

HYDROLOGY REPORT

Johnson Bridge (#3275) over Flat Bay River (also known as Curtis Creek) carries US Route 1A (Kennedy Highway) in Harrington, 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 in a tidal zone.

The watershed area for this project is 2.90 square miles with 0.3 square miles of wetlands. The watershed is located primarily to the north and west of the bridge location. Flat Bay River flows into Flat Bay, which outlets into Harrington Bay, which outlets to both Narraguagus Bay and Pleasant Bay.

<u>Return Period (yr.)</u>	<u>Flow (ft³/s)</u>
1.1	49.6
2	101.4
5	159.0
10	199.0
25	260.7
50	302.4
100	354.0
500	474.2

The FEMA Flood Insurance Study (FIS) for Washington County, Maine was published with an Effective date of July 18, 2017. The 100-year Base Flood Elevation (BFE) at Flat Bay River at Johnson Bridge is 10- feet, NAVD 1988. This is based on tidal surge analysis with the Atlantic Ocean as the flood source. As shown in Table 17, Coastal Transect Parameters, the 100-year stillwater elevation is 9.8 feet at Transect 83 near the project site. The BFE includes the effect of wave action, though the flood zone at the project site is Zone AE with no significant wave action expected.

As discussed at the preliminary kick-off meeting, there is no reported history of the road being overtopped.

HYDRAULIC MODELING

The recently published Flood Insurance Rate Map (FIRM) indicates that the culvert is located within a Zone AE floodplain and that the BFE is driven by coastal storm surge from the Atlantic Ocean. For this reason, there is no available model from FEMA to analyze fluvial flooding from the upstream watershed to assess hydraulic sufficiency in accordance with Maine DOT standards. Therefore, a new fluvial hydraulic model has been developed. The existing and proposed culvert was analyzed using HEC-RAS 5.0.3 (September 2016), a one-dimensional hydraulics software program developed by the United States Army Corps of Engineers.

The model of the stream was generated with 3 cross sections located upstream of the culvert, and 3 located downstream. The cross sections were developed using field survey provided by Maine DOT, supplemented with contour mapping developed from aerial LiDAR survey with 2' contours. The field survey was used to obtain the main channel data for all cross sections except the furthest downstream cross-section at RS 1260. For this cross section, the main channel data was extrapolated into the LiDAR data based on the field survey of the channel further upstream.

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

- Steady flow analysis method
- Roughness factors (Manning's "n") of 0.035 and 0.05 were used for the channel and overbank areas, respectively, based on visual field evaluation of stream and floodplain conditions. The channel is relatively straight and smooth, and the overbank is mostly devoid of large vegetation.
- Expansion and contraction values of 0.3 and 0.1, respectively, with 0.5 and 0.3 used at the culvert.
- Ineffective flow areas were set based on a contraction ratio of approximately 1:1 upstream of the culvert, and an expansion ratio of approximately 3:1 to 4:1 downstream of the culvert, taking into account topography and stream meander.
- Flow regime was set to "subcritical" due to the relatively flat channel slope.
- The downstream boundary condition was varied depending on the type of analysis:
 - For analysis of the full range of discharges determined using the USGS regression equations, the downstream boundary was set to "normal depth".
 - For analysis of the 50-year design discharge, two separate downstream boundary conditions were modeled: one using Mean High Water (MHW) and one using Mean Low Water (MLW). The values for MHW and MLW were based on gage data from the site provided by MaineDOT, which is provided in Appendix E.
 - For analysis of impacts to the FEMA 100-year Base Flood Elevation (BFE), the downstream boundary was set using the BFE shown on the Effective FIRM panel for the project site.

- The existing culvert was modeled using a standard “Pipe Arch” shape with span of 15’-5” and a rise of 9’-4”, which has nearly the same cross-section area as the 14’-8” x 9’-8” arch shown on the provided as-built plans.

There is no gage data available for calibration of storm event flows. However, the results of the existing conditions analysis are consistent with past flooding history, which indicates that the roadway is not overtopped by flood flows. In addition, visual inspection of the culvert showed evidence of high water marks that were consistent with the MHW elevations provided by MaineDOT which indicate that MHW is at or near the crown of the existing culvert.

For the proposed replacement structure, a standard reinforced concrete box culvert with span of 16’ and rise of 13’ was selected. This selection was based on the following considerations:

1. In an email from Charlie Hebson (MaineDOT) on April 27, 2017 it was recommended to lower the upstream invert elevation from -2.69 to -3.75.
2. In an email from Charlie Hebson (MaineDOT) on July 12, 2017 it was recommended to lower the downstream invert elevation by 6” from -4.61 to -5.11.
3. In an email from Charlie Hebson (MaineDOT) on July 12, 2017 it was recommended to raise the downstream crown elevation from +7.5 to +8.0 to account for sea level rise. The recommended structure provides a downstream crown elevation of +7.89.
4. The recommended span of 16’ is based on 1.2 * BFW, estimated based on field measurements.

Results of the existing and proposed conditions models indicate that the proposed structure is hydraulically improved when compared to the existing structure. It is expected to pass all flows up to and including the 500-year return period, as does the existing culvert. The following summarizes the analysis of proposed structure:

1. The proposed structure will result in 0.80’ of backwater for the 100-year storm under normal depth conditions downstream of the culvert, and 0.07’ of backwater when downstream tailwater is at the BFE elevation of +10.0 feet NAVD 1988.
2. The proposed structure achieves a headwater/rise ratio of 0.9 for the 50-year storm.

Summary of Hydraulic Analysis Results

Return Period (Years)	Proposed Structure	Existing Structure
Water Surface Elevations (ft.) – Tailwater at Normal Depth		
1.1	-2.48 (US) / -2.27 (DS)	-1.17 (US) / -2.27 (DS)
2	-1.78 (US) / -1.68 (DS)	-0.48 (US) / -1.68 (DS)
50	0.06 (US) / -0.24 (DS)	1.46 (US) / -0.24 (DS)
100	0.45 (US) / 0.04 (DS)	1.90 (US) / 0.04 (DS)
500	1.29 (US) / 0.61 (DS)	2.86 (US) / 0.61 (DS)
Discharge Velocity (ft./s) - Tailwater at Normal Depth		
1.1	4.49 (US) / 1.30 (DS)	1.27 (US) / 1.30 (DS)
2	4.11 (US) / 1.94 (DS)	1.74 (US) / 1.94 (DS)
50	4.01 (US) / 3.25 (DS)	2.43 (US) / 3.25 (DS)
100	4.00 (US) / 3.48 (DS)	2.51 (US) / 3.48 (DS)
500	4.01 (US) / 3.97 (DS)	2.67 (US) / 3.97 (DS)

US = Culvert Upstream at RS 1772
DS = Culvert Downstream at RS 1632

Summary of Tide Gage Datums – Cutler Farris Wharf (Little River)

Datum	Value (feet)
Mean Higher High Water (MHHW)	14.55
Mean High Water (MHW)	14.10
Mean Tide Level (MTL)	7.25
Mean Low Water (MLW)	0.40
Mean Lower Low Water (MLLW)	0.00

SCOUR ANALYSIS

The proposed culvert is a four-sided box culvert, and is therefore not susceptible to scour. A 2ft deep concrete toewall will be installed both upstream and downstream, providing additional protection against undermining of the box culvert. In addition, the downstream channel velocities are low and not expected to increase due to the proposed project.

WIN:	21693.00
Town:	Harrington
Route No.	US 1
Asset ID:	3275
Lat:	44.5990
Long:	-67.82307

Project Name:	Harrington Johnson Bridge
Stream Name:	Curtis Creek
Bridge Name:	Johnson
Analysis by:	CSH
Date:	3/8/2017

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

Enter data in blue cells only!

	km ²	mi ²	ac
A	7.51	2.90	1856.0
W	0.86	0.3	213.4
P _c	592262	4940876	
County	Washington		
pptA	44.2		
SG	0.045		

Enter data in [mi²]

Watershed Area *DRNAREA*

Wetlands area (by NWI)

watershed centroid (E, N; UTM 19N; meters)

choose county from drop-down menu

mean annual precipitation (inches; by look-up)

sand & gravel aquifer as decimal fraction of watershed A

Worksheet prepared by:

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Environmental Office
Maine Dept. Transportation
Augusta, ME 04333-0016
207-557-1052
Charles.Hebson@maine.gov
ver. 2016 Feb 05

A (km ²)	7.51	Conf Lvl	0.67
W (%)	11.50		

NWI Wetlands % *STORNWI*

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

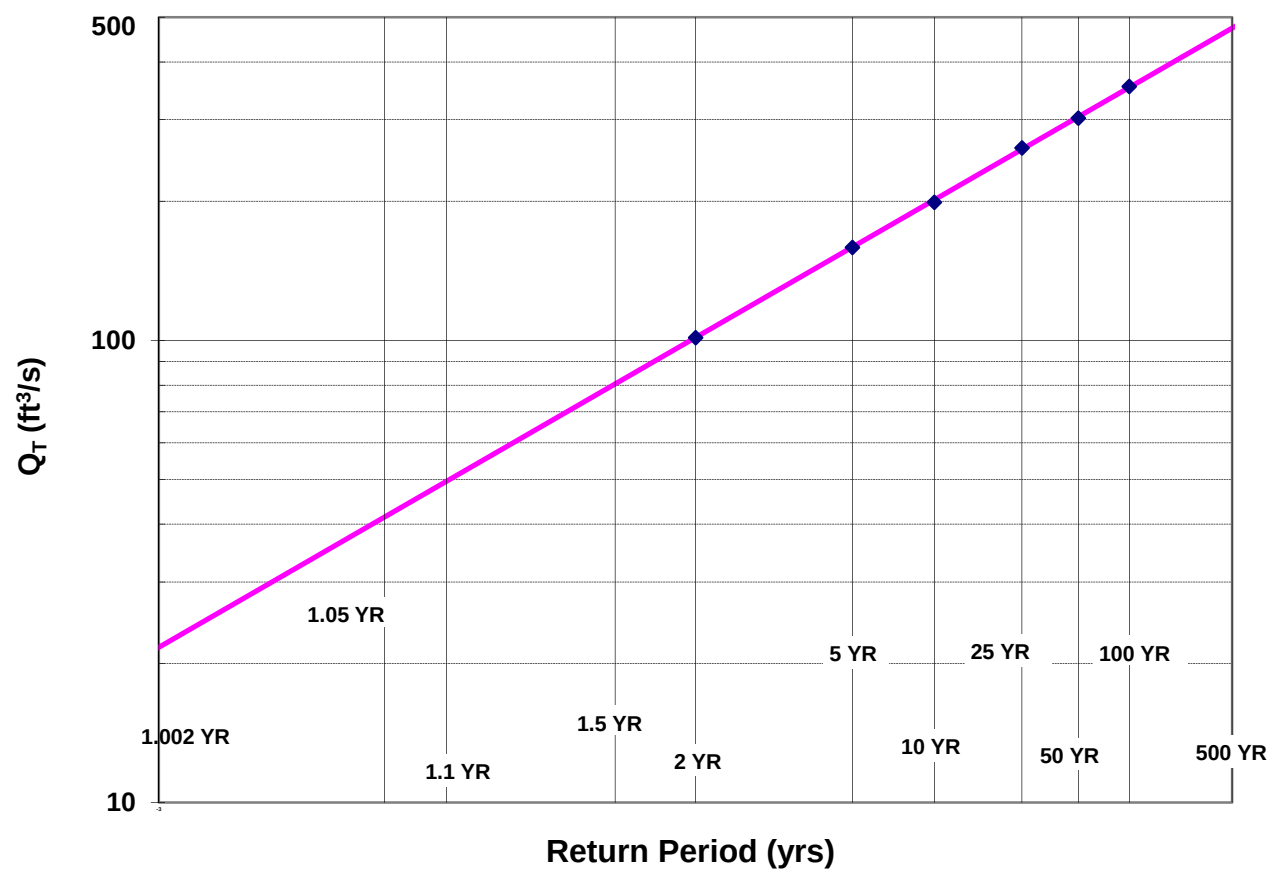
Lombard, P.J. & G.A. Hodgkins, 2015.
Peak flow regression equations for small, ungaged streams in
Maine - Comparing map-based to field-based variables
SIR 2015-4059, USGS, Augusta, ME

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

Ret Pd	Peak Flow Estimate		
T (yr)	Lower	Q _T (m ³ /s)	Upper
1.1		1.40	
2		2.87	
5		4.50	
10		5.63	
25		7.38	
50		8.56	
100		10.03	
500		13.43	

Q _T (ft ³ /s)
49.6
101.4
159.0
199.0
260.7
302.4
354.0
474.2

Log-Normal Probability Plot



WIN: 21693.00
 Town: Harrington
 Route No. US 1
 Asset ID: 3275
 Lat: 44.59895 Long: -67.82307

Project Name: Harrington Johnson Bridge
 Stream Name: Curtis Creek
 Bridge Name: Johnson
 Analysis by: CSH
 Date: 3/8/2017

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

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

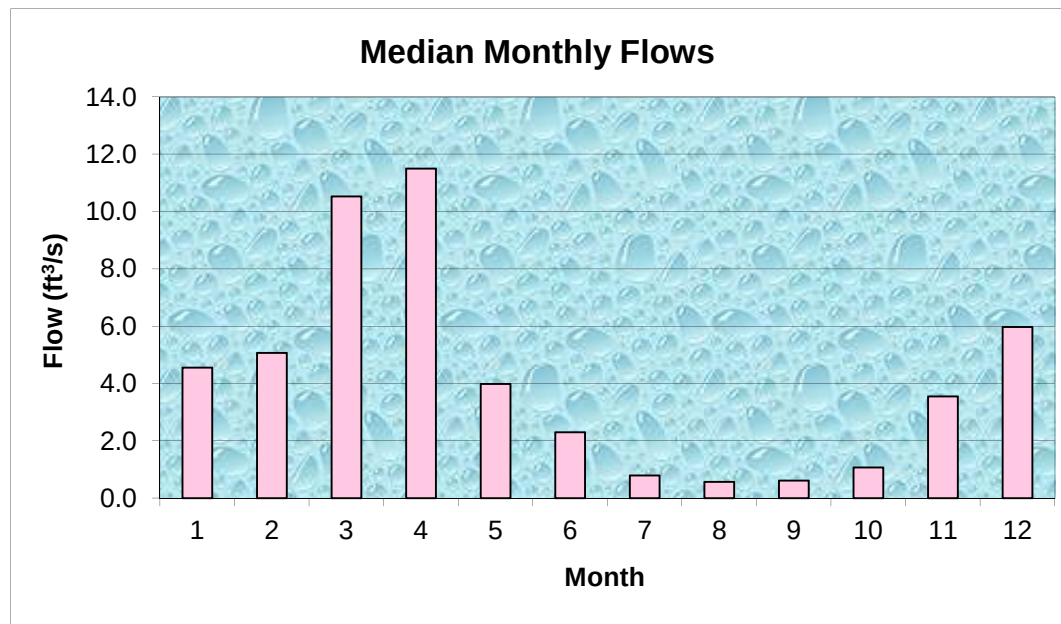
	Value	Variable	Explanation
	2.90	A	Area (mi ²)
592261.6	4940876	P_c	Watershed centroid (E,N; UTM; Zone 19; meters)
	31.01	DIST	Distance from Coastal reference line (mi)
	44.2	pptA	Mean Annual Precipitation (inches)
	0.05	SG	Sand & Gravel Aquifer (decimal fraction of watershed area)

Month	Q_{median} (ft ³ /s)	(m ³ /s)
Jan	4.56	0.1291
Feb	5.08	0.1438
Mar	10.54	0.2986
Apr	11.50	0.3259
May	3.99	0.1130
Jun	2.31	0.0654
Jul	0.79	0.0225
Aug	0.57	0.0163
Sep	0.62	0.0175
Oct	1.08	0.0306
Nov	3.56	0.1009
Dec	5.98	0.1693

Q_{bf}	15.9
ann avg	5.9
ann med	3.0
$Q_{1.002}$	21.7
$Q_{1.01}$	29.1
$Q_{1.05}$	41.4
Q_{bf}	45.5

assume v = 4ft/s

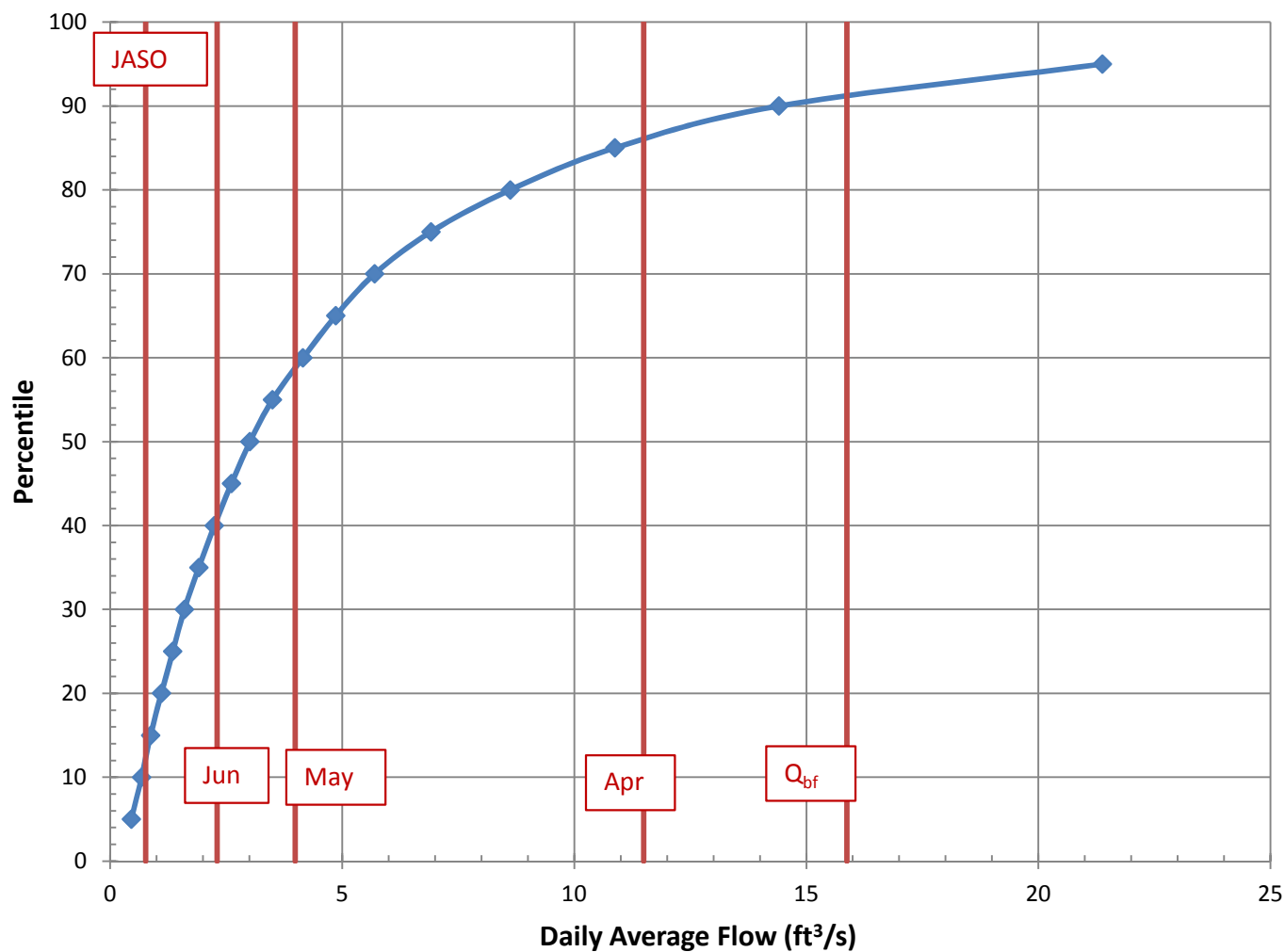
W_{bf}	13.3	estimated bankfull width (ft)
d_{bf}	0.9	estimated bankfull depth (ft)
A_{bf}	11.4	estimated bankfull flow area (ft ²)



References

Dudley, R.W., 2004. Hydraulic Geometry Relations ..., SIR 2004-5042
 Dudley, R.W., 2004. Estimating Monthly Streamflows ... , SIR 2004-5026

Daily Average Flow Distribution



Daily Avg Flow Dist

$A_{ws} = (mi^2)$ 2.9

$Q (ft^3/s)$

Pctl	Median	84 th pctl
5	0.46	0.73
10	0.68	1.02
15	0.87	1.27
20	1.10	1.54
25	1.35	1.81
30	1.60	2.06
35	1.91	2.36
40	2.24	2.71
45	2.62	3.06
50	3.01	3.62
55	3.50	4.21
60	4.15	4.94
65	4.86	5.76
70	5.70	6.72
75	6.91	8.08
80	8.62	9.64
85	10.88	12.36
90	14.41	16.59
95	21.38	25.80

Q_{bf} 15.9

$Q_{1.002}$ 21.7

$Q_{1.1}$ 49.6

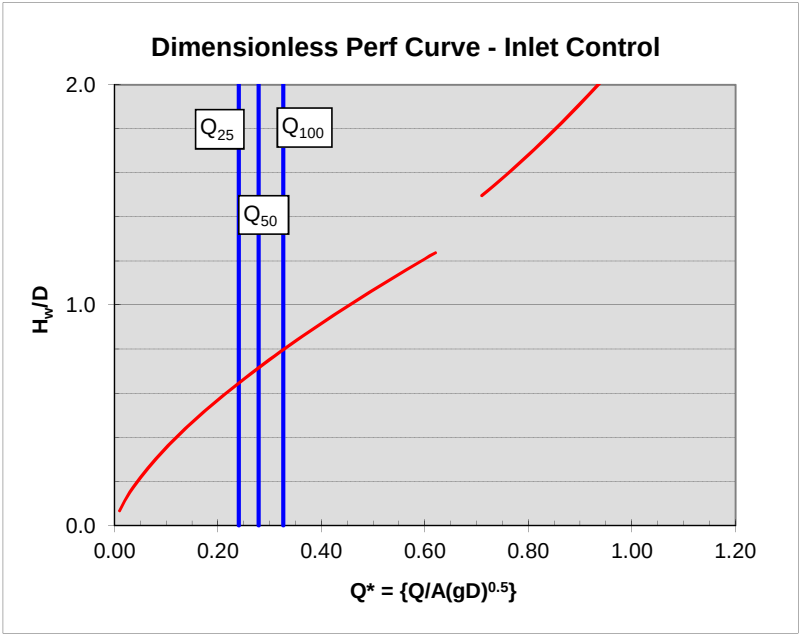
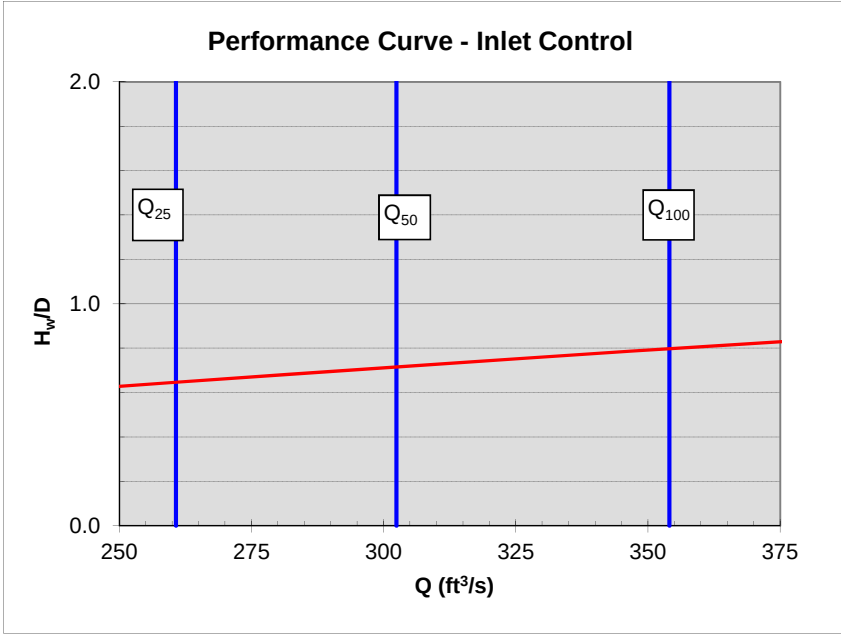
Q_2 101.4

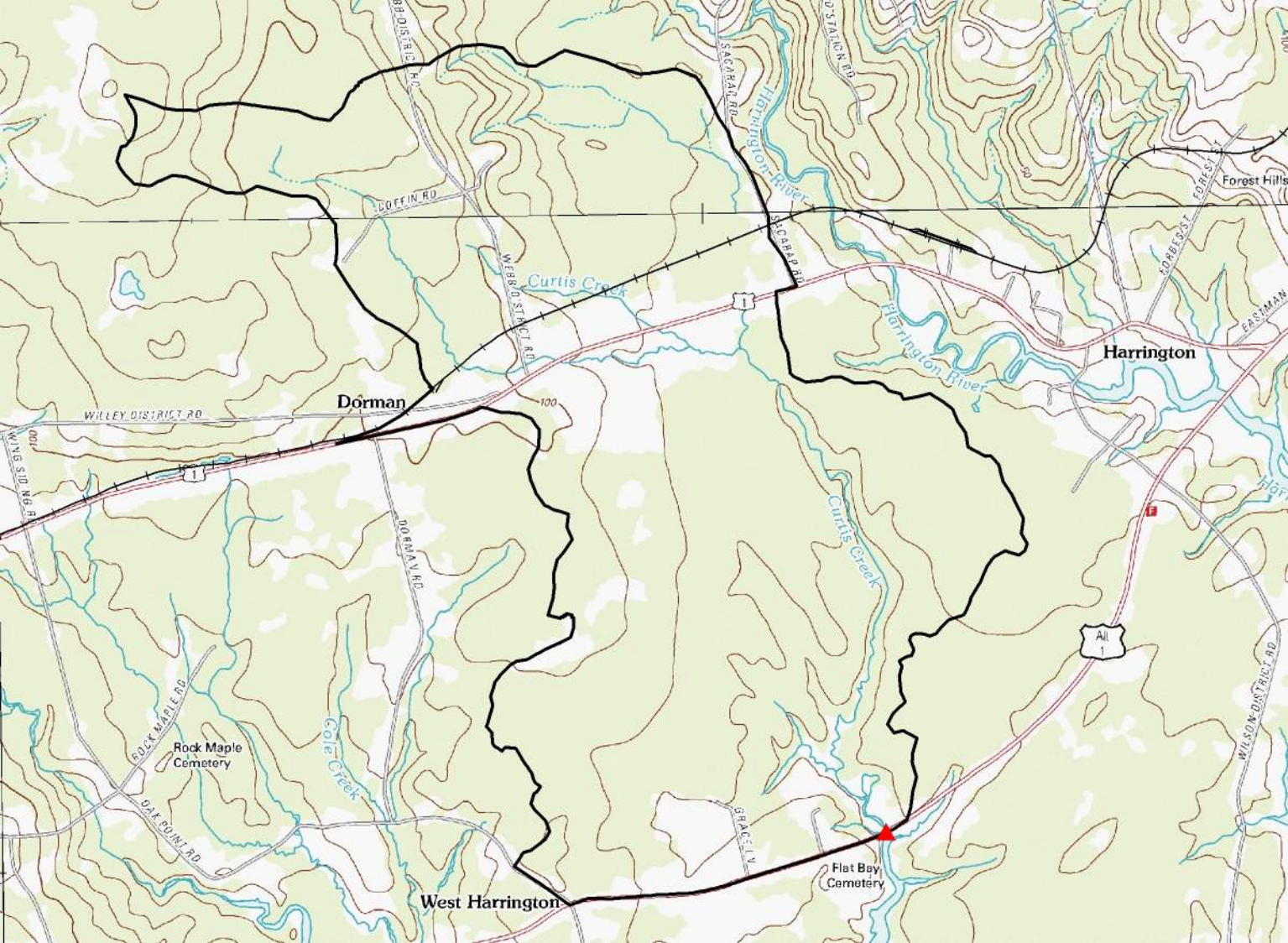
NOTE: This page is for preliminary sizing only.
Final design should be done with HY8 or HDS-5

Preliminary Culvert Sizing - Round & Box Culverts

Shape:	Box			
Type:	Box 0 ww			
D or R (ft)	6	Q_{25}	260.7	trial D / R = 8.1 trial w: BFW = 13.3
w (ft)	13 box width	Q_{50}	302.4	
Slope (ft/ft)	0.02	Q_{100}	354.0	
A (ft ²)	78.00			
g (ft/s ²)	32.2			

Note:
culvert dimensions are for open flow area; adjust for lost capacity
due to embedding / backfilling (min {2' / 25% rise} embedment)

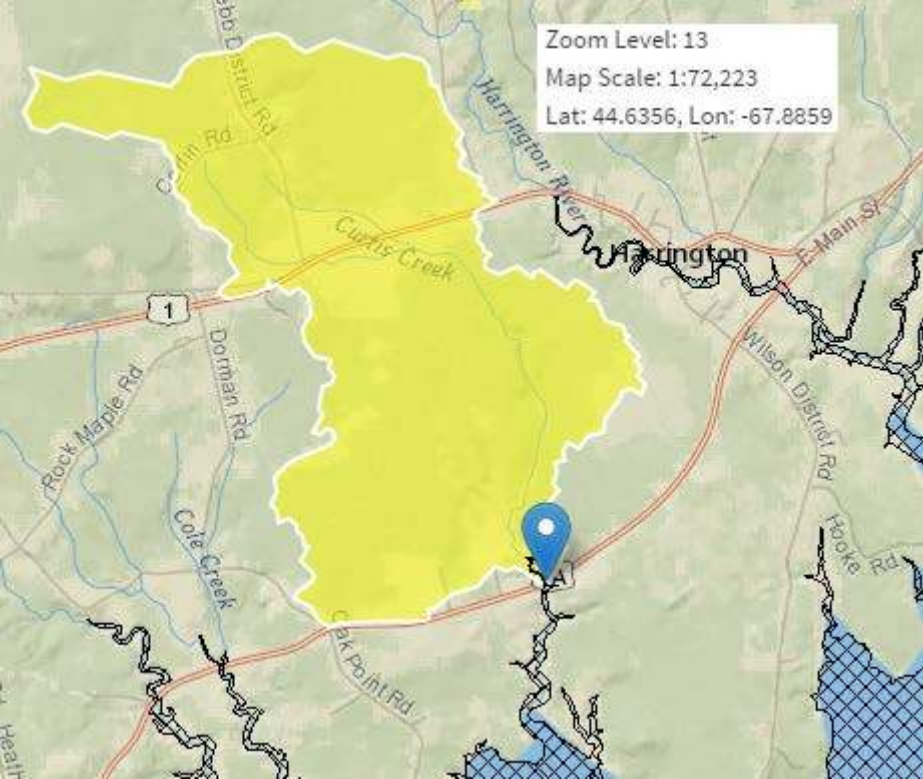




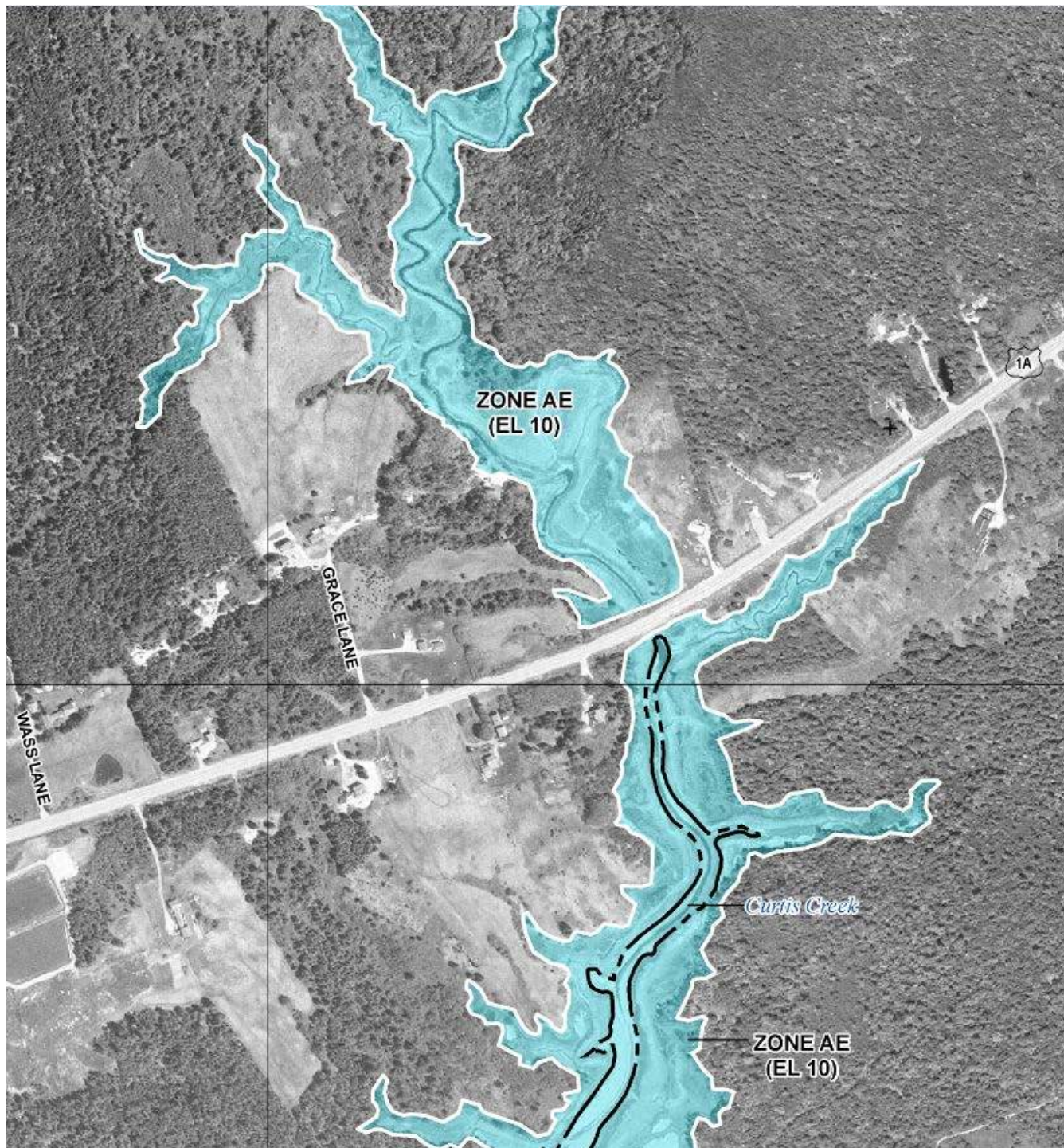
Zoom Level: 13

Map Scale: 1:72,223

Lat: 44.6356, Lon: -67.8859



Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	2.9	square miles
STORNWI	Percentage of storage (combined water bodies and wetlands) from the National Wetlands Inventory	11.5	percent
ELEV	Mean Basin Elevation	66.9	feet
PRECIP	Mean Annual Precipitation	49.8	inches
SANDGRAVAP	Percentage of land surface underlain by sand and gravel aquifers	4.46	percent
COASTDIST	Shortest distance from the coastline to the basin centroid	31.8	miles
CENTROIDX	Basin centroid horizontal (x) location in state plane coordinates	592261.56	State plane coordinates
CENTROIDY	Basin centroid vertical (y) location in state plane units	4940875.91	State plane coordinates
SANDGRAVAF	Fraction of land surface underlain by sand and gravel aquifers	0.045	dimensionless
LC11IMP	Average percentage of impervious area determined from NLCD 2011 impervious dataset	1.84	percent
LC11DEV	Percentage of developed (urban) land from NLCD 2011 classes 21-24	6.34	percent
LC06WATER	Percent of open water, class 11, from NLCD 2006	0	percent
ELEVMAX	Maximum basin elevation	188.2	feet
BSLDEM10M	Mean basin slope computed from 10 m DEM	3.2	percent
STATSGOA	Percentage of area of Hydrologic Soil Type A from STATSGO	4	percent



NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

WASHINGTON COUNTY, MAINE
(ALL JURISDICTIONS)

PANEL **1777** OF **2075**



FEMA

Panel Contains:

COMMUNITY	NUMBER	PANEL	SUFFIX
COLUMBIA, TOWN OF	230307	1777	E
HARRINGTON, TOWN OF	230314	1777	E

VERSION NUMBER
2.2.2.1

MAP NUMBER
23029C1777E

EFFECTIVE DATE
JULY 18, 2017

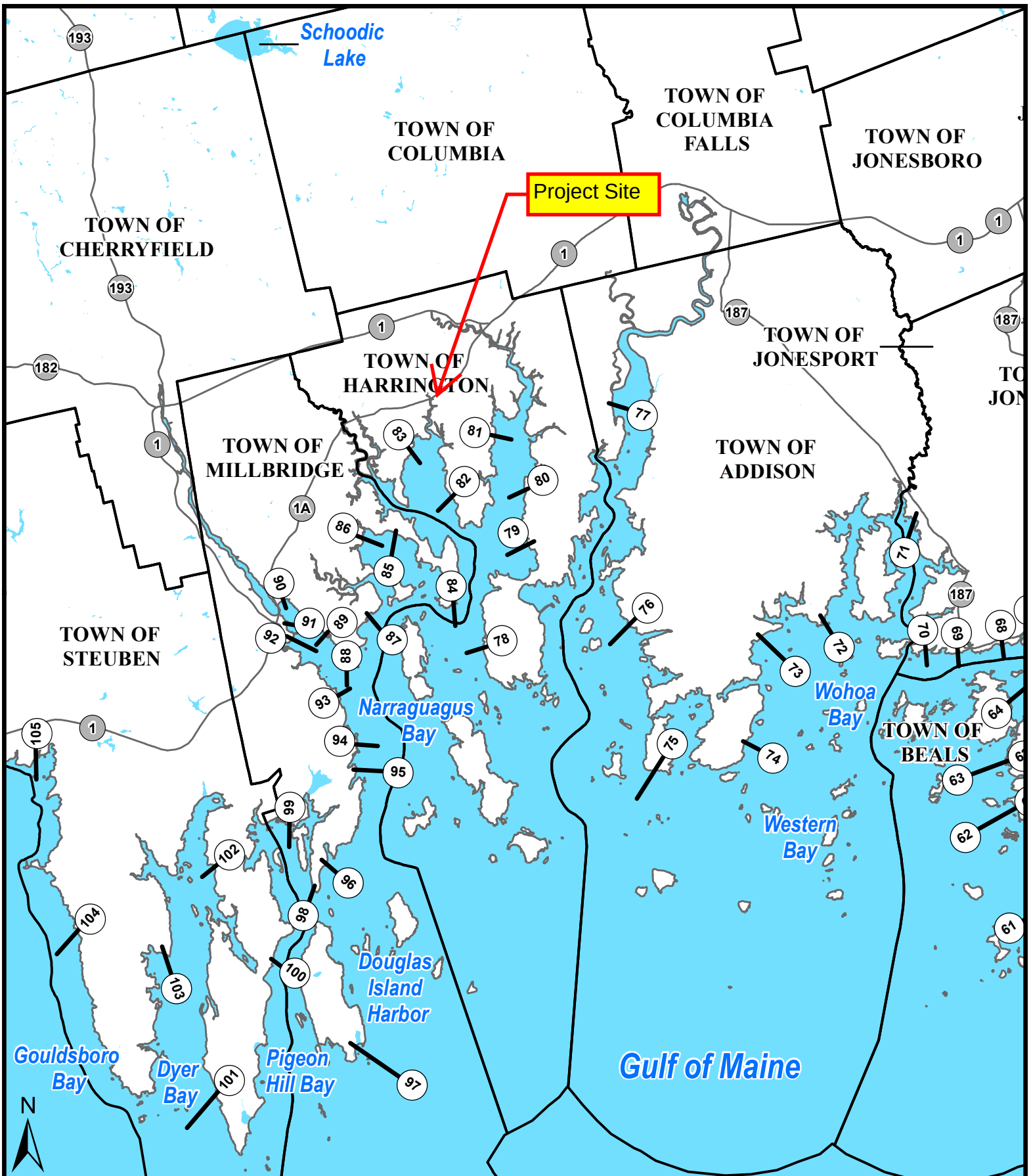
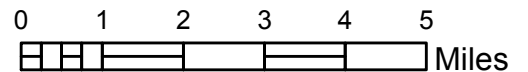


FIGURE 9

Federal Emergency Management Agency
WASHINGTON COUNTY, ME
 (ALL JURISDICTIONS)



TRANSECT LOCATION MAP

Table 17: Coastal Transect Parameters – (continued)

Flood Source	Coastal Transect	Starting Wave Conditions for the 1% Annual Chance		Starting Stillwater Elevations (ft NAVD88) Range of Stillwater Elevations (ft NAVD88)				
		Significant Wave Height H _s (feet)	Peak Wave Period T _p (seconds)	10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Harrington Bay	78	5.5	3.5	9.3 *	* *	9.6 *	9.8 9.9-9.8	10.3 *
Harrington Bay	79	3.1	2.4	9.3 *	* *	9.6 *	9.8 9.8-9.8	10.3 *
Harrington River	80	2.7	2.3	9.3 *	* *	9.6 *	9.8 9.8-9.8	10.3 *
Harrington River	81	2.9	2.3	9.3 *	* *	9.6 *	9.8 9.8-9.8	10.3 *
Flat Bay	82	3.0	2.4	9.3 *	* *	9.6 *	9.8 9.8-9.8	10.3 *
Flat Bay	83	3.1	2.4	9.3 *	* *	9.6 *	9.8 9.8-9.8	10.3 *
Harrington Bay	84	5.0	3.1	9.3 *	* *	9.6 *	9.8 9.8-9.8	10.3 *

*Not calculated for this Flood Risk project

From: Hebson, Charles
Sent: Thursday, April 27, 2017 3:07 PM
To: Myers, Richard E
Cc: Ham, Eric; Chamberlain, Kristen; Lickus, Mark
Subject: Harrington Profile

The existing inverts look pretty good but if possible I would like to see us lower it just a bit. Sorry I did not catch this earlier.

If you look at the photos (in CPD folder) and the tide data, you can see there is a control DS of the outlet, such that we have 18" of water at the OI at low tide (WL = - 3'); the DS control prevents any further drainage. You can also see that the II is the control on US water levels on the low tide / drainage cycle.

There is enough slope to the pipe so that at low tide we do not get any backwater thru the pipe (again, see photos and tide graph). I think the current inverts are OI = -4.61 & II = -2.69; pipe L = 131' & S = 0.015. If we could set the new II at -3.75 we can get 9" of water on II even at low tide. We should keep OI where it is (or lower it if we are trying to maintain some kind of minimum slope on the new structure).

Just a thought.

Thanks

Charles Hebson, P.E.



MaineDOT / Environmental Office
State House Station 16
Augusta ME 04333-0016
207.557.1052

From: Hebson, Charles
Sent: Wednesday, July 12, 2017 3:14 PM
To: Nichols, Brian J
Subject: Harrington 21693 Tidal Data

Brian,

Tide data graph is attached. Culvert inverts should not be raised above existing. Ideally lower by 6-in.

Culvert crowns should be kept at least as high as they are now. Ideally increased to at least MHHW (7-ft NAVD) – or a bit higher in anticipation of sea level rise – say 7.5 or 8’.

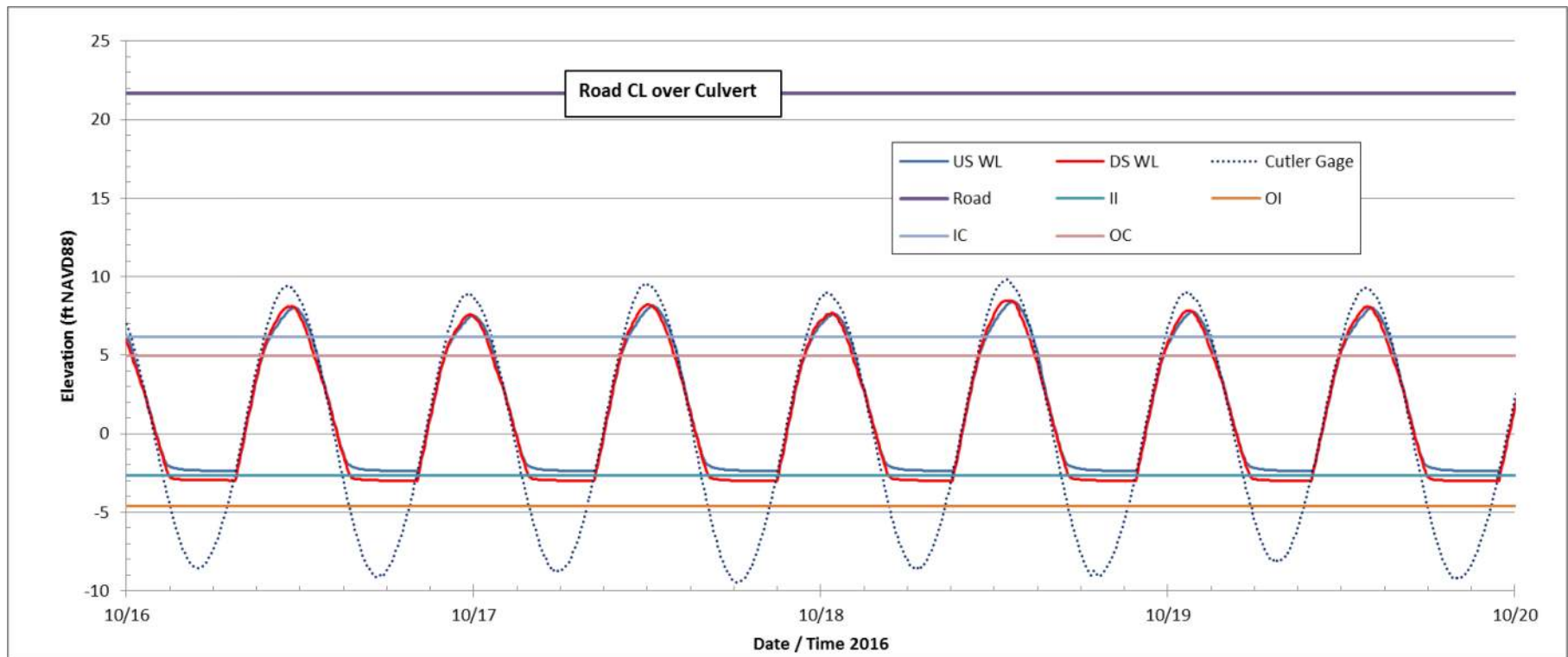
Charlie

Charles Hebson, P.E.



MaineDOT / Environmental Office
State House Station 16
Augusta ME 04333-0016
207.557.1052

Harrington WIN 21693 Johnson Bridge on US1 – “Spring Tide” for October 2016 – **PLS VERIFY ROAD & CULVERT ELEVATIONS!**



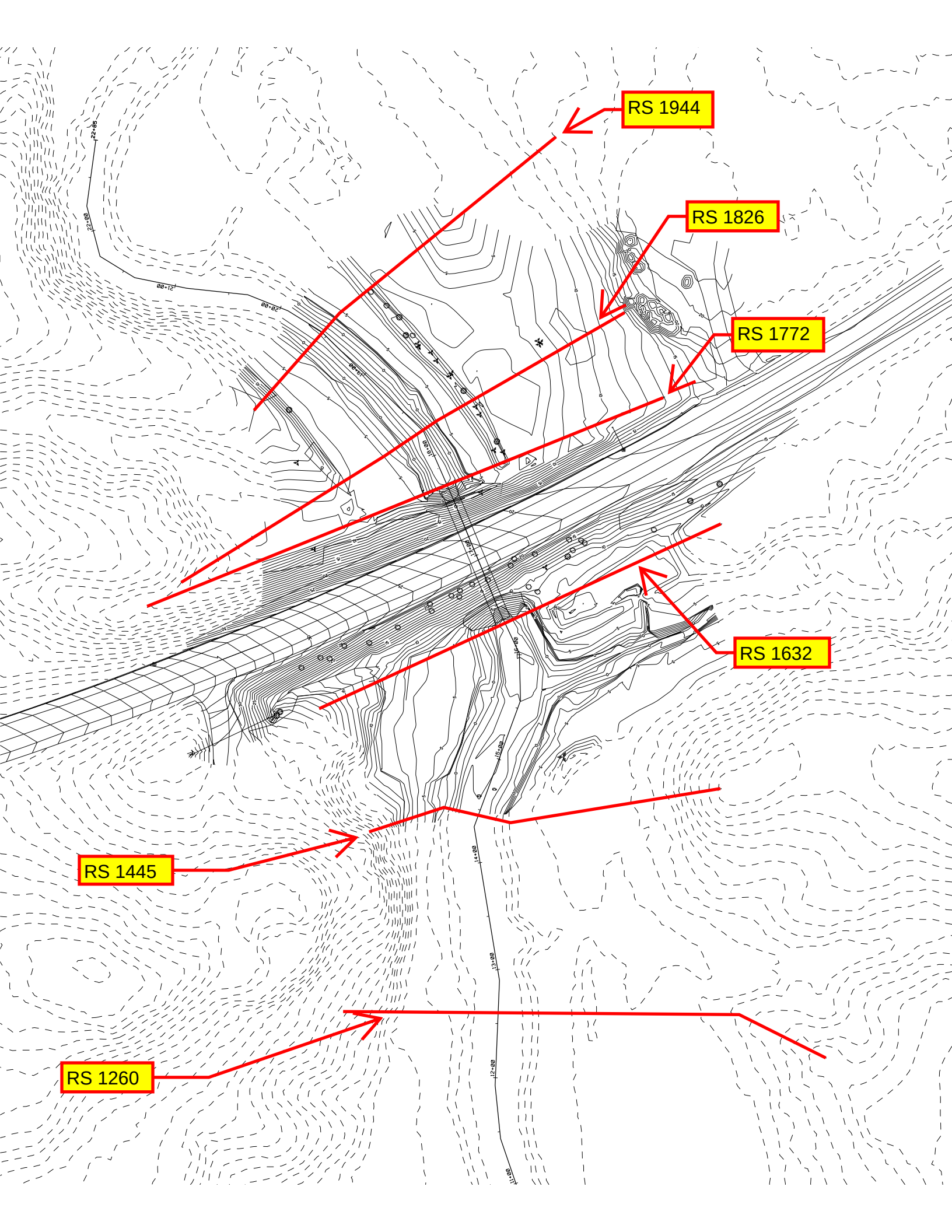
Gages at Culvert: Blue US, Red DS

NOAA Tide Gage – Cutler Farris Wharf – dotted line

Tide gage Datums – Cutler Farris Wharf (Little River)

Datum	Value (station datum)	Value (NAVD88)	Value (MLLW)	Description
MHHW	20.03	7.01	14.55	Mean Higher-High Water
MHW	19.58	6.56	14.1	Mean High Water
MTL	12.73	-0.29	7.25	Mean Tide Level
MSL	12.67	-0.35	7.19	Mean Sea Level
DTL	12.76	-0.26	7.28	Mean Diurnal Tide Level
MLW	5.88	-7.14	0.4	Mean Low Water
MLLW	5.48	-7.54	0	Mean Lower-Low Water
NAVD88	13.02	0	7.54	North American Vertical Datum of 1988
STND	0	-13.02	-5.48	Station Datum
GT	14.56	1.54	9.08	Great Diurnal Range
MN	13.7	0.68	8.22	Mean Range of Tide
DHQ	0.45	-12.57	-5.03	Mean Diurnal High Water Inequality
DLQ	0.4	-12.62	-5.08	Mean Diurnal Low Water Inequality
HWI	3.26	-9.76	-2.22	Greenwich High Water Interval (in hours)
LWI	9.52	-3.5	4.04	Greenwich Low Water Interval (in hours)
Maximum	23.85	10.83	18.37	Highest Observed Water Level ()

Minimum	2.37	-10.65	-3.11	Lowest Observed Water Level (1/30/2014 9:12:00 PM)
HAT	22.79	9.77	17.31	Highest Astronomical Tide (11/5/1998 4:00:00 PM)
LAT	2.83	-10.19	-2.65	Lowest Astronomical Tide (11/5/1998 4:00:00 PM)



RS 1260

RS 1445

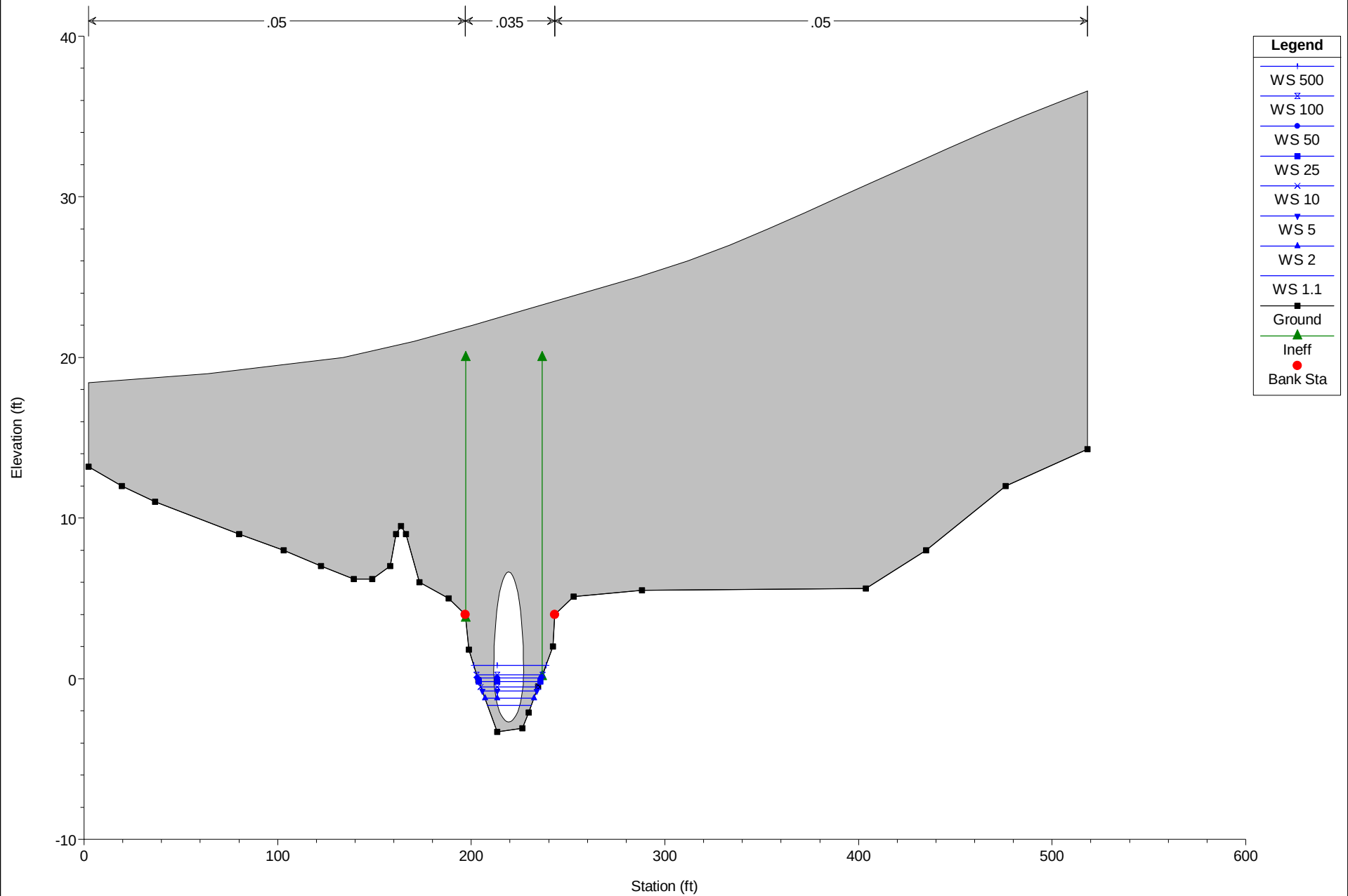
RS 1632

RS 1772

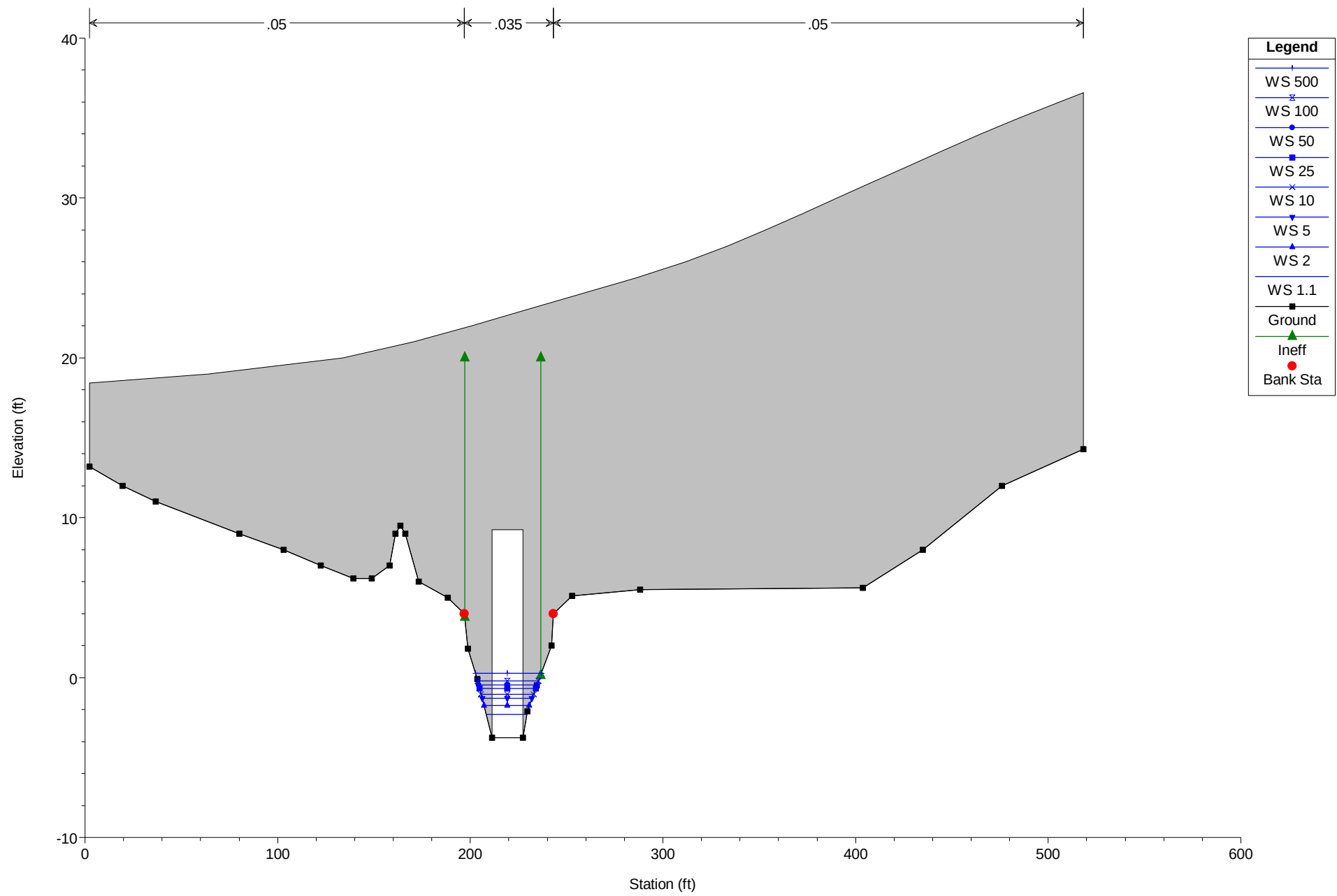
RS 1826

RS 1944

Harrington Plan: Existing - Normal Depth 7/26/2017

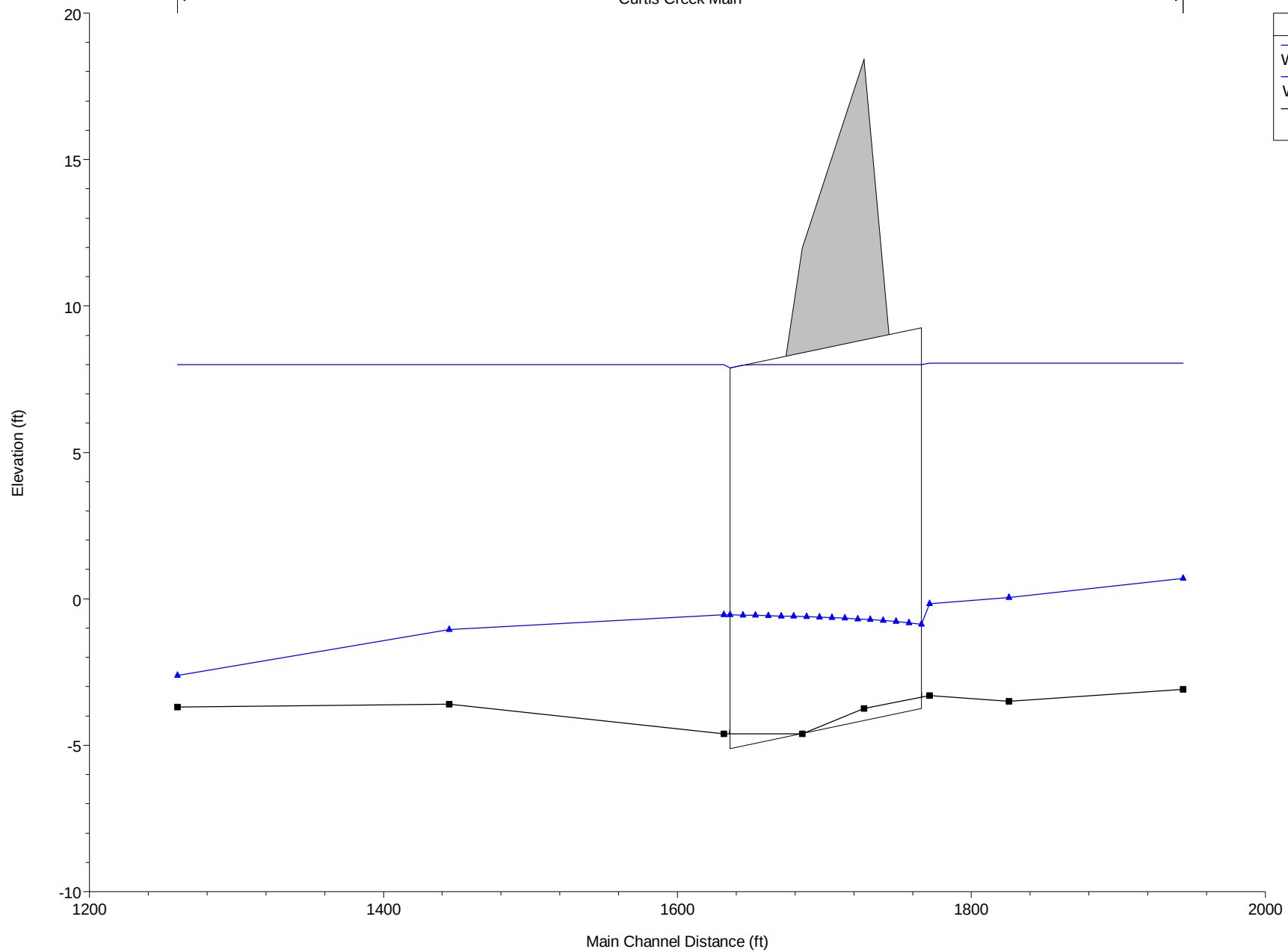


Harrington Plan: Proposed - Normal Depth 7/26/2017



Harrington Plan: Proposed 50 Yr Design 7/13/2017

Curtis Creek Main



HEC-RAS River: Curtis Creek Reach: Main

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)	
Main	1944	1.1	Existing - Normal Depth	49.60	-3.10	-1.00		-0.93	0.001868	2.04	24.28	20.13	0.33
Main	1944	1.1	Proposed - Normal Depth	49.60	-3.10	-1.28		-1.17	0.003726	2.62	18.92	18.13	0.45
Main	1944	2	Existing - Normal Depth	101.40	-3.10	-0.28		-0.18	0.001906	2.50	40.64	25.29	0.35
Main	1944	2	Proposed - Normal Depth	101.40	-3.10	-0.68		-0.51	0.003964	3.26	31.08	22.42	0.49
Main	1944	5	Existing - Normal Depth	159.00	-3.10	0.36		0.48	0.001768	2.73	58.21	29.85	0.34
Main	1944	5	Proposed - Normal Depth	159.00	-3.10	-0.19		0.02	0.004059	3.71	42.84	25.90	0.51
Main	1944	10	Existing - Normal Depth	199.00	-3.10	0.74		0.86	0.001679	2.84	70.06	32.56	0.34
Main	1944	10	Proposed - Normal Depth	199.00	-3.10	0.10		0.34	0.004045	3.93	50.61	27.96	0.52
Main	1944	25	Existing - Normal Depth	260.70	-3.10	1.28		1.42	0.001522	2.94	88.77	36.44	0.33
Main	1944	25	Proposed - Normal Depth	260.70	-3.10	0.50		0.77	0.003937	4.18	62.41	30.84	0.52
Main	1944	50	Existing - Normal Depth	302.40	-3.10	1.63		1.76	0.001419	2.97	101.76	38.91	0.32
Main	1944	50	Proposed - Normal Depth	302.40	-3.10	0.75		1.04	0.003828	4.30	70.38	32.63	0.52
Main	1944	100	Existing - Normal Depth	354.00	-3.10	2.05		2.19	0.001268	2.98	118.77	41.47	0.31
Main	1944	100	Proposed - Normal Depth	354.00	-3.10	1.05		1.35	0.003648	4.40	80.54	34.79	0.51
Main	1944	500	Existing - Normal Depth	474.20	-3.10	2.99		3.13	0.000969	2.97	159.64	45.31	0.28
Main	1944	500	Proposed - Normal Depth	474.20	-3.10	1.74		2.05	0.003102	4.46	106.30	39.73	0.48
Main	1826	1.1	Existing - Normal Depth	49.60	-3.50	-1.14	-2.24	-1.10	0.001006	1.64	30.17	21.70	0.25
Main	1826	1.1	Proposed - Normal Depth	49.60	-3.50	-1.78	-2.24	-1.65	0.004436	2.80	17.73	17.54	0.49
Main	1826	2	Existing - Normal Depth	101.40	-3.50	-0.44	-1.77	-0.37	0.001261	2.16	46.98	26.55	0.29
Main	1826	2	Proposed - Normal Depth	101.40	-3.50	-1.36	-1.77	-1.12	0.006682	3.97	25.53	20.25	0.62
Main	1826	5	Existing - Normal Depth	159.00	-3.50	0.20	-1.38	0.29	0.001248	2.43	65.55	30.79	0.29
Main	1826	5	Proposed - Normal Depth	159.00	-3.50	-0.88	-1.38	-0.58	0.006382	4.42	35.95	23.39	0.63
Main	1826	10	Existing - Normal Depth	199.00	-3.50	0.59	-1.16	0.69	0.001205	2.56	77.84	32.83	0.29
Main	1826	10	Proposed - Normal Depth	199.00	-3.50	-0.56	-1.16	-0.24	0.005842	4.54	43.87	25.70	0.61
Main	1826	25	Existing - Normal Depth	260.70	-3.50	1.14	-0.85	1.26	0.001115	2.69	96.84	35.55	0.29
Main	1826	25	Proposed - Normal Depth	260.70	-3.50	-0.08	-0.85	0.24	0.004958	4.57	57.00	29.12	0.58
Main	1826	50	Existing - Normal Depth	302.40	-3.50	1.50	-0.66	1.61	0.001047	2.76	109.63	36.89	0.28
Main	1826	50	Proposed - Normal Depth	302.40	-3.50	0.22	-0.66	0.55	0.004394	4.57	66.19	30.90	0.55
Main	1826	100	Existing - Normal Depth	354.00	-3.50	1.93	-0.45	2.05	0.000963	2.81	125.93	38.53	0.27
Main	1826	100	Proposed - Normal Depth	354.00	-3.50	0.58	-0.45	0.90	0.003844	4.56	77.61	32.79	0.52
Main	1826	500	Existing - Normal Depth	474.20	-3.50	2.89	-0.01	3.02	0.000853	2.86	166.01	45.06	0.26
Main	1826	500	Proposed - Normal Depth	474.20	-3.50	1.38	-0.01	1.70	0.002881	4.50	105.46	36.46	0.47
Main	1772	1.1	Existing - Normal Depth	49.60	-3.30	-1.17	-2.48	-1.15	0.000521	1.27	39.18	25.59	0.18
Main	1772	1.1	Proposed - Normal Depth	49.60	-3.30	-2.48	-2.48	-2.16	0.021027	4.49	11.04	17.47	1.00
Main	1772	2	Existing - Normal Depth	101.40	-3.30	-0.48	-2.08	-0.43	0.000714	1.74	58.32	29.88	0.22
Main	1772	2	Proposed - Normal Depth	101.40	-3.30	-1.78	-2.08	-1.52	0.008142	4.11	24.69	21.79	0.68
Main	1772	5	Existing - Normal Depth	159.00	-3.30	0.16	-1.73	0.23	0.000754	2.02	78.84	33.66	0.23
Main	1772	5	Proposed - Normal Depth	159.00	-3.30	-1.18	-1.73	-0.92	0.005462	4.09	38.90	25.52	0.58
Main	1772	10	Existing - Normal Depth	199.00	-3.30	0.55	-1.51	0.63	0.000733	2.16	92.07	35.81	0.23
Main	1772	10	Proposed - Normal Depth	199.00	-3.30	-0.81	-1.51	-0.55	0.004496	4.07	48.90	27.85	0.54
Main	1772	25	Existing - Normal Depth	260.70	-3.30	1.11	-1.23	1.19	0.000698	2.33	111.70	38.89	0.23
Main	1772	25	Proposed - Normal Depth	260.70	-3.30	-0.27	-1.23	-0.02	0.003536	4.03	64.70	31.15	0.49
Main	1772	50	Existing - Normal Depth	302.40	-3.30	1.46	-1.06	1.56	0.000675	2.43	124.61	40.85	0.23

HEC-RAS River: Curtis Creek Reach: Main (Continued)

Reach	River Sta	Profile	Plan	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
Main	1772	50	Proposed - Normal Depth	302.40	-3.30	0.06	-1.06	0.31	0.003100	4.01	75.41	33.09	0.47
Main	1772	100	Existing - Normal Depth	354.00	-3.30	1.90	-0.86	2.00	0.000637	2.51	140.84	43.08	0.23
Main	1772	100	Proposed - Normal Depth	354.00	-3.30	0.45	-0.86	0.70	0.002619	4.00	88.48	35.23	0.44
Main	1772	500	Existing - Normal Depth	474.20	-3.30	2.86	-0.45	2.97	0.000551	2.67	177.60	44.60	0.22
Main	1772	500	Proposed - Normal Depth	474.20	-3.30	1.29	-0.45	1.54	0.001949	4.01	118.12	39.87	0.39
Main	1706		Culvert										
Main	1632	1.1	Existing - Normal Depth	49.60	-4.61	-2.27	-3.67	-2.24	0.000476	1.30	38.30	25.24	0.17
Main	1632	1.1	Proposed - Normal Depth	49.60	-4.61	-2.27	-3.67	-2.24	0.000476	1.30	38.30	25.24	0.17
Main	1632	2	Existing - Normal Depth	101.40	-4.61	-1.68	-3.26	-1.62	0.000813	1.94	52.38	31.48	0.24
Main	1632	2	Proposed - Normal Depth	101.40	-4.61	-1.68	-3.26	-1.62	0.000813	1.94	52.37	31.48	0.24
Main	1632	5	Existing - Normal Depth	159.00	-4.61	-1.18	-2.88	-1.09	0.001072	2.43	65.31	36.90	0.28
Main	1632	5	Proposed - Normal Depth	159.00	-4.61	-1.18	-2.88	-1.09	0.001072	2.43	65.31	36.90	0.28
Main	1632	10	Existing - Normal Depth	199.00	-4.61	-0.89	-2.66	-0.78	0.001203	2.71	73.54	39.83	0.30
Main	1632	10	Proposed - Normal Depth	199.00	-4.61	-0.89	-2.66	-0.78	0.001203	2.71	73.54	39.83	0.30
Main	1632	25	Existing - Normal Depth	260.70	-4.61	-0.48	-2.37	-0.34	0.001352	3.05	85.59	43.17	0.32
Main	1632	25	Proposed - Normal Depth	260.70	-4.61	-0.48	-2.37	-0.34	0.001352	3.05	85.59	43.17	0.32
Main	1632	50	Existing - Normal Depth	302.40	-4.61	-0.24	-2.19	-0.07	0.001405	3.25	93.14	45.17	0.33
Main	1632	50	Proposed - Normal Depth	302.40	-4.61	-0.24	-2.19	-0.07	0.001405	3.25	93.14	45.17	0.33
Main	1632	100	Existing - Normal Depth	354.00	-4.61	0.04	-1.97	0.23	0.001437	3.48	101.67	47.30	0.34
Main	1632	100	Proposed - Normal Depth	354.00	-4.61	0.04	-1.97	0.23	0.001437	3.48	101.67	47.30	0.34
Main	1632	500	Existing - Normal Depth	474.20	-4.61	0.61	-1.52	0.86	0.001506	3.97	119.48	50.07	0.36
Main	1632	500	Proposed - Normal Depth	474.20	-4.61	0.61	-1.52	0.86	0.001506	3.97	119.48	50.07	0.36
Main	1445	1.1	Existing - Normal Depth	49.60	-3.60	-2.48		-2.42	0.002360	1.83	27.10	32.12	0.35
Main	1445	1.1	Proposed - Normal Depth	49.60	-3.60	-2.48		-2.42	0.002360	1.83	27.10	32.12	0.35
Main	1445	2	Existing - Normal Depth	101.40	-3.60	-1.93		-1.85	0.002014	2.22	45.59	35.70	0.35
Main	1445	2	Proposed - Normal Depth	101.40	-3.60	-1.93		-1.85	0.002014	2.22	45.59	35.70	0.35
Main	1445	5	Existing - Normal Depth	159.00	-3.60	-1.45		-1.35	0.001844	2.50	63.50	38.86	0.35
Main	1445	5	Proposed - Normal Depth	159.00	-3.60	-1.45		-1.35	0.001844	2.50	63.50	38.86	0.35
Main	1445	10	Existing - Normal Depth	199.00	-3.60	-1.16		-1.05	0.001785	2.65	75.08	41.12	0.35
Main	1445	10	Proposed - Normal Depth	199.00	-3.60	-1.16		-1.05	0.001785	2.65	75.08	41.12	0.35
Main	1445	25	Existing - Normal Depth	260.70	-3.60	-0.76		-0.63	0.001721	2.82	92.40	44.81	0.35
Main	1445	25	Proposed - Normal Depth	260.70	-3.60	-0.76		-0.63	0.001721	2.82	92.40	44.81	0.35
Main	1445	50	Existing - Normal Depth	302.40	-3.60	-0.51		-0.38	0.001680	2.91	103.80	47.08	0.35
Main	1445	50	Proposed - Normal Depth	302.40	-3.60	-0.51		-0.38	0.001679	2.91	103.80	47.08	0.35
Main	1445	100	Existing - Normal Depth	354.00	-3.60	-0.22		-0.08	0.001597	3.01	117.58	48.77	0.34
Main	1445	100	Proposed - Normal Depth	354.00	-3.60	-0.22		-0.08	0.001597	3.01	117.58	48.77	0.34
Main	1445	500	Existing - Normal Depth	474.20	-3.60	0.38		0.54	0.001474	3.21	147.72	52.13	0.34
Main	1445	500	Proposed - Normal Depth	474.20	-3.60	0.38		0.54	0.001474	3.21	147.72	52.13	0.34
Main	1260	1.1	Existing - Normal Depth	49.60	-3.70	-2.62	-3.37	-2.61	0.000500	0.95	52.11	51.57	0.17
Main	1260	1.1	Proposed - Normal Depth	49.60	-3.70	-2.62	-3.37	-2.61	0.000500	0.95	52.11	51.57	0.17
Main	1260	2	Existing - Normal Depth	101.40	-3.70	-2.06	-3.17	-2.03	0.000500	1.23	82.18	54.96	0.18

HEC-RAS River: Curtis Creek Reach: Main (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)	
Main	1260	2	Proposed - Normal Depth	101.40	-3.70	-2.06	-3.17	-2.03	0.000500	1.23	82.18	54.96	0.18
Main	1260	5	Existing - Normal Depth	159.00	-3.70	-1.56	-2.99	-1.53	0.000500	1.45	110.03	57.92	0.18
Main	1260	5	Proposed - Normal Depth	159.00	-3.70	-1.56	-2.99	-1.53	0.000500	1.45	110.03	57.92	0.18
Main	1260	10	Existing - Normal Depth	199.00	-3.70	-1.27	-2.87	-1.23	0.000501	1.56	127.46	59.70	0.19
Main	1260	10	Proposed - Normal Depth	199.00	-3.70	-1.27	-2.87	-1.23	0.000501	1.56	127.46	59.70	0.19
Main	1260	25	Existing - Normal Depth	260.70	-3.70	-0.86	-2.71	-0.81	0.000500	1.71	152.43	62.15	0.19
Main	1260	25	Proposed - Normal Depth	260.70	-3.70	-0.86	-2.71	-0.81	0.000500	1.71	152.43	62.15	0.19
Main	1260	50	Existing - Normal Depth	302.40	-3.70	-0.61	-2.61	-0.56	0.000501	1.80	168.28	63.67	0.19
Main	1260	50	Proposed - Normal Depth	302.40	-3.70	-0.61	-2.61	-0.56	0.000501	1.80	168.28	63.67	0.19
Main	1260	100	Existing - Normal Depth	354.00	-3.70	-0.31	-2.50	-0.26	0.000500	1.89	187.11	65.42	0.20
Main	1260	100	Proposed - Normal Depth	354.00	-3.70	-0.31	-2.50	-0.26	0.000500	1.89	187.11	65.42	0.20
Main	1260	500	Existing - Normal Depth	474.20	-3.70	0.29	-2.25	0.36	0.000501	2.08	227.94	69.06	0.20
Main	1260	500	Proposed - Normal Depth	474.20	-3.70	0.29	-2.25	0.36	0.000501	2.08	227.94	69.06	0.20

HEC-RAS River: Curtis Creek Reach: Main Profile: 100

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)	
Main	1944	100	Existing - FEMA	354.00	-3.10	10.37		10.37	0.000005	0.43	1372.73	308.59	0.02
Main	1944	100	Proposed - FEMA	354.00	-3.10	10.07		10.07	0.000006	0.46	1280.74	304.47	0.03
Main	1826	100	Existing - FEMA	354.00	-3.50	10.37	-0.45	10.37	0.000006	0.47	989.87	407.62	0.03
Main	1826	100	Proposed - FEMA	354.00	-3.50	10.07	-0.45	10.07	0.000007	0.49	944.12	400.27	0.03
Main	1772	100	Existing - FEMA	354.00	-3.30	10.36	-0.86	10.37	0.000012	0.75	472.71	408.57	0.04
Main	1772	100	Proposed - FEMA	354.00	-3.30	10.06	-0.86	10.07	0.000013	0.77	460.88	399.00	0.04
Main	1706			Culvert									
Main	1632	100	Existing - FEMA	354.00	-4.61	10.00	-1.97	10.01	0.000014	0.86	410.39	307.00	0.04
Main	1632	100	Proposed - FEMA	354.00	-4.61	10.00	-1.97	10.01	0.000014	0.86	410.39	307.00	0.04
Main	1445	100	Existing - FEMA	354.00	-3.60	10.00		10.00	0.000003	0.37	1322.56	238.63	0.02
Main	1445	100	Proposed - FEMA	354.00	-3.60	10.00		10.00	0.000003	0.37	1322.56	238.63	0.02
Main	1260	100	Existing - FEMA	354.00	-3.70	10.00	-2.50	10.00	0.000002	0.27	1798.70	316.60	0.01
Main	1260	100	Proposed - FEMA	354.00	-3.70	10.00	-2.50	10.00	0.000002	0.27	1798.70	316.60	0.01

HEC-RAS Plan: Prop 50 Yr River: Curtis Creek Reach: Main

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Main	1944	50 Yr @ MHW	302.40	-3.10	8.05		8.06	0.000013	0.59	738.89	228.41	0.04
Main	1944	50 Yr @ MLW	302.40	-3.10	0.70		1.00	0.004073	4.40	68.79	32.28	0.53
Main	1826	50 Yr @ MHW	302.40	-3.50	8.05	-0.66	8.06	0.000013	0.58	648.69	346.36	0.04
Main	1826	50 Yr @ MLW	302.40	-3.50	0.05	-0.66	0.43	0.005577	4.97	60.85	29.97	0.61
Main	1772	50 Yr @ MHW	302.40	-3.30	8.04	-1.06	8.05	0.000018	0.79	381.42	324.56	0.04
Main	1772	50 Yr @ MLW	302.40	-3.30	-0.18	-1.06	0.13	0.004196	4.47	67.69	31.73	0.54
Main	1706		Culvert									
Main	1632	50 Yr @ MHW	302.40	-4.61	8.00	-2.19	8.01	0.000017	0.87	348.42	271.45	0.05
Main	1632	50 Yr @ MLW	302.40	-4.61	-0.55	-2.19	-0.34	0.001936	3.61	83.69	42.65	0.38
Main	1445	50 Yr @ MHW	302.40	-3.60	8.00		8.00	0.000006	0.44	871.84	212.00	0.03
Main	1445	50 Yr @ MLW	302.40	-3.60	-1.05	-1.90	-0.82	0.003482	3.79	79.77	42.16	0.49
Main	1260	50 Yr @ MHW	302.40	-3.70	8.00	-2.61	8.00	0.000003	0.31	1198.30	273.10	0.02
Main	1260	50 Yr @ MLW	302.40	-3.70	-2.61	-2.61	-2.10	0.018111	5.76	52.54	51.62	1.01

Plan: Prop 50 Yr Curtis Creek Main RS: 1706 Culv Group: Arch Culvert Profile: 50 Yr @ MHW

Q Culv Group (cfs)	302.40	Culv Full Len (ft)	10.28
# Barrels	1	Culv Vel US (ft/s)	1.61
Q Barrel (cfs)	302.40	Culv Vel DS (ft/s)	1.45
E.G. US. (ft)	8.05	Culv Inv El Up (ft)	-3.75
W.S. US. (ft)	8.04	Culv Inv El Dn (ft)	-5.11
E.G. DS (ft)	8.01	Culv Frctn Ls (ft)	0.00
W.S. DS (ft)	8.00	Culv Exit Loss (ft)	0.02
Delta EG (ft)	0.04	Culv Entr Loss (ft)	0.02
Delta WS (ft)	0.05	Q Weir (cfs)	
E.G. IC (ft)	-0.34	Weir Sta Lft (ft)	
E.G. OC (ft)	8.05	Weir Sta Rgt (ft)	
Culvert Control	Outlet	Weir Submerg	
Culv WS Inlet (ft)	7.99	Weir Max Depth (ft)	
Culv WS Outlet (ft)	7.89	Weir Avg Depth (ft)	
Culv Nml Depth (ft)	1.42	Weir Flow Area (sq ft)	
Culv Crt Depth (ft)	2.23	Min El Weir Flow (ft)	20.01

Plan: Prop 50 Yr Curtis Creek Main RS: 1706 Culv Group: Arch Culvert Profile: 50 Yr @ MLW

Q Culv Group (cfs)	302.40	Culv Full Len (ft)	
# Barrels	1	Culv Vel US (ft/s)	6.56
Q Barrel (cfs)	302.40	Culv Vel DS (ft/s)	4.14
E.G. US. (ft)	0.13	Culv Inv El Up (ft)	-3.75
W.S. US. (ft)	-0.18	Culv Inv El Dn (ft)	-5.11
E.G. DS (ft)	-0.34	Culv Frctn Ls (ft)	0.00
W.S. DS (ft)	-0.55	Culv Exit Loss (ft)	0.06
Delta EG (ft)	0.48	Culv Entr Loss (ft)	0.33
Delta WS (ft)	0.37	Q Weir (cfs)	
E.G. IC (ft)	-0.34	Weir Sta Lft (ft)	
E.G. OC (ft)	0.13	Weir Sta Rgt (ft)	
Culvert Control	Outlet	Weir Submerg	
Culv WS Inlet (ft)	-0.87	Weir Max Depth (ft)	
Culv WS Outlet (ft)	-0.55	Weir Avg Depth (ft)	
Culv Nml Depth (ft)	1.42	Weir Flow Area (sq ft)	
Culv Crt Depth (ft)	2.23	Min El Weir Flow (ft)	20.01

Existing Conditions Input

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

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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      X
XXXXXXX XXXX  X      XXX XXXX  XXXXXX  XXXX
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X    X  XXXXXX  XXXX      X    X      X    X      XXXXX
  
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PROJECT DATA

Project Title: Harrington
 Project File : Harrington.prj
 Run Date and Time: 7/26/2017 3:19:01 PM

Project in English units

PLAN DATA

Plan Title: Existing - Normal Depth
 Plan File : j:\52745-TSK06 - Harrington ME\HECRAS\Harrington.p01

Geometry Title: Existing
 Geometry File : j:\52745-TSK06 - Harrington ME\HECRAS\Harrington.g01

Flow Title : USGS Reg w/ Normal Depth
 Flow File : j:\52745-TSK06 - Harrington ME\HECRAS\Harrington.f01

Plan Summary Information:

Number of: Cross Sections	=	6	Multiple Openings	=	0
Culverts	=	1	Inline Structures	=	0
Bridges	=	0	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: Subcritical Flow

FLOW DATA

Flow Title: USGS Reg w/ Normal Depth
 Flow File : j:\52745-TSK06 - Harrington ME\HECRAS\Harrington.f01

Flow Data (cfs)

River	Reach	RS	1.1	2	5	10	25	50	100	500
Curtis Creek	Main	1944	49.6	101.4	159	199	260.7	302.4	354	474.2

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
Curtis Creek	Main	1.1		Normal S = 0.0005
Curtis Creek	Main	2		Normal S = 0.0005
Curtis Creek	Main	5		Normal S = 0.0005

Curtis Creek	Main	10
Curtis Creek	Main	25
Curtis Creek	Main	50
Curtis Creek	Main	100
Curtis Creek	Main	500

Normal S = 0.0005
Normal S = 0.0005
Normal S = 0.0005
Normal S = 0.0005
Normal S = 0.0005

GEOMETRY DATA

Geometry Title: Existing

Geometry File : j:\52745-TSK06 - Harrington ME\HECRAS\Harrington.g01

CROSS SECTION

RIVER: Curtis Creek

REACH: Main RS: 1944

INPUT

Description: 19+44

Station Elevation Data			num=	30					
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	16	21	14	30.3	12	53.9	10	120.4	8
181.7	6.2	201.4	6	213.1	6	214.4	6.9	216.9	7.5
223	9.2	225.6	8	234	5.8	245.5	5.3	257.6	4.9
262.7	4.4	264.4	1.9	278.3	-1.8	281.5	-3	283.9	-3.1
286.3	-2.7	292.7	-1.8	309	3	315.3	3.9	332.2	5.2
350.9	6.8	353	7.7	362.6	12.7	371	13.8	378.1	14

Manning's n Values			num=	3		
Sta	n Val	Sta	n Val	Sta	n Val	
0	.05	262.7	.035	315.3	.05	

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff	Contr.	Expan.
262.7	315.3	118.42	118.42	118.42		.1	.3

CROSS SECTION

RIVER: Curtis Creek

REACH: Main RS: 1826

INPUT

Description: 18+26

Station Elevation Data			num=	33					
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	13	26.5	11	41	10	56.5	9	87.4	7
114.7	6	132.2	5.7	151	6	158.4	7	162.5	9
163.9	9.5	167.6	9.7	169.5	9	177.7	6	192.4	5
201	4	202.5	2	216.2	-3.5	221	-3.1	226.5	-2.5
233	-.9	237.2	0	240	1	241.3	2	261.4	5.2
284.4	5.3	296.1	6	318.4	8	349.6	6	401.9	4.6
418	6	439.6	10	479.6	14				

Manning's n Values			num=	3		
Sta	n Val	Sta	n Val	Sta	n Val	
0	.05	201	.035	261.4	.05	

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff	Contr.	Expan.
201	261.4	54.12	54.12	54.12		.3	.5

Ineffective Flow			num=	2		
Sta L	Sta R	Elev	Permanent			
0	123.1	20	F			
275.5	479.6	20	F			

CROSS SECTION

RIVER: Curtis Creek

REACH: Main RS: 1772

INPUT

Description: 17+72

Station Elevation Data			num=	29					
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
2.3	13.2	19.6	12	36.8	11	80	9	103	8
122.3	7	139.4	6.2	148.8	6.2	158.1	7	161.1	9

163.8	9.5	166.3	9	173.3	6	188.4	5	196.9	4
198.8	1.8	203.6	-.1	213.5	-3.3	226.5	-3.1	229.6	-2.1
234.6	-.5	242.1	2	243	4	252.8	5.1	288.1	5.5
403.9	5.6	435	8	476	12	518.3	14.3		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
2.3	.05	196.9	.035	243	.05

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.

196.9	243	139.94	139.94	139.94	.3	.5
-------	-----	--------	--------	--------	----	----

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
2.3	197.1	20	F
236.5	518.3	20	F

CULVERT

RIVER: Curtis Creek
REACH: Main RS: 1706

INPUT

Description:

Distance from Upstream XS = 44.5

Deck/Roadway Width = 42

Weir Coefficient = 2.6

Upstream Deck/Roadway Coordinates

num=	21								
Sta	Hi	Cord	Lo	Cord	Sta	Hi	Cord	Lo	Cord
0	18.4				63.9	19			
170.4	21				200.8	22			
257.2	24				286.1	25			
333.5	27				353.2	28			
390.5	30				408.6	31			
446.1	33				465	34			
505.8	36				526.7	37			

Upstream Bridge Cross Section Data

Station	Elevation	Data	num=	29					
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
2.3	13.2	19.6	12	36.8	11	80	9	103	8
122.3	7	139.4	6.2	148.8	6.2	158.1	7	161.1	9
163.8	9.5	166.3	9	173.3	6	188.4	5	196.9	4
198.8	1.8	203.6	-.1	213.5	-3.3	226.5	-3.1	229.6	-2.1
234.6	-.5	242.1	2	243	4	252.8	5.1	288.1	5.5
403.9	5.6	435	8	476	12	518.3	14.3		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
2.3	.05	196.9	.035	243	.05

Bank Sta: Left Right Coeff Contr. Expan.

196.9	243	.3	.5
-------	-----	----	----

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
2.3	197.1	20	F
236.5	518.3	20	F

Downstream Deck/Roadway Coordinates

num=	21								
Sta	Hi	Cord	Lo	Cord	Sta	Hi	Cord	Lo	Cord
0	18.4				63.9	19			
170.4	21				200.8	22			
257.2	24				286.1	25			
333.5	27				353.2	28			
390.5	30				408.6	31			
446.1	33				465	34			
505.8	36				526.7	37			

Downstream Bridge Cross Section Data

Station	Elevation	Data	num=	34					
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-.7	12	28.6	11	39.4	10	49.7	8	55.8	7
67.3	6	79.1	5.7	127	5.7	141.1	6	146.3	7
174.9	8	178.7	8.3	181.8	8	188	7	193	4
194.4	0	198.1	-1	204.6	-2	210.1	-3	213.1	-4.6
219.3	-4.61	227.8	-3.7	231.2	-2.3	246	1	256.8	4
273.6	5	299	6	320.3	7	328.2	8	343.8	9

351.7 12 372.6 14 387.9 16 408.5 19.3

Manning's n Values num= 3
Sta n Val Sta n Val Sta n Val
-.7 .05 193 .035 256.8 .05

Bank Sta: Left Right Coeff Contr. Expan.
193 256.8 .3 .5
Ineffective Flow num= 2
Sta L Sta R Elev Permanent
-.7 208.9 15 F
239.9 408.5 15 F

Upstream Embankment side slope = 1.8 horiz. to 1.0 vertical
Downstream Embankment side slope = 3 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow = .98
Elevation at which weir flow begins =
Energy head used in spillway design =
Spillway height used in design =
Weir crest shape = Broad Crested

Number of Culverts = 1

Culvert Name Shape Rise Span
Arch Culvert Pipe Arch 9.33 15.41
FHWA Chart # 34- 18 inch corner radius; Corrugated metal
FHWA Scale # 2 - Mitered to slope
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist Length Top n Bottom n Depth Blocked Entrance Loss Coef Exit Loss Coef
5.4 130.3 .024 .024 0 .7 1
Upstream Elevation = -2.69
Centerline Station = 219.3
Downstream Elevation = -4.61
Centerline Station = 219.3

CROSS SECTION

RIVER: Curtis Creek
REACH: Main RS: 1632

INPUT

Description:

Station Elevation Data num= 34
Sta Elev Sta Elev Sta Elev Sta Elev Sta Elev
-.7 12 28.6 11 39.4 10 49.7 8 55.8 7
67.3 6 79.1 5.7 127 5.7 141.1 6 146.3 7
174.9 8 178.7 8.3 181.8 8 188 7 193 4
194.4 0 198.1 -1 204.6 -2 210.1 -3 213.1 -4.6
219.3 -4.61 227.8 -3.7 231.2 -2.3 246 1 256.8 4
273.6 5 299 6 320.3 7 328.2 8 343.8 9
351.7 12 372.6 14 387.9 16 408.5 19.3

Manning's n Values num= 3
Sta n Val Sta n Val Sta n Val
-.7 .05 193 .035 256.8 .05

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
193 256.8 186.88 186.88 186.88 .3 .5
Ineffective Flow num= 2
Sta L Sta R Elev Permanent
-.7 208.9 15 F
239.9 408.5 15 F

CROSS SECTION

RIVER: Curtis Creek
REACH: Main RS: 1445

INPUT

Description: 14+45

Station Elevation Data num= 28
Sta Elev Sta Elev Sta Elev Sta Elev Sta Elev
0 26.2 3.1 26 11.9 24 20.7 22 27.9 20
33.9 18 38.6 16 43.3 14 50.2 12 63 10
84.9 8 174.6 6 202 4.1 205.6 -.4 211 -1.3
215.1 -2.5 220 -3.5 229.4 -3.3 243.6 -3.6 254.3 -.2
267 2.4 269.9 4.1 280.2 5.2 288.5 6.5 295.7 7.5

299.1 8.9 313.6 15.2 331.8 22

Manning's n Values num= 3
Sta n Val Sta n Val Sta n Val
0 .05 202 .035 269.9 .05

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
202 269.9 184.65 184.65 184.65 .1 .3

CROSS SECTION

RIVER: Curtis Creek
REACH: Main RS: 1260

INPUT

Description: 12+60

Station Elevation Data num= 24
Sta Elev Sta Elev Sta Elev Sta Elev Sta Elev
0 18.2 15.1 18 32.2 16 45.3 14 76.8 12
96.3 10 124.6 8 188.9 6.1 221.4 8 232.1 8
244.5 6 275.1 4 298.2 -3.7 343.3 -3.7 366.4 4
401.3 6 408.4 8 412.9 10 417.6 12 423.1 14
429.6 16 438.9 18 451.3 20 455.3 21

Manning's n Values num= 3
Sta n Val Sta n Val Sta n Val
0 .05 275.1 .035 366.4 .05

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
275.1 366.4 0 0 0 .1 .3

Proposed Conditions Input

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: Harrington
 Project File : Harrington.prj
 Run Date and Time: 7/26/2017 3:20:03 PM

Project in English units

PLAN DATA

Plan Title: Proposed - Normal Depth
 Plan File : j:\52745-TSK06 - Harrington ME\HECRAS\Harrington.p03

Geometry Title: Proposed
 Geometry File : j:\52745-TSK06 - Harrington ME\HECRAS\Harrington.g02

Flow Title : USGS Reg w/ Normal Depth
 Flow File : j:\52745-TSK06 - Harrington ME\HECRAS\Harrington.f01

Plan Summary Information:

Number of: Cross Sections	=	6	Multiple Openings	=	0
Culverts	=	1	Inline Structures	=	0
Bridges	=	0	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: Subcritical Flow

FLOW DATA

Flow Title: USGS Reg w/ Normal Depth
 Flow File : j:\52745-TSK06 - Harrington ME\HECRAS\Harrington.f01

Flow Data (cfs)

River	Reach	RS	1.1	2	5	10	25	50	100	500
Curtis Creek	Main	1944	49.6	101.4	159	199	260.7	302.4	354	474.2

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
Curtis Creek	Main	1.1		Normal S = 0.0005
Curtis Creek	Main	2		Normal S = 0.0005
Curtis Creek	Main	5		Normal S = 0.0005

Curtis Creek	Main	10
Curtis Creek	Main	25
Curtis Creek	Main	50
Curtis Creek	Main	100
Curtis Creek	Main	500

Normal S = 0.0005
Normal S = 0.0005
Normal S = 0.0005
Normal S = 0.0005
Normal S = 0.0005

GEOMETRY DATA

Geometry Title: Proposed

Geometry File : j:\52745-TSK06 - Harrington ME\HECRAS\Harrington.g02

CROSS SECTION

RIVER: Curtis Creek

REACH: Main RS: 1944

INPUT

Description: 19+44

Station Elevation Data			num=	30							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	16	21	14	30.3	12	53.9	10	120.4	8		
181.7	6.2	201.4	6	213.1	6	214.4	6.9	216.9	7.5		
223	9.2	225.6	8	234	5.8	245.5	5.3	257.6	4.9		
262.7	4.4	264.4	1.9	278.3	-1.8	281.5	-3	283.9	-3.1		
286.3	-2.7	292.7	-1.8	309	3	315.3	3.9	332.2	5.2		
350.9	6.8	353	7.7	362.6	12.7	371	13.8	378.1	14		

Manning's n Values			num=	3						
Sta	n Val	Sta	n Val	Sta	n Val					
0	.05	262.7	.035	315.3	.05					

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	262.7	315.3		118.42	118.42	118.42		.1	.3

CROSS SECTION

RIVER: Curtis Creek

REACH: Main RS: 1826

INPUT

Description: 18+26

Station Elevation Data			num=	33							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	13	26.5	11	41	10	56.5	9	87.4	7		
114.7	6	132.2	5.7	151	6	158.4	7	162.5	9		
163.9	9.5	167.6	9.7	169.5	9	177.7	6	192.4	5		
201	4	202.5	2	216.2	-3.5	221	-3.1	226.5	-2.5		
233	-.9	237.2	0	240	1	241.3	2	261.4	5.2		
284.4	5.3	296.1	6	318.4	8	349.6	6	401.9	4.6		
418	6	439.6	10	479.6	14						

Manning's n Values			num=	3						
Sta	n Val	Sta	n Val	Sta	n Val					
0	.05	201	.035	261.4	.05					

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	201	261.4		54.12	54.12	54.12		.3	.5

Ineffective Flow			num=	2						
Sta L	Sta R	Elev	Permanent							
0	123.1	20	F							
275.5	479.6	20	F							

CROSS SECTION

RIVER: Curtis Creek

REACH: Main RS: 1772

INPUT

Description: 17+72

Station Elevation Data			num=	29							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
2.3	13.2	19.6	12	36.8	11	80	9	103	8		
122.3	7	139.4	6.2	148.8	6.2	158.1	7	161.1	9		

163.8	9.5	166.3	9	173.3	6	188.4	5	196.9	4
198.8	1.8	203.6	-.1	213.5	-3.3	226.5	-3.1	229.6	-2.1
234.6	-.5	242.1	2	243	4	252.8	5.1	288.1	5.5
403.9	5.6	435	8	476	12	518.3	14.3		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
2.3	.05	196.9	.035	243	.05

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.

196.9	243	139.94	139.94	139.94	.3	.5
-------	-----	--------	--------	--------	----	----

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
2.3	197.1	20	F
236.5	518.3	20	F

CULVERT

RIVER: Curtis Creek
REACH: Main RS: 1706

INPUT

Description:

Distance from Upstream XS = 44.5

Deck/Roadway Width = 42

Weir Coefficient = 2.6

Upstream Deck/Roadway Coordinates

num=	21								
Sta	Hi	Cord	Lo	Cord	Sta	Hi	Cord	Lo	Cord
0	18.4				63.9	19			
170.4	21				200.8	22			
257.2	24				286.1	25			
333.5	27				353.2	28			
390.5	30				408.6	31			
446.1	33				465	34			
505.8	36				526.7	37			

Upstream Bridge Cross Section Data

Station	Elevation	Data	num=	29					
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
2.3	13.2	19.6	12	36.8	11	80	9	103	8
122.3	7	139.4	6.2	148.8	6.2	158.1	7	161.1	9
163.8	9.5	166.3	9	173.3	6	188.4	5	196.9	4
198.8	1.8	203.6	-.1	211.3	-3.75	227.3	-3.75	229.6	-2.1
234.6	-.5	242.1	2	243	4	252.8	5.1	288.1	5.5
403.9	5.6	435	8	476	12	518.3	14.3		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
2.3	.05	196.9	.035	243	.05

Bank Sta: Left Right Coeff Contr. Expan.

196.9	243	.3	.5
-------	-----	----	----

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
2.3	197.1	20	F
236.5	518.3	20	F

Downstream Deck/Roadway Coordinates

num=	21								
Sta	Hi	Cord	Lo	Cord	Sta	Hi	Cord	Lo	Cord
0	18.4				63.9	19			
170.4	21				200.8	22			
257.2	24				286.1	25			
333.5	27				353.2	28			
390.5	30				408.6	31			
446.1	33				465	34			
505.8	36				526.7	37			

Downstream Bridge Cross Section Data

Station	Elevation	Data	num=	34					
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-.7	12	28.6	11	39.4	10	49.7	8	55.8	7
67.3	6	79.1	5.7	127	5.7	141.1	6	146.3	7
174.9	8	178.7	8.3	181.8	8	188	7	193	4
194.4	0	198.1	-1	204.6	-2	210.1	-3	211.3	-4.61
227.3	-4.61	227.8	-3.7	231.2	-2.3	246	1	256.8	4
273.6	5	299	6	320.3	7	328.2	8	343.8	9

351.7 12 372.6 14 387.9 16 408.5 19.3

Manning's n Values num= 3
Sta n Val Sta n Val Sta n Val
-.7 .05 193 .035 256.8 .05

Bank Sta: Left Right Coeff Contr. Expan.
193 256.8 .3 .5
Ineffective Flow num= 2
Sta L Sta R Elev Permanent
-.7 208.9 15 F
239.9 408.5 15 F

Upstream Embankment side slope = 1.8 horiz. to 1.0 vertical
Downstream Embankment side slope = 3 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow = .98
Elevation at which weir flow begins =
Energy head used in spillway design =
Spillway height used in design =
Weir crest shape = Broad Crested

Number of Culverts = 1

Culvert Name Shape Rise Span
Arch Culvert Box 13 16
FHWA Chart # 8 - flared wingwalls
FHWA Scale # 1 - Wingwall flared 30 to 75 deg.
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist Length Top n Bottom n Depth Blocked Entrance Loss Coef Exit Loss Coef
5.4 130.3 .013 .013 0 .5 1
Upstream Elevation = -3.75
Centerline Station = 219.3
Downstream Elevation = -5.11
Centerline Station = 219.3

CROSS SECTION

RIVER: Curtis Creek
REACH: Main RS: 1632

INPUT

Description:

Station Elevation Data num= 34
Sta Elev Sta Elev Sta Elev Sta Elev Sta Elev
-.7 12 28.6 11 39.4 10 49.7 8 55.8 7
67.3 6 79.1 5.7 127 5.7 141.1 6 146.3 7
174.9 8 178.7 8.3 181.8 8 188 7 193 4
194.4 0 198.1 -1 204.6 -2 210.1 -3 213.1 -4.6
219.3 -4.61 227.8 -3.7 231.2 -2.3 246 1 256.8 4
273.6 5 299 6 320.3 7 328.2 8 343.8 9
351.7 12 372.6 14 387.9 16 408.5 19.3

Manning's n Values num= 3
Sta n Val Sta n Val Sta n Val
-.7 .05 193 .035 256.8 .05

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
193 256.8 186.88 186.88 186.88 .3 .5
Ineffective Flow num= 2
Sta L Sta R Elev Permanent
-.7 208.9 15 F
239.9 408.5 15 F

CROSS SECTION

RIVER: Curtis Creek
REACH: Main RS: 1445

INPUT

Description: 14+45

Station Elevation Data num= 28
Sta Elev Sta Elev Sta Elev Sta Elev Sta Elev
0 26.2 3.1 26 11.9 24 20.7 22 27.9 20
33.9 18 38.6 16 43.3 14 50.2 12 63 10
84.9 8 174.6 6 202 4.1 205.6 -.4 211 -1.3
215.1 -2.5 220 -3.5 229.4 -3.3 243.6 -3.6 254.3 -.2
267 2.4 269.9 4.1 280.2 5.2 288.5 6.5 295.7 7.5

299.1 8.9 313.6 15.2 331.8 22

Manning's n Values num= 3
Sta n Val Sta n Val Sta n Val
0 .05 202 .035 269.9 .05

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
 202 269.9 184.65 184.65 184.65 .1 .3

CROSS SECTION

RIVER: Curtis Creek
REACH: Main RS: 1260

INPUT

Description: 12+60

Station Elevation Data num= 24
Sta Elev Sta Elev Sta Elev Sta Elev Sta Elev
0 18.2 15.1 18 32.2 16 45.3 14 76.8 12
96.3 10 124.6 8 188.9 6.1 221.4 8 232.1 8
244.5 6 275.1 4 298.2 -3.7 343.3 -3.7 366.4 4
401.3 6 408.4 8 412.9 10 417.6 12 423.1 14
429.6 16 438.9 18 451.3 20 455.3 21

Manning's n Values num= 3
Sta n Val Sta n Val Sta n Val
0 .05 275.1 .035 366.4 .05

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
 275.1 366.4 0 0 0 .1 .3