HYDROLOGY REPORT

Twin Bridge (#5315) over the West Branch Souadabscook Stream carries State Route 69 (Carmel Road) in Hampden, Maine.

The drainage basin characteristics for this bridge were provided by the MaineDOT Environmental Group, Hydrology Section. Peak flows were calculated with techniques described in the United States Geological Survey (USGS) Water-Resources Investigations Report 99-4008 (Hodgkins, 1999 & Lombard/Hodgkins, 2015). These are shown in the table below. The bridge location is not in a tidal zone.

The watershed area for this project is 16.20 square miles with 1.56 square miles of wetlands. The watershed is located primarily to the south and west of the bridge location. The West Branch Souadabscook Stream flows east under Route 69, and proceeds in a northeasterly direction into Hammond Pond, which outlets into the Souadabscook Stream, and flows east into the Penobscot River.

Peak flows are shown in the table below.

Return Period (yr.)	Flow (ft^3/s)
1.1	247
2	501
5	781
10	989
25	1268
50	1488
100	1724
500	2308

The hydrology report indicates an estimated bankfull width (BFW) of 32.6 feet, and the proposed clear span is required to be at least 1.2*BFW.

The FEMA Flood Insurance Study (FIS) for the Town of Hampden, Maine was published September 4, 1987. The study indicates that most flooding occurs "in the winter or early spring months as a result of heavy rainfall on snow-covered or frozen ground. Flooding in the summer months is most often associated with thunderstorms, although tropical hurricanes occasionally generate prolonged heavy rainfall in the area." (FEMA FIS, 1987)

There is no reported history of the road being overtopped per Joe Prescott, Maine DOT Bridge Maintenance, Region 4. However, at the 11/28/2017 Public Meeting, resident Bonnie Parent indicated that flooding occurred in 1987 and that the stream overtopped the road. In the meeting transcript, Ms. Parent said, "It went right over and took the road right out." Ms. Parent also confirmed that the stream under the bridge often runs almost full when a rainy season occurs. Minutes from the Public Meeting can be made available upon request.

The Flood Insurance Rate Map (FIRM) and the Maine Flood Hazard Map (see Figure 2) indicate that the bridge is located within a Zone A floodplain. Therefore, 100-year Base Flood Elevations have not been established. "Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study (FIS) by approximate methods." (FEMA FIS, 1987) As noted in the FIS, detailed hydraulic methods were used for Hammond Pond, Souadabscook Stream, and the Penobscot River. The West Branch Souadabscook Stream was not included in the detailed hydraulic methods study, although it flows into Hammond Pond.

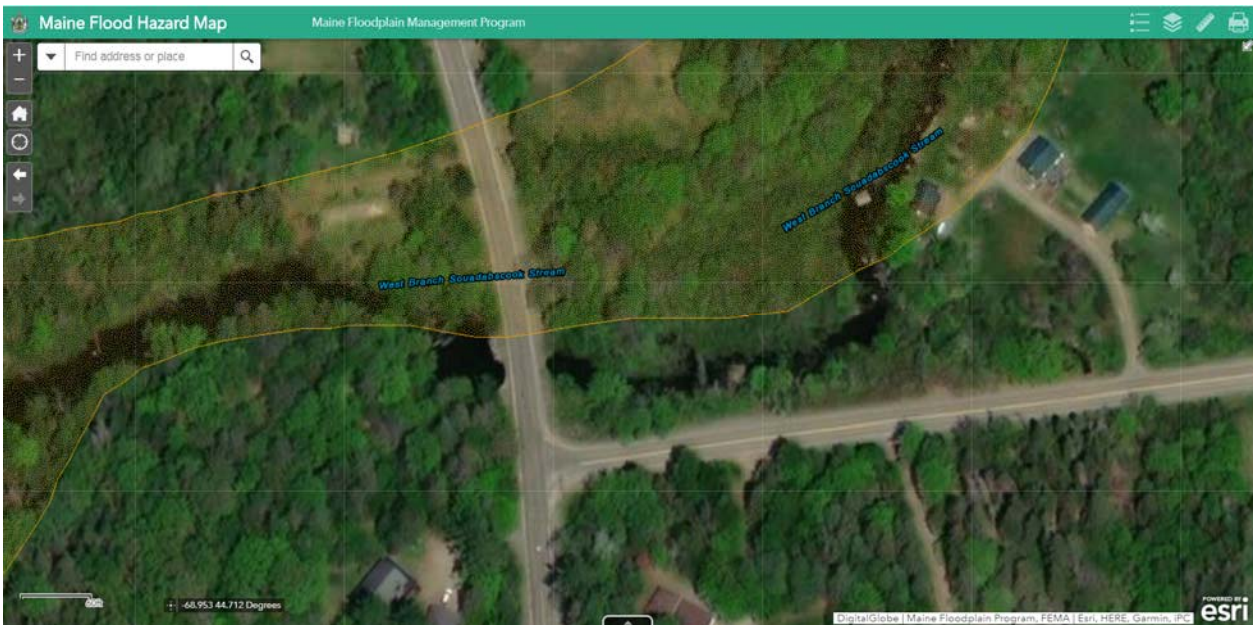

Figure 2 – Maine Flood Hazard Map showing bridge in Zone A (yellow hatch)

HYDRAULIC MODELING

The existing and proposed structures were analyzed using HEC-RAS 5.0.3 (September 2016), a one-dimensional hydraulics software program developed by the United States Army Corps of Engineers.

A hydraulic model of the stream was generated with 5 cross sections located upstream of the bridge, and 3 located downstream. Three cross sections were needed at the ledge falls, located approximately 70' upstream of the bridge, to adequately model this part of the stream. The cross sections were developed using ground survey, except for the cross sections located farthest upstream and downstream. These two cross sections (1 upstream and 1 downstream) were developed from aerial LiDAR survey with 2' contours, and the channel dimensions below the water surface were estimated based on survey near the bridge crossing.

The following parameters were used for the existing conditions and proposed conditions hydraulic models:

- Steady flow analysis method
- Manning's "n" of 0.045 for the channel, which is based on a clean, winding main channel, some pools and shoals, and weeds and stones. This is based on the site observations of bedrock/ledge, gravel, cobbles, and pebbles in the channel.
- Manning's "n" of 0.08 for the overbank areas with brush and trees.
- Expansion and contraction values of 0.3 and 0.1, respectively, except for the reach cross sections upstream and downstream of the bridge, which used 0.5 and 0.3, respectively.
- Ineffective flow areas upstream were set based on a contraction ratio of approximately 1:1, and an expansion ratio of approximately 3:1 to 4:1 was used on the downstream side, taking into account topography and stream meander.
- Flow regime was set to "mixed" to account for the hydraulic jump that occurs in the vicinity of the ledge falls.
- Boundary conditions upstream and downstream were set to "normal depth" and are based on the stream slope.
- Existing upstream arch crown elevation of 189.74.
- Proposed bridge low chord elevation of 190.11, which is a few inches higher than the existing arch crown.

Typically, a hydraulic model for the existing condition is calibrated with known water surface elevations for a given flow rate. However, this information is not known, so the model was checked for reasonableness using the following considerations:

1. The model indicates that overtopping of the road doesn't occur for flows with a 100 year or lower return period. It did indicate overtopping of the road with a 500-year return period.
2. Elevations for the existing conditions from the hydraulic model were compared against a measured water surface elevation obtained during a site visit on May 10, 2017. Additionally, this measured water surface elevation was used in conjunction with approximate locations of rust staining on the existing bridge to estimate the approximate ordinary high water elevation.

HYDRAULIC RESULTS

Scour under the existing bridge has caused the downstream thalweg elevations to be higher than the upstream thalweg elevations (i.e. reversed slope). See the channel profile in Figure 3.

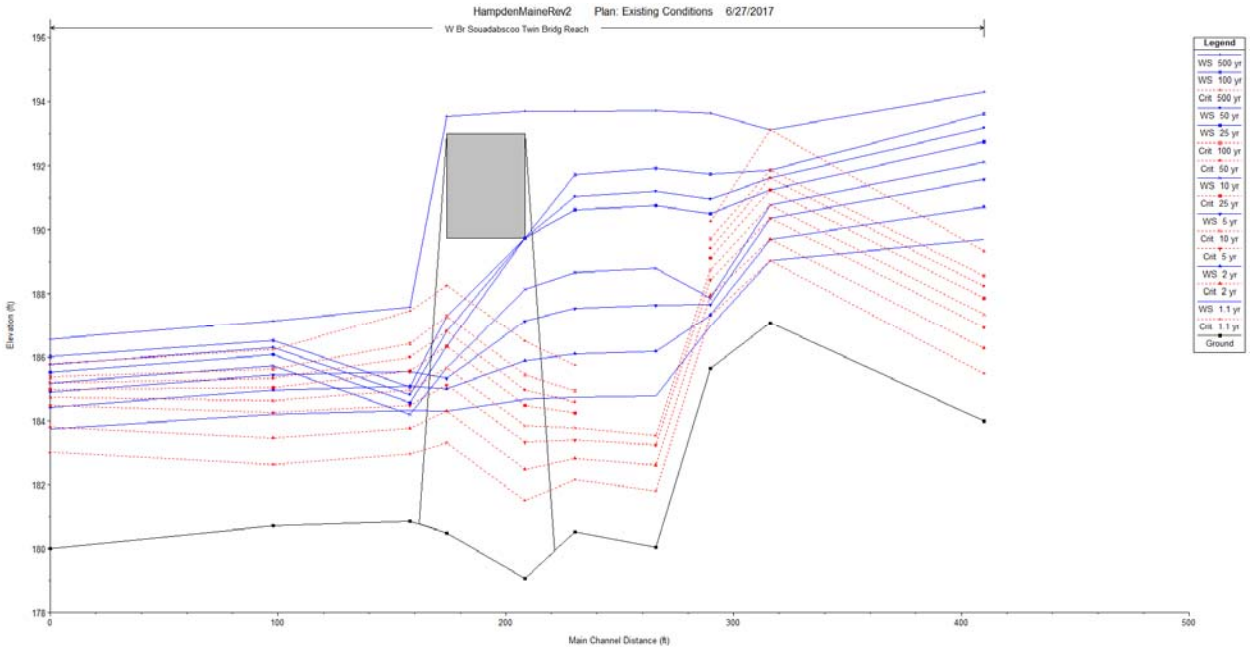

Figure 3 – Existing Conditions Flow Profiles. Note that downstream flow is from right to left, and the bottom of channel elevation is higher at the downstream bridge fascia than at the upstream fascia due to scour.

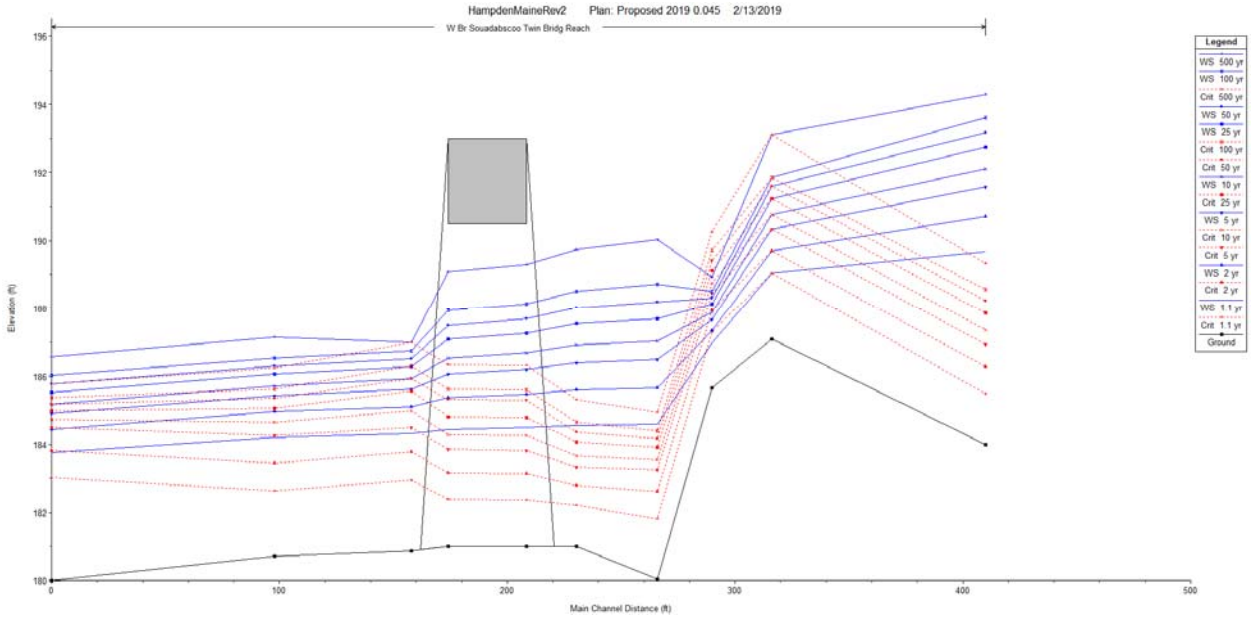

Figure 4 – Post Project Flow Profiles

As can be seen in Figure 4, there is significant improvement in the post project flow profiles when compared to those for the existing conditions. The hydraulic models indicate that the proposed structure is expected to pass all flows up to and including the 500-year return period, unlike the existing bridge which is overtopped at the 500-year return period. The proposed structure provides 2.09 feet of freeboard for the 50-year return period, which is greater than the desired 2 feet minimum, and is in stark contrast to the existing structure whose inlet is

submerged for the existing condition. For the 100-year return period, the proposed structure provides 1.60 feet of freeboard, which is greater than the 1' minimum preferred freeboard, and significantly improved over the existing condition. For more information, see the Summary of Hydraulic Analysis Table below.

At the 11/28/2017 Public Meeting, resident Bonnie Parent expressed concern for the house just downstream of the bridge. She was specifically concerned about how this project would affect potential future flooding at the house since it had flooded in 1987 when the roadway was overtopped.

Based on Ms. Parent's questions, the post-project model and other hydraulic parameters were reviewed to address this concern.

1. It is noted that the house is far enough downstream to be beyond the limits of this hydraulic study.
2. The watershed area for this project is 16.2 square miles, so it is not small. Floodplain storage affects flows; the more floodplain storage upstream, the more the flow is reduced. Based on the Maine Flood Hazard Map, there appears to be significant floodplain storage upstream of the modeled reach.
3. The flows used in the hydraulic analysis are from the Hydrology Report provided by Maine DOT, and the same flows are used at all cross-section locations for a steady flow analysis. Maine DOT expects a steady flow analysis for most typical projects, and since this project is not expected to affect peak stream discharges, a steady flow analysis is appropriate.
4. In reviewing the HEC-RAS flood profiles (existing and post-project), the upstream water surface elevation is controlled by the ledge falls just upstream of the bridge. Therefore, the ledge falls serves as a hydraulic control point for the West Branch Souadabscook Stream. This is significant in that the ledge falls controls the amount of flow going downstream, and not the bridge. Therefore, the downstream flows are expected to be the same regardless of the fact that the proposed bridge has a larger opening.

Summary of Hydraulic Analysis Results

Return Period (Years)	Existing Structure	Proposed Structure
Water Surface Elevations (ft.)		
1.1	184.74 (US) / 184.20 (DS)	184.56 (US) / 184.20 (DS)
2	186.09 (US) / 184.96 (DS)	185.59 (US) / 184.96 (DS)
25	190.62 (US) / 186.06 (DS)	187.55 (US) / 186.06 (DS)
50	191.03 (US) / 186.30 (DS)	188.02 (US) / 186.30 (DS)
100	191.71 (US) / 186.52 (DS)	188.51 (US) / 186.52 (DS)
Vertical Clearance / Freeboard at Bridge Upstream (ft.)		
50	-1.29*	2.09
100	-1.97*	1.60
Discharge Velocity (ft./s)		
1.1	1.64 (US) / 2.55 (DS)	1.46 (US) / 2.55 (DS)
2	2.37 (US) / 3.68 (DS)	2.18 (US) / 3.68 (DS)
25	3.05 (US) / 6.34 (DS)	3.69 (US) / 6.34 (DS)
50	3.42 (US) / 6.95 (DS)	4.01 (US) / 6.95 (DS)
100	3.70 (US) / 7.57 (DS)	4.32 (US) / 7.57 (DS)
500	2.12 (US) / 7.63 (DS) **	4.90 (US) / 7.63 (DS)

US = Bridge Upstream at RS 10307

DS = Bridge Downstream at RS 10175 (Hydraulic jump occurs in existing conditions at RS 10235, and is therefore not used.)

* Indicates that the arch crown is submerged below the water surface elevation

** Note that the bridge is overtopped for the existing conditions model at the 500-year return period

SCOUR ANALYSIS

The proposed foundations are founded on bedrock and are therefore considered stable and not susceptible to scour.

Appendix E

Hydraulics Data

Project Name:		**PIN:**	18959
Stream Name:	W Br Souadabscook	**Town:**	Hampden
Bridge Name:	Twin Bridge	**Bridge No.**	5315
Route No.	ME69	**USGS Quad:**	
Analysis by:	CSH	**Date:**	2/11/2016

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

Enter data in blue cells only!

	km^2	mi^2	ac	
A	41.96	16.20	10368.0	***Enter data in [mi^2]*** Watershed Area
W	4.03	1.56	995.3	Wetlands area (by NWI)
P_c	500229.8	4948401		watershed centroid (E, N; UTM 19N; meters)
County	Penobscot S			*choose county from drop-down menu*
pptA	39.5			mean annual precipitation (inches; by look-up)
SG	0.04			sand & gravel aquifer as decimal fraction of watershed A

A (km^2)	41.96	**Conf Lvl**	0.67
W (%)	9.60		

Worksheet prepared by:
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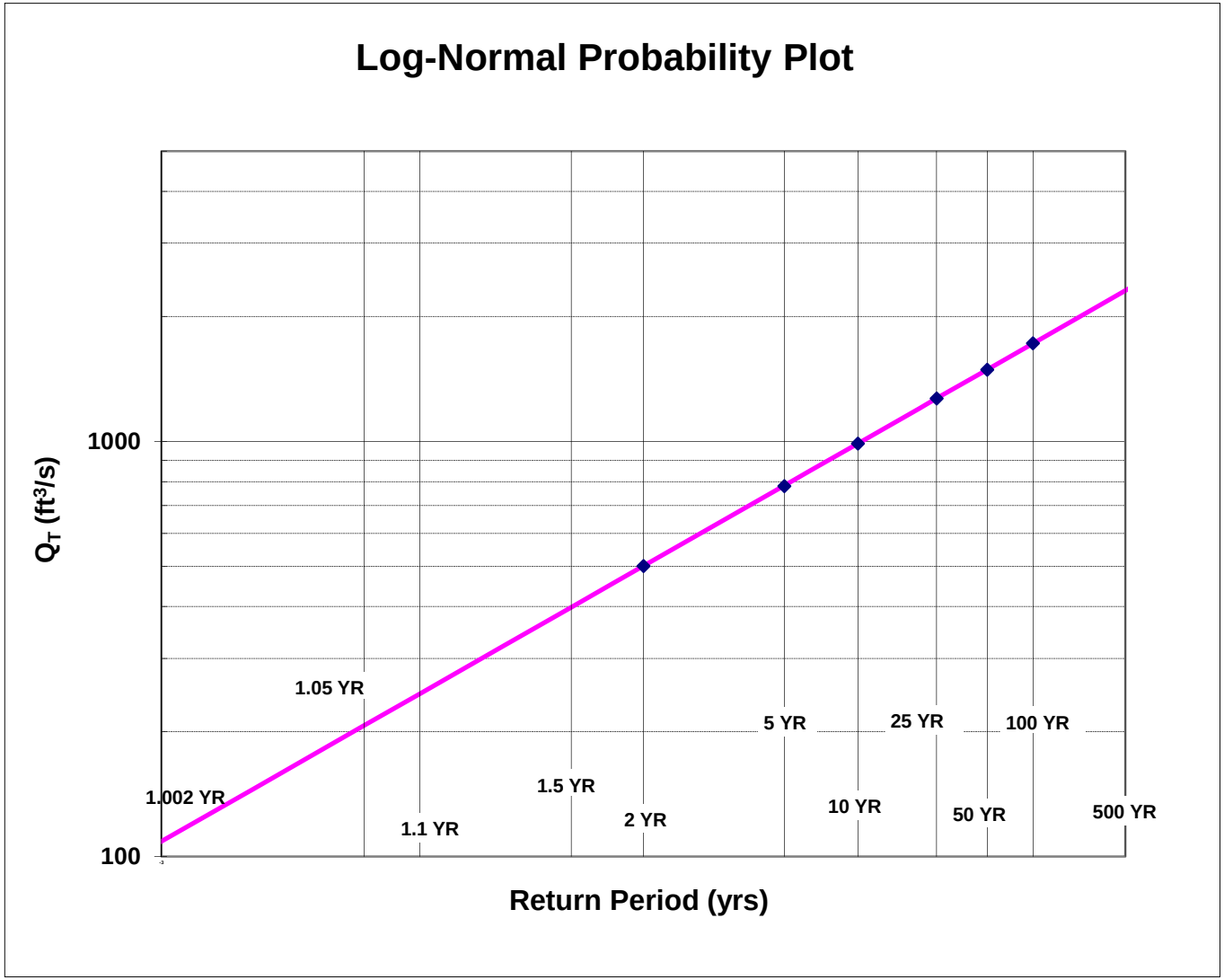
Environmental Office
Maine Dept. Transportation
Augusta, ME 04333-0016
207-557-1052
Charles.Hebson@maine.gov

Ret Pd T (yr)	Peak Flow Estimate Lower	Q_T (m^3/s)	Upper	Q_T (ft^3/s)
1.1		6.99		246.8
2		14.20		501.3
5		22.12		780.9
10		28.00		988.7
25		35.92		1268.4
50		42.15		1488.4
100		48.83		1724.1
500		65.37		2308.3

Reference:

Hodgkins, G., 1999.
Estimating the magnitude of peak flows for streams in Maine for selected recurrence intervals
Water-Resources Investigations Report 99-4008
US Geological Survey, Augusta, Maine

$Q_T = b \times A^a \times 10^{-wW}$


Log-Normal Probability Plot
1000
100
Q_T (ft³/s)
1.05 YR
1.002 YR
1.1 YR
1.5 YR
2 YR
5 YR
10 YR
25 YR
50 YR
100 YR
500 YR
Return Period (yrs)

Project Name:	0	**PIN:**	18959
Stream Name:	W Br Souadabscook	**Town:**	Hampden
Bridge Name:	Twin Bridge	**Bridge No.**	5315
Route No.	ME69	**USGS Quad:**	0
Analysis by:	CSH	**Date:**	2/11/2016

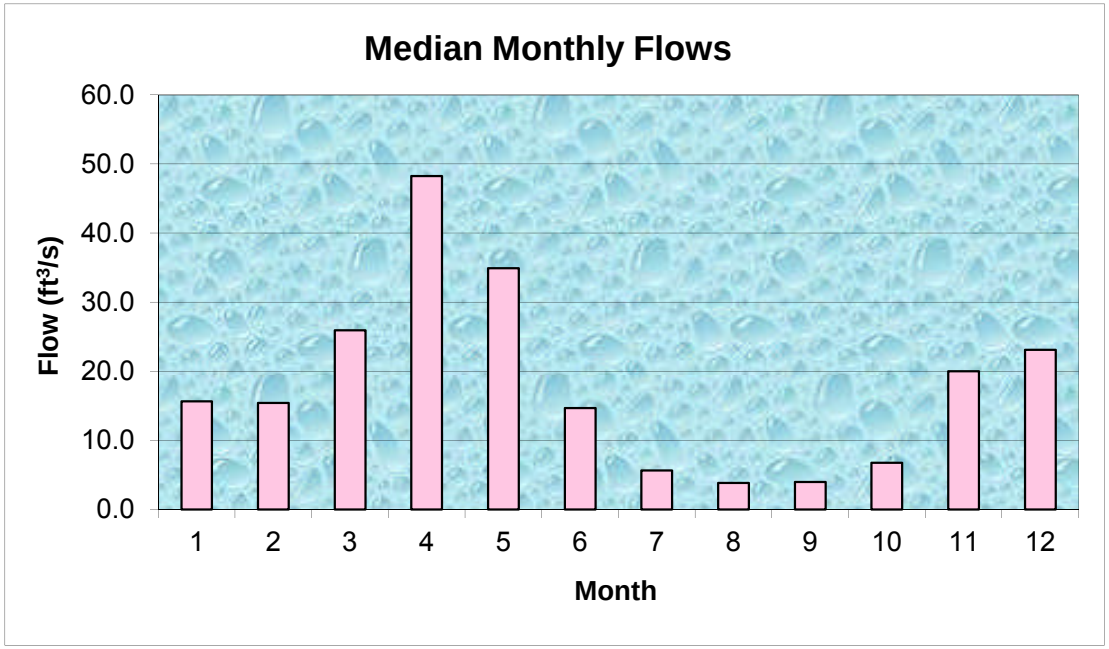
DO NOT ENTER ANY DATA ON THIS PAGE; EVERYTHING IS CALCULATED

MAINE MONTHLY MEDIAN FLOWS BY USGS REGRESSION EQUATIONS (2004)

Worksheet prepared by:
Charles S. Hebson, PE
Chief Hydrologist
Maine Dept. Transportation
Augusta, ME 04333-0016
207-624-3073
Charles.Hebson@maine.gov

	Value	Variable	Explanation
	16.200	*A*	Area (mi^2)
500229.8	4948401	P_c	Watershed centroid (E,N; UTM; Zone 19; meters)
	63.45	*DIST*	Distance from Coastal reference line (mi)
	39.5	*pptA*	Mean Annual Precipitation (inches)
	0.04	*SG*	Sand & Gravel Aquifer (decimal fraction of watershed area)

Month	Q_{median} (ft3/s)	(m^3/s)
Jan	**15.69**	0.4448
Feb	**15.44**	0.4376
Mar	**25.94**	0.7352
Apr	**48.27**	1.3678
May	**34.95**	0.9904
Jun	**14.69**	0.4164
Jul	**5.66**	0.1604
Aug	**3.88**	0.1100
Sep	**3.98**	0.1128
Oct	**6.77**	0.1918
Nov	**20.02**	0.5673
Dec	**23.12**	0.6553



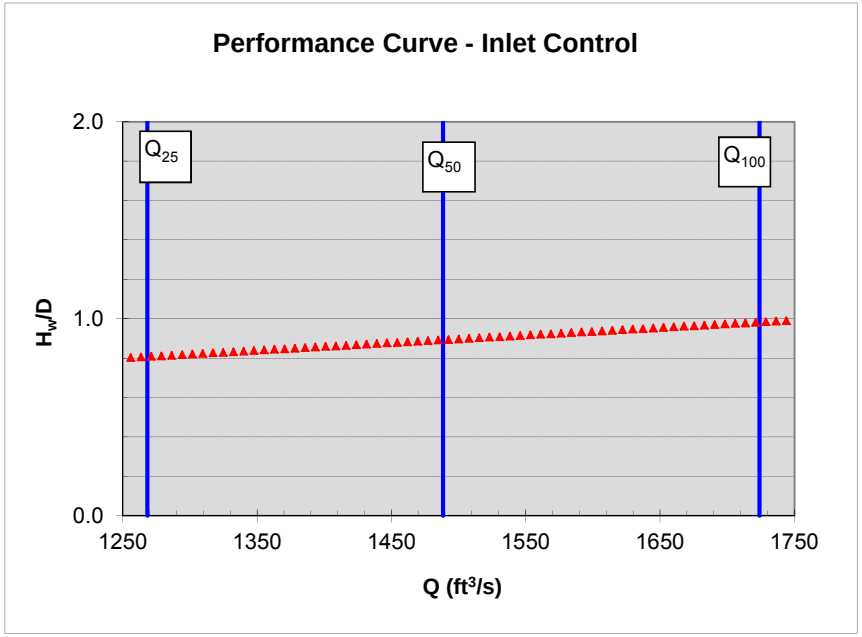
Q_{bf}	**96.6**	
ann avg	**30.7**	
ann med	**14.4**	
$Q_{1.002}$	**108.8**	
$Q_{1.01}$	145.5	
$Q_{1.05}$	206.7	

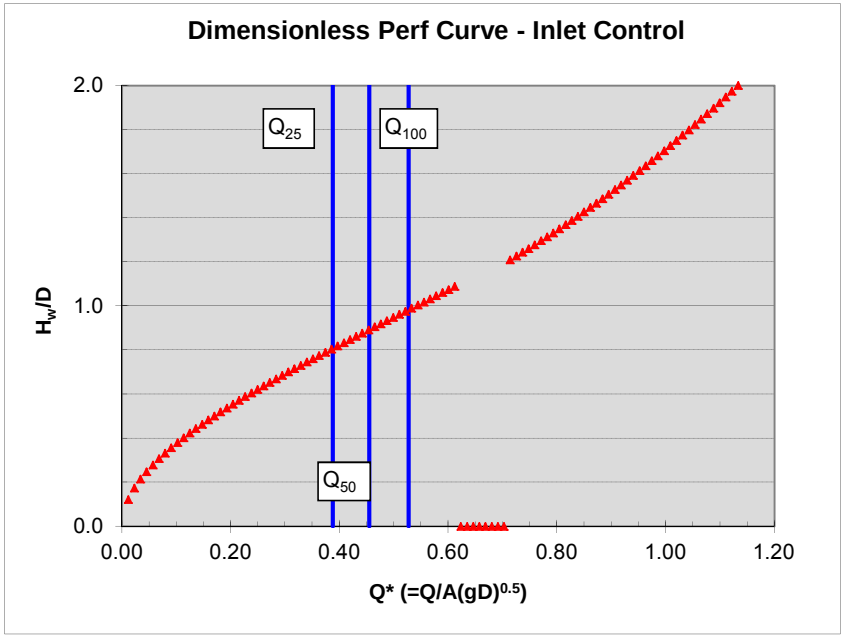
W_{bf}	32.6	estimated bankfull width
d_{bf}	2.5	
Q_{bf}	330.0	assume v = 4ft/s

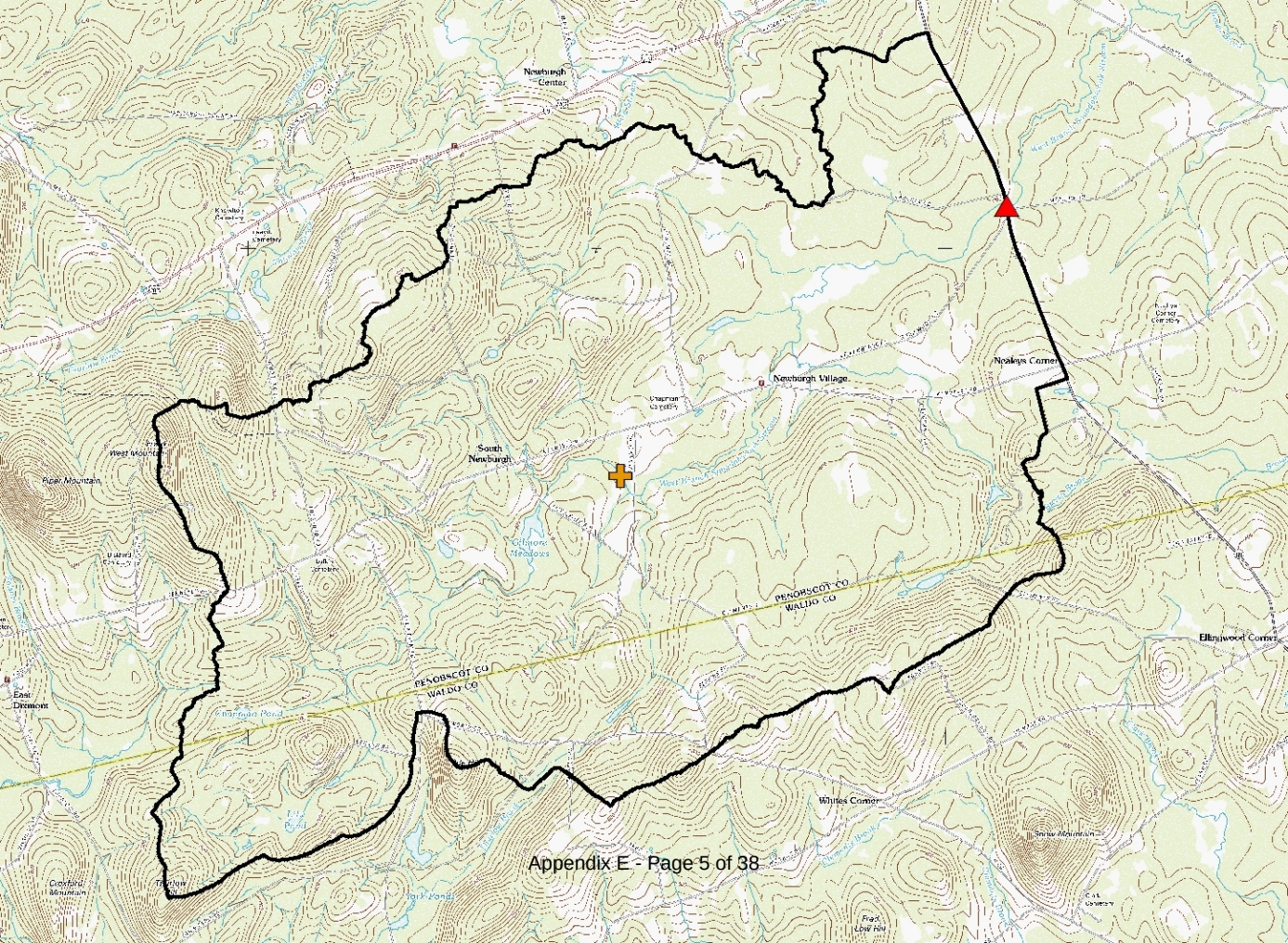
NOTE: ***This page is for preliminary sizing only.***
Final design should be done with HY8 or HDS-5

Preliminary Culvert Sizing - Round Pipes

Type:	Circ RCP Proj		Q_{25}	1268.4		
D (ft)	14		Q_{50}	1488.4	trial D =	14.02
w (ft)	*9*	*box width*	Q_{100}	1724.1		
Slope (ft/ft)	0.02					
A (ft^2)	153.94					
g	32.2					






Newburgh Center
Newburgh Village
Nealeys Corner
South Newburgh
PENOBSCOT CO
WALDO CO
PENOBSCOT CO
WALDO CO
Ellingwood Corner
Whites Corner
East Dixmont
Bear Mountain

StreamStats Version 3.0

Basin Characteristics Ungaged Site Report

Date: Thurs Feb 11, 2016 10:00:11 AM GMT-5
Study Area: Maine
NAD 1983 Latitude: 44.712 (44 42 43)
NAD 1983 Longitude: -68.9509 (-68 57 04)

Label	Value	Units	Definition
DRNAREA	16.2	square miles	Area that drains to a point on a stream
STORNWI	9.96	percent	Percentage of storage (combined water bodies and wetlands) from the National Wetlands Inventory
ELEV	370.4	feet	Mean Basin Elevation
PRECIP	43.4	inches	Mean Annual Precipitation
PRDECFEB90	10.1	inches	Basin average mean precipitation for December to February from PRISM 1961-1990
SANDGRAVAP	3.66	percent	Percentage of land surface underlain by sand and gravel aquifers
COASTDIST	64.5	miles	Shortest distance from the coastline to the basin centroid
CENTROIDX	500229.81	State plane coordinates	Basin centroid horizontal (x) location in state plane coordinates
CENTROIDY	4948400.81	State plane coordinates	Basin centroid vertical (y) location in state plane units
SANDGRAVAF	0.04	dimensionless	Fraction of land surface underlain by sand and gravel aquifers
LC11IMP	0.59	percent	Percentage of impervious area determined from NLCD 2011 impervious dataset
LC11DEV	4.41	percent	Percentage of land-use from NLCD 2011 classes 21-24

StreamStats Version 3.0

Flow Statistics Ungaged Site Report

Date: Thurs Feb 11, 2016 10:01:17 AM GMT-5
Study Area: Maine
NAD 1983 Latitude: 44.712 (44 42 43)
NAD 1983 Longitude: -68.9509 (-68 57 04)
Drainage Area: 16.2 mi2

Regional Hydraulic Geometry Basin Characteristics			
100% Central and Coastal Bankfull 2004 5042 (16.2 mi2)			
Parameter	Value	Regression Equation Valid Range	
		Min	Max
Drainage Area (square miles)	16.2	2.92	298

Regional Median Flows Basin Characteristics
100% Undefined Region (16.2 mi2)

The selected watershed is entirely in an area for which flow equations were not defined.

Monthly Mean Flows Basin Characteristics			
100% Statewide Mean Monthly SIR 2004 5026 (16.2 mi2)			
Parameter	Value	Regression Equation Valid Range	
		Min	Max
Drainage Area (square miles)	16.2	9.79	1418
Fraction of Sand and Gravel Aquifers (dimensionless)	0.04	0	0.455
Mean Annual Precipitation (inches)	43.4	37.8	47.9
Distance From Coast To Basin Centroid (miles)	64.5	42.7	193

Monthly Median Flows Basin Characteristics			
100% Statewide Median Monthly SIR 2004 5026 (16.2 mi2)			
Parameter	Value	Regression Equation Valid Range	
		Min	Max
Drainage Area (square miles)	16.2	9.79	1418
Fraction of Sand and Gravel Aquifers (dimensionless)	0.04	0	0.455

Mean Annual Precipitation (inches)	43.4	37.8	47.9
Distance From Coast To Basin Centroid (miles)	64.5	42.7	193

Peak Flow Basin Characteristics			
100% Statewide Peak Flow Full WRI 99 4008 (16.2 mi2)			
Parameter	Value	Regression Equation Valid Range	
		Min	Max
Drainage Area (square miles)	16.2	0.93	1653
Percentage of Storage from NWI (percent)	9.96	0.7	26.7

Annual Flows Basin Characteristics			
100% Statewide Annual SIR 2004 5026 (16.2 mi2)			
Parameter	Value	Regression Equation Valid Range	
		Min	Max
Drainage Area (square miles)	16.2	9.79	1418
Fraction of Sand and Gravel Aquifers (dimensionless)	0.04	0	0.455
Basin Ave Precip Dec Feb PRISM 1990 (inches)	10.1	7.71	12.6

Regional Hydraulic Geometry Statistics						
Statistic	Value	Unit	Prediction Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
					Min	Max
BFFLOW	96.6	ft3/s	54			
BFWDTH	32.6	ft	33			
BFDPTH	1.53	ft	26			
BFAREA	49.9	ft2	57			

http://pubs.usgs.gov/sir/2004/5042/pdf/sir2004-5042.pdf (http://pubs.usgs.gov/sir/2004/5042/pdf/sir2004-5042.pdf)
Dudley_ R.W._ 2004_ Hydraulic-Geometry Relations for Rivers in Coastal and Central Maine: U.S. Geological Survey Scientific Investigations Report 2004-5042_ 30 p

Monthly Mean Flows Statistics						
Statistic	Value	Unit	Prediction Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
					Min	Max
Q1	24.2	ft3/s	11	30		
Q2	23.4	ft3/s	10	41		

Q3	49.6	ft3/s	24	7.3		
Q4	82.3	ft3/s	17	4.9		
Q5	47.4	ft3/s	17	7		
Q6	24.2	ft3/s	16	13		
Q7	10.4	ft3/s	22	8.4		
Q8	7.6	ft3/s	25	8.6		
Q9	8.7	ft3/s	23	14		
Q10	17.7	ft3/s	22	17		
Q11	35	ft3/s	21	12		
Q12	35.6	ft3/s	13	29		

http://water.usgs.gov/pubs/sir/2004/5026/pdf/sir2004-5026.pdf (http://water.usgs.gov/pubs/sir/2004/5026/pdf/sir2004-5026.pdf)
Dudley_ R.W._ 2004_ Estimating Monthly_ Annual_ and Low 7-Day_ 10-Year Streamflows for Ungaged Rivers in Maine: U.S. Geological Survey Scientific Investigations Report 2004-5026_ 22 p.

Monthly Median Flows Statistics						
Statistic	Value	Unit	Prediction Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
					Min	Max
JAND50	15.5	ft3/s	18	8.9		
FEBD50	15.2	ft3/s	16	18		
MARD50	25.5	ft3/s	19	13		
APRD50	62.1	ft3/s	24	3.8		
MAYD50	35.2	ft3/s	23	3.9		
JUND50	14.7	ft3/s	26	4.3		
JULD50	5.66	ft3/s	31	3.6		
AUGD50	3.88	ft3/s	35	3.9		
SEPD50	3.98	ft3/s	32	5.4		
OCTD50	6.77	ft3/s	31	8.3		
NOVD50	20	ft3/s	35	4.4		
DECD50	22.9	ft3/s	14	22		

http://water.usgs.gov/pubs/sir/2004/5026/pdf/sir2004-5026.pdf (http://water.usgs.gov/pubs/sir/2004/5026/pdf/sir2004-5026.pdf)
Dudley_ R.W._ 2004_ Estimating Monthly_ Annual_ and Low 7-Day_ 10-Year Streamflows for Ungaged Rivers in Maine: U.S. Geological Survey Scientific Investigations Report 2004-5026_ 22 p.

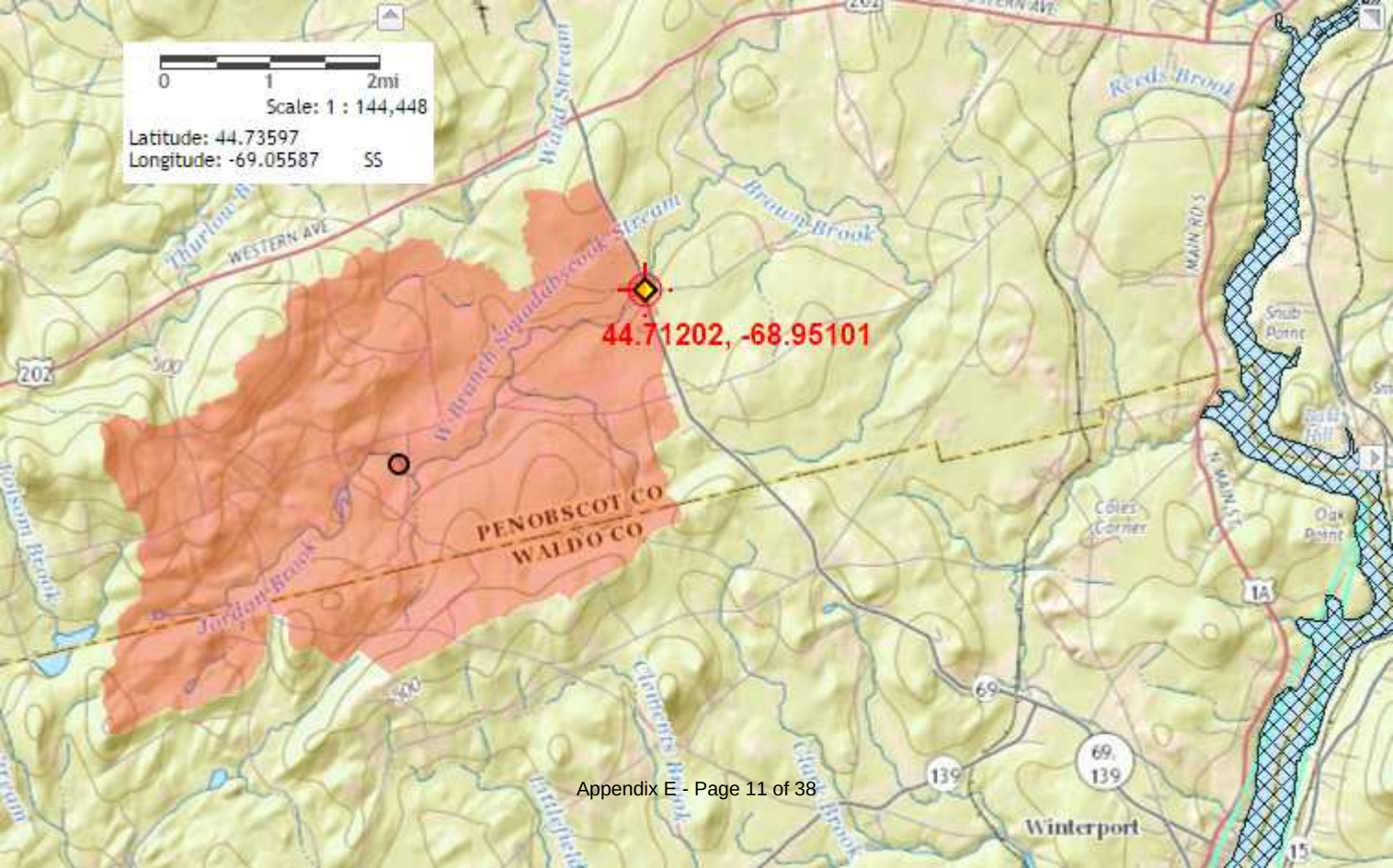
Peak Flow Statistics						
Statistic	Value	Unit	Prediction Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
					Min	Max

PK2	490	ft3/s	35	1.8	273	881
PK5	762	ft3/s	36	2.5	420	1380
PK10	964	ft3/s	37	3.2	523	1780
PK25	1240	ft3/s	39	4.1	654	2340
PK50	1450	ft3/s	40	4.8	750	2800
PK100	1680	ft3/s	41	5.4	850	3310
PK500	2240	ft3/s	45	6.4	1070	4690

http://me.water.usgs.gov/99-4008.pdf (http://me.water.usgs.gov/99-4008.pdf)
Hodgkins_ G. A._ 1999_ Estimating the Magnitude of Peak Flows for Streams in Maine for Selected Recurrence Intervals: U.S. Geological Survey Water-Resources Investigations Report 99-4008_ 45 p.

Annual Flows Statistics						
Statistic	Value	Unit	Prediction Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
					Min	Max
QA	31	ft3/s	7.6	9.9		
MEDAN	14.8	ft3/s	14	6.9		
M7D10Y	0.76	ft3/s	44	2.9		

http://water.usgs.gov/pubs/sir/2004/5026/pdf/sir2004-5026.pdf (http://water.usgs.gov/pubs/sir/2004/5026/pdf/sir2004-5026.pdf)
Dudley_ R.W._ 2004_ Estimating Monthly_ Annual_ and Low 7-Day_ 10-Year Streamflows for Ungaged Rivers in Maine: U.S. Geological Survey Scientific Investigations Report 2004-5026_ 22 p.


0
1
2mi
Scale: 1 : 144,448
Latitude: 44.73597
Longitude: -69.05587
SS
44.71202, -68.95101
PENOBSCOT CO
WALDO CO
W Branch Sqoodabscook Stream
Brawn Brook
Reeds Brook
Jordan Brook
Winterport
WESTERN AVE
202
69
139
1A

650 Elm St. Suite 402
Manchester, NH 03101
wsp.com

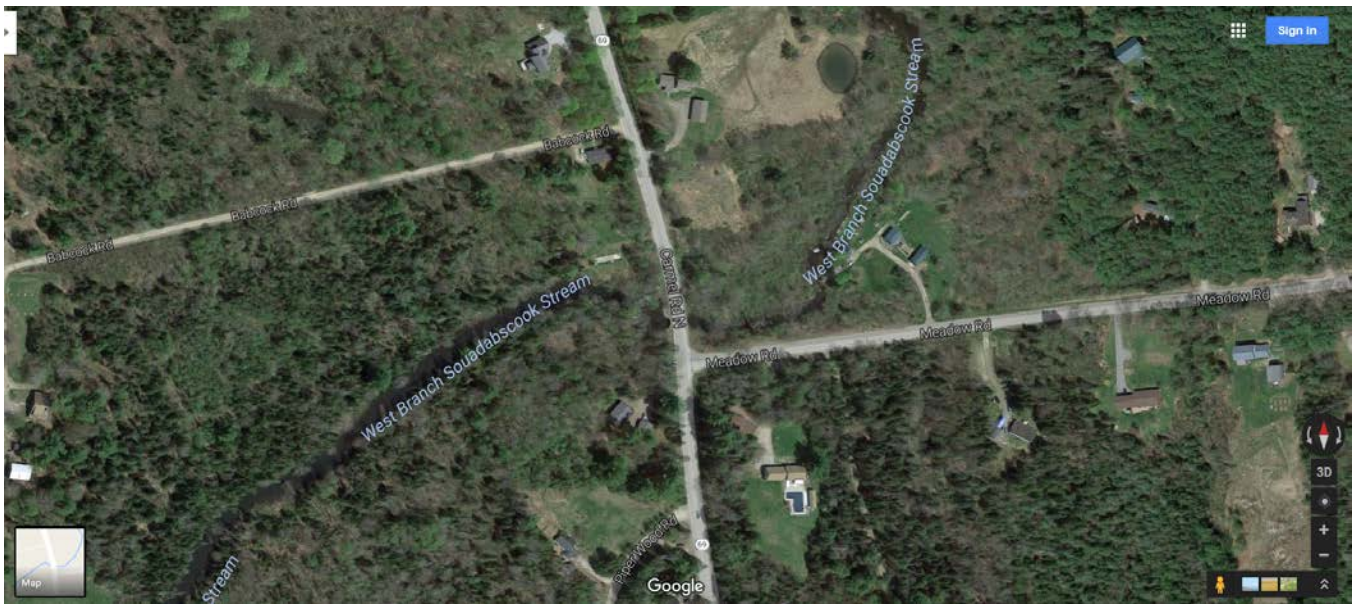
Project: Hampden, ME - Rte 69 over West Branch Souadabscook Stream
Task: ***Hydraulic Study***

Client: Maine DOT

Calculated by: K. James
Date: 6/27/2017
Checked by: K. Dauber
Date: 6/29/2017

Hydraulic Model:

Overhead View



Larger Overhead View

Site visit performed 5-10-2017 (after a period of time with substantial rainfall)

Upstream with ledge falls (Google)

Upstream 5-10-2017

Downstream (Google)

Downstream 5-10-2017

Manning's "n" Values:

(HEC-RAS Reference Manual Table 3-1)

Manning's n for overbank:

The existing channel is located in a wooded region with trees and some brush in the overbank areas. From Table 3-1 of HEC-RAS Reference Manual for Natural Streams, under Flood Plains, select highest value for "Light Brush and Trees in Summer":

Assume n = 0.08 (ranges from 0.04 to 0.08)

Manning's n for channel:

The existing channel is described in the existing plans as being covered with rocks and boulders with ledge showing on the bank upstream. The 8/27/2014 Underwater Dive Inspection Report describes the streambed as being composed of muck and debris, and the channel being deeper on the right side with ledge falls upstream. During 5-10-2017 site visit by WSP personnel, streambed was observed to be "pebbles, cobbles and some larger rocks".

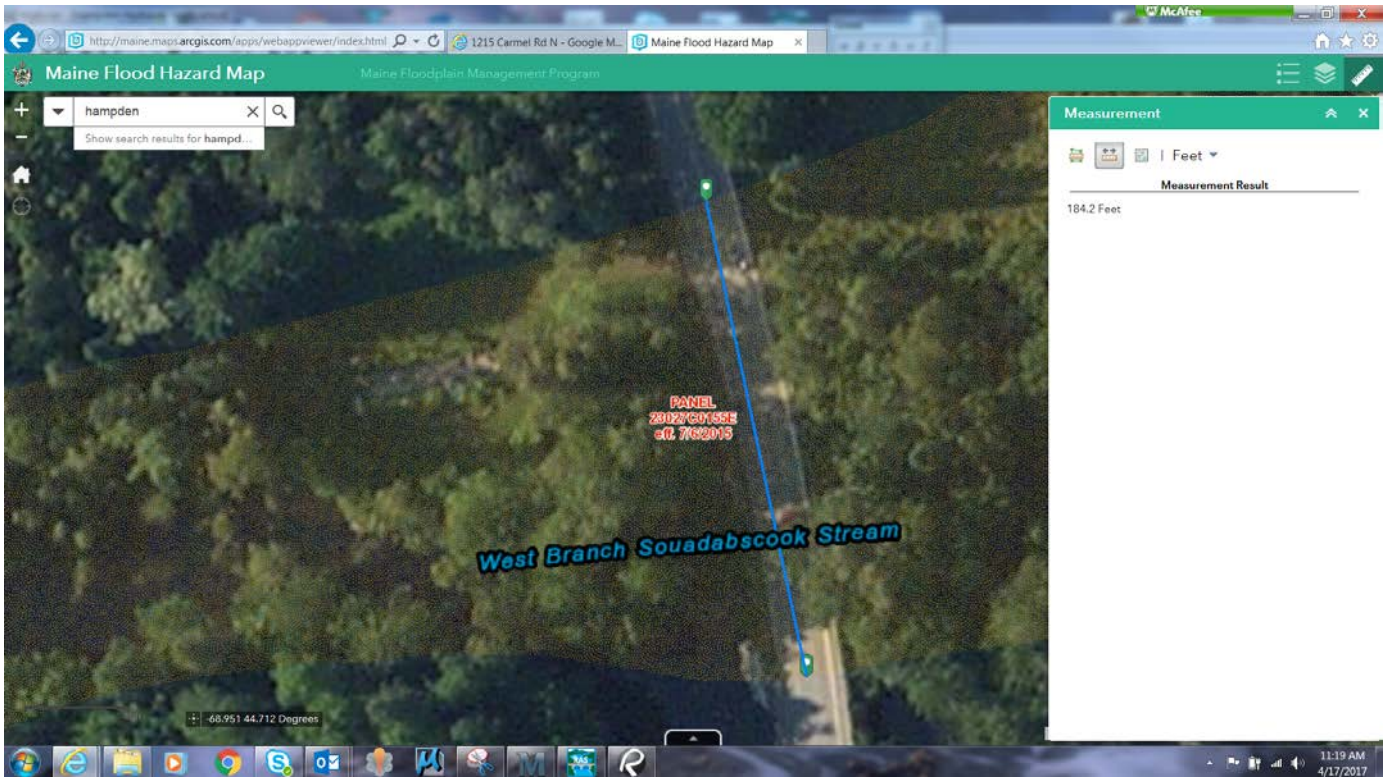
From Table 3-1, for Natural Streams, Main Channels, select Clean, winding, some pools and shoals, but some weeds and stones"

Assume n = 0.045

Table 3-1 Manning's 'n' Values

Type of Channel and Description	Minimum	Normal	Maximum
A. *Natural Streams*			
1. **Main Channels**			
a. Clean, straight, full, no rifts or deep pools	0.025	0.030	0.033
b. Same as above, but more stones and weeds	0.030	0.035	0.040
c. Clean, winding, some pools and shoals	0.033	0.040	0.045
d. Same as above, but some weeds and stones	0.035	0.045	0.050
e. Same as above, lower stages, more ineffective slopes and sections	0.040	0.048	0.055
f. Same as "d" but more stones	0.045	0.050	0.060
g. Sluggish reaches, weedy. deep pools	0.050	0.070	0.080
h. Very weedy reaches, deep pools, or floodways with heavy stands of timber and brush	0.070	0.100	0.150
2. **Flood Plains**			
a. Pasture no brush			
1. Short grass	0.025	0.030	0.035
2. High grass	0.030	0.035	0.050
b. Cultivated areas			
1. No crop	0.020	0.030	0.040
2. Mature row crops	0.025	0.035	0.045
3. Mature field crops	0.030	0.040	0.050
c. Brush			
1. Scattered brush, heavy weeds	0.035	0.050	0.070
2. Light brush and trees, in winter	0.035	0.050	0.060
3. Light brush and trees, in summer	0.040	0.060	0.080
4. Medium to dense brush, in winter	0.045	0.070	0.110
5. Medium to dense brush, in summer	0.070	0.100	0.160
d. Trees			
1. Cleared land with tree stumps, no sprouts	0.030	0.040	0.050
2. Same as above, but heavy sprouts	0.050	0.060	0.080
3. Heavy stand of timber, few down trees, little undergrowth, flow below branches	0.080	0.100	0.120
4. Same as above, but with flow into branches	0.100	0.120	0.160
5. Dense willows, summer, straight	0.110	0.150	0.200

Maine Flood Hazard Map: Bridge is in Zone A

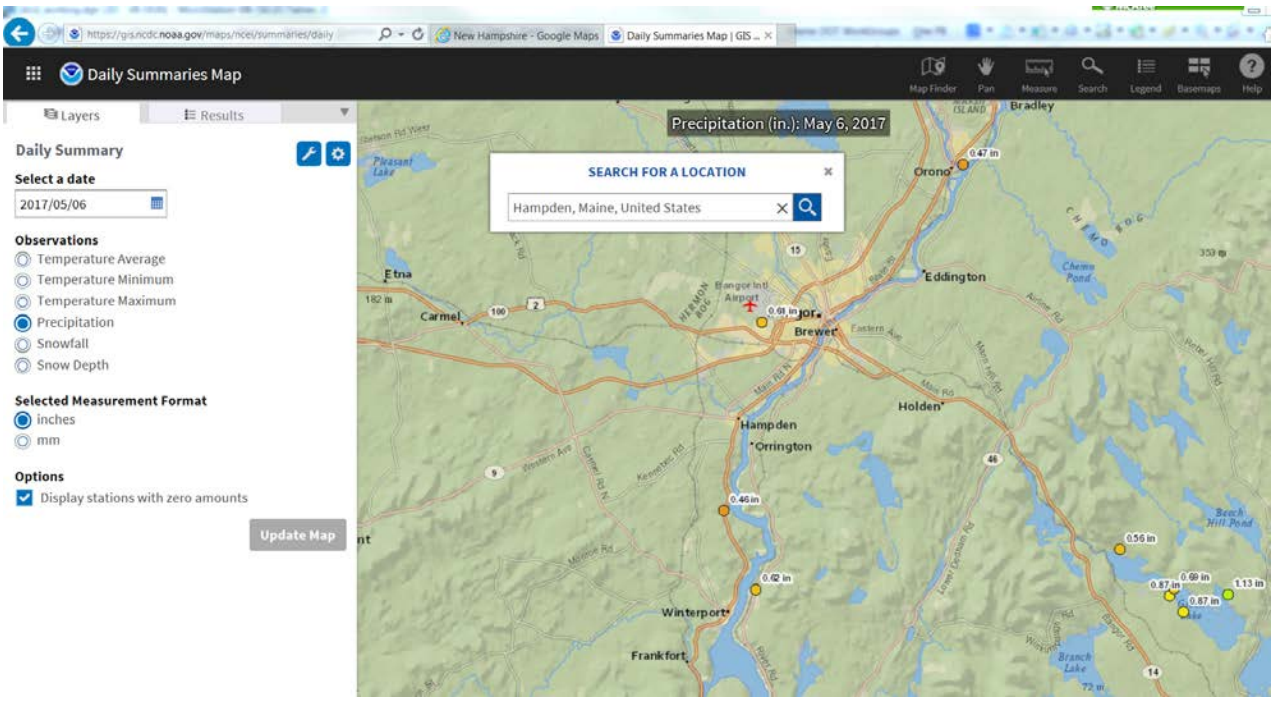


The Flood Insurance Study (FIS) dated September 4, 1987 for the Town of Hampden was obtained for this project. This study contains flood elevation profiles for Souadabscook Stream. The West Branch of the Souadabscook Stream is much further upstream, and flows into Hammond Pond, with the Souadabscook Stream flowing out of Hammond Pond (see figure below). No flood elevation profiles are included in the FIS for the West Branch of the Souadabscook Stream.

West Branch of the Souadabscook Stream / Hammond Pond / Souadabscook Stream

Measured / Estimated Water Surface Elevation for 5/10/2017 Site Visit:

Note that site visit was conducted after a period of a couple of weeks with moderate rainfall. From project photos, the flow appears to be close to a bankfull width flow. Example rainfall:



Bridge Geometry per Existing Plans:

$rise_{spring} := 7.50 \cdot ft$ — Arch rise from springline from existing plans dated April, 1950

$abut := 4.5 \cdot ft$ — Height of abutment / support below springline per existing plans

$rise := rise_{spring} + abut = 12\,ft$ — Distance from crown of arch to bottom of abutments / streambed per existing plans

$dist_{streambed} := 12 \cdot ft$ — Field measurement of distance from crown of arch to bottom of streambed at upstream end of bridge on 5/10/2017

The measured rise matches the existing plans, therefore, the structure size was built per the existing plans, OK.

There are two Topo.dgn files that were downloaded from Maine DOT's FTP site. They are both dated 3/31/2017, but one contains elevation text (timestamp of 3:17pm) and the other does not (timestamp 3:23pm). The 3:17pm file has a level labelled S_Drainage_Culvert_Slipline that contains three lines with the middle one labelled with elevations of 189.74 and 189.75. These appear to be the bridge crown elevations.

In the 3DTopo_120816.dgn file, there is also a level labelled S_Drainage_Invert with two spot locations. The upstream spot location is El 177.72 and the downstream spot location is El 179.79. (Contrary to expectations, the downstream invert is higher than the upstream invert, and the invert is supposed to be natural streambed.)

$El_{upstream.invert} := 177.72 \cdot ft$

$El_{downstream.invert} := 179.79 \cdot ft$

$El_{crown.survey} := 189.74 \cdot ft$

$rise_{upstream} := El_{crown.survey} - El_{upstream.invert} = 12.02\,ft$ — Matches existing plans, OK

$rise_{downstream} := El_{crown.survey} - El_{downstream.invert} = 9.95\,ft$ — Signficantly lower than existing plans

Estimated Water Surface Elevation at 5/10/2017:

$dist_{h20} := 5 \cdot ft + 10 \cdot in = 5.83\,ft$ Distance measured from crown of arch to water surface

$El_{h20} := El_{crown.survey} - dist_{h20} = 183.91\,ft$ Estimated water elevation at 5/10/2017.
From the site visit photos, it appears that the flow is near, but below, bankfull flow.

Approximate Water Surface Elevations based on Lidar Survey:

Lidar aerial survey is available for this project, and contours are provided for every 2' elevation change. Since lidar doesn't penetrate through water, the lowest contours for the stream can be used to approximate the water surface elevation to within 2'. (Proof that lidar doesn't penetrate water - ground survey El 179 is the lowest contour at the upstream end of bridge and El 184 is the lowest from the lidar survey in this area.) Therefore:

1. At the upstream side above the ledge falls (cross section at river station 10486.57), the lowest contour along the edge of the stream is El 190. Therefore, the actual water surface elevation at the time of the lidar survey was between El 188 and El 190. Edit the cross section channel geometry between the stations with elevation = 190. From site visit photographs, the stream depth appears deeper than at the ledge falls because the water is not turbulent at this section. Assume water surface at average of El 188 and El 190 = El 189. Assume initial depth of water = 5'. Width of stream appears to be wider than in the ledge falls area. Therefore, assume initial bottom of stream at El 184.
2. In the vicinity of the ledge falls, the lowest elevation from the lidar survey is El 184. Therefore, the actual water surface elevation was between El 182 and El 184.
3. Near the downstream end of the bridge the lowest elevation from the lidar survey is El 184. Therefore, the actual water surface elevation was between El 182 and El 184.
4. At cross section STA 10077 (farthest downstream), the bottom of the channel was set just a little lower than the thalweg elevation at cross section STA 10175.

Bankfull Elevations:

The following definition of bankfull elevation is from the August 2008 US Forest Service manual titled "Stream Simulation: An Ecological Approach to Providing Passage for Aquatic Organisms at Road Stream Crossings"

Identifying Bankfull Elevation

Bankfull elevation is the point where water fills the channel just before beginning to spill onto the flood plain. Bankfull discharge is the flow in the channel (cubic feet per second) when the water surface is at bankfull elevation. Bankfull discharge typically occurs every 1 to 2 years (Leopold et al. 1964), but its frequency of occurrence can vary depending on channel type, hydrologic regime, and watershed conditions. Bankfull is recognized as a surrogate for the range of flows that maintain channel shape and size (Emmett 2004). It is often referred to as the effective discharge of a stream: the flow responsible for moving the most sediment (Dunne and Leopold 1978) and maintaining channel form. This is why bankfull flow width is the minimum structure width required for simulating and maintaining channel form and functions through a crossing.

Strictly speaking, bankfull applies only to alluvial streams with flood plains. In alluvial stream types, use some or all of the following indicators for recognizing bankfull elevation, depending on the situation (Harrelson et al. 1994):

- Elevation of the edge of an active flood plain (flood plain may be present as discontinuous patches).
- Elevation associated with the top of the highest depositional features such as point- and mid-channel bars.
- Changes in slope on the banks [figure 5.5(a)].
- Changes in particle size of bank materials (from coarser to finer).
- Changes in vegetation types (from moss to lichens, from grass to alder, etc.).
- Stain lines on rock and scour lines in moss and lichens.

Be careful when using vegetation as a geomorphic indicator as vegetation in some channels is inundated by bankfull flows. Depositional features should be the primary geomorphic indicator for identifying bankfull flow in alluvial channels.

Not all indicators will be present at each cross section. They vary with channel type, and false or confusing indicators have to be sorted out at each site. Flagging and surveying many bankfull elevations along a substantial length of channel helps to eliminate misleading indicators and is essential for accurate identification. The ideal method for consistently identifying bankfull elevations is to plot the bankfull longitudinal profile using points where bankfull was confidently identified. Then—where the profile crosses any cross section—that is the bankfull elevation at that cross section (Emmett 2004).

Maine DOT provided the required bankfull width of 33'. Determine approximate bankfull elevations at the proposed bridge.

1. From survey, S_Drainage_Waterway is located at approximately 183 to 183.5 (upstream both sides of stream at existing bridge). This is assumed to delineate the waterway at the time of survey, and doesn't likely represent a bankfull elevation.
2. From survey, S_Drainage_Waterway is located at approximately 183 (downstream both sides of stream at existing bridge). This is assumed to delineate the waterway at the time of survey, and doesn't likely represent a bankfull elevation.
3. From HEC-RAS cross section STA 10307 (upstream end of existing culvert), left bank elevation is 183.55 (looking downstream) & the right bank is not definitive. The left bank is not very definitive. This upstream section is not considered to be typical for the stream due to channel features.
4. From HEC-RAS cross section STA 10234 (downstream end of existing bridge left bank elevation is 184.47 (looking downstream) & right bank is not definitive. The left bank has a very well defined floodplain.
5. From HEC-RAS analysis of existing bridge upstream Q1.1 El = 184.74 & Q2 El = 186.09
6. From HEC-RAS analysis of existing bridge downstream Q1.1 El = 184.20 & Q2 El = 184.96

Based on the above information, estimate the bankfull elevation to be approximately 185.0.

Geometric Input for HEC-RAS Analysis:

Geometric data (stream alignment and channel cross-sections) for HEC-RAS was prepared using Autocad Civil 3D by Royd Benjamin.

Then the following data was added for the existing conditions:

1. Manning's n values for channel and overbank regions
2. Main channel bank stations were preliminarily adjusted to match the edge of bank lines (layer labeled as S_Drainage_Waterway) from the surveyed topography file. However, the locations of the bank stations were further altered to make sense for the cross section.
3. Expansion and contraction coefficients, as well as ineffective flow areas, for sections just up and downstream of the bridge.
4. Reference Manual page 6-37 recommends weir coefficient = 3.0 for flow over elevated roadway approach embankments.
5. The existing structure was modeled as a bridge due to the need to model the irregular shape formed by the steel plate arch on abutments, as well as to properly model the irregular natural channel bottom.
6. Deck/Roadway Data Editor - High chord elevations were determined using contours and spot elevations along the high edge of the roadway. Low chord elevations were based on the existing and proposed structures.
7. The n value used under the bridge was the same as in the rest of the channel.
8. Proposed HEC-RAS model by others.

HEC-RAS HEC-RAS 5.0.3 September 2016
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X       X   X     X  X    X
X     X  X        X            X   X    X    X   X
XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
X     X  X        X            X  X     X    X        X
X     X  X        X    X       X   X    X    X        X
X     X  XXXXXX    XXXX        X    X   X    X   XXXXX
```

PROJECT DATA
Project Title: HampdenMaineRev2
Project File : HampdenMaineRev2.prj
Run Date and Time: 6/27/2017 12:26:02 PM

Project in English units

PLAN DATA

Plan Title: Existing Conditions
Plan File : C:\Work - New\Hampden Maine\Hydraulics 2019 Work\Proposed Conditions HEC-RAS by Greg Shaffer\Hampden 2019 RAS\HampdenMaineRev2.p02

Geometry Title: Hampden-Exist-Geometry
Geometry File : C:\Work - New\Hampden Maine\Hydraulics 2019 Work\Proposed Conditions HEC-RAS by Greg Shaffer\Hampden 2019 RAS\HampdenMaineRev2.g01

Flow Title : All Flows
Flow File : C:\Work - New\Hampden Maine\Hydraulics 2019 Work\Proposed Conditions HEC-RAS by Greg Shaffer\Hampden 2019 RAS\HampdenMaineRev2.f01

Plan Summary Information:

Number of:	Cross Sections	= 8	Multiple Openings	=	0
	Culverts	= 0	Inline Structures	=	0
	Bridges	= 1	Lateral Structures	=	0

Computational Information

Water surface calculation tolerance	= 0.01
Critical depth calculation tolerance	= 0.01
Maximum number of iterations	= 20
Maximum difference tolerance	= 0.3
Flow tolerance factor	= 0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Mixed Flow

FLOW DATA

Flow Title: All Flows
Flow File : C:\Work - New\Hampden Maine\Hydraulics 2019 Work\Proposed Conditions HEC-RAS by Greg Shaffer\Hampden 2019 RAS\HampdenMaineRev2.f01

Flow Data (cfs)

River	Reach	RS	1.1 yr	2 yr	5 yr	10 yr	25 yr	50 yr	100 yr	500 yr
W Br Souadabscoo	Twin Bridg Reach	10486.57		247	501	781	989	1268	1488	1724	2308

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
W Br Souadabscoo	Twin Bridg Reach	1.1 yr	Normal S = 0.01	Normal S = 0.0073
W Br Souadabscoo	Twin Bridg Reach	2 yr	Normal S = 0.01	Normal S = 0.0073
W Br Souadabscoo	Twin Bridg Reach	5 yr	Normal S = 0.01	Normal S = 0.0073
W Br Souadabscoo	Twin Bridg Reach	10 yr	Normal S = 0.01	Normal S = 0.0073
W Br Souadabscoo	Twin Bridg Reach	25 yr	Normal S = 0.01	Normal S = 0.0073
W Br Souadabscoo	Twin Bridg Reach	50 yr	Normal S = 0.01	Normal S = 0.0073
W Br Souadabscoo	Twin Bridg Reach	100 yr	Normal S = 0.01	Normal S = 0.0073
W Br Souadabscoo	Twin Bridg Reach	500 yr	Normal S = 0.01	Normal S = 0.0073

GEOMETRY DATA

Geometry Title: Hampden-Exist-Geometry
Geometry File : C:\Work - New\Hampden Maine\Hydraulics 2019 Work\Proposed Conditions HEC-RAS by Greg Shaffer\Hampden 2019 RAS\HampdenMaineRev2.g01

CROSS SECTION

RIVER: W Br Souadabscoo
REACH: Twin Bridg Reach RS: 10486.57

INPUT
Description: Lidar generated with added data below El 190
Station Elevation Data num= 21

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	194	5.88	194	45.49	192.77	53.6	192.47	65.88	192
72.43	191.29	80.1	190.61	82.78	190.35	86.25	190	107	184
128	184	149.48	190	165.06	191.89	165.53	191.95	166.17	192
185.28	192	199.11	192.48	226.35	193.45	248.65	194	272.01	194
274.85	194.25								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.08	86.25	.045	149.48	.08

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
86.25	149.48	93.73	93.73	.1	.3

CROSS SECTION

RIVER: W Br Souadabscoo
REACH: Twin Bridg Reach RS: 10392.84

INPUT
Description: Upper Ledge Falls
Station Elevation Data num= 38

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	192.92	4.15	192.84	12.46	192.65	18.53	192.53	30.09	192
56.55	192	57.96	191.92	58.55	191.88	60.52	191.75	84.19	190
88.85	190	90.28	189.76	94.4	188.85	95.53	188.6	96.1	188.47
98.05	188	120.28	188	126.56	188.11	130.23	187.09	131.94	187.66
133.7	188.27	133.83	188.7	134.51	190	136.48	190.74	136.8	190.82
139.99	192	172.64	192	174.24	192.1	174.35	192.11	175.5	192.18
205.65	192.68	206.53	192.88	208.84	192.82	210.73	192.87	216.74	193.2
221.77	194	261.99	194	269.39	194.52				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.08	96.1	.045	133.7	.08

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
96.1	133.7	26.38	26.38	.1	.3

CROSS SECTION

RIVER: W Br Souadabscoo
REACH: Twin Bridg Reach RS: 10366.46

INPUT
Description: Middle Ledge Falls
Station Elevation Data num= 74

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	192.97	2.4	192.88	5.35	192.77	13.81	191.85	16.5	191.75
19.57	191.65	24.4	191.48	25.13	191.53	25.38	191.45	30.71	191.24
35.31	190.81	45.14	190.58	46.98	190.52	56.81	190.01	59.4	189.79
64.31	189.54	65.28	189.52	70.69	190	72.85	190	76.67	189.36
78.11	189.28	79.74	189.14	91.34	188	97.25	187.65	107.08	187.54
110.87	187.64	111.76	187.65	113.53	187.57	113.87	187.17	114.64	186.33
115.18	186.17	115.8	185.65	115.81	186.28	115.95	186.31	116.47	186.28
123.41	186.48	123.76	186.55	126.53	186.67	132.57	186.84	133.86	186.82
139.93	186	141.96	186.16	147.27	186.14	148.07	186.11	148.61	185.94
150.49	185.73	151.43	185.87	152.85	185.78	154.14	185.8	158.83	186.92
158.88	186.94	158.96	186.94	162.27	187.14	163.67	188	166.3	189.78
167	190	171.36	190.32	176.54	190.47	183.89	190.33	184.22	190.32
187.55	190.35	189.78	190.38	191.6	190.5	195.17	190.59	199.34	191.26

200.15	191.36	201.6	191.53	206.02	192	232.76	192	238.86	192.76
243.11	193.2	246.71	193.45	257.08	194	263.69	194		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.08	113.87	.045	158.88	.08

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
113.87	158.88	24.02	24.02	.1	.3

CROSS SECTION

RIVER: W Br Souadabscoo
REACH: Twin Bridg Reach RS: 10342.43

INPUT
Description: Lower Ledge Falls
Station Elevation Data num= 74

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	193.02	3.24	192.89	4.83	192.82	9.35	192.32	19.63	191.19
26.3	189.88	27.7	189.84	29.55	189.68	40.64	189.71	42.41	189.78
47.65	189.62	54.3	189.75	54.49	189.73	61.18	188.99	65.7	188.47
67.92	188.21	74.94	187.9	79.7	188.16	89.03	187.82	90.68	187.72
96.42	187.37	109.7	186.94	110.21	186.89	110.35	186.82	113.85	183.77
114.29	183.18	114.39	183.11	118.03	183.13	120.33	182.89	125.15	182.45
127.42	182.25	127.94	182.33	129.33	182.34	134.73	183.07	134.85	183.09
135.13	183.12	139.82	183.37	141.7	183.82	143.2	183.91	144.79	184.02
145.71	184.04	147.32	183.14	147.35	183.1	147.56	182.81	148.33	182.25
149.57	181.45	150.33	181.39	151.91	181.29	155.49	180.98	163.42	180.61
166.31	180.37	167.91	180.03	169.33	180.09	176.16	180.2	178.42	180.29
180.58	180.72	183.99	181.77	184.65	181.88	190.36	183.32	191.24	183.65
194.91	185.38	196.3	186.1	204.12	188	206.12	188	210.83	188.3
212.22	188.38	215.32	188.73	225.02	190	233.62	190.95	242.76	192
245.79	192	259.13	192.67	265.38	193.04	267.01	193.13		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.08	113.85	.045	190.36	.08

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
113.85	190.36	35.24	35.24	.3	.5

CROSS SECTION

RIVER: W Br Souadabscoo
REACH: Twin Bridg Reach RS: 10307.19

INPUT
Description: Upstream End of Culvert
Station Elevation Data num= 63

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	193.37	7.99	193.02	8.23	193	8.53	192.93	17.95	191.54
25.75	189.61	26.94	189.33	28.57	189.26	34.61	189.21	39.63	189.28
47.56	189.42	52.92	189.24	57.77	189.34	72.54	188.9	75.72	188.55
80.93	188.36	86.95	188.06	95.06	187.65	102.08	187.4	115.56	185.03
117.94	184.83	119.35	184.19	121.25	183.85	129.2	183.44	129.73	183.55
130.26	183.3	130.54	183.05	135.34	182.67	135.96	182.15	141.44	181.98
144.91	181.94	150.75	181.57	153.86	181.48	155.32	181.43	158.08	181.27
160.2	181.07	161.02	180.99	161.07	180.85	161.51	180.75	163.64	180.8
170.92	180.54	175.57	180.79	177.86	180.68	178.53	180.89	178.68	180.91
178.92	180.92	181.06	181.09	186.17	181.21	189.95	181.6	197.19	182.23

198.11	182.38	200.44	183.37	203.61	184.41	206.71	185.48	207.78	185.78
219.66	188.74	221.16	189.35	222.31	189.51	231.3	190.73	235.49	190.82
250.31	191.54	254.13	191.6	263.1	192.07				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.08	129.73	.045	200.44	.08

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
129.73	200.44	72.47	72.47	.3	.5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	157.6	193	F
205.6	263.1	194	F

BRIDGE

RIVER: W Br Souadabscoo
REACH: Twin Bridg Reach RS: 10267.96

INPUT
Description: Existing Twin Bridge Culvert
Distance from Upstream XS = 22
Deck/Roadway Width = 34.43
Weir Coefficient = 3
Upstream Deck/Roadway Coordinates
num= 31

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
0	194.8		36.81	194		86.95	193	
155.18	193		158.08	193.29		163.93	193.29	
163.93	193.29	182.24	164.72	193.29	183.55	165.65	193.29	184.77
166.71	193.44	185.88	167.87	193.44	186.86	169.14	193.44	187.72
170.49	193.44	188.44	171.92	193.44	189	173.39	193.44	189.41
174.9	193.44	189.66	176.43	193.44	189.74	177.96	193.44	189.66
179.47	193.44	189.41	180.94	193.44	189	182.37	193.44	188.44
183.72	193.44	187.72	184.99	193.44	186.86	186.15	193.44	185.88
187.21	193.44	184.77	188.14	193.44	183.55	188.93	193.44	182.24
188.93	193.44		234.95	194		241.32	193.8	
263.1	194.64							

Upstream Bridge Cross Section Data
Station Elevation Data num= 61

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	193.37	7.99	193.02	8.23	193	8.53	192.93	17.95	191.54
25.75	189.61	26.94	189.33	28.57	189.26	34.61	189.21	39.63	189.28
47.56	189.42	52.92	189.24	57.77	189.34	72.54	188.9	75.72	188.55
80.93	188.36	86.95	188.06	95.06	187.65	102.08	187.4	115.56	185.03
117.94	184.83	119.35	184.19	121.25	183.85	129.2	183.44	129.73	183.55
130.26	183.3	130.54	183.05	135.34	182.67	135.96	182.15	141.44	181.98
144.91	181.94	150.75	181.57	153.86	181.48	155.32	181.43	158.08	181.27
160.2	181.07	161.02	180.99	161.07	180.85	161.51	180.75	163.64	180.8
165.71	181	172.31	179.07	179.06	179.4	185.31	181	186.56	182
187.78	183	189.95	181.6	197.19	182.23	198.11	182.38	200.44	183.37
203.61	184.41	206.71	185.48	207.78	185.78	219.66	188.74	221.16	189.35
222.31	189.51	231.3	190.73	235.49	190.82	250.31	191.54	254.13	191.6
263.1	192.07								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.08	163.64	.045	189.95	.08

Bank Sta: Left	Right	Coeff Contr.	Expan.

```
        163.64  189.95              .3       .5
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0   157.6     193       F
   205.6   263.1     194       F

Downstream  Deck/Roadway Coordinates
    num=      31
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
       0  194.66           30.35     194           83.67     193
  157.27     193           165.42  193.29           167.89  193.29
  167.89  193.29  182.24  168.68  193.29  183.55  169.61  193.29  184.77
  170.67  193.29  185.88  171.83  193.29  186.86   173.1  193.29  187.72
  174.45  193.29  188.44  175.88  193.29     189  177.35  193.44  189.41
  178.86  193.44  189.66  180.39  193.44  189.74  181.92  193.44  189.66
  183.43  193.44  189.41   184.9  193.44     189  186.33  193.44  188.44
  187.68  193.44  187.72  188.95  193.44  186.86  190.11  193.44  185.88
  191.17  193.44  184.77   192.1  193.44  183.55  192.89  193.44  182.24
  192.89  193.44           235.53     194           241.51   193.8
  266.61   194.7

Downstream Bridge Cross Section Data
Station Elevation Data    num=      68
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  191.27   12.41  190.25    14.2  190.42   19.51  189.85   32.64  189.47
   37.34  188.83   44.51  187.64   49.49  186.67   52.71  186.38   54.31  185.98
   66.95  185.44   74.62  185.11   91.27   184.6   93.22  184.57   103.8  184.51
  115.72  184.03  117.33  183.97  122.53   183.8  123.93  183.74  130.16  184.01
   142.7  184.57  147.33   184.6   152.8   184.5   158.7  184.58  163.53  184.47
  164.49  184.12   164.7  184.05  165.92  183.33  166.92  183.06  167.62  183.31
  170.54     183  174.97  180.62  177.38   180.5  179.55  180.53  188.73     183
  190.62     184  191.36     184  192.58     183  196.07  182.25  196.44   182.3
  197.49  182.45  198.23  182.82  199.74  183.33  202.58   184.3  206.21  186.11
  208.22  186.55  212.52  187.13  215.45  187.41  223.82   187.6  225.65  187.71
  228.66  188.12  237.08  189.51  242.12  191.08  247.67  193.58  247.99  193.45
  249.86  193.86  251.09   193.8  251.58  193.89  252.64  193.99  255.04  194.25
  255.42  194.27  255.54   194.3  256.07  194.33  259.57   194.5  261.77  194.56
  263.08  194.61   265.7  194.67  266.61  194.69

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .08  167.62    .045  196.07     .08

Bank Sta: Left   Right    Coeff Contr.   Expan.
        167.62  196.07              .3       .5
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0   166.7   187.5       F
   195.9  266.61     193       F

Upstream Embankment side slope              =       1 horiz. to 1.0 vertical
Downstream Embankment side slope            =       1 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .95
Elevation at which weir flow begins         =
Energy head used in spillway design         =
Spillway height used in design              =
Weir crest shape                            = Broad Crested

Number of Bridge Coefficient Sets =  1

Low Flow Methods and Data
      Energy
Selected Low Flow Methods = Highest Energy Answer
```

```
High Flow Method
       Pressure and Weir flow
           Submerged Inlet Cd          =
           Submerged Inlet + Outlet Cd =      .8
           Max Low Cord                =

Additional Bridge Parameters
       Add Friction component to Momentum
       Do not add Weight component to Momentum
       Class B flow critical depth computations use critical depth
           inside the bridge at the upstream end
       Criteria to check for pressure flow = Upstream energy grade line

CROSS SECTION


RIVER: W Br Souadabscoo
REACH: Twin Bridg Reach   RS: 10234.73

INPUT
Description: Downstream End of Culvert
Station Elevation Data    num=      66
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  191.27   12.41  190.25    14.2  190.42   19.51  189.85   32.64  189.47
   37.34  188.83   44.51  187.64   49.49  186.67   52.71  186.38   54.31  185.98
   66.95  185.44   74.62  185.11   91.27   184.6   93.22  184.57   103.8  184.51
  115.72  184.03  117.33  183.97  122.53   183.8  123.93  183.74  130.16  184.01
   142.7  184.57  147.33   184.6   152.8   184.5   158.7  184.58  163.53  184.47
  164.49  184.12   164.7  184.05  165.92  183.33  166.92  183.06  175.23  181.85
  176.97  181.67  178.14   181.6  184.72  180.88  185.47  180.87  191.16  181.22
  191.98  181.24  196.07  182.25  196.44   182.3  197.49  182.45  198.23  182.82
  199.74  183.33  202.58   184.3  206.21  186.11  208.22  186.55  212.52  187.13
  215.45  187.41  223.82   187.6  225.65  187.71  228.66  188.12  237.08  189.51
  242.12  191.08  247.67  193.58  247.99  193.45  249.86  193.86  251.09   193.8
  251.58  193.89  252.64  193.99  255.04  194.25  255.42  194.27  255.54   194.3
  256.07  194.33  259.57   194.5  261.77  194.56  263.08  194.61   265.7  194.67
  266.61  194.69

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .08  163.53    .045  202.58     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.    Expan.
        163.53  202.58             60.15   60.15   60.15             .3       .5
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0   166.7   187.5         F
   195.9  266.61     193         F

CROSS SECTION


RIVER: W Br Souadabscoo
REACH: Twin Bridg Reach   RS: 10174.57

INPUT
Description:
Station Elevation Data    num=      55
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  189.73   21.92  188.82    42.5     188   43.52     188   57.83  187.21
    74.1     186   82.69     186   97.16  184.92  102.15  184.71  116.74     184
  164.62     184  165.62  183.83  170.56  182.99  172.38  182.74  173.75  182.04
```

173.81	181.97	174.12	181.62	175.63	181.56	179.44	181.5	181.65	181.43
184.68	181.48	187.06	181.15	189.93	181.01	194.32	180.74	197.33	180.71
199.16	181.26	200.59	182.09	203.33	182.77	206.25	184.21	224.61	191.36
232.88	193.43	233.52	193.72	234.96	194	235.23	193.9	235.26	193.65
235.41	193.74	235.71	193.72	235.96	193.75	236.03	193.71	236.4	193.78
236.52	193.79	237.08	193.81	237.92	193.83	237.97	193.83	238.37	193.85
241.45	193.95	244.21	194.01	245.28	194.04	247.15	194.11	247.44	194.08
247.96	194.08	248.51	194.07	250.45	194.03	252.04	194	252.8	193.98

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.08	164.62	.045	206.25	.08

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
164.62	206.25	97.88	97.88	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	129.65	187	F
218	252.8	193	F

CROSS SECTION

RIVER: W Br Souadabscoo
REACH: Twin Bridg Reach RS: 10076.69

INPUT
Description: Lidar generated with one added point at sta 202
Station Elevation Data num= 49

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	190	1.11	190	5.55	189.8	6.92	189.75	7.55	189.72
10.79	189.57	12.39	189.49	13.94	189.42	29.94	188.63	40.1	188.23
44.87	188	46.65	188	46.96	187.92	47.21	187.85	53.81	186
56.47	185.48	58.54	185.1	62.31	184	159.36	184	159.61	183.98
159.93	183.97	176.75	182.98	183.58	182.52	191.83	181.95	193.55	181.74
202	180	210.26	183.51	212.6	183.5	214.09	183.88	214.69	184.32
216.7	186	217.13	186.31	219.14	188	219.56	188.3	223.22	190
223.33	190.09	225.27	190.3	231.61	191.27	236.39	192	237.43	192.11
241.17	192.21	273.26	193.59	279.94	193.88	282.51	193.93	283.14	194
285.03	194	291.67	194.65	291.72	194.65	293.04	194.74		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.08	159.93	.045	210.26	.08

Bank Sta: Left	Right	Coeff Contr.	Expan.
159.93	210.26	.1	.3

HEC-RAS HEC-RAS 5.0.3 September 2016
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X       X   X     X  X    X
X     X  X        X            X   X    X    X   X
XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
X     X  X        X            X  X     X    X        X
X     X  X        X    X       X   X    X    X        X
X     X  XXXXXX    XXXX        X    X   X    X   XXXXX
```

PROJECT DATA
Project Title: HampdenMaineRev2
Project File : HampdenMaineRev2.prj
Run Date and Time: 2/13/2019 5:05:12 PM

Project in English units

PLAN DATA

Plan Title: Proposed 2019 0.045
Plan File : C:\Work - New\Hampden Maine\Hydraulics 2019 Work\Proposed Conditions HEC-RAS by Greg Shaffer\Hampden 2019 RAS\HampdenMaineRev2.p01

Geometry Title: Hampden-Proposed-Geo-2019-0.045
Geometry File : C:\Work - New\Hampden Maine\Hydraulics 2019 Work\Proposed Conditions HEC-RAS by Greg Shaffer\Hampden 2019 RAS\HampdenMaineRev2.g02

Flow Title   : All Flows
Flow File   : C:\Work - New\Hampden Maine\Hydraulics 2019 Work\Proposed Conditions HEC-RAS by Greg Shaffer\Hampden 2019 RAS\HampdenMaineRev2.f01

Plan Description:
Bank Manning's: 0.08
Channel: 0.045

Plan Summary Information:

Number of: Cross Sections	=	8	Multiple Openings	=	0
Culverts	=	0	Inline Structures	=	0
Bridges	=	1	Lateral Structures	=	0

Computational Information

Water surface calculation tolerance	= 0.01
Critical depth calculation tolerance	= 0.01
Maximum number of iterations	= 20
Maximum difference tolerance	= 0.3
Flow tolerance factor	= 0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance

Computational Flow Regime: Mixed Flow

FLOW DATA

Flow Title: All Flows
Flow File : C:\Work - New\Hampden Maine\Hydraulics 2019 Work\Proposed Conditions HEC-RAS by Greg Shaffer\Hampden 2019 RAS\HampdenMaineRev2.f01

Flow Data (cfs)

River	Reach	RS	1.1 yr	2 yr	5 yr	10 yr	25 yr	50 yr	100 yr	500 yr
W Br Souadabscoo	Twin Bridg Reach	10486.57	247	501	781	989	1268	1488	1724	2308

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
W Br Souadabscoo	Twin Bridg Reach	1.1 yr	Normal S = 0.01	Normal S = 0.0073
W Br Souadabscoo	Twin Bridg Reach	2 yr	Normal S = 0.01	Normal S = 0.0073
W Br Souadabscoo	Twin Bridg Reach	5 yr	Normal S = 0.01	Normal S = 0.0073
W Br Souadabscoo	Twin Bridg Reach	10 yr	Normal S = 0.01	Normal S = 0.0073
W Br Souadabscoo	Twin Bridg Reach	25 yr	Normal S = 0.01	Normal S = 0.0073
W Br Souadabscoo	Twin Bridg Reach	50 yr	Normal S = 0.01	Normal S = 0.0073
W Br Souadabscoo	Twin Bridg Reach	100 yr	Normal S = 0.01	Normal S = 0.0073
W Br Souadabscoo	Twin Bridg Reach	500 yr	Normal S = 0.01	Normal S = 0.0073

GEOMETRY DATA

Geometry Title: Hampden-Proposed-Geo-2019-0.045
Geometry File : C:\Work - New\Hampden Maine\Hydraulics 2019 Work\Proposed Conditions HEC-RAS by Greg Shaffer\Hampden 2019 RAS\HampdenMaineRev2.g02

CROSS SECTION

RIVER: W Br Souadabscoo

REACH: Twin Bridg Reach RS: 10486.57

INPUT
Description: Lidar generated with added data below El 190
Station Elevation Data num= 21

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	194	5.88	194	45.49	192.77	53.6	192.47	65.88	192
72.43	191.29	80.1	190.61	82.78	190.35	86.25	190	107	184
128	184	149.48	190	165.06	191.89	165.53	191.95	166.17	192
185.28	192	199.11	192.48	226.35	193.45	248.65	194	272.01	194
274.85	194.25								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.08	86.25	.045	149.48	.08

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
86.25	149.48	93.73	93.73	.1	.3

CROSS SECTION

RIVER: W Br Souadabscoo
REACH: Twin Bridg Reach RS: 10392.84

INPUT
Description: Upper Ledge Falls
Station Elevation Data num= 38

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	192.92	4.15	192.84	12.46	192.65	18.53	192.53	30.09	192
56.55	192	57.96	191.92	58.55	191.88	60.52	191.75	84.19	190
88.85	190	90.28	189.76	94.4	188.85	95.53	188.6	96.1	188.47
98.05	188	120.28	188	126.56	188.11	130.23	187.09	131.94	187.66
133.7	188.27	133.83	188.7	134.51	190	136.48	190.74	136.8	190.82
139.99	192	172.64	192	174.24	192.1	174.35	192.11	175.5	192.18
205.65	192.68	206.53	192.88	208.84	192.82	210.73	192.87	216.74	193.2
221.77	194	261.99	194	269.39	194.52				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.08	96.1	.045	133.7	.08

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
96.1	133.7	26.38	26.38	.1	.3

CROSS SECTION

RIVER: W Br Souadabscoo
REACH: Twin Bridg Reach RS: 10366.46

INPUT
Description: Middle Ledge Falls
Station Elevation Data num= 74

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	192.97	2.4	192.88	5.35	192.77	13.81	191.85	16.5	191.75
19.57	191.65	24.4	191.48	25.13	191.53	25.38	191.45	30.71	191.24
35.31	190.81	45.14	190.58	46.98	190.52	56.81	190.01	59.4	189.79
64.31	189.54	65.28	189.52	70.69	190	72.85	190	76.67	189.36
78.11	189.28	79.74	189.14	91.34	188	97.25	187.65	107.08	187.54
110.87	187.64	111.76	187.65	113.53	187.57	113.87	187.17	114.64	186.33
115.18	186.17	115.8	185.65	115.81	186.28	115.95	186.31	116.47	186.28
123.41	186.48	123.76	186.55	126.53	186.67	132.57	186.84	133.86	186.82

139.93	186	141.96	186.16	147.27	186.14	148.07	186.11	148.61	185.94
150.49	185.73	151.43	185.87	152.85	185.78	154.14	185.8	158.83	186.92
158.88	186.94	158.96	186.94	162.27	187.14	163.67	188	166.3	189.78
167	190	171.36	190.32	176.54	190.47	183.89	190.33	184.22	190.32
187.55	190.35	189.78	190.38	191.6	190.5	195.17	190.59	199.34	191.26
200.15	191.36	201.6	191.53	206.02	192	232.76	192	238.86	192.76
243.11	193.2	246.71	193.45	257.08	194	263.69	194		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.08	113.87	.045	158.88	.08

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
113.87	158.88	24.02	24.02	.1	.3

CROSS SECTION

RIVER: W Br Souadabscoo
REACH: Twin Bridg Reach RS: 10342.43

INPUT
Description: Lower Ledge Falls
Station Elevation Data num= 74

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	193.02	3.24	192.89	4.83	192.82	9.35	192.32	19.63	191.19
26.3	189.88	27.7	189.84	29.55	189.68	40.64	189.71	42.41	189.78
47.65	189.62	54.3	189.75	54.49	189.73	61.18	188.99	65.7	188.47
67.92	188.21	74.94	187.9	79.7	188.16	89.03	187.82	90.68	187.72
96.42	187.37	109.7	186.94	110.21	186.89	110.35	186.82	113.85	183.77
114.29	183.18	114.39	183.11	118.03	183.13	120.33	182.89	125.15	182.45
127.42	182.25	127.94	182.33	129.33	182.34	134.73	183.07	134.85	183.09
135.13	183.12	139.82	183.37	141.7	183.82	143.2	183.91	144.79	184.02
145.71	184.04	147.32	183.14	147.35	183.1	147.56	182.81	148.33	182.25
149.57	181.45	150.33	181.39	151.91	181.29	155.49	180.98	163.42	180.61
166.31	180.37	167.91	180.03	169.33	180.09	176.16	180.2	178.42	180.29
180.58	180.72	183.99	181.77	184.65	181.88	190.36	183.32	191.24	183.65
194.91	185.38	196.3	186.1	204.12	188	206.12	188	210.83	188.3
212.22	188.38	215.32	188.73	225.02	190	233.62	190.95	242.76	192
245.79	192	259.13	192.67	265.38	193.04	267.01	193.13		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.08	113.85	.045	190.36	.08

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
113.85	190.36	35.24	35.24	.3	.5

CROSS SECTION

RIVER: W Br Souadabscoo
REACH: Twin Bridg Reach RS: 10307.19

INPUT
Description: Upstream End of Culvert
Station Elevation Data num= 44

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	193.37	7.99	193.02	8.23	193	8.53	192.93	17.95	191.54
25.75	189.61	26.94	189.33	28.57	189.26	34.61	189.21	39.63	189.28
47.56	189.42	52.92	189.24	57.77	189.34	72.54	188.9	75.72	188.55
80.93	188.36	86.95	188.06	95.06	187.65	102.08	187.4	104.63	187
109.9	186	119.63	185	143.52	184	148	183	151.15	182

155.55	181	179.93	181	181.06	181.09	186.17	181.21	189.95	181.6
197.19	182.23	198.11	182.38	200.44	183.37	203.61	184.41	206.71	185.48
207.78	185.78	219.66	188.74	221.16	189.35	222.31	189.51	231.3	190.73
235.49	190.82	250.31	191.54	254.13	191.6	263.1	192.07		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.08	143.52	.045	203.61	.08

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
143.52	203.61	72.47	72.47	.3	.5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	140.11	192.45	F
200.07	263.1	192.49	F

BRIDGE

RIVER: W Br Souadabscoo
REACH: Twin Bridg Reach RS: 10267.96

INPUT
Description: Existing Twin Bridge Culvert
Distance from Upstream XS = 22
Deck/Roadway Width = 34.43
Weir Coefficient = 3
Upstream Deck/Roadway Coordinates
num= 32

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
0	194.8		36.81	194		86.95	193	
143.87	193	190.49	158.08	193.29	190.49	163.93	193.29	190.49
163.93	193.29	190.49	164.72	193.29	190.49	165.65	193.29	190.49
166.71	193.44	190.49	167.87	193.44	190.49	169.14	193.44	190.49
170.49	193.44	190.49	171.92	193.44	190.49	173.39	193.44	190.49
174.9	193.44	190.49	176.43	193.44	190.49	177.96	193.44	190.49
179.47	193.44	190.49	180.94	193.44	190.49	182.37	193.44	190.49
183.72	193.44	190.49	184.99	193.44	190.49	186.15	193.44	190.49
187.21	193.44	190.49	188.14	193.44	190.49	188.93	193.44	190.49
188.93	193.44	190.49	193.55	193.44	190.49	234.95	194	
241.32	193.8		263.1	194.64				

Upstream Bridge Cross Section Data
Station Elevation Data num= 44

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	193.37	7.99	193.02	8.23	193	8.53	192.93	17.95	191.54
25.75	189.61	26.94	189.33	28.57	189.26	34.61	189.21	39.63	189.28
47.56	189.42	52.92	189.24	57.77	189.34	72.54	188.9	75.72	188.55
80.93	188.36	86.95	188.06	95.06	187.65	102.08	187.4	104.63	187
109.9	186	119.63	185	143.87	185	147.49	185	149.56	184
151.63	183	153.7	182	155.77	181	181.65	181	183.72	182
185.79	183	187.86	184	189.93	185	193.55	185	206.71	185.48
207.78	185.78	219.66	188.74	221.16	189.35	222.31	189.51	231.3	190.73
235.49	190.82	250.31	191.54	254.13	191.6	263.1	192.07		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.08	149.56	.045	187.86	.08

Bank Sta: Left	Right	Coeff Contr.	Expan.
143.87	193.55	.3	.5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent

```
      0  140.11  192.45       F
  200.07   263.1  192.49       F

Downstream  Deck/Roadway Coordinates
    num=      31
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
       0  194.66           30.35     194           83.67     193
  157.27     193          162.36  193.29  190.49  167.89  193.29  190.49
  168.68  193.29  190.49  169.61  193.29  190.49  170.67  193.29  190.49
  171.83  193.29  190.49   173.1  193.29  190.49  174.45  193.29  190.49
  175.88  193.29  190.49  177.35  193.44  190.49  178.86  193.44  190.49
  180.39  193.44  190.49  181.92  193.44  190.49  183.43  193.44  190.49
   184.9  193.44  190.49  186.33  193.44  190.49  187.68  193.44  190.49
  188.95  193.44  190.49  190.11  193.44  190.49  191.17  193.44  190.49
   192.1  193.44  190.49  192.89  193.44  190.49  192.89  193.44  190.49
  212.05   193.7  190.49  235.53     194          241.51   193.8
  266.61   194.7

Downstream Bridge Cross Section Data
Station Elevation Data    num=      48
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  191.27   12.41  190.25    14.2  190.42   19.51  189.85   32.64  189.47
   37.34  188.83   44.51  187.64   49.49  186.67   52.71  186.38   54.31  185.98
   66.95  185.44   74.62  185.11   91.74     185  144.77     185  156.43     185
  162.36     185  165.98     185  168.05     184  170.12     183  172.19     182
  174.26     181  199.78     181  201.79     182  203.79     183  206.33     184
  208.43     185  212.05     185  215.45     186  223.82   187.6  225.65  187.71
  228.66  188.12  237.08  189.51  242.12  191.08  247.67  193.58  247.99  193.45
  249.86  193.86  251.09   193.8  251.58  193.89  252.64  193.99  255.04  194.25
  255.42  194.27  255.54   194.3  256.07  194.33  259.57   194.5  261.77  194.56
  263.08  194.61   265.7  194.67  266.61  194.69

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .08  168.05    .045  201.79     .08

Bank Sta: Left   Right    Coeff Contr.   Expan.
        162.36  212.05            .3       .5
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0  154.63     192       F
  215.22  266.61     192       F

Upstream Embankment side slope              =       1 horiz. to 1.0 vertical
Downstream Embankment side slope            =       1 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .95
Elevation at which weir flow begins         =
Energy head used in spillway design         =
Spillway height used in design              =
Weir crest shape                            = Broad Crested

Number of Bridge Coefficient Sets =  1

Low Flow Methods and Data
       Energy
       Momentum               Cd   =     1.2
Selected Low Flow Methods = Highest Energy Answer

High Flow Method
       Pressure and Weir flow
           Submerged Inlet Cd          =
           Submerged Inlet + Outlet Cd =      .8
           Max Low Cord                =
                                       Page 6
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Additional Bridge Parameters
       Add Friction component to Momentum
       Do not add Weight component to Momentum
       Class B flow critical depth computations use critical depth
           inside the bridge at the upstream end
       Criteria to check for pressure flow = Upstream energy grade line

CROSS SECTION


RIVER: W Br Souadabscoo
REACH: Twin Bridg Reach   RS: 10234.73

INPUT
Description: Downstream End of Culvert
Station Elevation Data    num=      56
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  191.27   12.41  190.25    14.2  190.42   19.51  189.85   32.64  189.47
   37.34  188.83   44.51  187.64   49.49  186.67   52.71  186.38   54.31  185.98
   66.95  185.44   74.62  185.11   91.74     185  144.77     185  156.43     185
  168.05     184  170.11     183  173.86     182  175.23  181.85  176.97  181.67
  178.14   181.6  184.72  180.88  185.47  180.87  191.16  181.22  191.98  181.24
  196.07  182.25  196.44   182.3  197.49  182.45  198.23  182.82  199.74  183.33
  201.71     184   204.6     185   208.1     186   210.1     187  212.52  187.13
  215.45  187.41  223.82   187.6  225.65  187.71  228.66  188.12  237.08  189.51
  242.12  191.08  247.67  193.58  247.99  193.45  249.86  193.86  251.09   193.8
  251.58  193.89  252.64  193.99  255.04  194.25  255.42  194.27  255.54   194.3
  256.07  194.33  259.57   194.5  261.77  194.56  263.08  194.61   265.7  194.67
  266.61  194.69

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .08  168.05    .045  201.71     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        168.05  201.71             60.15   60.15   60.15             .3       .5
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0  154.63     192        F
  215.22  266.61     192        F

CROSS SECTION


RIVER: W Br Souadabscoo
REACH: Twin Bridg Reach   RS: 10174.57

INPUT
Description:
Station Elevation Data    num=      55
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  189.73   21.92  188.82    42.5     188   43.52     188   57.83  187.21
    74.1     186   82.69     186   97.16  184.92  102.15  184.71  116.74     184
  164.62     184  165.62  183.83  170.56  182.99  172.38  182.74  173.75  182.04
  173.81  181.97  174.12  181.62  175.63  181.56  179.44   181.5  181.65  181.43
  184.68  181.48  187.06  181.15  189.93  181.01  194.32  180.74  197.33  180.71
  199.16  181.26  200.59  182.09  203.33  182.77  206.25  184.21  224.61  191.36
  232.88  193.43  233.52  193.72  234.96     194  235.23   193.9  235.26  193.65
  235.41  193.74  235.71  193.72  235.96  193.75  236.03  193.71   236.4  193.78
  236.52  193.79  237.08  193.81  237.92  193.83  237.97  193.83  238.37  193.85
  241.45  193.95  244.21  194.01  245.28  194.04  247.15  194.11  247.44  194.08
  247.96  194.08  248.51  194.07  250.45  194.03  252.04     194   252.8  193.98
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Manning's n Values         num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .08  164.62    .045  206.25     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.    Expan.
        164.62  206.25             97.88   97.88   97.88             .1       .3
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0  129.65     187       F
     218   252.8     193       F

CROSS SECTION


RIVER: W Br Souadabscoo
REACH: Twin Bridg Reach   RS: 10076.69

INPUT
Description: Lidar generated with one added point at sta 202
Station Elevation Data    num=      49
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     190    1.11     190    5.55   189.8    6.92  189.75    7.55  189.72
   10.79  189.57   12.39  189.49   13.94  189.42   29.94  188.63    40.1  188.23
   44.87     188   46.65     188   46.96  187.92   47.21  187.85   53.81     186
   56.47  185.48   58.54   185.1   62.31     184  159.36     184  159.61  183.98
  159.93  183.97  176.75  182.98  183.58  182.52  191.83  181.95  193.55  181.74
     202     180  210.26  183.51   212.6   183.5  214.09  183.88  214.69  184.32
   216.7     186  217.13  186.31  219.14     188  219.56   188.3  223.22     190
  223.33  190.09  225.27   190.3  231.61  191.27  236.39     192  237.43  192.11
  241.17  192.21  273.26  193.59  279.94  193.88  282.51  193.93  283.14     194
  285.03     194  291.67  194.65  291.72  194.65  293.04  194.74

Manning's n Values         num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .08  159.93    .045  210.26     .08

Bank Sta: Left   Right    Coeff Contr.    Expan.
        159.93  210.26             .1       .3
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HEC-RAS River: W Br Souadabscoo Reach: Twin Bridg Reach

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Twin Bridg Reach	10486.57	1.1 yr	Exist Cond	247.00	184.00	189.69	185.48	189.71	0.000177	1.06	233.60	61.07	0.10
Twin Bridg Reach	10486.57	1.1 yr	Prop 2019 0.045	247.00	184.00	189.69	185.48	189.71	0.000177	1.06	233.60	61.07	0.10
Twin Bridg Reach	10486.57	2 yr	Exist Cond	501.00	184.00	190.70	186.27	190.75	0.000342	1.68	301.70	76.24	0.14
Twin Bridg Reach	10486.57	2 yr	Prop 2019 0.045	501.00	184.00	190.70	186.27	190.75	0.000342	1.68	301.70	76.24	0.14
Twin Bridg Reach	10486.57	5 yr	Exist Cond	781.00	184.00	191.58	186.94	191.66	0.000461	2.19	376.08	92.78	0.16
Twin Bridg Reach	10486.57	5 yr	Prop 2019 0.045	781.00	184.00	191.58	186.94	191.66	0.000461	2.19	376.08	92.78	0.16
Twin Bridg Reach	10486.57	10 yr	Exist Cond	989.00	184.00	192.11	187.36	192.21	0.000540	2.52	430.24	125.60	0.18
Twin Bridg Reach	10486.57	10 yr	Prop 2019 0.045	989.00	184.00	192.11	187.36	192.21	0.000540	2.52	430.24	125.60	0.18
Twin Bridg Reach	10486.57	25 yr	Exist Cond	1268.00	184.00	192.74	187.87	192.86	0.000619	2.88	519.38	159.95	0.20
Twin Bridg Reach	10486.57	25 yr	Prop 2019 0.045	1268.00	184.00	192.74	187.87	192.86	0.000619	2.88	519.37	159.95	0.20
Twin Bridg Reach	10486.57	50 yr	Exist Cond	1488.00	184.00	193.17	188.23	193.31	0.000669	3.12	594.20	185.88	0.21
Twin Bridg Reach	10486.57	50 yr	Prop 2019 0.045	1488.00	184.00	193.17	188.23	193.31	0.000669	3.12	594.19	185.88	0.21
Twin Bridg Reach	10486.57	100 yr	Exist Cond	1724.00	184.00	193.61	188.56	193.78	0.000705	3.33	682.92	214.72	0.21
Twin Bridg Reach	10486.57	100 yr	Prop 2019 0.045	1724.00	184.00	193.61	188.56	193.78	0.000705	3.33	682.91	214.72	0.21
Twin Bridg Reach	10486.57	500 yr	Exist Cond	2308.00	184.00	194.29	189.34	194.51	0.000882	3.95	850.34	274.85	0.24
Twin Bridg Reach	10486.57	500 yr	Prop 2019 0.045	2308.00	184.00	194.29	189.34	194.51	0.000882	3.95	850.48	274.85	0.24
Twin Bridg Reach	10392.84	1.1 yr	Exist Cond	247.00	187.09	189.05	189.05	189.60	0.029529	5.98	41.96	40.50	1.01
Twin Bridg Reach	10392.84	1.1 yr	Prop 2019 0.045	247.00	187.09	189.05	189.05	189.60	0.029529	5.98	41.96	40.50	1.01
Twin Bridg Reach	10392.84	2 yr	Exist Cond	501.00	187.09	189.71	189.71	190.56	0.024630	7.48	69.78	43.83	1.00
Twin Bridg Reach	10392.84	2 yr	Prop 2019 0.045	501.00	187.09	189.71	189.71	190.56	0.024630	7.48	69.78	43.83	1.00
Twin Bridg Reach	10392.84	5 yr	Exist Cond	781.00	187.09	190.35	190.35	191.42	0.020530	8.42	101.63	56.01	0.96
Twin Bridg Reach	10392.84	5 yr	Prop 2019 0.045	781.00	187.09	190.35	190.35	191.42	0.020530	8.42	101.63	56.01	0.96
Twin Bridg Reach	10392.84	10 yr	Exist Cond	989.00	187.09	190.77	190.77	191.95	0.018575	8.92	126.50	62.83	0.94
Twin Bridg Reach	10392.84	10 yr	Prop 2019 0.045	989.00	187.09	190.77	190.77	191.95	0.018575	8.92	126.50	62.83	0.94
Twin Bridg Reach	10392.84	25 yr	Exist Cond	1268.00	187.09	191.24	191.24	192.58	0.017487	9.58	157.65	70.47	0.93
Twin Bridg Reach	10392.84	25 yr	Prop 2019 0.045	1268.00	187.09	191.24	191.24	192.58	0.017487	9.58	157.65	70.47	0.93
Twin Bridg Reach	10392.84	50 yr	Exist Cond	1488.00	187.09	191.61	191.61	193.01	0.016205	9.91	184.94	76.50	0.91
Twin Bridg Reach	10392.84	50 yr	Prop 2019 0.045	1488.00	187.09	191.61	191.61	193.01	0.016205	9.91	184.94	76.50	0.91
Twin Bridg Reach	10392.84	100 yr	Exist Cond	1724.00	187.09	191.85	191.85	193.45	0.017052	10.61	204.27	80.67	0.95
Twin Bridg Reach	10392.84	100 yr	Prop 2019 0.045	1724.00	187.09	191.85	191.85	193.45	0.017052	10.61	204.27	80.67	0.95
Twin Bridg Reach	10392.84	500 yr	Exist Cond	2308.00	187.09	193.13	193.13	194.23	0.009172	9.39	419.88	215.37	0.73
Twin Bridg Reach	10392.84	500 yr	Prop 2019 0.045	2308.00	187.09	193.12	193.12	194.23	0.009186	9.40	419.55	215.35	0.73
Twin Bridg Reach	10366.46	1.1 yr	Exist Cond	247.00	185.65	186.98	187.31	188.12	0.126829	8.58	28.81	45.55	1.89
Twin Bridg Reach	10366.46	1.1 yr	Prop 2019 0.045	247.00	185.65	186.98	187.31	188.12	0.126829	8.58	28.81	45.55	1.89
Twin Bridg Reach	10366.46	2 yr	Exist Cond	501.00	185.65	187.34	187.94	189.24	0.117779	11.08	46.01	48.86	1.96
Twin Bridg Reach	10366.46	2 yr	Prop 2019 0.045	501.00	185.65	187.34	187.94	189.24	0.117779	11.08	46.01	48.86	1.96
Twin Bridg Reach	10366.46	5 yr	Exist Cond	781.00	185.65	187.66	188.44	190.23	0.109825	12.92	63.14	66.11	1.98
Twin Bridg Reach	10366.46	5 yr	Prop 2019 0.045	781.00	185.65	187.66	188.44	190.23	0.109825	12.92	63.14	66.11	1.98
Twin Bridg Reach	10366.46	10 yr	Exist Cond	989.00	185.65	187.87	188.75	190.81	0.104675	13.92	77.47	70.01	1.98
Twin Bridg Reach	10366.46	10 yr	Prop 2019 0.045	989.00	185.65	187.87	188.75	190.81	0.104675	13.92	77.47	70.01	1.98
Twin Bridg Reach	10366.46	25 yr	Exist Cond	1268.00	185.65	190.50	189.12	190.92	0.004561	5.65	319.25	144.34	0.49
Twin Bridg Reach	10366.46	25 yr	Prop 2019 0.045	1268.00	185.65	188.13	189.12	191.46	0.098631	14.97	95.96	73.85	1.97
Twin Bridg Reach	10366.46	50 yr	Exist Cond	1488.00	185.65	190.96	189.41	191.38	0.004084	5.73	391.08	163.79	0.47
Twin Bridg Reach	10366.46	50 yr	Prop 2019 0.045	1488.00	185.65	188.31	189.41	191.93	0.095393	15.71	109.61	75.98	1.97
Twin Bridg Reach	10366.46	100 yr	Exist Cond	1724.00	185.65	191.73	189.73	192.06	0.002826	5.28	524.43	186.43	0.40
Twin Bridg Reach	10366.46	100 yr	Prop 2019 0.045	1724.00	185.65	188.51	189.73	192.35	0.090616	16.30	124.69	78.25	1.95
Twin Bridg Reach	10366.46	500 yr	Exist Cond	2308.00	185.65	193.63	190.26	193.82	0.001262	4.31	958.18	250.01	0.28
Twin Bridg Reach	10366.46	500 yr	Prop 2019 0.045	2308.00	185.65	188.93	190.26	193.34	0.084063	17.69	159.03	83.21	1.94
Twin Bridg Reach	10342.43	1.1 yr	Exist Cond	247.00	180.03	184.78	181.82	184.80	0.000289	1.12	223.33	80.95	0.12
Twin Bridg Reach	10342.43	1.1 yr	Prop 2019 0.045	247.00	180.03	184.59	181.82	184.61	0.000365	1.20	207.63	80.31	0.13
Twin Bridg Reach	10342.43	2 yr	Exist Cond	501.00	180.03	186.17	182.61	186.21	0.000314	1.52	339.38	85.52	0.13
Twin Bridg Reach	10342.43	2 yr	Prop 2019 0.045	501.00	180.03	185.65	182.61	185.70	0.000489	1.74	294.99	83.74	0.16
Twin Bridg Reach	10342.43	5 yr	Exist Cond	781.00	180.03	187.64	183.25	187.69	0.000280	1.75	477.74	110.70	0.13
Twin Bridg Reach	10342.43	5 yr	Prop 2019 0.045	781.00	180.03	186.48	183.25	186.55	0.000605	2.21	365.72	87.12	0.18
Twin Bridg Reach	10342.43	10 yr	Exist Cond	989.00	180.03	188.79	183.54	188.84	0.000235	1.80	633.35	152.90	0.12
Twin Bridg Reach	10342.43	10 yr	Prop 2019 0.045	989.00	180.03	187.03	183.54	187.12	0.000664	2.49	414.18	93.04	0.19
Twin Bridg Reach	10342.43	25 yr	Exist Cond	1268.00	180.03	190.76		190.80	0.000147	1.69	993.04	210.05	0.10
Twin Bridg Reach	10342.43	25 yr	Prop 2019 0.045	1268.00	180.03	187.70	183.91	187.82	0.000715	2.81	483.96	111.85	0.21
Twin Bridg Reach	10342.43	50 yr	Exist Cond	1488.00	180.03	191.21		191.26	0.000165	1.85	1089.23	216.42	0.11
Twin Bridg Reach	10342.43	50 yr	Prop 2019 0.045	1488.00	180.03	188.20	184.17	188.34	0.000740	3.02	545.69	141.06	0.21
Twin Bridg Reach	10342.43	100 yr	Exist Cond	1724.00	180.03	191.92		191.97	0.000164	1.93	1247.34	229.05	0.11
Twin Bridg Reach	10342.43	100 yr	Prop 2019 0.045	1724.00	180.03	188.72	184.39	188.87	0.000742	3.19	622.25	151.70	0.22
Twin Bridg Reach	10342.43	500 yr	Exist Cond	2308.00	180.03	193.71		193.77	0.000146	2.04	1704.32	267.01	0.10
Twin Bridg Reach	10342.43	500 yr	Prop 2019 0.045	2308.00	180.03	190.03	184.95	190.20	0.000691	3.45	843.09	199.70	0.21
Twin Bridg Reach	10307.19	1.1 yr	Exist Cond	247.00	180.54	184.74	182.16	184.78	0.000466	1.64	153.29	86.42	0.15
Twin Bridg Reach	10307.19	1.1 yr	Prop 2019 0.045	247.00	181.00	184.56	182.21	184.59	0.000457	1.46	170.99	73.82	0.15
Twin Bridg Reach	10307.19	2 yr	Exist Cond	501.00	180.54	186.09	182.82	186.18	0.000634	2.37	218.15	99.53	0.19
Twin Bridg Reach	10307.19	2 yr	Prop 2019 0.045	501.00	181.00	185.59	182.80	185.67	0.000691	2.18	233.19	93.27	0.19
Twin Bridg Reach	10307.19	5 yr	Exist Cond	781.00	180.54	187.53	183.40	187.65	0.000639	2.83	287.11	116.38	0.20
Twin Bridg Reach	10307.19	5 yr	Prop 2019 0.045	781.00	181.00	186.39	183.32	186.51	0.000914	2.83	280.94	102.39	0.23
Twin Bridg Reach	10307.19	10 yr	Exist Cond	989.00	180.54	188.66	183.78	188.80	0.000584	3.02	341.52	144.67	0.20
Twin Bridg Reach	10307.19	10 yr	Prop 2019 0.045	989.00	181.00	186.91	183.67	187.07	0.001039	3.23	312.15	107.22	0.25
Twin Bridg Reach	10307.19	25 yr	Exist Cond	1268.00	180.54	190.62	184.24	190.76	0.000435	3.05	435.40	208.82	0.18
Twin Bridg Reach	10307.19	25 yr	Prop 2019 0.045	1268.00	181.00	187.55	184.06	187.76	0.001167	3.69	350.47	117.03	0.27
Twin Bridg Reach	10307.19	50 yr	Exist Cond	1488.00	180.54	191.03	184.59	191.21	0.000518	3.42	455.17	219.83	0.19
Twin Bridg Reach	10307.19	50 yr	Prop 2019 0.045	1488.00	181.00	188.02	184.36	188.27	0.001244	4.01	378.87	129.13	0.28
Twin Bridg Reach	10307.19	100 yr	Exist Cond	1724.00	180.54	191.71	184.94	191.91	0.000555	3.70	487.55	239.33	0.20
Twin Bridg Reach	10307.19	100 yr	Prop 2019 0.045	1724.00	181.00	188.51	184.65	188.80	0.001307	4.32	408.15	141.99	0.29
Twin Bridg Reach	10307.19	500 yr	Exist Cond	2308.00	180.54	193.70	185.74	193.76	0.000150	2.12	1565.85	263.10	0.11
Twin Bridg Reach	10307.19	500 yr	Prop 2019 0.045	2308.00	181.00	189.74	185.31	190.11	0.001356	4.90	481.74	198.78	0.30

HEC-RAS River: W Br Souadabscoo Reach: Twin Bridg Reach (Continued)

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Twin Bridg Reach	10267.96			Bridge									
Twin Bridg Reach	10234.73	1.1 yr	Exist Cond	247.00	180.87	184.31	182.96	184.47	0.002582	3.19	77.36	66.91	0.35
Twin Bridg Reach	10234.73	1.1 yr	Prop 2019 0.045	247.00	180.87	184.32	182.94	184.47	0.002697	3.04	82.05	38.36	0.34
Twin Bridg Reach	10234.73	2 yr	Exist Cond	501.00	180.87	185.08	183.76	185.47	0.004571	5.03	99.63	128.40	0.48
Twin Bridg Reach	10234.73	2 yr	Prop 2019 0.045	501.00	180.87	185.10	183.78	185.43	0.004250	4.59	116.51	129.38	0.45
Twin Bridg Reach	10234.73	5 yr	Exist Cond	781.00	180.87	185.55	184.48	186.28	0.007230	6.89	113.34	140.59	0.62
Twin Bridg Reach	10234.73	5 yr	Prop 2019 0.045	781.00	180.87	185.61	184.50	186.17	0.006068	6.06	142.65	143.88	0.55
Twin Bridg Reach	10234.73	10 yr	Exist Cond	989.00	180.87	184.20	184.96	186.97	0.047757	13.34	74.12	61.04	1.48
Twin Bridg Reach	10234.73	10 yr	Prop 2019 0.045	989.00	180.87	185.92	184.97	186.65	0.007300	7.00	158.75	152.11	0.62
Twin Bridg Reach	10234.73	25 yr	Exist Cond	1268.00	180.87	184.57	185.55	188.04	0.050037	14.95	84.84	102.19	1.55
Twin Bridg Reach	10234.73	25 yr	Prop 2019 0.045	1268.00	180.87	186.27	185.55	187.25	0.008832	8.15	177.62	155.50	0.69
Twin Bridg Reach	10234.73	50 yr	Exist Cond	1488.00	180.87	184.83	185.98	188.86	0.051949	16.11	92.34	119.75	1.60
Twin Bridg Reach	10234.73	50 yr	Prop 2019 0.045	1488.00	180.87	186.51	185.92	187.69	0.010017	8.99	190.52	157.85	0.74
Twin Bridg Reach	10234.73	100 yr	Exist Cond	1724.00	180.87	185.07	186.43	189.73	0.054303	17.32	99.54	128.29	1.65
Twin Bridg Reach	10234.73	100 yr	Prop 2019 0.045	1724.00	180.87	186.74	186.29	188.15	0.011287	9.85	202.86	160.41	0.79
Twin Bridg Reach	10234.73	500 yr	Exist Cond	2308.00	180.87	187.59	187.45	188.19	0.005397	7.66	515.32	178.40	0.57
Twin Bridg Reach	10234.73	500 yr	Prop 2019 0.045	2308.00	180.87	187.00	187.00	189.22	0.016634	12.40	217.50	162.31	0.97
Twin Bridg Reach	10174.57	1.1 yr	Exist Cond	247.00	180.71	184.20	182.63	184.31	0.002040	2.55	103.10	93.71	0.30
Twin Bridg Reach	10174.57	1.1 yr	Prop 2019 0.045	247.00	180.71	184.20	182.63	184.31	0.002040	2.55	103.10	93.71	0.30
Twin Bridg Reach	10174.57	2 yr	Exist Cond	501.00	180.71	184.96	183.45	185.15	0.002906	3.68	161.46	111.51	0.37
Twin Bridg Reach	10174.57	2 yr	Prop 2019 0.045	501.00	180.71	184.96	183.45	185.15	0.002906	3.68	161.46	111.51	0.37
Twin Bridg Reach	10174.57	5 yr	Exist Cond	781.00	180.71	185.43	184.26	185.76	0.004061	4.79	199.07	119.10	0.45
Twin Bridg Reach	10174.57	5 yr	Prop 2019 0.045	781.00	180.71	185.43	184.26	185.76	0.004061	4.79	199.07	119.10	0.45
Twin Bridg Reach	10174.57	10 yr	Exist Cond	989.00	180.71	185.72	184.64	186.14	0.004817	5.50	222.29	123.72	0.50
Twin Bridg Reach	10174.57	10 yr	Prop 2019 0.045	989.00	180.71	185.72	184.64	186.14	0.004817	5.50	222.29	123.72	0.50
Twin Bridg Reach	10174.57	25 yr	Exist Cond	1268.00	180.71	186.06	185.05	186.61	0.005713	6.34	249.90	137.77	0.55
Twin Bridg Reach	10174.57	25 yr	Prop 2019 0.045	1268.00	180.71	186.06	185.05	186.61	0.005716	6.34	249.86	137.76	0.55
Twin Bridg Reach	10174.57	50 yr	Exist Cond	1488.00	180.71	186.30	185.34	186.95	0.006390	6.95	268.99	141.51	0.58
Twin Bridg Reach	10174.57	50 yr	Prop 2019 0.045	1488.00	180.71	186.30	185.34	186.95	0.006390	6.95	268.99	141.51	0.58
Twin Bridg Reach	10174.57	100 yr	Exist Cond	1724.00	180.71	186.52	185.62	187.30	0.007089	7.57	287.61	145.13	0.62
Twin Bridg Reach	10174.57	100 yr	Prop 2019 0.045	1724.00	180.71	186.52	185.62	187.30	0.007089	7.57	287.61	145.13	0.62
Twin Bridg Reach	10174.57	500 yr	Exist Cond	2308.00	180.71	187.14	186.24	187.82	0.006092	7.63	474.88	155.03	0.59
Twin Bridg Reach	10174.57	500 yr	Prop 2019 0.045	2308.00	180.71	187.14	186.24	187.82	0.006092	7.63	474.88	155.03	0.59
Twin Bridg Reach	10076.69	1.1 yr	Exist Cond	247.00	180.00	183.75	183.02	183.95	0.007286	3.60	69.29	49.97	0.52
Twin Bridg Reach	10076.69	1.1 yr	Prop 2019 0.045	247.00	180.00	183.75	183.02	183.95	0.007286	3.60	69.29	49.97	0.52
Twin Bridg Reach	10076.69	2 yr	Exist Cond	501.00	180.00	184.43	183.81	184.72	0.007308	4.47	148.40	154.00	0.55
Twin Bridg Reach	10076.69	2 yr	Prop 2019 0.045	501.00	180.00	184.43	183.81	184.72	0.007308	4.47	148.40	154.00	0.55
Twin Bridg Reach	10076.69	5 yr	Exist Cond	781.00	180.00	184.89	184.50	185.23	0.007301	5.12	219.68	156.12	0.57
Twin Bridg Reach	10076.69	5 yr	Prop 2019 0.045	781.00	180.00	184.89	184.50	185.23	0.007301	5.12	219.68	156.12	0.57
Twin Bridg Reach	10076.69	10 yr	Exist Cond	989.00	180.00	185.18	184.74	185.56	0.007306	5.51	264.61	157.60	0.58
Twin Bridg Reach	10076.69	10 yr	Prop 2019 0.045	989.00	180.00	185.18	184.74	185.56	0.007306	5.51	264.61	157.60	0.58
Twin Bridg Reach	10076.69	25 yr	Exist Cond	1268.00	180.00	185.52	184.98	185.95	0.007301	5.95	319.18	159.87	0.59
Twin Bridg Reach	10076.69	25 yr	Prop 2019 0.045	1268.00	180.00	185.52	184.98	185.95	0.007301	5.95	319.18	159.87	0.59
Twin Bridg Reach	10076.69	50 yr	Exist Cond	1488.00	180.00	185.77	185.18	186.23	0.007303	6.26	358.72	161.43	0.60
Twin Bridg Reach	10076.69	50 yr	Prop 2019 0.045	1488.00	180.00	185.77	185.18	186.23	0.007303	6.26	358.72	161.43	0.60
Twin Bridg Reach	10076.69	100 yr	Exist Cond	1724.00	180.00	186.02	185.37	186.51	0.007302	6.56	398.73	162.96	0.61
Twin Bridg Reach	10076.69	100 yr	Prop 2019 0.045	1724.00	180.00	186.02	185.37	186.51	0.007302	6.56	398.73	162.96	0.61
Twin Bridg Reach	10076.69	500 yr	Exist Cond	2308.00	180.00	186.56	185.78	187.14	0.007307	7.22	488.97	165.64	0.62
Twin Bridg Reach	10076.69	500 yr	Prop 2019 0.045	2308.00	180.00	186.56	185.78	187.14	0.007307	7.22	488.97	165.64	0.62