HYDROLOGY REPORT

Peak flows were calculated on March 8, 2017 by the Maine Department of Transportation using the United States Geological Survey (USGS) Regression Equations (Hodgkins, 1999 & Lombard/Hodgkins, 2015).

SUMMARY

Drainage Area	1.7	mi^2
Q1.1	39.0	ft^3/s
Q10	163.9	ft^3/s
Q25	214.5	ft^3/s
Q50	252.0	ft^3/s
Q100	294.9	ft^3/s
Q500	400.0	ft^3/s

Reported by: Olin Mather
Date: November 20, 2017

HYDRAULIC REPORT

ANALYSIS

The original bridge consists of stone masonry abutments and was widened (downstream) circa 1946. Plans from the reconstruction are available. According to recent survey and field measurements, the existing structure has an irregular hydraulic opening. For the purposes of the analysis, the existing hydraulic conditions were evaluated based on an average hydraulic opening (12 ft span x 7.4 ft rise) using the Army Corps of Engineers Hydrologic Engineering Center River Analysis System (HEC-RAS) software (version 5.0.3). Based on recent survey, the existing structure has an upstream invert elevation of 243.9 ft and low chord elevation of 250.8 ft. The minimum roadway elevation was identified as 256.4 ft in the southern approach.

The preferred replacement alternative is a 40 ft span, voided slab, integral abutment bridge. The proposed hydraulic conditions were evaluated based on a 236 sf hydraulic opening, with an invert elevation of 245.0 ft (top of infill material) and low chord elevation of 253.0 ft. The minimum roadway elevation will be maintained at an elevation of 256.4 ft in the southern approach.

Due to the proximity of the bridge to the Kennebec River, CHA utilized a known water surface elevation as the downstream boundary condition, which was referenced from the effective Flood Insurance Study (FIS) for the Town of Anson dated July 1995. Water surface elevations along this section of the Kennebec River are controlled by the Anson Dam, located approximately 1.1 miles downstream of the bridge. According to the FIS, tailwater is expected to overtop the bridge between the 5- and 10-yr events on the Kennebec River.

CHA evaluated the hydraulics at the bridge utilizing two downstream boundary conditions in the Kennebec River, normal and flood flow. Based on recent survey and field measurements, 247.6 ft was utilized as the normal pool (no tailwater) elevation for the Kennebec River. For the flood scenario, CHA utilized coincidental peak guidance to determine the associated event on the Kennebec River. Based on the drainage area ratio of 1: 1,000, and a 50-yr design flood for the proposed bridge, the 5-yr (255.7ft) water surface elevation was used on the Kennebec River.

RESULTS

Assuming normal pool conditions in the Kennebec River, the proposed bridge provides the necessary 2 ft of freeboard during the design (50-yr) flood event. During this scenario, the proposed structure was found to maintain or reduce headwater elevations and reduce outlet velocities. However, during the coincidental peak scenario, both the existing and proposed bridge do not provide the required freeboard, since the estimated 5-yr water surface elevation on Kennebec River is higher than the existing and proposed low chord elevation. During the coincident peak scenario, the tailwater controls water surface elevations through the modeled section of Gilman Brook with overtopping of the bridge occurring between the 5-yr and 10-yr events on the Kennebec River.

During the recent site visit, CHA identified the streambed material to be primarily sand with some gravel and fines, which is consistent with the boring information presented in the Draft Geotechnical Report dated July 2017. As such, CHA utilized the HEC-18 open-bottom culvert equations and a medium sand D_{50} of 0.002 ft to estimate the scour potential at the proposed bridge. It should be noted that the computed scour depths are conservative and will be limited by the bottom of the culvert left in place, however they were developed to show the relative scour potential associated with different design configurations. When assuming no wingwalls, CHA calculated the potential for 10.8-13.0 ft of total scour during the 100-year event.

Finally, the bankfull width of Gilman Brook was estimated to be 10-12 ft upstream of the influence from the Kennebec River at normal pool. As such, the proposed alternative provides a span greater than 1.2 times the bank full width, reduces velocities through the bridge, and provides a natural channel bottom to promote the passage of aquatic organisms.

SUMMARY

Hydraulic Summary	Units	Existing Structure	Proposed Structure
		Avg. 12' Span Bridge	40' span
No Tailwater Condition (Normal Pool Elevation on Kennebec River is 247.6 ft)			
Total Area of Waterway Opening	ft^2	82.0	160.0
Headwater elevation @ $Q_{1.1}$	ft	247.6	247.6
Headwater elevation @ Q_{10}	ft	248.1	248.0
Headwater elevation @ Q_{25}	ft	248.4	248.2
Headwater elevation @ Q_{50}	ft	248.6	248.4
Headwater elevation @ Q_{100}	ft	248.9	248.6
Headwater elevation @ Q_{500}	ft	249.7	249.2

Freeboard @ Q_{50}	ft	2.2	4.6
Freeboard @ Q_{100}	ft	1.9	4.4
Outlet velocity @ $Q_{1.1}$	ft/s	1.0	0.8
Outlet velocity @ Q_{10}	ft/s	3.9	3.0
Outlet velocity @ Q_{25}	ft/s	4.9	3.8
Outlet velocity @ Q_{50}	ft/s	5.6	4.3
Outlet velocity @ Q_{100}	ft/s	6.3	4.9
Outlet velocity @ Q_{500}	ft/s	7.7	6.0
Tailwater Condition (Coincidental Peak Analysis with Kennebec River)			
Headwater elevation @ $Q_{50\ (Q5\ TW)}$	ft	255.9	255.7
Tailwater elevation $_{(Kennebec)}$	ft	255.7	255.7
Freeboard @ $Q_{50\ (Q5\ TW)}$	ft	-5.1	-2.7

Low Chord Elevation	ft	250.8	253.0

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Note: All elevations based on North American Vertical Datum (NAVD) of 1988. Peak flow and elevation data from the flood of record along Gilman Brook was not available. Due to the proximity of the bridge to the Kennebec River (tailwater impacts), CHA also modeled the water surface elevations assuming coincidental peak guidance. Assuming a tailwater condition from the Kennebec River, the existing and proposed bridges are overtopped during flood events greater than the 5-yr event.