HYDRAULIC REPORT

Existing Bridge

Prestile Brook Bridge (#0125) is located in the town Easton on Richardson Rd over Prestile Stream. The bridge was built in 1970. The existing bridge is three 6'-0" diameter steel plate pipes, each approx. 58' in length. The slope of the culvert is about 0.8%. The culvert is in poor condition. The pipes are heavily rusted and have some deformation.

Immediately upstream of the crossing are two reservoirs (Christina & Industrial Waste Pond). This helps contribute to wetlands being a large percentage of the drainage area (33%) Because of this large percentage, the Hydrology Section of MaineDOT's Environment Office, suspects that peak flow during the low flow months would be somewhat less than what the USGS Regression Formula produced.

The existing culvert has been analyzed using HY8. The existing structure appears to be adequately sized as the barrel is only 60% full at Q_{50}. However, the triple pipe configuration is prone to catch debris and maintenance forces have reported the need for debris removal on several occasions. There have not been any reports of the stream overtopping the roadway. Velocities do not seem high enough to cause scour problems.

Proposed Bridge

Prestile Brook Bridge (#0125) in Easton is scoped for a bridge culvert replacement in the 2010-2011 BTIP. The proposed structure will be a 12'-0" Span x 6'-0" Rise Precast Concrete Box Culvert, with the invert buried approx 12" below streambed yielding a 60 sq. ft hydraulic opening. A 12'-0" Span x 5'-0" Rise Box with the invert at grade with the streambed was examined. The analysis showed it would have adequately passed the peak flows with some reduction in headwater elevation. However, outlet velocities would have been higher than desired. The decision was made to bury the invert 12" and allow the natural bottom to decrease velocities. An additional foot of rise was added to the culvert to maintain the 60 sq ft hydraulic opening. This has been found to also pass hydraulically with slightly lower headwater elevations at all peak flows.

All three replacement alternatives were found to have been able to adequately pass Q_{50} and Q_{100} peak flows. The selection of Alternative 5 was therefore based on other factors such as limiting the amount of approach work and the desire of Bridge Maintenance to reduce the crossing to a single barrel.

SUMMARY

	Existing Structure Triple Steel Plate Pipes 6'-0" Diameter	**Proposed Structure** Single Precast Conc. Box Culvert 12'-0" Span x 6'-0" Rise
Area of Waterway Opening	84.8 ft^2	60.0 ft^2
Elevation of Centerline of Roadway	614.6 ft.	614.6 ft.
Invert Elevation @ Inlet	607.2 ft	606.5 ft
Invert Elevation @ Outlet	606.7 ft	605.0 ft
Inlet Depth @ $Q_{1.1}$	1.71 ft	1.37 ft
Outlet Depth @ $Q_{1.1}$	1.07 ft	0.80 ft
Headwater Elevation @ $Q_{1.1}$	608.91 ft	608.27 ft
Headwater Elevation @ Q_{50}	610.78 ft	610.09 ft
Headwater Elevation @ Q_{100}	611.02 ft	610.45 ft
HW/D @ Q_{50}	0.60	0.76
Discharge Velocity @ $Q_{1.1}$	4.88 fps	3.82 fps
Discharge Velocity @ Q_{50}	7.15 fps	8.64 fps
Discharge Velocity @ Q_{100}	7.40 fps	9.11 fps

Reported By: Brian J. Nichols
Date: December 16, 2009

HY-8 Analysis Results

Culvert Summary Table - Culvert 1

Culvert Crossing: Slipline

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
49.70	49.70	609.50	1.64	1.80	2-M2c	1.17	1.10	1.12	0.80	5.04	3.62
66.76	66.76	609.82	1.91	2.12	2-M2c	1.37	1.28	1.30	0.95	5.47	4.02
83.82	83.82	610.10	2.16	2.40	2-M2c	1.55	1.46	1.47	1.09	5.83	4.35
100.88	100.88	610.35	2.39	2.65	2-M2c	1.70	1.60	1.61	1.21	6.14	4.63
117.94	117.94	610.58	2.60	2.88	2-M2c	1.85	1.73	1.75	1.33	6.43	4.89
135.00	135.00	610.81	2.80	3.11	2-M2c	2.00	1.86	1.88	1.44	6.69	5.11
152.06	152.06	611.01	3.00	3.31	2-M2c	2.14	1.99	2.00	1.54	6.93	5.32
169.12	169.12	611.21	3.19	3.51	2-M2c	2.27	2.10	2.11	1.64	7.16	5.50
186.18	186.18	611.41	3.38	3.71	2-M2c	2.40	2.21	2.22	1.73	7.38	5.68
195.60	195.60	611.51	3.48	3.81	2-M2c	2.47	2.26	2.28	1.78	7.50	5.77
220.30	220.30	611.78	3.75	4.08	2-M2c	2.65	2.41	2.42	1.90	7.79	6.00

HY-8 Analysis Results

Culvert Summary Table - Culvert 1

Culvert Crossing: Existing/In-kind

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
49.70	49.70	608.91	1.55	1.71	2-M2c	1.10	1.03	1.07	0.80	4.88	3.62
66.76	66.76	609.19	1.82	1.99	2-M2c	1.29	1.23	1.24	0.95	5.28	4.02
83.82	83.82	609.45	2.04	2.25	2-M2c	1.43	1.37	1.39	1.09	5.62	4.35
100.88	100.88	609.70	2.24	2.50	2-M2c	1.58	1.50	1.53	1.21	5.92	4.63
117.94	117.94	609.92	2.44	2.72	2-M2c	1.72	1.64	1.66	1.33	6.18	4.89
135.00	135.00	610.12	2.62	2.92	2-M2c	1.85	1.77	1.78	1.44	6.42	5.11
152.06	152.06	610.32	2.79	3.12	2-M2c	1.96	1.88	1.89	1.54	6.64	5.32
169.12	169.12	610.50	2.96	3.30	2-M2c	2.08	1.98	2.00	1.64	6.85	5.50
186.18	186.18	610.68	3.12	3.48	2-M2c	2.19	2.08	2.10	1.73	7.04	5.68
195.60	195.60	610.78	3.20	3.58	2-M2c	2.25	2.13	2.15	1.78	7.15	5.77
220.30	220.30	611.02	3.43	3.82	2-M2c	2.41	2.28	2.29	1.90	7.40	6.00

HY-8 Analysis Results

Culvert Summary Table - Culvert 1

Culvert Crossing: Steel Pipe Arches 1

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
49.70	49.70	608.08	0.00	1.08	3-M1t	0.58	0.00	0.80	0.80	3.58	3.62
66.76	66.76	608.32	0.00	1.32	3-M1t	0.77	0.00	0.95	0.95	4.04	4.02
83.82	83.82	608.54	0.00	1.54	3-M1t	0.97	0.00	1.09	1.09	4.43	4.35
100.88	100.88	608.75	0.00	1.75	3-M1t	1.17	0.00	1.21	1.21	4.78	4.63
117.94	117.94	609.23	0.00	2.23	3-M2t	1.36	0.00	1.33	1.33	5.10	4.89
135.00	135.00	609.45	0.00	2.45	3-M2t	1.56	0.00	1.44	1.44	5.40	5.11
152.06	152.06	609.66	0.00	2.66	3-M2t	1.76	0.00	1.54	1.54	5.68	5.32
169.12	169.12	609.86	0.00	2.86	3-M2t	1.96	0.00	1.64	1.64	5.94	5.50
186.18	186.18	610.06	0.00	3.06	3-M2t	2.15	0.00	1.73	1.73	6.20	5.68
195.60	195.60	610.17	2.82	2.92	3-M1t	1.58	1.57	1.78	1.78	6.33	5.77
220.30	220.30	610.45	0.00	3.45	3-M2t	2.55	0.00	1.90	1.90	6.68	6.00

HY-8 Analysis Results

Culvert Summary Table - Culvert 1

Culvert Crossing: Aluminum Pipe Arches

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
49.70	49.70	608.15	0.00	1.15	3-M1t	0.62	0.00	0.80	0.80	3.90	3.62
66.76	66.76	608.40	0.00	1.40	3-M1t	0.83	0.00	0.95	0.95	4.41	4.02
83.82	83.82	608.64	0.00	1.64	3-M1t	1.05	0.00	1.09	1.09	4.84	4.35
100.88	100.88	609.13	0.00	2.13	3-M2t	1.26	0.00	1.21	1.21	5.23	4.63
117.94	117.94	609.37	0.00	2.37	3-M2t	1.47	0.00	1.33	1.33	5.58	4.89
135.00	135.00	609.60	0.00	2.60	3-M2t	1.69	0.00	1.44	1.44	5.91	5.11
152.06	152.06	609.83	0.00	2.83	3-M2t	1.90	0.00	1.54	1.54	6.21	5.32
169.12	169.12	610.04	0.00	3.04	3-M2t	2.11	0.00	1.64	1.64	6.49	5.50
186.18	186.18	610.26	0.00	3.26	3-M2t	2.33	0.00	1.73	1.73	6.76	5.68
195.60	195.60	610.37	2.81	3.22	3-M1t	1.71	1.67	1.78	1.78	6.91	5.77
220.30	220.30	610.68	0.00	3.68	3-M2t	2.75	0.00	1.90	1.90	7.27	6.00

HY-8 Analysis Results

Culvert Summary Table - Culvert 1

Culvert Crossing: Precast Box Culvert

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
49.70	49.70	608.27	1.37	1.77	3-M1t	0.92	0.90	1.30	0.80	3.82	3.62
66.76	66.76	608.66	1.67	2.16	3-M1t	1.11	1.11	1.45	0.95	4.59	4.02
83.82	83.82	609.04	1.95	2.54	3-M1t	1.29	1.28	1.59	1.09	5.27	4.35
100.88	100.88	609.36	2.20	2.86	3-M1t	1.46	1.46	1.71	1.21	5.89	4.63
117.94	117.94	609.68	2.44	3.18	3-M1t	1.62	1.62	1.83	1.33	6.45	4.89
135.00	135.00	609.97	2.69	3.47	3-M1t	1.77	1.77	1.94	1.44	6.97	5.11
152.06	152.06	610.26	2.94	3.76	3-M1t	1.93	1.92	2.04	1.54	7.46	5.32
169.12	169.12	609.70	3.20	0.0*	1-S2n	2.06	2.07	2.07	1.64	8.18	5.50
186.18	186.18	609.95	3.45	0.0*	1-S2n	2.18	2.20	2.19	1.73	8.50	5.68
195.60	195.60	610.09	3.59	0.0*	1-S2n	2.24	2.28	2.27	1.78	8.64	5.77
220.30	220.30	610.45	3.95	0.90	1-S2n	2.42	2.47	2.42	1.90	9.11	6.00

Project Name:	Easton	**PIN:**	16698.00
Stream Name:	Prestile Stream	**Town:**	Easton
Bridge Name:	Prestile Brook #1	**Bridge No.**	0125
Route No.	Richardson Rd.	**USGS Quad:**	
Analysis by:	AWMann	**Date:**	9/1/2009

Peak Flow Calculations by USGS Regression Equations (Hodgkins, 1999)

Enter data in blue cells only!

	km^2	mi^2	ac	*Enter data in [mi^2]*
A	27.80	10.734	6869.7	Watershed Area
W	9.11	3.519	2252.1	Wetlands area (by NWI)
P_c	584722	5170697		watershed centroid (E, N; UTM 19N; meters)
County	Aroostook N			*choose county from drop-down menu*
pptA	36.1			mean annual precipitation (inches; by look-up)
SG	0.00			sand & gravel aquifer as decimal fraction of watershed A

A (km^2)	27.80	**Conf Lvl**	0.67
W (%)	32.78		

Worksheet prepared by:
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Ret Pd T (yr)	Peak Flow Estimate Lower	Q_T (m^3/s)	Upper	Q_T (ft^3/s)
1.1		1.41		49.7
2	1.68	2.42	3.49	85.5
5	2.35	3.39	4.90	119.8
10	2.76	4.05	5.94	143.0
25	3.29	4.91	7.31	173.3
50	3.67	5.54	8.37	195.6
100	4.07	6.24	9.56	220.3
500	4.91	7.81	12.41	275.6

Reference:

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

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