



HYDROLOGY AND HYDRAULICS REPORT
St. George River Bridge over St. George River
Union, ME

Bridge Number #5893

September 27, 2024

Prepared for:
Maine Department of Transportation

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Hydrology and Hydraulics Report

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Hydrology and Hydraulics Report

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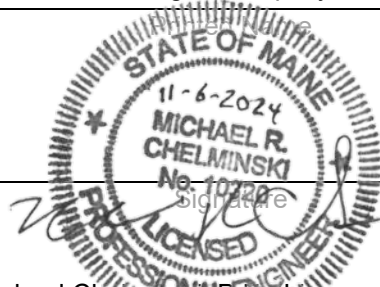
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1 Introduction

1.1 Purpose

The Maine Department of Transportation (MEDOT) proposes replacement of St. George River Bridge (#5893) over the St. George River on State Route 17 (locally known as Heald Highway) in Union, Maine (Project). The location of St. George River Bridge (Site) is shown at Latitude: $44^{\circ} 13' 0.66''$ N, Longitude: $69^{\circ} 16' 41.38''$ W in Figure 1. The purpose of this report is to present the methods and results of a hydrology and hydraulic study (the Study) for the preliminary proposed bridge replacement design. The objective of the Study is to evaluate the hydraulic performance and scour potential of the proposed bridge.



Latitude: $44^{\circ} 13' 0.66''$ N, Longitude: $69^{\circ} 16' 41.38''$ W

Figure 1. Location of the St. George River Bridge including an overview map of the surrounding features; basemap imagery is based on publicly available imagery accessed online from Google Maps in September 2024.

1.2 Scope

The scope of the Study includes review and analysis of existing hydrologic data, developing a numerical hydraulic model of the Study reach of the St. George River for existing and proposed conditions, evaluating and comparing the hydraulic model results for existing and proposed conditions, and calculating stable material size for scour protection measures. This report includes descriptions of the Project, data collection and analysis, and Study findings, conclusions, and recommendations.



1.3 References

The following data sources, references, and reports pertinent to the subject bridge were available and were used as part of the Study:

1. Bridge file information provided by MEDOT, including bridge inspection reports and site photographs.
2. U.S. Geological Survey (USGS) topographic maps.
3. Information provided by MEDOT from USGS regression equations and the USGS StreamStats online software tool. (September 2024).
4. OCM Partners (2015). *Maine and Massachusetts 2015 QL1 and QL2 Lidar*.
5. Soil boring information, including the composition, distribution, and depth of materials obtained from the borings.
6. Channel cross-sections and survey obtained from MEDOT. (August 2024).
7. Federal Emergency Management Agency. (July 6, 2016). *Flood Insurance Rate Map 23013C0135D*. Knox County. (FIRM)
8. Federal Emergency Management Agency. (July 6, 2016). *Flood Insurance Study 23013CV000A*. Knox County, Maine. (FIS)
9. Federal Highway Administration. (April 2012). HEC-18. *Evaluating Scour at Bridges - Fifth Edition*.
10. Federal Highway Administration. (April 2012). HEC-20. *Stream Stability at Highway Structures - Fourth Edition*.
11. Federal Highway Administration. (September 2009). HEC-23. *Bridge Scour and Stream Instability Countermeasures: Experience, Selection, and Design Guidance - Third Edition*.
12. Maine Department of Transportation. (August 2003). *Bridge Design Guide*.

2 Project Description

2.1 St. George River

The St. George River generally flows in a southerly direction and discharges into Round Pond. According to the United States Geological Survey (USGS) StreamStats tool (ver. 4.16.1), the tributary drainage area of St. George River at the approximate location of the Project Bridge is 114.66 square miles (Figure 2). Based on information obtained from StreamStats, the average basin slope is approximately 7.4 percent.



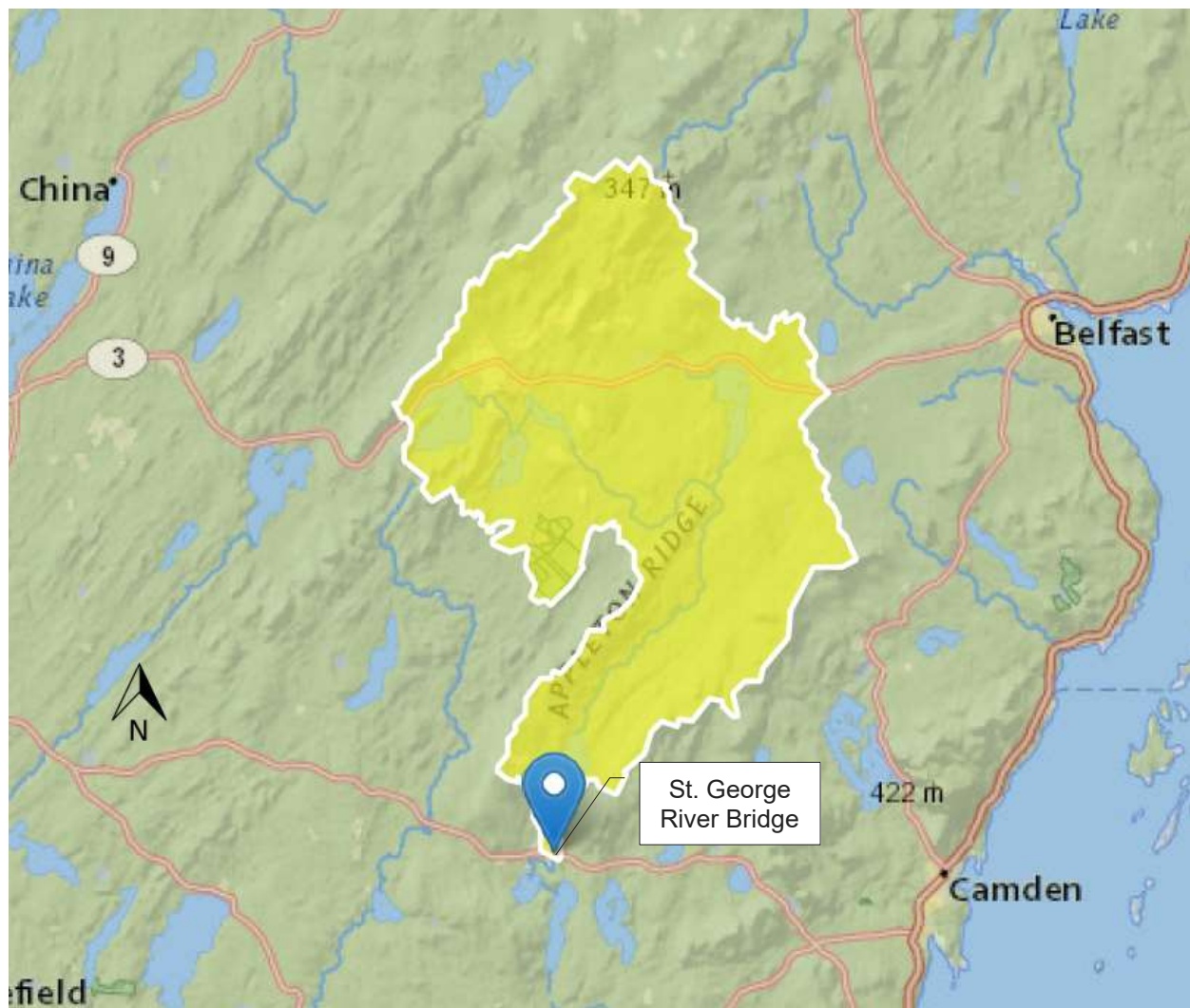


Figure 2. Approximate drainage area depicted in yellow as delineated from USGS StreamStats

2.2 Existing Structure

The existing St. George River Bridge (#5893) was built in 1960 and is a three simple span bridge (49.25 ft, 63.5 ft, 59.25 ft) with painted steel beams, a composite cast-in-place deck, bituminous wearing surface and membrane waterproofing, concrete parapets, and aluminum three-beam rail on wooden posts. The St. George River Bridge carries Route 17, locally known as Heald Highway, over the St. George River. The bridge has a 15-degree skew and carries two 11-ft lanes of traffic. According to the most recent inspection report (2022), the deck is in poor condition with some minor spalls, delaminations and cracking with areas of efflorescence and rust staining. The bridge drains have section loss at the ends from severe corrosion. The superstructure is in satisfactory condition with moderate corrosion and paint distress, primarily at the



beam ends. The substructure is in fair condition due to the pier condition, with cracking, efflorescence, delaminations and rust staining. There are isolated spalls on the West Pier and the west rip rap slopes are sloughing. The stub abutments are in good overall condition.

2.3 Proposed Structure

Several different replacement alternatives were assessed during this phase of project planning, following which, a preferred alternative was selected. The preferred alternative for the proposed structure is a single span steel bridge, with a hydraulic opening of 168 ft. The proposed span exceeds the bankfull width of 81.3 ft and has 1.75:1 slopes up to the integral abutments. Note that the design span substantially exceeds 1.2-times the bankfull width due to incorporation of a single 4-ft-wide wildlife bench along the right (west) side of the river. Further discussion of the proposed bridge components will be discussed in the preliminary design report.

3 Engineering Methods

Hydrologic and hydraulic analyses were conducted to estimate flow speeds and water surface elevations at the proposed bridge location. The following sections briefly describe the hydrologic and hydraulic analysis methodologies.

3.1 Hydrologic Analysis

MEDOT provided Stantec with peak flow and flow duration statistics for the Study reach of the St. George River on September 4, 2024, which were based on USGS regression equations for the state of Maine¹. Stantec also reviewed the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS) for peak flow statistics along the St. George River. The Site is located in an area designed by FEMA as "Special Flood Hazard Area Subject to Inundation by the 1% Annual Chance Flood" Zone AE. Peak and normal flows estimated at the Site are presented in Table 1 and Table 2 below, respectively.

¹ Lombard and Hodgkins, 2021. Estimating Flood Magnitude and Frequency on Gaged and Ungaged Streams in Maine. SIR 2021-xxxx, USGS, Augusta, ME; Hodgkins, G.A., 1999 Estimating the magnitude of peak flows for streams in Maine for Selected Recurrence Intervals. WRIR 99-4008, USGS, Augusta, ME; Lombard and Hodgkins, 2015. Peak Flow regression equations for small, ungaged streams: in Maine: Comparing Map-Based to Field-Based Variables. SIR 2015-4059, USGS, August, ME; Dudley, 2004, Estimating Monthly Stream Flows..., SIR 2004-5026; Dudley, 2013, FY2013 Progress Report – Phase 1..., USFWS QRP Project; Dudley, 2015, Regression Equations for Monthly and Annual Mean..., USGS, SIR 2015-5151.



Table 1. St. George River peak flows

Return Interval	Annual Exceedance Probability	Flow (cfs)
		MaineDOT Provided
Bankfull		754
1.1-year	90%	1,305
2-year	50%	2,290
5-year	20%	3,235
10-year	10%	3,910
25-year	4%	4,765
50-year	2%	5,435
100-year	1%	6,095
200-year	0.50%	6,745
500-year	0.20%	7,610

Table 2. St. George River annual (normal) flows

Normal Flow Description	Flow (cfs) MaineDOT Provided
Mean Annual Flow	228
95% Annual Exceedance	18
50% (Median) Annual Exceedance	119
5% Annual Exceedance	845

Per the MEDOT Bridge Design Guide (August 2003), the design flood for bridges is the 50-year flow event. Supporting information on the estimates of hydrology for the Study, including hydrologic computations and background information, are provided in Appendix A.

3.2 Hydraulic Analysis

The United States Army Corps of Engineers HEC-RAS software (Version 6.3.1) was used to develop a combined one-dimensional numerical hydraulic model (Model). The Model was used to simulate water surface elevation profiles and flow speeds across a range of flows for both existing and proposed conditions. The bridge and immediately adjacent reaches of the brook were modeled using a one-dimensional domain. The vertical datum used for the Model is the North American Vertical Datum of 1988 (NAVD88).

3.2.1 MODEL DEVELOPMENT

The spatial extents of the Model along the St. George River are from approximately 750 ft upstream to 1,350 ft downstream of the Site. Cross-sections were developed using topographic and bathymetric survey



data provided by MEDOT (August 2024) and augmented with the 2013 USGS-NRCS LiDAR data. Cross-section locations in the Model are shown in Figure 3. The low chord for the proposed bridge was raised from the existing elevation of 65.39 ft to 61.57 ft.

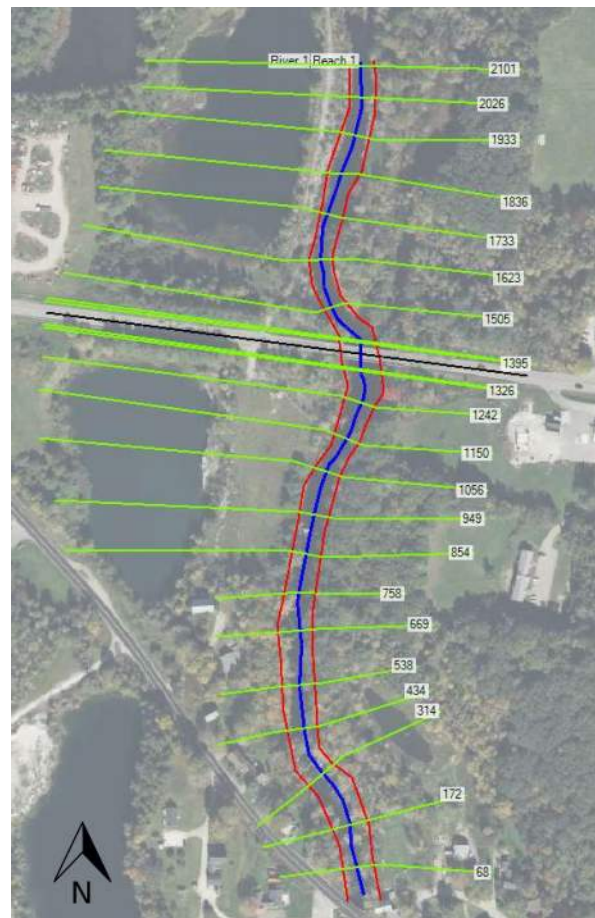


Figure 3. Existing Conditions Model cross-section locations

Channel and overbank roughness coefficients were developed based on professional judgement and review of aerial photography and terrain data (i.e., LiDAR data). Inflows used in the Model were based on the hydrologic estimates for the Site (reference Section 3.1) and defined the upstream boundary condition. A rating curve based on elevation and discharges from the FEMA FIS defined the downstream boundary condition. Simulations were run in steady-state mode with a constant inflow value.

3.2.2 PROPOSED CONDITIONS MODEL

The proposed conditions Model was developed by replacing the existing bridge geometry with the proposed bridge geometry. Boundary conditions and other geometric parameterizations, including cross-sections representing the upstream and downstream reaches of the brook, were not changed between the existing and proposed conditional Models.



3.3 Scour Analysis

Scour at the bridge was evaluated using the Model simulation results and information obtained from the field. Total scour at the bridge consisted of three components: (1) contraction scour due to constriction or the location of the bridge; (2) local scour; and (3) long-term aggradation or degradation of the brook channel. Local scour at the bridge was evaluated for abutment scour (there are no piers). The scour design storm is the 100-year event, and the scour check storm is the 500-year event based on the MEDOT Bridge Design Guide (2003).

Contraction scour was estimated based on live-bed contraction scour conditions using a representative median particle size diameter (D_{50}) for sand based on the geotechnical investigation performed by New England Boring Contractors in May 2024.

Abutment scour depths at the proposed bridge were developed using Equations 8.3, 8.4, and 8.5, National Cooperative Highway Research Program (NCHRP) 24-30 Abutment Scour Approach in the Federal Highway Administration (FHWA) Hydraulic Engineering Circular No. 18 (HEC-18), "Evaluating Scour at Bridges" Fifth Edition. Abutment scour is estimated based on an amplification factor applied to the calculated contraction scour depth. Input parameters for these equations are summarized in Table 3.

Live-bed contraction scour was calculated using Equation 8.5 in HEC-18. Maximum flow depth resulting from abutment scour was calculated using Equation 8.3 in HEC-18. Abutment scour depth was calculated using Equation 8.4 in HEC-18. The abutment scour computed from the NCHRP approach is total scour at the abutment and is not added to contraction scour because it already includes contraction scour.

Stantec assessed long-term aggradation/degradation scour qualitatively based on site reconnaissance, site photos, and survey.

Table 3. Scour depth equation parameters

Parameter	Value	Units
α_A (amplification factor for live-bed conditions)	<i>calculated</i>	dimensionless
y_0 (flow depth prior to scour)	<i>from Model</i>	<i>ft</i>
y_1 (upstream flow depth)	<i>from Model</i>	<i>ft</i>
q_1 (unit discharge, upstream section)	<i>from Model</i>	<i>ft³/s/ft</i>
q_{2c} (unit discharge, in the constricted opening)	<i>from Model</i>	<i>ft³/s/ft</i>
D_{50} (particle size with 50% finer)	2.7	mm

3.4 Stable Material Sizing

The stable material size for the proposed bridge was evaluated using the Model simulation results downstream of the subject bridge. Stable material size at the proposed bridge was developed using Equation 4.1 in the FHWA Hydraulic Engineering Circular No. 23, "Bridge Scour and Stream Instability Countermeasures: Experience, Selection, and Design Guidance" Third Edition (HEC-23). Input parameters for this equation include the depth of water and average flow speed ("velocity") and are summarized in



Table 4.

Table 4. Equation 4.1 parameters

Parameter	Value	Units
S_f (safety factor)	1.1	dimensionless
C_s (stability coefficient)	0.3	dimensionless
C_v (vertical velocity distribution coefficient)	1	dimensionless
C_t (thickness coefficient)	1	dimensionless
D (depth)	<i>from Model</i>	<i>ft</i>
S_g (specific gravity of rock)	62.4	dimensionless
V (channel cross-sectional average velocity)	<i>from Model</i>	<i>ft/second (s)</i>
K_1 (side-slope correction factor)	0.98	dimensionless
G (gravity)	32.2	ft/s^2

Equation 4.1 in HEC-23 calculates the stable D_{30} material size; a stable D_{50} (median) material size was calculated as follows using Equation 4.2 in HEC-23:

$$D_{50} = 1.2 D_{30}$$

4 Results

The following section presents the results from the Study, including the hydraulic analysis, scour analysis, and stable material sizing.

4.1 Hydraulic Analysis Results

Water surface elevation (WSE) and average channel flow speed (ft-per-second [fps]) simulation results from the Model for existing and proposed conditions are presented below in Table 5. Freeboard is presented based on the distance between the upstream water surface elevation at the bridge and the elevation of the bottom of the low chord (i.e., 65.39 ft and 61.57 ft for existing and proposed conditions, respectively).



Hydrology and Hydraulics Report

4 Results

Table 5. Summary of Model results at the cross-section immediately upstream of the bridge

Return Interval	Discharge (cfs)	Existing Conditions WSE (ft, NAVD88)	Proposed Conditions WSE (ft, NAVD88)	Existing Conditions Freeboard (ft)	Proposed Conditions Freeboard (ft)	Existing Conditions Average Channel Flow Speed (fps)	Proposed Conditions Average Channel Flow Speed (fps)
Bankfull	754	47.9	47.9	17.5	13.7	1.35	1.35
1.1-yr	1,305	49.1	49.1	16.3	12.5	1.93	1.94
2-yr	2,290	50.7	50.6	14.7	11.0	2.74	2.75
5-yr	3,235	51.9	51.9	13.5	9.7	3.36	3.37
10-yr	3,910	52.7	52.6	12.7	9.0	3.74	3.76
25-yr	4,765	53.6	53.5	11.8	8.1	4.18	4.20
50-yr	5,435	54.2	54.1	11.2	7.5	4.50	4.53
100-yr	6,095	54.8	54.7	10.6	6.9	4.79	4.83
200-yr	6,745	55.3	55.2	10.1	6.4	5.07	5.10
500-yr	7,610	56.0	55.9	9.4	5.7	5.42	5.46
95% Exceedance	18	44.8	44.8	20.6	16.8	0.07	0.07
50% Exceedance	119	45.7	45.7	19.7	15.9	0.34	0.34
5% Exceedance	845	48.1	48.1	17.3	13.5	1.45	1.46
Mean annual	228	46.2	46.2	19.2	15.4	0.58	0.58



The Model analyses indicate that the proposed bridge will result in a small reduction in upstream water surface elevations and commensurate small increases in flow speed. The proposed bridge does not overtop up to the 500-year event. A minimum of 2.0 ft of freeboard is maintained at the proposed bridge up to the 100-year event.

4.2 Scour Analysis Results

Combined depths of abutment and contraction scour for the simulated flood flow events are depicted in Table 6.

Table 6. Abutment and contraction scour depths

Return Interval	Scour Depth (ft)
100-yr	5.1
500-yr	10.3

Review of the existing channel profile from survey data indicates that the channel adjacent to the bridge is approximately 3 ft lower than the channel approximately 400 ft downstream from the bridge and approximately 5 ft lower than the channel 300 ft upstream from the bridge. These observations suggest that contraction scour has occurred in the vicinity of the bridge but not progressed upstream or downstream. Review of the water surface profile for the 500-year return-interval event suggests that the slope of the water surface downstream from the bridge is similar to the channel slope and that a pronounced grade control is not present. Long-term vertical degradation of the channel is therefore not anticipated. Based on the noted depression in the channel under the bridge, it is identified that the channel could be subject to aggradation under the bridge. It is not, however, expected that aggradation in the channel under or adjacent to the bridge would substantially impact hydraulic conditions at the bridge or reduce the freeboard below MEDOT criteria.

Total scour, as described in Section 3.3, estimated for the proposed bridge for the scour design and check flows are presented in Table 7. The reported total scour depths in Table 7 are the same as the reported abutment and contraction scour depths in Table 6. The basis for reporting these values follows on the description above that identified the potential for aggradation in the channel under and adjacent to the bridge.

Table 7. Total scour depths

Return Interval	Scour Depth (ft)
100-yr	5.1
500-yr	10.3

Supporting calculations for the scour analysis are provided in Appendix C.



4.3 Stable Material Sizing Results

Stable material sizes for the simulated flood flow events are presented in Table 8. The table indicates that material with a minimum D_{50} of 6-inch angular rock would be stable for the 100- and 500-year events.

Table 8. D_{50} (median, inches) stable material size

Return Interval	D_{50} (inches)
100-yr	1.0
500-yr	1.3

Supporting calculations for the stable material and countermeasure analysis are provided in Appendix D. Stable material and countermeasure analysis does not include consideration for ice or woody debris loading.

5 Conclusions and Recommendations

The hydraulic and scour analysis predict that the proposed bridge crossing will not increase water surface elevations during normal and flood flow events. However, flow speeds are expected to increase during high-flow events. It is recommended that future design includes consideration for ice and woody debris loading. Scour protection countermeasures with a minimum D_{50} of 6 inches angular should be incorporated into the final design.

Based upon the findings described in this memo, we recommend the design of the proposed bridge continue to be advanced. Bridge openings and structural components should remain as presented herein, or if revised, should be re-evaluated for hydraulic considerations.



Appendix A Hydrology



WIN: 27158.00
 Town: Union
 Route No. ME17 Heald Hwy
 Asset ID: 5893
 Lat: 44.21691 Long: -69.27824

Project Name:
 Stream Name: St George River
 Bridge Name: St George River
 Analysis by: csh
 Date: 9/4/2024

Peak Flow Calculations by USGS Regression Equations (Lombard/Hodgkins, 2021; Hodgkins, 1999 & Lombard/Hodgkins, 2015)

Enter data in blue cells only!

	km ²	mi ²	ac
A	296.97	114.66	73382.4
W	46.51	18.0	11491.7
P _c	481083	4912503	
County	Knox		

Enter data in [mi²]

Watershed Area *DRNAREA*
 Wetlands area (by NWI)

watershed centroid (E, N; UTM 19N; meters)
 choose county from drop-down menu

ver. 2021 Jan 01

Worksheet prepared by:

Charles S. Hebson, PE
 Environmental Office
 Maine Dept. Transportation
 Augusta, ME 04333-0016
 207-557-1052
Charles.Hebson@maine.gov

Watershed Characteristics from StreamStats

STORAGE	16.38	
STORNWI	15.66	NWI Wetlands %
SANDGRAV	0.05	sand & gravel aquifer as decimal fraction of watershed A
ELEV	379.8	mean basin elevation (ft)
BSLDEM10M	7.37	mean basin slope (%)
COASTDIST	51.10	distance from the coast (mi)
ELEVMAX	1131.6	maximum basin elevation (ft)
LC06WATER	4.37	percent of drainage basin land cover as open water
PRECIP	47.3	mean annual precipitation
STATSGOA	4.31	mean basin percentage of hydrological soil group A

References:

Hodgkins, G.A., 1999.
 Estimating the magnitude of peak flows for streams in Maine
 for Selected Recurrence Intervals
WRIR 99-4008, USGS Augusta, ME

Lombard, P.J. & G.A. Hodgkins, 2015.
 Peak flow regression equations for small, ungaged streams:
 in Maine: Comparing Map-Based to Field-Based Variables
SIR 2015-4059, USGS, Augusta, ME

Lombard, P.J. & G.A. Hodgkins, 2020.
 Estimating Flood Magnitude and Frequency on Gaged and
 Ungaged Streams in Maine
SIR 2020-5092, USGS, Augusta, ME.

Ret Pd	I24	Q _T (ft ³ /s)		Q _T (ft ³ /s)
T (yr)		1999 / 2015	2020	Design
1.1				1305
2	3.20	1817	2289	2290
5	4.00	2599	3236	3235
10	4.67	3148	3910	3910
25	5.59	3849	4764	4765
50	6.28	4380	5433	5435
100	7.00	4943	6093	6095
200	7.85	5508	6745	6745

Calculated Bankfull Width: 81.3 ft

Instructions:

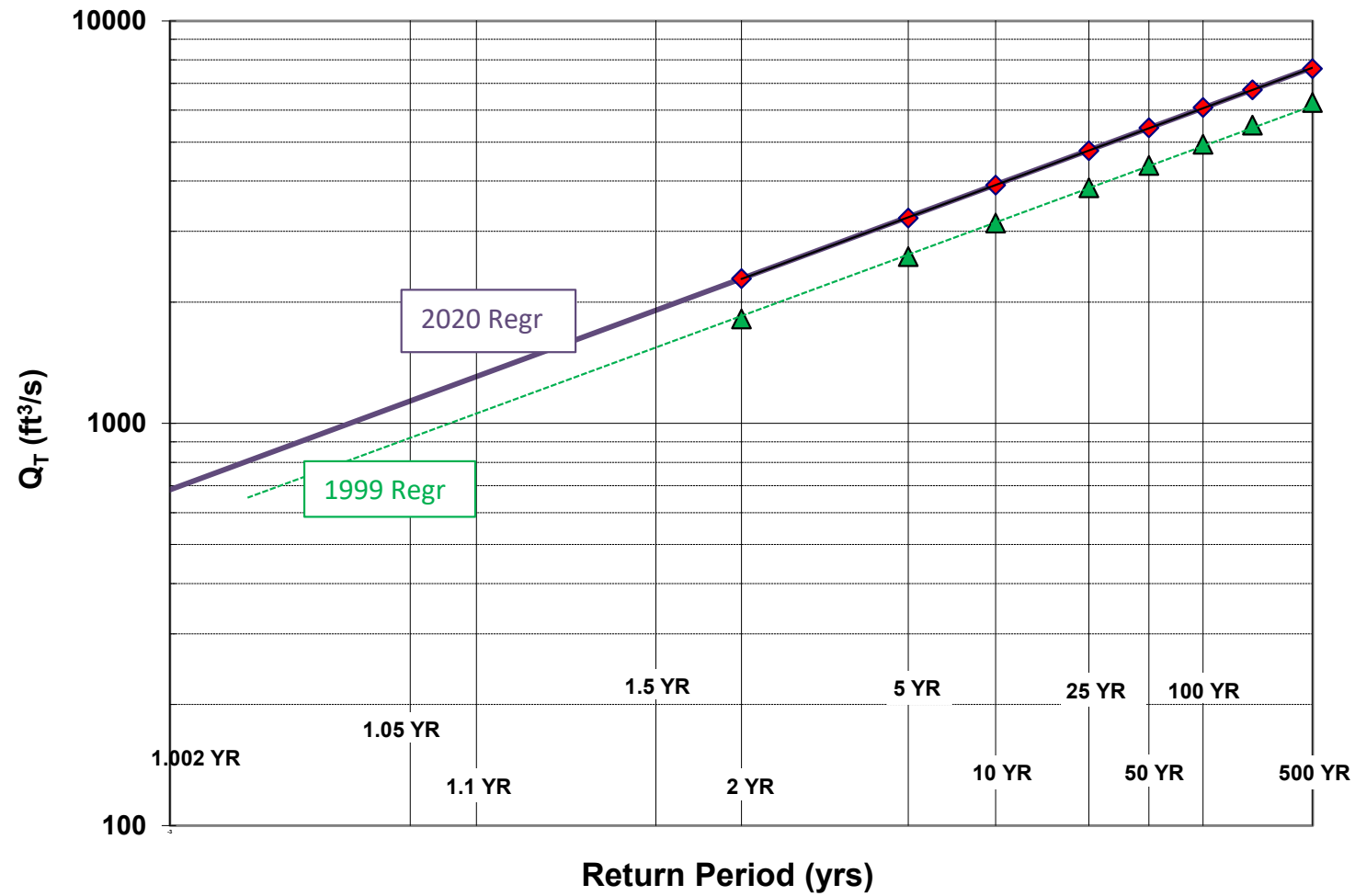
Enter values in blue cells only, watershed data from StreamStats

Copy I24 values from Stream Stats

Use results under "Design"

Check against gage data and FEMA studies if available

Log-Normal Probability Plot



WIN:	27158.00
Town:	Union
Route No.	ME17 Heald Hwy
Asset ID:	5893
Lat:	44.21691
Long:	-69.27824

Project Name:	0
Stream Name:	St George River
Bridge Name:	St George River
Analysis by:	csh
Date:	9/4/2024

DO NOT ENTER ANY DATA ON THIS PAGE; EVERYTHING IS CALCULATED

MAINE MONTHLY MEDIAN FLOWS and HYDRAULIC GEOMETRY BY USGS REGRESSION EQUATIONS (2004, 2013, 2015)

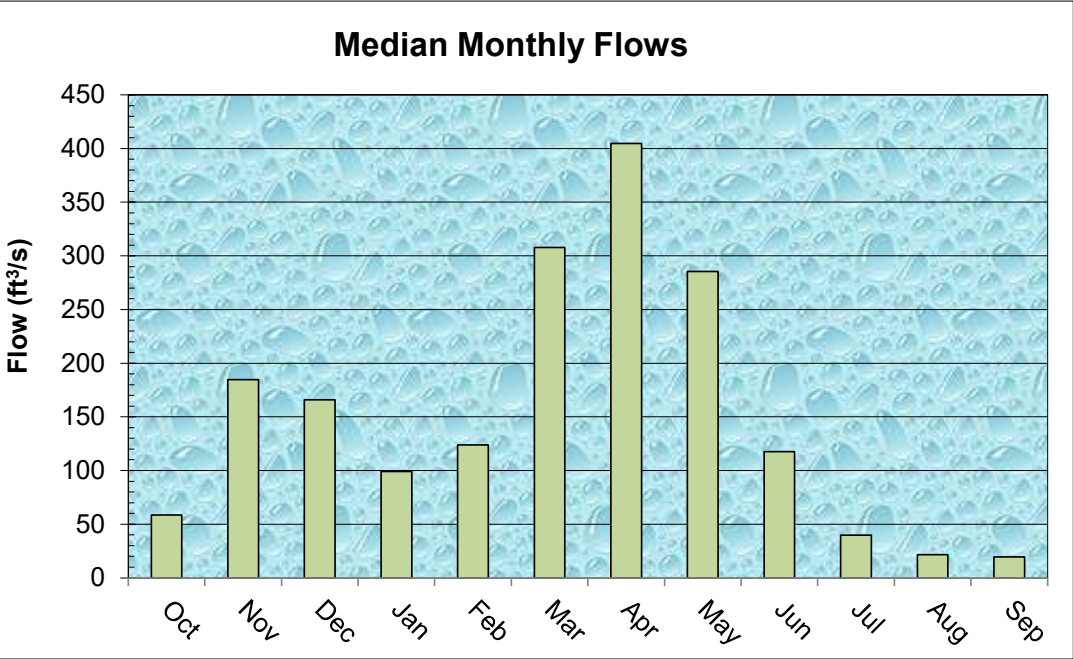
Value	Variable	Explanation
114.66	A	Area (mi ²)
481083	P _c	Watershed centroid (E,N; UTM; Zone 19; meters)
51.10	DIST	Distance from Coastal reference line (mi)
47.3	pptA	Mean Annual Precipitation (inches)
0.00	SG	Sand & Gravel Aquifer (decimal fraction of watershed area)

Month	Q _{median} (ft ³ /s)	(m ³ /s)
Jan	99.07	2.8074
Feb	123.85	3.5098
Mar	307.70	8.7197
Apr	404.56	11.4647
May	285.59	8.0933
Jun	117.70	3.3354
Jul	39.75	1.1266
Aug	21.65	0.6134
Sep	19.53	0.5536
Oct	58.69	1.6632
Nov	184.72	5.2348
Dec	165.94	4.7026

Q _{bf}	754.3
ann avg	227.6
ann med	110.0
Q _{1.002}	684.0
Q _{1.01}	861.1
Q _{1.05}	1136.6
Q _{1.1}	1307.1
Q _{bf}	1074.4

assume v = 4ft/s

W _{bf}	81.3	estimated bankfull width (ft)
d _{bf}	3.0	estimated bankfull depth (ft)
A _{bf}	268.6	estimated bankfull flow area (ft ²)



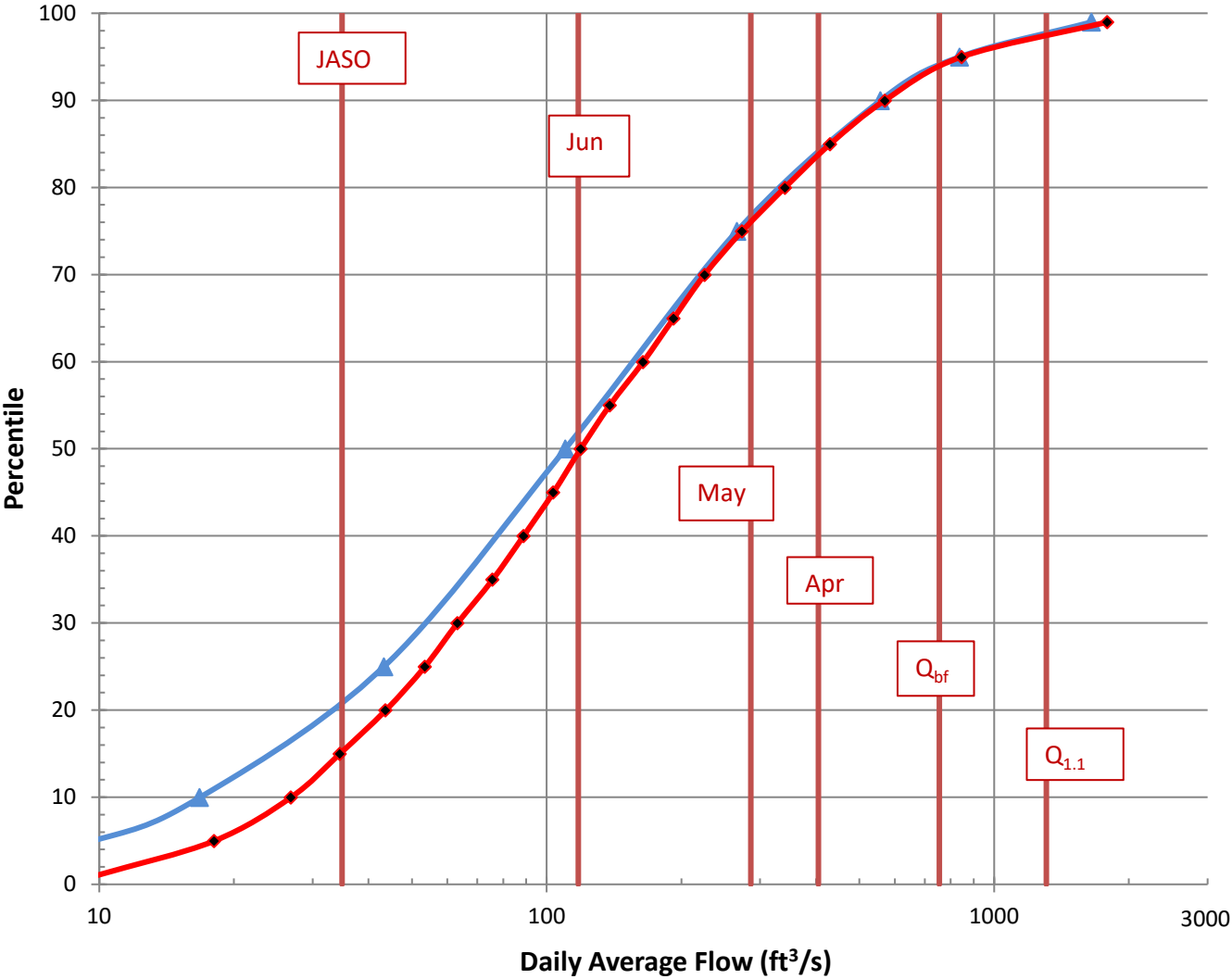
References

Dudley, 2013. FY2013 Progress Report - Phase 1 ..., USFWS QRP Project

Dudley, 2004. Estimating Monthly Streamflows ... , SIR 2004-5026

Dudley, 2015. Regression Equations for Monthly & Annual Mean..., USGS SIR 2015-5151

Daily Average Flow Distribution



Daily Avg Flow Dist

$A_{ws} = (mi^2)$ 114.7

$Q (ft^3/s)$

Pctl	Median	84 th pctl
1.00E-06	0.00	0.00
1	9.83	17.40
5	18.05	29.05
10	26.81	40.31
15	34.46	50.33
20	43.64	61.04
25	53.38	71.55
30	63.17	81.49
35	75.68	93.14
40	88.75	107.11
45	103.45	121.10
50	119.10	142.97
55	138.31	166.41
60	164.27	195.34
65	192.18	227.57
70	225.42	265.51
75	273.26	319.28
80	340.79	381.21
85	430.00	488.52
90	569.61	655.97
95	845.36	1020.09
99	1787.63	2353.48

Q_{bf} 754.3

$Q_{1.002}$ 684.0

$Q_{1.1}$ 1307.1

Q_2 2288.9



GREGORYS CORNER

Frye Mountain
State Game
Management
Area

THURSTONS CORNER

CENTER MONTVILLE

Montville

Morrill

POORS MILL

MC FARLANDS CORNER

NORTH SEARSMONT

BELMONT CORNER

Liberty

SOUTH MONTVILLE

Belmont

Searsmont

GHEAT

SOUTH LIBERTY

SAWPIT CORNER

TOWNHOUSE CORNER

BURKETTVILLE

LINCOLNVILLE CENTER

LUCAS CORNER

Appleton

DRAKE CORNER

Washington

Hope

NEY
VER

Union

SOUTH HOPE

MELVIN HEIGHTS

Camden State Park

Camden

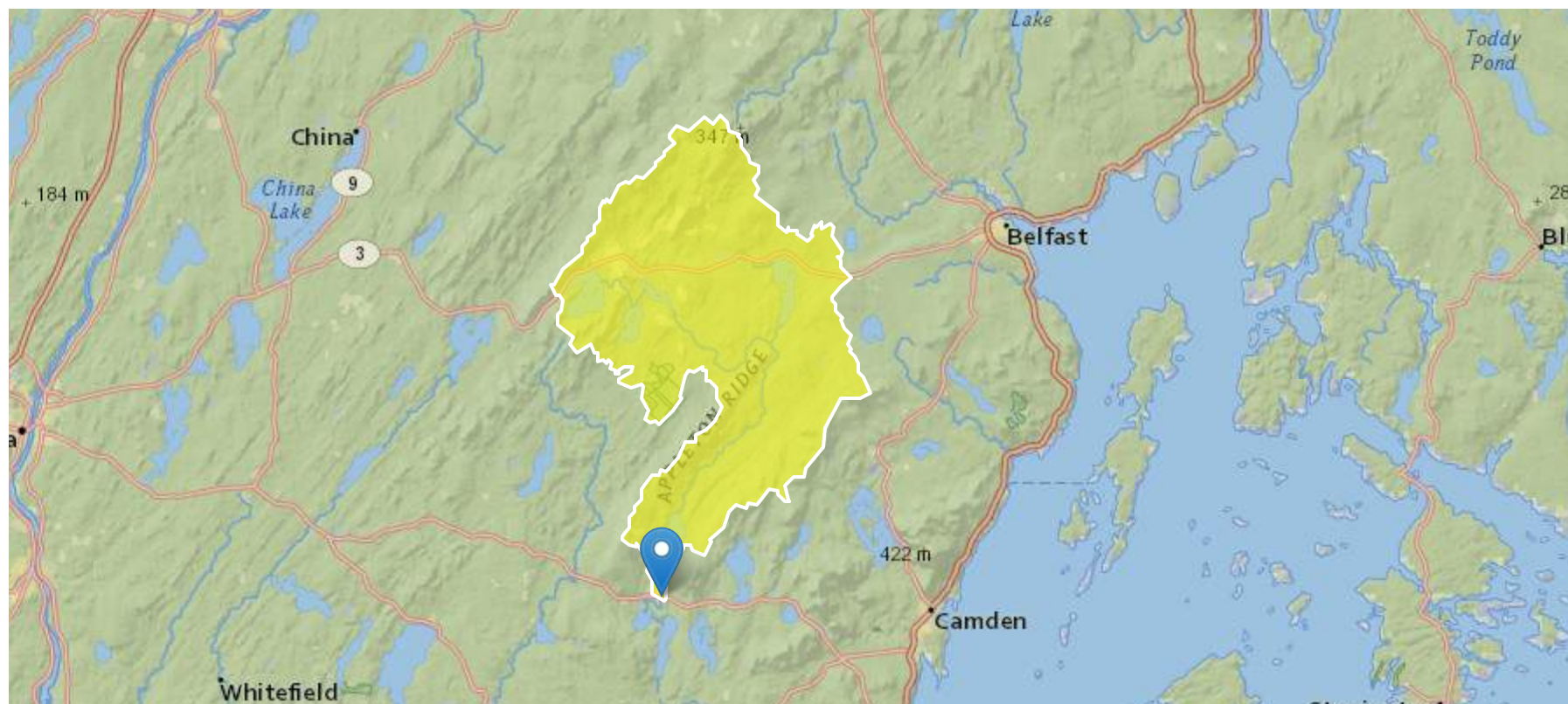
2023.11.17_27158_Hydrology_StreamStats Report, Union, St. George River Bridge #5893, Rt. 17

Region ID: ME

Workspace ID: ME20231117151743491000

Clicked Point (Latitude, Longitude): 44.21691, -69.27824

Time: 2023-11-17 10:18:10 -0500



+ Collapse All

➤ Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
BSLDEM10M	Mean basin slope computed from 10 m DEM	7.37	percent
CENTROIDX	Basin centroid horizontal (x) location in state plane coordinates	481083.15	meters
CENTROIDY	Basin centroid vertical (y) location in state plane units	4912503.1	meters
COASTDIST	Shortest distance from the coastline to the basin centroid	51.1	miles
DRNAREA	Area that drains to a point on a stream	114.66	square miles
ELEV	Mean Basin Elevation	379.8	feet
ELEVMAX	Maximum basin elevation	1131.6	feet
I24H100Y	Maximum 24-hour precipitation that occurs on average once in 100 years	7	inches
I24H10Y	Maximum 24-hour precipitation that occurs on average once in 10 years	4.67	inches
I24H200Y	Maximum 24-hour precipitation that occurs on average once in 200 years	7.85	inches
I24H25Y	Maximum 24-hour precipitation that occurs on average once in 25 years	5.59	inches
I24H2Y	Maximum 24-hour precipitation that occurs on average once in 2 years - Equivalent to precipitation intensity index	3.2	inches
I24H500Y	Maximum 24-hour precipitation that occurs on average once in 500 years	9.14	inches
I24H50Y	Maximum 24-hour precipitation that occurs on average once in 50 years	6.28	inches
I24H5Y	Maximum 24-hour precipitation that occurs on average once in 5 years	4	inches
JULAVPRE	Mean July Precipitation	3.37	inches
LC06WATER	Percent of open water, class 11, from NLCD 2006	4.37	percent
PCTSNDGRV	Percentage of land surface underlain by sand and gravel deposits	5.026	percent

Parameter Code	Parameter Description	Value	Unit
PRDECFEB90	Basin average mean precipitation for December to February from PRISM 1961-1990	11.5	inches
PRECIP	Mean Annual Precipitation	47.3	inches
SANDGRAVAF	Fraction of land surface underlain by sand and gravel aquifers	0.05	dimensionless
SANDGRAVAP	Percentage of land surface underlain by sand and gravel aquifers	5.01	percent
STATSGOA	Percentage of area of Hydrologic Soil Type A from STATSGO	4.31	percent
STORAGE	Percentage of area of storage (lakes ponds reservoirs wetlands)	16.378	percent
STORNWI	Percentage of storage (combined water bodies and wetlands) from the National Wetlands Inventory	15.66	percent

➤ Peak-Flow Statistics

Peak-Flow Statistics Parameters [Statewide multiparameter peakflows SIR 2020 5092]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	114.66	square miles	0.26	5680
I24H2Y	24 Hour 2 Year Precipitation	3.2	inches	1.92	4.17
STORAGE	Percent Storage	16.378	percent	0	29.4
I24H5Y	24 Hour 5 Year Precipitation	4	inches	2.48	5.38
I24H10Y	24 Hour 10 Year Precipitation	4.67	inches	2.84	6.38
I24H25Y	24 Hour 25 Year Precipitation	5.59	inches	3.3	7.75
I24H50Y	24 Hour 50 Year Precipitation	6.28	inches	3.65	8.79

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
I24H100Y	24 Hour 100 Year Precipitation	7	inches	3.99	9.88
I24H200Y	24 Hour 200 Year Precipitation	7.85	inches	5.26	11.1
I24H500Y	24 Hour 500 Year Precipitation	9.14	inches	5.95	13.1

Peak-Flow Statistics Flow Report [Statewide multiparameter peakflows SIR 2020 5092]

PIL: Lower 90% Prediction Interval, PIU: Upper 90% Prediction Interval, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PIL	PIU	ASEp
50-percent AEP flood	2290	ft ³ /s	1230	4250	39.1
20-percent AEP flood	3240	ft ³ /s	1770	5930	38.1
10-percent AEP flood	3910	ft ³ /s	2110	7240	38.9
4-percent AEP flood	4760	ft ³ /s	2540	8920	39.9
2-percent AEP flood	5430	ft ³ /s	2850	10300	39.7
1-percent AEP flood	6090	ft ³ /s	3220	11500	40.7
0.5-percent AEP flood	6750	ft ³ /s	3450	13200	42.8
0.2-percent AEP flood	7610	ft ³ /s	3850	15100	43.8

Peak-Flow Statistics Citations

Lombard, P.J., and Hodgkins, G.A., 2020, Estimating flood magnitude and frequency on gaged and ungaged streams in Maine: U.S. Geological Survey Scientific Investigations Report 2020–5092, 56 p. (<https://doi.org/10.3133/sir20205092>)

➤ Annual Flow Statistics

Annual Flow Statistics Parameters [Statewide Annual SIR 2015 5151]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	114.66	square miles	14.9	1419
SANDGRAVAF	Fraction of Sand and Gravel Aquifers	0.05	dimensionless	0	0.212
ELEV	Mean Basin Elevation	379.8	feet	239	2120

Annual Flow Statistics Flow Report [Statewide Annual SIR 2015 5151]

PIL: Lower 90% Prediction Interval, PIU: Upper 90% Prediction Interval, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	ASEp
Mean Annual Flow	228	ft ³ /s	16

Annual Flow Statistics Citations

Dudley, R.W., 2015, Regression equations for monthly and annual mean and selected percentile streamflows for ungaged rivers in Maine: U.S. Geological Survey Scientific Investigations Report 2015–5151, 35 p. (<http://dx.doi.org/10.3133/sir20155151>)

USGS Data Disclaimer: Unless otherwise stated, all data, metadata and related materials are considered to satisfy the quality standards relative to the purpose for which the data were collected. Although these data and associated metadata have been reviewed for accuracy and completeness and approved for release by the U.S. Geological Survey (USGS), no warranty expressed or implied is made regarding the display or utility of the data for other purposes, nor on all computer systems, nor shall the act of distribution constitute any such warranty.

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USGS Product Names Disclaimer: Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

Application Version: 4.18.1

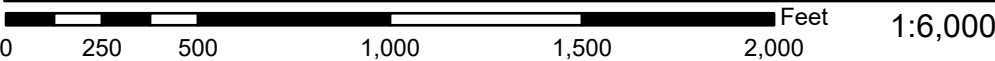
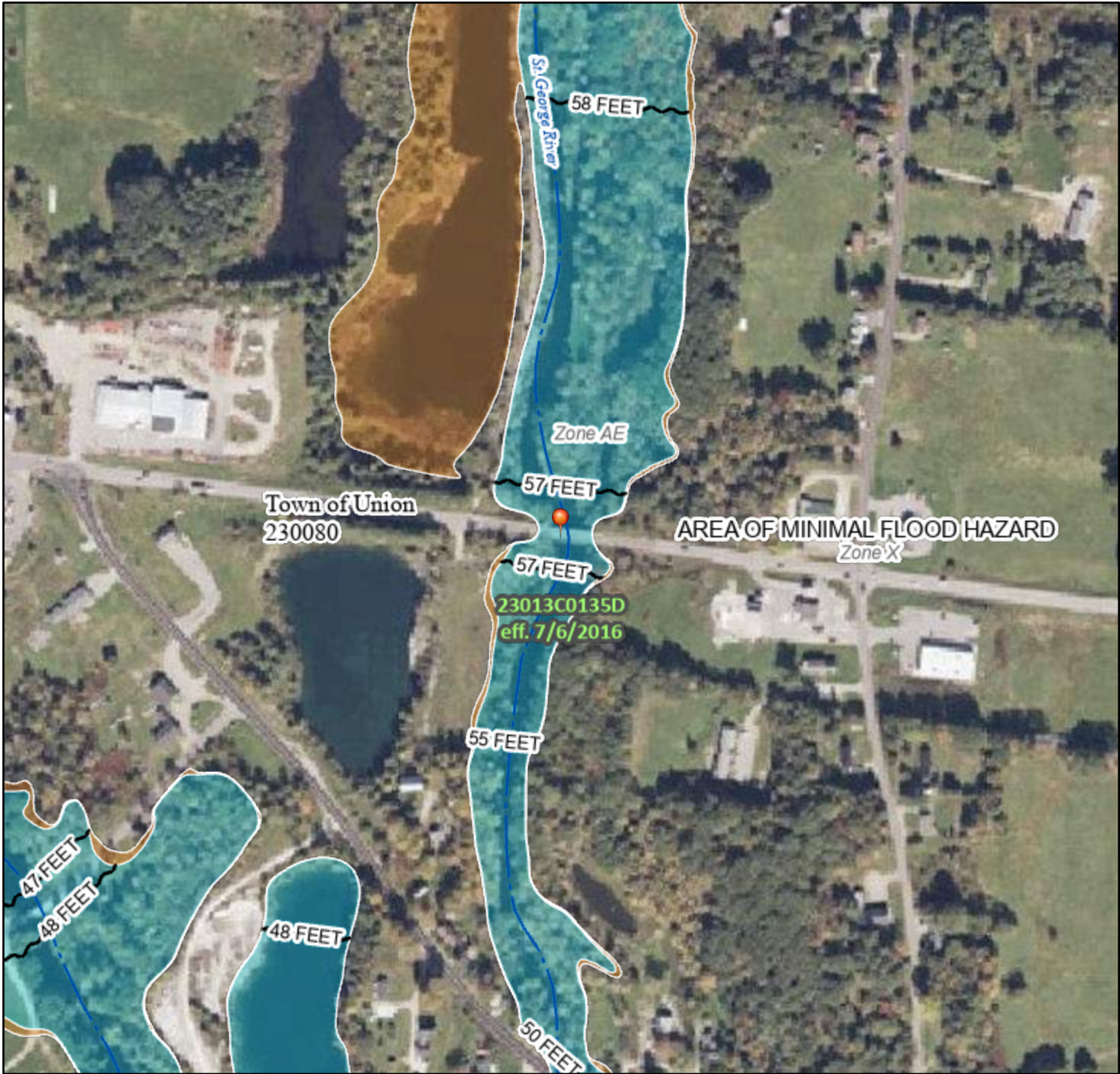
StreamStats Services Version: 1.2.22

NSS Services Version: 2.2.1

National Flood Hazard Layer FIRMMette



69°17'W 44°13'13"N



Basemap Imagery Source: USGS National Map 2023

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
GENERAL STRUCTURES		Area of Undetermined Flood Hazard Zone D
		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES		20.2 Cross Sections with 1% Annual Chance Water Surface Elevation
		17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
		Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
MAP PANELS		Coastal Transect Baseline
		Profile Baseline
		Hydrographic Feature
		Digital Data Available
		No Digital Data Available
		Unmapped



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 9/4/2024 at 7:40 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.

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.

The AE Zone category has been divided by a **Limit of Moderate Wave Action (LMWA)**. The LMWA represents the approximate landward limit of the 1.5-foot breaking wave. The effects of wave hazards between the VE Zone and the LMWA (or between the shoreline and the LMWA for areas where VE Zones are not identified) will be similar to, but less severe than those in the VE Zone.

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 for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 19. The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM 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, NNGS12
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 its website at <http://www.ngs.noaa.gov>.

Base map information shown on the Flood Insurance Rate Map (FIRM) was produced by Woolpert, Inc. at a scale of 1:400, from aerial photography dated 2012 or later.

The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

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.

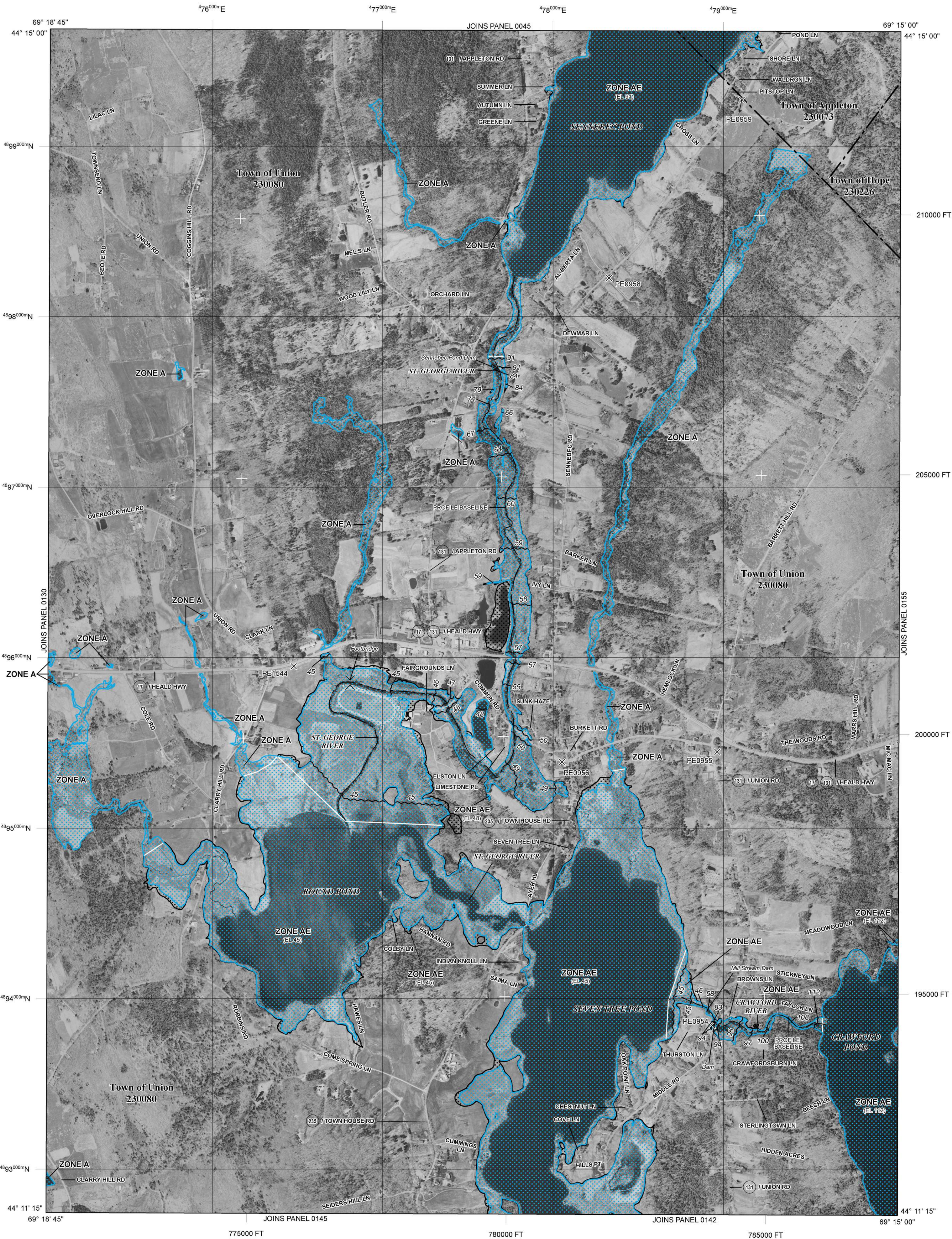
Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels, community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which 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 (FMIX)** at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA website at <http://www.fema.gov/business/nfp>.

State of Maine Floodway Note: Under the Maine Revised Statutes Annotated (M.R.S.A.) Title 38 § 439-A, 7C where the floodway is not designated on the Flood Insurance Rate Map, the floodway is considered to be the channel of a river or other water course and the adjacent land areas to a distance of one-half the width of the floodplain, as measured from the normal high water mark to the upland limit of the floodplain, unless a technical evaluation certified by a registered professional engineer is provided demonstrating the actual floodway based upon approved FEMA modeling methods.

Only coastal structures that are certified to provide protection from the 1-percent-annual chance flood are shown on this panel. However, all structures taken into consideration for the purpose of coastal flood hazard analysis and mapping are present in the DFIRM database in S_Gen_Struct.



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 Areas 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.

- 1% Annual Chance Floodplain Boundary
- 0.2% Annual Chance 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.
- Limit of Moderate Wave Action
- Limit of Moderate Wave Action
- Base Flood Elevation line and value; elevation in feet*
- Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

- Cross section line
- Transect line
- Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
- 1000-meter Universal Transverse Mercator grid values, zone 19
- Bench mark (see explanation in Notes to Users section of this FIRM panel)
- River Mile

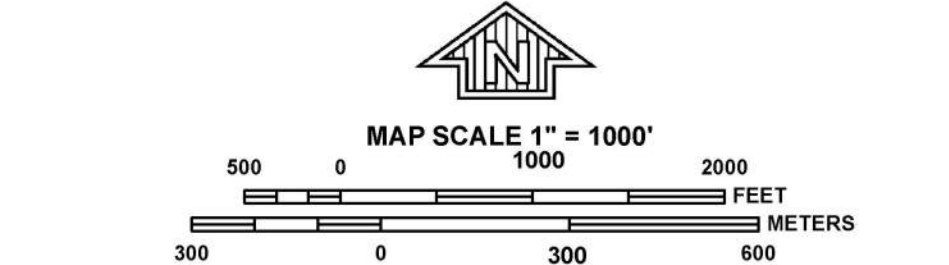
MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
July 6, 2016

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.



NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0135D

FIRM
FLOOD INSURANCE RATE MAP
KNOX COUNTY, MAINE
(ALL JURISDICTIONS)

PANEL 135 OF 925
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
APPLETON, TOWN OF	230073	0135	D
HOPE, TOWN OF	230226	0135	D
UNION, TOWN OF	230080	0135	D

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
23013C0135D

EFFECTIVE DATE
JULY 6, 2016

Federal Emergency Management Agency

Table 5 - Summary of Discharges

<u>Flooding Source and Location</u>	<u>Drainage Area (square miles)</u>	Peak Discharges (cubic feet per second)			
		<u>10-Percent- Annual- Chance</u>	<u>2-Percent- Annual-Chance</u>	<u>1-Percent- Annual-Chance</u>	<u>0.2-Percent- Annual-Chance</u>
CRAWFORD RIVER At State Highway 131/Union Road	30.3	910	1,450	1,790	2,140
GOOSE RIVER At the confluence with Rockport Harbor	8.6	679	1,058	1,253	1,790
Just downstream of pond at Rollins Road	2.5	263	471	591	948
HOSMER POND Just downstream of pond at Rollins Road	2.5	263	471	591	948
JONES BROOK At confluence with Long Cove	1.80	139	243	300	590
MEDOMAK RIVER At the Lincoln/Waldo County Boundary	46.1	2,990	4,250	5,400	6,960
At State Road 17/Heald Highway	35.3	2,820	3,940	4,920	6,220
At Carroll Road	33.3	2,820	3,960	4,940	6,240
At Skidmore Road	19.4	2,310	3,240	4,040	5,140
At Union Road	16.8	2,130	2,980	3,720	4,710
Approximately 5,575 feet upstream of Union Road	12.9	1,860	2,600	3,240	4,090
MEGUNTICOOK RIVER Just upstream of Knox Mill Dam	33.7	1,095	1,710	2,030	2,920
MILL STREAM At Miller Road	9.0	410	690	850	1,000
At State Highway 17/235/ Heald Highway	8.5	370	670	830	970
ST. GEORGE RIVER Approximately 1,600 feet downstream of Rockland Branch Railroad	230.7	4,230	6,290	7,480	8,900
At State Route 90/Camden Road	198.7	3,820	5,680	6,750	8,050
At Powder Mill Road	191.6	3,730	5,560	6,590	7,880
At Common Road (Town of Union)	123.1	4,450	7,100	8,520	9,910
STREAM TO MOSQUITO HARBOR At confluence with Mosquito Harbor	1.45	143	256	320	644

Appendix B Hydraulic Analysis Output



HEC-RAS Plan: Existing_rev1 River: River 1 Reach: Reach 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Reach 1	2101	1.1yr	1305.00	45.15	49.54	47.80	49.65	0.001669	3.59	645.40	286.47	0.36
Reach 1	2101	2yr	2290.00	45.15	51.08	48.70	51.19	0.001022	3.70	1101.81	302.04	0.31
Reach 1	2101	5yr	3235.00	45.15	52.32	49.05	52.44	0.000810	3.87	1483.54	632.91	0.28
Reach 1	2101	10yr	3910.00	45.15	53.11	49.44	53.24	0.000735	4.01	1732.37	642.12	0.28
Reach 1	2101	25yr	4765.00	45.15	54.03	49.84	54.16	0.000669	4.17	2025.46	649.30	0.27
Reach 1	2101	50yr	5435.00	45.15	54.69	50.08	54.83	0.000634	4.29	2240.77	654.37	0.26
Reach 1	2101	100yr	6095.00	45.15	55.31	50.29	55.46	0.000605	4.40	2442.20	659.57	0.26
Reach 1	2101	200yr	6745.00	45.15	55.89	50.48	56.04	0.000583	4.51	2633.75	664.67	0.26
Reach 1	2101	500yr	7610.00	45.15	56.60	50.70	56.77	0.000563	4.66	2873.62	671.57	0.26
Reach 1	2101	bankfull	754.30	45.15	48.60	47.46	48.70	0.002302	3.29	394.58	247.95	0.40
Reach 1	2101	5th percentile	845.00	45.15	48.72	47.67	48.83	0.002297	3.42	426.39	251.56	0.41
Reach 1	2101	50th percentile	119.00	45.15	47.15	46.30	47.17	0.000931	1.52	126.34	125.24	0.24
Reach 1	2101	95th percentile	18.00	45.15	46.51	45.59	46.51	0.000154	0.50	56.89	92.79	0.09
Reach 1	2101	mean	228.00	45.15	47.58	46.63	47.62	0.001341	1.95	184.32	148.12	0.29
Reach 1	2026	1.1yr	1305.00	45.31	49.51		49.56	0.000637	2.46	909.24	298.63	0.23
Reach 1	2026	2yr	2290.00	45.31	51.05		51.12	0.000521	2.83	1376.14	305.31	0.22
Reach 1	2026	5yr	3235.00	45.31	52.30		52.38	0.000472	3.12	1761.02	614.57	0.22
Reach 1	2026	10yr	3910.00	45.31	53.10		53.18	0.000452	3.31	2008.86	627.21	0.22
Reach 1	2026	25yr	4765.00	45.31	54.01		54.11	0.000438	3.53	2299.13	646.79	0.22
Reach 1	2026	50yr	5435.00	45.31	54.68		54.78	0.000431	3.69	2512.60	654.91	0.22
Reach 1	2026	100yr	6095.00	45.31	55.29		55.41	0.000427	3.85	2712.51	663.53	0.22
Reach 1	2026	200yr	6745.00	45.31	55.87		55.99	0.000421	3.98	2903.68	672.04	0.22
Reach 1	2026	500yr	7610.00	45.31	56.59		56.72	0.000416	4.14	3143.28	680.18	0.22
Reach 1	2026	bankfull	754.30	45.31	48.56		48.59	0.000633	1.98	635.90	275.71	0.22
Reach 1	2026	5th percentile	845.00	45.31	48.68		48.72	0.000673	2.11	670.74	278.24	0.23
Reach 1	2026	50th percentile	119.00	45.31	47.13		47.14	0.000226	0.74	261.73	245.40	0.12
Reach 1	2026	95th percentile	18.00	45.31	46.51		46.51	0.000039	0.21	130.31	178.80	0.04
Reach 1	2026	mean	228.00	45.31	47.55		47.56	0.000317	1.04	368.17	256.83	0.14
Reach 1	1933	1.1yr	1305.00	44.78	49.46		49.50	0.000515	2.30	1036.11	317.63	0.21
Reach 1	1933	2yr	2290.00	44.78	51.01		51.07	0.000450	2.71	1534.00	323.33	0.21
Reach 1	1933	5yr	3235.00	44.78	52.26		52.34	0.000420	3.01	1942.30	648.94	0.21
Reach 1	1933	10yr	3910.00	44.78	53.06		53.14	0.000409	3.21	2204.51	663.41	0.21
Reach 1	1933	25yr	4765.00	44.78	53.97		54.07	0.000401	3.44	2511.31	680.53	0.21
Reach 1	1933	50yr	5435.00	44.78	54.64		54.74	0.000398	3.60	2736.80	689.60	0.21
Reach 1	1933	100yr	6095.00	44.78	55.25		55.37	0.000396	3.76	2947.75	700.66	0.21
Reach 1	1933	200yr	6745.00	44.78	55.83		55.96	0.000395	3.90	3148.92	712.85	0.22
Reach 1	1933	500yr	7610.00	44.78	56.55		56.68	0.000396	4.09	3401.21	726.21	0.22
Reach 1	1933	bankfull	754.30	44.78	48.51		48.54	0.000510	1.88	736.00	313.65	0.20
Reach 1	1933	5th percentile	845.00	44.78	48.63		48.66	0.000545	2.00	774.43	314.24	0.21
Reach 1	1933	50th percentile	119.00	44.78	47.12		47.12	0.000128	0.63	335.15	250.82	0.09
Reach 1	1933	95th percentile	18.00	44.78	46.51		46.51	0.000013	0.16	198.97	206.56	0.03
Reach 1	1933	mean	228.00	44.78	47.53		47.54	0.000209	0.92	442.57	272.02	0.12
Reach 1	1836	1.1yr	1305.00	45.06	49.37		49.44	0.000695	2.64	756.09	252.65	0.24
Reach 1	1836	2yr	2290.00	45.06	50.92		51.02	0.000584	3.04	1155.84	260.42	0.23
Reach 1	1836	5yr	3235.00	45.06	52.17		52.29	0.000539	3.35	1486.12	602.31	0.23
Reach 1	1836	10yr	3910.00	45.06	52.97		53.09	0.000523	3.56	1700.60	613.34	0.23
Reach 1	1836	25yr	4765.00	45.06	53.88		54.02	0.000510	3.79	1953.70	683.38	0.23
Reach 1	1836	50yr	5435.00	45.06	54.54		54.70	0.000499	3.95	2141.33	709.92	0.23
Reach 1	1836	100yr	6095.00	45.06	55.16		55.32	0.000491	4.09	2318.17	717.86	0.23
Reach 1	1836	200yr	6745.00	45.06	55.73		55.91	0.000483	4.22	2489.42	730.89	0.23
Reach 1	1836	500yr	7610.00	45.06	56.45		56.64	0.000478	4.39	2707.55	741.46	0.24
Reach 1	1836	bankfull	754.30	45.06	48.42		48.48	0.000706	2.21	520.10	246.87	0.23
Reach 1	1836	5th percentile	845.00	45.06	48.54		48.60	0.000759	2.35	548.62	247.76	0.24
Reach 1	1836	50th percentile	119.00	45.06	47.10		47.11	0.000177	0.76	221.87	198.13	0.11
Reach 1	1836	95th percentile	18.00	45.06	46.50		46.50	0.000020	0.20	118.06	140.78	0.03
Reach 1	1836	mean	228.00	45.06	47.50		47.52	0.000281	1.10	305.02	220.16	0.14
Reach 1	1733	1.1yr	1305.00	46.16	49.15		49.31	0.002298	4.01	535.66	264.26	0.42
Reach 1	1733	2yr	2290.00	46.16	50.80		50.93	0.001118	3.80	983.60	279.67	0.32
Reach 1	1733	5yr	3235.00	46.16	52.08		52.22	0.000858	3.94	1351.30	676.20	0.29
Reach 1	1733	10yr	3910.00	46.16	52.88		53.03	0.000758	4.04	1596.13	693.70	0.28
Reach 1	1733	25yr	4765.00	46.16	53.81		53.96	0.000669	4.14	1894.26	712.31	0.27
Reach 1	1733	50yr	5435.00	46.16	54.49		54.64	0.000623	4.23	2115.41	720.93	0.26
Reach 1	1733	100yr	6095.00	46.16	55.10		55.26	0.000591	4.33	2322.71	730.59	0.26
Reach 1	1733	200yr	6745.00	46.16	55.69		55.85	0.000566	4.42	2521.42	738.47	0.25
Reach 1	1733	500yr	7610.00	46.16	56.41		56.58	0.000543	4.55	2771.60	749.07	0.25
Reach 1	1733	bankfull	754.30	46.16	47.79	47.79	48.24	0.012679	6.09	192.71	230.21	0.89
Reach 1	1733	5th percentile	845.00	46.16	48.10		48.40	0.006983	5.13	266.29	243.78	0.68
Reach 1	1733	50th percentile	119.00	46.16	46.78	46.78	47.02	0.023389	3.96	30.05	62.60	1.01
Reach 1	1733	95th percentile	18.00	46.16	46.41	46.41	46.49	0.032177	2.28	7.91	48.35	0.99
Reach 1	1733	mean	228.00	46.16	47.09	47.09	47.39	0.015909	4.50	57.15	137.42	0.90
Reach 1	1623	1.1yr	1305.00	41.34	49.12		49.21	0.000367	2.77	749.40	283.78	0.19
Reach 1	1623	2yr	2290.00	41.34	50.76		50.87	0.000349	3.14	1231.92	303.46	0.19
Reach 1	1623	5yr	3235.00	41.34	52.04		52.16	0.000332	3.38	1632.25	449.67	0.19
Reach 1	1623	10yr	3910.00	41.34	52.85		52.97	0.000320	3.51	1898.29	554.56	0.19
Reach 1	1623	25yr	4765.00	41.34	53.78		53.91	0.000322	3.73	2234.17	633.87	0.20
Reach 1	1623	50yr	5435.00	41.34	54.46		54.59	0.000308	3.80	2491.29	653.92	0.19

HEC-RAS Plan: Existing_rev1 River: River 1 Reach: Reach 1 (Continued)

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Reach 1	1623	100yr	6095.00	41.34	55.08		55.21	0.000303	3.90	2739.26	684.30	0.20
Reach 1	1623	200yr	6745.00	41.34	55.67		55.80	0.000290	3.93	2979.33	698.55	0.19
Reach 1	1623	500yr	7610.00	41.34	56.39		56.53	0.000277	3.98	3277.66	715.91	0.19
Reach 1	1623	bankfull	754.30	41.34	47.93	44.05	48.01	0.000328	2.29	433.92	239.69	0.18
Reach 1	1623	5th percentile	845.00	41.34	48.15		48.23	0.000341	2.40	488.44	252.81	0.18
Reach 1	1623	50th percentile	119.00	41.34	45.67	42.49	45.67	0.000054	0.67	178.56	56.05	0.07
Reach 1	1623	95th percentile	18.00	41.34	44.76	41.87	44.76	0.000003	0.14	129.45	51.62	0.02
Reach 1	1623	mean	228.00	41.34	46.21	42.86	46.23	0.000123	1.09	209.94	59.19	0.10
Reach 1	1505	1.1yr	1305.00	39.84	49.12	44.58	49.17	0.000210	2.15	957.71	278.20	0.15
Reach 1	1505	2yr	2290.00	39.84	50.75	45.94	50.82	0.000237	2.64	1422.33	291.03	0.16
Reach 1	1505	5yr	3235.00	39.84	52.03	46.89	52.11	0.000251	2.98	1801.05	300.12	0.17
Reach 1	1505	10yr	3910.00	39.84	52.84	47.18	52.93	0.000257	3.18	2044.47	303.88	0.17
Reach 1	1505	25yr	4765.00	39.84	53.76	47.93	53.87	0.000265	3.41	2327.78	307.65	0.18
Reach 1	1505	50yr	5435.00	39.84	54.43	48.22	54.55	0.000270	3.58	2535.84	311.79	0.18
Reach 1	1505	100yr	6095.00	39.84	55.05	48.50	55.17	0.000275	3.74	2729.39	314.23	0.18
Reach 1	1505	200yr	6745.00	39.84	55.64	48.76	55.77	0.000279	3.88	2913.48	317.20	0.19
Reach 1	1505	500yr	7610.00	39.84	56.35	49.08	56.49	0.000286	4.06	3141.72	320.56	0.19
Reach 1	1505	bankfull	754.30	39.84	47.93	43.45	47.97	0.000174	1.73	643.82	251.27	0.13
Reach 1	1505	5th percentile	845.00	39.84	48.15	43.63	48.19	0.000181	1.81	700.11	254.42	0.13
Reach 1	1505	50th percentile	119.00	39.84	45.66	41.54	45.67	0.000032	0.56	241.21	96.32	0.05
Reach 1	1505	95th percentile	18.00	39.84	44.76	40.62	44.76	0.000002	0.12	159.66	81.88	0.01
Reach 1	1505	mean	228.00	39.84	46.21	42.05	46.22	0.000071	0.90	299.38	142.78	0.08
Reach 1	1395	1.1yr	1305.00	40.09	49.10	43.51	49.15	0.000148	1.84	724.81	113.76	0.12
Reach 1	1395	2yr	2290.00	40.09	50.69	44.46	50.79	0.000231	2.61	909.91	119.21	0.16
Reach 1	1395	5yr	3235.00	40.09	51.92	45.20	52.08	0.000293	3.19	1060.08	124.00	0.18
Reach 1	1395	10yr	3910.00	40.09	52.70	45.68	52.89	0.000330	3.56	1157.38	127.59	0.19
Reach 1	1395	25yr	4765.00	40.09	53.58	46.23	53.82	0.000373	3.98	1271.91	131.21	0.21
Reach 1	1395	50yr	5435.00	40.09	54.22	46.61	54.50	0.000403	4.28	1356.78	134.17	0.22
Reach 1	1395	100yr	6095.00	40.09	54.81	46.97	55.12	0.000431	4.56	1436.24	136.89	0.23
Reach 1	1395	200yr	6745.00	40.09	55.36	47.30	55.71	0.000455	4.82	1512.58	139.65	0.23
Reach 1	1395	500yr	7610.00	40.09	56.03	47.75	56.43	0.000488	5.15	1607.93	143.32	0.24
Reach 1	1395	bankfull	754.30	40.09	47.92	42.85	47.95	0.000090	1.28	593.91	109.23	0.09
Reach 1	1395	5th percentile	845.00	40.09	48.14	42.97	48.17	0.000100	1.39	618.15	110.20	0.10
Reach 1	1395	50th percentile	119.00	40.09	45.66	41.31	45.67	0.000011	0.33	358.63	98.13	0.03
Reach 1	1395	95th percentile	18.00	40.09	44.76	40.62	44.76	0.000001	0.07	272.17	92.18	0.01
Reach 1	1395	mean	228.00	40.09	46.21	41.74	46.21	0.000025	0.55	412.91	101.75	0.05
Reach 1	1390	1.1yr	1305.00	39.91	49.09	43.46	49.15	0.000276	1.93	681.88	105.64	0.13
Reach 1	1390	2yr	2290.00	39.91	50.67	44.44	50.79	0.000421	2.74	853.66	111.25	0.17
Reach 1	1390	5yr	3235.00	39.91	51.90	45.22	52.07	0.000528	3.36	992.62	115.19	0.19
Reach 1	1390	10yr	3910.00	39.91	52.67	45.72	52.88	0.000592	3.74	1081.97	117.35	0.20
Reach 1	1390	25yr	4765.00	39.91	53.55	46.31	53.81	0.000665	4.18	1186.33	120.35	0.22
Reach 1	1390	50yr	5435.00	39.91	54.18	46.72	54.49	0.000716	4.50	1263.37	122.77	0.23
Reach 1	1390	100yr	6095.00	39.91	54.76	47.12	55.11	0.000764	4.79	1335.33	124.92	0.24
Reach 1	1390	200yr	6745.00	39.91	55.31	47.47	55.69	0.000806	5.07	1404.20	127.13	0.25
Reach 1	1390	500yr	7610.00	39.91	55.97	47.93	56.42	0.000863	5.42	1489.72	129.58	0.26
Reach 1	1390	bankfull	754.30	39.91	47.92	42.77	47.95	0.000172	1.35	561.06	100.96	0.10
Reach 1	1390	5th percentile	845.00	39.91	48.14	42.90	48.17	0.000190	1.45	583.41	101.92	0.10
Reach 1	1390	50th percentile	119.00	39.91	45.66	41.23	45.67	0.000016	0.34	345.16	90.35	0.03
Reach 1	1390	95th percentile	18.00	39.91	44.76	40.46	44.76	0.000001	0.07	265.31	85.34	0.01
Reach 1	1390	mean	228.00	39.91	46.21	41.66	46.21	0.000044	0.58	395.07	93.42	0.05
Reach 1	1350	Bridge										
Reach 1	1326	1.1yr	1305.00	39.72	48.64	43.02	48.70	0.000204	1.97	670.20	103.99	0.13
Reach 1	1326	2yr	2290.00	39.72	50.19	44.06	50.32	0.000317	2.80	838.13	111.79	0.17
Reach 1	1326	5yr	3235.00	39.72	51.39	44.86	51.57	0.000402	3.44	974.15	115.73	0.20
Reach 1	1326	10yr	3910.00	39.72	52.14	45.37	52.36	0.000455	3.85	1061.36	118.00	0.21
Reach 1	1326	25yr	4765.00	39.72	52.98	45.95	53.27	0.000515	4.32	1162.68	120.53	0.23
Reach 1	1326	50yr	5435.00	39.72	53.60	46.36	53.93	0.000559	4.66	1237.05	122.69	0.24
Reach 1	1326	100yr	6095.00	39.72	54.16	46.73	54.53	0.000599	4.97	1306.32	124.74	0.25
Reach 1	1326	200yr	6745.00	39.72	54.68	47.09	55.10	0.000636	5.27	1371.87	126.55	0.26
Reach 1	1326	500yr	7610.00	39.72	55.32	47.54	55.80	0.000685	5.65	1454.05	128.86	0.27
Reach 1	1326	bankfull	754.30	39.72	47.49	42.26	47.52	0.000126	1.37	553.75	98.53	0.10
Reach 1	1326	5th percentile	845.00	39.72	47.71	42.39	47.74	0.000139	1.47	575.48	99.34	0.11
Reach 1	1326	50th percentile	119.00	39.72	45.24	40.75	45.25	0.000012	0.35	339.87	90.37	0.03
Reach 1	1326	95th percentile	18.00	39.72	44.32	40.10	44.32	0.000001	0.07	259.68	83.87	0.01
Reach 1	1326	mean	228.00	39.72	45.79	41.16	45.80	0.000034	0.58	390.18	93.71	0.05
Reach 1	1323	1.1yr	1305.00	39.83	48.64	43.01	48.70	0.000187	1.92	691.40	110.66	0.13
Reach 1	1323	2yr	2290.00	39.83	50.20	44.03	50.31	0.000288	2.72	869.86	118.53	0.16
Reach 1	1323	5yr	3235.00	39.83	51.39	44.82	51.56	0.000365	3.34	1014.72	123.48	0.19
Reach 1	1323	10yr	3910.00	39.83	52.14	45.32	52.35	0.000412	3.73	1108.03	126.09	0.20
Reach 1	1323	25yr	4765.00	39.83	52.99	45.90	53.26	0.000465	4.18	1216.56	128.83	0.22
Reach 1	1323	50yr	5435.00	39.83	53.61	46.29	53.91	0.000504	4.51	1296.31	131.10	0.23
Reach 1	1323	100yr	6095.00	39.83	54.17	46.66	54.52	0.000539	4.81	1370.53	133.22	0.24
Reach 1	1323	200yr	6745.00	39.83	54.69	47.01	55.08	0.000572	5.09	1440.80	135.42	0.25
Reach 1	1323	500yr	7610.00	39.83	55.34	47.46	55.78	0.000615	5.46	1529.26	138.51	0.26
Reach 1	1323	bankfull	754.30	39.83	47.49	42.27	47.52	0.000116	1.33	568.35	102.59	0.10

HEC-RAS Plan: Existing_rev1 River: River 1 Reach: Reach 1 (Continued)

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Reach 1	1323	5th percentile	845.00	39.83	47.71	42.40	47.74	0.000128	1.44	591.08	104.22	0.10
Reach 1	1323	50th percentile	119.00	39.83	45.24	40.82	45.25	0.000011	0.34	347.14	92.98	0.03
Reach 1	1323	95th percentile	18.00	39.83	44.32	40.20	44.32	0.000001	0.07	264.63	86.30	0.01
Reach 1	1323	mean	228.00	39.83	45.79	41.20	45.80	0.000032	0.57	398.96	96.81	0.05
Reach 1	1242	1.1yr	1305.00	40.72	48.55		48.67	0.000385	2.80	489.53	362.05	0.20
Reach 1	1242	2yr	2290.00	40.72	50.04		50.27	0.000565	3.90	639.39	399.31	0.25
Reach 1	1242	5yr	3235.00	40.72	51.18		51.51	0.000680	4.69	771.67	423.58	0.28
Reach 1	1242	10yr	3910.00	40.72	51.90		52.29	0.000747	5.18	864.13	444.50	0.29
Reach 1	1242	25yr	4765.00	40.72	52.72		53.19	0.000807	5.69	975.69	462.01	0.31
Reach 1	1242	50yr	5435.00	40.72	53.31		53.84	0.000853	6.07	1062.12	483.56	0.32
Reach 1	1242	100yr	6095.00	40.72	53.87		54.44	0.000879	6.37	1149.65	497.77	0.33
Reach 1	1242	200yr	6745.00	40.72	54.38		55.00	0.000910	6.67	1235.79	512.31	0.34
Reach 1	1242	500yr	7610.00	40.72	55.04		55.70	0.000926	6.97	1350.99	525.78	0.34
Reach 1	1242	bankfull	754.30	40.72	47.44		47.50	0.000251	1.98	390.36	335.20	0.15
Reach 1	1242	5th percentile	845.00	40.72	47.65		47.72	0.000274	2.13	408.84	338.16	0.16
Reach 1	1242	50th percentile	119.00	40.72	45.24		45.24	0.000038	0.55	216.81	286.64	0.06
Reach 1	1242	95th percentile	18.00	40.72	44.32		44.32	0.000002	0.12	156.01	267.73	0.01
Reach 1	1242	mean	228.00	40.72	45.78		45.79	0.000085	0.89	256.05	305.75	0.08
Reach 1	1150	1.1yr	1305.00	40.26	48.54		48.64	0.000299	2.57	540.65	468.42	0.17
Reach 1	1150	2yr	2290.00	40.26	50.03		50.21	0.000436	3.53	700.59	478.28	0.22
Reach 1	1150	5yr	3235.00	40.26	51.18		51.43	0.000528	4.25	832.57	487.58	0.24
Reach 1	1150	10yr	3910.00	40.26	51.89		52.21	0.000583	4.68	919.49	494.59	0.26
Reach 1	1150	25yr	4765.00	40.26	52.72		53.10	0.000642	5.18	1023.76	503.10	0.28
Reach 1	1150	50yr	5435.00	40.26	53.31		53.74	0.000683	5.53	1101.94	509.42	0.29
Reach 1	1150	100yr	6095.00	40.26	53.86		54.34	0.000719	5.86	1177.78	522.46	0.30
Reach 1	1150	200yr	6745.00	40.26	54.38		54.90	0.000752	6.16	1253.38	538.29	0.31
Reach 1	1150	500yr	7610.00	40.26	55.02		55.60	0.000792	6.53	1354.28	554.67	0.32
Reach 1	1150	bankfull	754.30	40.26	47.43		47.48	0.000191	1.82	428.37	452.89	0.13
Reach 1	1150	5th percentile	845.00	40.26	47.64		47.70	0.000212	1.96	448.96	462.61	0.14
Reach 1	1150	50th percentile	119.00	40.26	45.24		45.24	0.000024	0.48	250.40	427.91	0.04
Reach 1	1150	95th percentile	18.00	40.26	44.32		44.32	0.000001	0.10	187.15	422.63	0.01
Reach 1	1150	mean	228.00	40.26	45.77		45.78	0.000056	0.79	288.53	437.37	0.07
Reach 1	1056	1.1yr	1305.00	39.57	48.49		48.61	0.000299	2.73	523.82	413.56	0.18
Reach 1	1056	2yr	2290.00	39.57	49.93		50.16	0.000491	3.94	663.29	429.18	0.24
Reach 1	1056	5yr	3235.00	39.57	51.02		51.37	0.000646	4.89	780.20	439.07	0.28
Reach 1	1056	10yr	3910.00	39.57	51.69		52.13	0.000746	5.49	856.53	444.48	0.30
Reach 1	1056	25yr	4765.00	39.57	52.45		53.01	0.000863	6.19	946.38	450.71	0.33
Reach 1	1056	50yr	5435.00	39.57	52.99		53.64	0.000949	6.70	1012.61	454.92	0.34
Reach 1	1056	100yr	6095.00	39.57	53.49		54.23	0.001030	7.17	1074.89	458.98	0.36
Reach 1	1056	200yr	6745.00	39.57	53.94		54.78	0.001107	7.62	1133.49	462.72	0.38
Reach 1	1056	500yr	7610.00	39.57	54.51		55.47	0.001206	8.19	1207.93	467.83	0.40
Reach 1	1056	bankfull	754.30	39.57	47.41		47.46	0.000175	1.87	430.27	403.05	0.13
Reach 1	1056	5th percentile	845.00	39.57	47.62		47.68	0.000195	2.02	447.74	404.71	0.14
Reach 1	1056	50th percentile	119.00	39.57	45.24		45.24	0.000019	0.46	261.22	387.21	0.04
Reach 1	1056	95th percentile	18.00	39.57	44.32		44.32	0.000001	0.09	198.25	379.88	0.01
Reach 1	1056	mean	228.00	39.57	45.77		45.78	0.000046	0.78	300.46	393.07	0.06
Reach 1	949	1.1yr	1305.00	43.34	48.23		48.52	0.001698	4.35	308.61	385.17	0.38
Reach 1	949	2yr	2290.00	43.34	49.56		50.04	0.001965	5.65	431.49	398.83	0.43
Reach 1	949	5yr	3235.00	43.34	50.57		51.23	0.002132	6.60	536.22	408.14	0.46
Reach 1	949	10yr	3910.00	43.34	51.20		51.97	0.002231	7.19	605.02	413.83	0.48
Reach 1	949	25yr	4765.00	43.34	51.92		52.83	0.002340	7.86	686.52	419.25	0.50
Reach 1	949	50yr	5435.00	43.34	52.44		53.45	0.002422	8.35	746.38	423.82	0.51
Reach 1	949	100yr	6095.00	43.34	52.91		54.03	0.002501	8.80	802.82	428.47	0.53
Reach 1	949	200yr	6745.00	43.34	53.34		54.57	0.002577	9.23	856.15	432.53	0.54
Reach 1	949	500yr	7610.00	43.34	53.87		55.24	0.002678	9.77	923.86	437.52	0.55
Reach 1	949	bankfull	754.30	43.34	47.23		47.41	0.001381	3.34	227.14	373.91	0.33
Reach 1	949	5th percentile	845.00	43.34	47.43		47.62	0.001424	3.52	242.31	375.48	0.34
Reach 1	949	50th percentile	119.00	43.34	45.20		45.23	0.000800	1.41	84.55	359.28	0.22
Reach 1	949	95th percentile	18.00	43.34	44.32		44.32	0.000578	0.63	28.53	349.21	0.16
Reach 1	949	mean	228.00	43.34	45.70		45.76	0.001000	1.92	118.46	362.27	0.26
Reach 1	854	1.1yr	1305.00	43.24	48.00		48.32	0.002845	4.53	289.83	338.58	0.42
Reach 1	854	2yr	2290.00	43.24	49.28		49.80	0.003142	5.81	405.04	354.52	0.46
Reach 1	854	5yr	3235.00	43.24	50.28		50.97	0.003311	6.74	504.56	367.17	0.49
Reach 1	854	10yr	3910.00	43.24	50.90		51.71	0.003404	7.31	571.92	375.34	0.50
Reach 1	854	25yr	4765.00	43.24	51.62		52.56	0.003506	7.94	653.11	382.93	0.52
Reach 1	854	50yr	5435.00	43.24	52.13		53.17	0.003576	8.39	714.27	388.81	0.53
Reach 1	854	100yr	6095.00	43.24	52.60		53.74	0.003640	8.80	772.90	394.76	0.54
Reach 1	854	200yr	6745.00	43.24	53.04		54.28	0.003702	9.19	829.76	401.98	0.55
Reach 1	854	500yr	7610.00	43.24	53.58		54.94	0.003781	9.67	903.58	410.34	0.56
Reach 1	854	bankfull	754.30	43.24	47.04		47.23	0.002454	3.54	212.83	328.41	0.38
Reach 1	854	5th percentile	845.00	43.24	47.22		47.44	0.002615	3.72	227.18	330.34	0.38
Reach 1	854	50th percentile	119.00	43.24	45.12		45.15	0.000860	1.49	79.72	303.91	0.23
Reach 1	854	95th percentile	18.00	43.24	44.30		44.30	0.000123	0.46	39.13	280.18	0.08
Reach 1	854	mean	228.00	43.24	45.59		45.65	0.001245	2.09	109.27	311.37	0.29
Reach 1	758	1.1yr	1305.00	43.47	47.44		47.96	0.004443	5.80	227.69	83.91	0.60

HEC-RAS Plan: Existing_rev1 River: River 1 Reach: Reach 1 (Continued)

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Reach 1	758	2yr	2290.00	43.47	48.70		49.44	0.004014	6.98	344.59	101.43	0.60
Reach 1	758	5yr	3235.00	43.47	49.72		50.61	0.003700	7.75	451.81	108.72	0.60
Reach 1	758	10yr	3910.00	43.47	50.37		51.35	0.003555	8.20	523.27	113.27	0.60
Reach 1	758	25yr	4765.00	43.47	51.10		52.20	0.003433	8.72	608.79	118.84	0.60
Reach 1	758	50yr	5435.00	43.47	51.64		52.82	0.003354	9.08	673.58	122.87	0.60
Reach 1	758	100yr	6095.00	43.47	52.14		53.40	0.003274	9.39	736.54	126.68	0.60
Reach 1	758	200yr	6745.00	43.47	52.62		53.93	0.003197	9.66	797.64	129.58	0.60
Reach 1	758	500yr	7610.00	43.47	53.20		54.60	0.003146	10.03	873.32	133.02	0.60
Reach 1	758	bankfull	754.30	43.47	46.54		46.90	0.004700	4.82	156.77	74.86	0.58
Reach 1	758	5th percentile	845.00	43.47	46.71		47.09	0.004624	5.01	169.35	75.97	0.58
Reach 1	758	50th percentile	119.00	43.47	44.90		45.00	0.003662	2.42	49.27	53.93	0.45
Reach 1	758	95th percentile	18.00	43.47	44.26		44.27	0.001521	0.97	18.47	40.84	0.26
Reach 1	758	mean	228.00	43.47	45.27		45.43	0.004795	3.26	70.00	59.87	0.53
Reach 1	669	1.1yr	1305.00	43.26	47.31		47.59	0.002555	4.29	306.55	99.16	0.42
Reach 1	669	2yr	2290.00	43.26	48.65		49.07	0.002434	5.27	444.39	106.90	0.43
Reach 1	669	5yr	3235.00	43.26	49.70		50.25	0.002379	5.98	560.20	112.38	0.44
Reach 1	669	10yr	3910.00	43.26	50.36		50.99	0.002374	6.43	635.14	115.24	0.45
Reach 1	669	25yr	4765.00	43.26	51.11		51.84	0.002391	6.96	722.46	118.46	0.46
Reach 1	669	50yr	5435.00	43.26	51.65		52.46	0.002408	7.33	787.00	120.66	0.47
Reach 1	669	100yr	6095.00	43.26	52.15		53.04	0.002423	7.68	848.19	122.70	0.48
Reach 1	669	200yr	6745.00	43.26	52.62		53.58	0.002437	8.00	906.55	124.61	0.48
Reach 1	669	500yr	7610.00	43.26	53.19		54.25	0.002481	8.42	977.91	126.82	0.49
Reach 1	669	bankfull	754.30	43.26	46.35		46.54	0.002635	3.53	213.91	93.82	0.41
Reach 1	669	5th percentile	845.00	43.26	46.53		46.74	0.002632	3.67	230.66	94.80	0.41
Reach 1	669	50th percentile	119.00	43.26	44.46		44.55	0.006874	2.49	47.76	80.10	0.57
Reach 1	669	95th percentile	18.00	43.26	43.77	43.77	43.90	0.028689	2.91	6.18	24.00	1.01
Reach 1	669	mean	228.00	43.26	44.95		45.05	0.003541	2.59	88.20	84.72	0.45
Reach 1	538	1.1yr	1305.00	42.07	47.02		47.31	0.001824	4.36	303.99	88.74	0.40
Reach 1	538	2yr	2290.00	42.07	48.30		48.78	0.002035	5.60	422.87	97.05	0.44
Reach 1	538	5yr	3235.00	42.07	49.32		49.95	0.002121	6.46	525.00	103.10	0.46
Reach 1	538	10yr	3910.00	42.07	49.95		50.68	0.002180	7.00	591.12	106.36	0.48
Reach 1	538	25yr	4765.00	42.07	50.67		51.52	0.002242	7.60	668.88	109.72	0.49
Reach 1	538	50yr	5435.00	42.07	51.19		52.13	0.002287	8.03	726.31	112.01	0.50
Reach 1	538	100yr	6095.00	42.07	51.67		52.71	0.002326	8.42	780.91	114.11	0.51
Reach 1	538	200yr	6745.00	42.07	52.12		53.25	0.002358	8.78	833.08	116.07	0.52
Reach 1	538	500yr	7610.00	42.07	52.66		53.90	0.002431	9.27	895.87	118.49	0.53
Reach 1	538	bankfull	754.30	42.07	46.10		46.27	0.001576	3.36	225.20	82.21	0.35
Reach 1	538	5th percentile	845.00	42.07	46.27		46.46	0.001626	3.55	239.28	83.56	0.36
Reach 1	538	50th percentile	119.00	42.07	44.32		44.34	0.000603	1.29	92.18	66.71	0.19
Reach 1	538	95th percentile	18.00	42.07	43.62	42.56	43.62	0.000091	0.37	48.65	55.57	0.07
Reach 1	538	mean	228.00	42.07	44.77		44.83	0.000909	1.85	123.57	71.06	0.25
Reach 1	434	1.1yr	1305.00	43.28	45.76	45.76	46.82	0.014198	8.29	157.48	74.78	1.01
Reach 1	434	2yr	2290.00	43.28	46.74	46.74	48.24	0.012490	9.84	233.82	80.04	1.00
Reach 1	434	5yr	3235.00	43.28	47.52	47.52	49.39	0.011486	10.99	297.74	83.95	1.00
Reach 1	434	10yr	3910.00	43.28	48.10	48.10	50.12	0.010359	11.47	347.83	90.42	0.97
Reach 1	434	25yr	4765.00	43.28	48.72	48.72	50.96	0.009674	12.12	409.41	102.72	0.96
Reach 1	434	50yr	5435.00	43.28	49.17	49.17	51.57	0.009291	12.58	456.19	105.13	0.95
Reach 1	434	100yr	6095.00	43.28	49.58	49.58	52.13	0.009039	13.02	499.66	107.00	0.95
Reach 1	434	200yr	6745.00	43.28	49.96	49.96	52.66	0.008859	13.44	540.60	108.65	0.95
Reach 1	434	500yr	7610.00	43.28	50.85	50.41	53.38	0.007008	13.07	639.14	112.29	0.86
Reach 1	434	bankfull	754.30	43.28	45.07	45.07	45.83	0.015847	7.04	107.18	70.58	1.01
Reach 1	434	5th percentile	845.00	43.28	45.19	45.19	46.01	0.015472	7.27	116.18	71.50	1.01
Reach 1	434	50th percentile	119.00	43.28	43.89	43.89	44.14	0.022446	4.00	29.72	59.46	1.00
Reach 1	434	95th percentile	18.00	43.28	43.50	43.50	43.58	0.032663	2.25	7.98	50.11	1.00
Reach 1	434	mean	228.00	43.28	44.16	44.16	44.54	0.020085	4.90	46.50	63.11	1.01
Reach 1	314	1.1yr	1305.00	40.66	44.98	43.50	45.32	0.002901	4.68	279.97	85.95	0.45
Reach 1	314	2yr	2290.00	40.66	46.39	44.46	46.90	0.002782	5.77	410.26	99.66	0.46
Reach 1	314	5yr	3235.00	40.66	47.18	45.22	47.92	0.003294	6.95	491.04	104.32	0.52
Reach 1	314	10yr	3910.00	40.66	47.76	45.74	48.63	0.003409	7.56	553.17	107.28	0.54
Reach 1	314	25yr	4765.00	40.66	48.59	46.35	49.57	0.003269	8.05	644.35	117.97	0.54
Reach 1	314	50yr	5435.00	40.66	49.23	46.77	50.27	0.003132	8.35	724.87	136.86	0.53
Reach 1	314	100yr	6095.00	40.66	49.87	47.19	50.95	0.002936	8.53	827.44	168.60	0.52
Reach 1	314	200yr	6745.00	40.66	50.53	47.60	51.61	0.002708	8.61	940.34	177.56	0.51
Reach 1	314	500yr	7610.00	40.66	51.41		52.48	0.002411	8.66	1105.45	194.11	0.49
Reach 1	314	bankfull	754.30	40.66	43.87	42.81	44.12	0.002970	3.99	188.93	79.55	0.46
Reach 1	314	5th percentile	845.00	40.66	44.09	42.94	44.35	0.002951	4.09	206.50	80.65	0.45
Reach 1	314	50th percentile	119.00	40.66	41.91	41.66	42.02	0.006357	2.63	45.21	65.73	0.56
Reach 1	314	95th percentile	18.00	40.66	41.23	41.13	41.29	0.010494	1.89	9.54	33.27	0.62
Reach 1	314	mean	228.00	40.66	42.34	41.93	42.49	0.004737	3.06	74.59	69.38	0.52
Reach 1	172	1.1yr	1305.00	39.06	44.22		44.47	0.016907	3.98	329.74	89.89	0.35
Reach 1	172	2yr	2290.00	39.06	45.66		46.04	0.018234	5.03	468.57	102.58	0.38
Reach 1	172	5yr	3235.00	39.06	46.27		46.87	0.024796	6.30	532.61	106.87	0.46
Reach 1	172	10yr	3910.00	39.06	46.83		47.54	0.026269	6.89	593.56	110.94	0.48
Reach 1	172	25yr	4765.00	39.06	47.74		48.52	0.024341	7.24	697.93	119.17	0.47
Reach 1	172	50yr	5435.00	39.06	48.45		49.26	0.022520	7.41	785.92	126.72	0.46
Reach 1	172	100yr	6095.00	39.06	49.18		50.00	0.020478	7.48	881.08	135.25	0.44

HEC-RAS Plan: Existing_rev1 River: River 1 Reach: Reach 1 (Continued)

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Reach 1	172	200yr	6745.00	39.06	49.92		50.73	0.018408	7.49	983.66	142.01	0.43
Reach 1	172	500yr	7610.00	39.06	50.90		51.69	0.015967	7.44	1127.43	149.58	0.40
Reach 1	172	bankfull	754.30	39.06	43.12		43.28	0.015184	3.17	237.91	78.52	0.32
Reach 1	172	5th percentile	845.00	39.06	43.34		43.51	0.015593	3.31	254.94	80.25	0.33
Reach 1	172	50th percentile	119.00	39.06	40.78		40.82	0.011141	1.55	76.91	59.48	0.24
Reach 1	172	95th percentile	18.00	39.06	39.80		39.81	0.010063	0.77	23.49	48.44	0.19
Reach 1	172	mean	228.00	39.06	41.40		41.46	0.011925	1.99	114.75	64.03	0.26
Reach 1	68	1.1yr	1305.00	36.50	40.08	40.08	41.18	0.073304	8.40	155.33	70.86	1.00
Reach 1	68	2yr	2290.00	36.50	41.13	41.11	42.63	0.069849	9.81	233.55	77.88	1.00
Reach 1	68	5yr	3235.00	36.50	43.04	41.92	44.12	0.027633	8.35	389.85	85.45	0.67
Reach 1	68	10yr	3910.00	36.50	44.41	42.43	45.35	0.017250	7.80	510.04	90.65	0.56
Reach 1	68	25yr	4765.00	36.50	45.92	43.04	46.79	0.012082	7.56	651.07	96.36	0.48
Reach 1	68	50yr	5435.00	36.50	46.80	43.49	47.70	0.010771	7.68	737.83	99.99	0.46
Reach 1	68	100yr	6095.00	36.50	47.67	43.88	48.59	0.009658	7.76	826.70	104.00	0.45
Reach 1	68	200yr	6745.00	36.50	48.53	44.28	49.45	0.008719	7.82	918.69	109.89	0.43
Reach 1	68	500yr	7610.00	36.50	49.65	44.82	50.57	0.007697	7.87	1044.74	116.13	0.41
Reach 1	68	bankfull	754.30	36.50	39.31	39.31	40.14	0.082238	7.30	103.28	63.97	1.01
Reach 1	68	5th percentile	845.00	36.50	39.45	39.45	40.33	0.080287	7.53	112.26	65.24	1.01
Reach 1	68	50th percentile	119.00	36.50	37.79	37.79	38.15	0.106326	4.80	24.81	35.08	1.01
Reach 1	68	95th percentile	18.00	36.50	37.04	37.04	37.21	0.138886	3.27	5.50	16.85	1.01
Reach 1	68	mean	228.00	36.50	38.19	38.19	38.69	0.099970	5.67	40.18	42.15	1.02

HEC-RAS Plan: Proposed_rev2 River: River 1 Reach: Reach 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Reach 1	2101	1.1yr	1305.00	45.15	49.53	47.80	49.64	0.001686	3.60	643.04	286.11	0.37
Reach 1	2101	2yr	2290.00	45.15	51.05	48.70	51.17	0.001041	3.72	1095.30	301.89	0.31
Reach 1	2101	5yr	3235.00	45.15	52.29	49.05	52.41	0.000828	3.89	1472.81	632.50	0.29
Reach 1	2101	10yr	3910.00	45.15	53.07	49.44	53.20	0.000753	4.04	1719.27	641.80	0.28
Reach 1	2101	25yr	4765.00	45.15	53.98	49.84	54.11	0.000687	4.21	2008.68	648.90	0.27
Reach 1	2101	50yr	5435.00	45.15	54.63	50.08	54.78	0.000652	4.33	2221.06	653.90	0.27
Reach 1	2101	100yr	6095.00	45.15	55.24	50.29	55.39	0.000623	4.45	2419.46	658.98	0.27
Reach 1	2101	200yr	6745.00	45.15	55.81	50.48	55.97	0.000602	4.56	2607.35	663.92	0.26
Reach 1	2101	500yr	7610.00	45.15	56.52	50.70	56.69	0.000581	4.70	2844.75	670.69	0.26
Reach 1	2101	bankfull	754.30	45.15	48.60	47.46	48.70	0.002302	3.29	394.58	247.95	0.40
Reach 1	2101	5th percentile	845.00	45.15	48.72	47.67	48.83	0.002304	3.42	425.90	251.51	0.41
Reach 1	2101	50th percentile	119.00	45.15	47.15	46.30	47.17	0.000931	1.52	126.34	125.24	0.24
Reach 1	2101	95th percentile	18.00	45.15	46.51	45.59	46.51	0.000154	0.50	56.89	92.79	0.09
Reach 1	2101	mean	228.00	45.15	47.58	46.63	47.62	0.001341	1.95	184.32	148.12	0.29
Reach 1	2026	1.1yr	1305.00	45.31	49.50		49.55	0.000643	2.46	906.69	298.46	0.23
Reach 1	2026	2yr	2290.00	45.31	51.03		51.10	0.000529	2.85	1369.45	305.22	0.22
Reach 1	2026	5yr	3235.00	45.31	52.27		52.35	0.000481	3.14	1750.17	613.94	0.22
Reach 1	2026	10yr	3910.00	45.31	53.05		53.14	0.000462	3.33	1995.79	626.52	0.22
Reach 1	2026	25yr	4765.00	45.31	53.96		54.06	0.000448	3.56	2282.40	646.11	0.22
Reach 1	2026	50yr	5435.00	45.31	54.62		54.73	0.000442	3.72	2492.94	654.18	0.22
Reach 1	2026	100yr	6095.00	45.31	55.22		55.34	0.000439	3.88	2689.77	662.48	0.23
Reach 1	2026	200yr	6745.00	45.31	55.79		55.92	0.000434	4.01	2877.13	670.87	0.23
Reach 1	2026	500yr	7610.00	45.31	56.50		56.64	0.000428	4.18	3114.36	679.20	0.23
Reach 1	2026	bankfull	754.30	45.31	48.56		48.59	0.000633	1.98	635.90	275.71	0.22
Reach 1	2026	5th percentile	845.00	45.31	48.68		48.72	0.000675	2.11	670.17	278.20	0.23
Reach 1	2026	50th percentile	119.00	45.31	47.13		47.14	0.000226	0.74	261.73	245.40	0.12
Reach 1	2026	95th percentile	18.00	45.31	46.51		46.51	0.000039	0.21	130.31	178.80	0.04
Reach 1	2026	mean	228.00	45.31	47.55		47.56	0.000317	1.04	368.17	256.83	0.14
Reach 1	1933	1.1yr	1305.00	44.78	49.45		49.49	0.000520	2.30	1033.24	317.59	0.21
Reach 1	1933	2yr	2290.00	44.78	50.99		51.05	0.000457	2.72	1526.68	323.24	0.21
Reach 1	1933	5yr	3235.00	44.78	52.23		52.30	0.000429	3.03	1930.56	647.83	0.21
Reach 1	1933	10yr	3910.00	44.78	53.01		53.10	0.000418	3.23	2190.42	661.74	0.21
Reach 1	1933	25yr	4765.00	44.78	53.92		54.02	0.000411	3.46	2493.34	679.82	0.21
Reach 1	1933	50yr	5435.00	44.78	54.58		54.68	0.000407	3.63	2715.71	688.68	0.21
Reach 1	1933	100yr	6095.00	44.78	55.18		55.30	0.000406	3.79	2923.42	699.33	0.22
Reach 1	1933	200yr	6745.00	44.78	55.75		55.88	0.000406	3.94	3120.62	711.03	0.22
Reach 1	1933	500yr	7610.00	44.78	56.46		56.60	0.000408	4.13	3370.25	724.75	0.22
Reach 1	1933	bankfull	754.30	44.78	48.51		48.54	0.000510	1.88	736.00	313.65	0.20
Reach 1	1933	5th percentile	845.00	44.78	48.63		48.66	0.000546	2.00	773.73	314.23	0.21
Reach 1	1933	50th percentile	119.00	44.78	47.12		47.12	0.000128	0.63	335.15	250.82	0.09
Reach 1	1933	95th percentile	18.00	44.78	46.51		46.51	0.000013	0.16	198.97	206.56	0.03
Reach 1	1933	mean	228.00	44.78	47.53		47.54	0.000209	0.92	442.57	272.02	0.12
Reach 1	1836	1.1yr	1305.00	45.06	49.36		49.43	0.000702	2.65	753.61	252.59	0.24
Reach 1	1836	2yr	2290.00	45.06	50.90		51.00	0.000594	3.05	1149.61	260.30	0.23
Reach 1	1836	5yr	3235.00	45.06	52.14		52.25	0.000551	3.37	1476.11	601.70	0.23
Reach 1	1836	10yr	3910.00	45.06	52.92		53.05	0.000535	3.58	1688.52	612.73	0.23
Reach 1	1836	25yr	4765.00	45.06	53.82		53.97	0.000523	3.82	1938.20	679.88	0.24
Reach 1	1836	50yr	5435.00	45.06	54.48		54.64	0.000513	3.98	2123.01	709.14	0.24
Reach 1	1836	100yr	6095.00	45.06	55.08		55.25	0.000505	4.13	2296.96	716.68	0.24
Reach 1	1836	200yr	6745.00	45.06	55.65		55.83	0.000498	4.26	2464.19	729.49	0.24
Reach 1	1836	500yr	7610.00	45.06	56.36		56.55	0.000493	4.43	2679.75	740.12	0.24
Reach 1	1836	bankfull	754.30	45.06	48.42		48.48	0.000706	2.21	520.10	246.87	0.23
Reach 1	1836	5th percentile	845.00	45.06	48.53		48.60	0.000761	2.36	548.00	247.74	0.24
Reach 1	1836	50th percentile	119.00	45.06	47.10		47.11	0.000177	0.76	221.87	198.13	0.11
Reach 1	1836	95th percentile	18.00	45.06	46.50		46.50	0.000020	0.20	118.06	140.78	0.03
Reach 1	1836	mean	228.00	45.06	47.50		47.52	0.000281	1.10	305.02	220.16	0.14
Reach 1	1733	1.1yr	1305.00	46.16	49.14		49.30	0.002345	4.04	532.10	264.14	0.42
Reach 1	1733	2yr	2290.00	46.16	50.77		50.91	0.001145	3.83	976.13	279.45	0.32
Reach 1	1733	5yr	3235.00	46.16	52.04		52.18	0.000881	3.97	1339.42	675.51	0.29
Reach 1	1733	10yr	3910.00	46.16	52.84		52.98	0.000780	4.07	1581.57	692.74	0.28
Reach 1	1733	25yr	4765.00	46.16	53.76		53.91	0.000690	4.18	1875.41	711.50	0.27
Reach 1	1733	50yr	5435.00	46.16	54.42		54.57	0.000643	4.28	2093.40	720.08	0.26
Reach 1	1733	100yr	6095.00	46.16	55.03		55.19	0.000611	4.37	2297.32	728.76	0.26
Reach 1	1733	200yr	6745.00	46.16	55.60		55.77	0.000586	4.47	2491.93	737.27	0.26
Reach 1	1733	500yr	7610.00	46.16	56.31		56.49	0.000562	4.60	2739.26	747.74	0.26
Reach 1	1733	bankfull	754.30	46.16	47.79	47.79	48.24	0.012679	6.09	192.71	230.21	0.89
Reach 1	1733	5th percentile	845.00	46.16	48.09		48.39	0.007184	5.18	263.49	243.50	0.69
Reach 1	1733	50th percentile	119.00	46.16	46.78	46.78	47.02	0.023389	3.96	30.05	62.60	1.01
Reach 1	1733	95th percentile	18.00	46.16	46.41	46.41	46.49	0.032177	2.28	7.91	48.35	0.99
Reach 1	1733	mean	228.00	46.16	47.09	47.09	47.39	0.015909	4.50	57.15	137.42	0.90
Reach 1	1623	1.1yr	1305.00	41.34	49.10		49.20	0.000371	2.78	745.52	283.67	0.19
Reach 1	1623	2yr	2290.00	41.34	50.73		50.84	0.000355	3.16	1223.55	303.21	0.20
Reach 1	1623	5yr	3235.00	41.34	52.00		52.12	0.000339	3.41	1619.14	440.44	0.20
Reach 1	1623	10yr	3910.00	41.34	52.81		52.93	0.000327	3.54	1882.01	546.12	0.20
Reach 1	1623	25yr	4765.00	41.34	53.72		53.85	0.000331	3.77	2211.95	632.75	0.20
Reach 1	1623	50yr	5435.00	41.34	54.39		54.52	0.000318	3.84	2465.23	648.46	0.20

HEC-RAS Plan: Proposed_rev2 River: River 1 Reach: Reach 1 (Continued)

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Reach 1	1623	100yr	6095.00	41.34	55.01		55.14	0.000305	3.90	2709.42	681.94	0.20
Reach 1	1623	200yr	6745.00	41.34	55.58		55.72	0.000300	3.98	2943.63	697.10	0.20
Reach 1	1623	500yr	7610.00	41.34	56.30		56.44	0.000287	4.04	3239.21	713.35	0.19
Reach 1	1623	bankfull	754.30	41.34	47.92	44.05	48.00	0.000330	2.29	432.07	239.46	0.18
Reach 1	1623	5th percentile	845.00	41.34	48.14		48.23	0.000344	2.40	486.34	252.60	0.18
Reach 1	1623	50th percentile	119.00	41.34	45.67	42.49	45.67	0.000054	0.67	178.56	56.05	0.07
Reach 1	1623	95th percentile	18.00	41.34	44.76	41.87	44.76	0.000003	0.14	129.50	51.63	0.02
Reach 1	1623	mean	228.00	41.34	46.21	42.86	46.23	0.000123	1.09	209.95	59.19	0.10
Reach 1	1505	1.1yr	1305.00	39.84	49.10	44.58	49.15	0.000212	2.16	953.93	278.05	0.15
Reach 1	1505	2yr	2290.00	39.84	50.72	45.94	50.79	0.000241	2.65	1414.32	290.25	0.16
Reach 1	1505	5yr	3235.00	39.84	51.99	46.89	52.07	0.000255	3.00	1788.72	299.88	0.17
Reach 1	1505	10yr	3910.00	39.84	52.79	47.18	52.88	0.000262	3.20	2029.94	303.65	0.17
Reach 1	1505	25yr	4765.00	39.84	53.70	47.93	53.81	0.000271	3.44	2309.59	307.35	0.18
Reach 1	1505	50yr	5435.00	39.84	54.37	48.22	54.48	0.000277	3.61	2514.74	311.53	0.18
Reach 1	1505	100yr	6095.00	39.84	54.98	48.50	55.10	0.000282	3.77	2705.66	313.92	0.19
Reach 1	1505	200yr	6745.00	39.84	55.55	48.76	55.68	0.000287	3.91	2885.75	316.78	0.19
Reach 1	1505	500yr	7610.00	39.84	56.26	49.08	56.40	0.000294	4.10	3111.87	320.09	0.19
Reach 1	1505	bankfull	754.30	39.84	47.92	43.45	47.96	0.000175	1.73	641.87	251.20	0.13
Reach 1	1505	5th percentile	845.00	39.84	48.14	43.63	48.18	0.000183	1.81	698.00	253.72	0.13
Reach 1	1505	50th percentile	119.00	39.84	45.66	41.54	45.67	0.000032	0.56	241.22	96.32	0.05
Reach 1	1505	95th percentile	18.00	39.84	44.76	40.62	44.76	0.000002	0.12	159.74	81.95	0.01
Reach 1	1505	mean	228.00	39.84	46.21	42.05	46.22	0.000071	0.90	299.41	142.82	0.08
Reach 1	1395	1.1yr	1305.00	40.09	49.08	43.51	49.13	0.000149	1.84	723.27	113.71	0.12
Reach 1	1395	2yr	2290.00	40.09	50.66	44.46	50.76	0.000233	2.62	906.60	119.09	0.16
Reach 1	1395	5yr	3235.00	40.09	51.88	45.20	52.04	0.000297	3.21	1054.90	123.83	0.18
Reach 1	1395	10yr	3910.00	40.09	52.65	45.68	52.84	0.000336	3.58	1151.14	127.39	0.19
Reach 1	1395	25yr	4765.00	40.09	53.52	46.23	53.76	0.000380	4.00	1263.91	130.91	0.21
Reach 1	1395	50yr	5435.00	40.09	54.15	46.61	54.43	0.000411	4.31	1347.37	133.87	0.22
Reach 1	1395	100yr	6095.00	40.09	54.73	46.97	55.04	0.000440	4.60	1425.47	136.49	0.23
Reach 1	1395	200yr	6745.00	40.09	55.27	47.30	55.62	0.000466	4.86	1499.81	139.18	0.24
Reach 1	1395	500yr	7610.00	40.09	55.93	47.75	56.34	0.000500	5.19	1593.88	142.78	0.25
Reach 1	1395	bankfull	754.30	40.09	47.92	42.85	47.94	0.000091	1.29	593.07	109.19	0.09
Reach 1	1395	5th percentile	845.00	40.09	48.14	42.97	48.17	0.000101	1.39	617.24	110.16	0.10
Reach 1	1395	50th percentile	119.00	40.09	45.66	41.31	45.67	0.000011	0.33	358.65	98.13	0.03
Reach 1	1395	95th percentile	18.00	40.09	44.76	40.62	44.76	0.000001	0.07	272.26	92.19	0.01
Reach 1	1395	mean	228.00	40.09	46.21	41.74	46.21	0.000025	0.55	412.93	101.76	0.05
Reach 1	1390	1.1yr	1305.00	39.91	49.07	43.46	49.13	0.000278	1.94	680.44	105.59	0.13
Reach 1	1390	2yr	2290.00	39.91	50.64	44.44	50.76	0.000426	2.75	850.55	111.15	0.17
Reach 1	1390	5yr	3235.00	39.91	51.86	45.22	52.03	0.000536	3.37	987.77	115.06	0.19
Reach 1	1390	10yr	3910.00	39.91	52.62	45.72	52.83	0.000602	3.76	1076.18	117.20	0.20
Reach 1	1390	25yr	4765.00	39.91	53.48	46.31	53.75	0.000678	4.20	1178.93	120.12	0.22
Reach 1	1390	50yr	5435.00	39.91	54.11	46.72	54.42	0.000731	4.53	1254.69	122.51	0.23
Reach 1	1390	100yr	6095.00	39.91	54.68	47.12	55.03	0.000781	4.83	1325.41	124.63	0.24
Reach 1	1390	200yr	6745.00	39.91	55.21	47.47	55.61	0.000826	5.10	1392.46	126.75	0.25
Reach 1	1390	500yr	7610.00	39.91	55.87	47.93	56.32	0.000885	5.46	1476.88	129.22	0.26
Reach 1	1390	bankfull	754.30	39.91	47.91	42.77	47.94	0.000172	1.35	560.28	100.93	0.10
Reach 1	1390	5th percentile	845.00	39.91	48.13	42.90	48.16	0.000191	1.46	582.56	101.88	0.11
Reach 1	1390	50th percentile	119.00	39.91	45.66	41.23	45.67	0.000016	0.34	345.17	90.35	0.03
Reach 1	1390	95th percentile	18.00	39.91	44.76	40.46	44.76	0.000001	0.07	265.40	85.35	0.01
Reach 1	1390	mean	228.00	39.91	46.21	41.66	46.21	0.000044	0.58	395.09	93.42	0.05
Reach 1	1350	Bridge										
Reach 1	1326	1.1yr	1305.00	39.72	48.64	43.02	48.70	0.000204	1.97	670.20	103.99	0.13
Reach 1	1326	2yr	2290.00	39.72	50.19	44.06	50.32	0.000317	2.80	838.13	111.79	0.17
Reach 1	1326	5yr	3235.00	39.72	51.39	44.86	51.57	0.000402	3.44	974.15	115.73	0.20
Reach 1	1326	10yr	3910.00	39.72	52.14	45.37	52.36	0.000455	3.85	1061.36	118.00	0.21
Reach 1	1326	25yr	4765.00	39.72	52.98	45.95	53.27	0.000515	4.32	1162.68	120.53	0.23
Reach 1	1326	50yr	5435.00	39.72	53.60	46.36	53.93	0.000559	4.66	1237.05	122.69	0.24
Reach 1	1326	100yr	6095.00	39.72	54.16	46.73	54.53	0.000599	4.97	1306.32	124.74	0.25
Reach 1	1326	200yr	6745.00	39.72	54.68	47.09	55.10	0.000636	5.27	1371.87	126.55	0.26
Reach 1	1326	500yr	7610.00	39.72	55.32	47.54	55.80	0.000685	5.65	1454.05	128.86	0.27
Reach 1	1326	bankfull	754.30	39.72	47.49	42.26	47.52	0.000126	1.37	553.75	98.53	0.10
Reach 1	1326	5th percentile	845.00	39.72	47.71	42.39	47.74	0.000139	1.47	575.48	99.34	0.11
Reach 1	1326	50th percentile	119.00	39.72	45.24	40.75	45.25	0.000012	0.35	339.87	90.37	0.03
Reach 1	1326	95th percentile	18.00	39.72	44.32	40.10	44.32	0.000001	0.07	259.68	83.87	0.01
Reach 1	1326	mean	228.00	39.72	45.79	41.16	45.80	0.000034	0.58	390.18	93.71	0.05
Reach 1	1323	1.1yr	1305.00	39.83	48.64	43.01	48.70	0.000187	1.92	691.40	110.66	0.13
Reach 1	1323	2yr	2290.00	39.83	50.20	44.03	50.31	0.000288	2.72	869.86	118.53	0.16
Reach 1	1323	5yr	3235.00	39.83	51.39	44.82	51.56	0.000365	3.34	1014.72	123.48	0.19
Reach 1	1323	10yr	3910.00	39.83	52.14	45.32	52.35	0.000412	3.73	1108.03	126.09	0.20
Reach 1	1323	25yr	4765.00	39.83	52.99	45.90	53.26	0.000465	4.18	1216.56	128.83	0.22
Reach 1	1323	50yr	5435.00	39.83	53.61	46.29	53.91	0.000504	4.51	1296.31	131.10	0.23
Reach 1	1323	100yr	6095.00	39.83	54.17	46.66	54.52	0.000539	4.81	1370.53	133.22	0.24
Reach 1	1323	200yr	6745.00	39.83	54.69	47.01	55.08	0.000572	5.09	1440.80	135.42	0.25
Reach 1	1323	500yr	7610.00	39.83	55.34	47.46	55.78	0.000615	5.46	1529.26	138.51	0.26
Reach 1	1323	bankfull	754.30	39.83	47.49	42.27	47.52	0.000116	1.33	568.35	102.59	0.10

HEC-RAS Plan: Proposed_rev2 River: River 1 Reach: Reach 1 (Continued)

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Reach 1	1323	5th percentile	845.00	39.83	47.71	42.40	47.74	0.000128	1.44	591.08	104.22	0.10
Reach 1	1323	50th percentile	119.00	39.83	45.24	40.82	45.25	0.000011	0.34	347.14	92.98	0.03
Reach 1	1323	95th percentile	18.00	39.83	44.32	40.20	44.32	0.000001	0.07	264.63	86.30	0.01
Reach 1	1323	mean	228.00	39.83	45.79	41.20	45.80	0.000032	0.57	398.96	96.81	0.05
Reach 1	1242	1.1yr	1305.00	40.72	48.55		48.67	0.000385	2.80	489.53	362.05	0.20
Reach 1	1242	2yr	2290.00	40.72	50.04		50.27	0.000565	3.90	639.39	399.31	0.25
Reach 1	1242	5yr	3235.00	40.72	51.18		51.51	0.000680	4.69	771.67	423.58	0.28
Reach 1	1242	10yr	3910.00	40.72	51.90		52.29	0.000747	5.18	864.13	444.50	0.29
Reach 1	1242	25yr	4765.00	40.72	52.72		53.19	0.000807	5.69	975.69	462.01	0.31
Reach 1	1242	50yr	5435.00	40.72	53.31		53.84	0.000853	6.07	1062.12	483.56	0.32
Reach 1	1242	100yr	6095.00	40.72	53.87		54.44	0.000879	6.37	1149.65	497.77	0.33
Reach 1	1242	200yr	6745.00	40.72	54.38		55.00	0.000910	6.67	1235.79	512.31	0.34
Reach 1	1242	500yr	7610.00	40.72	55.04		55.70	0.000926	6.97	1350.99	525.78	0.34
Reach 1	1242	bankfull	754.30	40.72	47.44		47.50	0.000251	1.98	390.36	335.20	0.15
Reach 1	1242	5th percentile	845.00	40.72	47.65		47.72	0.000274	2.13	408.84	338.16	0.16
Reach 1	1242	50th percentile	119.00	40.72	45.24		45.24	0.000038	0.55	216.81	286.64	0.06
Reach 1	1242	95th percentile	18.00	40.72	44.32		44.32	0.000002	0.12	156.01	267.73	0.01
Reach 1	1242	mean	228.00	40.72	45.78		45.79	0.000085	0.89	256.05	305.75	0.08
Reach 1	1150	1.1yr	1305.00	40.26	48.54		48.64	0.000299	2.57	540.65	468.42	0.17
Reach 1	1150	2yr	2290.00	40.26	50.03		50.21	0.000436	3.53	700.59	478.28	0.22
Reach 1	1150	5yr	3235.00	40.26	51.18		51.43	0.000528	4.25	832.57	487.58	0.24
Reach 1	1150	10yr	3910.00	40.26	51.89		52.21	0.000583	4.68	919.49	494.59	0.26
Reach 1	1150	25yr	4765.00	40.26	52.72		53.10	0.000642	5.18	1023.76	503.10	0.28
Reach 1	1150	50yr	5435.00	40.26	53.31		53.74	0.000683	5.53	1101.94	509.42	0.29
Reach 1	1150	100yr	6095.00	40.26	53.86		54.34	0.000719	5.86	1177.78	522.46	0.30
Reach 1	1150	200yr	6745.00	40.26	54.38		54.90	0.000752	6.16	1253.38	538.29	0.31
Reach 1	1150	500yr	7610.00	40.26	55.02		55.60	0.000792	6.53	1354.28	554.67	0.32
Reach 1	1150	bankfull	754.30	40.26	47.43		47.48	0.000191	1.82	428.37	452.89	0.13
Reach 1	1150	5th percentile	845.00	40.26	47.64		47.70	0.000212	1.96	448.96	462.61	0.14
Reach 1	1150	50th percentile	119.00	40.26	45.24		45.24	0.000024	0.48	250.40	427.91	0.04
Reach 1	1150	95th percentile	18.00	40.26	44.32		44.32	0.000001	0.10	187.15	422.63	0.01
Reach 1	1150	mean	228.00	40.26	45.77		45.78	0.000056	0.79	288.53	437.37	0.07
Reach 1	1056	1.1yr	1305.00	39.57	48.49		48.61	0.000299	2.73	523.82	413.56	0.18
Reach 1	1056	2yr	2290.00	39.57	49.93		50.16	0.000491	3.94	663.29	429.18	0.24
Reach 1	1056	5yr	3235.00	39.57	51.02		51.37	0.000646	4.89	780.20	439.07	0.28
Reach 1	1056	10yr	3910.00	39.57	51.69		52.13	0.000746	5.49	856.53	444.48	0.30
Reach 1	1056	25yr	4765.00	39.57	52.45		53.01	0.000863	6.19	946.38	450.71	0.33
Reach 1	1056	50yr	5435.00	39.57	52.99		53.64	0.000949	6.70	1012.61	454.92	0.34
Reach 1	1056	100yr	6095.00	39.57	53.49		54.23	0.001030	7.17	1074.89	458.98	0.36
Reach 1	1056	200yr	6745.00	39.57	53.94		54.78	0.001107	7.62	1133.49	462.72	0.38
Reach 1	1056	500yr	7610.00	39.57	54.51		55.47	0.001206	8.19	1207.93	467.83	0.40
Reach 1	1056	bankfull	754.30	39.57	47.41		47.46	0.000175	1.87	430.27	403.05	0.13
Reach 1	1056	5th percentile	845.00	39.57	47.62		47.68	0.000195	2.02	447.74	404.71	0.14
Reach 1	1056	50th percentile	119.00	39.57	45.24		45.24	0.000019	0.46	261.22	387.21	0.04
Reach 1	1056	95th percentile	18.00	39.57	44.32		44.32	0.000001	0.09	198.25	379.88	0.01
Reach 1	1056	mean	228.00	39.57	45.77		45.78	0.000046	0.78	300.46	393.07	0.06
Reach 1	949	1.1yr	1305.00	43.34	48.23		48.52	0.001698	4.35	308.61	385.17	0.38
Reach 1	949	2yr	2290.00	43.34	49.56		50.04	0.001965	5.65	431.49	398.83	0.43
Reach 1	949	5yr	3235.00	43.34	50.57		51.23	0.002132	6.60	536.22	408.14	0.46
Reach 1	949	10yr	3910.00	43.34	51.20		51.97	0.002231	7.19	605.02	413.83	0.48
Reach 1	949	25yr	4765.00	43.34	51.92		52.83	0.002340	7.86	686.52	419.25	0.50
Reach 1	949	50yr	5435.00	43.34	52.44		53.45	0.002422	8.35	746.38	423.82	0.51
Reach 1	949	100yr	6095.00	43.34	52.91		54.03	0.002501	8.80	802.82	428.47	0.53
Reach 1	949	200yr	6745.00	43.34	53.34		54.57	0.002577	9.23	856.15	432.53	0.54
Reach 1	949	500yr	7610.00	43.34	53.87		55.24	0.002678	9.77	923.86	437.52	0.55
Reach 1	949	bankfull	754.30	43.34	47.23		47.41	0.001381	3.34	227.14	373.91	0.33
Reach 1	949	5th percentile	845.00	43.34	47.43		47.62	0.001424	3.52	242.31	375.48	0.34
Reach 1	949	50th percentile	119.00	43.34	45.20		45.23	0.000800	1.41	84.55	359.28	0.22
Reach 1	949	95th percentile	18.00	43.34	44.32		44.32	0.000578	0.63	28.53	349.21	0.16
Reach 1	949	mean	228.00	43.34	45.70		45.76	0.001000	1.92	118.46	362.27	0.26
Reach 1	854	1.1yr	1305.00	43.24	48.00		48.32	0.002845	4.53	289.83	338.58	0.42
Reach 1	854	2yr	2290.00	43.24	49.28		49.80	0.003142	5.81	405.04	354.52	0.46
Reach 1	854	5yr	3235.00	43.24	50.28		50.97	0.003311	6.74	504.56	367.17	0.49
Reach 1	854	10yr	3910.00	43.24	50.90		51.71	0.003404	7.31	571.92	375.34	0.50
Reach 1	854	25yr	4765.00	43.24	51.62		52.56	0.003506	7.94	653.11	382.93	0.52
Reach 1	854	50yr	5435.00	43.24	52.13		53.17	0.003576	8.39	714.27	388.81	0.53
Reach 1	854	100yr	6095.00	43.24	52.60		53.74	0.003640	8.80	772.90	394.76	0.54
Reach 1	854	200yr	6745.00	43.24	53.04		54.28	0.003702	9.19	829.76	401.98	0.55
Reach 1	854	500yr	7610.00	43.24	53.58		54.94	0.003781	9.67	903.58	410.34	0.56
Reach 1	854	bankfull	754.30	43.24	47.04		47.23	0.002454	3.54	212.83	328.41	0.38
Reach 1	854	5th percentile	845.00	43.24	47.22		47.44	0.002615	3.72	227.18	330.34	0.38
Reach 1	854	50th percentile	119.00	43.24	45.12		45.15	0.000860	1.49	79.72	303.91	0.23
Reach 1	854	95th percentile	18.00	43.24	44.30		44.30	0.000123	0.46	39.13	280.18	0.08
Reach 1	854	mean	228.00	43.24	45.59		45.65	0.001245	2.09	109.27	311.37	0.29
Reach 1	758	1.1yr	1305.00	43.47	47.44		47.96	0.004443	5.80	227.69	83.91	0.60

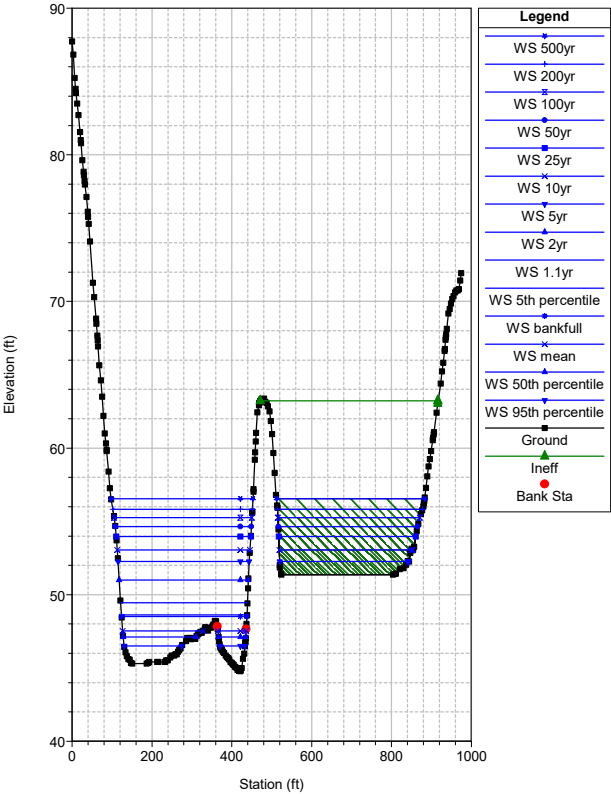
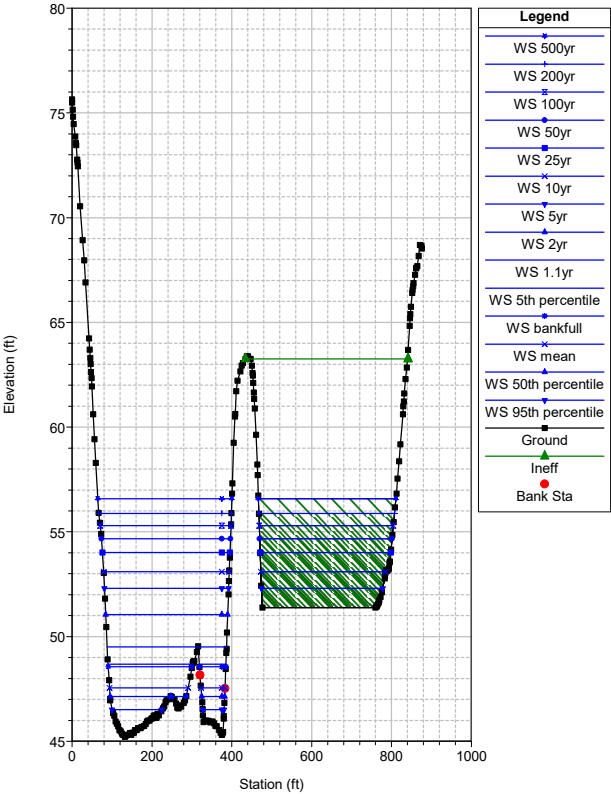
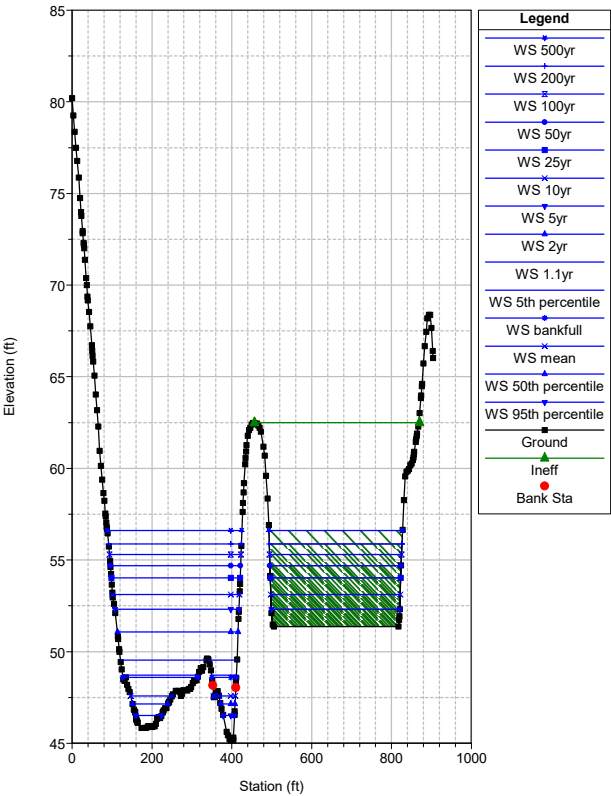
HEC-RAS Plan: Proposed_rev2 River: River 1 Reach: Reach 1 (Continued)

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Reach 1	758	2yr	2290.00	43.47	48.70		49.44	0.004014	6.98	344.59	101.43	0.60
Reach 1	758	5yr	3235.00	43.47	49.72		50.61	0.003700	7.75	451.81	108.72	0.60
Reach 1	758	10yr	3910.00	43.47	50.37		51.35	0.003555	8.20	523.27	113.27	0.60
Reach 1	758	25yr	4765.00	43.47	51.10		52.20	0.003433	8.72	608.79	118.84	0.60
Reach 1	758	50yr	5435.00	43.47	51.64		52.82	0.003354	9.08	673.58	122.87	0.60
Reach 1	758	100yr	6095.00	43.47	52.14		53.40	0.003274	9.39	736.54	126.68	0.60
Reach 1	758	200yr	6745.00	43.47	52.62		53.93	0.003197	9.66	797.64	129.58	0.60
Reach 1	758	500yr	7610.00	43.47	53.20		54.60	0.003146	10.03	873.32	133.02	0.60
Reach 1	758	bankfull	754.30	43.47	46.54		46.90	0.004700	4.82	156.77	74.86	0.58
Reach 1	758	5th percentile	845.00	43.47	46.71		47.09	0.004624	5.01	169.35	75.97	0.58
Reach 1	758	50th percentile	119.00	43.47	44.90		45.00	0.003662	2.42	49.27	53.93	0.45
Reach 1	758	95th percentile	18.00	43.47	44.26		44.27	0.001521	0.97	18.47	40.84	0.26
Reach 1	758	mean	228.00	43.47	45.27		45.43	0.004795	3.26	70.00	59.87	0.53
Reach 1	669	1.1yr	1305.00	43.26	47.31		47.59	0.002555	4.29	306.55	99.16	0.42
Reach 1	669	2yr	2290.00	43.26	48.65		49.07	0.002434	5.27	444.39	106.90	0.43
Reach 1	669	5yr	3235.00	43.26	49.70		50.25	0.002379	5.98	560.20	112.38	0.44
Reach 1	669	10yr	3910.00	43.26	50.36		50.99	0.002374	6.43	635.14	115.24	0.45
Reach 1	669	25yr	4765.00	43.26	51.11		51.84	0.002391	6.96	722.46	118.46	0.46
Reach 1	669	50yr	5435.00	43.26	51.65		52.46	0.002408	7.33	787.00	120.66	0.47
Reach 1	669	100yr	6095.00	43.26	52.15		53.04	0.002423	7.68	848.19	122.70	0.48
Reach 1	669	200yr	6745.00	43.26	52.62		53.58	0.002437	8.00	906.55	124.61	0.48
Reach 1	669	500yr	7610.00	43.26	53.19		54.25	0.002481	8.42	977.91	126.82	0.49
Reach 1	669	bankfull	754.30	43.26	46.35		46.54	0.002635	3.53	213.91	93.82	0.41
Reach 1	669	5th percentile	845.00	43.26	46.53		46.74	0.002632	3.67	230.66	94.80	0.41
Reach 1	669	50th percentile	119.00	43.26	44.46		44.55	0.006874	2.49	47.76	80.10	0.57
Reach 1	669	95th percentile	18.00	43.26	43.77	43.77	43.90	0.028689	2.91	6.18	24.00	1.01
Reach 1	669	mean	228.00	43.26	44.95		45.05	0.003541	2.59	88.20	84.72	0.45
Reach 1	538	1.1yr	1305.00	42.07	47.02		47.31	0.001824	4.36	303.99	88.74	0.40
Reach 1	538	2yr	2290.00	42.07	48.30		48.78	0.002035	5.60	422.87	97.05	0.44
Reach 1	538	5yr	3235.00	42.07	49.32		49.95	0.002121	6.46	525.00	103.10	0.46
Reach 1	538	10yr	3910.00	42.07	49.95		50.68	0.002180	7.00	591.12	106.36	0.48
Reach 1	538	25yr	4765.00	42.07	50.67		51.52	0.002242	7.60	668.88	109.72	0.49
Reach 1	538	50yr	5435.00	42.07	51.19		52.13	0.002287	8.03	726.31	112.01	0.50
Reach 1	538	100yr	6095.00	42.07	51.67		52.71	0.002326	8.42	780.91	114.11	0.51
Reach 1	538	200yr	6745.00	42.07	52.12		53.25	0.002358	8.78	833.08	116.07	0.52
Reach 1	538	500yr	7610.00	42.07	52.66		53.90	0.002431	9.27	895.87	118.49	0.53
Reach 1	538	bankfull	754.30	42.07	46.10		46.27	0.001576	3.36	225.20	82.21	0.35
Reach 1	538	5th percentile	845.00	42.07	46.27		46.46	0.001626	3.55	239.28	83.56	0.36
Reach 1	538	50th percentile	119.00	42.07	44.32		44.34	0.000603	1.29	92.18	66.71	0.19
Reach 1	538	95th percentile	18.00	42.07	43.62	42.56	43.62	0.000091	0.37	48.65	55.57	0.07
Reach 1	538	mean	228.00	42.07	44.77		44.83	0.000909	1.85	123.57	71.06	0.25
Reach 1	434	1.1yr	1305.00	43.28	45.76	45.76	46.82	0.014198	8.29	157.48	74.78	1.01
Reach 1	434	2yr	2290.00	43.28	46.74	46.74	48.24	0.012490	9.84	233.82	80.04	1.00
Reach 1	434	5yr	3235.00	43.28	47.52	47.52	49.39	0.011486	10.99	297.74	83.95	1.00
Reach 1	434	10yr	3910.00	43.28	48.10	48.10	50.12	0.010359	11.47	347.83	90.42	0.97
Reach 1	434	25yr	4765.00	43.28	48.72	48.72	50.96	0.009674	12.12	409.41	102.72	0.96
Reach 1	434	50yr	5435.00	43.28	49.17	49.17	51.57	0.009291	12.58	456.19	105.13	0.95
Reach 1	434	100yr	6095.00	43.28	49.58	49.58	52.13	0.009039	13.02	499.66	107.00	0.95
Reach 1	434	200yr	6745.00	43.28	49.96	49.96	52.66	0.008859	13.44	540.60	108.65	0.95
Reach 1	434	500yr	7610.00	43.28	50.85	50.41	53.38	0.007008	13.07	639.14	112.29	0.86
Reach 1	434	bankfull	754.30	43.28	45.07	45.07	45.83	0.015847	7.04	107.18	70.58	1.01
Reach 1	434	5th percentile	845.00	43.28	45.19	45.19	46.01	0.015472	7.27	116.18	71.50	1.01
Reach 1	434	50th percentile	119.00	43.28	43.89	43.89	44.14	0.022446	4.00	29.72	59.46	1.00
Reach 1	434	95th percentile	18.00	43.28	43.50	43.50	43.58	0.032663	2.25	7.98	50.11	1.00
Reach 1	434	mean	228.00	43.28	44.16	44.16	44.54	0.020085	4.90	46.50	63.11	1.01
Reach 1	314	1.1yr	1305.00	40.66	44.98	43.50	45.32	0.002901	4.68	279.97	85.95	0.45
Reach 1	314	2yr	2290.00	40.66	46.39	44.46	46.90	0.002782	5.77	410.26	99.66	0.46
Reach 1	314	5yr	3235.00	40.66	47.18	45.22	47.92	0.003294	6.95	491.04	104.32	0.52
Reach 1	314	10yr	3910.00	40.66	47.76	45.74	48.63	0.003409	7.56	553.17	107.28	0.54
Reach 1	314	25yr	4765.00	40.66	48.59	46.35	49.57	0.003269	8.05	644.35	117.97	0.54
Reach 1	314	50yr	5435.00	40.66	49.23	46.77	50.27	0.003132	8.35	724.87	136.86	0.53
Reach 1	314	100yr	6095.00	40.66	49.87	47.19	50.95	0.002936	8.53	827.44	168.60	0.52
Reach 1	314	200yr	6745.00	40.66	50.53	47.60	51.61	0.002708	8.61	940.34	177.56	0.51
Reach 1	314	500yr	7610.00	40.66	51.41		52.48	0.002411	8.66	1105.45	194.11	0.49
Reach 1	314	bankfull	754.30	40.66	43.87	42.81	44.12	0.002970	3.99	188.93	79.55	0.46
Reach 1	314	5th percentile	845.00	40.66	44.09	42.94	44.35	0.002951	4.09	206.50	80.65	0.45
Reach 1	314	50th percentile	119.00	40.66	41.91	41.66	42.02	0.006357	2.63	45.21	65.73	0.56
Reach 1	314	95th percentile	18.00	40.66	41.23	41.13	41.29	0.010494	1.89	9.54	33.27	0.62
Reach 1	314	mean	228.00	40.66	42.34	41.93	42.49	0.004737	3.06	74.59	69.38	0.52
Reach 1	172	1.1yr	1305.00	39.06	44.22		44.47	0.016907	3.98	329.74	89.89	0.35
Reach 1	172	2yr	2290.00	39.06	45.66		46.04	0.018234	5.03	468.57	102.58	0.38
Reach 1	172	5yr	3235.00	39.06	46.27		46.87	0.024796	6.30	532.61	106.87	0.46
Reach 1	172	10yr	3910.00	39.06	46.83		47.54	0.026269	6.89	593.56	110.94	0.48
Reach 1	172	25yr	4765.00	39.06	47.74		48.52	0.024341	7.24	697.93	119.17	0.47
Reach 1	172	50yr	5435.00	39.06	48.45		49.26	0.022520	7.41	785.92	126.72	0.46
Reach 1	172	100yr	6095.00	39.06	49.18		50.00	0.020478	7.48	881.08	135.25	0.44

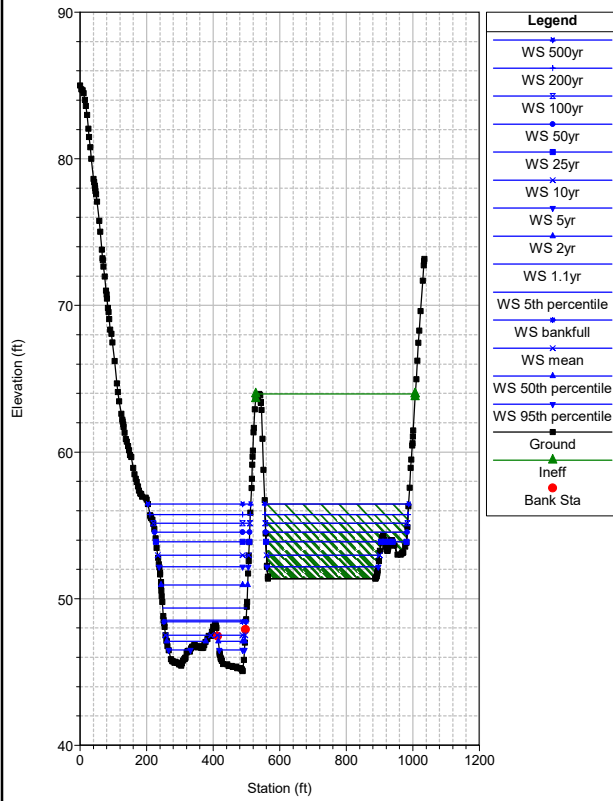
HEC-RAS Plan: Proposed_rev2 River: River 1 Reach: Reach 1 (Continued)

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Reach 1	172	200yr	6745.00	39.06	49.92		50.73	0.018408	7.49	983.66	142.01	0.43
Reach 1	172	500yr	7610.00	39.06	50.90		51.69	0.015967	7.44	1127.43	149.58	0.40
Reach 1	172	bankfull	754.30	39.06	43.12		43.28	0.015184	3.17	237.91	78.52	0.32
Reach 1	172	5th percentile	845.00	39.06	43.34		43.51	0.015593	3.31	254.94	80.25	0.33
Reach 1	172	50th percentile	119.00	39.06	40.78		40.82	0.011141	1.55	76.91	59.48	0.24
Reach 1	172	95th percentile	18.00	39.06	39.80		39.81	0.010063	0.77	23.49	48.44	0.19
Reach 1	172	mean	228.00	39.06	41.40		41.46	0.011925	1.99	114.75	64.03	0.26
Reach 1	68	1.1yr	1305.00	36.50	40.08	40.08	41.18	0.073304	8.40	155.33	70.86	1.00
Reach 1	68	2yr	2290.00	36.50	41.13	41.11	42.63	0.069849	9.81	233.55	77.88	1.00
Reach 1	68	5yr	3235.00	36.50	43.04	41.92	44.12	0.027633	8.35	389.85	85.45	0.67
Reach 1	68	10yr	3910.00	36.50	44.41	42.43	45.35	0.017250	7.80	510.04	90.65	0.56
Reach 1	68	25yr	4765.00	36.50	45.92	43.04	46.79	0.012082	7.56	651.07	96.36	0.48
Reach 1	68	50yr	5435.00	36.50	46.80	43.49	47.70	0.010771	7.68	737.83	99.99	0.46
Reach 1	68	100yr	6095.00	36.50	47.67	43.88	48.59	0.009658	7.76	826.70	104.00	0.45
Reach 1	68	200yr	6745.00	36.50	48.53	44.28	49.45	0.008719	7.82	918.69	109.89	0.43
Reach 1	68	500yr	7610.00	36.50	49.65	44.82	50.57	0.007697	7.87	1044.74	116.13	0.41
Reach 1	68	bankfull	754.30	36.50	39.31	39.31	40.14	0.082238	7.30	103.28	63.97	1.01
Reach 1	68	5th percentile	845.00	36.50	39.45	39.45	40.33	0.080287	7.53	112.26	65.24	1.01
Reach 1	68	50th percentile	119.00	36.50	37.79	37.79	38.15	0.106326	4.80	24.81	35.08	1.01
Reach 1	68	95th percentile	18.00	36.50	37.04	37.04	37.21	0.138886	3.27	5.50	16.85	1.01
Reach 1	68	mean	228.00	36.50	38.19	38.19	38.69	0.099970	5.67	40.18	42.15	1.02

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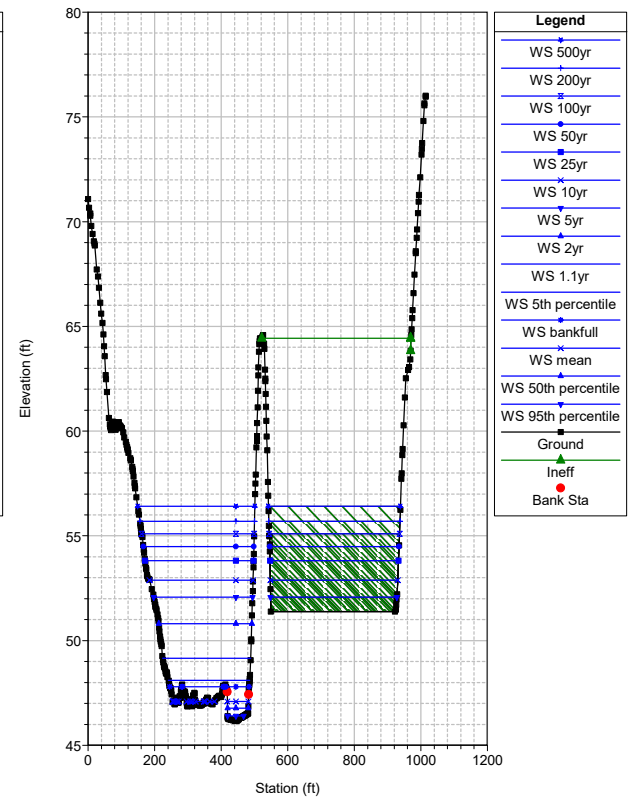


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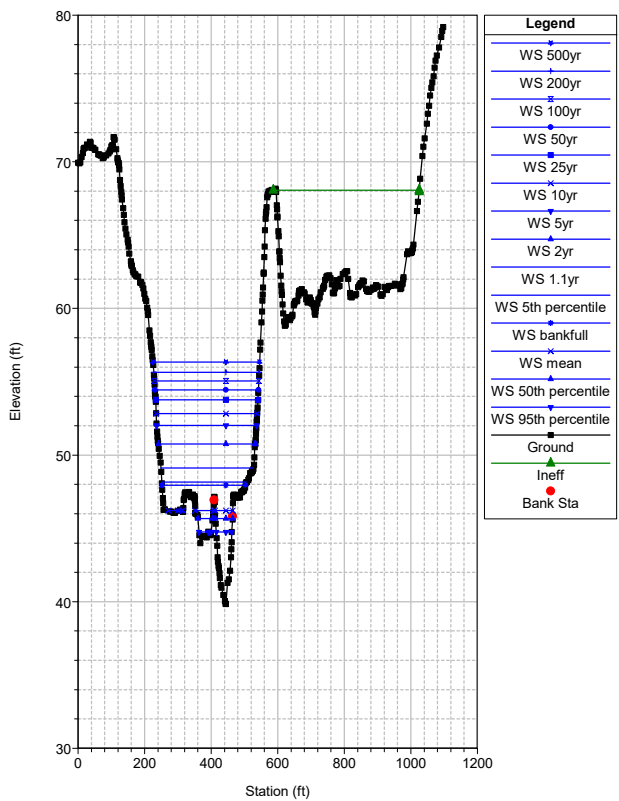
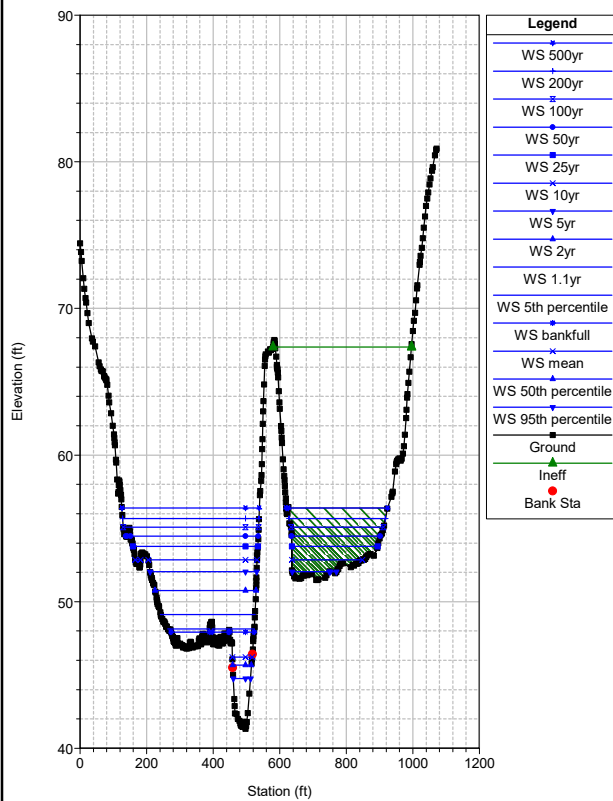


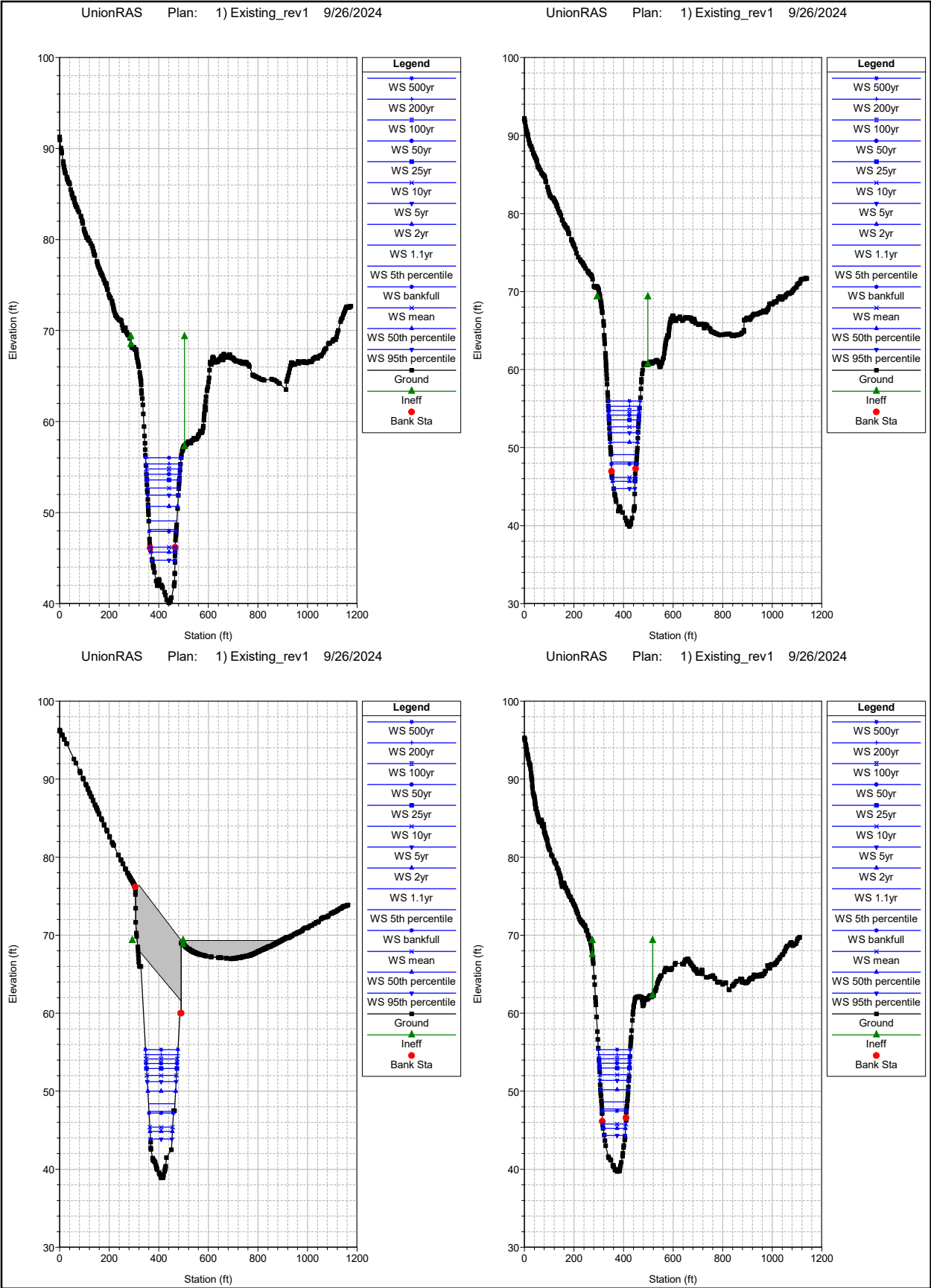
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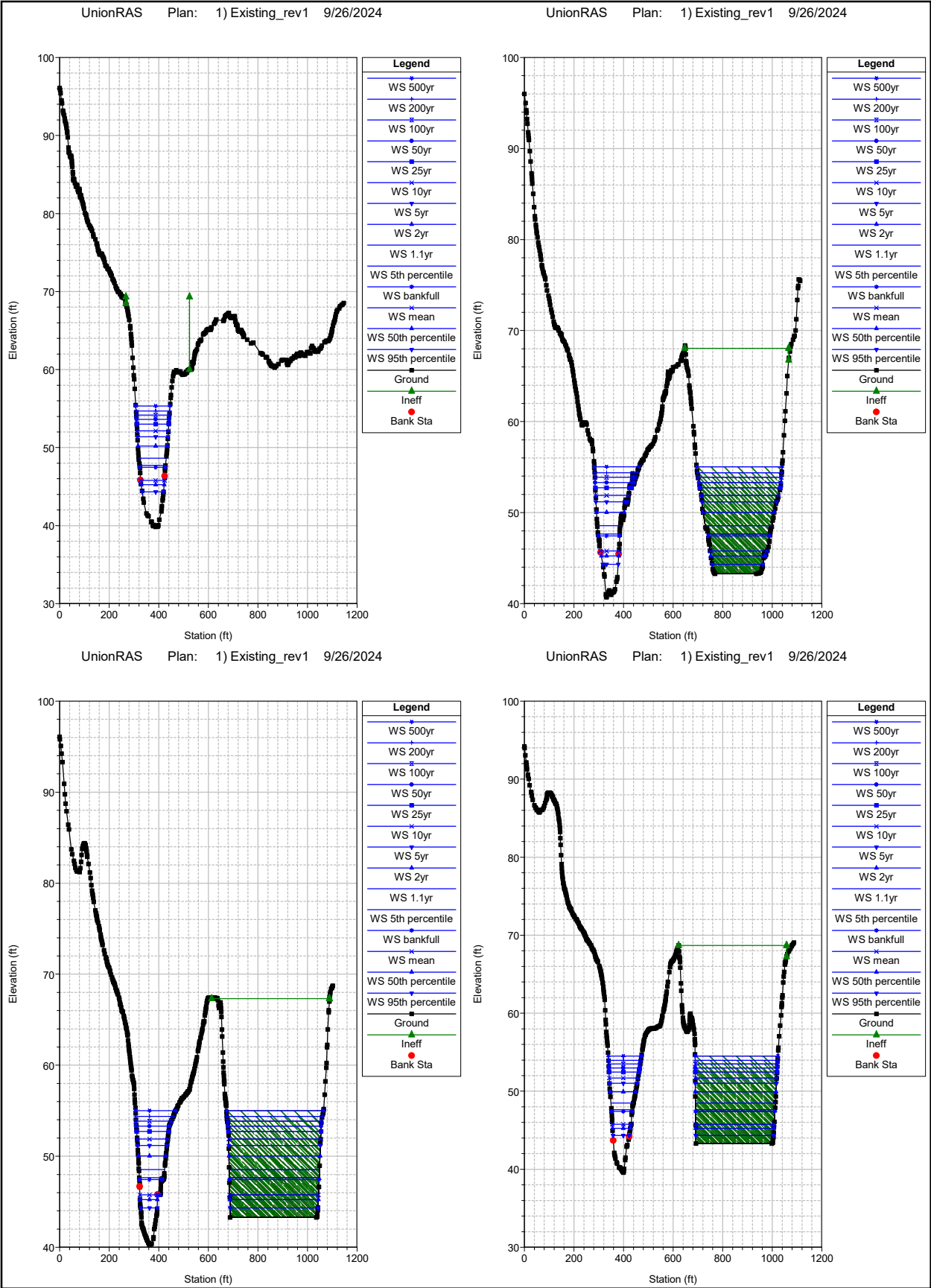
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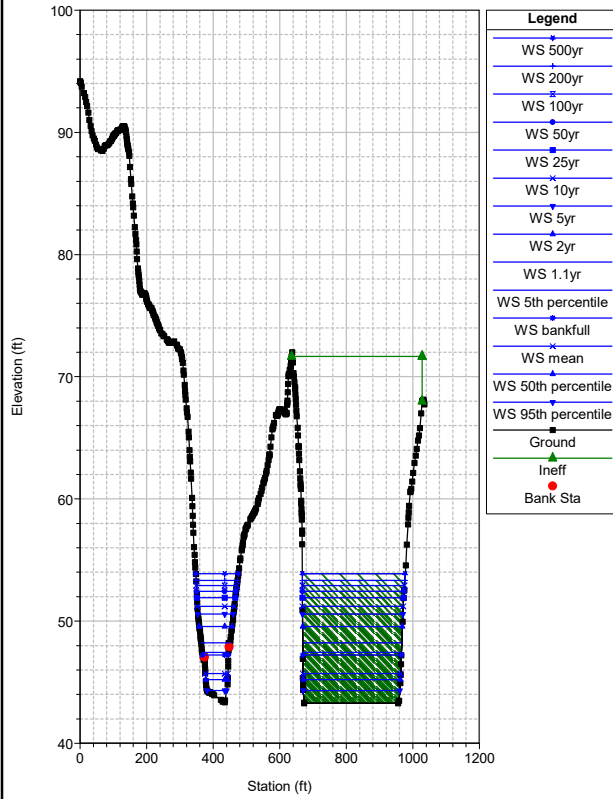
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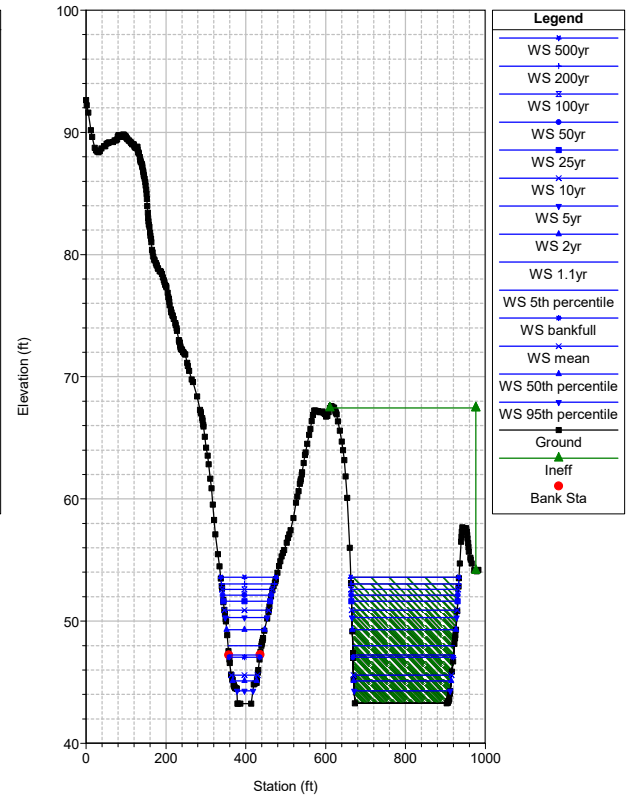


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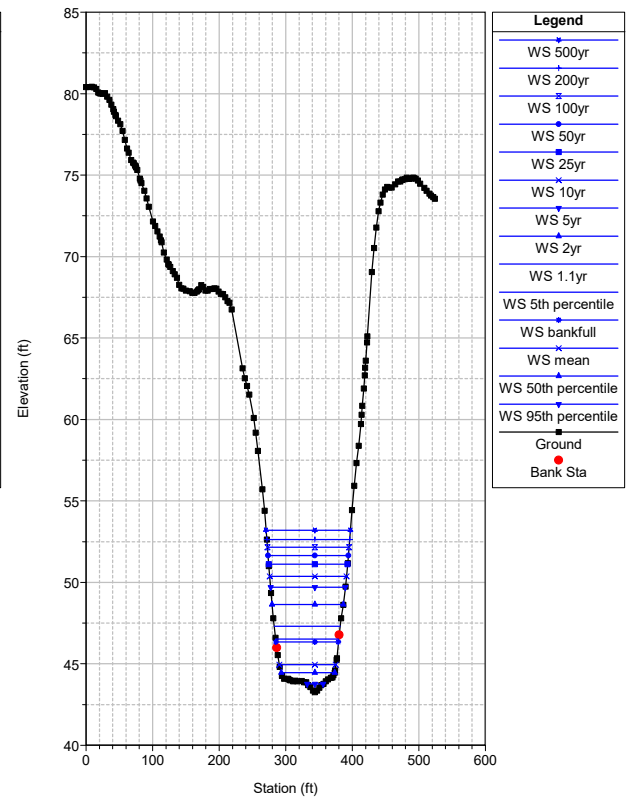
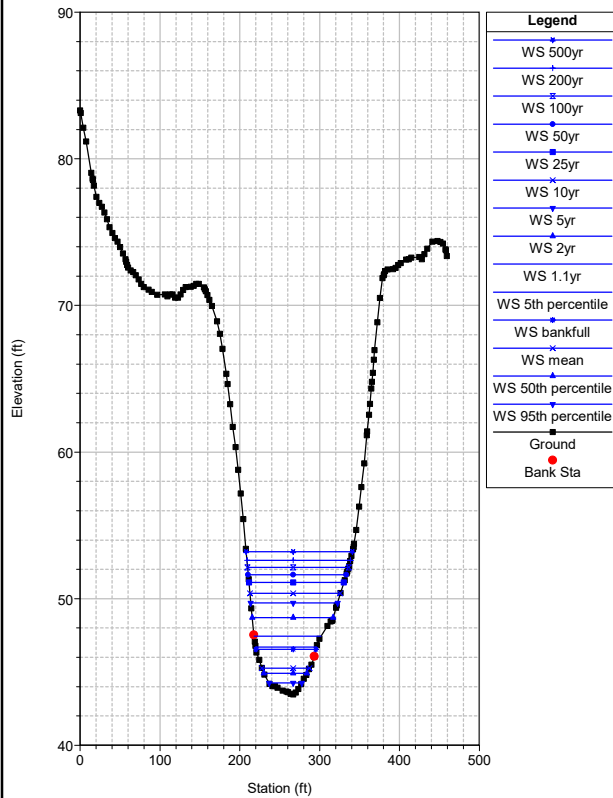


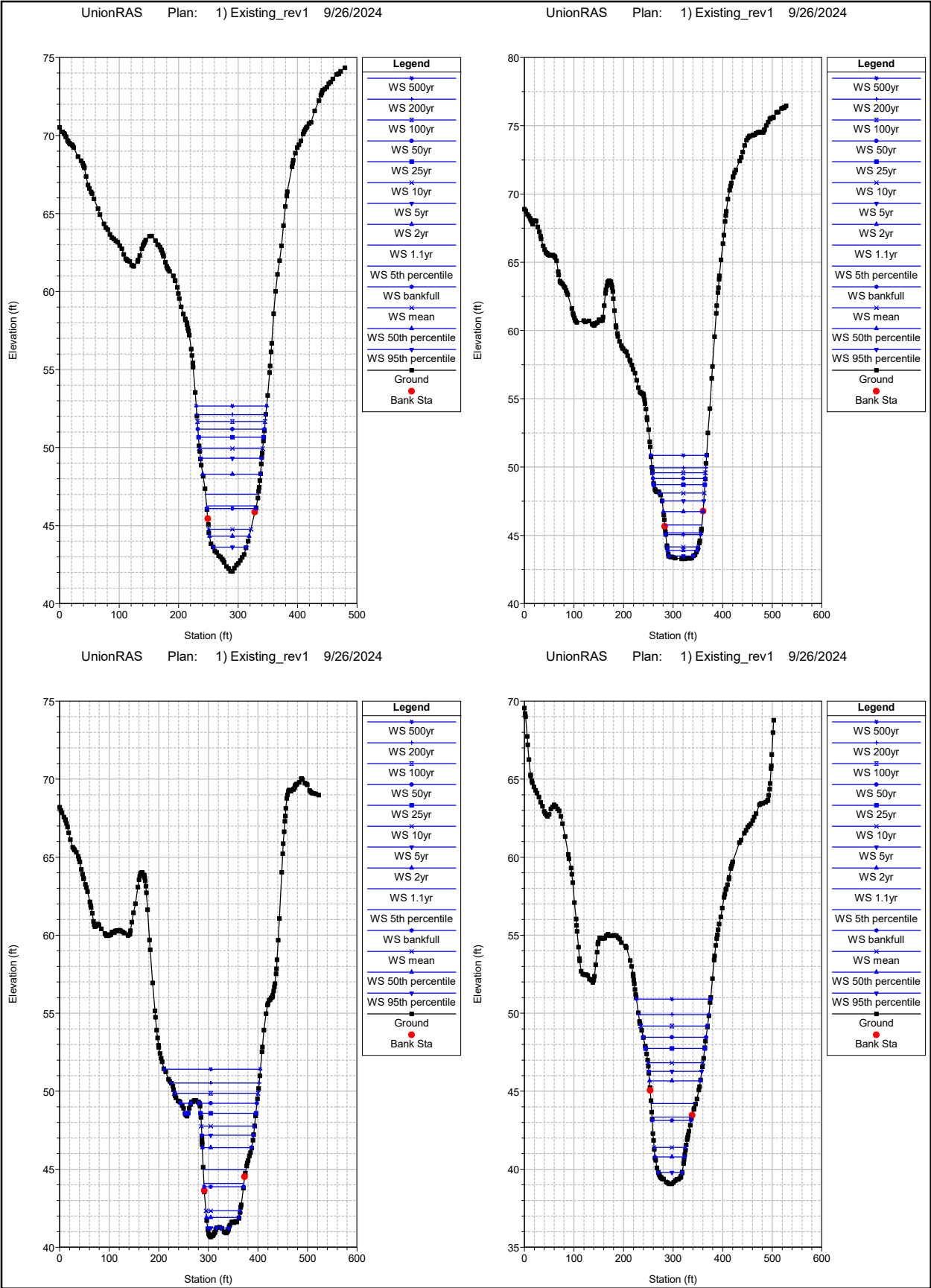
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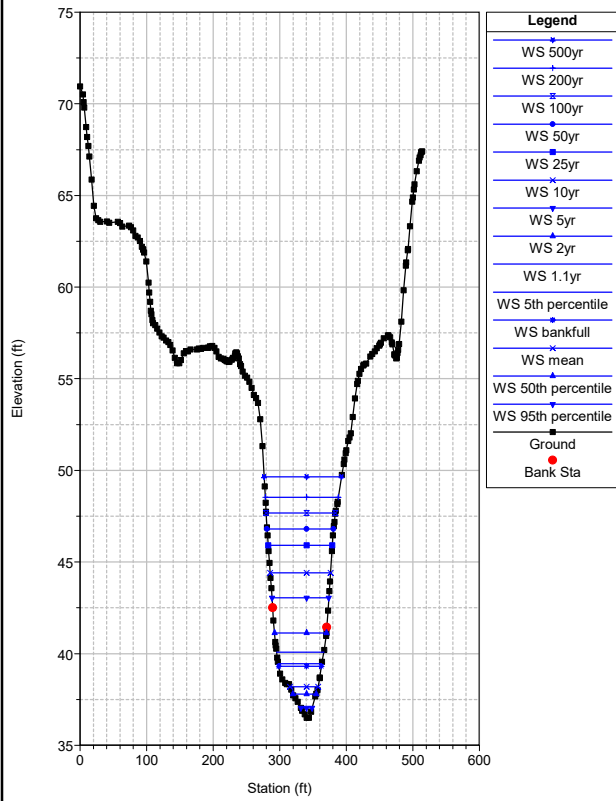
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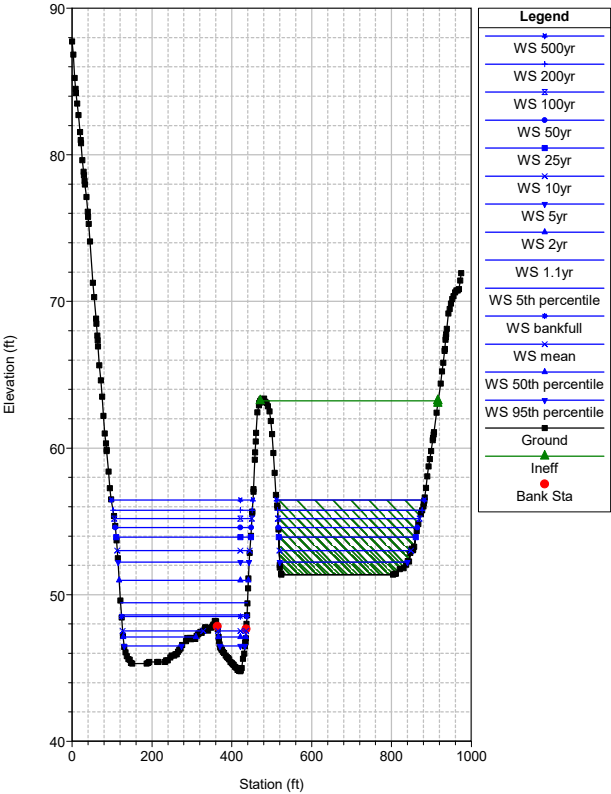
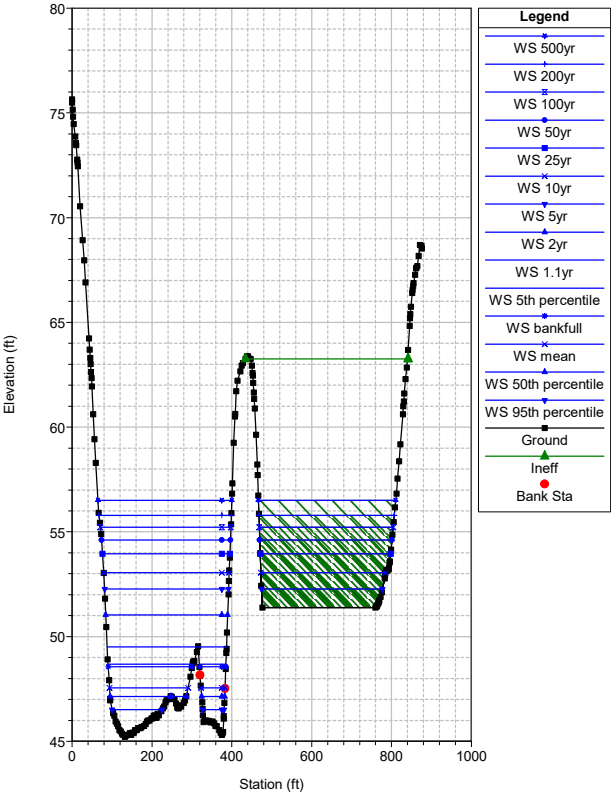
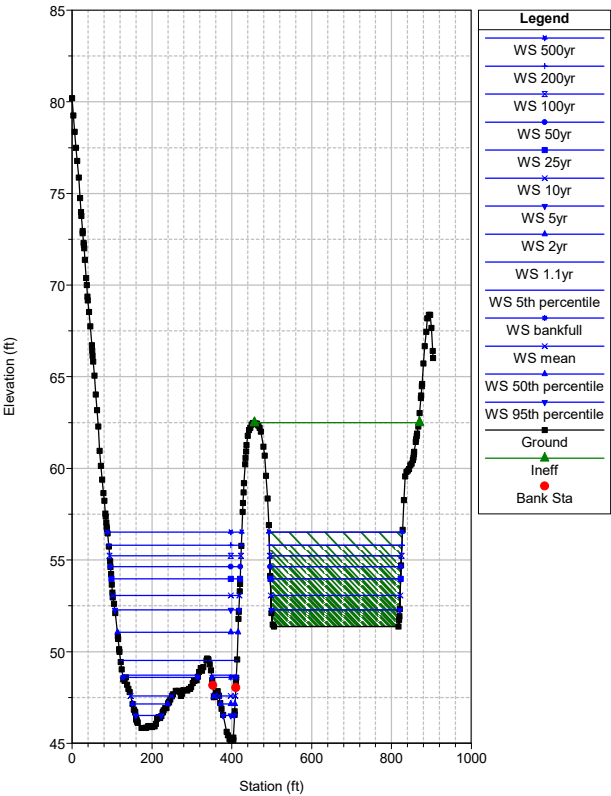
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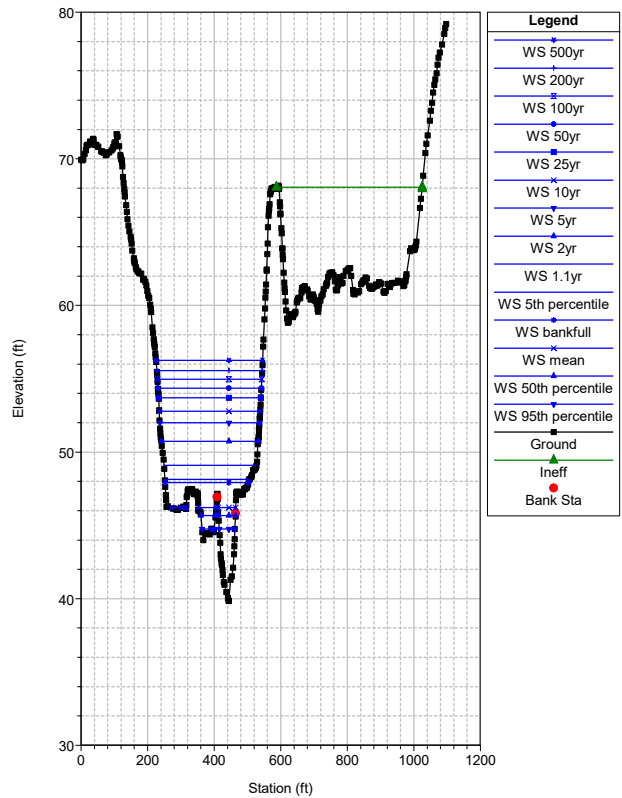
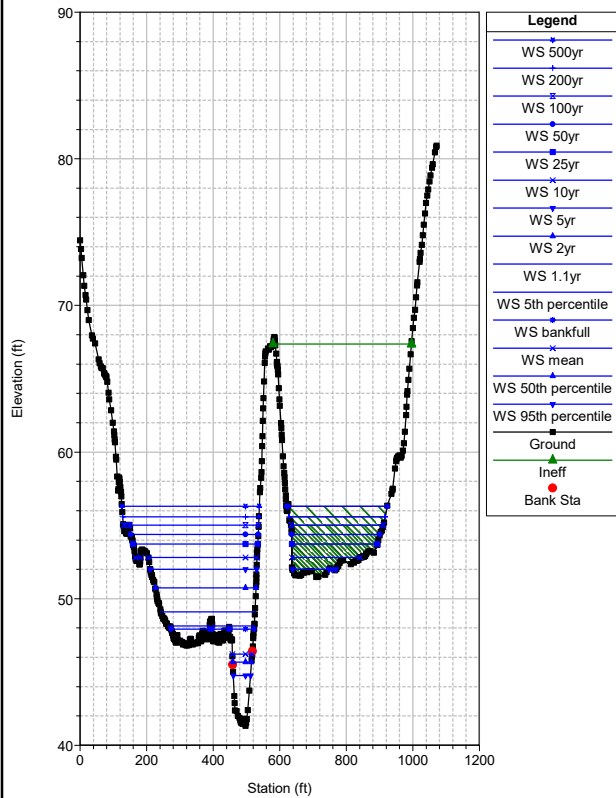
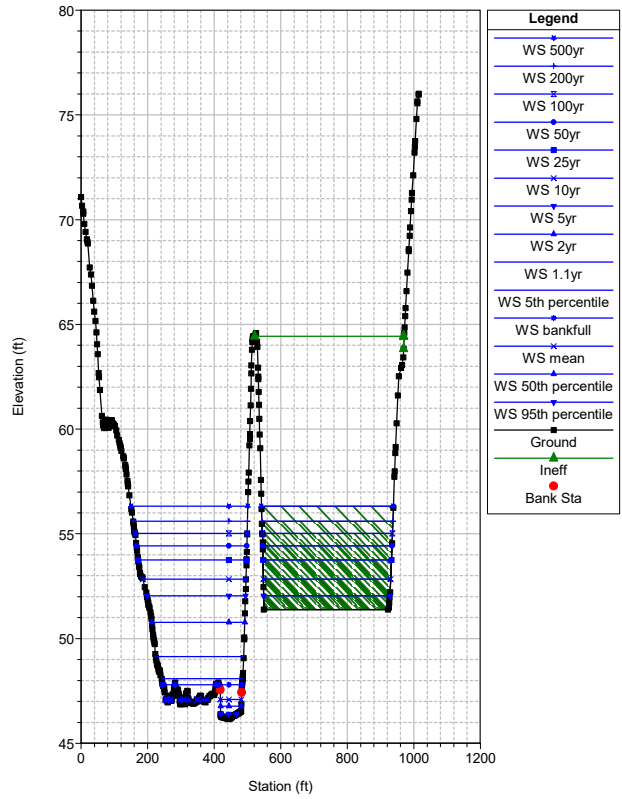
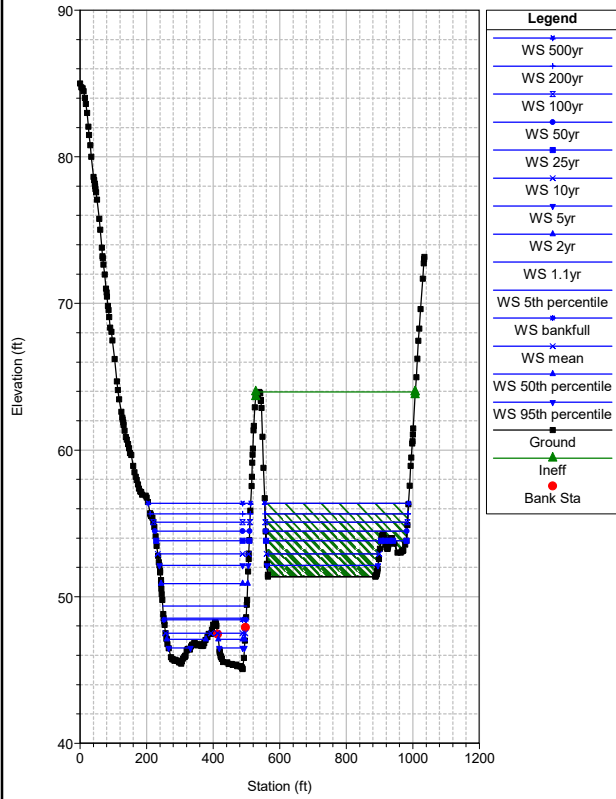


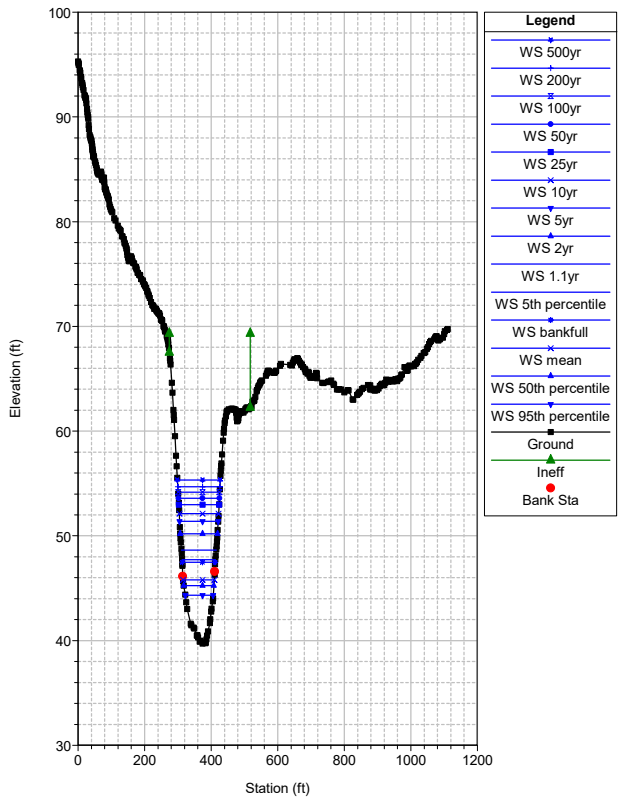
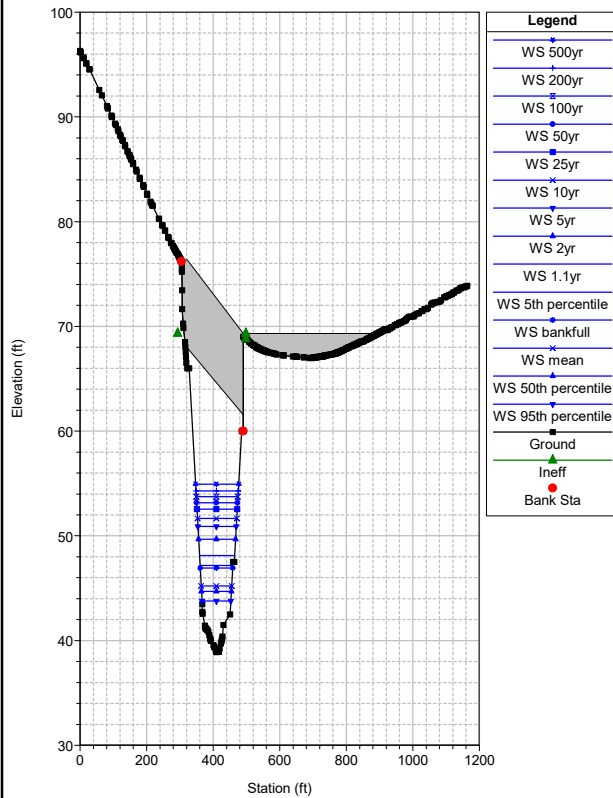
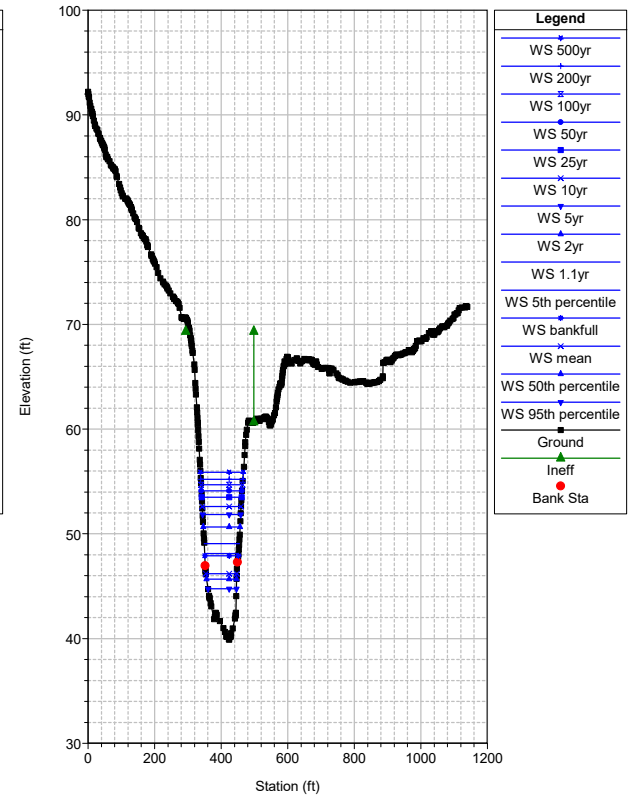
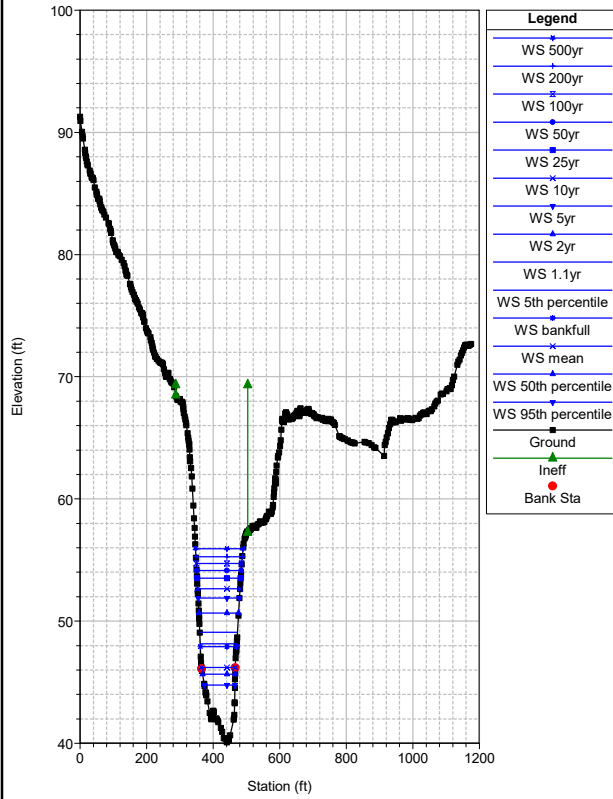


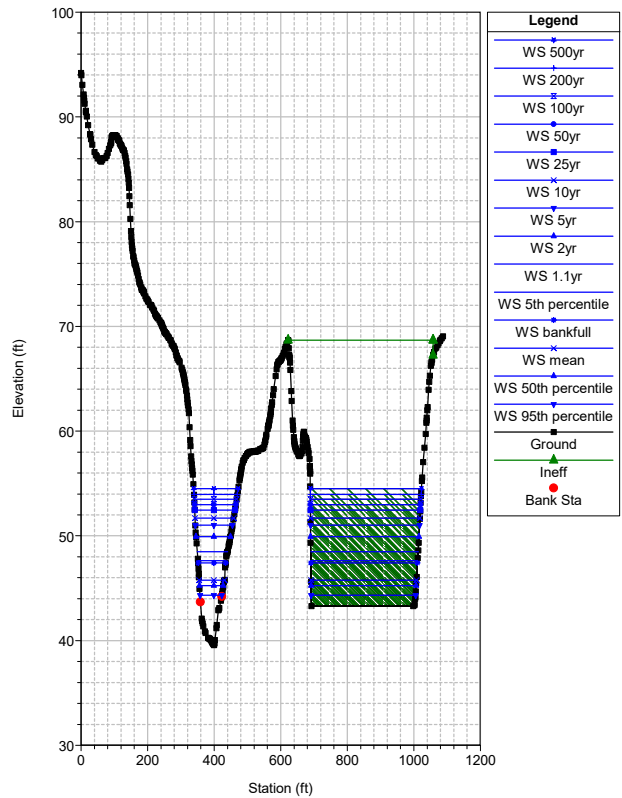
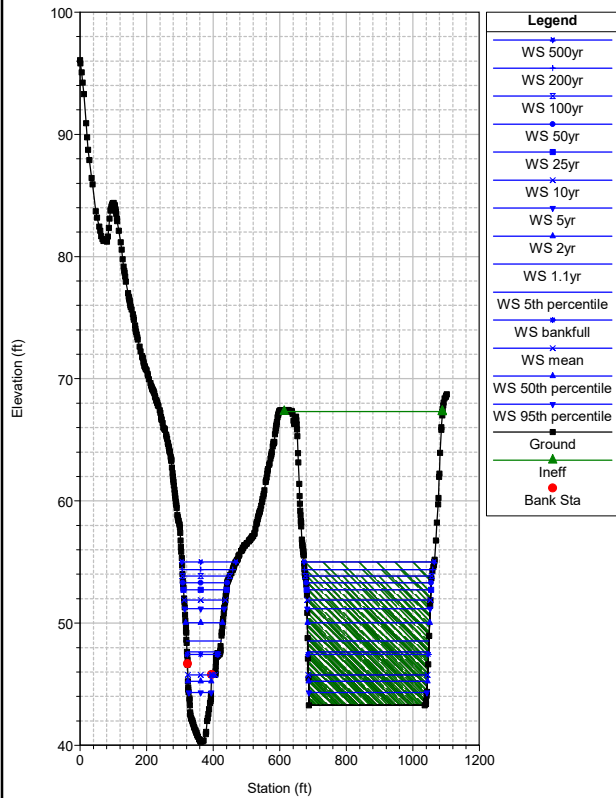
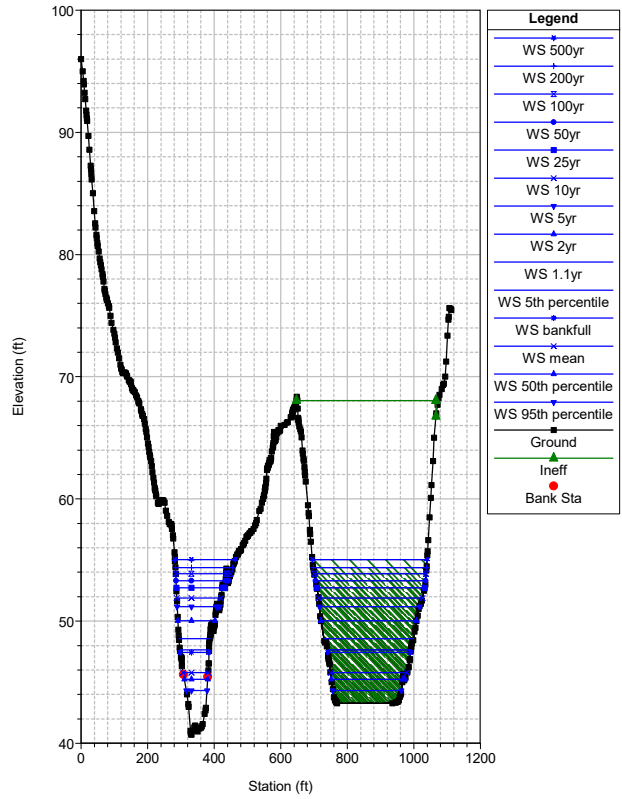
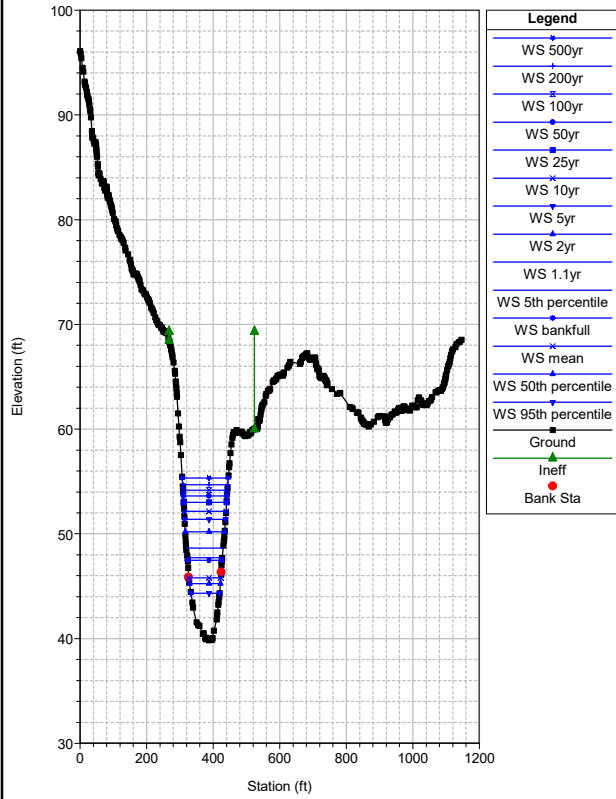


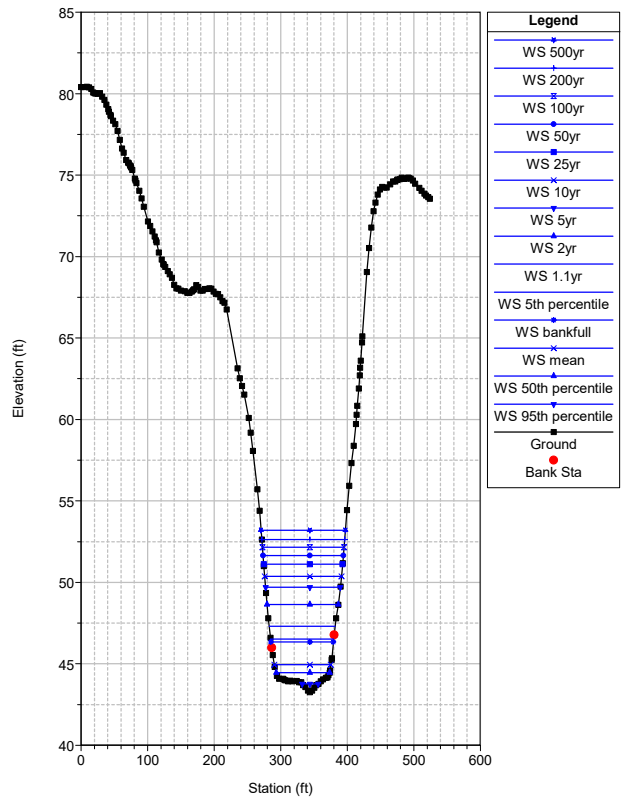
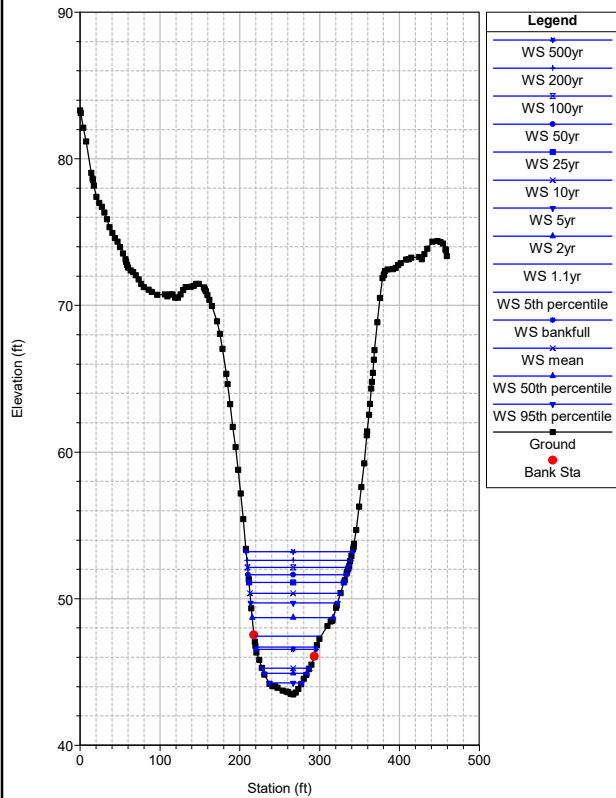
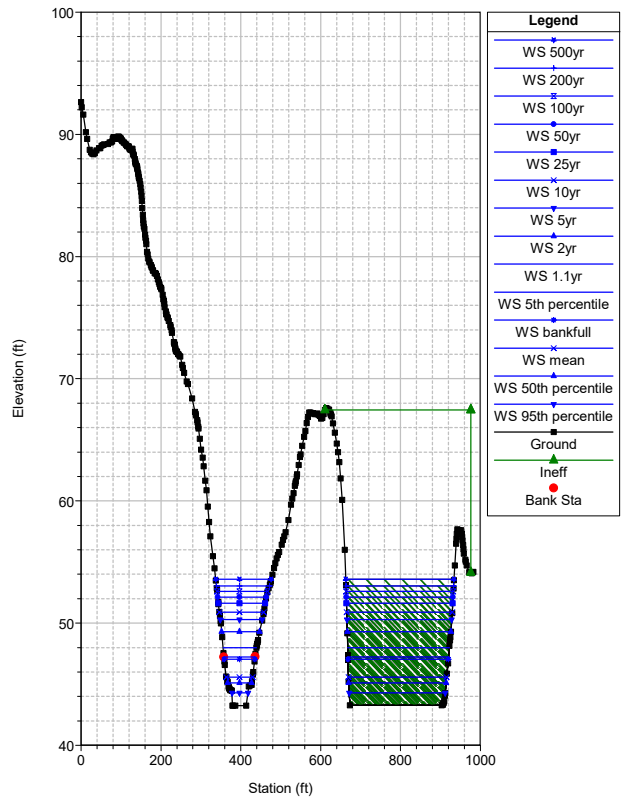
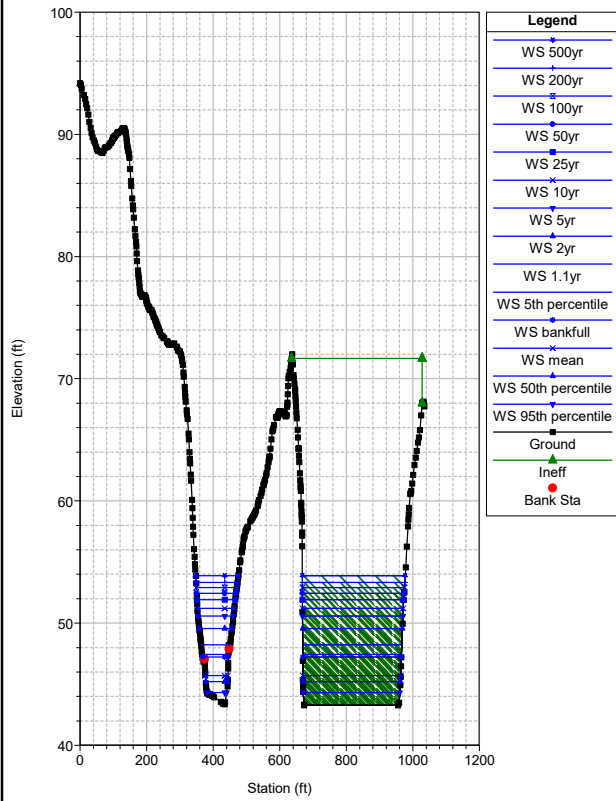
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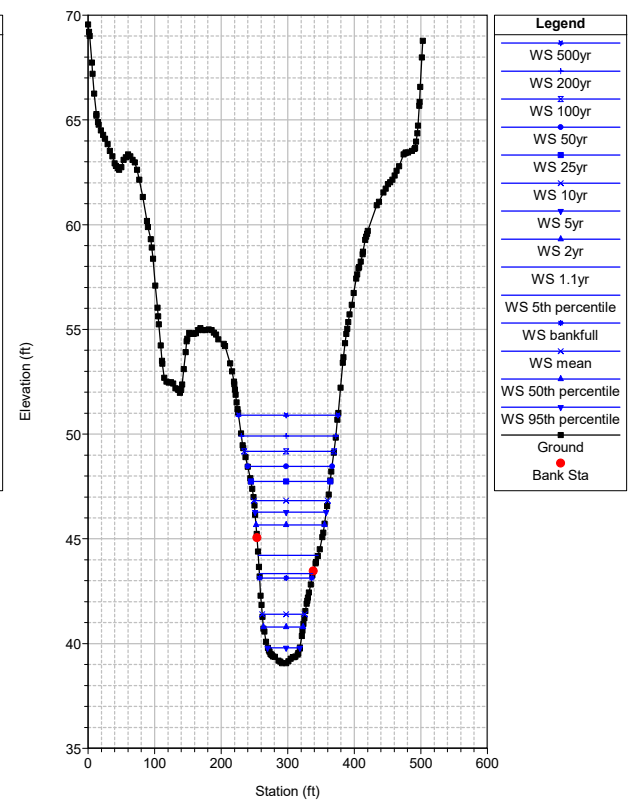
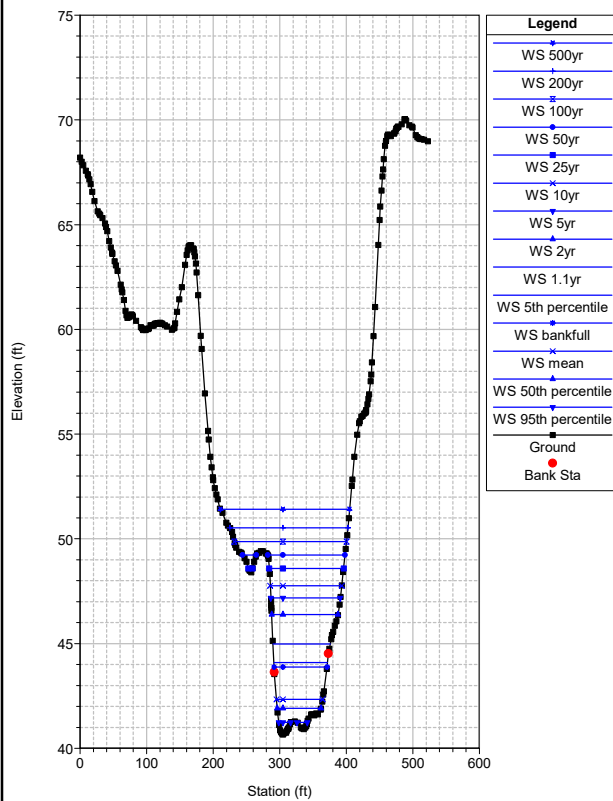
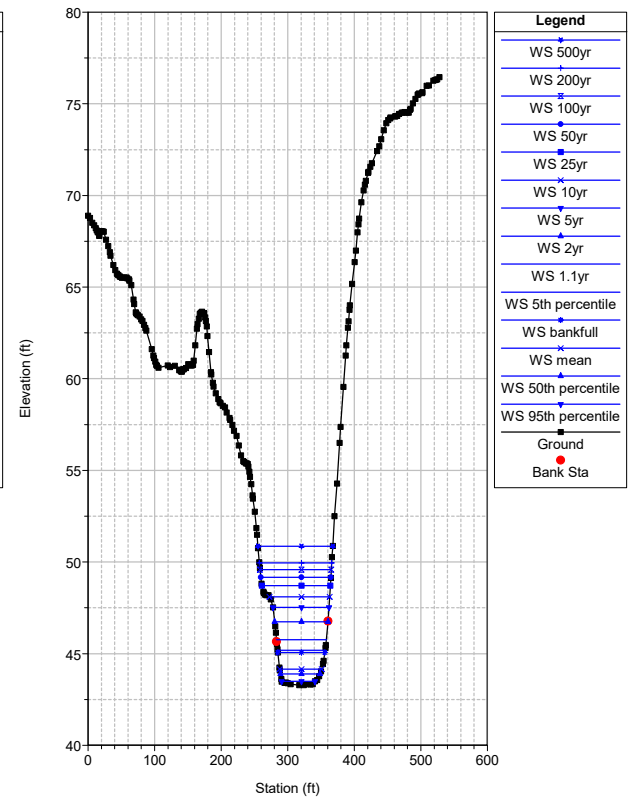
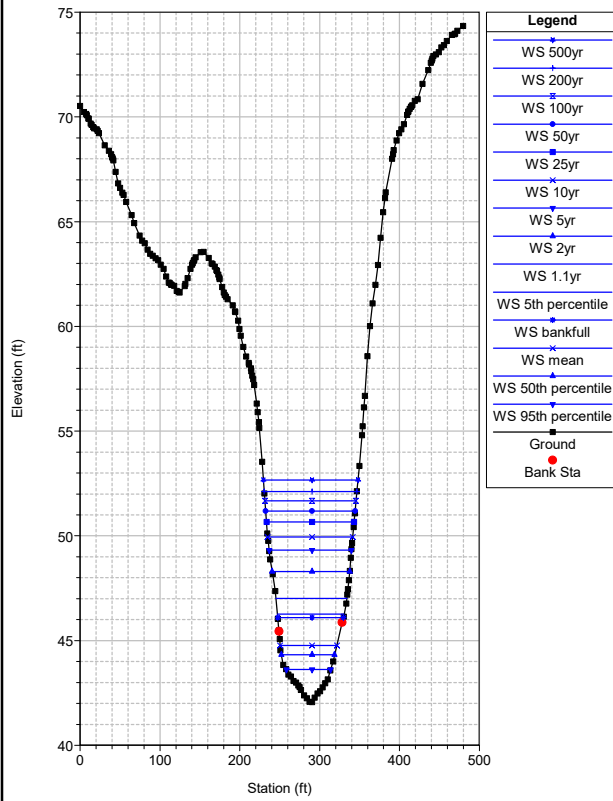


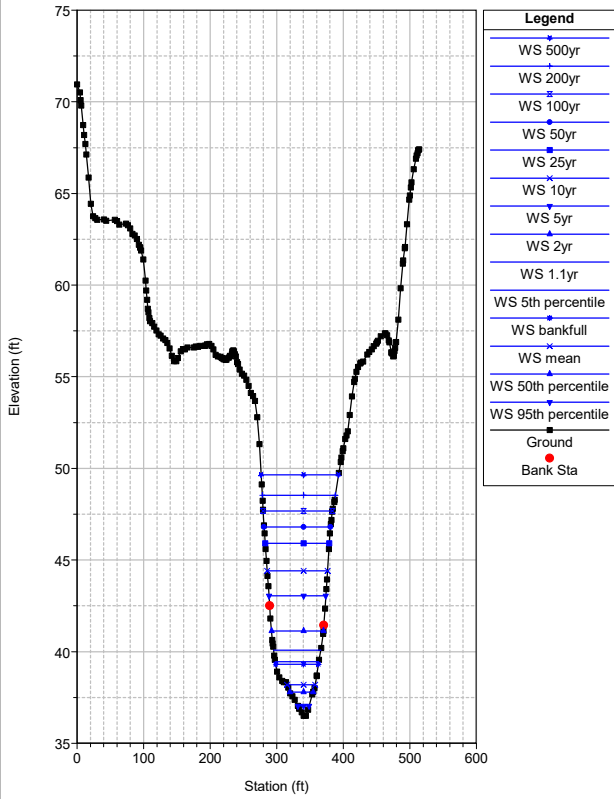












Appendix C Scour Analysis Calculations



SCOUR ANALYSIS - NCHRP 24-20 Abutment Approach

Live-Bed Scour Equation - HEC-18 Eqns 8.3, 8.4, 8.5, and 8.6

Bridge/Culvert Name: St. George Bridge
 Town Union, ME
 Lat: 44° 13' 0.66" N
 Long: 69° 16' 41.38" W

Storm Size: 100-Year
 HEC-RAS Proj: UnionRAS
 HEC-RAS Geom: Proposed_rev2
 HEC-RAS Xsection: 1350

Notes

- (1) left bank and right bank defined from looking downstream
- (2) cross section for critical velocity is located ~ 1 bridge length upstream
- (3) bridge is located at Sta. 1350 ft

$$y_{\max} = \alpha_A y_c \text{ or } y_{\max} = \alpha_B y_c$$

$$y_s = y_{\max} - y_0$$

live bed eqn

$$y_c = y_1 \left(\frac{q_{2c}}{q_1} \right)^{5/7}$$

Input:

	LOB	CHANNEL	ROB
Width Bridge section (ft)			129
Upstream Width (ft)			136.5
Discharge Bridge Section (cfs)			6095
Upstream Discharge (cfs)			6095
y1			12.61
q1 Upstream Unit Discharge (ft ² /s/ft)			44.65
q2c			47.25

q2c/q1			1.06
alpha a			1.5
y0			14.8

Output:

yc			13.24
y _{max}			19.85
ys			5.05

SCOUR ANALYSIS - NCHRP 24-20 Abutment Approach

Live-Bed Scour Equation - HEC-18 Eqns 8.3, 8.4, 8.5, and 8.6

Bridge/Culvert Name: St. George Bridge
 Town Union, ME
 Lat: 44° 13' 0.66" N
 Long: 69° 16' 41.38" W

Storm Size: 500-Year
 HEC-RAS Proj: UnionRAS
 HEC-RAS Geom: Proposed_rev2
 HEC-RAS Xsection: 1350

Notes

- (1) left bank and right bank defined from looking downstream
- (2) cross section for critical velocity is located ~ 1 bridge length upstream
- (3) bridge is located at Sta. 1350 ft

$$y_{\max} = \alpha_A y_c \text{ or } y_{\max} = \alpha_B y_c$$

$$y_s = y_{\max} - y_0$$

live bed eqn

$$y_c = y_1 \left(\frac{q_{2c}}{q_1} \right)^{5/7}$$

Input:

	LOB	CHANNEL	ROB
Width Bridge section (ft)		130	
Upstream Width (ft)		142.79	
Discharge Bridge Section (cfs)		7610	
Upstream Discharge (cfs)		7610	
y1		13.82	
q1 Upstream Unit Discharge (ft ² /s/ft)		53.30	
q2c		58.54	
D50		0.0076	
q2c/q1		1.10	
alpha a		1.6	
y0		13.71	
yc		14.98	
y _{max}		23.96	
ys		10.25	

Output:

Appendix D Stable Material Sizing Calculations



Revetment Riprap - HEC-23 Approach

Equation - HEC-23 Eqns 4.1, 4.2

Bridge/Culvert Name: St. George Bridge
Town Union, ME
Lat: 44° 13' 0.66" N
Long: 69° 16' 41.38" W

Storm Size: 100-Year
HEC-RAS Proj: UnionRAS
HEC-RAS Geom: Proposed_rev2
HEC-RAS Xsection: 1350

Notes

- (1) left bank and right bank defined from looking downstream
- (2) cross section for critical velocity is located immediate downstream of bridge face
- (3) bridge is located at Sta. 1350 ft

Input:

y (ft)	14.44
Sf	1.1
Cs	0.3
Cv	1
Ct	1
Vavg (ft/s)	5.0
Theta	18.4
K1	0.98
Rc (ft)	0
W (ft)	129
Sg	2.65
g (ft/s ²)	32.2
V des (ft/s)	5.0
D30 (feet)	0.07
D50 (feet)	0.08
D50 (inches)	0.96

Revetment Riprap - HEC-23 Approach

Equation - HEC-23 Eqns 4.1, 4.2

Bridge/Culvert Name: St. George Bridge
Town Union, ME
Lat: 44° 13' 0.66" N
Long: 69° 16' 41.38" W

Storm Size: 500-Year
HEC-RAS Proj: UnionRAS
HEC-RAS Geom: Proposed_rev2
HEC-RAS Xsection: 1350

Notes

- (1) left bank and right bank defined from looking downstream
- (2) cross section for critical velocity is located immediate downstream of bridge face
- (3) bridge is located at Sta. 1350 ft

Input:

y (ft)	15.6
Sf	1.1
Cs	0.3
Cv	1
Ct	1
Vavg (ft/s)	5.7
Theta	18.4
K1	0.98
Rc (ft)	0
W (ft)	130
Sg	2.65
g (ft/s ²)	32.2
V des (ft/s)	5.7
D30 (feet)	0.09
D50 (feet)	0.11
D50 (inches)	1.30