HYDRAULIC REPORT

Hydraulics

The State Route 133 (Livermore Falls Road) bridge crosses Wilson Stream approximately 9.6 miles upstream of its confluence with the Sandy River in Farmington, Maine. The 1985 Town of Farmington Flood Insurance Study (FIS) reported the following peak discharges at the project site, which were found to be generally 20%-25% higher than the recently calculated project design/check peak discharge values.

1985 Town of Farmington Flood Insurance Study (FIS) Peak Discharge Summary				
Location	**10-Year**	**50-Year**	**100-Year**	**500-Year**
At State Route 133	3,400	5,600	6,800	9,700

The hydraulic analysis for the FIS was prepared using the Soil Conservation Service (SCS) Water Surface Profile Model WSP2 (WSP2). An existing condition HEC-RAS model that incorporated FEMA flows and known Water Surface Elevations (WSEL) was developed. The downstream boundary condition was set at normal depth, with an estimated downstream slope of 0.0012. The downstream boundary condition was considered acceptable for developing the existing and proposed condition HEC-RAS models, based on:

- The starting water surface elevation (SWSEL) at River Station (RS) 200 were within 0.1 feet of the 100-year FEMA SWSEL.
- WSEL at FEMA Lettered Sections P (downstream) and Q (upstream) were within 0.6 feet
- WSEL at DS face of bridge was within 0.1 feet for the 1987 Flood of Record (FOR)

To investigate the feasibility of passing the flood of record, an existing condition model for the 1987 April Fool's Day Flood, which is recognized as the flood of record (FOR) for Farmington, was developed. The USGS published historical flood records are listed below. Historical elevations were based on the 1929 National Geodetic Vertical Datum (NGVD) and converted to the 1988 North American Vertical Datum (NAVD) by subtracting 0.46 feet.

Historical Flood Data					
Flood Year	Location (Miles US from Mouth)		Description	Elevation	
				NGVD 1929	NAVD 1988
1987	9.6	miles	Farmington, Maine, upstream side Route 133 bridge, left bank	368.7	368.2
	9.6	miles	Farmington, Maine, downstream side Route 133 bridge, right bank	366.8	366.3

The existing low-lying bridge does not pass the 50-year event. The 50-year event flows into the bridge and there is approximately 3 feet of backwater associated with the pressure flow.

The precise location of the 1987 measurements (at the "upstream side" and the "downstream side") were not recorded. For estimating the discharge for the flood of record, these observations were considered at the immediate downstream face of the bridge and where the stage increase associated with pressure flow occurs at the upstream face of the bridge. The discharge associated with the recorded flood of record elevations was estimated to be 6150 cfs, which corresponds to an approximate 286-year event.

Existing topography and river sections were surveyed in June 2018. Geometric data for the existing bridge was taken from the existing bridge plans. (See Appendix D). All elevations were referenced to the project datum (NAVD 1988). Geometric data for the proposed bridge was taken from the preliminary design and plans (see Appendix A).

Manning's "n" values were based on information from the FEMA study, with channel "n" consisting of 0.05 and overbank "n" consisting of 0.075.

Headwater Elevations for estimating freeboard in the Hydraulic Summary table below considered the WSEL at Upstream Approach Section (River Station 1100) and adjustments associated with the reported Energy Grade Lines.

Scour

A scour analysis was performed in accordance with FHWA guidelines (HEC-18 and associated guidance documents HEC-23 and HEC-20) for the Q100 scour design and Q500 scour check. Borings were obtained behind the existing bridge abutments, and the stream bed D50 was extrapolated to the channel and estimated to be 0.03mm, which represents potential of Live Bed contraction scour.

The proposed bridge shows abutment scour at the Q100 storm event, and contraction and abutment scour at the Q500 storm event as summarized in the table below. Scour was calculated by using the HEC-RAS Hydraulic Design Function for Bridge Scour. The HEC-18 Froehlich equation does not accurately predict local scour, so the total scour depths are exaggerated. Scour depths will be refined during the Final Design phase for the Plans Impact Complete (PIC) submission. Plain Riprap is recommended based on HEC 23 sizing guidelines.

Reported By: Ronald L. Joy, PE (MJ)

Date: February 2020

Hydraulic Summary				
Elevations, Velocities & Freeboards	**Existing Structure**		**Proposed Structure**	
	62' Single Span Steel Plate Girder		**115' Single Span Steel Plate Girder**	
$Q_{1.1}$ Headwater Elevation	360.07	ft	359.39	ft
Q_{10} Headwater Elevation	365.89	ft	364.19	ft
Q_{25} Headwater Elevation	366.70	ft	365.44	ft
Q_{50} Headwater Elevation	367.65	ft	366.27	ft
Q_{100} Headwater Elevation	369.18	ft	367.08	ft
Q_{286} Headwater Elevation	370.66	ft	369.01	ft
Q_{500} Headwater Elevation	371.28	ft	369.24	ft
$Q_{1.1}$ Discharge Velocity	5.6	fps	2.7	fps
Q_{10} Discharge Velocity	8.0	fps	4.5	fps
Q_{25} Discharge Velocity	9.2	fps	5.0	fps
Q_{50} Discharge Velocity	10.5	fps	5.3	fps
Q_{100} Discharge Velocity	12.0	fps	5.6	fps
Q_{286} Discharge Velocity	11.6	fps	6.9	fps
Q_{500} Discharge Velocity	10.6	fps	7.3	fps
Bottom Beam Elevation	364.78	ft	367.05	ft
Q_{25} Freeboard	-1.9	ft	1.6	ft
Q_{50} Freeboard	-2.9	ft	0.8	ft
Q_{100} Freeboard	-4.4	ft	0.0	ft
Q_{286} Freeboard (FOR)	-5.9	ft	-2.0	ft

Notes:

1. All elevations based on North American Vertical Datum (NAVD) of 1988.
2. (FOR) is the Flood of Record.

Scour Summary						
Element	100-Year			500-Year		
	Contraction	Local	Total	Contraction	Local	Total
Abutment No. 1	0.00	11.36	**11.4**	0.42	12.67	**13.1**
Abutment No. 2	0.00	16.86	**16.9**	0.42	22.57	**23.0**

Notes:

1. All preliminary values are in feet.
2. Contraction scour is measured from bottom of stream and local scour is measured from where proposed grade meets the abutment face.

Reported By: Ronald L. Joy, PE (MJ)

Date: March 2019

Appendix E –

Hydrology, Hydraulic & Scour Documentation

Hydrology, Hydraulic, & Scour Information

WIN:	22236.00	**Project Name:**	Farmington Br3286 Hamlin
Town:	Farmington	**Stream Name:**	Wilson Stream
Route No.	Rt 133	**Bridge Name:**	Hamlin
Asset ID:	3286	**Analysis by:**	DFB
Lat:	44.6228 **Long:** -70.16010	**Date:**	8/21/2017

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

Enter data in blue cells only!

	km²	mi²	ac	***Enter data in [mi²]***
A	134.68	52.00	33280.0	Watershed Area *DRNAREA*
W	9.41	3.6	2326.3	Wetlands area (by NWI)
P_c	400171	4942163		watershed centroid (E, N; UTM 19N; meters)
County	Franklin			*choose county from drop-down menu*
pptA	45.6			mean annual precipitation (inches; by look-up)
SG	0.02			sand & gravel aquifer as decimal fraction of watershed A

A (km²)	134.68	**Conf Lvl**	0.67
W (%)	6.99		NWI Wetlands % *STORNWI*

Ret Pd T (yr)	**Peak Flow Estimate Lower**	**Q_T (m^3/s)**	**Upper**	**Q_T (ft^3/s)**
1.1		22.73		802.6
2		44.78		1581.3
5		68.42		2416.0
10		85.84		3030.9
25		108.88		3844.4
50		126.89		4480.3
100		145.97		5154.0
500		193.21		6822.1

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

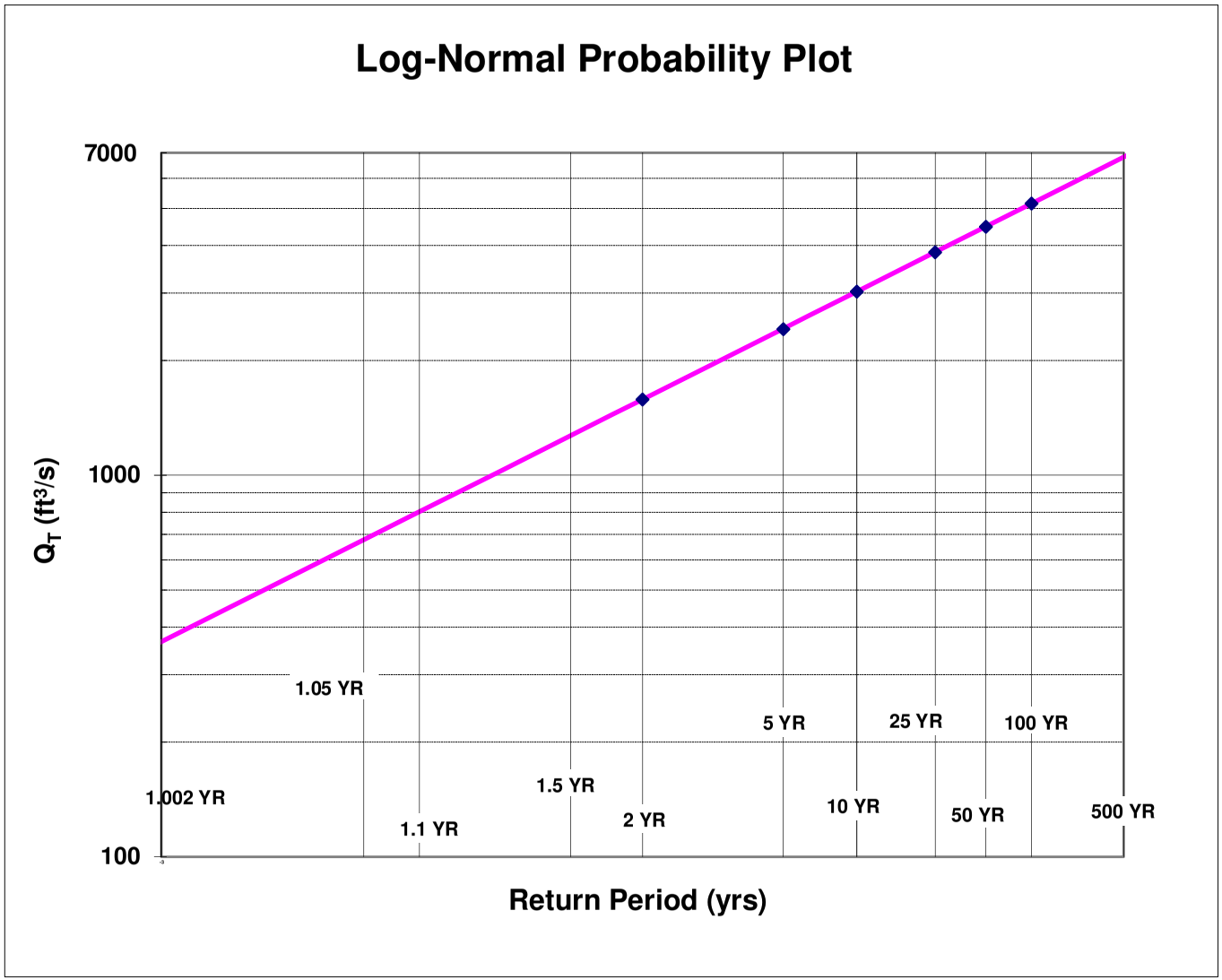
ver. 2017 Jun. 09

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

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


Log-Normal Probability Plot
7000
1000
100
Q_T (ft³/s)
1.05 YR
5 YR
25 YR
100 YR
1.002 YR
1.5 YR
10 YR
1.1 YR
2 YR
50 YR
500 YR
Return Period (yrs)

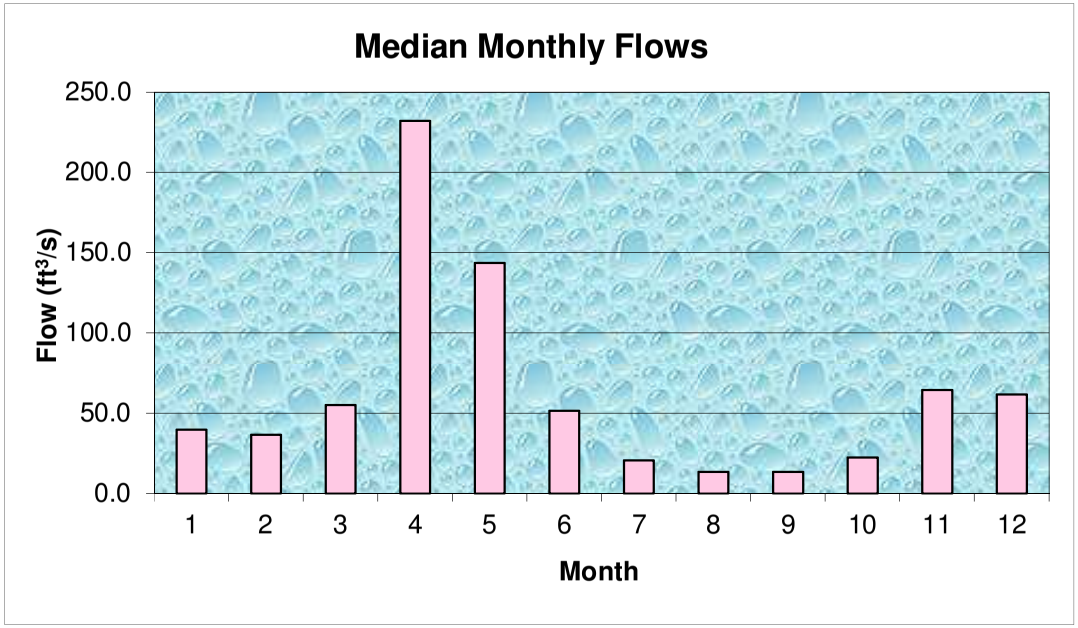
WIN:	22236.00	**Project Name:**	Farmington Br3286 Hamlin
Town:	Farmington	**Stream Name:**	Wilson Stream
Route No.	Rt 133	**Bridge Name:**	Hamlin
Asset ID:	3286	**Analysis by:**	DFB
Lat:	44.62280 **Long:** -70.16010	**Date:**	8/21/2017

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

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

	Value	Variable	Explanation
	52.00	*A*	Area (mi^2)
400171.1	4942163	P_c	Watershed centroid (E,N; UTM; Zone 19; meters)
	91.02	*DIST*	Distance from Coastal reference line (mi)
	45.6	*pptA*	Mean Annual Precipitation (inches)
	0.02	*SG*	Sand & Gravel Aquifer (decimal fraction of watershed area)

Month	Q_{median} (ft3/s)	(m^3/s)
Jan	**39.91**	1.1311
Feb	**36.67**	1.0392
Mar	**55.09**	1.5612
Apr	**232.27**	6.5821
May	**143.74**	4.0734
Jun	**51.54**	1.4605
Jul	**20.62**	0.5844
Aug	**13.49**	0.3822
Sep	**13.44**	0.3809
Oct	**22.51**	0.6378
Nov	**64.56**	1.8294
Dec	**61.68**	1.7480



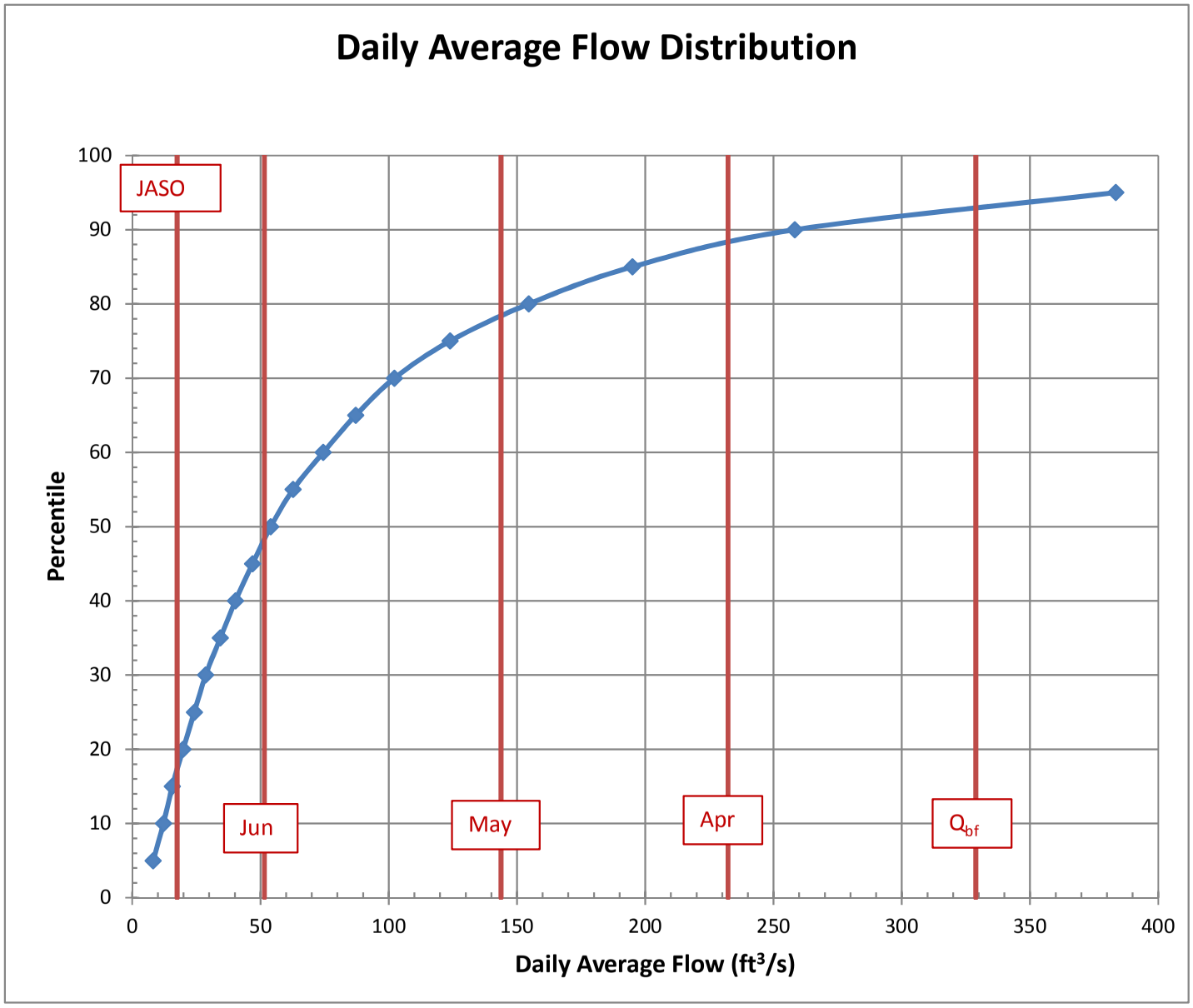
Q_{bf}	**328.8**	
ann avg	**105.6**	
ann med	**56.8**	
$Q_{1.002}$	**366.2**	
$Q_{1.01}$	**483.9**	
$Q_{1.05}$	**677.2**	
Q_{bf}	**526.8**	assume v = 4ft/s

W_{bf}	**57.9**	estimated bankfull width (ft)
d_{bf}	**2.3**	estimated bankfull depth (ft)
A_{bf}	**136.1**	estimated bankfull flow area (ft^2)

References

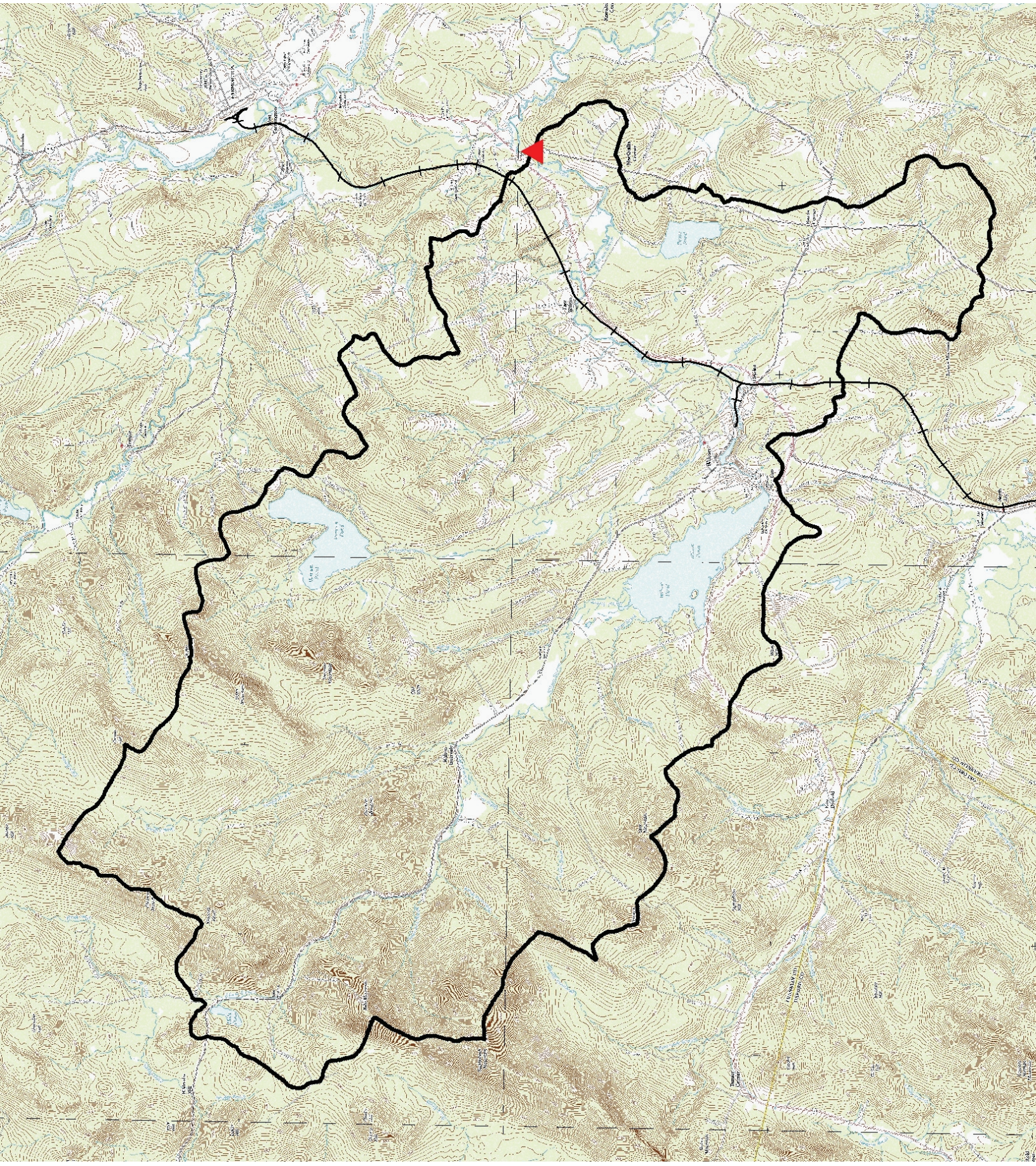
Dudley, R.W., 2013. FY2013 Progress Report - Phase 1 …, USFWS QRP Project

Dudley, R.W., 2004. Estimating Monthly Streamflows … , SIR 2004-5026



Daily Avg Flow Dist		
A_{ws} = (mi^2)		52.0
Q (ft^3/s)		
Pctl	**Median**	**84th pctl**
5	8.19	13.17
10	12.16	18.28
15	15.63	22.83
20	19.79	27.68
25	24.21	32.45
30	28.65	36.96
35	34.32	42.24
40	40.25	48.57
45	46.92	54.92
50	54.02	64.84
55	62.73	75.47
60	74.50	88.59
65	87.15	103.21
70	102.23	120.41
75	123.93	144.80
80	154.55	172.88
85	195.01	221.55
90	258.33	297.49
95	383.38	462.63

Q_{bf}	328.8
$Q_{1.002}$	366.2
$Q_{1.1}$	802.6
Q_2	1581.3



Farmington 22236 Br3286 Hamlin

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Workspace ID: ME20170821092028656000
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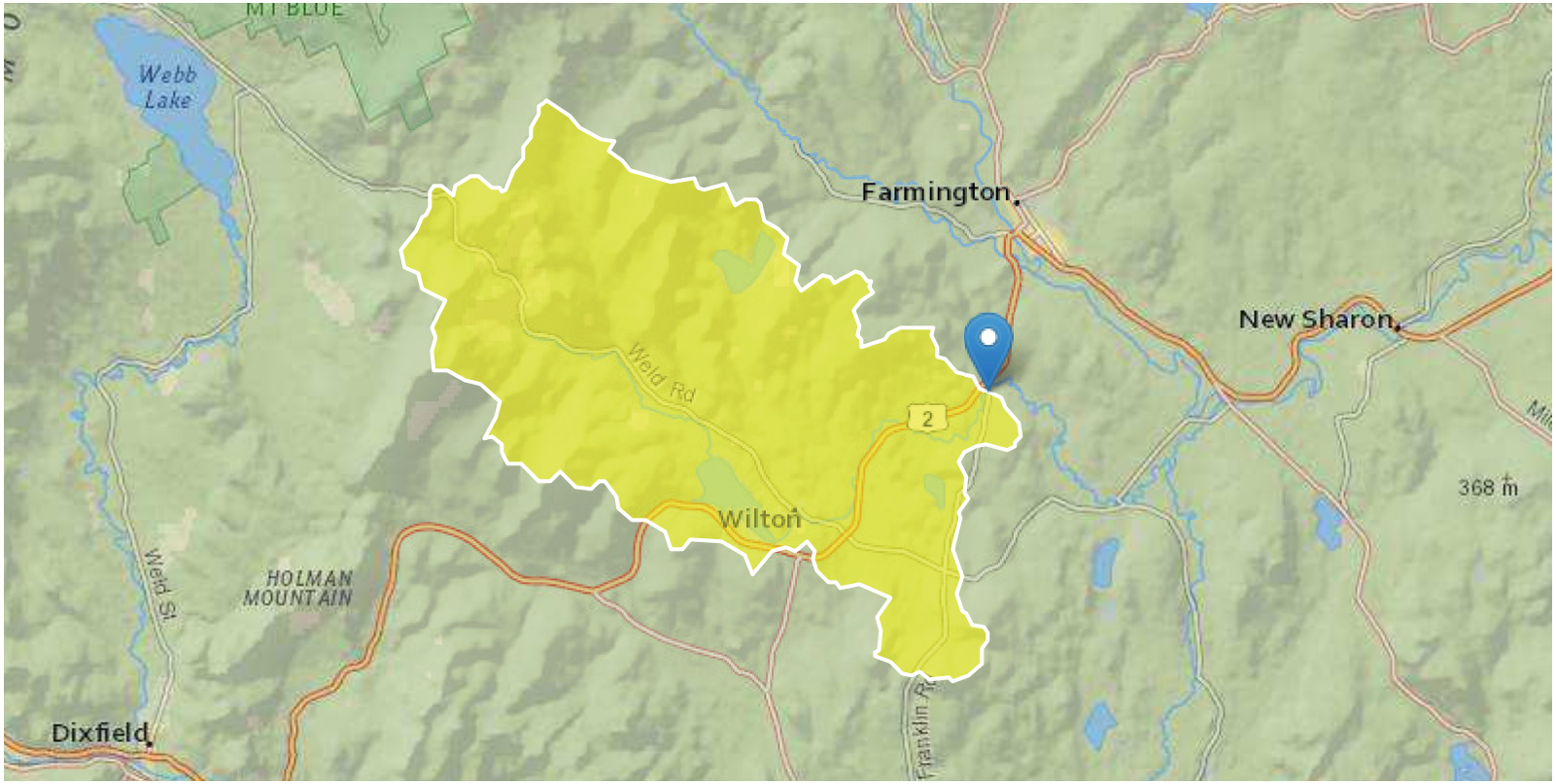
Time: 2017-08-21 09:22:01 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	52	square miles
STORNWI	Percentage of strorage (combined water bodies and wetlands) from the Nationa Wetlands Inventory	6.99	percent

E-7

Parameter Code	Parameter Description	Value	Unit
SANDGRAVAF	Fraction of land surface underlain by sand and gravel aquifers	0.02	dimensionless
ELEV	Mean Basin Elevation	908	feet
BSLDEM10M	Mean basin slope computed from 10 m DEM	13.7	percent
COASTDIST	Shortest distance from the coastline to the basin centroid	92.2	miles
ELEVMAX	Maximum basin elevation	2563.8	feet
LC06WATER	Percent of open water, class 11, from NLCD 2006	3.08	percent
LC11DEV	Percentage of developed (urban) land from NLCD 2011 classes 21-24	6.19	percent
LC11IMP	Average percentage of impervious area determined from NLCD 2011 impervious dataset	1.28	percent
PRECIP	Mean Annual Precipitation	48.9	inches
SANDGRAVAP	Percentage of land surface underlain by sand and gravel aquifers	2	percent
STATSGOA	Percentage of area of Hydrologic Soil Type A from STATSGO	2.59	percent

General Disclaimers

The delineation point is in an exclusion area.

Bankfull Statistics Parameters [Central and Coastal Bankfull 2004 5042]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	52	square miles	2.92	298

Bankfull Statistics Flow Report [Central and Coastal Bankfull 2004 5042]

PII: Prediction Interval-Lower, Plu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SEe
Bankfull Streamflow	329	ft^3/s	54.1

E-8

Statistic	Value	Unit	SEe
Bankfull Width	59.9	ft	33
Bankfull Depth	2.28	ft	26.2
Bankfull Area	136	ft^2	57.4

Bankfull Statistics Citations

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 (http://pubs.usgs.gov/sir/2004/5042/pdf/sir2004-5042.pdf)

Peak-Flow Statistics Parameters [Statewide Peak Flow Full GT 12sqmi WRI 99 4008]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	52	square miles	0.93	1653
STORNWI	Percentage of Storage from NWI	6.99	percent	0.7	26.7

Peak-Flow Statistics Flow Report [Statewide Peak Flow Full GT 12sqmi WRI 99 4008]

PII: Prediction Interval-Lower, PIu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PII	PIu	SE	SEp	Equiv. Yrs.
2 Year Peak Flood	1580	ft^3/s	885	2830	35.1	35.1	1.8
5 Year Peak Flood	2420	ft^3/s	1340	4360	36.1	36.1	2.5
10 Year Peak Flood	3030	ft^3/s	1660	5550	36.8	36.8	3.2
25 Year Peak Flood	3840	ft^3/s	2050	7210	38.6	38.6	4.1
50 Year Peak Flood	4480	ft^3/s	2340	8580	39.9	39.9	4.8
100 Year Peak Flood	5150	ft^3/s	2640	10100	41.2	41.2	5.4
500 Year Peak Flood	6820	ft^3/s	3300	14100	44.9	44.9	6.4

Peak-Flow Statistics Citations

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. (http://me.water.usgs.gov/99-4008.pdf)

Low-Flow Statistics Parameters [Statewide LowFlow SIR 2004 5026]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	52	square miles	9.79	1418
SANDGRAVAF	Fraction of Sand and Gravel Aquifers	0.02	dimensionless	0	0.455

Low-Flow Statistics Flow Report [Statewide LowFlow SIR 2004 5026]

PII: Prediction Interval-Lower, Plu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SE	SEp	Equiv. Yrs.
7 Day 10 Year Low Flow	2.66	ft^3/s	44.3	44.3	2.9

Low-Flow Statistics Citations

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. (http://water.usgs.gov/pubs/sir/2004/5026/pdf/sir2004-5026.pdf)

Flow-Duration Statistics Parameters [Statewide Annual SIR 2015 5151]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	52	square miles	14.9	1419
SANDGRAVAF	Fraction of Sand and Gravel Aquifers	0.02	dimensionless	0	0.212
ELEV	Mean Basin Elevation	908	feet	239	2120

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

PII: Prediction Interval-Lower, Plu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SEp
1 Percent Duration	1.26	ft^3/s	144

Statistic	Value	Unit	SEp
5 Percent Duration	3.94	ft^3/s	62
10 Percent Duration	7.37	ft^3/s	41
25 Percent Duration	20.3	ft^3/s	22
50 Percent Duration	51.5	ft^3/s	20
75 Percent Duration	124	ft^3/s	17
90 Percent Duration	271	ft^3/s	17
95 Percent Duration	423	ft^3/s	18
99 Percent Duration	940	ft^3/s	29

Flow-Duration Statistics Citations

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

Annual Flow Statistics Parameters [Statewide Annual SIR 2015 5151]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	52	square miles	14.9	1419
SANDGRAVAF	Fraction of Sand and Gravel Aquifers	0.02	dimensionless	0	0.212
ELEV	Mean Basin Elevation	908	feet	239	2120

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

PII: Prediction Interval-Lower, PIu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SEp
Mean Annual Flow	113	ft^3/s	16

Annual Flow Statistics Citations

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency and peak elevation-frequency relationships for each flooding source studied in detail affecting the community.

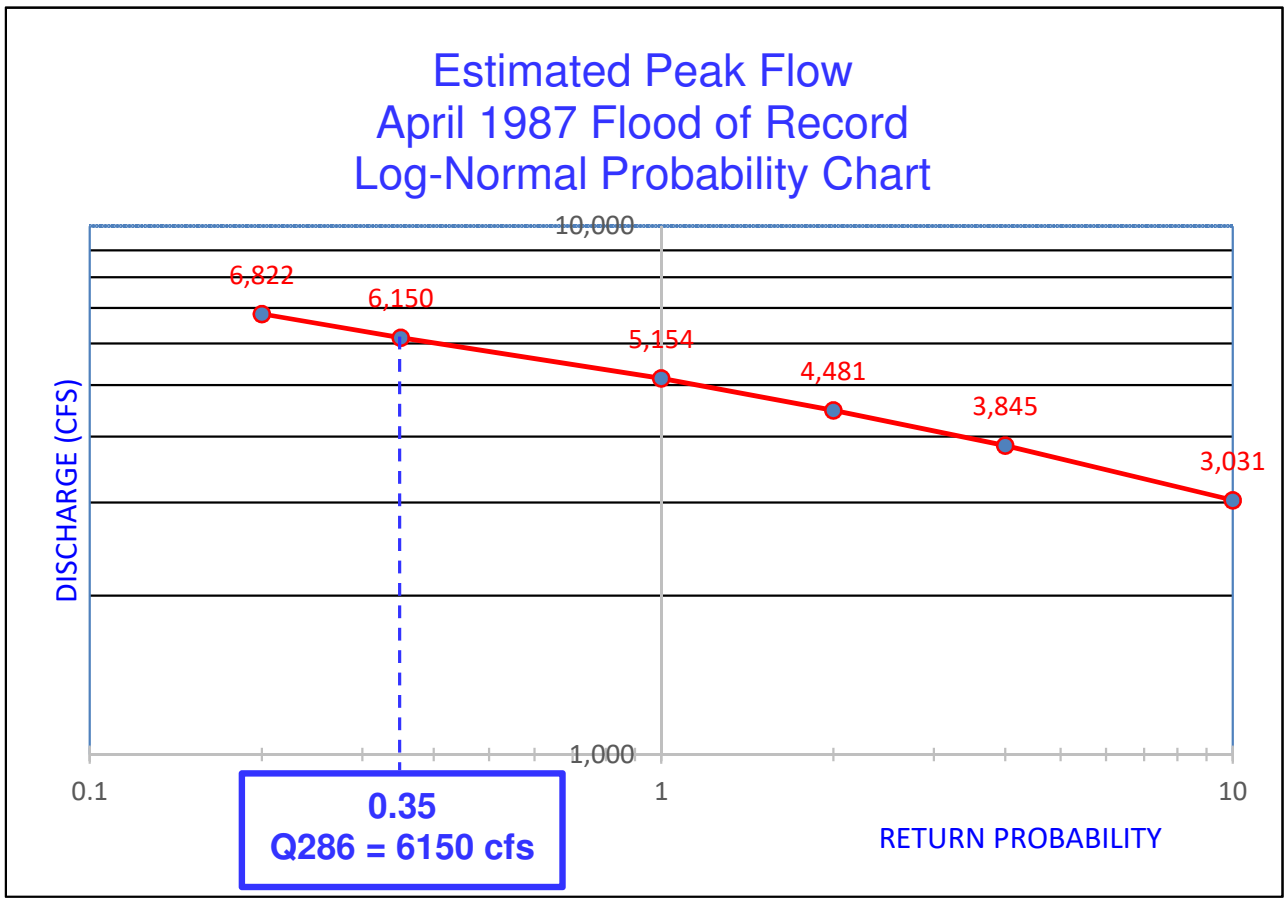
Flood discharges for the Sandy River; Wilson, Temple, and Barker Streams; Cascade and Beaver Brooks; and Clearwater Pond were generated from the SCS Technical Release No. 20 (TR-20) hydrologic evaluation model (Reference 5). The Sandy River watershed model was calibrated to a log-Pearson Type III analysis of the USGS stream gage (No. 01048000) near Mercer which has 54 years of record (References 6 and 7).

A summary of the drainage area-peak discharge relationships for the streams studied by detailed methods is shown in Table 1, "Summary of Discharges."

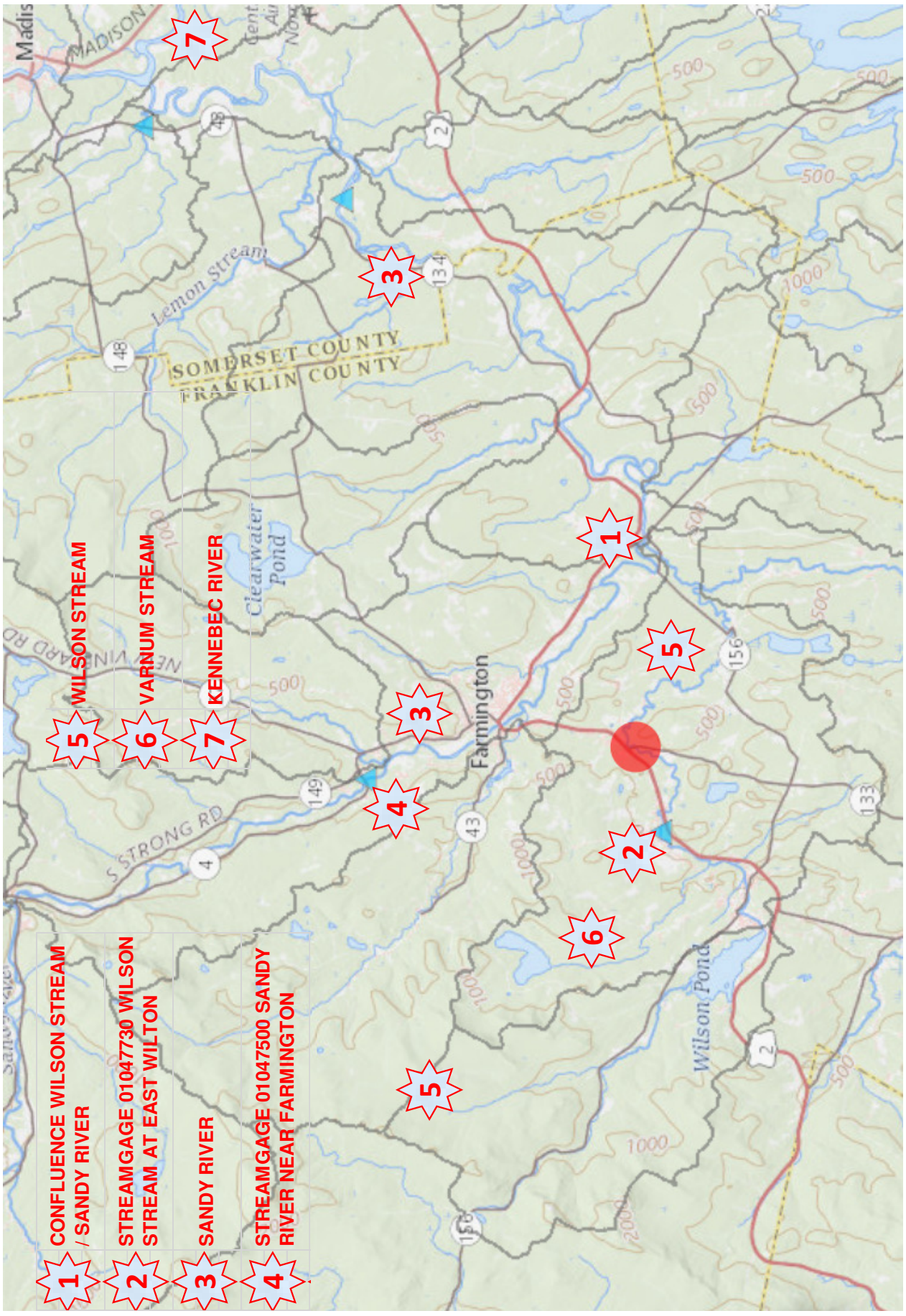
TABLE 1 - SUMMARY OF DISCHARGES

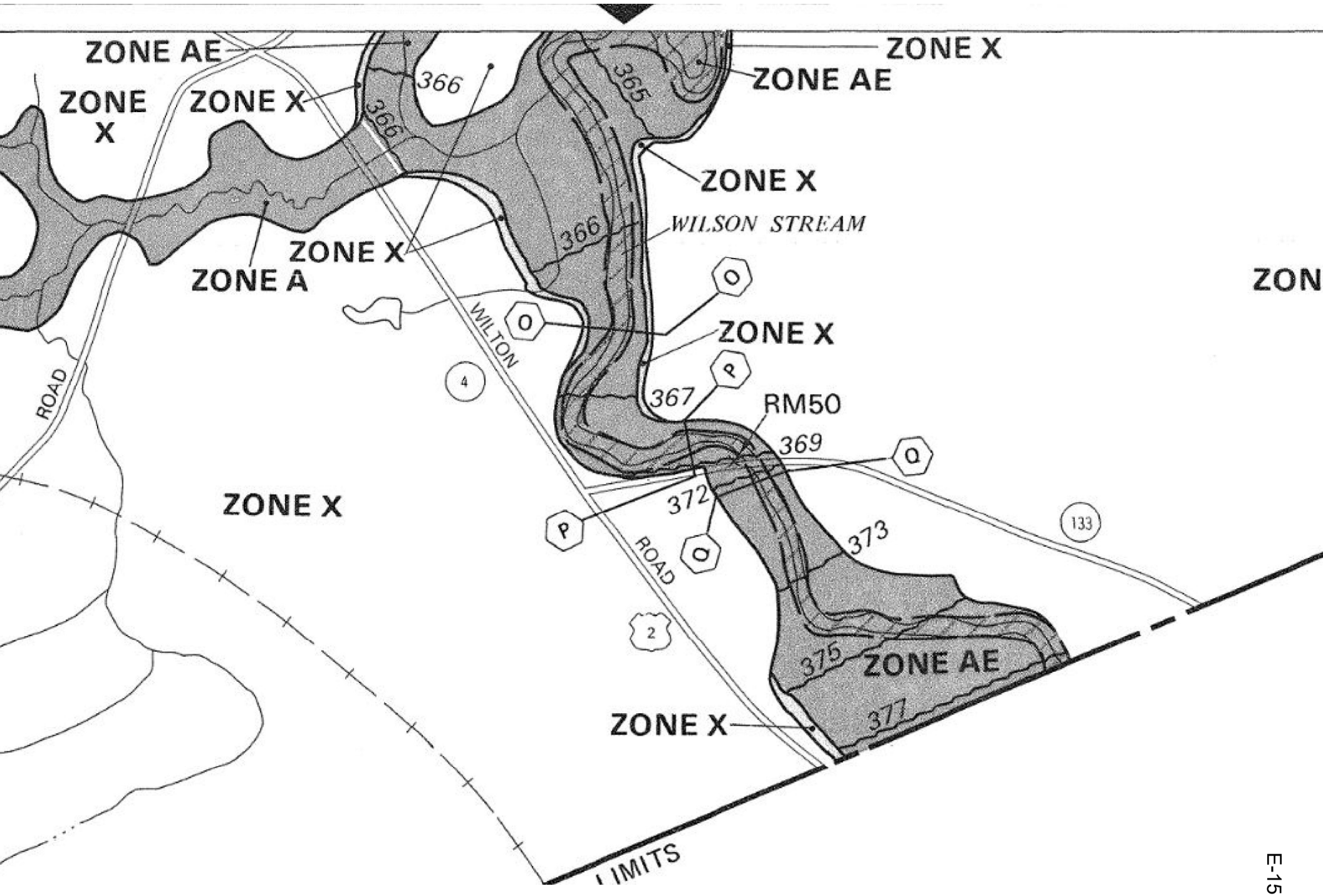
FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
SANDY RIVER					
At State Route 41	418.2	20,000	33,100	39,200	53,300
At U.S. Route 2	266.6	16,300	29,800	36,900	54,900*
At State Route 4	242.1	16,000	30,100*	37,600*	55,200*
WILSON STREAM					
At State Route 156 (lower crossing)	102.6	4,300	7,200	8,700	12,200
At State Route 156 (upper crossing)	66.0	3,800	6,400	7,700	10,700
At Webster Road	55.9	3,900*	6,500*	7,900*	11,200*
At State Route 133	51.6	3,400	5,600	6,800	9,700
TEMPLE STREAM					
At U.S. Route 2	33.3	3,500	6,400	7,800	11,300
At State Route 43	30.5	3,700*	6,950*	8,550*	12,250*
At Russell's Mill Road	28.6	3,650*	6,900*	8,450*	12,150*
At upstream corporate limits	22.4	3,600*	6,650*	8,200*	11,750*
BARKER STREAM					
At State Route 4	18.8	2,000	3,730	4,570	6,160
At State Route 27	4.6	1,120	1,970	2,390	3,340

*Increases due to storage effects



Farmington ME H&H Tables.xlsx
Hydrology Summary Table


1 CONFLUENCE WILSON STREAM / SANDY RIVER
2 STREAMGAGE 01047730 WILSON STREAM AT EAST WILTON
3 SANDY RIVER
4 STREAMGAGE 01047500 SANDY RIVER NEAR FARMINGTON
5 WILSON STREAM
6 VARNUM STREAM
7 KENNEBEC RIVER
SOMERSET COUNTY
FRANKLIN COUNTY
Farmington
Lemon Stream
Clearwater Pond
Wilson Pond
S STRONG RD
MADISON


ZONE AE
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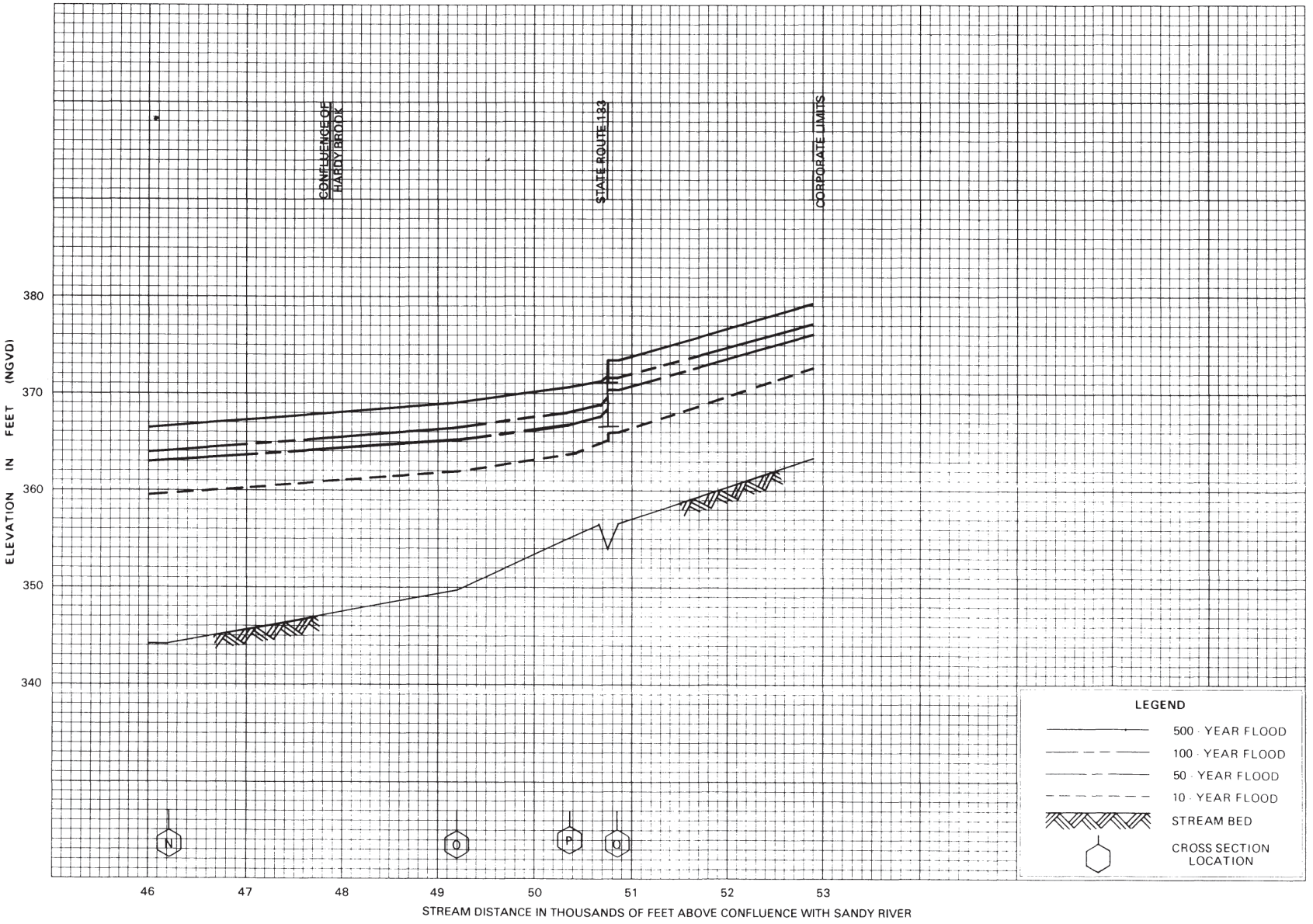
ZONE X
ZONE X
366
366
365
366
WILSON STREAM
ZONE X
ZONE A
ZONE X
ZONE X
WILTON
ROAD
4
367
RM50
369
ZONE X
372
373
ROAD
2
133
375
ZONE AE
377
ZONE X
LIMITS

Table 12.--Flood-crest stages for April 1987 flood in Maine--Continued

Stream and location	Miles upstream[a] from mouth	Elevation (in feet)
KENNEBEC RIVER BASIN--Continued		
Wilson Stream--Continued:		
Wilton, Maine, upstream from mouth of Coubers Brook, left bank	15.1	471.0
Wilton, Maine, downstream from Backus Garage, left bank	13.2	424.1
Wilton, Maine, U.S. Geological Survey gage 01047730, 0.1 mile upstream from railroad bridge, left bank	12.7	416.9
Wilton, Maine, downstream side East Wilton Bridge, right bank	12.6	407.0
Wilton, Maine, 40 feet upstream from railroad bridge, right bank	12.6	397.4
Wilton, Maine, 40 feet downstream from railroad bridge, right bank	12.6	395.4
Wilton, Maine, 100 feet upstream from Route 2 bridge, right bank	12.0	389.7
Wilton, Maine, 100 feet downstream from Route 2 bridge, right bank	12.0	386.5
Wilton, Maine, 0.2 mile downstream from Route 2 bridge, right bank	11.8	386.3
Wilton, Maine, upstream side, Butterfield Road bridge, left bank	10.6	383.2
Wilton, Maine, downstream side, Butterfield Road bridge, right bank	10.6	381.5
Farmington, Maine, upstream side Route 133 bridge, left bank	9.6	368.7
Farmington, Maine, downstream side Route 133 bridge, right bank	9.6	366.8
Farmington, Maine, 100 feet upstream from Webster Road bridge, right bank	7.5	359.4
Farmington, Maine, 100 feet downstream from Webster Road bridge, right bank	7.5	358.7
North Chesterville, Maine, 140 feet upstream from Knowltons Corner Road bridge, average of left and right bank elevations	3.8	351.4
North Chesterville, Maine, downstream side Knowltons Corner Road bridge, right bank	3.8	350.2
Chesterville, Maine, upstream side Route 156 bridge, right bank	.4	347.5
Chesterville, Maine, 300 feet downstream from Route 156 bridge, right bank	.4	345.5
Chesterville, Maine, confluence with Sandy River, right bank	0	345.4

[a] From Grover (1937, table 15).



FLOOD PROFILES

WILSON STREAM

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF FARMINGTON, ME

(FRANKLIN CO.)

11P

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Wilson Stream								
A	2,180	97/49[2]	1,275	6.8	345.3	333.9[4]	334.2	0.3
B	3,800	268/230[2]	1,716	5.9	345.6	336.1[4]	336.9	0.8
C	6,860	88/44[2]	1,951	4.6	345.6	338.0[4]	338.9	0.9
D	12,205	346	3,119	3.3	345.6	341.7[4]	342.5	0.8
E	19,405	172	2,816	3.0	345.6	345.3[4]	346.3	1.0
F	20,030	87[3]	1,064	7.6	347.4	347.4	348.3	0.9
G	20,200	124[3]	1,411	6.3	350.2	350.2	351.1	0.9
H	25,905	153	2,335	3.9	353.4	353.4	354.3	0.9
I	31,135	114	2,034	4.2	356.9	356.9	357.9	1.0
J	32,995	191	2,884	2.9	357.8	357.8	358.8	1.0
K	39,825	258	3,299	2.8	360.0	360.0	361.0	1.0
L	42,290	156	2,190	4.0	361.6	361.6	362.6	1.0
M	42,445	222	3,009	2.8	361.8	361.8	362.8	1.0
N	46,220	208	2,711	3.2	364.1	364.1	365.1	1.0
O	49,195	112	1,662	5.0	366.4	366.4	367.4	1.0
P	50,370	120	1,269	6.2	368.0	368.0	368.9	0.9
Q	50,850	122	1,470	5.7	371.6	371.6	372.5	0.9

[1]Feet above confluence with Sandy River
[2]Width/width within corporate limits
[3]This width extends beyond corporate limits
[4]Elevation computed without consideration of backwater effects from Sandy River

TABLE 3

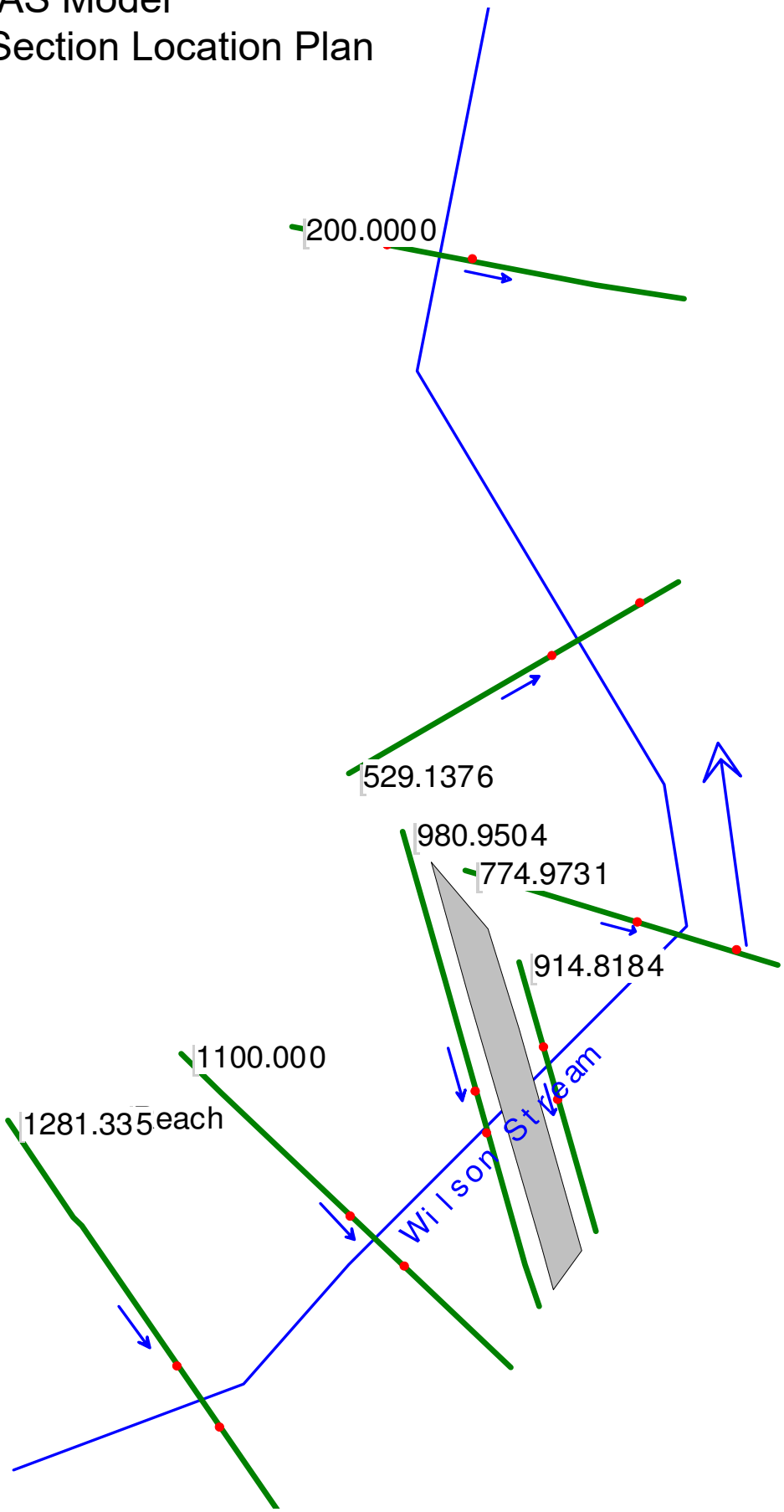
FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF FARMINGTON, ME
(FRANKLIN CO.)

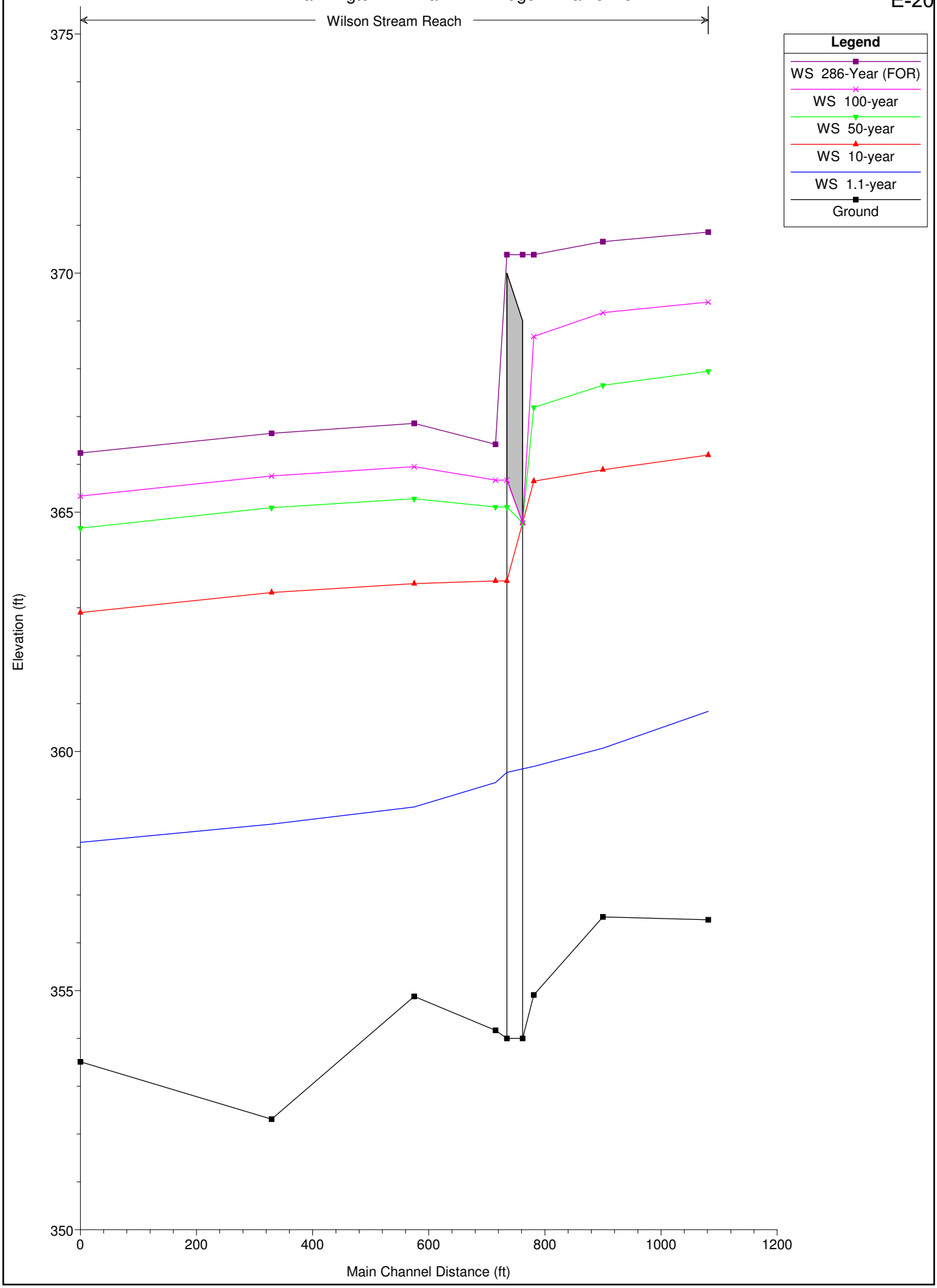
FLOODWAY DATA

WILSON STREAM

HEC-RAS Model
Cross Section Location Plan

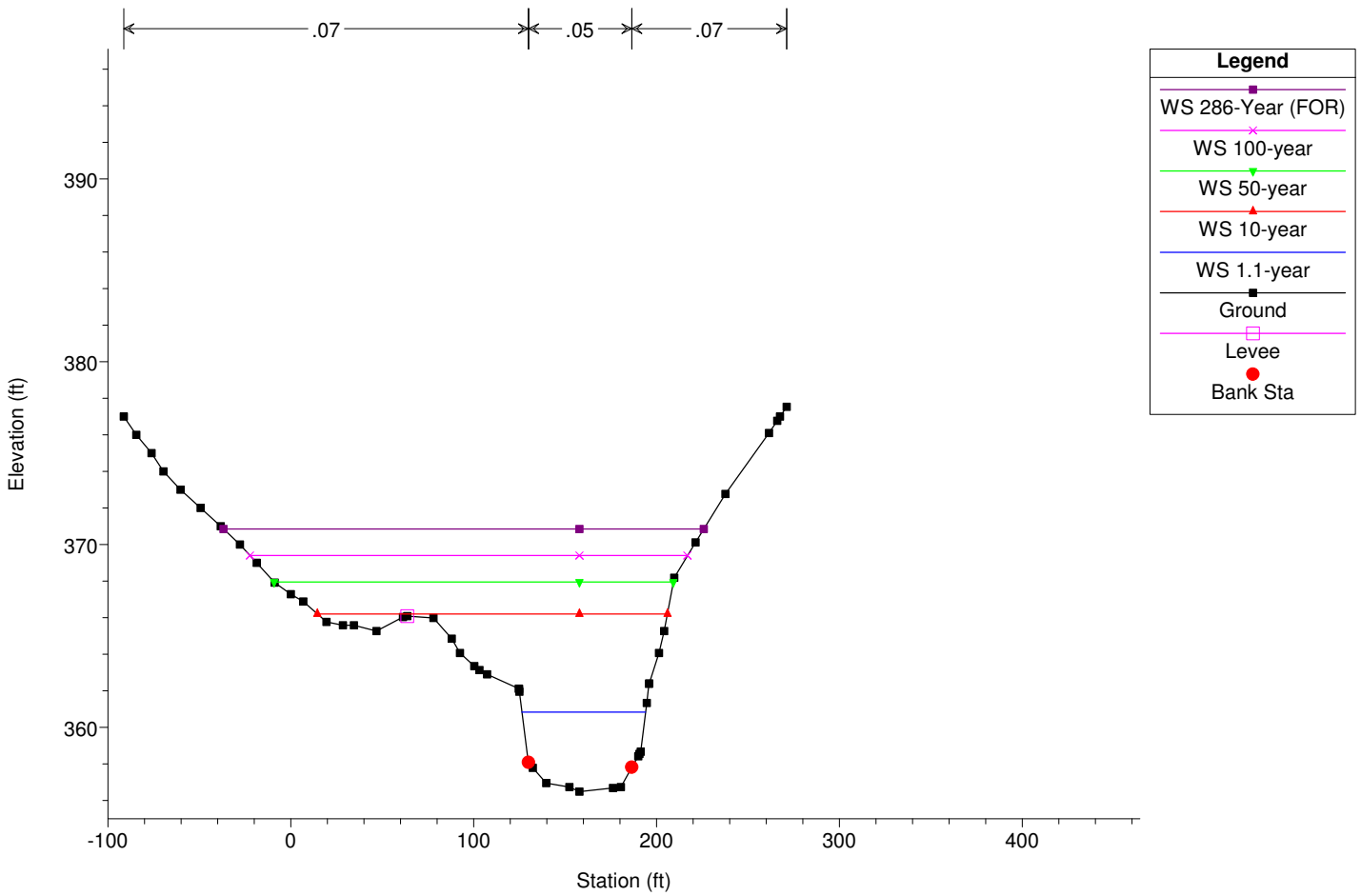


Farmington Plan: Ex. Bridge w.Maine Flow



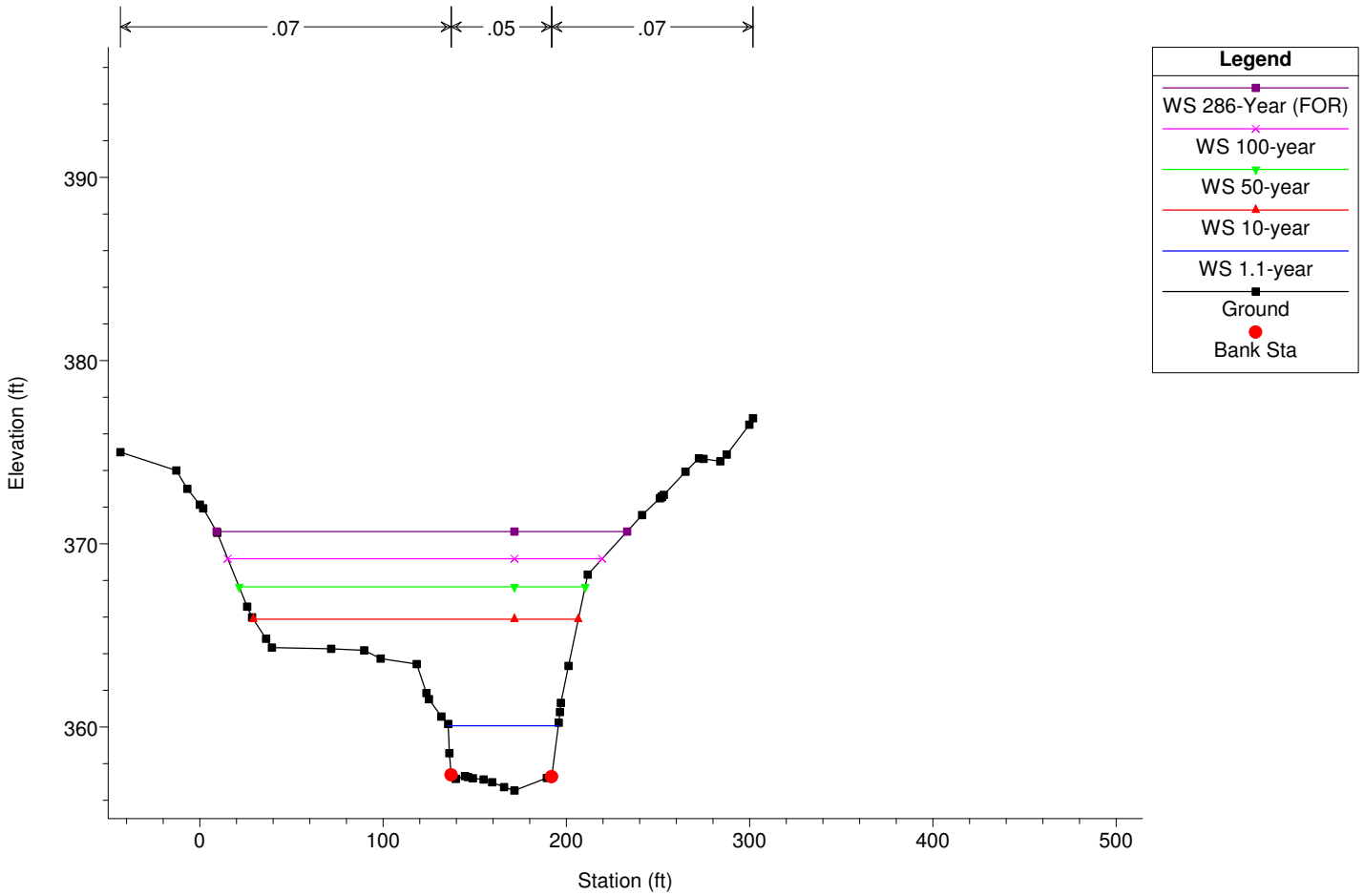
Farmington Plan: Ex. Bridge w.Maine Flow

RS = 1281.335



Farmington Plan: Ex. Bridge w.Maine Flow

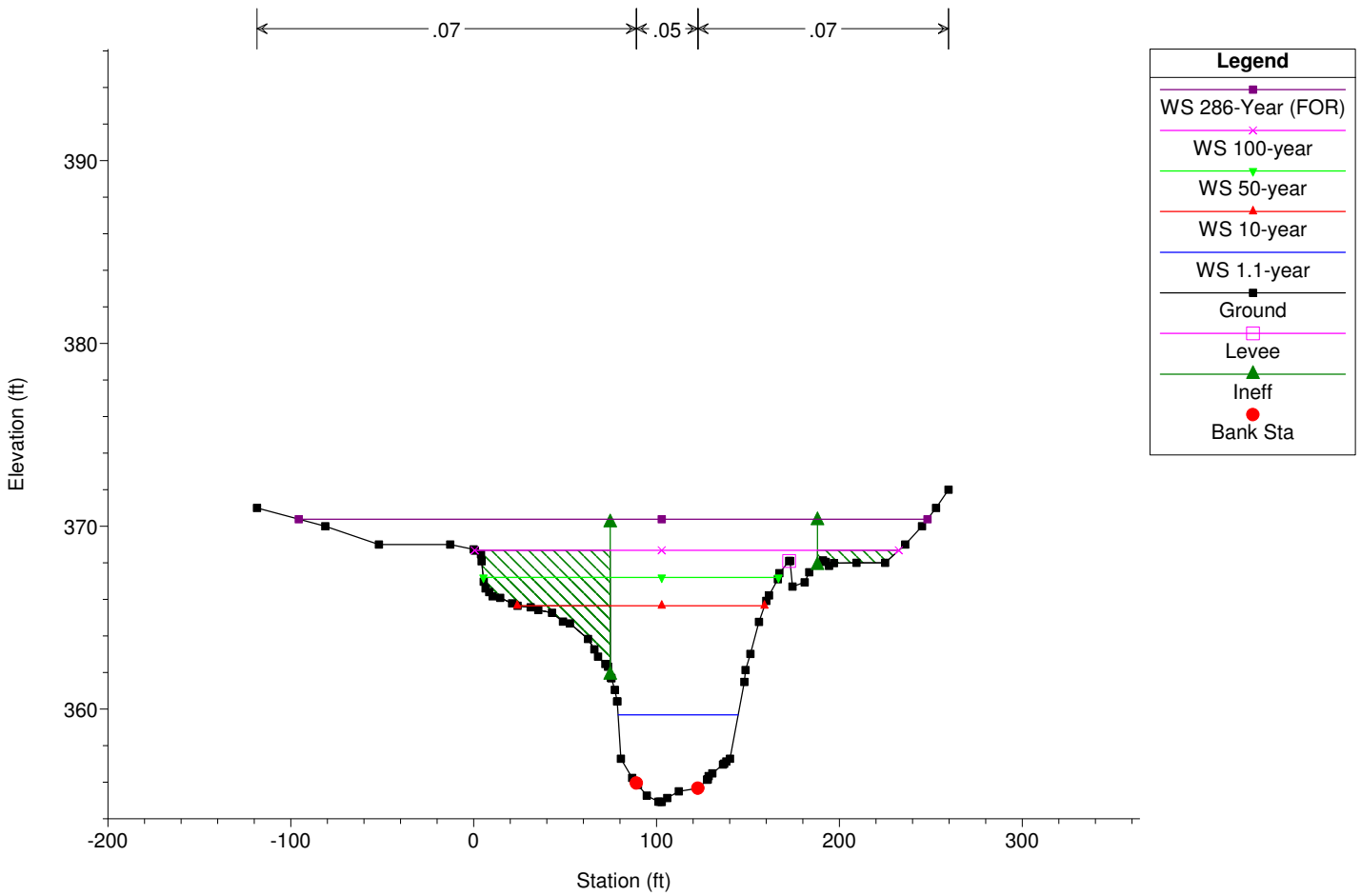
RS = 1100.000



1 in Horiz. = 100 ft 1 in Vert. = 10 ft

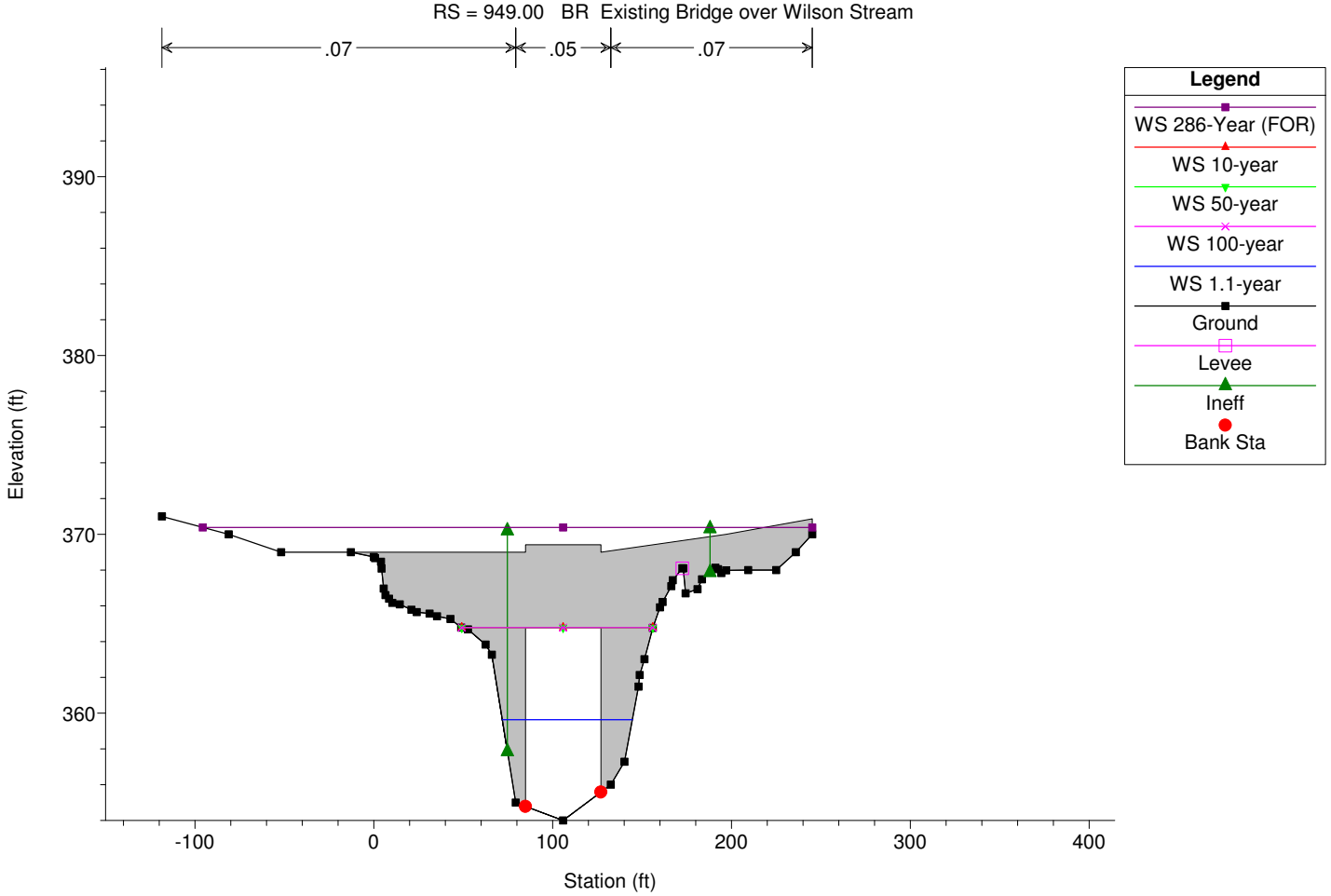
Farmington Plan: Ex. Bridge w.Maine Flow

RS = 980.9504



Farmington Plan: Ex. Bridge w.Maine Flow

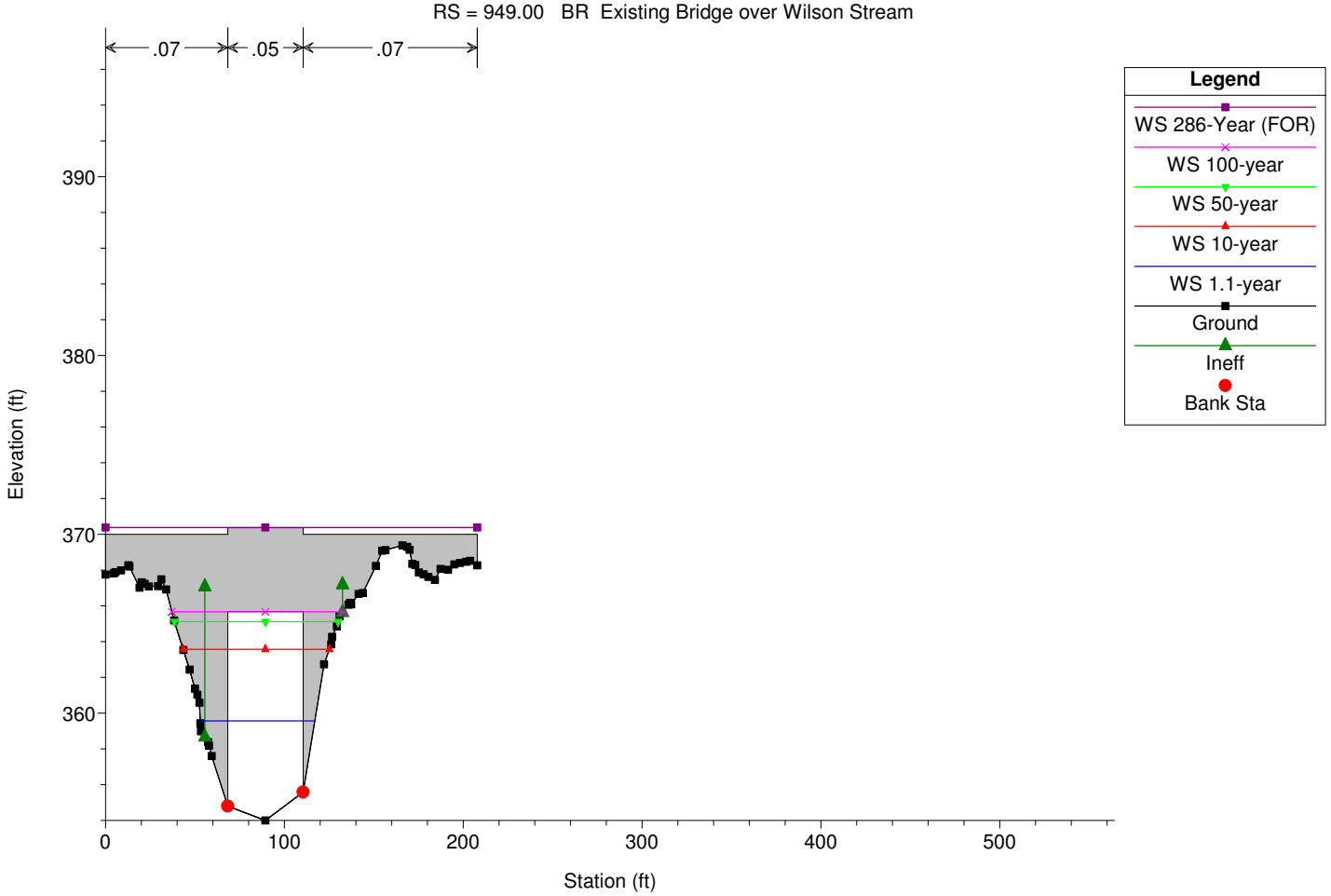
RS = 949.00 BR Existing Bridge over Wilson Stream



1 in Horiz. = 100 ft 1 in Vert. = 10 ft

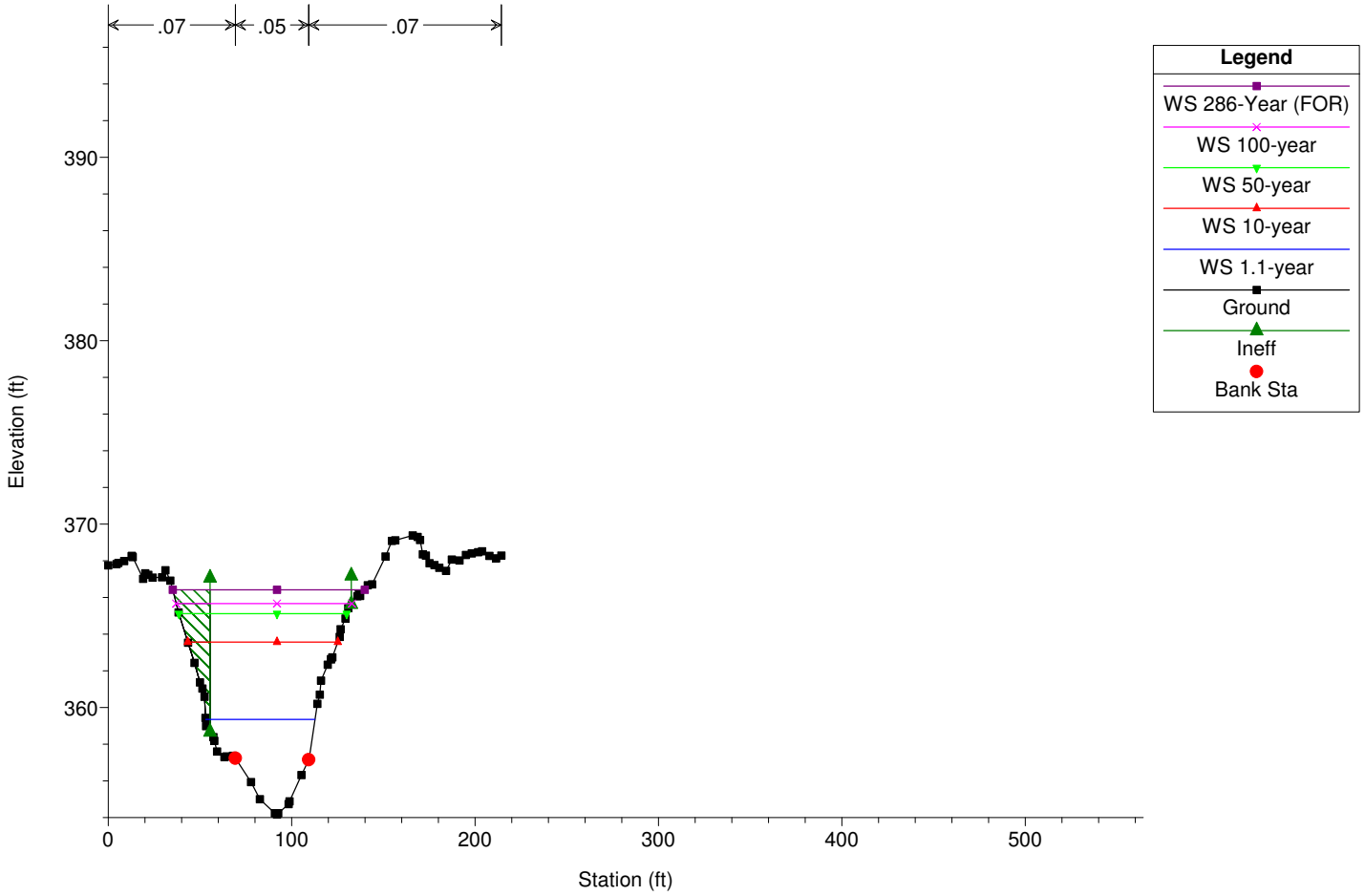
Farmington Plan: Ex. Bridge w.Maine Flow

RS = 949.00 BR Existing Bridge over Wilson Stream



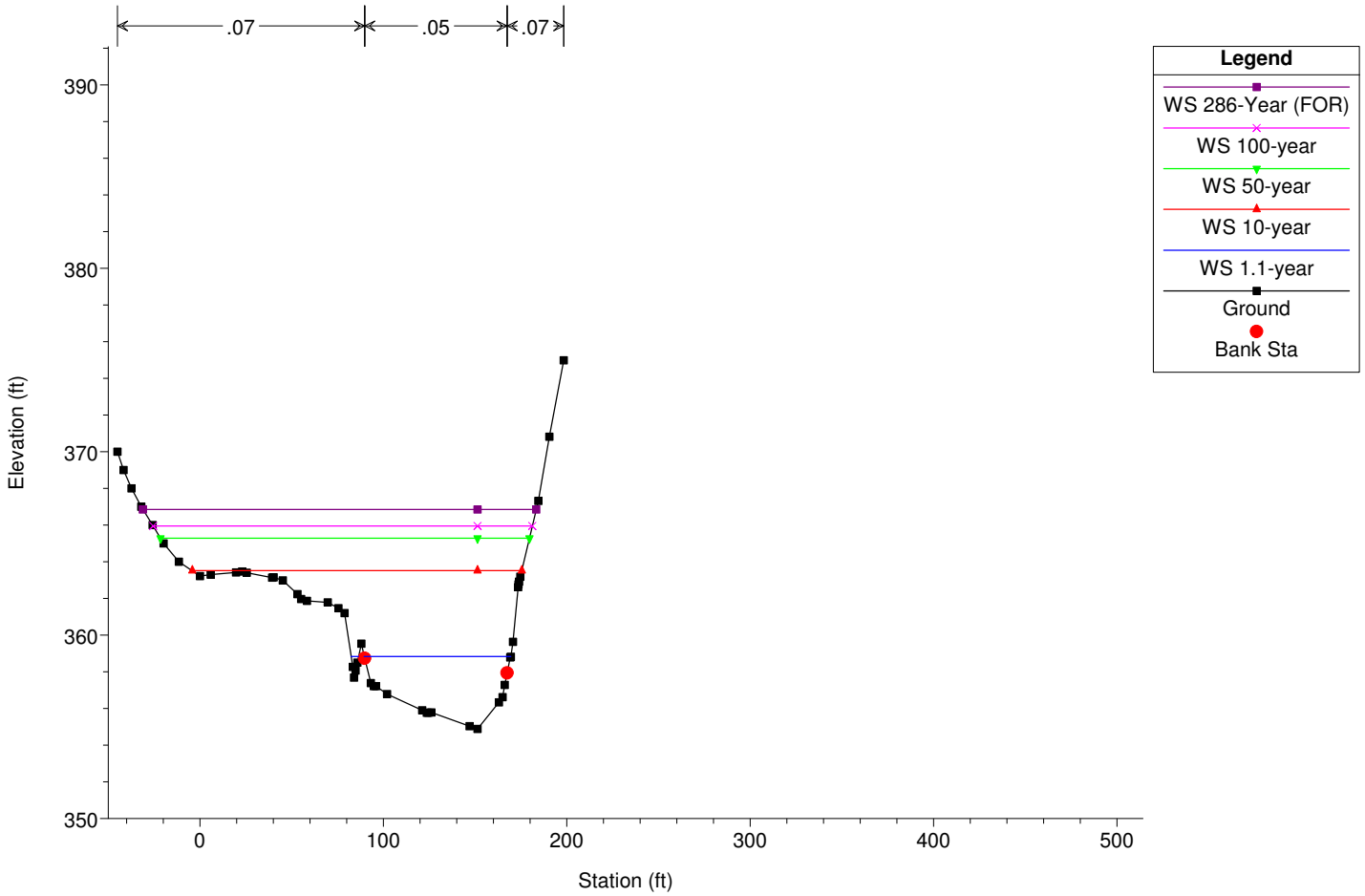
Farmington Plan: Ex. Bridge w.Maine Flow

RS = 914.8184

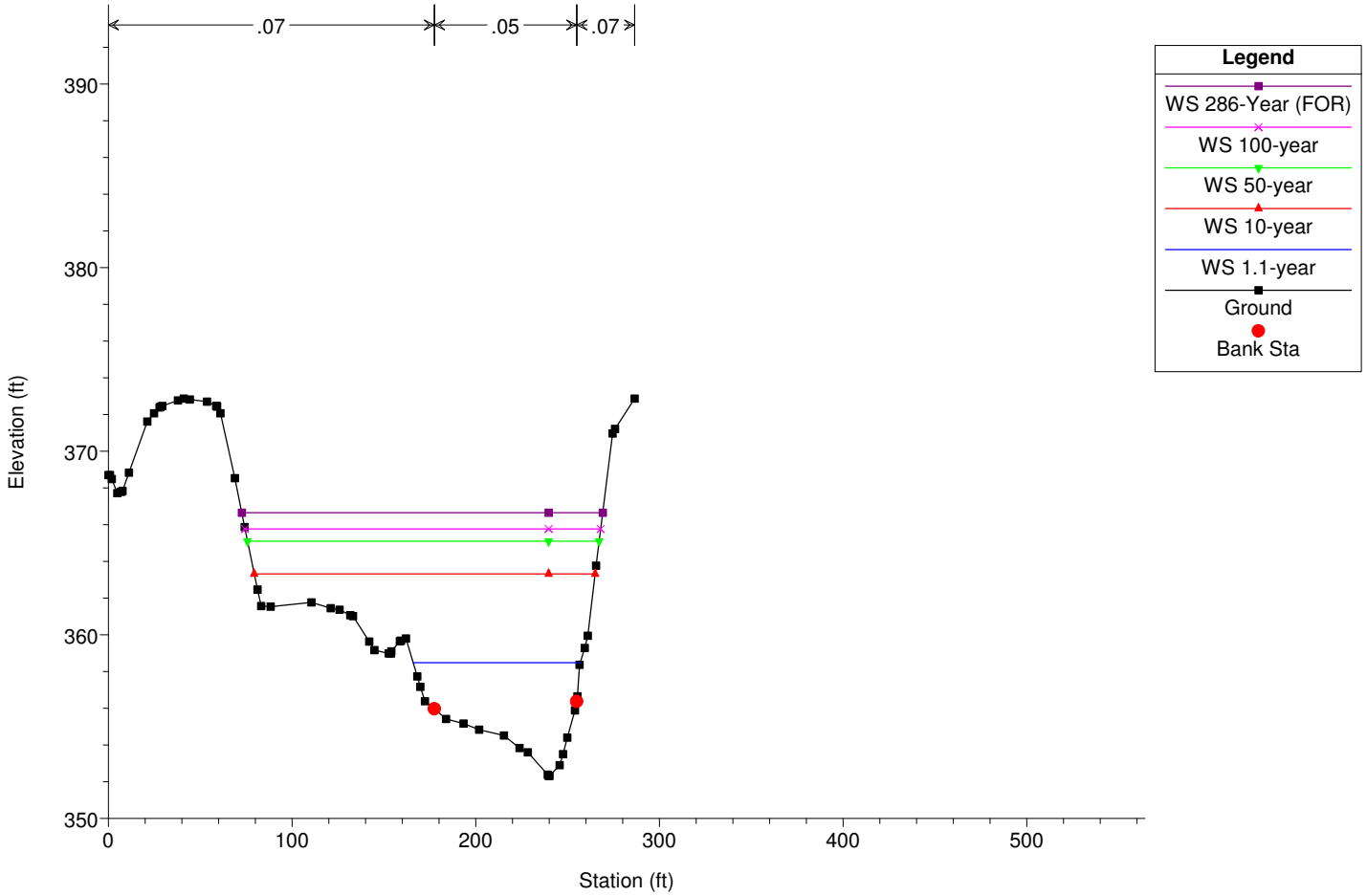


1 in Horiz. = 100 ft 1 in Vert. = 10 ft

Farmington Plan: Ex. Bridge w.Maine Flow
RS = 774.9731



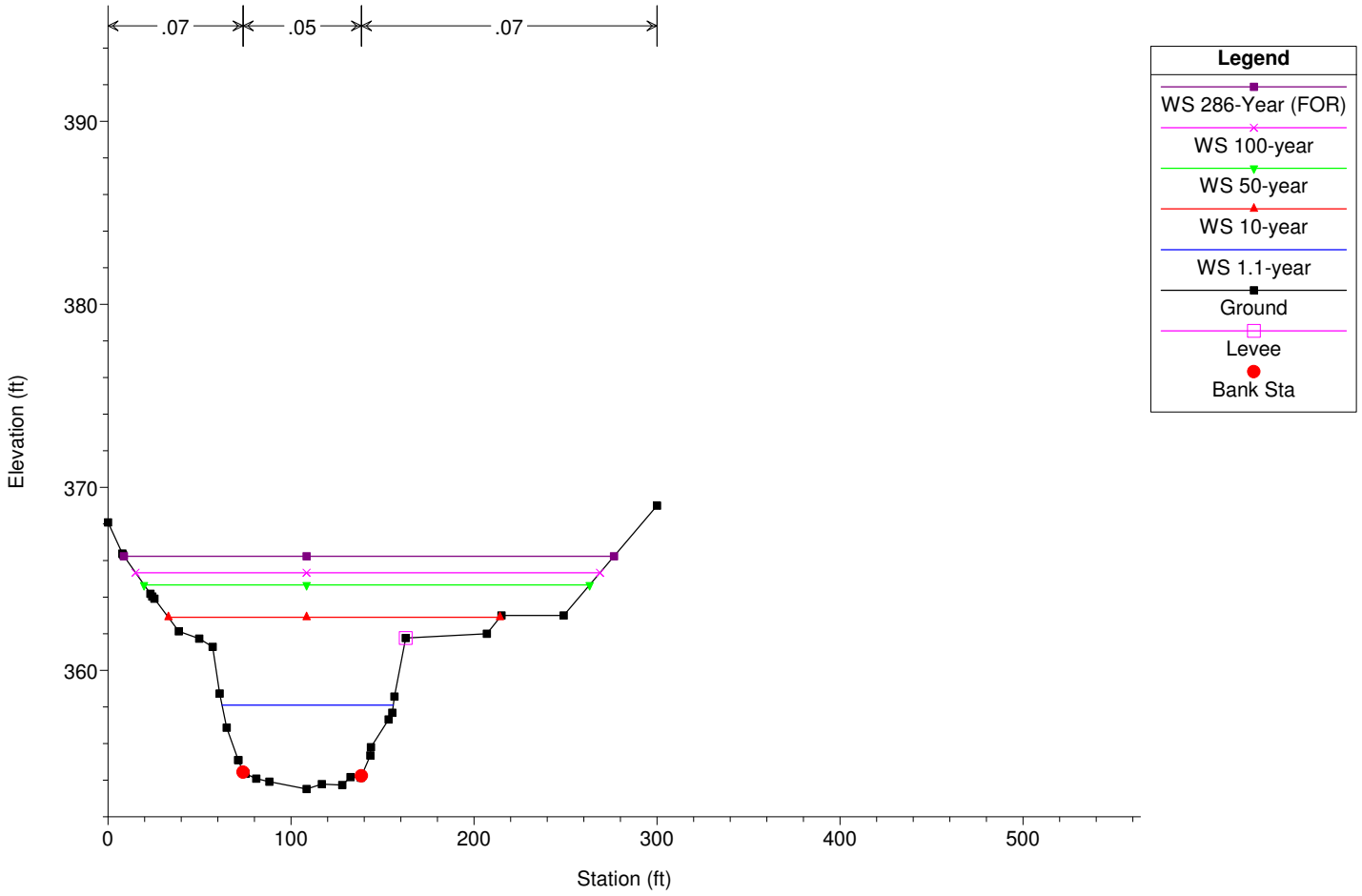
Farmington Plan: Ex. Bridge w.Maine Flow
RS = 529.1376



1 in Horiz. = 100 ft 1 in Vert. = 10 ft

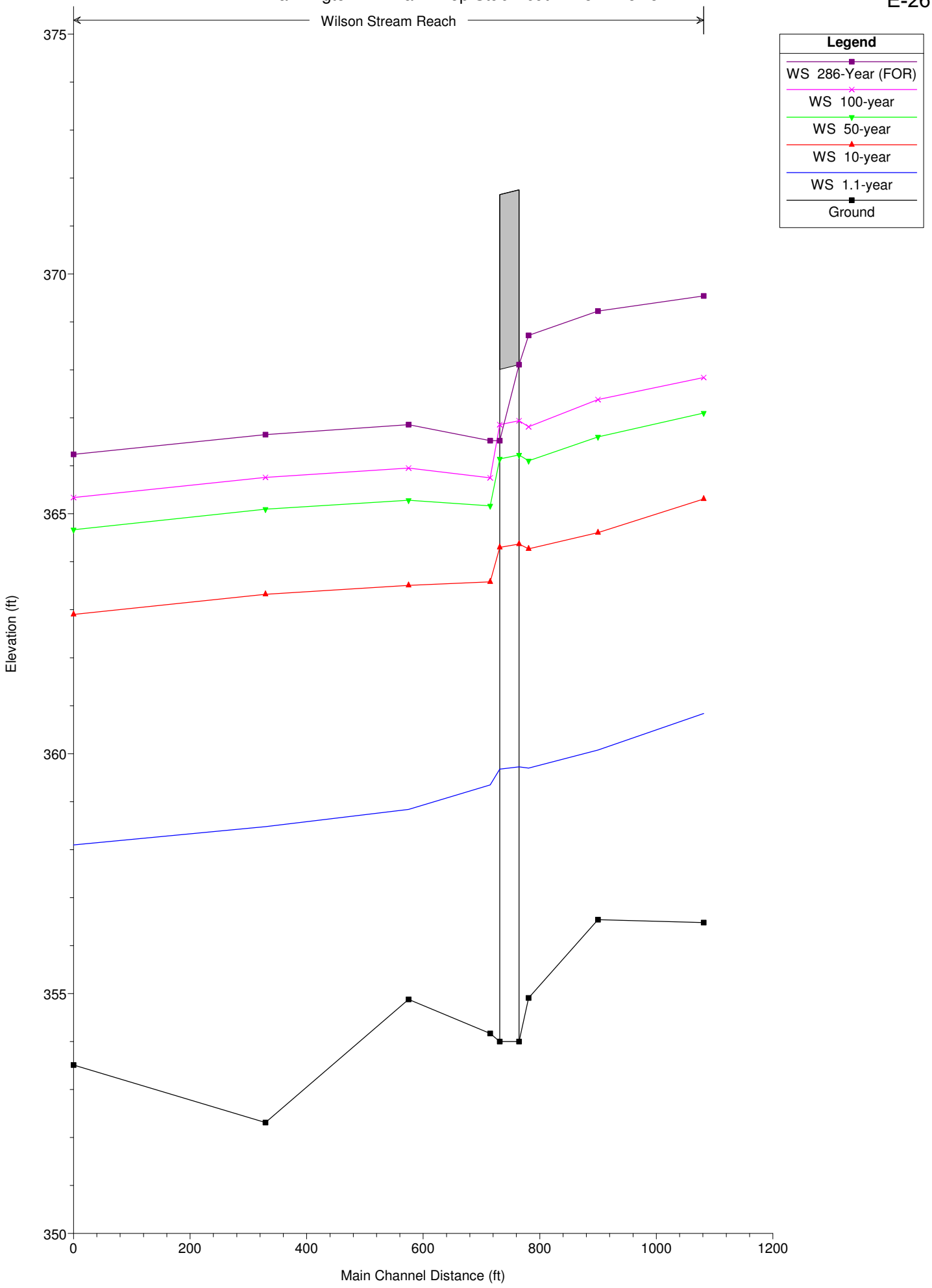
Farmington Plan: Ex. Bridge w.Maine Flow

RS = 200.0000



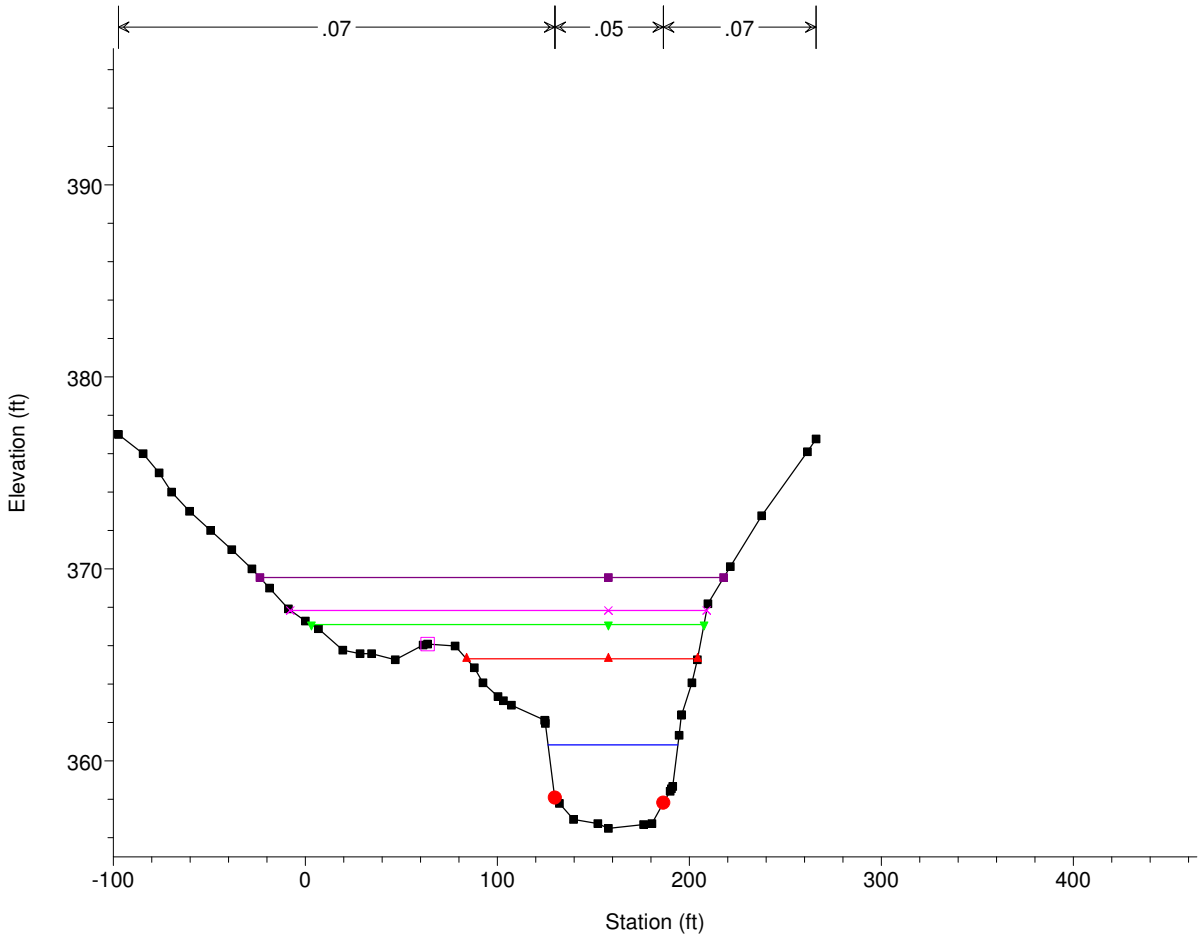
1 in Horiz. = 100 ft 1 in Vert. = 10 ft

Farmington Plan: Prop Stub Abut w.New Profile



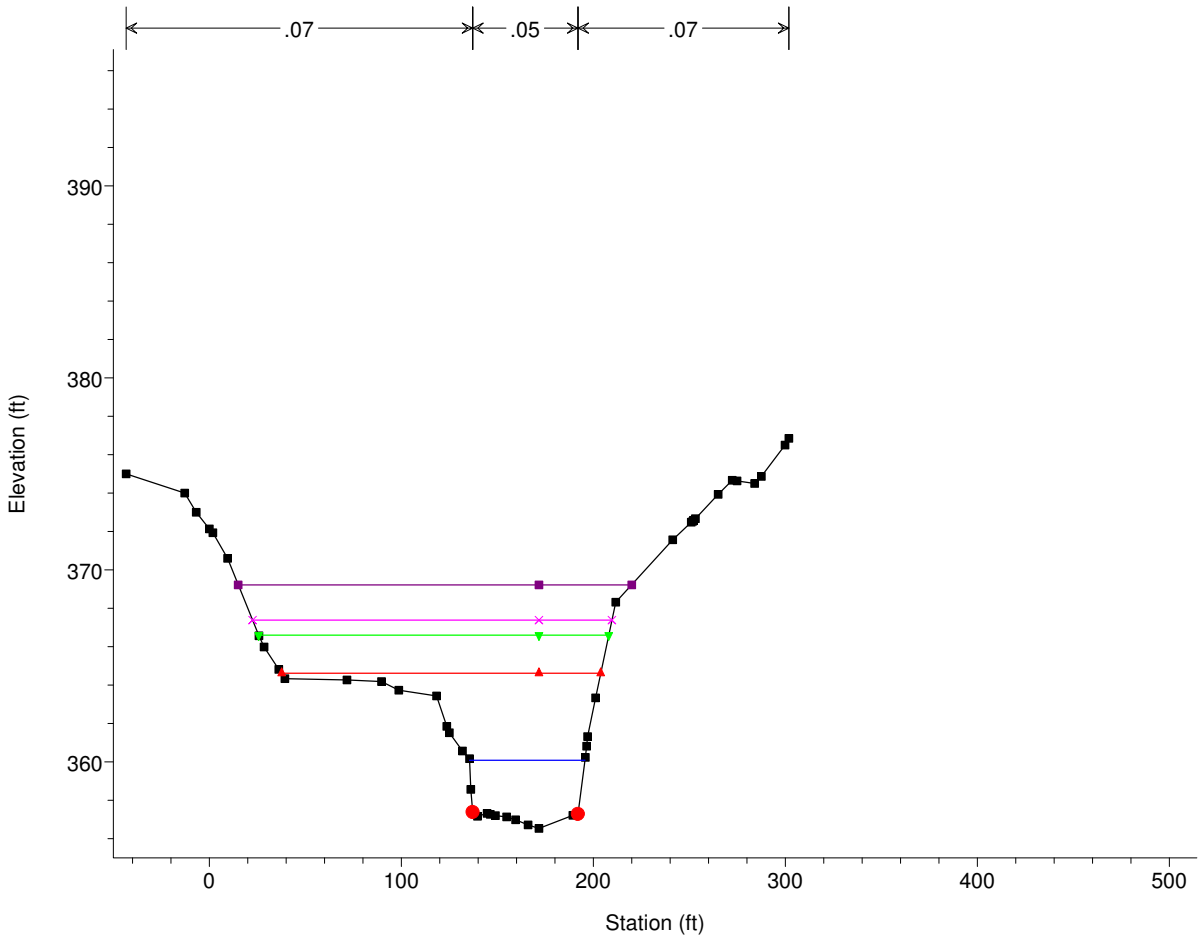
Farmington Plan: Prop Stub Abut w.New Profile

RS = 1281.335



Farmington Plan: Prop Stub Abut w.New Profile

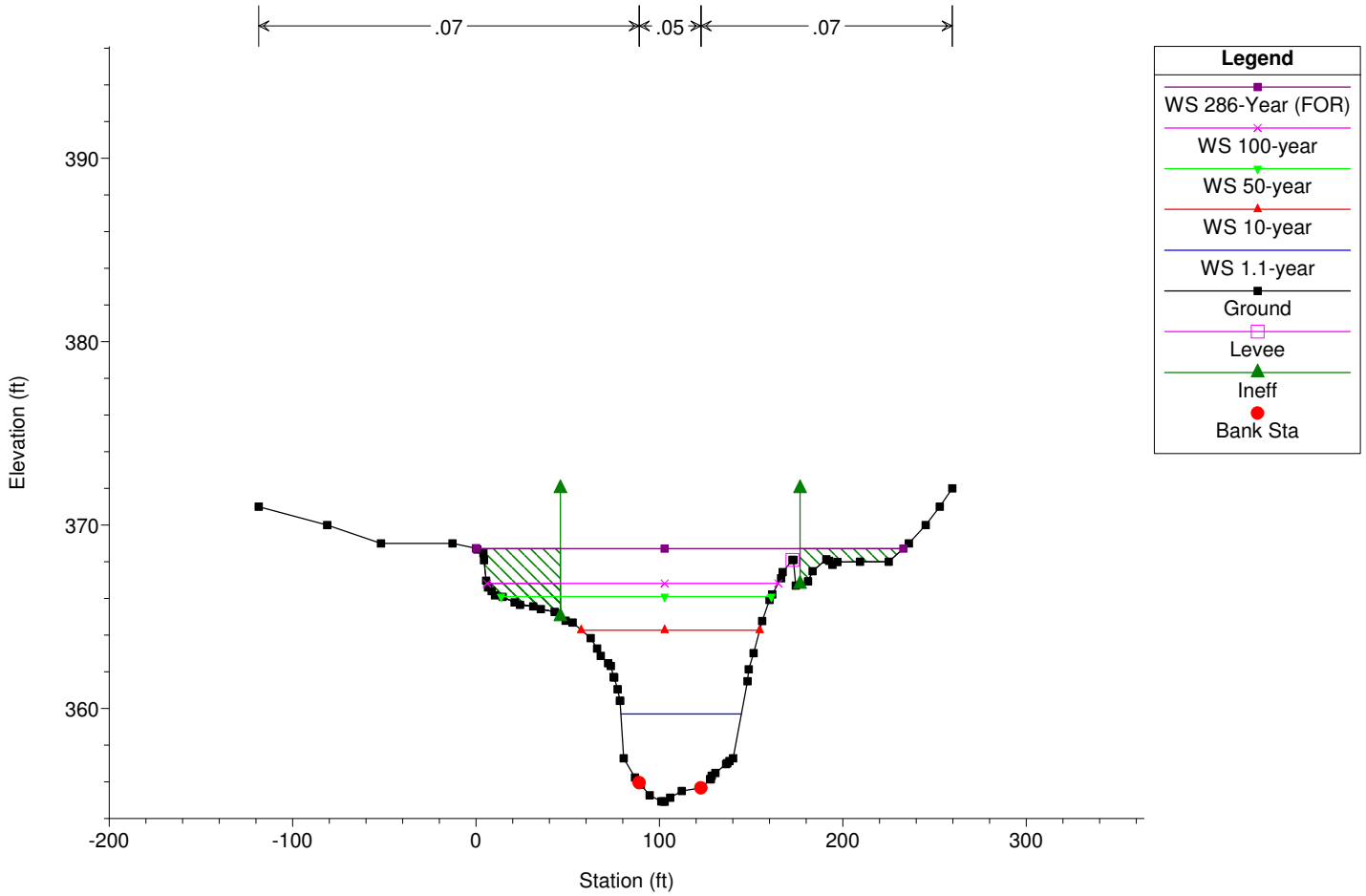
RS = 1100.000



1 in Horiz. = 100 ft 1 in Vert. = 10 ft

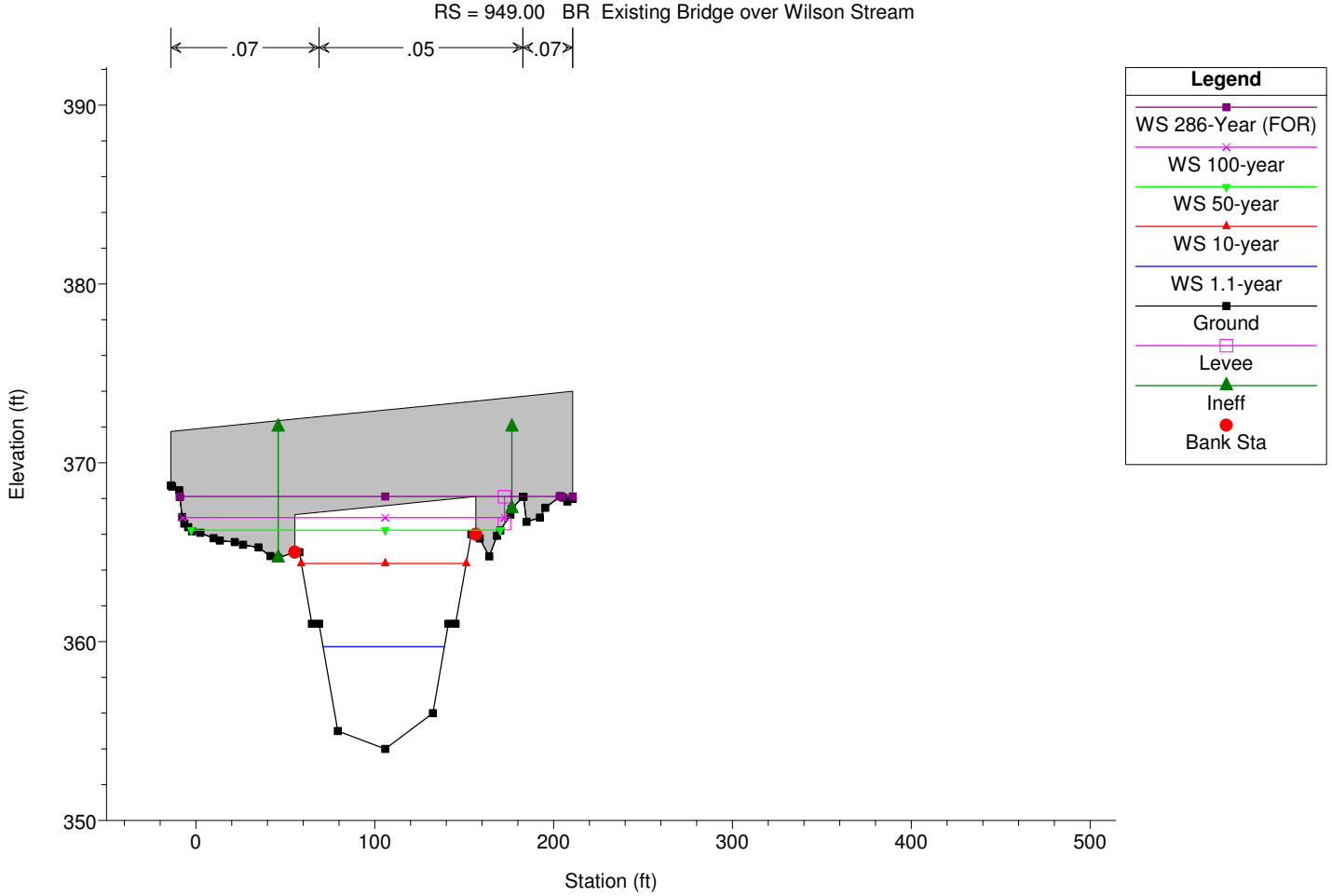
Farmington Plan: Prop Stub Abut w.New Profile

RS = 980.9504



Farmington Plan: Prop Stub Abut w.New Profile

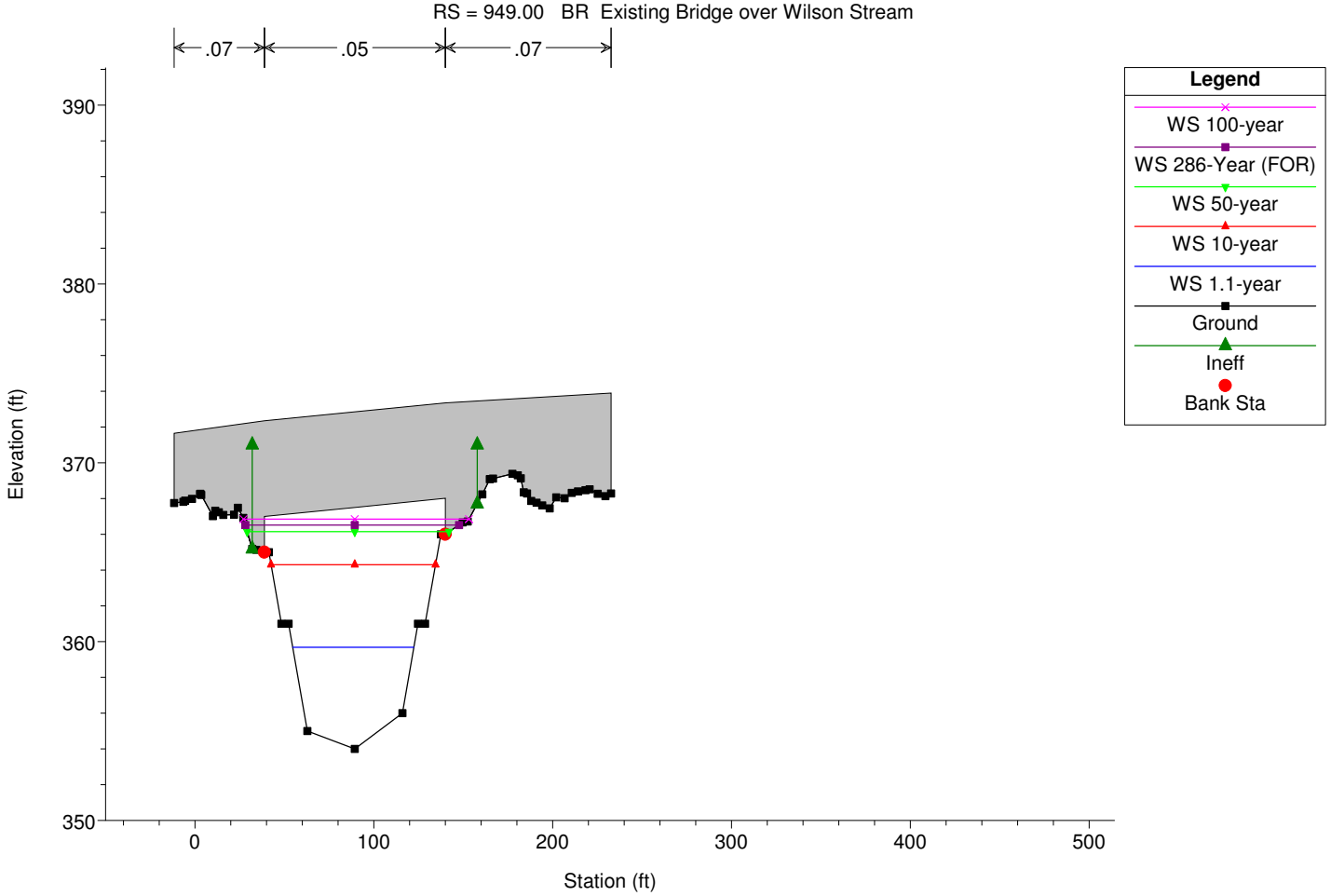
RS = 949.00 BR Existing Bridge over Wilson Stream



1 in Horiz. = 100 ft 1 in Vert. = 10 ft

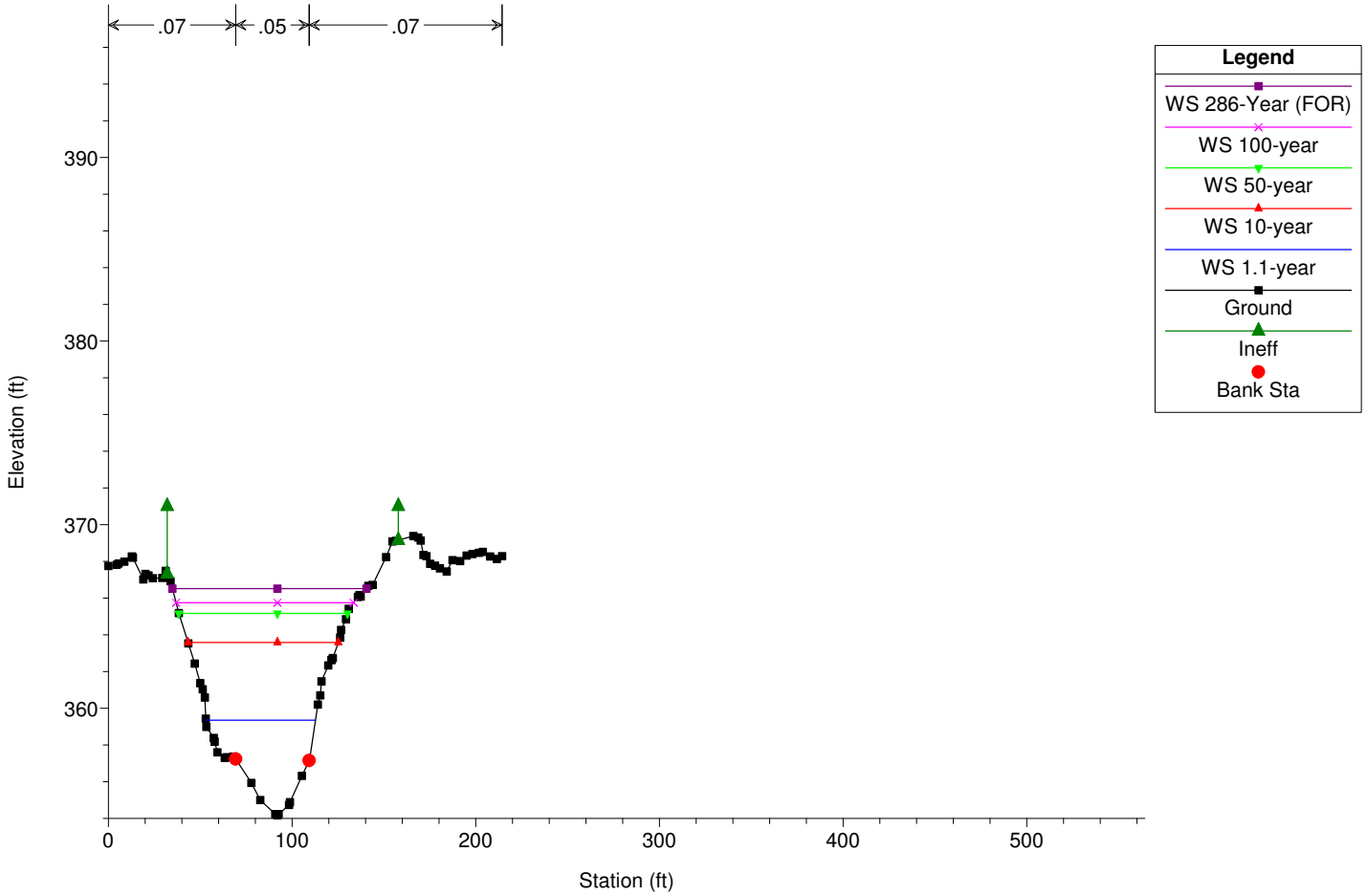
Farmington Plan: Prop Stub Abut w.New Profile

RS = 949.00 BR Existing Bridge over Wilson Stream



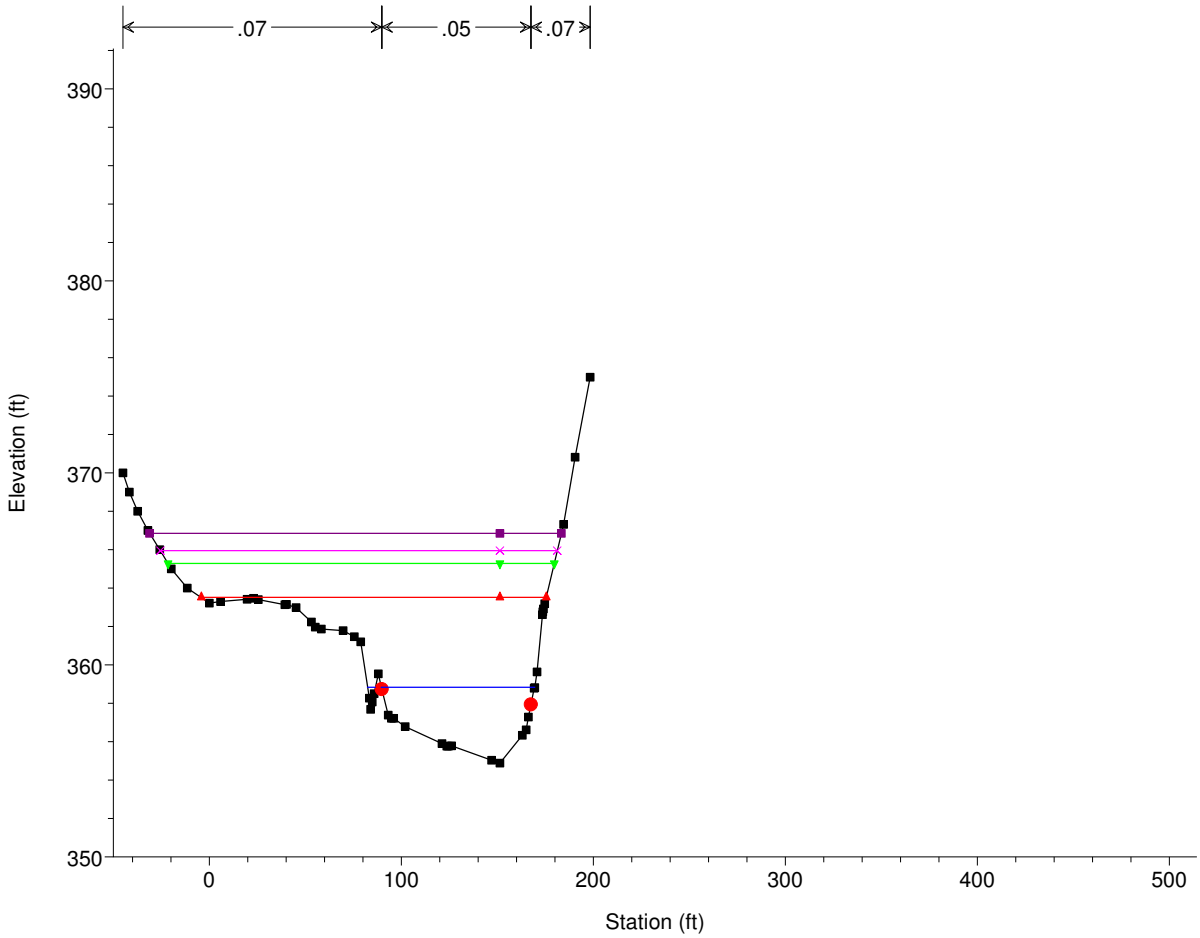
Farmington Plan: Prop Stub Abut w.New Profile

RS = 914.8184

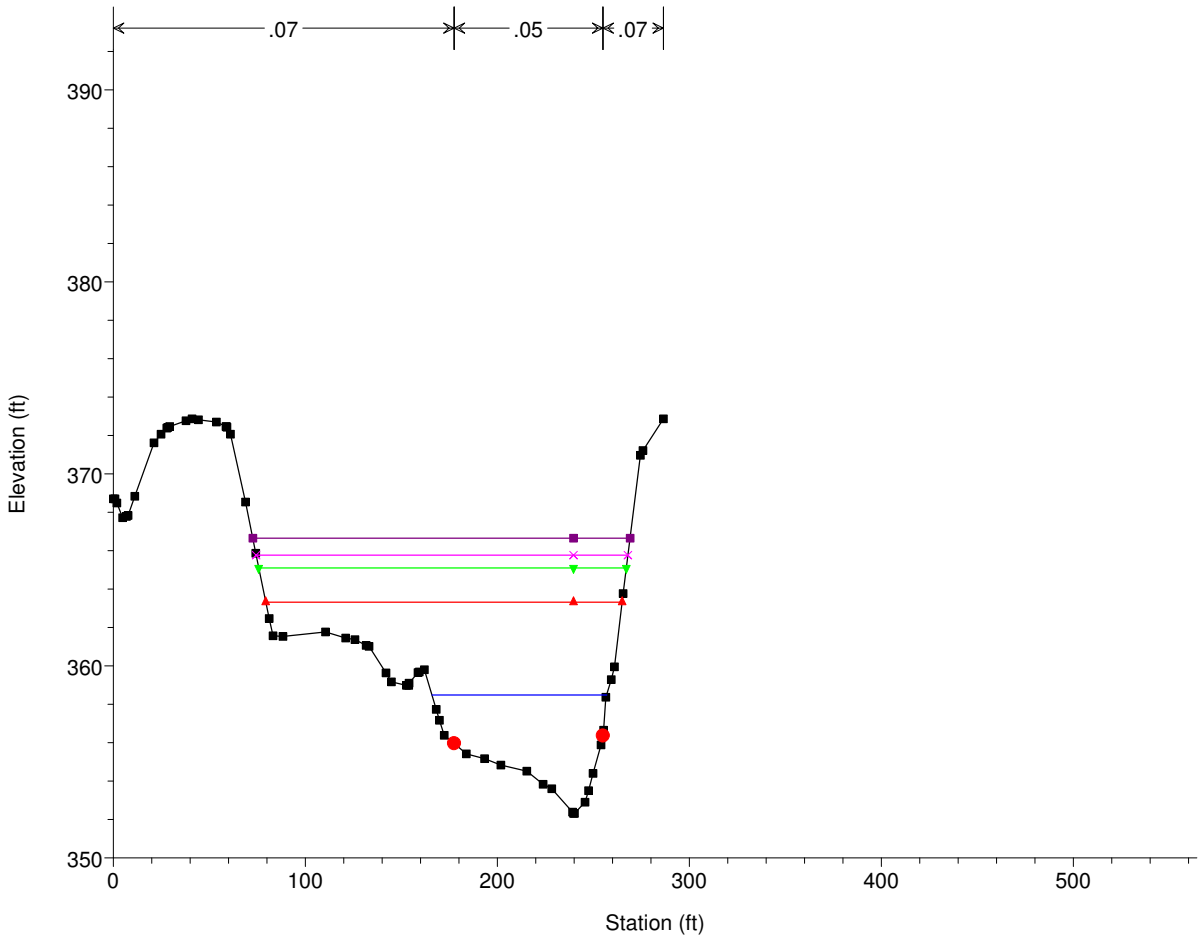


1 in Horiz. = 100 ft 1 in Vert. = 10 ft

Farmington Plan: Prop Stub Abut w.New Profile
RS = 774.9731



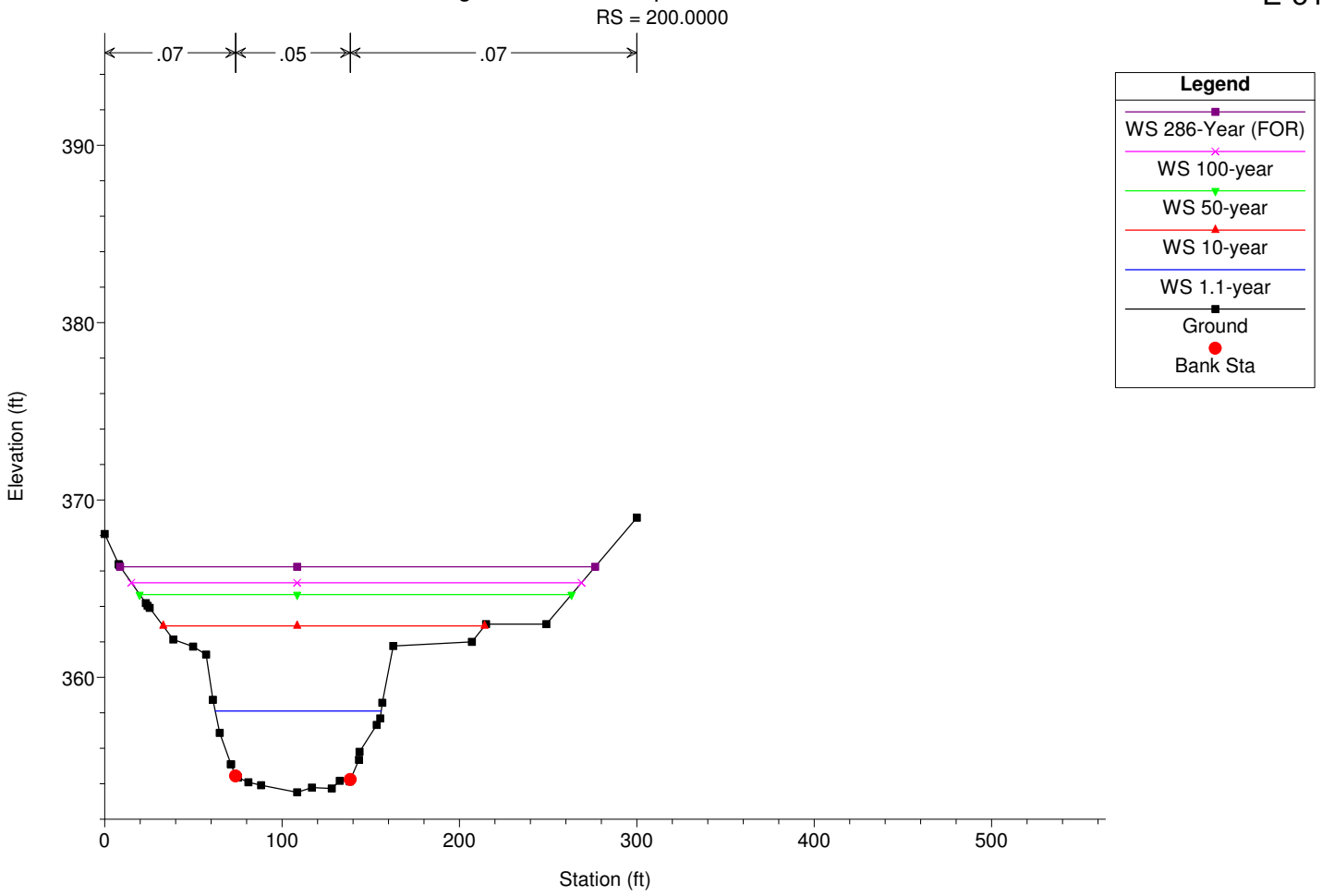
Farmington Plan: Prop Stub Abut w.New Profile
RS = 529.1376



1 in Horiz. = 100 ft 1 in Vert. = 10 ft

Farmington Plan: Prop Stub Abut w.New Profile

RS = 200.0000



1 in Horiz. = 100 ft 1 in Vert. = 10 ft

HEC-RAS River: Wilson Stream Reach: 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)	
Reach	200.0000	1.1-year	Ex. Bridge w	803.00	353.51	358.10	355.54	358.20	0.001201	2.70	331.00	93.63	0.23
Reach	200.0000	1.1-year	Prop Stub Ab	803.00	353.51	358.10	355.53	358.20	0.001201	2.70	331.00	93.63	0.23
Reach	200.0000	10-year	Ex. Bridge w	3031.00	353.51	362.90	357.87	363.17	0.001200	4.47	888.99	181.24	0.26
Reach	200.0000	10-year	Prop Stub Ab	3031.00	353.51	362.90	357.86	363.17	0.001200	4.47	888.99	181.24	0.26
Reach	200.0000	25-year	Ex. Bridge w	3845.00	353.51	363.98	358.47	364.28	0.001201	4.82	1127.27	232.61	0.27
Reach	200.0000	25-year	Prop Stub Ab	3845.00	353.51	363.98	358.47	364.28	0.001201	4.82	1127.27	232.61	0.27
Reach	200.0000	50-year	Ex. Bridge w	4481.00	353.51	364.67	358.92	364.99	0.001201	5.03	1291.59	243.53	0.27
Reach	200.0000	50-year	Prop Stub Ab	4481.00	353.51	364.67	358.90	364.99	0.001201	5.03	1291.59	243.53	0.27
Reach	200.0000	100-year	Ex. Bridge w	5154.00	353.51	365.34	359.36	365.67	0.001201	5.24	1457.72	253.88	0.27
Reach	200.0000	100-year	Prop Stub Ab	5154.00	353.51	365.34	359.34	365.67	0.001201	5.24	1457.71	253.88	0.27
Reach	200.0000	286-Year (FOR)	Ex. Bridge w	6150.00	353.51	366.24	359.98	366.59	0.001200	5.51	1692.48	267.82	0.28
Reach	200.0000	286-Year (FOR)	Prop Stub Ab	6150.00	353.51	366.24	359.97	366.59	0.001200	5.51	1692.48	267.82	0.28
Reach	200.0000	500-Year	Ex. Bridge w	6822.00	353.51	366.79	360.37	367.16	0.001201	5.67	1842.43	275.25	0.28
Reach	200.0000	500-Year	Prop Stub Ab	6822.00	353.51	366.79	360.36	367.16	0.001201	5.67	1842.43	275.25	0.28
Reach	529.1376	1.1-year	Ex. Bridge w	803.00	352.31	358.48		358.57	0.001028	2.44	341.95	90.98	0.21
Reach	529.1376	1.1-year	Prop Stub Ab	803.00	352.31	358.48		358.57	0.001028	2.44	341.95	90.98	0.21
Reach	529.1376	10-year	Ex. Bridge w	3031.00	352.31	363.32		363.51	0.000866	3.76	1022.15	185.58	0.22
Reach	529.1376	10-year	Prop Stub Ab	3031.00	352.31	363.32		363.51	0.000866	3.76	1022.15	185.58	0.22
Reach	529.1376	25-year	Ex. Bridge w	3845.00	352.31	364.41		364.62	0.000866	4.05	1225.83	189.12	0.22
Reach	529.1376	25-year	Prop Stub Ab	3845.00	352.31	364.41		364.62	0.000866	4.05	1225.83	189.12	0.22
Reach	529.1376	50-year	Ex. Bridge w	4481.00	352.31	365.10		365.34	0.000893	4.30	1356.82	191.39	0.23
Reach	529.1376	50-year	Prop Stub Ab	4481.00	352.31	365.10		365.34	0.000893	4.30	1356.83	191.40	0.23
Reach	529.1376	100-year	Ex. Bridge w	5154.00	352.31	365.76		366.02	0.000923	4.55	1484.73	193.59	0.24
Reach	529.1376	100-year	Prop Stub Ab	5154.00	352.31	365.76		366.02	0.000923	4.55	1484.73	193.59	0.24
Reach	529.1376	286-Year (FOR)	Ex. Bridge w	6150.00	352.31	366.65		366.95	0.000965	4.89	1658.79	196.52	0.25
Reach	529.1376	286-Year (FOR)	Prop Stub Ab	6150.00	352.31	366.65		366.95	0.000965	4.89	1658.79	196.52	0.25
Reach	529.1376	500-Year	Ex. Bridge w	6822.00	352.31	367.20		367.52	0.000995	5.11	1766.50	198.31	0.25
Reach	529.1376	500-Year	Prop Stub Ab	6822.00	352.31	367.20		367.52	0.000995	5.11	1766.50	198.31	0.25
Reach	774.9731	1.1-year	Ex. Bridge w	803.00	354.88	358.84		359.05	0.004056	3.71	218.75	84.10	0.39
Reach	774.9731	1.1-year	Prop Stub Ab	803.00	354.88	358.84		359.05	0.004056	3.71	218.75	84.10	0.39
Reach	774.9731	10-year	Ex. Bridge w	3031.00	354.88	363.51		363.88	0.001956	4.98	712.40	179.70	0.32
Reach	774.9731	10-year	Prop Stub Ab	3031.00	354.88	363.51		363.88	0.001956	4.98	712.40	179.70	0.32
Reach	774.9731	25-year	Ex. Bridge w	3845.00	354.88	364.59		364.98	0.001808	5.24	915.43	194.39	0.32
Reach	774.9731	25-year	Prop Stub Ab	3845.00	354.88	364.59		364.98	0.001808	5.24	915.43	194.39	0.32
Reach	774.9731	50-year	Ex. Bridge w	4481.00	354.88	365.28		365.69	0.001768	5.46	1052.74	201.16	0.32
Reach	774.9731	50-year	Prop Stub Ab	4481.00	354.88	365.28		365.69	0.001768	5.46	1052.75	201.16	0.32
Reach	774.9731	100-year	Ex. Bridge w	5154.00	354.88	365.95		366.38	0.001735	5.67	1189.63	206.77	0.32
Reach	774.9731	100-year	Prop Stub Ab	5154.00	354.88	365.95		366.38	0.001735	5.67	1189.62	206.77	0.32
Reach	774.9731	286-Year (FOR)	Ex. Bridge w	6150.00	354.88	366.86		367.32	0.001703	5.95	1379.78	214.48	0.32
Reach	774.9731	286-Year (FOR)	Prop Stub Ab	6150.00	354.88	366.86		367.32	0.001703	5.95	1379.79	214.48	0.32
Reach	774.9731	500-Year	Ex. Bridge w	6822.00	354.88	367.41		367.89	0.001693	6.13	1499.77	218.81	0.32
Reach	774.9731	500-Year	Prop Stub Ab	6822.00	354.88	367.41		367.89	0.001693	6.13	1499.77	218.81	0.32
Reach	914.8184	1.1-year	Ex. Bridge w	803.00	354.17	359.35	357.86	359.69	0.004425	4.83	182.73	59.57	0.43
Reach	914.8184	1.1-year	Prop Stub Ab	803.00	354.17	359.35	357.86	359.69	0.004443	4.84	183.88	59.57	0.43
Reach	914.8184	10-year	Ex. Bridge w	3031.00	354.17	363.57	360.84	364.43	0.004429	7.90	444.59	81.71	0.49
Reach	914.8184	10-year	Prop Stub Ab	3031.00	354.17	363.58	360.81	364.42	0.004372	7.86	472.84	81.82	0.49
Reach	914.8184	25-year	Ex. Bridge w	3845.00	354.17	364.52	361.59	365.58	0.004741	8.81	512.09	87.42	0.52
Reach	914.8184	25-year	Prop Stub Ab	3845.00	354.17	364.55	361.61	365.56	0.004601	8.70	555.01	87.69	0.51
Reach	914.8184	50-year	Ex. Bridge w	4481.00	354.17	365.11	362.23	366.35	0.005101	9.53	555.80	91.55	0.54
Reach	914.8184	50-year	Prop Stub Ab	4481.00	354.17	365.17	362.26	366.31	0.004877	9.35	610.16	91.87	0.53
Reach	914.8184	100-year	Ex. Bridge w	5154.00	354.17	365.67	362.87	367.10	0.005487	10.26	598.22	95.79	0.57
Reach	914.8184	100-year	Prop Stub Ab	5154.00	354.17	365.75	362.94	367.05	0.005163	10.01	665.10	96.60	0.55
Reach	914.8184	286-Year (FOR)	Ex. Bridge w	6150.00	354.17	366.42	363.70	368.11	0.005969	11.22	655.99	104.71	0.60
Reach	914.8184	286-Year (FOR)	Prop Stub Ab	6150.00	354.17	366.52	363.79	368.05	0.005579	10.92	743.40	105.71	0.58
Reach	914.8184	500-Year	Ex. Bridge w	6822.00	354.17	366.87	364.27	368.74	0.006313	11.86	690.39	110.65	0.62
Reach	914.8184	500-Year	Prop Stub Ab	6822.00	354.17	367.00	364.27	368.67	0.005845	11.49	794.74	111.73	0.60
Reach	949.00			Bridge									
Reach	980.9504	1.1-year	Ex. Bridge w	803.00	354.91	359.69	357.80	359.91	0.002835	4.20	234.96	65.71	0.36
Reach	980.9504	1.1-year	Prop Stub Ab	803.00	354.91	359.70	357.80	359.92	0.002806	4.18	235.76	65.74	0.35
Reach	980.9504	10-year	Ex. Bridge w	3031.00	354.91	365.65	360.41	366.05	0.001735	5.85	684.03	135.16	0.32
Reach	980.9504	10-year	Prop Stub Ab	3031.00	354.91	364.27	360.41	364.86	0.003037	7.03	588.53	97.37	0.42
Reach	980.9504	25-year	Ex. Bridge w	3845.00	354.91	366.33	361.22	366.88	0.002225	6.91	741.75	153.04	0.37
Reach	980.9504	25-year	Prop Stub Ab	3845.00	354.91	365.37	361.22	366.06	0.003144	7.73	705.00	120.64	0.43
Reach	980.9504	50-year	Ex. Bridge w	4481.00	354.91	367.19	361.95	367.82	0.002299	7.39	819.49	161.28	0.38
Reach	980.9504	50-year	Prop Stub Ab	4481.00	354.91	366.10	361.85	366.86	0.003186	8.16	788.56	147.21	0.44
Reach	980.9504	100-year	Ex. Bridge w	5154.00	354.91	368.68	362.41	369.31	0.002019	7.49	984.08	231.94	0.36
Reach	980.9504	100-year	Prop Stub Ab	5154.00	354.91	366.81	362.32	367.64	0.003254	8.60	871.43	158.84	0.45
Reach	980.9504	286-Year (FOR)	Ex. Bridge w	6150.00	354.91	370.39	363.19	370.83	0.001452	6.89	1786.88	343.71	0.31
Reach	980.9504	286-Year (FOR)	Prop Stub Ab	6150.00	354.91	368.72	363.28	369.45	0.002450	8.27	1113.65	232.81	0.40
Reach	980.9504	500-Year	Ex. Bridge w	6822.00	354.91	371.05	363.70	371.48	0.001370	6.89	2026.54	371.71	0.31
Reach	980.9504	500-Year	Prop Stub Ab	6822.00	354.91	368.86	363.82	369.72	0.002872	9.02	1132.19	240.59	0.43
Reach	1100.000	1.1-year	Ex. Bridge w	803.00	356.54	360.07		360.40	0.005554	4.68	176.47	60.07	0.47
Reach	1100.000	1.1-year	Prop Stub Ab	803.00	356.54	360.08		360.41	0.005505	4.67	176.95	60.08	0.47
Reach	1100.000	10-year	Ex. Bridge w	3031.00	356.54	365.89		366.26	0.001702	5.26	783.61	177.46	0.31
Reach	1100.000	10-year	Prop Stub Ab	3031.00	356.54	364.61		365.26	0.003388	6.69	563.67	166.30	0.43
Reach	1100.000	25-year	Ex. Bridge w	3845.00	356.54	366.70		367.13	0.001840	5.80	929.98	182.98	0.33
Reach	1100.000	25-year	Prop Stub Ab	3845.00	356.54	365.80		366.42	0.002865	6.78	768.00	176.69	0.40
Reach	1100.000	50-year	Ex. Bridge w	4481.00	356.54	367.65		368.07	0.001629	5.81	1107.22	188.84	0.31
Reach	1100.000	50-year	Prop Stub Ab	4481.00	356.54	366.60		367.21	0.002618	6.87	911.99	182.37	0.39
Reach	1100.000	100-year	Ex. Bridge w	5154.00	356.54	369.18		369.52	0.001187	5.42	1404.34	204.31	0.27
Reach	1100.000	100-year	Prop Stub Ab	5154.00	356.54	367.38		367.98	0.002424	6.96	1056.09	187.17	0.38

HEC-RAS River: Wilson Stream Reach: 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)	
Reach	1100.000	286-Year (FOR)	Ex. Bridge w	6150.00	356.54	370.66		370.98	0.001010	5.40	1722.33	224.05	0.26
Reach	1100.000	286-Year (FOR)	Prop Stub Ab	6150.00	356.54	369.22		369.70	0.001660	6.43	1414.37	204.96	0.32
Reach	1100.000	500-Year	Ex. Bridge w	6822.00	356.54	371.28		371.63	0.001020	5.59	1864.91	233.35	0.26
Reach	1100.000	500-Year	Prop Stub Ab	6822.00	356.54	369.47		370.02	0.001870	6.91	1465.18	208.21	0.34
Reach	1281.335	1.1-year	Ex. Bridge w	803.00	356.48	360.84	358.74	361.02	0.002188	3.47	243.97	67.61	0.31
Reach	1281.335	1.1-year	Prop Stub Ab	803.00	356.48	360.84	358.74	361.02	0.002182	3.46	244.20	67.62	0.31
Reach	1281.335	10-year	Ex. Bridge w	3031.00	356.48	366.20	361.28	366.55	0.001476	5.04	795.09	191.42	0.29
Reach	1281.335	10-year	Prop Stub Ab	3031.00	356.48	365.31	361.28	365.76	0.002118	5.65	654.37	120.40	0.34
Reach	1281.335	25-year	Ex. Bridge w	3845.00	356.48	367.04	362.00	367.45	0.001608	5.58	960.07	203.22	0.31
Reach	1281.335	25-year	Prop Stub Ab	3845.00	356.48	366.35	362.00	366.88	0.002209	6.24	824.32	193.41	0.36
Reach	1281.335	50-year	Ex. Bridge w	4481.00	356.48	367.95	362.52	368.35	0.001469	5.64	1152.76	218.33	0.30
Reach	1281.335	50-year	Prop Stub Ab	4481.00	356.48	367.10	362.52	367.64	0.002122	6.43	973.31	204.44	0.35
Reach	1281.335	100-year	Ex. Bridge w	5154.00	356.48	369.40	363.28	369.73	0.001096	5.29	1483.13	239.17	0.26
Reach	1281.335	100-year	Prop Stub Ab	5154.00	356.48	367.84	363.28	368.39	0.002035	6.60	1129.19	216.79	0.35
Reach	1281.335	286-Year (FOR)	Ex. Bridge w	6150.00	356.48	370.86	364.18	371.16	0.000928	5.24	1849.62	262.71	0.25
Reach	1281.335	286-Year (FOR)	Prop Stub Ab	6150.00	356.48	369.54	364.18	369.99	0.001478	6.19	1518.44	241.40	0.31
Reach	1281.335	500-Year	Ex. Bridge w	6822.00	356.48	371.49	364.63	371.81	0.000927	5.39	2018.85	273.48	0.25
Reach	1281.335	500-Year	Prop Stub Ab	6822.00	356.48	369.84	364.63	370.34	0.001632	6.61	1590.26	245.87	0.32

Plan: Ex. Bridge w Wilson Stream Reach RS: 949.00 Profile: 1.1-year

E.G. US. (ft)	359.91	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	359.69	E.G. Elev (ft)	359.86	359.79
Q Total (cfs)	803.00	W.S. Elev (ft)	359.64	359.56
Q Bridge (cfs)	803.00	Crit W.S. (ft)	356.84	356.84
Q Weir (cfs)		Max Chl Dpth (ft)	5.64	5.56
Weir Sta Lft (ft)		Vel Total (ft/s)	3.78	3.84
Weir Sta Rgt (ft)		Flow Area (sq ft)	212.36	209.07
Weir Submerg		Froude # Chl	0.28	0.29
Weir Max Depth (ft)		Specif Force (cu ft)	633.48	618.50
Min El Weir Flow (ft)	370.01	Hydr Depth (ft)	5.04	4.97
Min El Prs (ft)	364.78	W.P. Total (ft)	51.08	50.92
Delta EG (ft)	0.22	Conv. Total (cfs)	16317.2	15930.7
Delta WS (ft)	0.34	Top Width (ft)	42.10	42.10
BR Open Area (sq ft)	428.93	Frctn Loss (ft)	0.07	0.06
BR Open Vel (ft/s)	3.84	C & E Loss (ft)	0.00	0.03
BR Sluice Coef		Shear Total (lb/sq ft)	0.63	0.65
BR Sel Method	Energy only	Power Total (lb/ft s)	2.38	2.50

Plan: Ex. Bridge w Wilson Stream Reach RS: 949.00 Profile: 10-year

E.G. US. (ft)	366.05	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	365.65	E.G. Elev (ft)	366.05	364.43
Q Total (cfs)	3031.00	W.S. Elev (ft)	364.78	363.57
Q Bridge (cfs)	3031.00	Crit W.S. (ft)	360.04	360.03
Q Weir (cfs)		Max Chl Dpth (ft)	10.78	9.57
Weir Sta Lft (ft)		Vel Total (ft/s)	7.07	8.02
Weir Sta Rgt (ft)		Flow Area (sq ft)	428.93	377.70
Weir Submerg		Froude # Chl	0.38	0.46
Weir Max Depth (ft)		Specif Force (cu ft)	2854.14	2453.74
Min El Weir Flow (ft)	370.01	Hydr Depth (ft)		8.97
Min El Prs (ft)	364.78	W.P. Total (ft)	103.47	58.93
Delta EG (ft)	1.63	Conv. Total (cfs)	32894.5	38729.9
Delta WS (ft)	2.09	Top Width (ft)		42.10
BR Open Area (sq ft)	428.93	Frctn Loss (ft)		
BR Open Vel (ft/s)	7.07	C & E Loss (ft)		
BR Sluice Coef	0.35	Shear Total (lb/sq ft)	2.20	2.45
BR Sel Method	Press Only	Power Total (lb/ft s)	15.53	19.67

Plan: Ex. Bridge w Wilson Stream Reach RS: 949.00 Profile: 25-year

E.G. US. (ft)	366.88	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	366.33	E.G. Elev (ft)	366.88	365.58
Q Total (cfs)	3845.00	W.S. Elev (ft)	364.78	364.52
Q Bridge (cfs)	3845.00	Crit W.S. (ft)	360.97	360.98
Q Weir (cfs)		Max Chl Dpth (ft)	10.78	10.52
Weir Sta Lft (ft)		Vel Total (ft/s)	8.96	9.20
Weir Sta Rgt (ft)		Flow Area (sq ft)	428.93	417.80
Weir Submerg		Froude # Chl	0.48	0.50
Weir Max Depth (ft)		Specif Force (cu ft)	3259.71	3176.34
Min El Weir Flow (ft)	370.01	Hydr Depth (ft)		9.92
Min El Prs (ft)	364.78	W.P. Total (ft)	103.47	60.84
Delta EG (ft)	1.30	Conv. Total (cfs)	32894.5	44860.3
Delta WS (ft)	1.81	Top Width (ft)		42.10
BR Open Area (sq ft)	428.93	Frctn Loss (ft)		
BR Open Vel (ft/s)	8.96	C & E Loss (ft)		
BR Sluice Coef	0.42	Shear Total (lb/sq ft)	3.54	3.15
BR Sel Method	Press Only	Power Total (lb/ft s)	31.70	28.99

Plan: Ex. Bridge w Wilson Stream Reach RS: 949.00 Profile: 50-year

E.G. US. (ft)	367.82	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	367.19	E.G. Elev (ft)	367.82	366.35
Q Total (cfs)	4481.00	W.S. Elev (ft)	364.78	365.11
Q Bridge (cfs)	4481.00	Crit W.S. (ft)	361.66	361.65
Q Weir (cfs)		Max Chl Dpth (ft)	10.78	11.11
Weir Sta Lft (ft)		Vel Total (ft/s)	10.45	10.12
Weir Sta Rgt (ft)		Flow Area (sq ft)	428.93	442.81
Weir Submerg		Froude # Chl	0.56	0.54
Weir Max Depth (ft)		Specif Force (cu ft)	3643.42	3741.54
Min El Weir Flow (ft)	370.01	Hydr Depth (ft)		10.52
Min El Prs (ft)	364.78	W.P. Total (ft)	103.47	62.02
Delta EG (ft)	1.48	Conv. Total (cfs)	32894.5	48792.1
Delta WS (ft)	2.08	Top Width (ft)		42.10
BR Open Area (sq ft)	428.93	Frctn Loss (ft)		
BR Open Vel (ft/s)	10.45	C & E Loss (ft)		
BR Sluice Coef	0.46	Shear Total (lb/sq ft)	4.80	3.76
BR Sel Method	Press Only	Power Total (lb/ft s)	50.17	38.04

Plan: Ex. Bridge w Wilson Stream Reach RS: 949.00 Profile: 100-year

E.G. US. (ft)	369.31	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	368.68	E.G. Elev (ft)	369.31	367.10
Q Total (cfs)	5154.00	W.S. Elev (ft)	364.78	365.67
Q Bridge (cfs)	5154.00	Crit W.S. (ft)	362.34	362.35
Q Weir (cfs)		Max Chl Dpth (ft)	10.78	11.67
Weir Sta Lft (ft)		Vel Total (ft/s)	12.02	11.05
Weir Sta Rgt (ft)		Flow Area (sq ft)	428.93	466.44
Weir Submerg		Froude # Chl	0.65	0.57
Weir Max Depth (ft)		Specif Force (cu ft)	4113.29	4357.37
Min El Weir Flow (ft)	370.01	Hydr Depth (ft)		11.08
Min El Prs (ft)	364.78	W.P. Total (ft)	103.47	63.15
Delta EG (ft)	2.21	Conv. Total (cfs)	32894.5	52575.8
Delta WS (ft)	3.00	Top Width (ft)		42.10
BR Open Area (sq ft)	428.93	Frctn Loss (ft)		
BR Open Vel (ft/s)	12.02	C & E Loss (ft)		
BR Sluice Coef	0.48	Shear Total (lb/sq ft)	6.35	4.43
BR Sel Method	Press Only	Power Total (lb/ft s)	76.34	48.97

Plan: Ex. Bridge w Wilson Stream Reach RS: 949.00 Profile: 286-Year (FOR)

E.G. US. (ft)	370.83	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	370.39	E.G. Elev (ft)	370.83	370.76
Q Total (cfs)	6150.00	W.S. Elev (ft)	370.39	370.39
Q Bridge (cfs)	5786.67	Crit W.S. (ft)	363.32	363.32
Q Weir (cfs)	363.33	Max Chl Dpth (ft)	16.39	16.39
Weir Sta Lft (ft)	0.00	Vel Total (ft/s)	8.15	11.56
Weir Sta Rgt (ft)	207.76	Flow Area (sq ft)	754.38	532.12
Weir Submerg	0.00	Froude # Chl	0.43	0.55
Weir Max Depth (ft)	0.83	Specif Force (cu ft)	6610.97	7206.73
Min El Weir Flow (ft)	370.01	Hydr Depth (ft)	2.40	2.56
Min El Prs (ft)	364.78	W.P. Total (ft)	418.46	314.54
Delta EG (ft)	2.72	Conv. Total (cfs)		
Delta WS (ft)	3.96	Top Width (ft)	314.14	207.76
BR Open Area (sq ft)	428.93	Frctn Loss (ft)		
BR Open Vel (ft/s)	13.49	C & E Loss (ft)		
BR Sluice Coef		Shear Total (lb/sq ft)		
BR Sel Method	Press/Weir	Power Total (lb/ft s)		

Plan: Ex. Bridge w Wilson Stream Reach RS: 949.00 Profile: 500-Year

E.G. US. (ft)	371.48	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	371.05	E.G. Elev (ft)	371.48	371.33
Q Total (cfs)	6822.00	W.S. Elev (ft)	371.05	370.91
Q Bridge (cfs)	5910.95	Crit W.S. (ft)	363.94	363.95
Q Weir (cfs)	911.05	Max Chl Dpth (ft)	17.05	16.91
Weir Sta Lft (ft)	0.00	Vel Total (ft/s)	6.93	10.64
Weir Sta Rgt (ft)	207.76	Flow Area (sq ft)	984.00	641.08
Weir Submerg	0.00	Froude # Chl	0.36	0.53
Weir Max Depth (ft)	1.48	Specif Force (cu ft)	7066.67	7652.30
Min El Weir Flow (ft)	370.01	Hydr Depth (ft)	2.71	3.09
Min El Prs (ft)	364.78	W.P. Total (ft)	468.24	315.59
Delta EG (ft)	2.74	Conv. Total (cfs)		
Delta WS (ft)	4.18	Top Width (ft)	363.66	207.76
BR Open Area (sq ft)	428.93	Frctn Loss (ft)		
BR Open Vel (ft/s)	13.78	C & E Loss (ft)		
BR Sluice Coef		Shear Total (lb/sq ft)		
BR Sel Method	Press/Weir	Power Total (lb/ft s)		

Plan: Prop Stub Ab Wilson Stream Reach RS: 949.00 Profile: 1.1-year

E.G. US. (ft)	359.92	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	359.70	E.G. Elev (ft)	359.84	359.80
Q Total (cfs)	803.00	W.S. Elev (ft)	359.72	359.68
Q Bridge (cfs)	803.00	Crit W.S. (ft)	356.67	356.67
Q Weir (cfs)		Max Chl Dpth (ft)	5.72	5.68
Weir Sta Lft (ft)		Vel Total (ft/s)	2.71	2.74
Weir Sta Rgt (ft)		Flow Area (sq ft)	296.03	292.96
Weir Submerg		Froude # Chl	0.23	0.23
Weir Max Depth (ft)		Specif Force (cu ft)	778.13	765.54
Min El Weir Flow (ft)	372.01	Hydr Depth (ft)	4.36	4.32
Min El Prs (ft)	368.11	W.P. Total (ft)	70.28	70.10
Delta EG (ft)	0.23	Conv. Total (cfs)	22945.9	22590.4
Delta WS (ft)	0.35	Top Width (ft)	67.94	67.78
BR Open Area (sq ft)	985.26	Frctn Loss (ft)	0.04	0.04
BR Open Vel (ft/s)	2.74	C & E Loss (ft)	0.00	0.07
BR Sluice Coef		Shear Total (lb/sq ft)	0.32	0.33
BR Sel Method	Energy only	Power Total (lb/ft s)	0.87	0.90

Plan: Prop Stub Ab Wilson Stream Reach RS: 949.00 Profile: 10-year

E.G. US. (ft)	364.86	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	364.27	E.G. Elev (ft)	364.68	364.62
Q Total (cfs)	3031.00	W.S. Elev (ft)	364.37	364.30
Q Bridge (cfs)	3031.00	Crit W.S. (ft)	359.28	359.29
Q Weir (cfs)		Max Chl Dpth (ft)	10.37	10.30
Weir Sta Lft (ft)		Vel Total (ft/s)	4.48	4.52
Weir Sta Rgt (ft)		Flow Area (sq ft)	676.38	670.04
Weir Submerg		Froude # Chl	0.29	0.30
Weir Max Depth (ft)		Specif Force (cu ft)	3344.83	3302.46
Min El Weir Flow (ft)	372.01	Hydr Depth (ft)	7.34	7.29
Min El Prs (ft)	368.11	W.P. Total (ft)	97.01	96.73
Delta EG (ft)	0.44	Conv. Total (cfs)	69995.5	72358.5
Delta WS (ft)	0.69	Top Width (ft)	92.20	91.96
BR Open Area (sq ft)	985.26	Frctn Loss (ft)	0.06	0.04
BR Open Vel (ft/s)	4.52	C & E Loss (ft)	0.00	0.16
BR Sluice Coef		Shear Total (lb/sq ft)	0.82	0.76
BR Sel Method	Energy only	Power Total (lb/ft s)	3.66	3.43

Plan: Prop Stub Ab Wilson Stream Reach RS: 949.00 Profile: 25-year

E.G. US. (ft)	366.06	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	365.37	E.G. Elev (ft)	365.86	365.79
Q Total (cfs)	3845.00	W.S. Elev (ft)	365.48	365.41
Q Bridge (cfs)	3845.00	Crit W.S. (ft)	360.03	360.03
Q Weir (cfs)		Max Chl Dpth (ft)	11.48	11.41
Weir Sta Lft (ft)		Vel Total (ft/s)	4.91	4.96
Weir Sta Rgt (ft)		Flow Area (sq ft)	782.32	774.91
Weir Submerg		Froude # Chl	0.31	0.31
Weir Max Depth (ft)		Specif Force (cu ft)	4322.21	4268.76
Min El Weir Flow (ft)	372.01	Hydr Depth (ft)	8.00	7.94
Min El Prs (ft)	368.11	W.P. Total (ft)	103.02	102.87
Delta EG (ft)	0.50	Conv. Total (cfs)	84660.8	88494.7
Delta WS (ft)	0.81	Top Width (ft)	97.76	97.62
BR Open Area (sq ft)	985.26	Frctn Loss (ft)	0.07	0.05
BR Open Vel (ft/s)	4.96	C & E Loss (ft)	0.00	0.19
BR Sluice Coef		Shear Total (lb/sq ft)	0.98	0.89
BR Sel Method	Energy only	Power Total (lb/ft s)	4.81	4.41

Plan: Prop Stub Ab Wilson Stream Reach RS: 949.00 Profile: 50-year

E.G. US. (ft)	366.86	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	366.10	E.G. Elev (ft)	366.65	366.58
Q Total (cfs)	4481.00	W.S. Elev (ft)	366.23	366.14
Q Bridge (cfs)	4481.00	Crit W.S. (ft)	360.56	360.56
Q Weir (cfs)		Max Chl Dpth (ft)	12.23	12.14
Weir Sta Lft (ft)		Vel Total (ft/s)	5.24	5.29
Weir Sta Rgt (ft)		Flow Area (sq ft)	855.81	847.56
Weir Submerg		Froude # Chl	0.26	0.27
Weir Max Depth (ft)		Specif Force (cu ft)	5071.24	5008.88
Min El Weir Flow (ft)	372.01	Hydr Depth (ft)	8.46	8.38
Min El Prs (ft)	368.11	W.P. Total (ft)	108.01	107.85
Delta EG (ft)	0.54	Conv. Total (cfs)	96182.2	99561.4
Delta WS (ft)	0.94	Top Width (ft)	101.16	101.16
BR Open Area (sq ft)	985.26	Frctn Loss (ft)	0.07	0.05
BR Open Vel (ft/s)	5.29	C & E Loss (ft)	0.00	0.21
BR Sluice Coef		Shear Total (lb/sq ft)	1.07	0.99
BR Sel Method	Energy only	Power Total (lb/ft s)	5.62	5.25

Plan: Prop Stub Ab Wilson Stream Reach RS: 949.00 Profile: 100-year

E.G. US. (ft)	367.64	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	366.81	E.G. Elev (ft)	367.42	367.35
Q Total (cfs)	5154.00	W.S. Elev (ft)	366.94	366.86
Q Bridge (cfs)	5154.00	Crit W.S. (ft)	361.26	361.26
Q Weir (cfs)		Max Chl Dpth (ft)	12.94	12.86
Weir Sta Lft (ft)		Vel Total (ft/s)	5.55	5.60
Weir Sta Rgt (ft)		Flow Area (sq ft)	928.24	919.75
Weir Submerg		Froude # Chl	0.27	0.28
Weir Max Depth (ft)		Specif Force (cu ft)	5870.16	5800.83
Min El Weir Flow (ft)	372.01	Hydr Depth (ft)	9.18	9.09
Min El Prs (ft)	368.11	W.P. Total (ft)	109.45	109.28
Delta EG (ft)	0.59	Conv. Total (cfs)	109639.0	113097.4
Delta WS (ft)	1.06	Top Width (ft)	101.16	101.16
BR Open Area (sq ft)	985.26	Frctn Loss (ft)	0.07	0.05
BR Open Vel (ft/s)	5.60	C & E Loss (ft)	0.00	0.24
BR Sluice Coef		Shear Total (lb/sq ft)	1.17	1.09
BR Sel Method	Energy only	Power Total (lb/ft s)	6.50	6.11

Plan: Prop Stub Ab Wilson Stream Reach RS: 949.00 Profile: 286-Year (FOR)

E.G. US. (ft)	369.45	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	368.72	E.G. Elev (ft)	369.45	368.05
Q Total (cfs)	6150.00	W.S. Elev (ft)	368.11	366.52
Q Bridge (cfs)	6150.00	Crit W.S. (ft)	361.93	361.92
Q Weir (cfs)		Max Chl Dpth (ft)	14.11	12.52
Weir Sta Lft (ft)		Vel Total (ft/s)	6.18	6.94
Weir Sta Rgt (ft)		Flow Area (sq ft)	995.39	886.12
Weir Submerg		Froude # Chl	0.29	0.35
Weir Max Depth (ft)		Specif Force (cu ft)	7299.27	5929.59
Min El Weir Flow (ft)	372.01	Hydr Depth (ft)		8.76
Min El Prs (ft)	368.11	W.P. Total (ft)	211.94	108.61
Delta EG (ft)	1.40	Conv. Total (cfs)	78863.9	106722.0
Delta WS (ft)	2.20	Top Width (ft)		101.16
BR Open Area (sq ft)	985.26	Frctn Loss (ft)		
BR Open Vel (ft/s)	6.24	C & E Loss (ft)		
BR Sluice Coef	0.30	Shear Total (lb/sq ft)	1.78	1.69
BR Sel Method	Press Only	Power Total (lb/ft s)	11.02	11.74

Plan: Prop Stub Ab Wilson Stream Reach RS: 949.00 Profile: 500-Year

E.G. US. (ft)	369.72	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	368.86	E.G. Elev (ft)	369.72	368.67
Q Total (cfs)	6822.00	W.S. Elev (ft)	368.11	367.00
Q Bridge (cfs)	6822.00	Crit W.S. (ft)	362.34	362.36
Q Weir (cfs)		Max Chl Dpth (ft)	14.11	13.00
Weir Sta Lft (ft)		Vel Total (ft/s)	6.85	7.31
Weir Sta Rgt (ft)		Flow Area (sq ft)	995.39	933.73
Weir Submerg		Froude # Chl	0.32	0.36
Weir Max Depth (ft)		Specif Force (cu ft)	7571.47	6580.37
Min El Weir Flow (ft)	372.01	Hydr Depth (ft)		9.23
Min El Prs (ft)	368.11	W.P. Total (ft)	211.94	109.56
Delta EG (ft)	1.05	Conv. Total (cfs)	78863.9	115781.0
Delta WS (ft)	1.87	Top Width (ft)		101.16
BR Open Area (sq ft)	985.26	Frctn Loss (ft)		
BR Open Vel (ft/s)	6.92	C & E Loss (ft)		
BR Sluice Coef	0.33	Shear Total (lb/sq ft)	2.19	1.85
BR Sel Method	Press Only	Power Total (lb/ft s)	15.04	13.50

McFarland Johnson

CALCULATION COVER PAGE

PROJECT:	MJ JOB NO.:
Farmington, ME. Hamlin Bridge over Wilson Stream. Bridge No. 3286	18084.23
CLIENT:	**STATE JOB NO.:**
Maine Department of Transportation	WIN 22236.00
SUBJECT/ TITLE:	**FEDERAL JOB NO.:**
Preliminary Design Report: Scour Analysis	STP-2223(600)

REV. NO.	ORIGINATOR'S SIGNATURE / DATE	CHECKER'S SIGNATURE / DATE
	3/8/2019	3/8/2019

CALCULATION OBJECTIVE:

To calculate the abutment and contraction scour depths for the preliminary design report.

CALCULATION METHODOLOGY/ LIST of ASSUMPTIONS:

- HEC-RAS is used to calculate the abutment and contraction scour depths.
- The Froehlich equation is used to calculate abutment scour.
- The default (program chosen) equation will be used for contraction scour. This defaults to live bed scour for this structure.
- The D50 used in the analysis was taken from preliminary geotechnical analysis. Borings were taken in the approach roadway.
- Per the MaineDOT BDG, the Q100 storm event is used for scour design. The Q500 storm event is also run for the scour check.
- A preliminary riprap D50 is calculated using HEC 23 Design Guide 14. This value can be used to determine if plain, heavy, or a specialized riprap should be used at the site. Calculations indicate a plain riprap (D50 = 9") is acceptable.

REFERENCES / DESIGN FILES:

REFERENCE TITLE:	LOCATION:	REASON FOR REFERENCE:
MaineDOT Bridge Design Guide, with updates to 2017	http://www.maine.gov/mdot/bdg/	State design standards
HEC 18 – Evaluating Scour at Bridges, Fifth Edition	https://www.fhwa.dot.gov/engineering/hydraulics/pubs/hif12003.pdf	Design Guide
HEC 23 – Bridge Scour and Stream Instability Countermeasures: Experience, Selection, and Design Guidance – Third Edition. Volume 2.	https://www.fhwa.dot.gov/engineering/hydraulics/pubs/09111/09112.pdf	Design Guide

CONCLUSIONS:

The contraction and abutment scour depths have been calculated at the Q100 and Q500 storm events. See summary table for more information.

Scour Depth Summary

Project Description: Farmington, Maine. Hamlin Br No. 3286

Project Number:	18084.23	
Calcs By:	TEPA	3/8/2019
Check By:	RLJ	3/8/2019

Estimated Scour Depth Summary - Proposed Bridge

100-Year Event					
Left Abutment			**Right Abutment**		
Contraction Scour	Abutment Scour Froehlich	Total Scour	Contraction Scour	Abutment Scour Froehlich	Total Scour
0.0	**16.9**	**16.9**	**0.0**	**11.4**	**11.4**

500-Year Event					
Left Abutment			**Right Abutment**		
Contraction Scour	Abutment Scour Froehlich	Total Scour	Contraction Scour	Abutment Scour Froehlich	Total Scour
0.4	**22.6**	**23.0**	**0.4**	**12.7**	**13.1**

Notes

1) Depths are given in feet.

2) Some of the scour depths calculated may exceed he depth of bedrock. For these values, the assumed scour depth for design should be the bedrock depth.

3) The Froehlich equation for abutment scour was used. This is generally conservative.

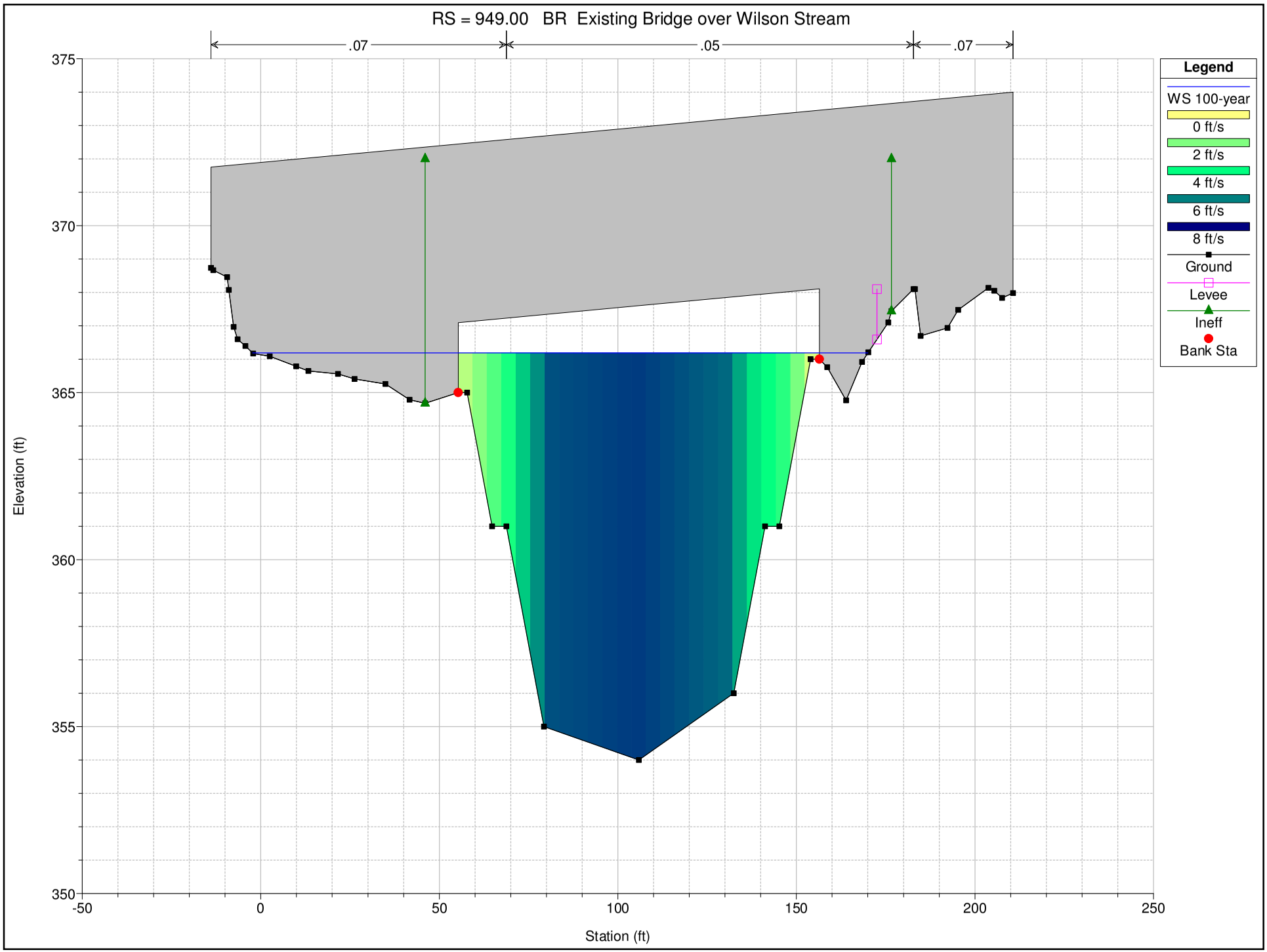
4) HEC-RAS determined that Live Bed conditions are applicable for the contraction scour analysis.

Contraction Scour

		Left	Channel	Right
Input Data				
	Average Depth (ft):	2.98	9.75	4.17
	Approach Velocity (ft/s):	2.47	7.72	2.83
	Br Average Depth (ft):	1.19	8.43	
	BR Opening Flow (cfs):	0.00	5154.00	
	BR Top WD (ft):		101.16	
	Grain Size D50 (mm):	0.03	0.03	0.03
	Approach Flow (cfs):	824.89	4137.43	191.68
	Approach Top WD (ft):	111.98	54.99	16.28
	K1 Coefficient:	0.590	0.690	0.590
Results				
	Scour Depth Ys (ft):		0.00	
	Critical Velocity (ft/s):		0.76	
	Equation:		Live	

Abutment Scour

		Left	Right
Input Data			
	Station at Toe (ft):	55.30	156.46
	Toe Sta at appr (ft):	137.09	192.08
	Abutment Length (ft):	111.98	16.28
	Depth at Toe (ft):	1.02	0.02
	K1 Shape Coef:	1.00 - Vertical abutment	
	Degree of Skew (degrees):	90.00	90.00
	K2 Skew Coef:	1.00	1.00
	Projected Length L' (ft):	111.98	16.28
	Avg Depth Obstructed Ya (ft):	2.98	4.17
	Flow Obstructed Qe (cfs):	824.87	191.75
	Area Obstructed Ae (sq ft):	333.96	67.84
Results			
	Scour Depth Ys (ft):	16.86	11.36
	Qe/Ae = Ve:	2.47	2.83
	Froude #:	0.25	0.24
	Equation:	Froehlich	Froehlich


RS = 949.00 BR Existing Bridge over Wilson Stream
.07
.05
.07
Legend
WS 100-year
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
375
370
365
360
355
350
-50
0
50
100
150
200
250
Station (ft)

HEC-RAS Scour Report: Q500

Contraction Scour

		Left	Channel	Right
Input Data				
	Average Depth (ft):	4.72	11.76	4.47
	Approach Velocity (ft/s):	2.91	7.58	2.62
	Br Average Depth (ft):	2.10	9.84	
	BR Opening Flow (cfs):	0.00	6822.00	
	BR Top WD (ft):		101.16	
	Grain Size D50 (mm):	0.03	0.03	0.03
	Approach Flow (cfs):	1646.95	4899.06	275.99
	Approach Top WD (ft):	120.12	54.99	23.59
	K1 Coefficient:	0.690	0.690	0.690
Results				
	Scour Depth Ys (ft):		0.42	
	Critical Velocity (ft/s):		0.78	
	Equation:		Live	

These variables were input manually. HEC-RAS was unable to automatically calculate the correct values, and defaulted to zero.

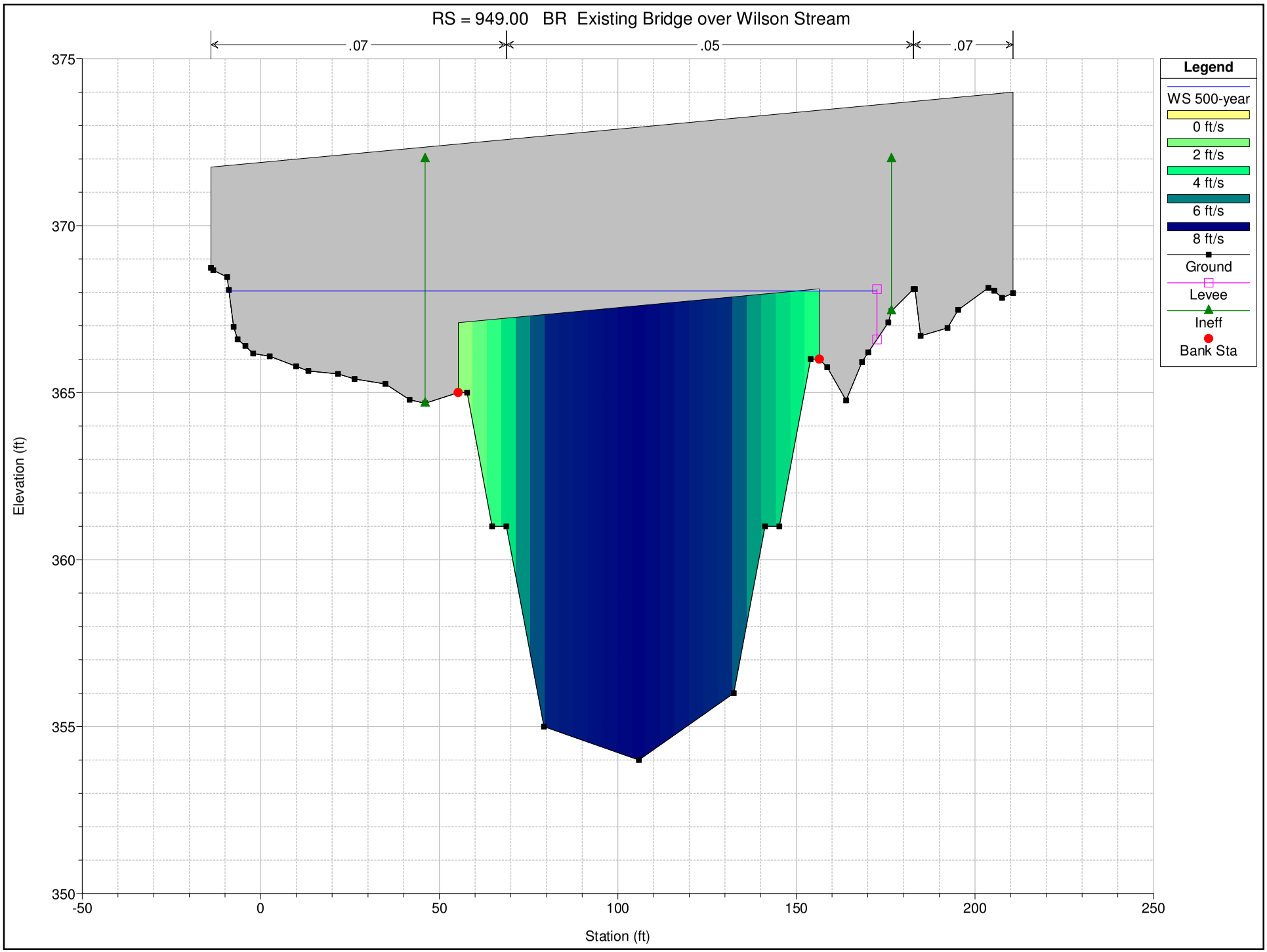
For this case, the Top Width is simply equal the bridge opening width. The Average Depth is taken as the Flow Area divided by the Top Width. This is consistent with how HEC-RAS would normally calculate these values.

Abutment Scour

		Left	Right
Input Data			
	Station at Toe (ft):	55.30	156.46
	Toe Sta at appr (ft):	137.09	192.08
	Abutment Length (ft):	120.12	23.59
	Depth at Toe (ft):	2.95	1.95
	K1 Shape Coef:	1.00 - Vertical abutment	
	Degree of Skew (degrees):	90.00	90.00
	K2 Skew Coef:	1.00	1.00
	Projected Length L' (ft):	120.12	23.59
	Avg Depth Obstructed Ya (ft):	4.72	4.47
	Flow Obstructed Qe (cfs):	1646.92	276.08
	Area Obstructed Ae (sq ft):	566.73	105.38
Results			
	Scour Depth Ys (ft):	22.57	12.67
	Qe/Ae = Ve:	2.91	2.62
	Froude #:	0.24	0.22
	Equation:	Froehlich	Froehlich

Combined Scour Depths

Left abutment scour + contraction scour (ft):	22.57
Right abutment scour + contraction scour (ft):	13.09


RS = 949.00 BR Existing Bridge over Wilson Stream
.07
.05
.07
Legend
WS 500-year
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
375
370
365
360
355
350
-50
0
50
100
150
200
250
Station (ft)

Riprap Design Calculations

Project Description: Farmington, Maine. Hamlin Br No. 3286

Project Number: 18084.23

Calcs By: TEPA 3/8/2019

Check By:

Purpose: To calculate the required riprap size for the design flow event.

References: HEC 23, Vol II, DG 14.

Note: The set-back ratio is << 5. Use the average velocity based on the entire contracted area through the bridge.

Constants

S_s =	2.65	assumed Riprap specific gravity
g =	32.2	ft/s
Is it a vertical wall abutment? =	Y	(Y or N)
K =	1.02	

Hyrdaulic Data from HEC-RAS

Upstream:	Storm Event	Q100	
	Channel Velocity =	6.05	fps
	Channel Depth =	12.19	ft
	Froude # =	0.31	
Downstream:	Storm Event	Q100	
	Channel Velocity =	6.13	fps
	Channel Depth =	12.08	ft
	Froude # =	0.31	

Output

Upstream d_{50} =	0.70	ft
Downstream d_{50} =	0.72	ft
Controlling d_{50} =	**8.66**	**in**

$$\frac{D_{50}}{y} = \frac{K}{(S_s - 1)}\left[\frac{V^2}{gy}\right]$$

Eq 14.1, HEC 23 Vol II

Bridge Output

File Type Options Help

River: Wilson Stream Profile: 100-year

Reach Reach RS: 949.00 Plan: Prop Stub Ab

Plan: Prop Stub Ab Wilson Stream Reach RS: 949.00 Profile: 100-year

		Element	Inside BR US	Inside BR DS
E.G. US. (ft)	367.04	E.G. Elev (ft)	366.76	366.66
W.S. US. (ft)	366.02	W.S. Elev (ft)	366.19	366.08
Q Total (cfs)	5154.00	Crit W.S. (ft)	361.26	361.26
Q Bridge (cfs)	5154.00	Max Chl Dpth (ft)	12.19	12.08
Q Weir (cfs)		Vel Total (ft/s)	6.05	6.13
Weir Sta Lft (ft)		Flow Area (sq ft)	852.30	840.68
Weir Sta Rgt (ft)		Froude # Chl	0.31	0.31
Weir Submerg		Specif Force (cu ft)	5281.10	5197.24
Weir Max Depth (ft)		Hydr Depth (ft)	8.43	8.31
Min El Weir Flow (ft)	372.01	W.P. Total (ft)	107.95	107.72
Min El Prs (ft)	368.11	Conv. Total (cfs)	95546.9	98301.1
Delta EG (ft)	0.93	Top Width (ft)	101.16	101.16
Delta WS (ft)	2.07	Frctn Loss (ft)	0.09	0.08
BR Open Area (sq ft)	985.26	C & E Loss (ft)	0.00	0.47
BR Open Vel (ft/s)	6.13	Shear Total (lb/sq ft)	1.43	1.34
BR Sluice Coef		Power Total (lb/ft s)	8.67	8.21
BR Sel Method	Energy only			

Soil Unit	Representative Zone	Boring	Sample	Depth (feet)	Elev. (feet)	% Fines (<No. 200)	D_{50} (mm)	Classification of D_{50} particle size	Representative D_{50} (mm)
Glacial Till	Streambed	BB-FWS-101	4D	15.0-17.0	355.0-353.0	61.8	0.03	Silt	0.03
			5D	19.5-21.5	350.5-348.5	73.2	0.03	Silt	
		BB-FWS-102	4D	15.0-17.0	354.2-352.2	77.7	0.02	Silt	

Prepared by: AVB 10/19/2018
Checked by_____