HYDROLOGY REPORT

Sabattus River Bridge Carries Route 126 over Sabattus River in the town of Sabattus, Maine. A hydrology report for Sabattus River watershed was developed. Peak flow estimates were provided by the Environmental Office and calculated using the 2021 United States Geological Survey Agency (USGS) full regression equation (see Appendix C). The summary of the site hydrology is in the table below.

SUMMARY		
Drainage Area	33.77	mi^2
Q1.1	345	ft^3/s
Q10	1155	ft^3/s
Q25	1435	ft^3/s
Q50	1660	ft^3/s
Q100	1880	ft^3/s
Q500	2440	ft^3/s

Reported by: Erin Brewer
Date: January 20, 2024

Note: All elevations based on North American Vertical Datum (NAVD) of 1988.

See Appendix C for the Hydraulic Report.

HYDRAULIC REPORT

The following is a report of the hydraulic analysis of the existing bridge and proposed bridge on Route 126 over Sabattus River in Sabattus, Maine.

INTRODUCTION

Sabattus River Bridge carries Route 126 over the Sabattus River. The existing bridge is a single-span steel girder structure. The span is 65 feet with no skew. The low chord of the existing structure is at approximately 201.21 feet. The existing bridge has a hydraulic opening of approximately 376 square feet.

The proposed structure is a 72 foot single span NEXT beam superstructure with integral abutments on h-piles founded on bedrock. The new bridge will provide the span to achieve 1.2 bankfull width (BFW) at Q1.1 flow. The low chord of the proposed structure is approximately 204.07 feet. The proposed structure offers approximately 537 square feet of hydraulic opening.

EXISTING DATA REVIEW

The existing site was reviewed for data that can be used in calibrating the model. Water elevation data for the Sabattus River was found in the Androscoggin County Flood Insurance Study (FIS) and in the 2010 Scour Assessment Report.

Sabattus River originates at the outlet of Sabattus Pond and flows southerly to the Androscoggin River in Lisbon. Six dams are located on the Sabattus River, including one approximately 800 feet upstream of the bridge. All of the dams but the one at the outlet of Sabattus Pond, have been or will be removed within the next 5 years. This includes the Fortier Dam, the one closest to the bridge. No USGS stream gages are located on the river.

The FIS has a longitudinal profile of the Sabattus River which shows the location of the bridge labeled as "Sabattus Road State Route 126." This longitudinal profile shows two cross sections taken, one upstream (Cross Section "AM") and one downstream (Cross Section "AL") of the bridge. The cross section labeled as "AL" is located 40 feet downstream of the bridge. A water surface elevation at cross section "AL" of 204.8 feet during Q100 flow is provided in the FIS Report.

Figure 1. Locations of dams near Sabattus River Bridge

The 2010 Scour Assessment Report included flooding and water elevation data. The Maine State Planning Office reported flooding in the Androscoggin Watershed in March 1953, December 1969, April 1987, September 1999, and December 2003. There was also flooding in the Androscoggin watershed during a more recent storm in December 2023. The Scour Assessment Report found that the low chord of the existing bridge is impacted by water beginning at Q10 flow.

HYDRAULIC ANALYSIS

Hydraulic calculations for the existing and proposed conditions along Sabattus River were performed using the U.S. Army Corps of Engineers' HEC-RAS program, version 5.0.7. HEC-RAS supports one-dimensional, steady flow, water surface profile calculations. The existing bridge and the new bridge options were analyzed. Cross-sections were taken from survey data gathered for this project and LiDAR data.

The downstream boundary condition was set as the downstream slope. This was originally approximated to be 0.0005 using the Sabattus River longitudinal profile shown in the FIS. The river is very flat downstream of the bridge and while performing a slope sensitivity analysis, the model was shown to be sensitive to the change in slope. Since the model is sensitive to the

slope, the Q100 flow water surface elevation was compared to the Q100 flow elevation provided in the FIS. In the FIS, there is a cross section with a Q100 flow of 204.8 feet. This cross section is located approximately 40 feet downstream of the bridge. In the HEC-RAS model the cross section immediately downstream of the bridge, located at River Station 1491, is approximately 30 feet downstream of the bridge. Table 1 below shows the water surface elevations at these downstream stations that can be compared to the FIS. When the downstream slope is 0.0001, the water surface is between 204.82 and 204.76 feet of elevation when it is expected to be 204.8 feet. Reviewing the location in the model where Upstream FIS Cross Section "AM" would show up shows that the elevation in the model is near the one provided at "AM." Therefore the 0.0001 downstream slope was the slope chosen to use in the hydraulic model.

DS Slope	DS Elevation (ft) at the bridge	Water Surface Elevation (ft) at River Station 1491	Water Surface Elevation (ft) at River Station 1348
0.000095	204.82	204.93	204.87
0.0001	204.72	204.82	204.76
0.00015	203.96	204.05	203.97
0.00045	202.41	202.42	202.25
0.0005	202.30	202.31	202.13
0.00055	202.21	202.21	202.02

Table 1. Downstream slope sensitivity analysis at Q100 flow

The 2010 Scour Assessment Report for the bridge states that the low chord of the bridge will not be impacted by Q1.1 storms but will be impacted by Q10 storm flows. The bottom chord elevation of the existing bridge is at approximately Elevation 201.21. For the Q1.1 flow the water surface elevation is 199.60 feet, below the low chord of the existing bridge. For the Q10 flow, the water surface elevation in the HEC-RAS model was found to be 202.84 feet. The Scour Assessment Report supports the validity of the HEC-RAS model.

The HEC-RAS models were run assuming subcritical flow. The models included approximately 2320 ft of the Sabattus River, with approximately 784 feet upstream and 1505 feet downstream of the bridge. There is a dam located approximately 800 feet upstream of the bridge, which is why the upstream extent of the hydraulic model stops short of 20*BFW from the bridge. At the station closest to the dam, the Froude number is 1.01 at Q1.1 flow. Therefore, a mixed flow regime was used in the model. This is the only flow that creates a Froude number greater than 1 on this model. This indicates that flow is critical at this location before it transitions to a subcritical flow. The slope of the river at this station is much steeper than the rest of the reach, where it makes sense to have critical flow.

Manning's n was determined using guidance from the *Hydraulic Design of Safe Bridges*; Table 3.1 included the Values for the Computation of the Manning Roughness Coefficient Using Equation 3.43 (after Chow 1959). Manning's n was determined to be 0.035 in the channel and 0.063 in the overbank using Equation 3.43. Ineffective flow areas were set upstream and

downstream of the bridge based on contraction and expansion from the bridge in the model. The contraction rate (CR) was determined to be 1.4 using Table 5.2 from *Hydraulic Design of Safe Bridges.* The expansion rate (ER) was assumed to be 1.8 based off Table 5.1 in the *Hydraulic Design of Safe Bridges*.

The analysis found that the proposed bridge is not overtopped by any storm event. Previous inspection reports state that there is a slight chance of overtopping the existing bridge, with an 11 to 100 year storm event able to overtop the bridge. The BDG states that for a riverine bridge, a freeboard depth of 2 feet minimum for Q50 flow is recommended on smaller streams where there has been no history of ice jams. The analysis found that the existing bridge has a freeboard of -3 feet at Q50. Increasing the span of the bridge did not increase the freeboard by a significant amount. Therefore, to significantly improve the freeboard the existing profile would need to be raised. The bridge would need to be raised approximately 5 feet to get the desired 2 feet of freeboard at Q50. A vertical curve raise of this height would create undesirable impacts at existing driveways and when toeing in the slope. The proposed bridge raised the road approximately 3 feet to achieve approximately 0 feet of freeboard at the Q50 flow. This improves the hydraulics at this bridge significantly.

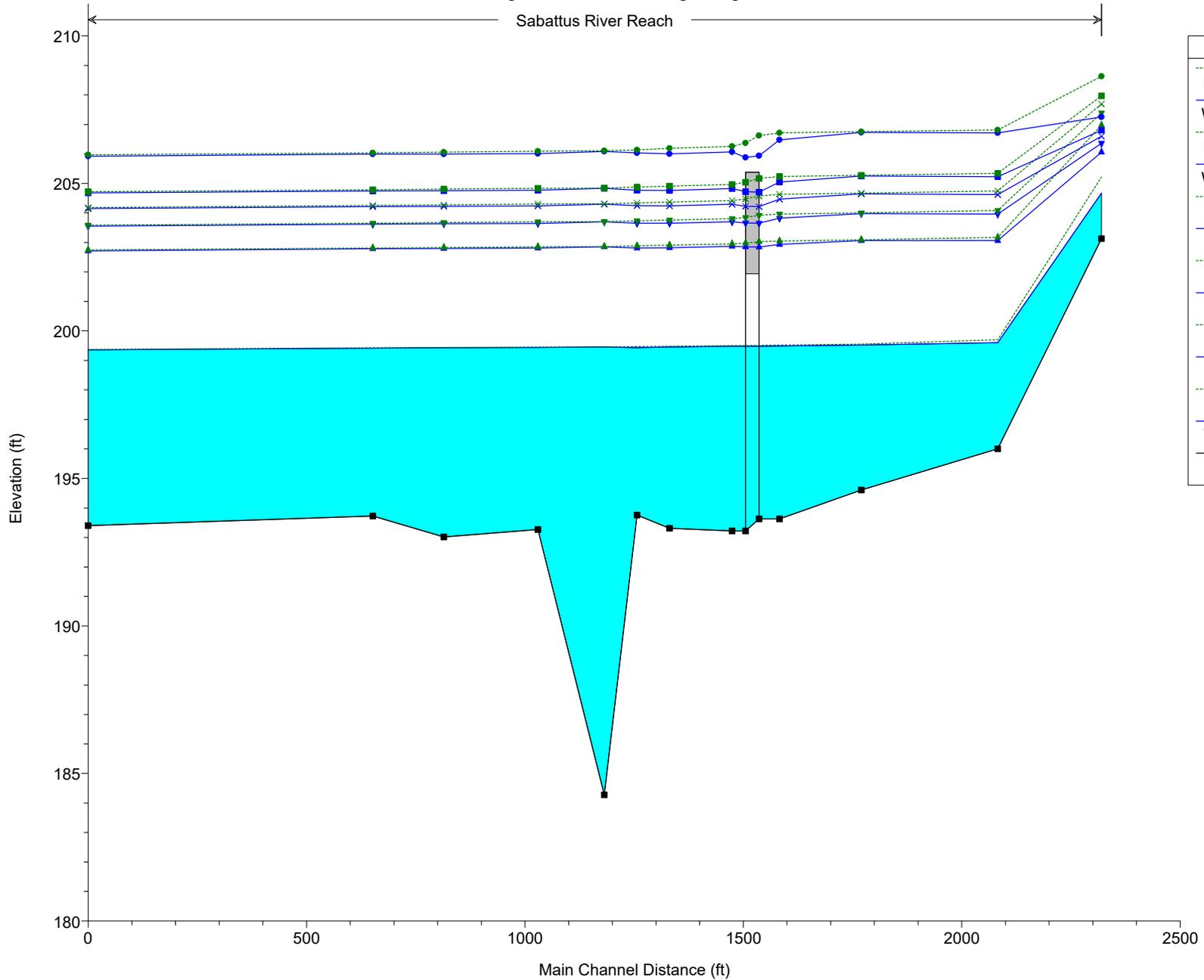|		Existing Structure Single Span Steel Girder	Recommended Structure 72' Single Span NEXT Beam
Total Area of Waterway Opening	ft^2	375.53	536.80
Headwater elevation @ $Q_{1.1}$	ft	199.48	199.60
Headwater elevation @ Q_{10}	ft	202.84	202.94
Headwater elevation @ Q_{25}	ft	203.65	203.77
Headwater elevation @ Q_{50}	ft	204.21	204.36
Headwater elevation @ Q_{100}	ft	204.7	204.89
Headwater elevation @ Q_{500}	ft	205.94	206.08
Freeboard @ Q_{50}	ft	-3.00	-0.29
Freeboard @ Q_{100}	ft	-3.49	-0.82
Outlet Velocity @ $Q_{1.1}$	ft/s	1.21	1.59
Outlet Velocity @ Q_{10}	ft/s	2.82	2.78
Outlet Velocity @ Q_{25}	ft/s	3.51	3.07
Outlet Velocity @ Q_{50}	ft/s	4.06	3.31
Outlet Velocity @ Q_{100}	ft/s	4.59	3.71
Outlet Velocity @ Q_{500}	ft/s	5.64	4.82

Table 2. Hydraulic analysis summary

Note: All elevations based on North American Vertical Datum (NAVD) of 1988.

HEC-RAS Plan: Exist Flow   River: Sabattus River   Reach: Reach

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Crit W.S.	Frctn Loss	C & E Loss	Top Width	Q Left	Q Channel	Q Right	Vel Chnl
			(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft/s)
Reach	1787.309	Q1.1	199.56	199.52		0.04	0.00	175.69	7.88	320.69	16.43	1.54
Reach	1787.309	Q10	203.09	203.07		0.03	0.01	355.38	274.91	634.33	245.75	1.60
Reach	1787.309	Q25	204.00	203.98		0.03	0.01	361.82	370.49	715.38	349.13	1.61
Reach	1787.309	Q50	204.67	204.65		0.03	0.01	366.14	446.44	780.81	432.75	1.63
Reach	1787.309	Q100	205.27	205.25		0.03	0.02	370.06	520.54	844.86	514.61	1.65
Reach	1787.309	Q500	206.75	206.73		0.03	0.02	380.34	709.79	1002.85	727.36	1.70
Reach	1600.087	Q1.1	199.52	199.49	195.43	0.01	0.00	207.14	4.92	335.81	4.27	1.52
Reach	1600.087	Q10	203.05	202.94	197.27	0.02	0.01	398.92	46.19	1060.98	47.84	2.82
Reach	1600.087	Q25	203.96	203.82	197.74	0.03	0.01	421.47	63.15	1305.70	66.14	3.13
Reach	1600.087	Q50	204.63	204.47	198.12	0.03	0.02	434.22	77.22	1501.41	81.37	3.37
Reach	1600.087	Q100	205.23	205.05	198.49	0.04	0.03	445.57	91.27	1692.13	96.60	3.58
Reach	1600.087	Q500	206.71	206.47	199.22	0.04	0.04	463.18	128.63	2174.06	137.31	4.05
Reach	1525 BR U	Q1.1	199.51	199.48	195.44	0.00	0.00	62.66	4.43	336.60	3.97	1.53
Reach	1525 BR U	Q10	203.02	202.84	197.28	0.03	0.02		37.03	1089.03	28.94	3.45
Reach	1525 BR U	Q25	203.92	203.65	197.76	0.05	0.03		46.01	1353.03	35.96	4.29
Reach	1525 BR U	Q50	204.58	204.21	198.13	0.07	0.03		53.23	1565.18	41.59	4.97
Reach	1525 BR U	Q100	205.17	204.70	198.48	0.09	0.04		60.28	1772.61	47.11	5.62
Reach	1525 BR U	Q500	206.62	205.94	199.21	0.19	0.06	213.78	162.95	2205.42	71.63	6.81
Reach	1525 BR D	Q1.1	199.51	199.48	195.37	0.00	0.00	62.66	5.56	339.44		1.21
Reach	1525 BR D	Q10	202.97	202.85	196.88	0.01	0.01		30.29	1124.71		2.82
Reach	1525 BR D	Q25	203.85	203.66	197.26	0.01	0.02		37.64	1397.36		3.51
Reach	1525 BR D	Q50	204.47	204.22	197.53	0.02	0.04		43.54	1616.46		4.06
Reach	1525 BR D	Q100	205.04	204.72	197.79	0.02	0.05		49.31	1830.69		4.59
Reach	1525 BR D	Q500	206.37	205.88	198.38	0.02	0.09	219.07	131.50	2308.50		5.64
Reach	1491.375	Q1.1	199.50	199.48		0.02	0.00	266.74	6.90	338.10		1.20
Reach	1491.375	Q10	202.95	202.86		0.04	0.00	354.43	37.53	1117.47		2.36
Reach	1491.375	Q25	203.81	203.70		0.05	0.00	393.31	49.24	1385.76		2.66
Reach	1491.375	Q50	204.42	204.30		0.05	0.00	424.93	58.82	1601.18		2.89
Reach	1491.375	Q100	204.97	204.82		0.06	0.00	450.82	68.30	1811.70		3.10
Reach	1491.375	Q500	206.26	206.06		0.07	0.00	505.40	93.05	2346.95		3.58
Reach	1348.516	Q1.1	199.48	199.46		0.01	0.00	68.15	1.62	341.40	1.97	1.34
Reach	1348.516	Q10	202.91	202.82		0.02	0.01	85.84	34.00	1090.88	30.12	2.50
Reach	1348.516	Q25	203.76	203.65		0.02	0.01	91.83	48.02	1342.10	44.87	2.78
Reach	1348.516	Q50	204.37	204.24		0.02	0.01	100.71	57.19	1544.77	58.04	3.00
Reach	1348.516	Q100	204.91	204.76		0.02	0.01	109.37	69.90	1738.31	71.79	3.20
Reach	1348.516	Q500	206.19	206.00		0.03	0.03	131.23	122.14	2214.70	103.16	3.63

Sabattus River Bridge   Plan: Existing Bridge Flow Data   3/26/2024
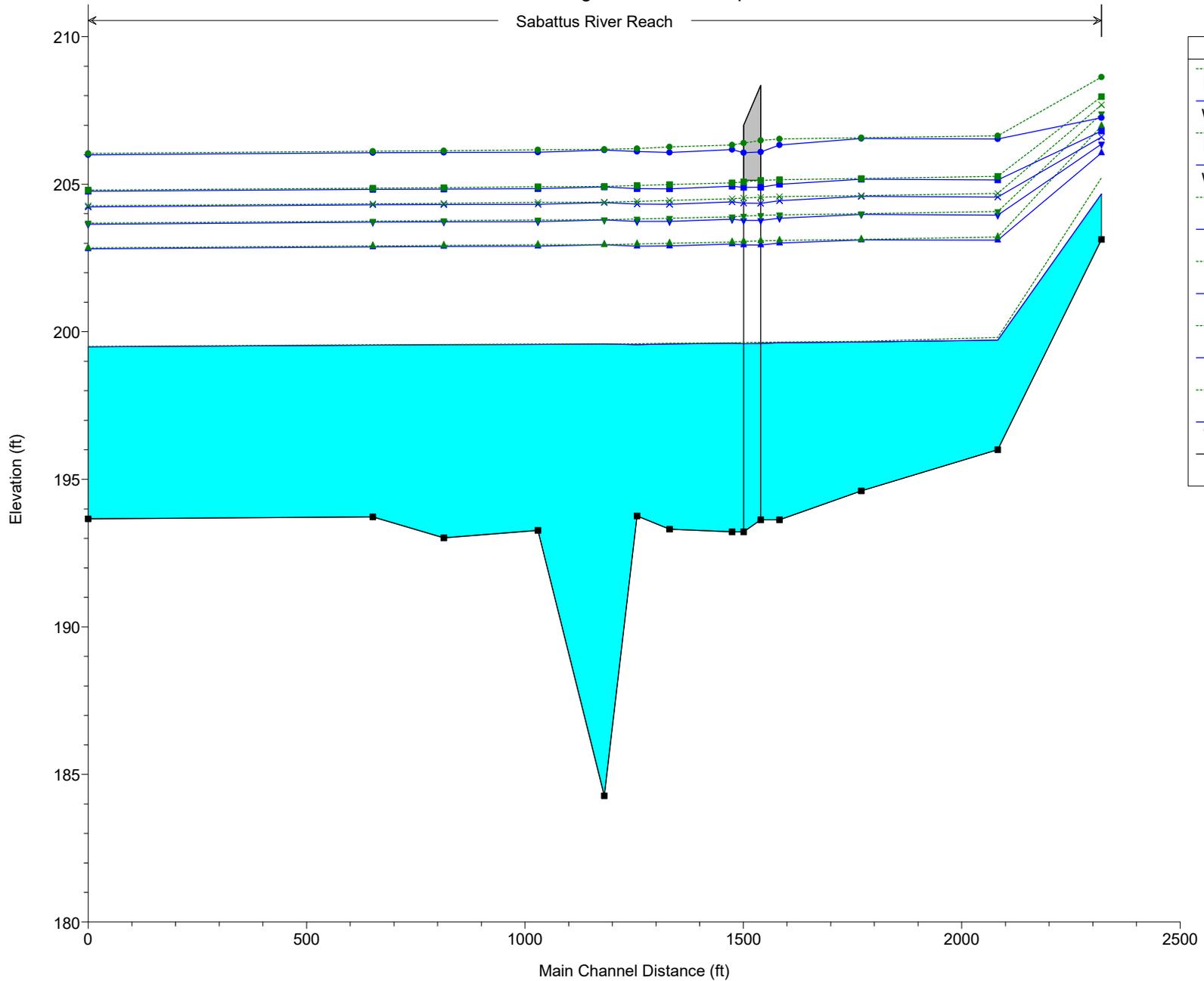
HEC-RAS Plan: 72 River: Sabattus River Reach: Reach

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Crit W.S.	Frctn Loss	C & E Loss	Top Width	Q Left	Q Channel	Q Right	Vel Chnl
			(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft/s)
Reach	1787.309	Q1.1	199.68	199.65		0.03	0.00	190.82	10.43	316.77	17.80	1.48
Reach	1787.309	Q10	203.13	203.11		0.03	0.01	355.68	276.22	631.09	247.69	1.59
Reach	1787.309	Q25	204.00	203.98		0.03	0.01	361.79	370.37	715.69	348.94	1.61
Reach	1787.309	Q50	204.61	204.59		0.03	0.01	365.79	445.11	784.30	430.59	1.65
Reach	1787.309	Q100	205.19	205.17		0.03	0.01	369.53	518.67	849.82	511.51	1.68
Reach	1787.309	Q500	206.57	206.55		0.03	0.02	379.00	706.40	1012.45	721.14	1.74
Reach	1600.087	Q1.1	199.65	199.62	195.22	0.01	0.00	222.61	14.19	319.43	11.38	1.39
Reach	1600.087	Q10	203.10	203.00	196.83	0.01	0.00	400.86	94.78	977.84	82.38	2.67
Reach	1600.087	Q25	203.96	203.84	197.29	0.01	0.01	421.91	126.63	1197.57	110.80	2.99
Reach	1600.087	Q50	204.58	204.44	197.62	0.01	0.01	433.68	152.77	1373.06	134.17	3.23
Reach	1600.087	Q100	205.15	205.00	197.86	0.02	0.01	444.86	179.01	1543.30	157.68	3.45
Reach	1600.087	Q500	206.53	206.33	198.93	0.03	0.02	461.64	248.11	1972.13	219.76	3.94
Reach	1525 BR U	Q1.1	199.64	199.60	195.38	0.01	0.00	47.98	1.19	342.52	1.29	1.61
Reach	1525 BR U	Q10	203.08	202.94	197.26	0.01	0.01	69.00	35.31	1082.71	36.98	3.12
Reach	1525 BR U	Q25	203.95	203.77	197.74	0.01	0.01	69.00	54.40	1325.72	54.88	3.48
Reach	1525 BR U	Q50	204.56	204.35	198.09	0.02	0.01	68.56	70.55	1527.21	62.24	3.78
Reach	1525 BR U	Q100	205.13	204.90	198.43	0.04	0.01	19.76	130.54	1677.80	71.66	4.00
Reach	1525 BR U	Q500	206.49	206.09	199.22	0.07	0.02		127.19	2214.48	98.34	5.28
Reach	1525 BR D	Q1.1	199.64	199.60	195.51	0.00	0.01	47.96		345.00		1.59
Reach	1525 BR D	Q10	203.06	202.94	197.37	0.01	0.01	69.00	13.66	1140.19	1.15	2.79
Reach	1525 BR D	Q25	203.92	203.78	197.86	0.01	0.02	69.00	22.60	1410.53	1.86	3.08
Reach	1525 BR D	Q50	204.53	204.36	198.23	0.01	0.02	67.57	29.96	1628.47	1.57	3.31
Reach	1525 BR D	Q100	205.08	204.89	198.57	0.01	0.02	20.93	55.64	1821.97	2.39	3.57
Reach	1525 BR D	Q500	206.40	206.07	199.37	0.01	0.05		57.84	2378.83	3.33	4.66
Reach	1491.375	Q1.1	199.63	199.61		0.02	0.00	274.32	12.95	328.42	3.62	1.12
Reach	1491.375	Q10	203.04	202.97		0.04	0.00	360.66	65.78	1070.69	18.53	2.18
Reach	1491.375	Q25	203.90	203.81		0.05	0.00	398.28	85.76	1325.06	24.18	2.46
Reach	1491.375	Q50	204.50	204.40		0.05	0.00	430.14	102.04	1529.18	28.78	2.67
Reach	1491.375	Q100	205.05	204.93		0.06	0.00	455.90	118.15	1728.52	33.34	2.86
Reach	1491.375	Q500	206.33	206.17		0.07	0.00	509.27	160.07	2234.74	45.19	3.30
Reach	1348.516	Q1.1	199.61	199.58		0.01	0.00	68.90	1.86	340.92	2.22	1.30
Reach	1348.516	Q10	203.00	202.91		0.02	0.01	86.24	34.85	1089.37	30.78	2.46
Reach	1348.516	Q25	203.85	203.74		0.02	0.01	93.07	48.07	1341.25	45.69	2.75
Reach	1348.516	Q50	204.45	204.32		0.02	0.01	102.07	57.68	1543.43	58.89	2.97
Reach	1348.516	Q100	204.99	204.84		0.02	0.01	110.70	70.99	1736.31	72.70	3.17
Reach	1348.516	Q500	206.26	206.08		0.03	0.02	132.41	123.97	2211.10	104.92	3.60

Sabattus River Bridge   Plan: 72' Span   3/18/2024

Plan View – Hydraulic Model Cross Section Locations

Sabattus River Dams

Little Sabattus Pond

Sabattus Pond

Sabattus River Bridge

No Name Pond

Auburn

Lewiston

Little Androscoggin River

Loon Pond

Sutherland Pond

Androscoggin River

Sabattus River

Little River

Worumbo

Pejepscot

Brunswick
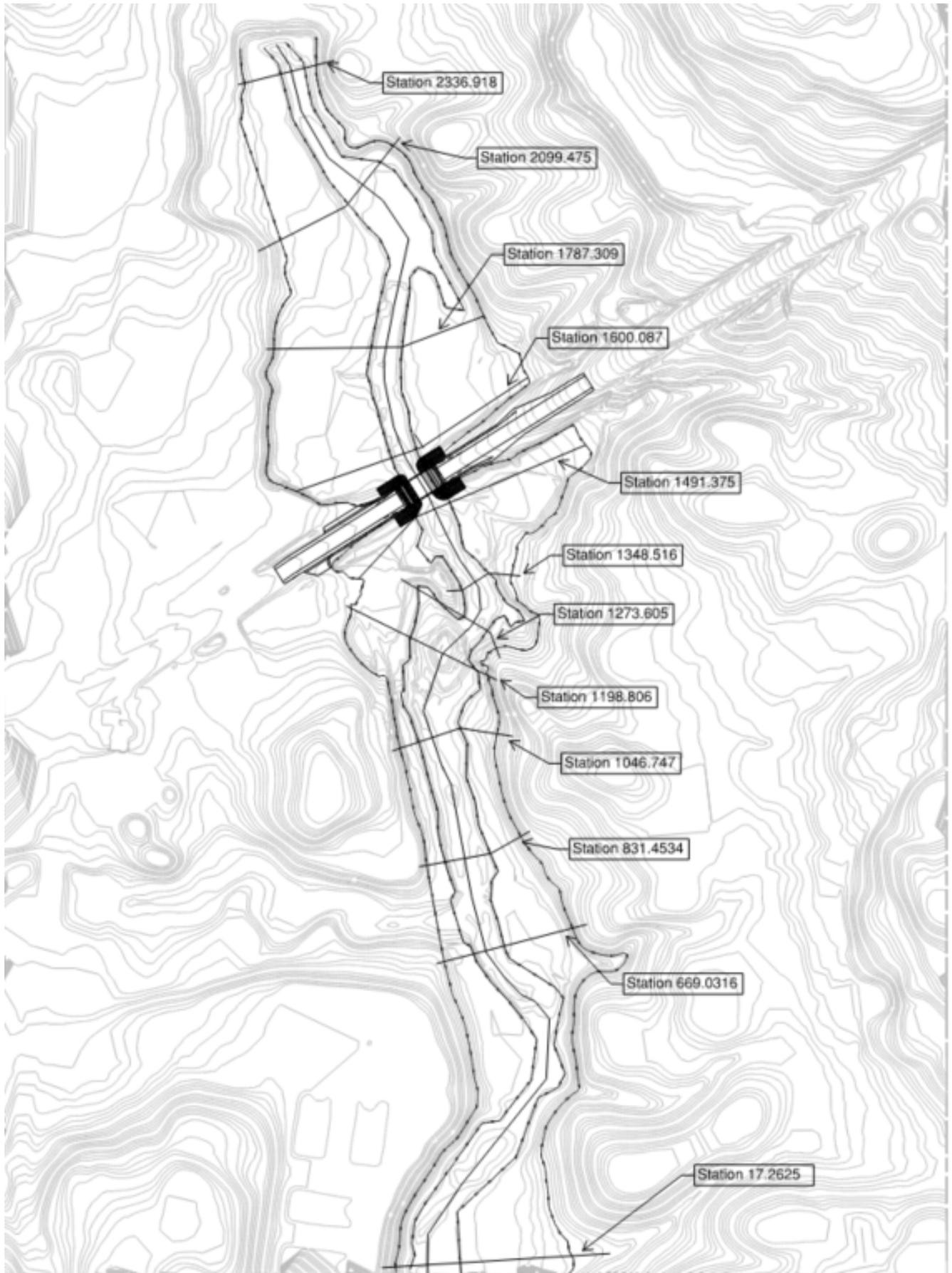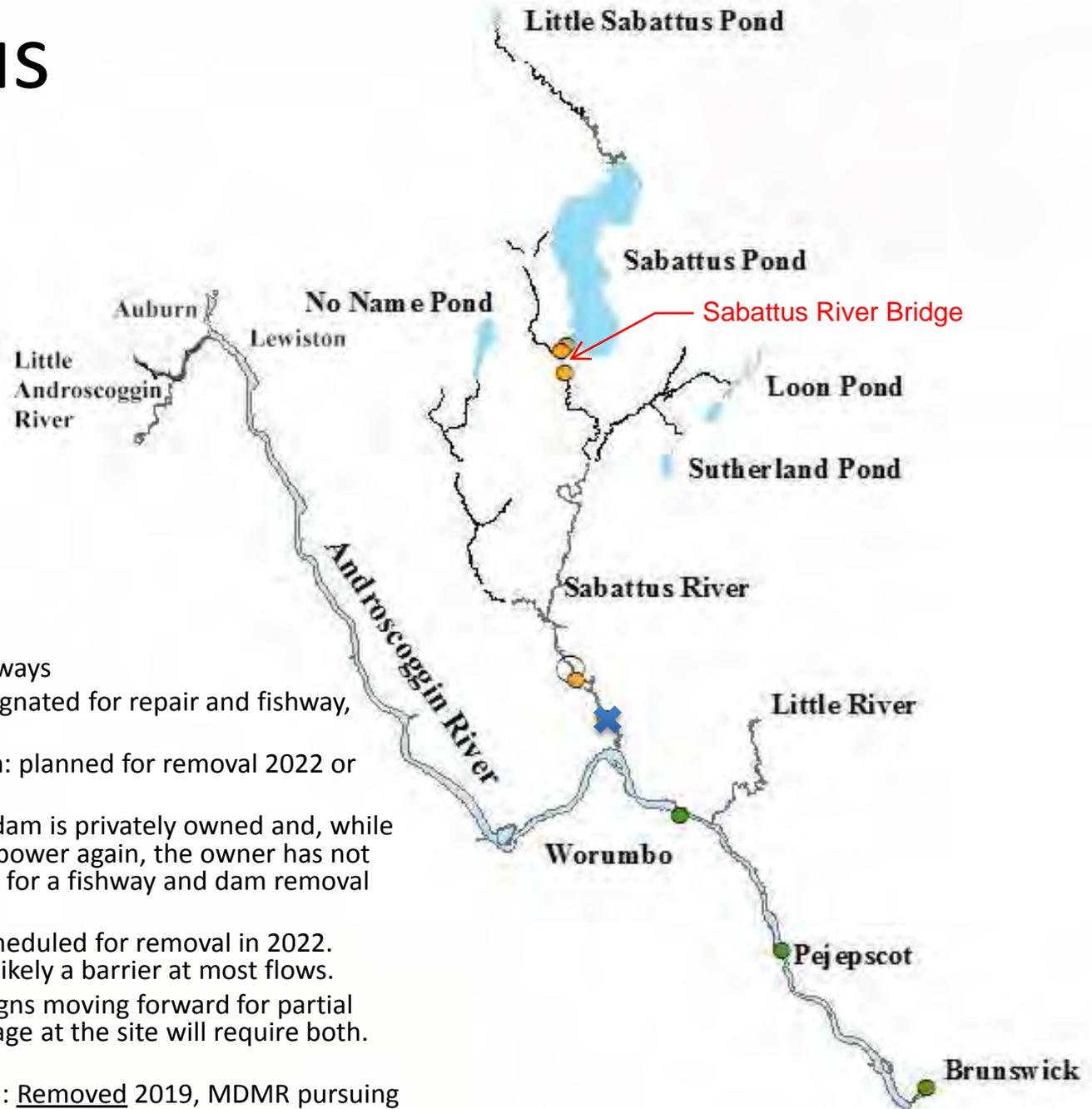
Dams (north to south)

🟠 Non-hydro without fishways

D1080 – Sleeper Dam: Designated for repair and fishway, designs moving forward

D1032 – Mill Remnant Dam: planned for removal 2022 or 2023

D1081 – Fortier Dam: The dam is privately owned and, while not likely to ever generate power again, the owner has not agreed to removal. Designs for a fishway and dam removal are both moving forward.

⚪ D1082 – Upper Dam: scheduled for removal in 2022. Breached in 2012, but still likely a barrier at most flows.

D1083 – Farwell Dam: Designs moving forward for partial removal and fishway. Passage at the site will require both. Scheduled for 2023.

✖ D1085 – Mill Street Dam: Removed 2019, MDMR pursuing designs for fish passage due to extensive alteration of site