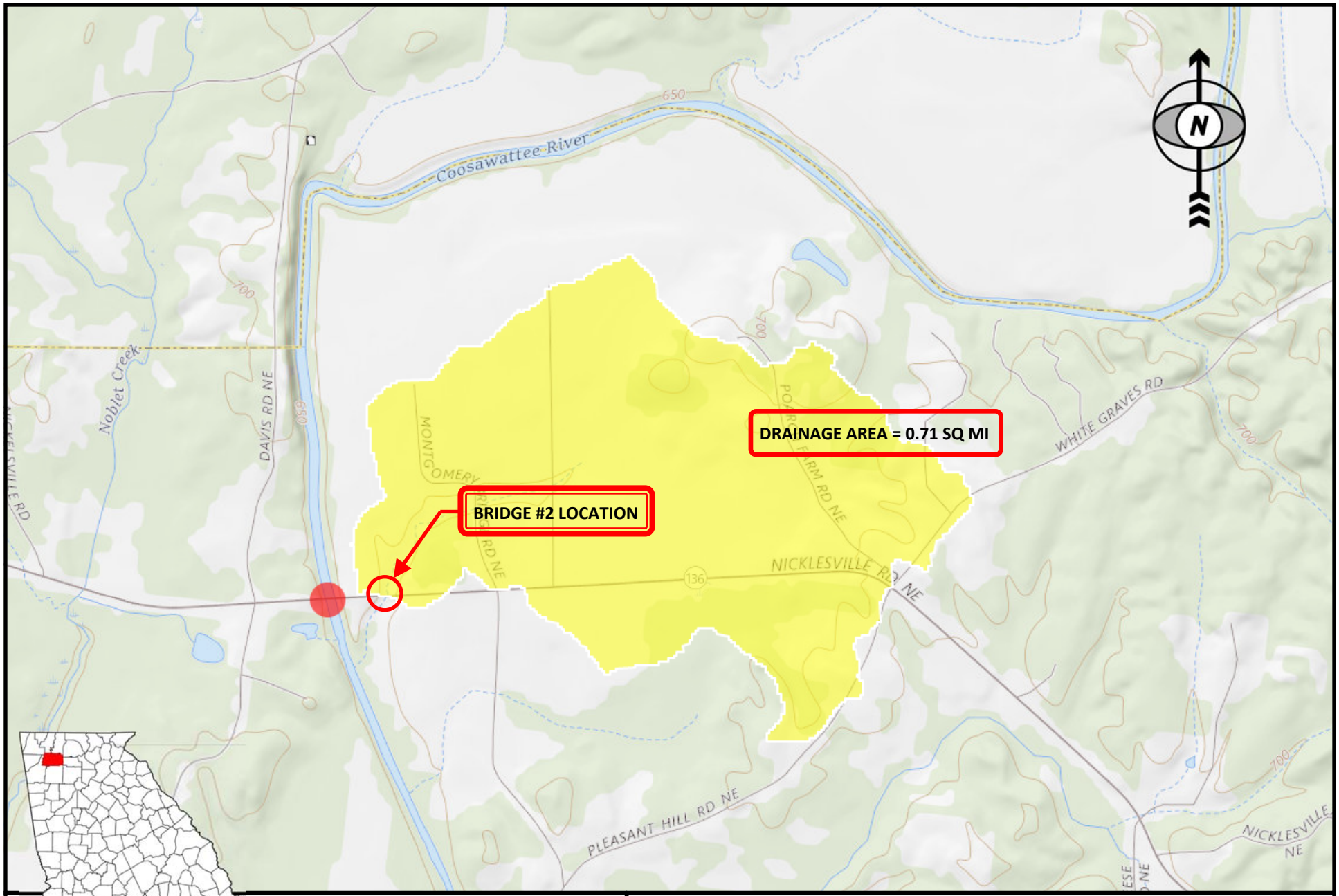
SR 136 OVER COOSAWATTEE RIVER & TRIBUTARY



DRAINAGE AREA MAP

Structure No. 129-0037-0

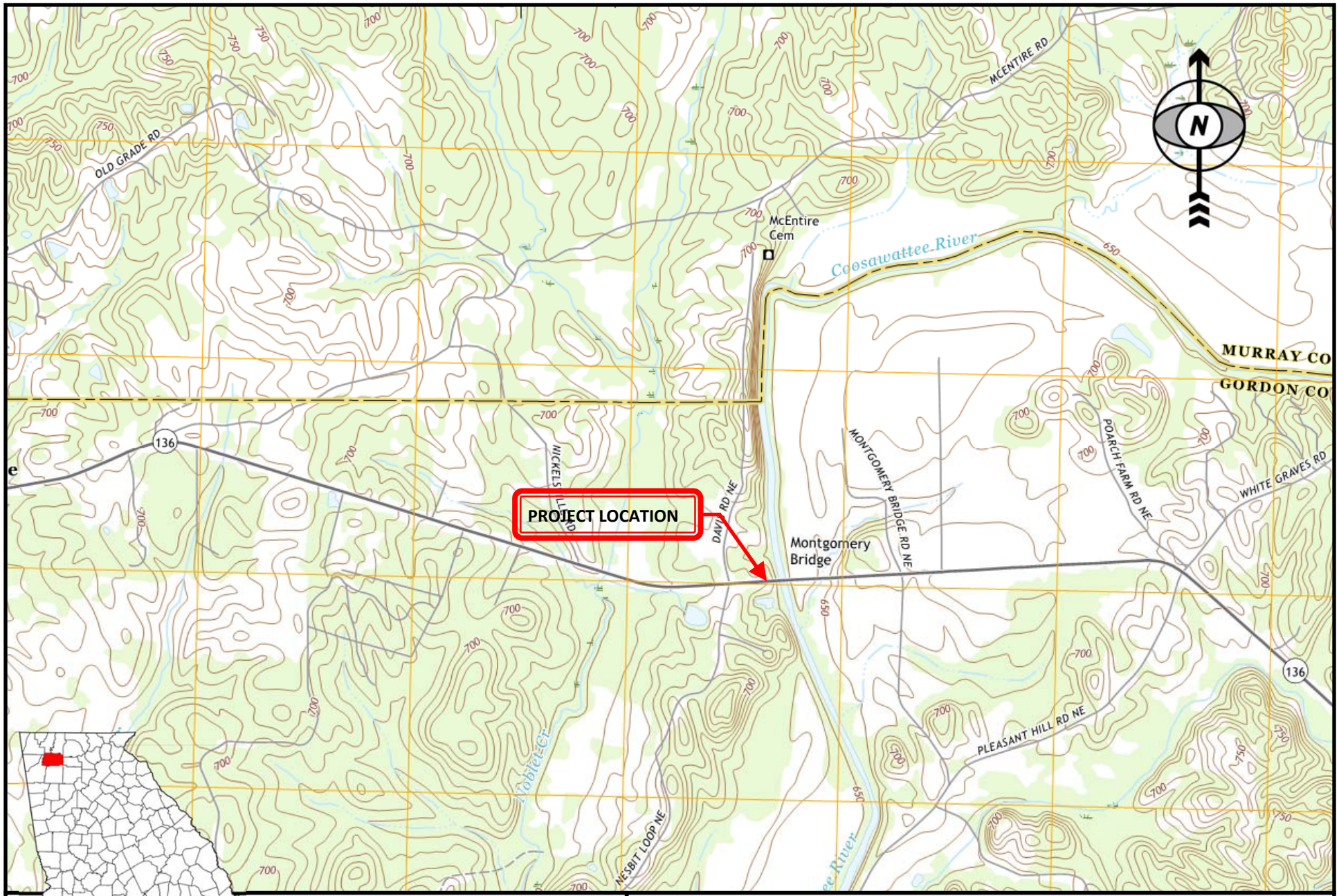
SR 136 OVER COOSAWATTEE RIVER & TRIBUTARY



DRAINAGE AREA MAP

Structure No. 129-0038-0

SR 136 OVER COOSAWATTEE RIVER & TRIBUTARY



QUAD MAP

SR 136 OVER COOSAWATTEE RIVER & TRIBUTARY

National Flood Hazard Layer FIRMette

FEMA

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 — Cross Sections with 1% Annual Chance Water Surface Elevation
- Coastal Transect
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

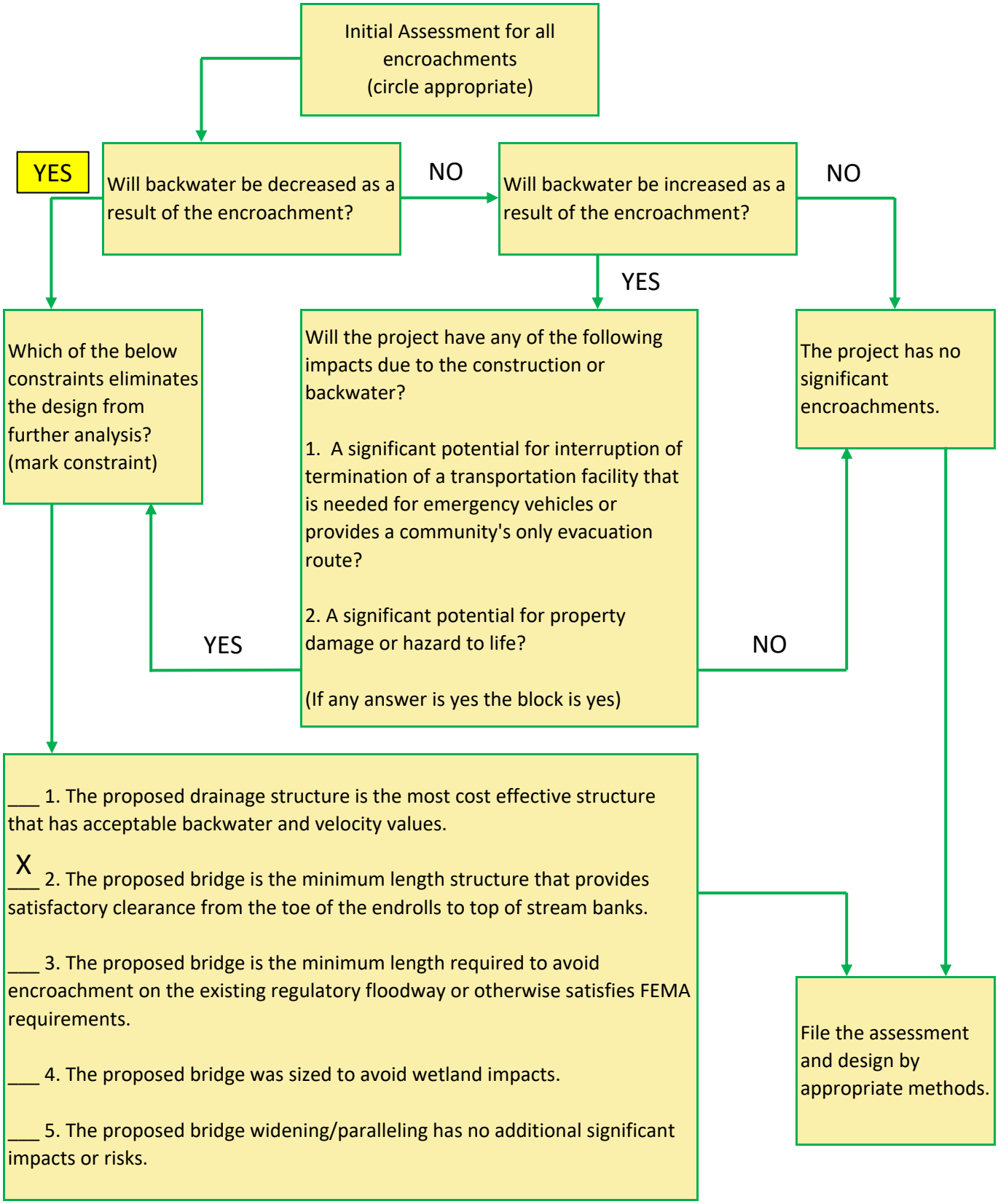
This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 6/5/2019 at 2:22:10 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

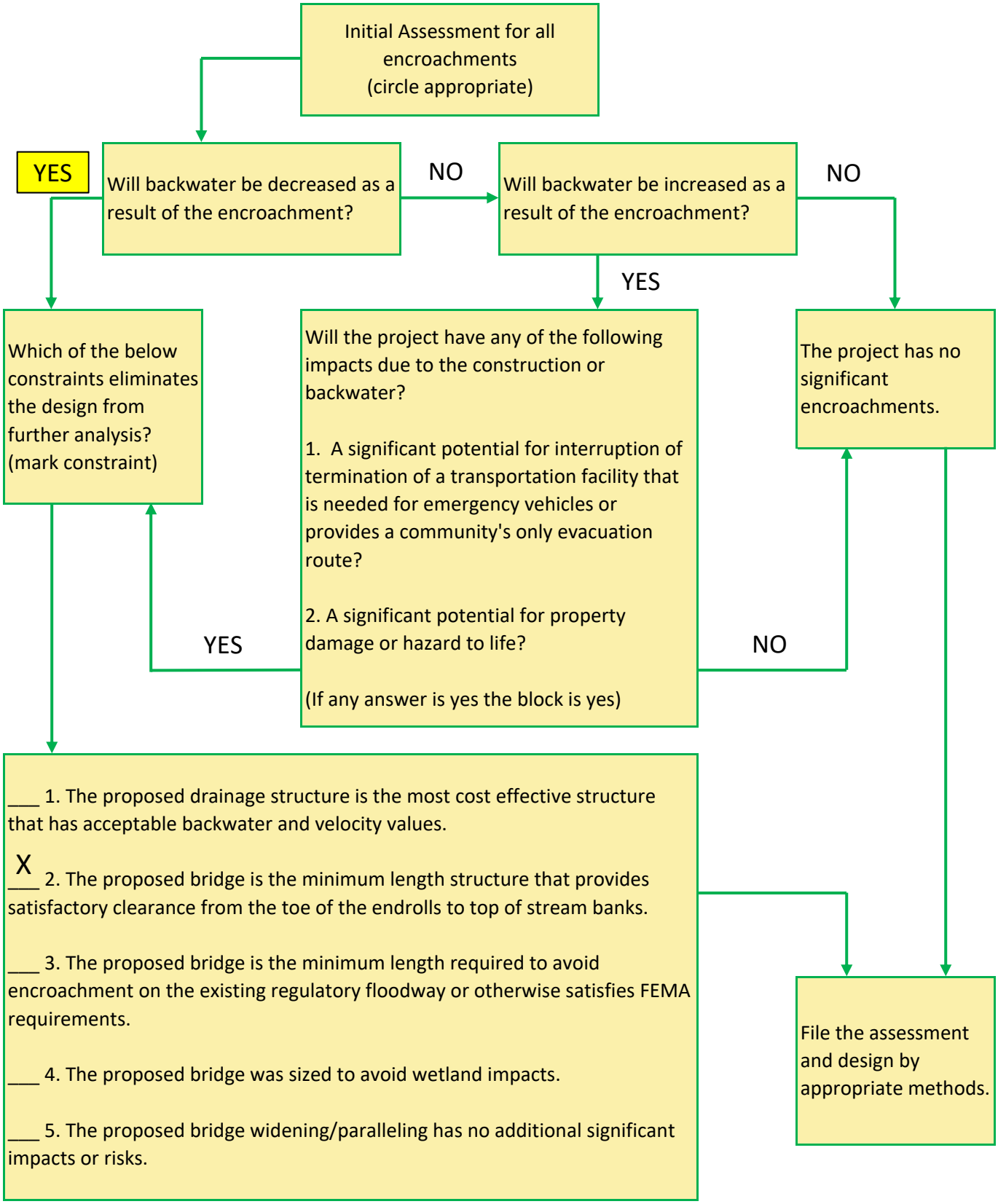
RISK ASSESSMENT - BRIDGE #1

SR 136 over Coosawattee River & Tributary



RISK ASSESSMENT - BRIDGE #2

SR 136 over Coosawattee River & Tributary



HYDRAULIC ENGINEERING FIELD REPORT

I. HYDRAULIC AND HYDROLOGICAL DATA REQUIRED FOR ALL EXISTING OR PROPOSED BRIDGE STREAM CROSSING PROJECTS

A. Project Location

Project No.: MPOPD1701093 County: GORDON District: GDOT #6

P.I. No.: 0013994 Stream Name: COOSAWATTEE RIVER Route: SR-136

Surveyed By: G.XIONG Date: 08.23.2018

B. Site Information

Floodplain and Stream Channel description:

1. Flat, rolling, mountainous, etc.: HILLY AND IN A MOUNTAINOUS REGION, VALLEY , RIVER BOTTOMS

2. Wooded, heavily vegetated, pasture, swampy, etc.: WOODED, HARDWOODS AND PINES
   SOME PASTURE LAND IN THE VICINITY

3. Stream channel description: well-defined banks, meandering, debris, etc.

   WELL DEFINED BANKS, SOME DOWNED TREES IN THE CHANNEL

4. Is there any fill in the upstream or downstream floodplain, which will affect the natural drainage or limit the floodplain width at this site?

   NO FILL NOTED IN THE UPSTREAM OR DOWNSTREAM FLOODPLAIN

C. Required Existing Bridge Information at Project Site

1. Bridge Identification No.: 129-0037-0
2. Date Built: 1966
3. Skew angle of bridge bents: -2.85°
4. Height of curb, parapet or barrier: 1.20'

Substructure Information:

1. Column type (concrete, steel, etc): CONCRETE COLUMNS AND STEEL COLUMNS
2. Size of columns: B2=10", B3=35", B4=35", B5=10"
3. Number of columns per bent: B1=0, B2=8, B3=2, B4=2, B5=8, B6=0
4. Guide Bank (Spur Dike) length, elevation and location (if applicable):

   NO SPUR DIKE

5. Note any scour problems at intermediate bents or abutments:

   BRIDGE DEFECTS NOTED ON THE GDOT WEBSITE,
   BRIDGE INSPECTION REPORT

Note: The above information is required for all bridges within the floodplain (main and overflow bridges) along the roadway. In addition, the location, size and number of barrels are required for all box culverts located within the floodplain.

D. Normal Water Surface Data

	WS ELEV
500 feet upstream of survey centerline:	635.89
At the survey centerline:	636.26
500 feet downstream of survey centerline:	636.04
Normal high tide:	N/A
Normal low tide:	N/A

E. Historical Flood Data

1. Extreme high water elevation at site: 641.00 +/- Date: 10.22.2018
2. Highest observed tide elevation: _____ Date: _____
3. Location of extreme high water elevation (upstream/downstream face of bridge at the centerline or station and offset if not at bridge):

4. Source of high water information: FIELD OBSERVATION HIGH WATER MARK ON COLUMN
5. Location and floor elevation of any houses/buildings/structures that have been flooded:
   N/A
6. Information about flood (number of times structure has been flooded, water surface elevations and date(s) of flood):
   N/A
7. Location and floor elevation of any houses/buildings/structures that have floor elevations within 2 feet of the extreme high water elevation:
   N/A

F. Benchmark Information

Location 1:

1. Benchmark Name: #101 Elevation: 667.65
2. Location *(project stations/offset)*: ROUGHLY 214' EAST, OF THE EAST EDGE OF BRIDGE
   Northing: 1674252.8673 Easting: 2112856.4147
3. Physical description: 5/8" REBAR WITH CAP

Location 2:

1. Benchmark Name: _____ Elevation: _____
2. Location *(project stations/offset)*: _____
   Northing: _____ Easting: _____
3. Physical description: _____

Location 3:

1. Benchmark Name: _____ Elevation: _____
2. Location *(project stations/offset)*: _____
   Northing: _____ Easting: _____
3. Physical description: _____

G. Upstream and Downstream Structures

Structure 1

1. Structure Type (railroad/highway bridge, culvert): NONE UP OR DOWNSTREAM WITHIN 2000'
2. Route Number (if applicable): _____
3. Distance from proposed structure along stream centerline: _____
4. Length of bridge or culvert size: _____
5. Superstructure (slab thickness, beam depth): _____
6. Substructure information: _____
7. Column Type (concrete, steel, etc.): _____
8. Size of Column: _____
9. Number of Columns per bent: _____

Structure 2

1. Structure Type (railroad/highway bridge, culvert): _____
2. Route Number (if applicable): _____
3. Distance from proposed structure along stream centerline: _____
4. Length of bridge or culvert size: _____
5. Superstructure (slab thickness, beam depth): _____
6. Substructure information: _____
7. Column Type (concrete, steel, etc.): _____
8. Size of Column: _____
9. Number of Columns per bent: _____

Structure 3

1. Structure Type (railroad/highway bridge, culvert): _____
2. Route Number (if applicable): _____
3. Distance from proposed structure along stream centerline: _____
4. Length of bridge or culvert size: _____
5. Superstructure (slab thickness, beam depth): _____
6. Substructure information: _____
7. Column Type (concrete, steel, etc.): _____
8. Size of Column: _____
9. Number of Columns per bent: _____

NOTE: The above information is required for all bridges or culverts, which lie within 2000 feet upstream or downstream of the project bridge, unless otherwise directed by the Office of Bridge Hydraulics.

H. Miscellaneous Information

1. Are there water surfaces affected by other factors (high water from other streams, reservoirs, etc.):

   WATER SURFACE ELEVATIONS ARE AFFECTED BY CARTERS LAKE REGULATION DAM, UPSTREAM

2. Give location (horizontal distance to dam or spill way along stream centerline), length, width and elevation of dam and spillway, if applicable:

   N/A

HYDRAULIC ENGINEERING FIELD REPORT

I. HYDRAULIC AND HYDROLOGICAL DATA REQUIRED FOR ALL EXISTING OR PROPOSED BRIDGE STREAM CROSSING PROJECTS

A. Project Location

Project No.: MPOPD1701093 County: GORDON District: GDOT #6

P.I. No.: 0013994 Stream Name: TRIBUTARY CREEK INTO COOSAWATTEE RIVER Route: SR-136

Surveyed By: G. XIONG Date: 08.24.2018

B. Site Information

Floodplain and Stream Channel description:

1. Flat, rolling, mountainous, etc.: HILLY AND NEAR MOUNTAINOUS REGION, VALLEY, RIVER BOTTOMS

2. Wooded, heavily vegetated, pasture, swampy, etc.: WOODED, HARDWOODS AND PINES
   PASTURES IN THE VICINITY

3. Stream channel description: well-defined banks, meandering, debris, etc.

   WELL DEFINED BANKS

4. Is there any fill in the upstream or downstream floodplain, which will affect the natural drainage or limit the floodplain width at this site?

   BEAVER DAMS ALONG THE CHANNEL, UPSTREAM AND DOWNSTREAM

C. Required Existing Bridge Information at Project Site

1. Bridge Identification No.: 129-0038-0
2. Date Built: 1965
3. Skew angle of bridge bents: 5.2°
4. Height of curb, parapet or barrier: 1.20'

Substructure Information:

1. Column type (concrete, steel, etc): STEEL H-BEAM
2. Size of columns: 10"
3. Number of columns per bent: 4
4. Guide Bank (Spur Dike) length, elevation and location (if applicable):

   NO SPUR DIKE

5. Note any scour problems at intermediate bents or abutments:

   BRIDGE DEFECTS NOTED ON THE GDOT WEBSITE

   BRIDGE INSPECTION REPORT

Note: The above information is required for all bridges within the floodplain (main and overflow bridges) along the roadway. In addition, the location, size and number of barrels are required for all box culverts located within the floodplain.

D. Normal Water Surface Data

	WS ELEV
500 feet upstream of survey centerline:	644.60
At the survey centerline:	643.80
500 feet downstream of survey centerline:	638.60
Normal high tide:	N/A
Normal low tide:	N/A

E. Historical Flood Data

1. Extreme high water elevation at site: 649.00 +/- Date: 10.22.2018
2. Highest observed tide elevation: N/A Date:
3. Location of extreme high water elevation (upstream/downstream face of bridge at the centerline or station and offset if not at bridge):

4. Source of high water information: FIELD OBSERVATION
   HIGH WATER MARK ON COLUMN
5. Location and floor elevation of any houses/buildings/structures that have been flooded:

6. Information about flood (number of times structure has been flooded, water surface elevations and date(s) of flood):

7. Location and floor elevation of any houses/buildings/structures that have floor elevations within 2 feet of the extreme high water elevation:

F. Benchmark Information

Location 1:

1. Benchmark Name: #101 Elevation: 667.65
2. Location *(project stations/offset)*: ROUGHLY 161' WEST OF THE WEST EDGE OF BRIDGE
   Northing: 1674252.8693 Easting: 2112856.4147
3. Physical description: 5/8" REBAR WITH CAP

Location 2:

1. Benchmark Name: Elevation:
2. Location *(project stations/offset)*:
   Northing: Easting:
3. Physical description:

Location 3:

1. Benchmark Name: Elevation:
2. Location *(project stations/offset)*:
   Northing: Easting:
3. Physical description:

G. Upstream and Downstream Structures

Structure 1

1. Structure Type (railroad/highway bridge, culvert): NONE WITHIN 2000'
2. Route Number (if applicable): _____
3. Distance from proposed structure along stream centerline: _____
4. Length of bridge or culvert size: _____
5. Superstructure (slab thickness, beam depth): _____
6. Substructure information: _____
7. Column Type (concrete, steel, etc.): _____
8. Size of Column: _____
9. Number of Columns per bent: _____

Structure 2

1. Structure Type (railroad/highway bridge, culvert): _____
2. Route Number (if applicable): _____
3. Distance from proposed structure along stream centerline: _____
4. Length of bridge or culvert size: _____
5. Superstructure (slab thickness, beam depth): _____
6. Substructure information: _____
7. Column Type (concrete, steel, etc.): _____
8. Size of Column: _____
9. Number of Columns per bent: _____

Structure 3

1. Structure Type (railroad/highway bridge, culvert): _____
2. Route Number (if applicable): _____
3. Distance from proposed structure along stream centerline: _____
4. Length of bridge or culvert size: _____
5. Superstructure (slab thickness, beam depth): _____
6. Substructure information: _____
7. Column Type (concrete, steel, etc.): _____
8. Size of Column: _____
9. Number of Columns per bent: _____

NOTE: The above information is required for all bridges or culverts, which lie within 2000 feet upstream or downstream of the project bridge, unless otherwise directed by the Office of Bridge Hydraulics.

H. Miscellaneous Information

1. Are there water surfaces affected by other factors (high water from other streams, reservoirs, etc.):
   BEAVER DAMS ALONG THE CHANNEL

2. Give location (horizontal distance to dam or spill way along stream centerline), length, width and elevation of dam and spillway, if applicable:
   N/A

SECTION 4

SMS Procedure and Results

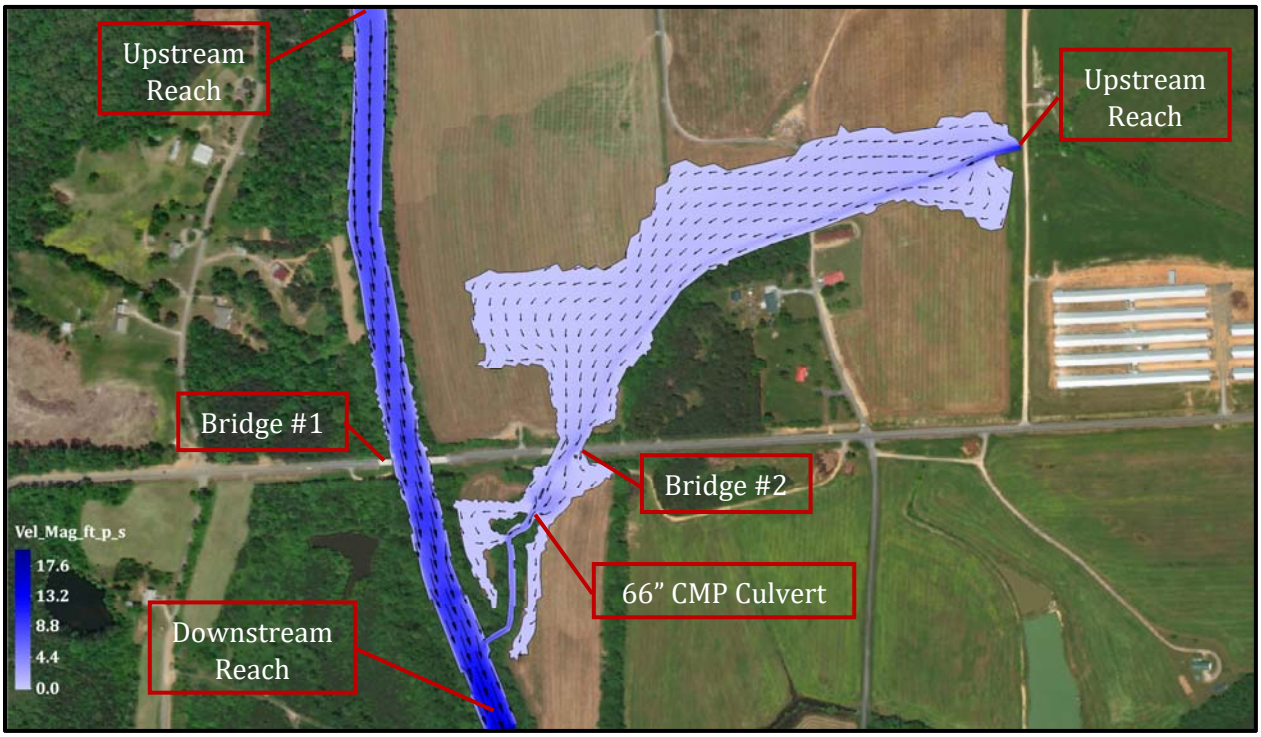
MODEL OVERVIEW

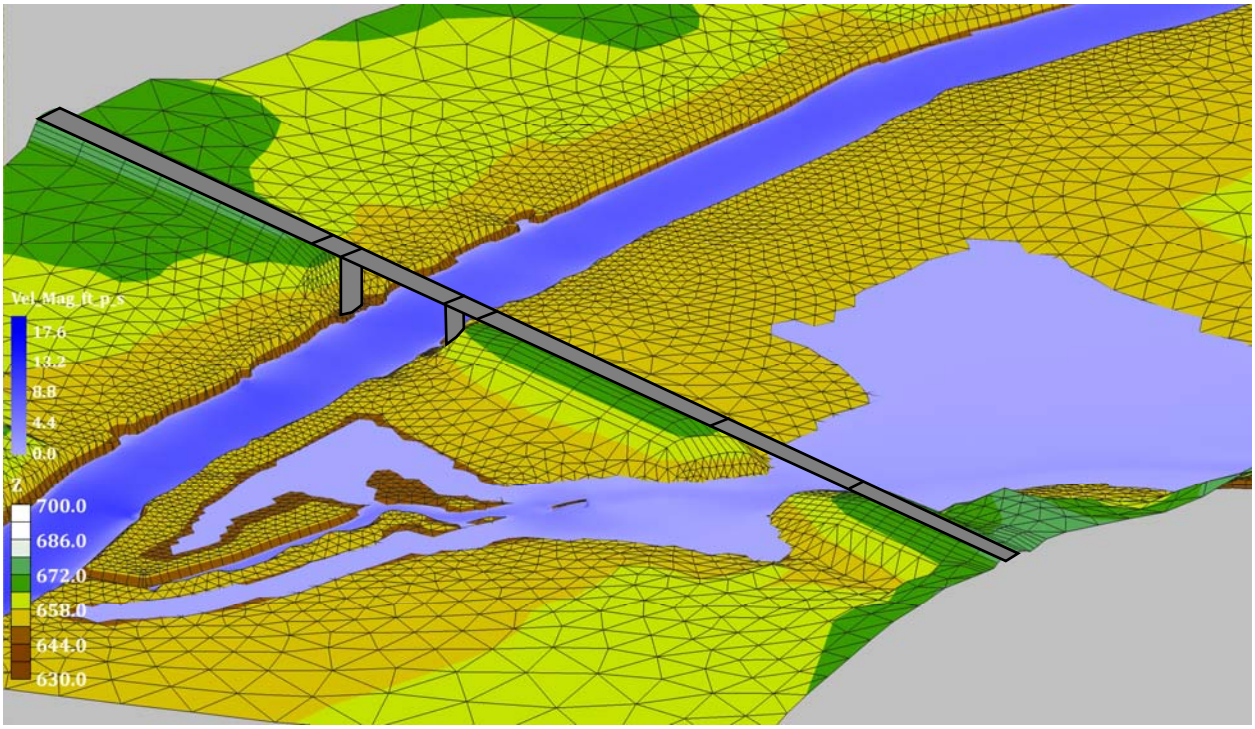
SRH-2D SUMMARY TABLES

BACKWATER PLOTS

VELOCITY PLOTS

Model Overview



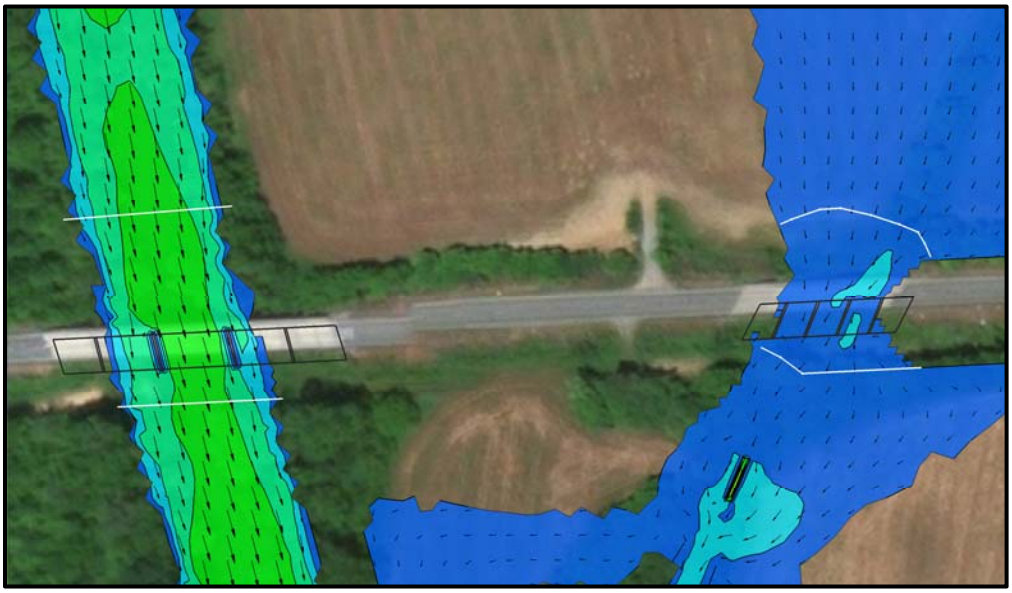


The above images represent the 100-year storm for the proposed conditions. The three structures (2 bridges and a culvert) were modeled as holes in the mesh. Pressure flow was only applied to the culvert as the freeboard for the bridges was nearly 20 ft.

Manning's Values

Cleared Agricultural – 0.065
Channel – 0.04
Wooded – 0.12
Cleared Residential – 0.06
GDOT Right of Way – 0.05
Corrugated Metal – 0.022

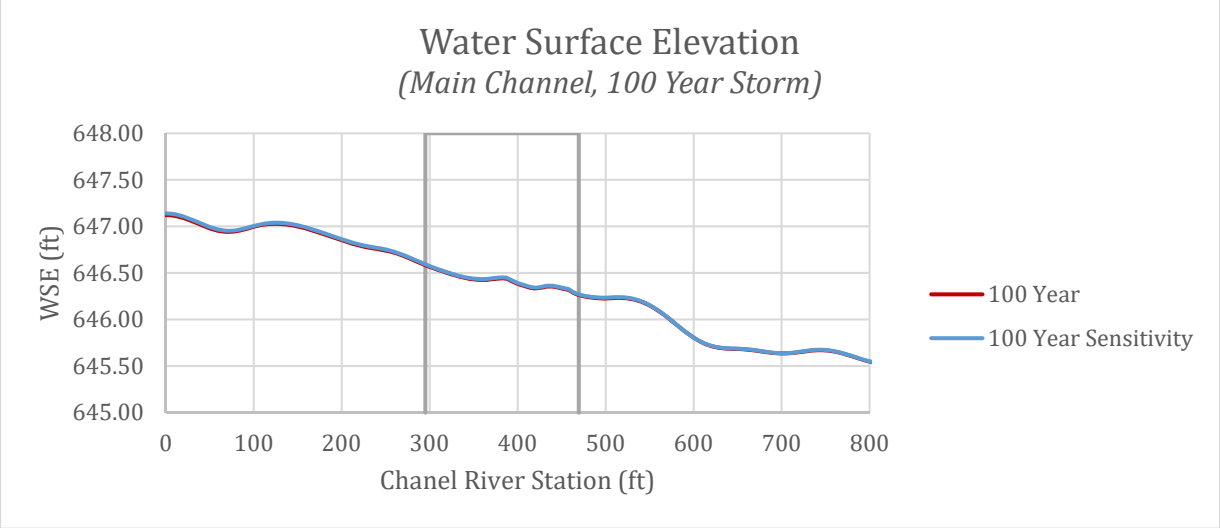
Hydraulic Values



The values for the hydraulic tables were extracted using the '1D-Hyd' module in SMS. The input requires bank lines and cross sections (represented in white above) similar to traditional HEC-RAS methods. The module will calculate average values across the channel and overbanks so it is

important that the cross section be perpendicular to the flow. The approach cross section for the main bridge was placed one channel width upstream of the bridge since the flow is contained within the channel. The approach cross section for the tributary bridge was placed where the flow begins to contract towards the bridge and where the backwater is greatest. The full valley cross sections for both bridges are located immediately downstream of the bridge openings and perpendicular to flow.

Sensitivity Analysis



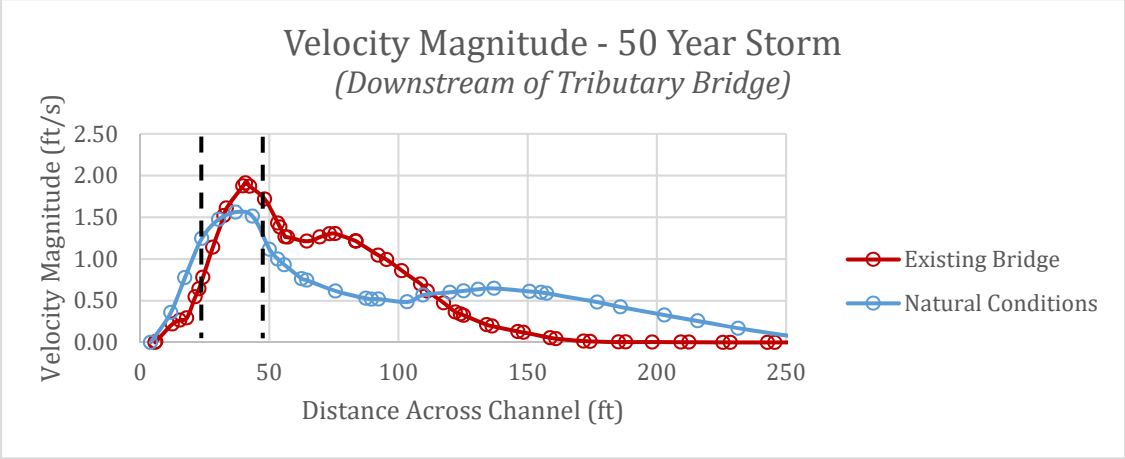
The downstream water surface elevation boundary condition was decreased by 1 ft. (639.25 to 638.25) to analyze the effect of this boundary condition on the hydraulic results. The analysis showed that the boundary condition does not impact the results at the bridges. The water surface elevations of the two models are within 0.002%. A similar analysis was performed for each storm event.

Other Considerations

The hydraulic summary tables represent a 1-dimensional cross section extracted from a 2-dimensional model. As such, the values shown may deviate from expected 1D values.

1. The channel velocities do not increase with the existing conditions for bridge #2 during the 50 year storm

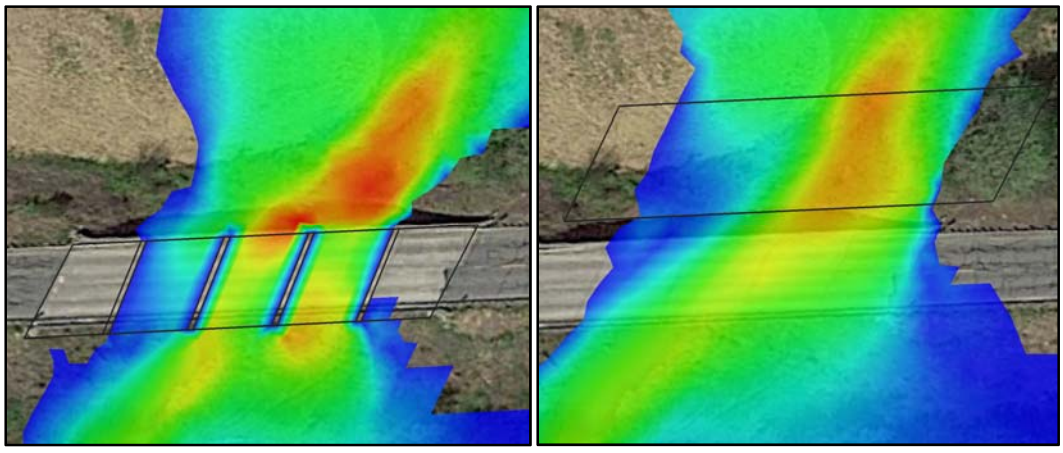
50 YEAR STORM	NATURAL (for existing)	EXISTING
Floodstage (Approach)	650.84	650.95
Floodstage (Full Valley)	650.76	650.74
Discharge Thru Structure (ft^3/s)	-	494
Discharge Over Road (ft^3/s)	-	0
Area of Opening (ft^2)	-	440
Velocity Thru Structure (ft/s)	-	1.12
Channel Velocity (ft/s)	1.34	1.33
Backwater (ft)	-	0.11



This can be explained by the nature of 2D flow distribution shown above. The average velocity is calculated for the narrow channel represented by the dashed lines. For the existing bridge, the velocities are higher towards the edge of the channel because the upstream bents are affecting the flow of the water. 1D equations can only estimate velocity distribution, as opposed to 2D equations where it is actually computed. As a result, the average velocities appear to be the same, when in reality, the existing bridge clearly creates substantially higher velocities in the channel.

2. The proposed bridge #2 causes higher velocities than the existing bridge in the channel and through the structure.

50 YEAR STORM	NATURAL (for existing)	EXISTING	NATURAL (for proposed)	PROPOSED
Floodstage (Approach)	650.84	650.95	650.84	650.89
Floodstage (Full Valley)	650.76	650.74	650.77	650.77
Discharge Thru Structure (ft^3/s)	-	494	-	494
Discharge Over Road (ft^3/s)	-	0	-	0
Area of Opening (ft^2)	-	440	-	421
Velocity Thru Structure (ft/s)	-	1.12	-	1.17
Channel Velocity (ft/s)	1.34	1.33	1.15	1.34
Backwater (ft)	-	0.11	-	0.05



The existing bridge (left) obstructs a large part of the channel causing higher velocities upstream and around the intermediate bents. The proposed bridge (right) allows the flow to move less hindered and reach higher velocities in the channel and downstream of the bridge.

Additionally, the bridges are on different alignments so the cross sections for the existing and proposed conditions are not the same. Regardless, the increase in velocity is still within the acceptable limits.

SRH-2D Results Summary
Natural Conditions (for existing)

50 (DESIGN) YEAR STORM

		Flow			Width			Normal Velocity			Hydr Depth			Discharge WSE		
Reach	**Station**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**
Main	**337.16**	0	9801	0	0	124.16	0	0	6.42	0	0	12.30	0	NA	645.98	NA
Main	**498.09**	0	9627	0	0	135.92	0	0	5.95	0	0	11.90	0	NA	645.79	NA
Tributary	**254.47**	166	178	150	116.02	19.92	80.63	0.64	1.13	0.71	2.23	7.94	2.62	650.84	650.84	650.84
Tributary	**459.73**	11	310	169	8.09	33.56	212.78	0.79	1.34	0.32	1.67	6.86	2.51	650.76	650.76	650.78

100 YEAR STORM

		Flow			Width			Normal Velocity			Hydr Depth			Discharge WSE		
Reach	**Station**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**
Main	**337.16**	0	10578	0	0	124.65	0	0	6.63	0	0	12.80	0	NA	646.53	NA
Main	**498.09**	0	10571	0	0	136.65	0	0	6.25	0	0	12.39	0	NA	646.35	NA
Tributary	**254.47**	204	194	182	119.80	19.92	83.86	0.69	1.18	0.77	2.46	8.23	2.81	651.14	651.14	651.14
Tributary	**459.73**	14	340	224	11.11	33.56	232.16	0.81	1.42	0.37	1.55	7.15	2.64	651.05	651.05	651.07

500 YEAR STORM

		Flow			Width			Normal Velocity			Hydr Depth			Discharge WSE		
Reach	**Station**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**
Main	**337.16**	0	12645	0	0	125.76	0	0	7.17	0	0	14.02	0	NA	647.87	NA
Main	**498.09**	0	12650	0	0	136.92	0	0	6.74	0	0	13.70	0	NA	647.68	NA
Tributary	**254.47**	299	232	258	134.50	19.92	92.65	0.81	1.32	0.90	2.72	8.80	3.08	651.70	651.70	651.70
Tributary	**459.73**	21	407	355	14.00	33.56	232.16	0.87	1.58	0.48	1.72	7.70	3.19	651.60	651.60	651.62

SRH-2D Results Summary
Existing Conditions

50 (DESIGN) YEAR STORM

		Flow			Width			Normal Velocity			Hydr Depth			Discharge WSE			Mean Velocity (ft/s)
Reach	**Station**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**	-
Main	**337.16**	0	9799	0	0	124.50	0	0	6.37	0	0	12.35	0	NA	646.08	NA	6.37
Main	**498.09**	0	9729	0	0	133.50	0	0	6.05	0	0	12.04	0	NA	645.78	NA	6.05
Tributary	**254.47**	188	180	125	118.30	19.92	82.17	0.69	1.12	0.56	2.29	8.05	2.71	650.95	650.95	650.95	0.81
Tributary	**459.73**	0	305	179	10.96	33.56	82.94	0.03	1.33	0.77	1.30	6.83	2.80	650.74	650.74	650.76	1.12

100 YEAR STORM

		Flow			Width			Normal Velocity			Hydr Depth			Discharge WSE			Mean Velocity (ft/s)
Reach	**Station**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**	-
Main	**337.16**	0	10612	0	0	124.95	0	0	6.60	0	0	12.87	0	NA	646.64	NA	6.60
Main	**498.09**	0	10556	0	0	134.63	0	0	6.28	0	0	12.49	0	NA	646.33	NA	6.28
Tributary	**254.47**	235	197	149	120.98	19.92	86.92	0.76	1.18	0.59	2.56	8.37	2.88	651.27	651.27	651.28	0.86
Tributary	**459.73**	0	344	226	10.96	33.56	91.15	0.04	1.44	0.84	1.60	7.14	2.95	651.05	651.04	651.06	1.20

500 YEAR STORM

		Flow			Width			Normal Velocity			Hydr Depth			Discharge WSE			Mean Velocity (ft/s)
Reach	**Station**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**	-
Main	**337.16**	0	12674	0	0	126.04	0	0	7.13	0	0	14.11	0	NA	648.00	NA	7.13
Main	**498.09**	0	12665	0	0	140.97	0	0	6.77	0	0	13.26	0	NA	647.66	NA	6.77
Tributary	**254.47**	349	234	205	138.25	19.92	95.49	0.90	1.31	0.67	2.82	8.98	3.20	651.88	651.88	651.89	0.96
Tributary	**459.73**	0	439	337	12.74	33.56	92.70	0.02	1.70	1.05	1.91	7.68	3.44	651.58	651.59	651.61	1.42

SRH-2D Results Summary
Natural Conditions (for proposed)

50 (DESIGN) YEAR STORM

		Flow			Width			Normal Velocity			Hydr Depth			Discharge WSE		
Reach	**Station**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**
Main	**Approach**	0	9730	0	0	129.95	0	0	6.05	0	0	12.31	0	NA	646.12	NA
Main	**Full Valley**	0	9707	0	0	132.04	0	0	6.24	0	0	11.68	0	NA	645.80	NA
Tributary	**Approach**	176	163	154	121.37	18.88	79.92	0.61	1.08	0.73	2.36	7.95	2.65	650.84	650.84	650.84
Tributary	**Full Valley**	5	259	228	25.84	32.26	187.71	0.10	1.15	0.56	2.02	6.97	2.19	650.77	650.77	650.79

100 YEAR STORM

		Flow			Width			Normal Velocity			Hydr Depth			Discharge WSE		
Reach	**Station**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**
Main	**Approach**	0	10541	0	0	129.95	0	0	6.27	0	0	12.87	0	NA	646.68	NA
Main	**Full Valley**	0	10514	0	0	134.26	0	0	6.47	0	0	12.04	0	NA	646.34	NA
Tributary	**Approach**	216	178	185	124.24	18.88	84.40	0.67	1.14	0.78	2.60	8.24	2.80	651.14	651.14	651.14
Tributary	**Full Valley**	11	282	286	25.84	32.26	193.44	0.19	1.20	0.61	2.31	7.26	2.42	651.06	651.07	651.08

500 YEAR STORM

		Flow			Width			Normal Velocity			Hydr Depth			Discharge WSE		
Reach	**Station**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**
Main	**Approach**	0	12661	0	0	135.39	0	0	6.80	0	0	13.73	0	NA	648.01	NA
Main	**Full Valley**	0	12618	0	0	138.70	0	0	7.02	0	0	12.96	0	NA	647.64	NA
Tributary	**Approach**	314	212	262	135.15	18.88	88.07	0.79	1.28	0.92	2.94	8.81	3.24	651.70	651.70	651.70
Tributary	**Full Valley**	29	337	424	25.84	32.26	195.78	0.39	1.34	0.74	2.86	7.81	2.94	651.61	651.62	651.63

SRH-2D Results Summary
Proposed Conditions

50 (DESIGN) YEAR STORM

		Flow			Width			Normal Velocity			Hydr Depth			Discharge WSE			Mean Velocity (ft/s)
Reach	**Station**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**	-
Main	**Approach**	0	9702	0	0	129.85	0	0	6.05	0	0	12.36	0	NA	646.12	NA	6.05
Main	**Full Valley**	0	9657	0	0	132.74	0	0	6.24	0	0	11.66	0	NA	645.80	NA	6.24
Tributary	**Approach**	209	190	86	122.13	18.88	42.38	0.72	1.26	0.75	2.40	7.99	2.69	650.89	650.89	650.89	0.94
Tributary	**Full Valley**	0	302	187	25.84	32.26	80.09	0.01	1.34	0.91	2.07	7.00	2.56	650.76	650.77	650.78	1.17

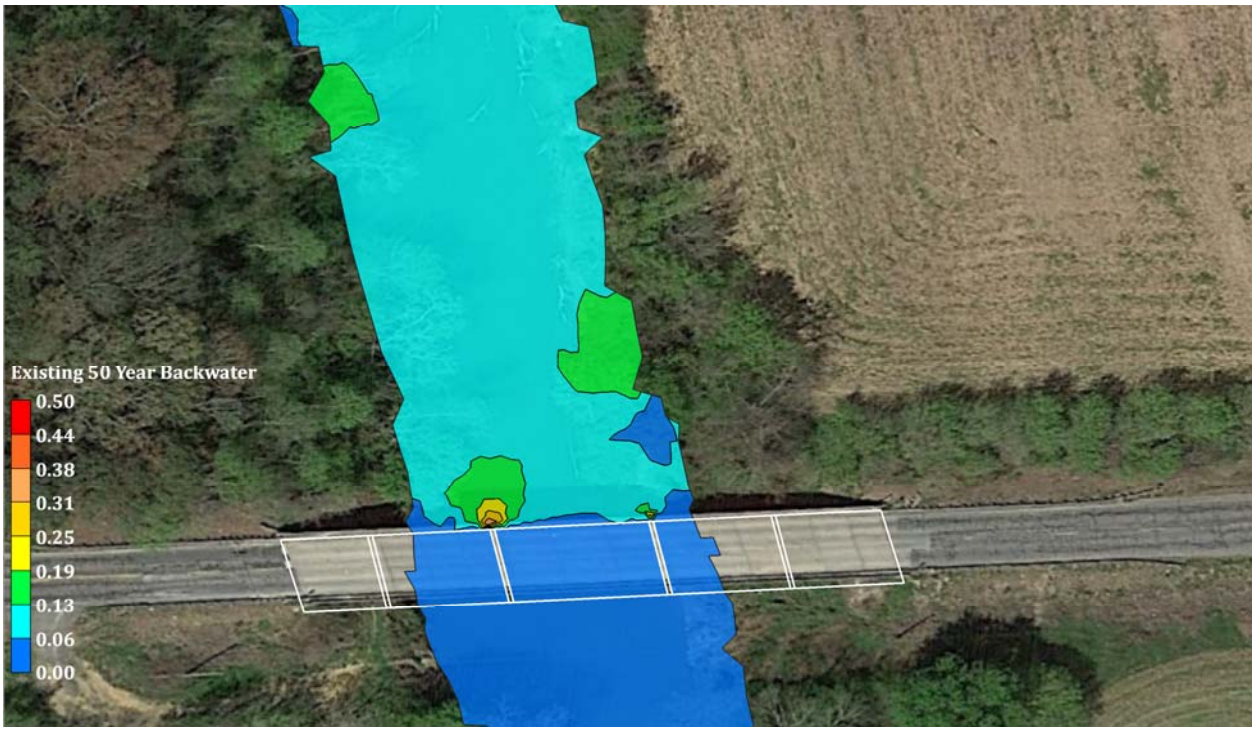
100 YEAR STORM

		Flow			Width			Normal Velocity			Hydr Depth			Discharge WSE			Mean Velocity (ft/s)
Reach	**Station**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**	-
Main	**Approach**	0	10517	0	0	129.85	0	0	6.27	0	0	12.92	0	NA	646.68	NA	6.27
Main	**Full Valley**	0	10470	0	0	133.42	0	0	6.47	0	0	12.14	0	NA	646.34	NA	6.47
Tributary	**Approach**	258	210	103	125.77	18.88	47.64	0.78	1.34	0.80	2.63	8.30	2.70	651.19	651.19	651.20	0.99
Tributary	**Full Valley**	6	334	237	25.84	32.26	82.37	0.10	1.42	1.04	2.36	7.29	2.77	651.06	651.06	651.07	1.25

500 YEAR STORM

		Flow			Width			Normal Velocity			Hydr Depth			Discharge WSE			Mean Velocity (ft/s)
Reach	**Station**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**	**Left**	**Chan**	**Right**	-
Main	**Approach**	0	12628	0	0	133.92	0	0	6.80	0	0	13.87	0	NA	648.01	NA	6.80
Main	**Full Valley**	0	12638	0	0	138.97	0	0	7.02	0	0	12.95	0	NA	647.64	NA	7.02
Tributary	**Approach**	378	254	147	135.15	18.88	51.27	0.92	1.51	0.93	3.04	8.89	3.09	651.79	651.79	651.79	1.11
Tributary	**Full Valley**	18	410	357	25.84	32.26	86.12	0.24	1.62	1.30	2.92	7.85	3.20	651.62	651.63	651.63	1.44

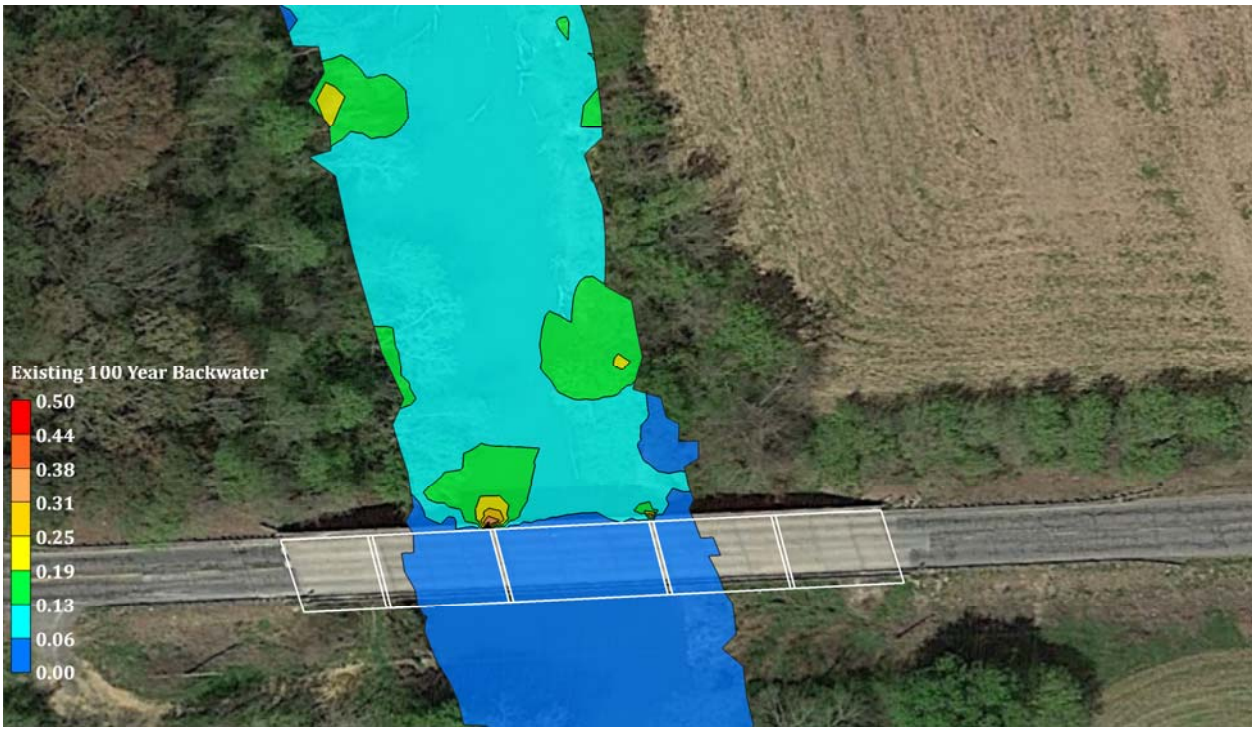
BACKWATER – 50 (DESIGN) YEAR STORM – BRIDGE #1



EXISTING CONDITIONS

PROPOSED CONDITIONS

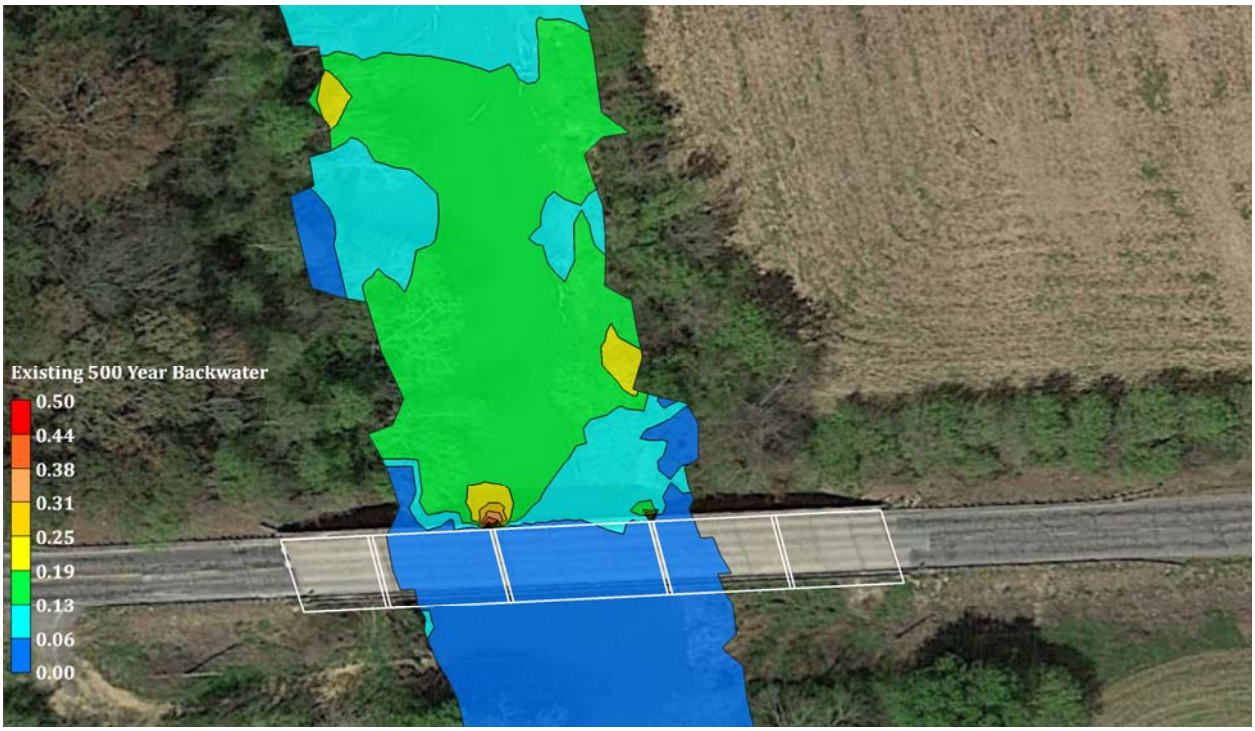
BACKWATER – 100 YEAR STORM – BRIDGE #1



EXISTING CONDITIONS

PROPOSED CONDITIONS

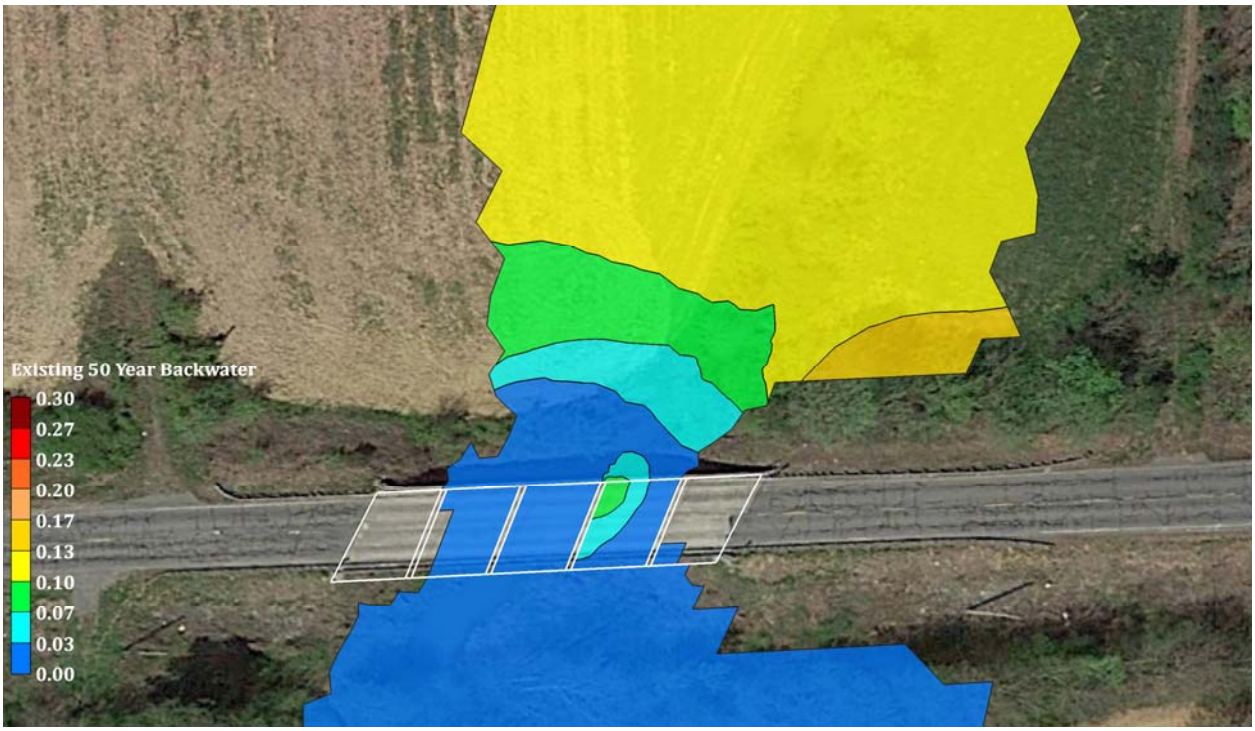
BACKWATER – 500 YEAR STORM – BRIDGE #1



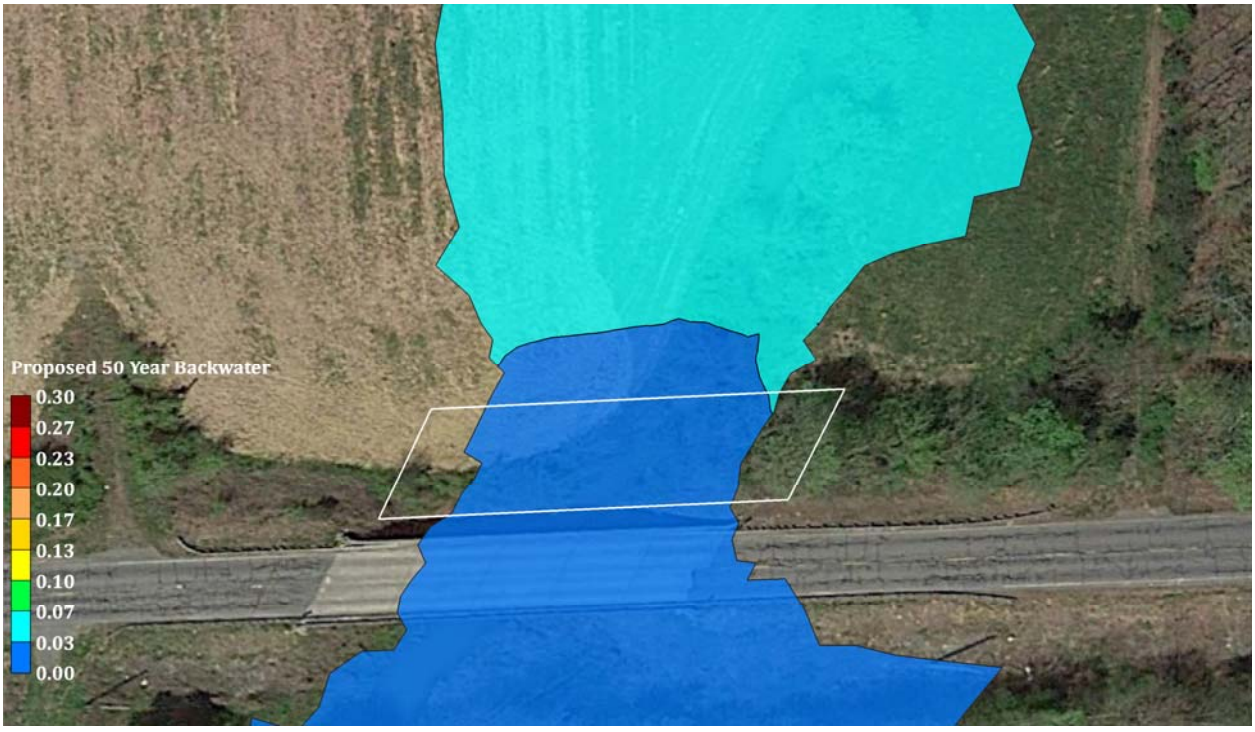
EXISTING CONDITIONS

PROPOSED CONDITIONS

BACKWATER – 50 (DESIGN) YEAR STORM – BRIDGE #2

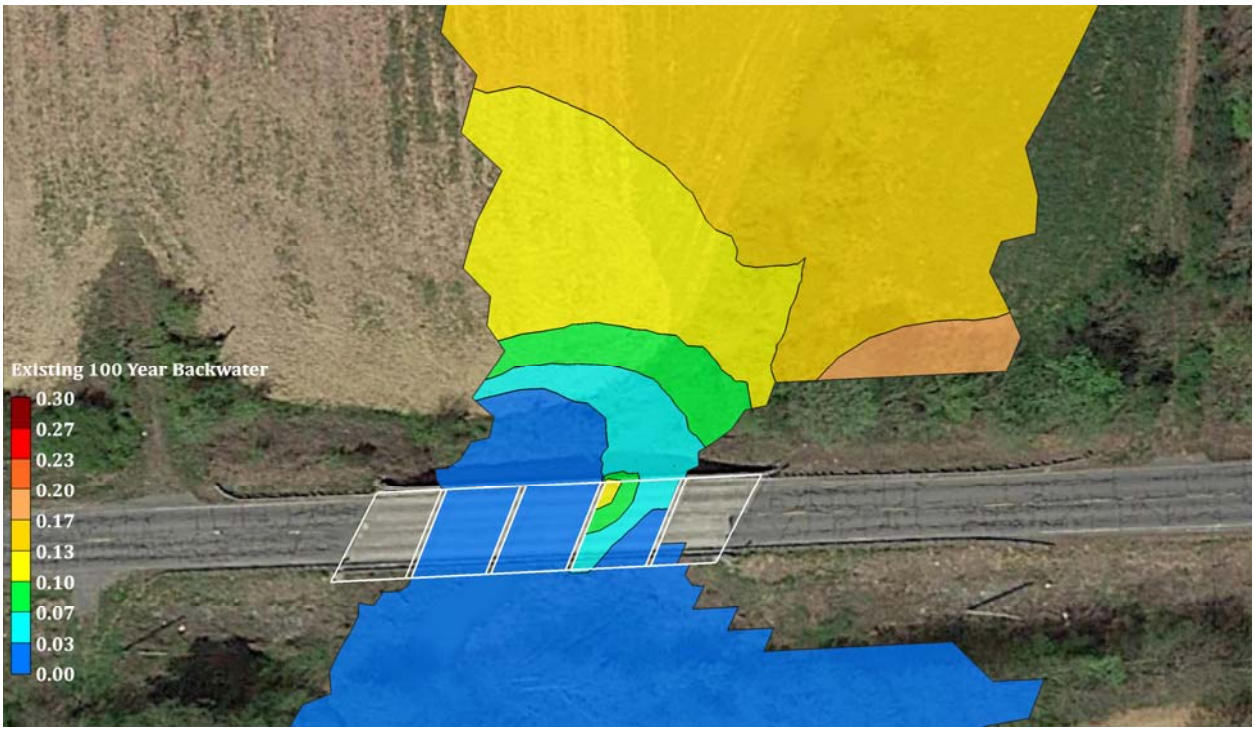


EXISTING CONDITIONS

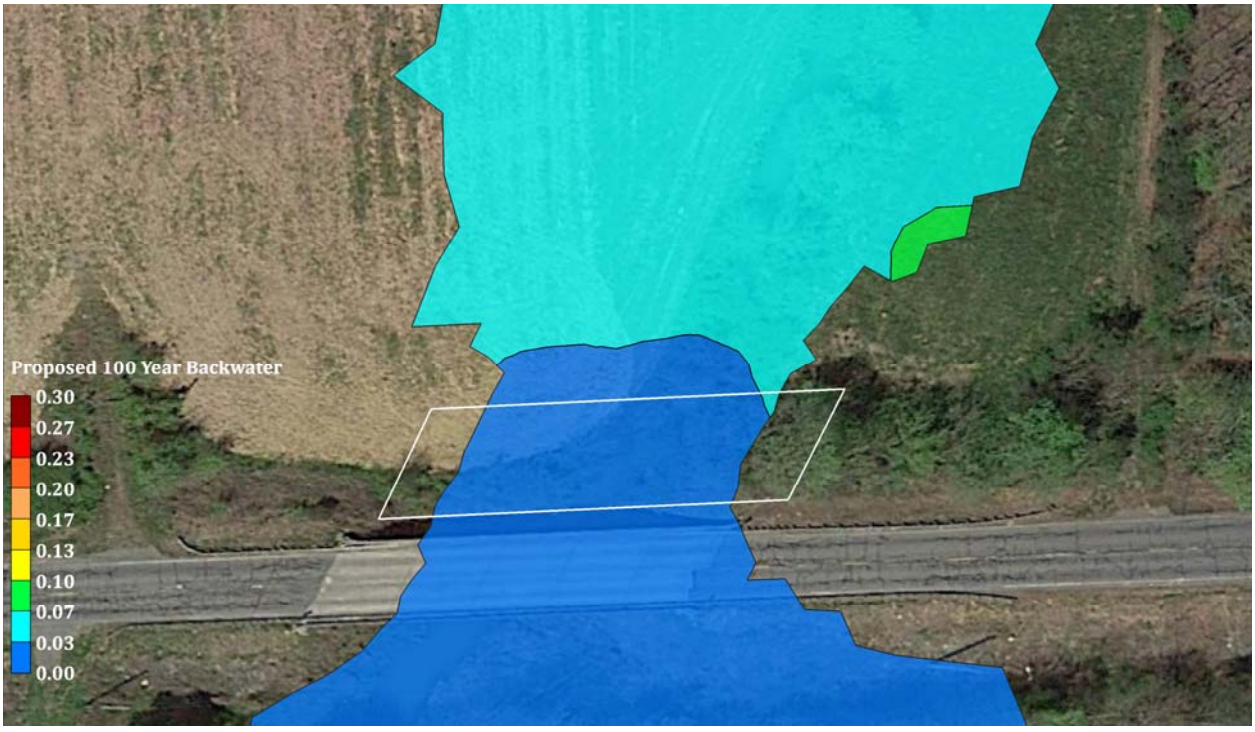


PROPOSED CONDITIONS

BACKWATER – 100 YEAR STORM – BRIDGE #2

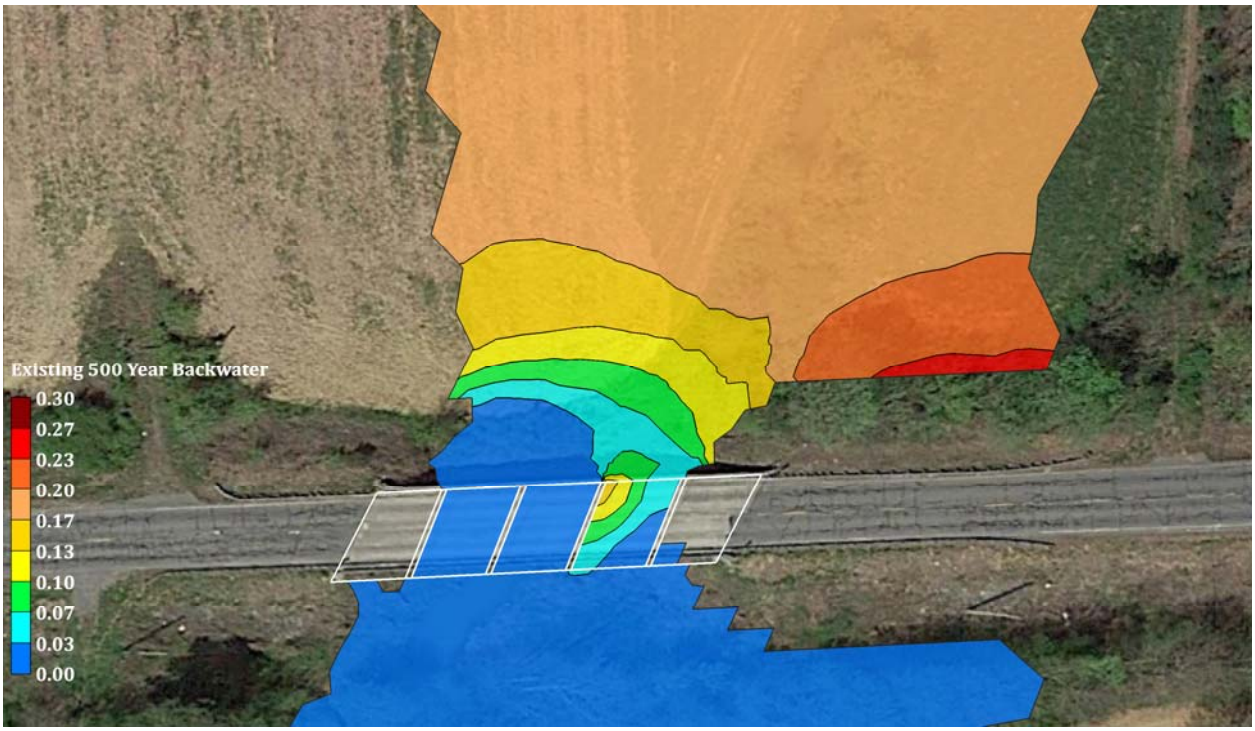


EXISTING CONDITIONS

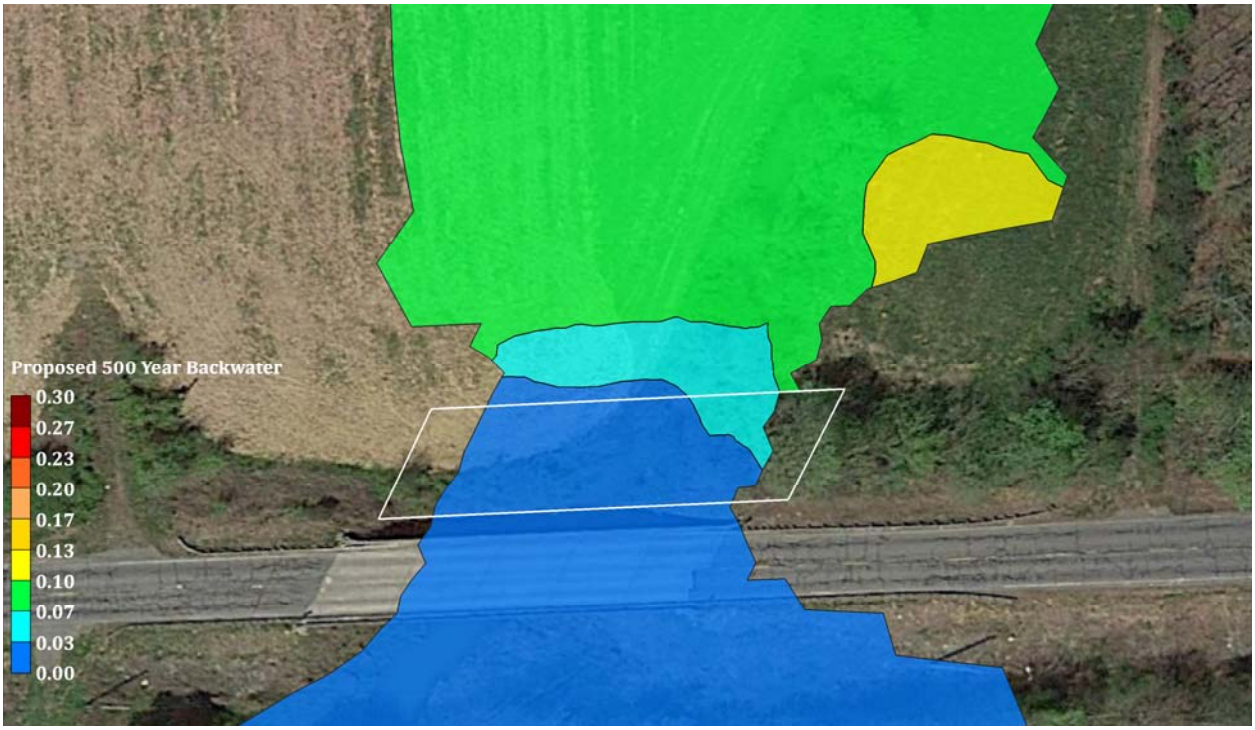


PROPOSED CONDITIONS

BACKWATER – 500 YEAR STORM – BRIDGE #2

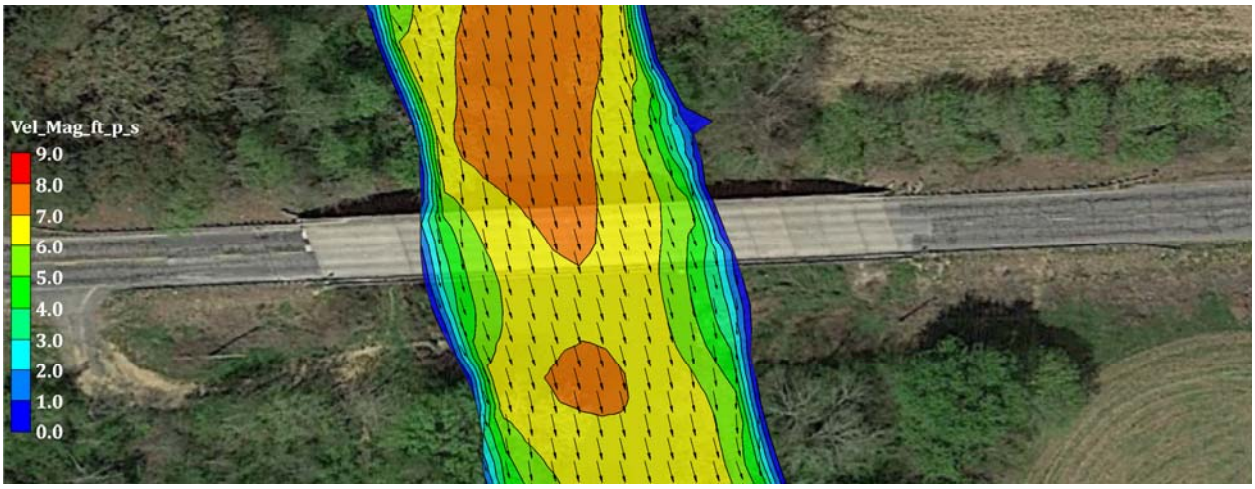


EXISTING CONDITIONS

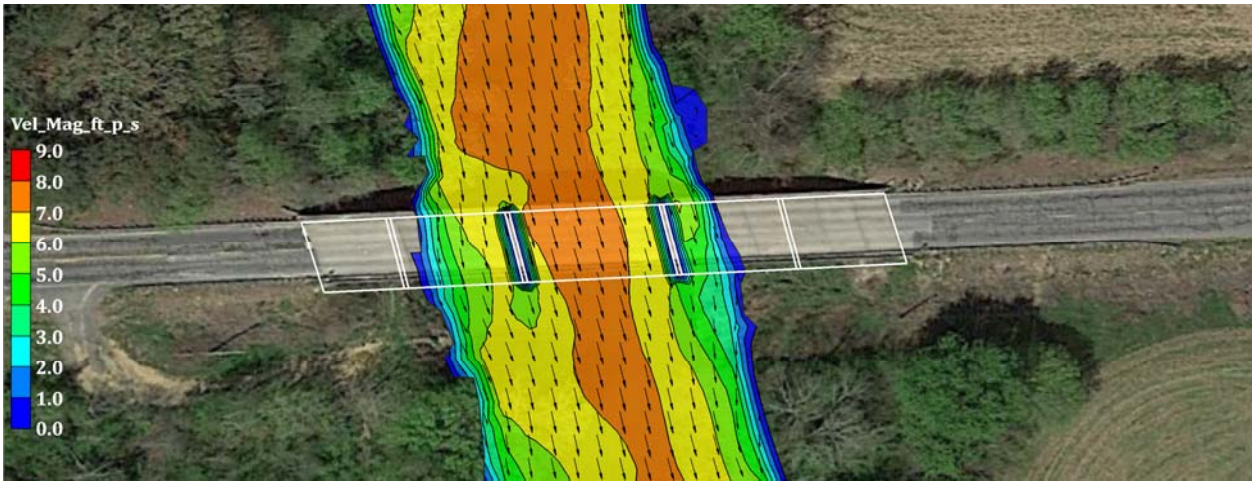


PROPOSED CONDITIONS

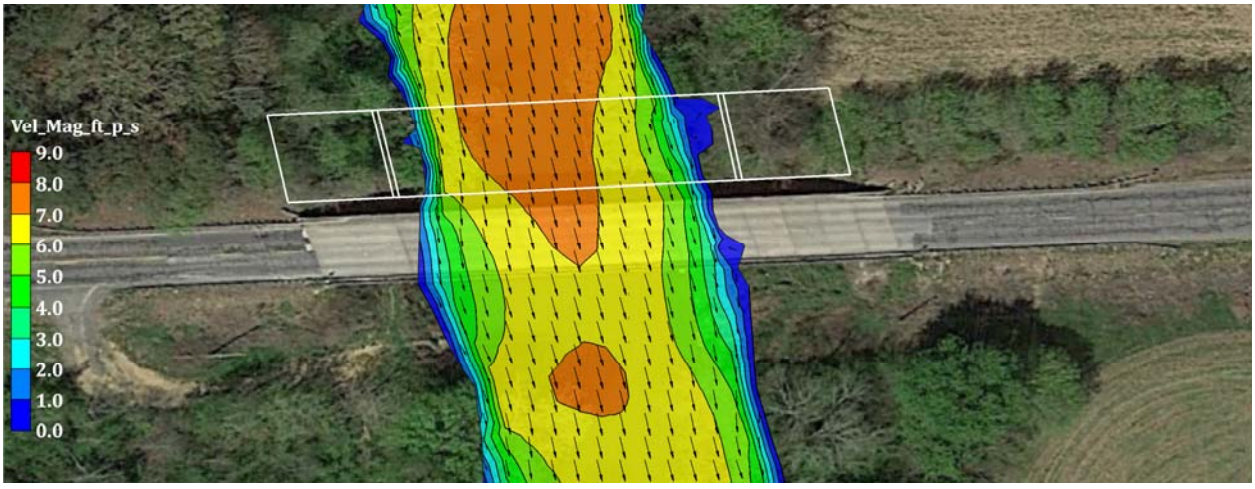
FLOW VELOCITY – 50 (DESIGN) YEAR STORM – BRIDGE #1



NATURAL CONDITIONS

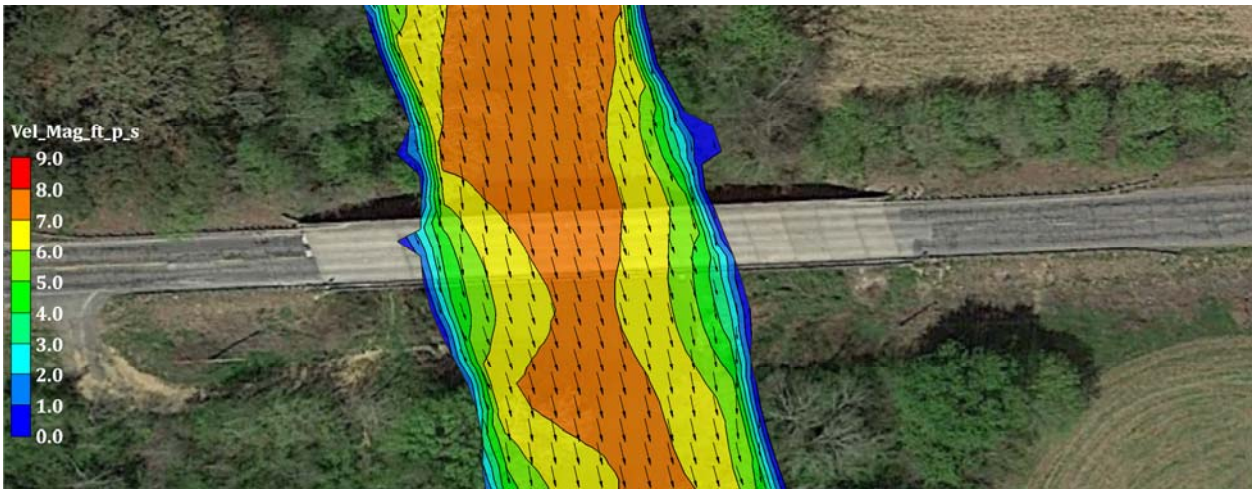


EXISTING CONDITIONS

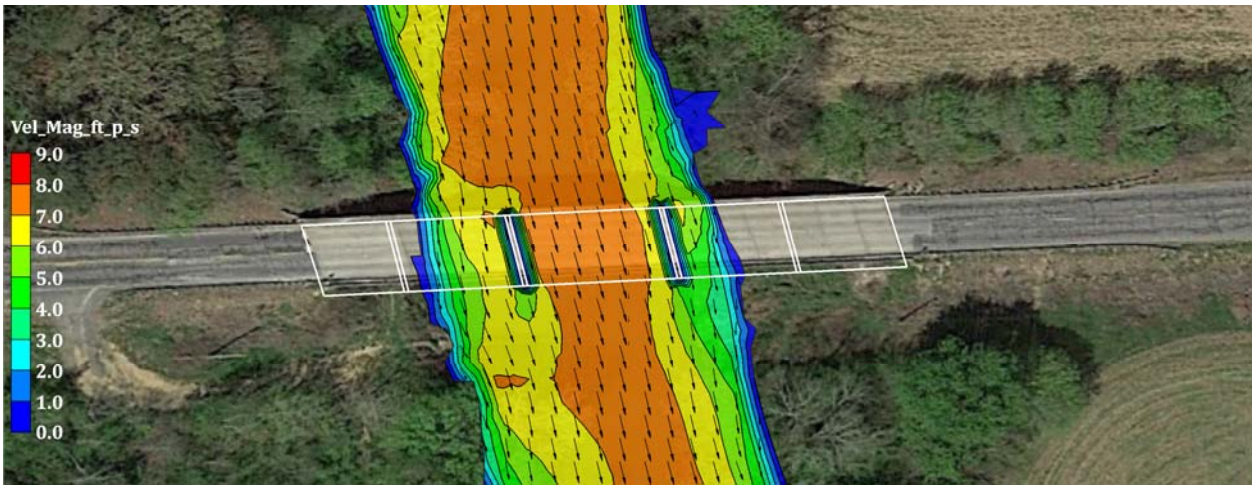


PROPOSED CONDITIONS

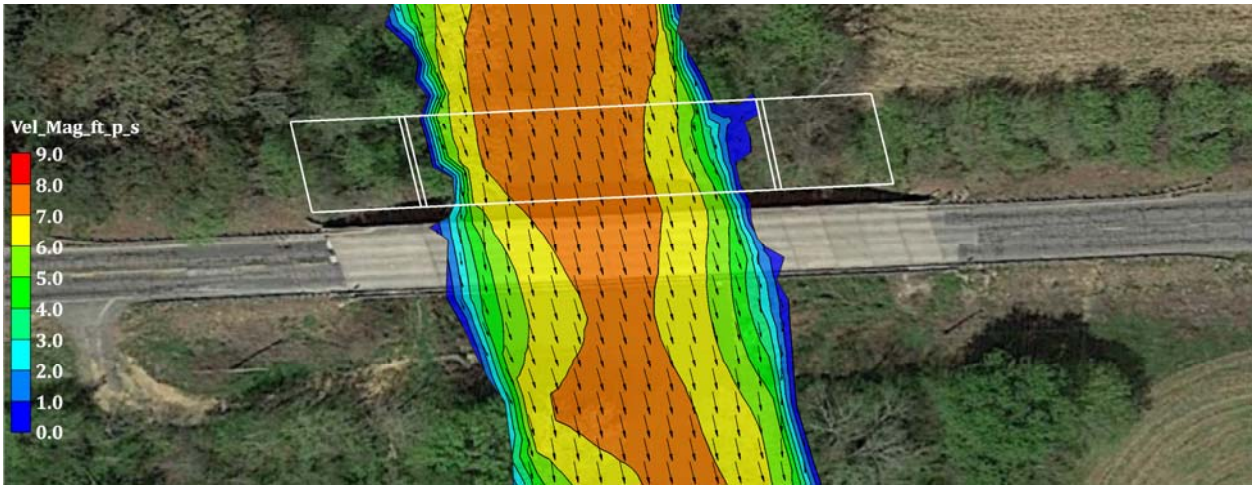
FLOW VELOCITY – 100 YEAR STORM – BRIDGE #1



NATURAL CONDITIONS

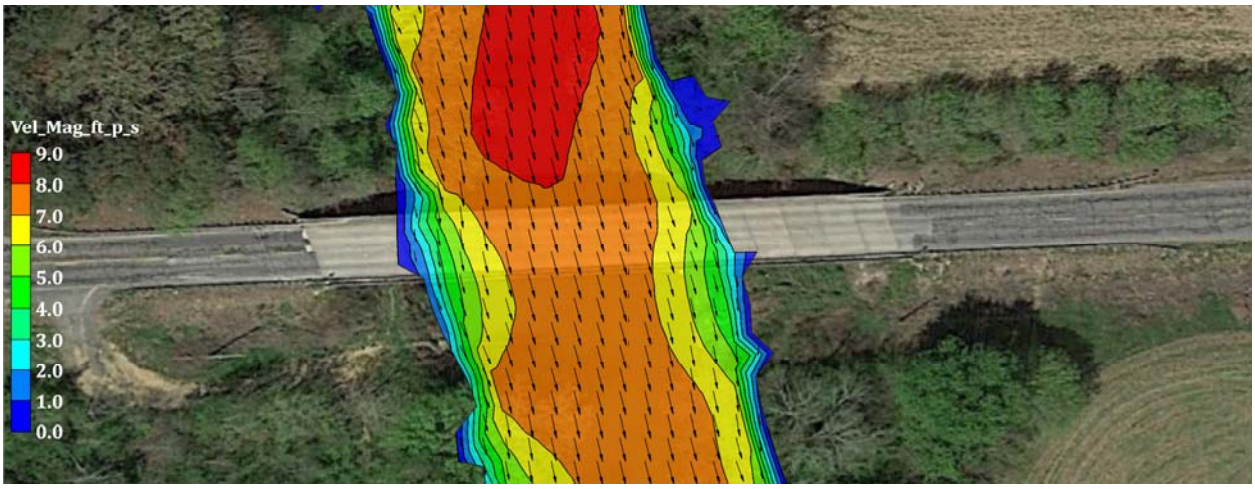


EXISTING CONDITIONS

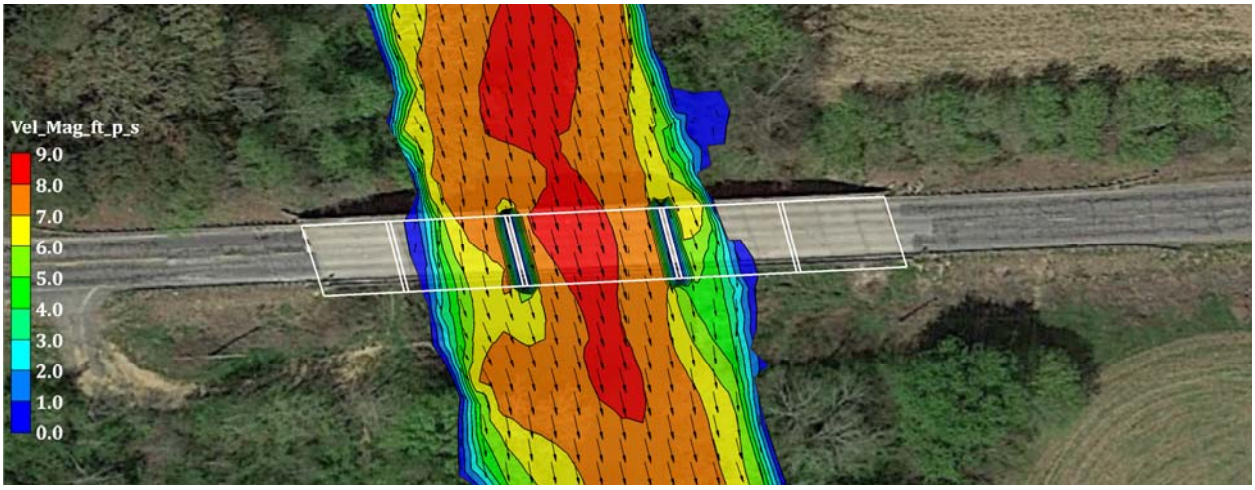


PROPOSED CONDITIONS

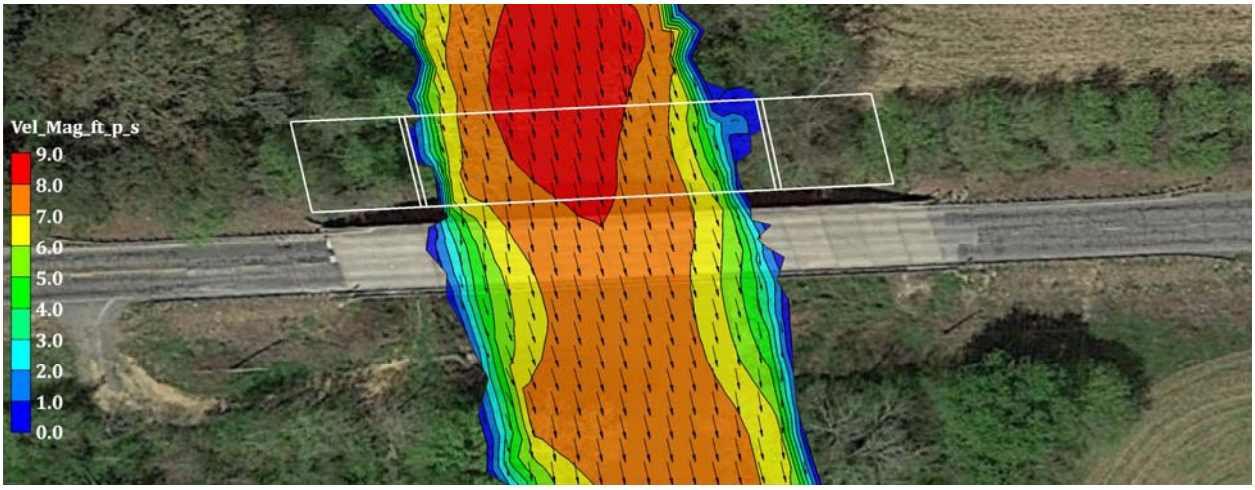
FLOW VELOCITY – 500 YEAR STORM – BRIDGE #1



NATURAL CONDITIONS

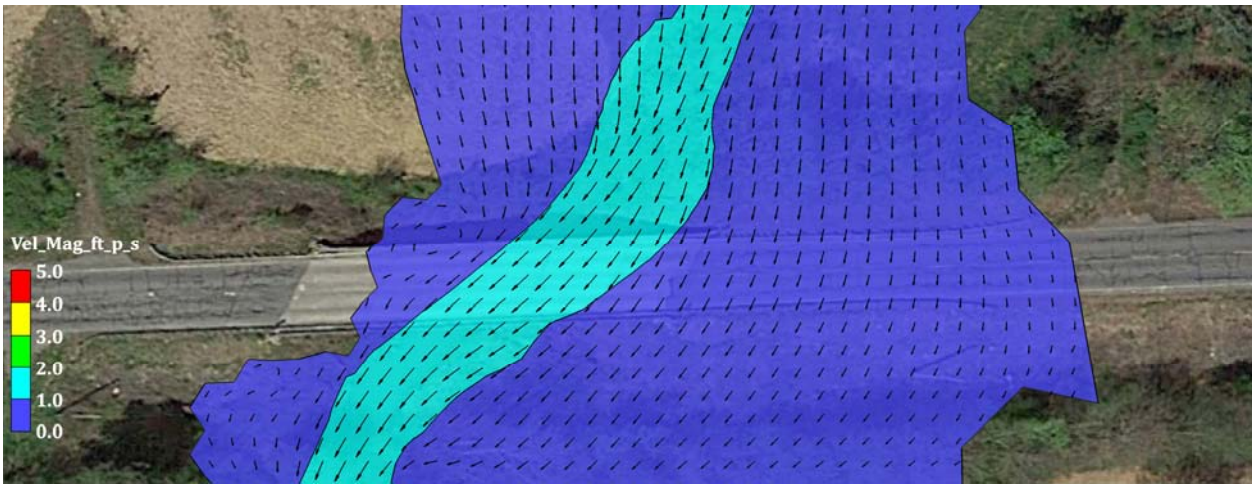


EXISTING CONDITIONS

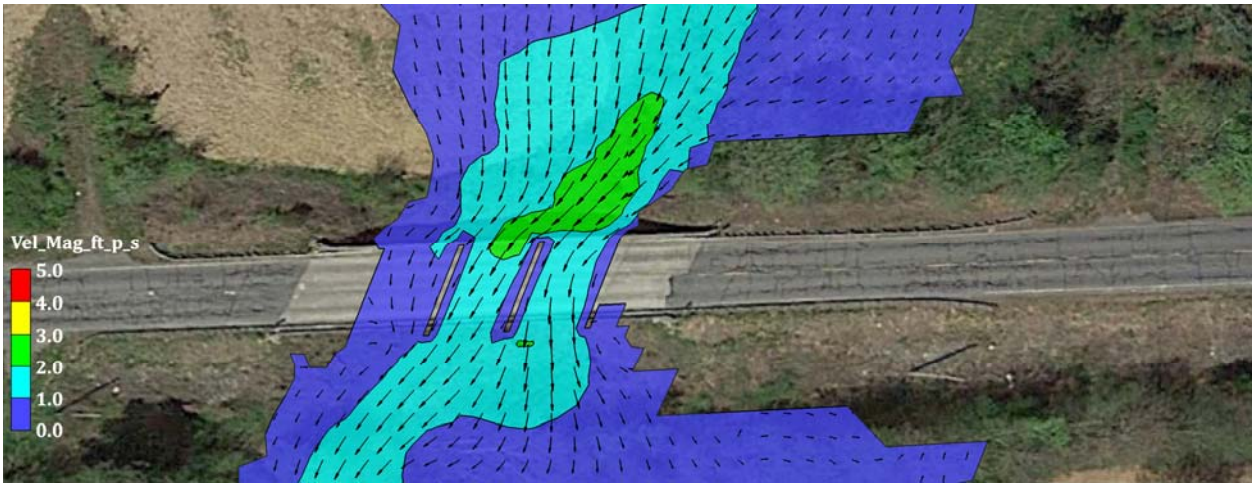


PROPOSED CONDITIONS

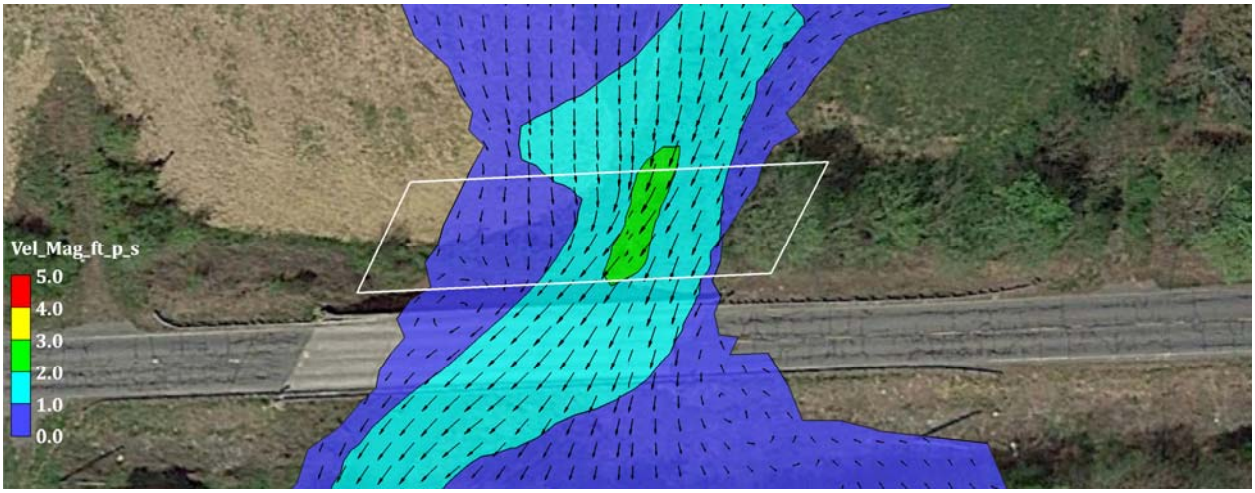
FLOW VELOCITY – 50 (DESIGN) YEAR STORM – BRIDGE #2



NATURAL CONDITIONS

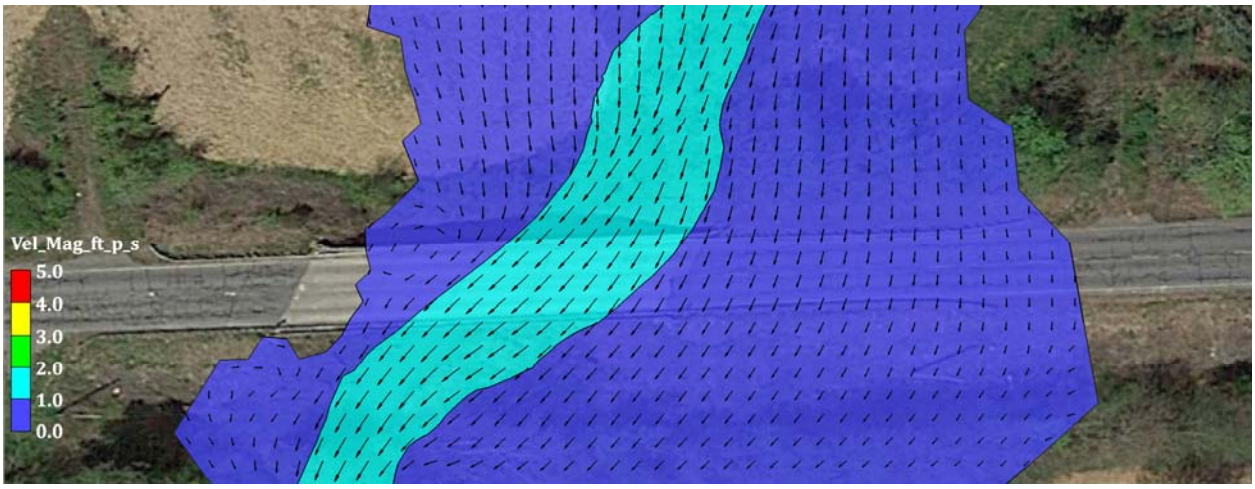


EXISTING CONDITIONS

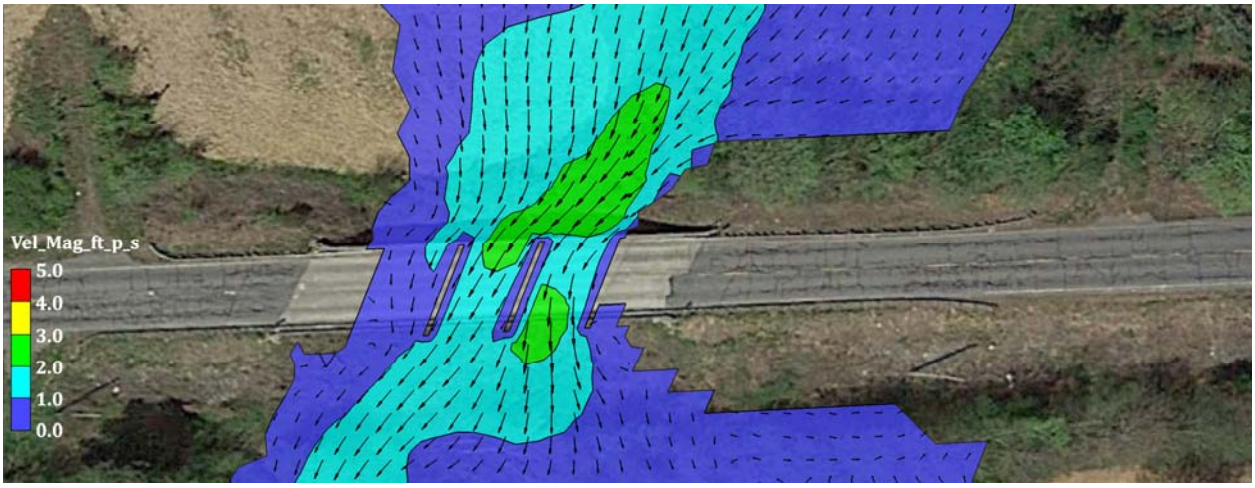


PROPOSED CONDITIONS

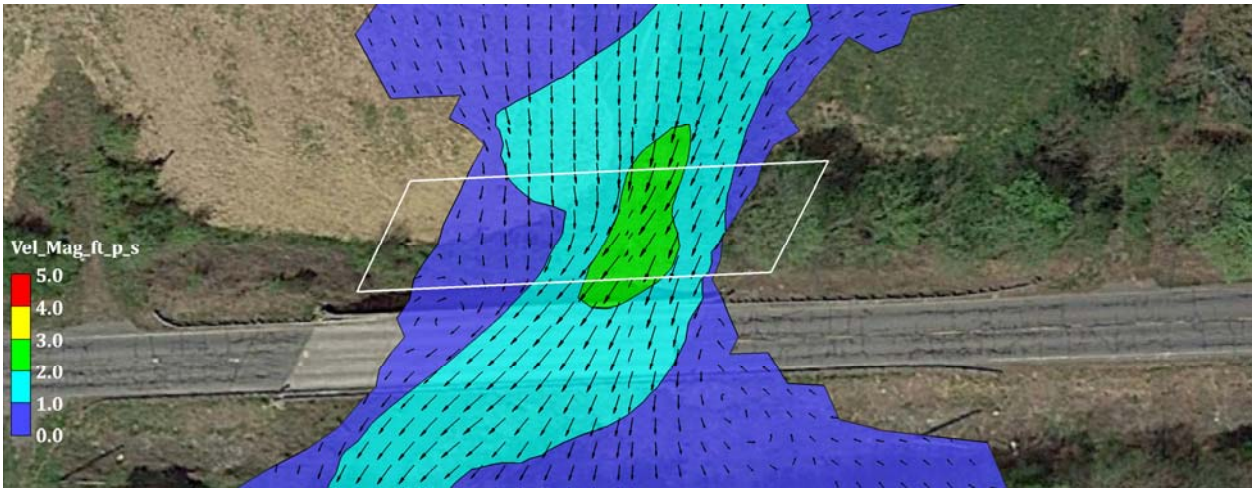
FLOW VELOCITY – 100 YEAR STORM – BRIDGE #2



NATURAL CONDITIONS

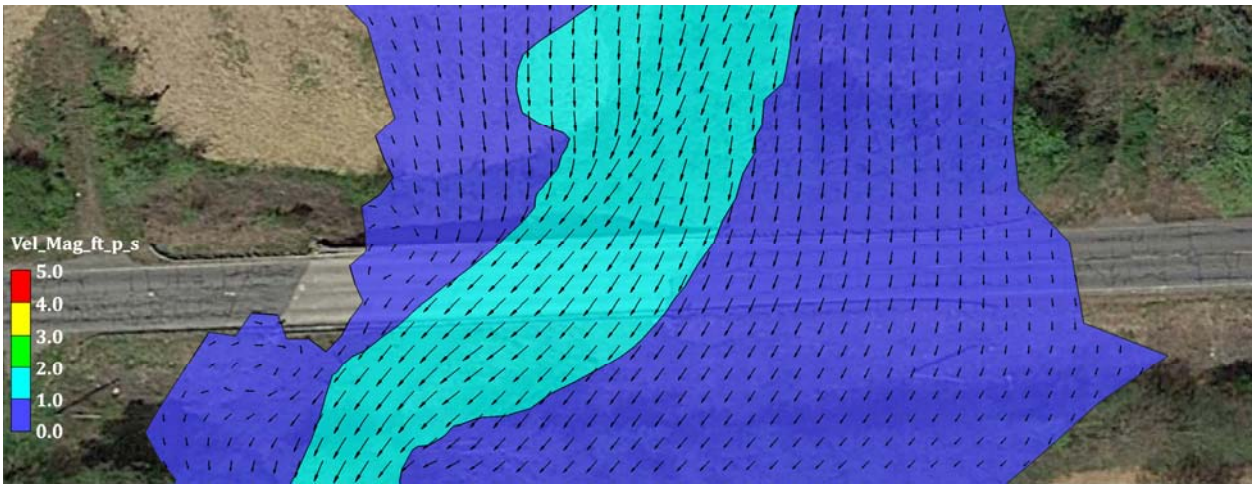


EXISTING CONDITIONS

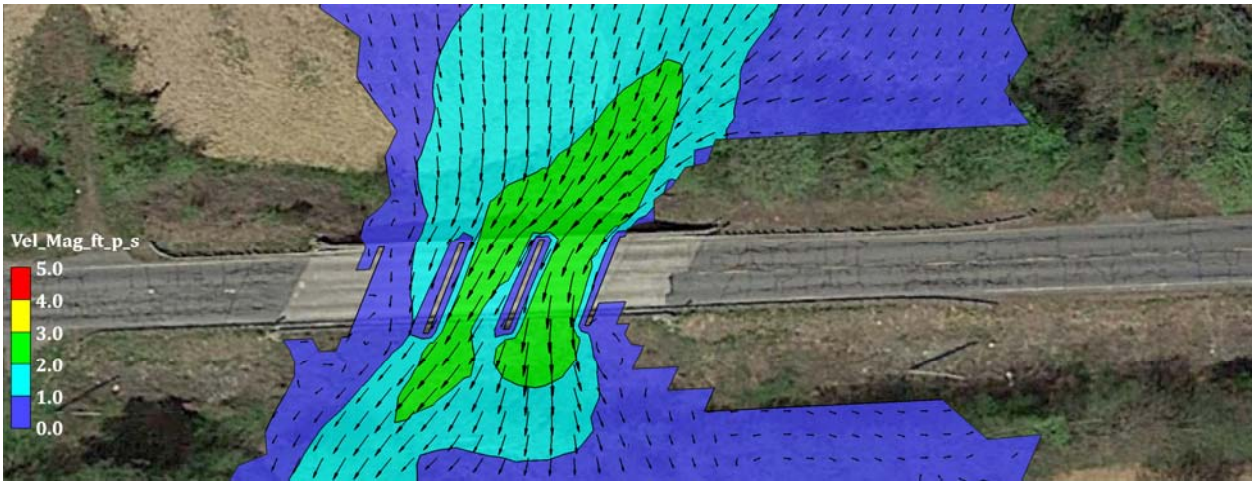


PROPOSED CONDITIONS

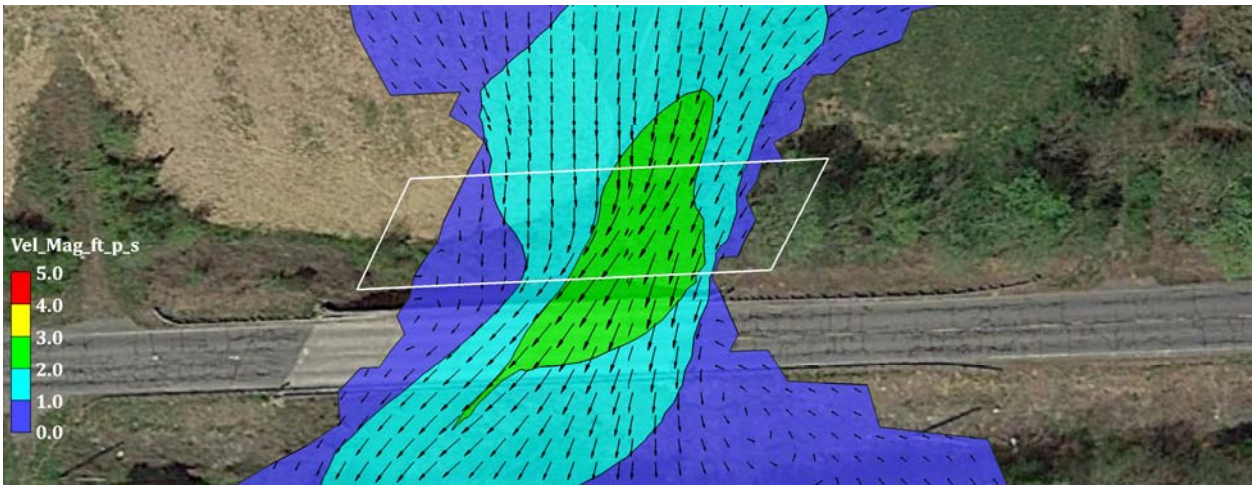
FLOW VELOCITY – 500 YEAR STORM – BRIDGE #2



NATURAL CONDITIONS



EXISTING CONDITIONS



PROPOSED CONDITIONS