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March 26, 2020

Ms. Kimberly Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, DC 20426

RE: 2019 Brunswick Project Fishway Report (FERC No. 2284) Article 30

Dear Secretary:

Brookfield White Pine Hydro LLC (BWPH) submits the attached annual fishway report in accordance with the Article 30 of the Brunswick Project FERC License. The attached fishway report was prepared by the Maine Department of Marine Resources (MDMR) and presents fishway activities and operations at the Brunswick fishway during the 2019 fish migration season.

If you have any questions regarding this filing, please contact Matthew LeBlanc at (207)-252-4870 or at Matthew.LebLANC@Brookfieldrenewable.com.

Sincerely,

Matthew LeBlanc for:

Kelly Maloney
Manager, Licensing and compliance

Attachment

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BWPH File (2284/1)

**State of Maine
Department of Marine Resources**

**2019 Report on the Operation of the
Brunswick Fishway FERC #2284**



Maine Department of Marine Resources
Bureau of Sea-Run Fisheries and Habitat
#172 State House Station
Augusta, ME 04333-0021

March 2020

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Figure 1. The Brunswick-Topsham Hydropower Station located in Brunswick, Maine. The fishway is located on river right just below the powerhouse. The tailrace is also on river right, separated from the larger portion of the spillway and tainter gates, by a retaining wall and Shad Island located just upstream of the route 201 bridge.

INTRODUCTION

The Androscoggin River is Maine's third largest river and drains an area of approximately 8,996 square kilometers. Historically, the Androscoggin provided access to an extensive and diverse aquatic habitat for large numbers of diadromous and resident fish species. For most species, the natural upstream migration barrier on the main stem of the Androscoggin River occurs at Lewiston Falls, 35.2 river kilometers (rkm) above tidewater. Although this site is an impassable barrier for most species, sea-run

Atlantic salmon and American eel can ascend the falls and could historically move upstream to Rumford, 128 rkm above tidewater. According to Atkins (1887) Rumford Falls is an impassable barrier to migrating salmon and excluded them from New Hampshire waters of the Androscoggin River.

River herring reproduce in lake, pond, and riverine habitats throughout the Androscoggin and Little Androscoggin River watersheds below Lewiston Falls, while American shad prefer the riverine habitat of these watersheds. Fishermen caught Atlantic salmon, which could ascend the earliest built low head dams at Brunswick, in Lewiston as late as 1815. However, a dam built at head-of-tide at Brunswick in 1807 excluded river herring and American shad from the non-tidal sections of the Androscoggin River.

The Little Androscoggin River, which enters the main stem Androscoggin on the west bank just below Lewiston Falls, supported large runs of diadromous fish. Sea-run fish ascended this major tributary to Biscoe Falls, 56 rkm above the river's confluence with the main stem Androscoggin. By the early 1930s, the construction of dams without fish passage capabilities, in combination with severely polluted waters, virtually eliminated all opportunity for fish to live and reproduce in the main stem and most of its tributaries. Since the early 1970s, substantial improvement in water quality and the provision of fishways at some of the dams have greatly enhanced the prospects for successful fish restoration within the lower Androscoggin River. The Little Androscoggin River still holds the majority of the unrealized potential for alosine restoration in the watershed.

In 1982, Central Maine Power Company (CMP) reconstructed a hydroelectric facility in Brunswick-Topsham, located at the first upstream dam on the river. During reconstruction, CMP built a vertical slot fishway with a trapping and sorting facility and a downstream passage capable of passing some anadromous and resident fish species (Figure 1). It was at this time that the Maine Department of Marine Resources (MDMR) began the Anadromous Fish Restoration Program in the lower Androscoggin River Watershed. American shad and alewives were the target species for spawning and nursery habitat in the lower main stem and tributaries below Lewiston Falls. In 1987, the Pejepscot Hydropower Project, the second dam on the Androscoggin River, provided upstream and downstream passage. Worumbo installed upstream and downstream passage in 1988 at the Worumbo Project, the third upstream dam on the river. This provided an opportunity for anadromous species to migrate upstream to Lewiston Falls.

The MDMR provides an annual report on the operation of the Brunswick fishway to enhance its cooperative partnership with Brookfield White Pine Hydro LLC (BWPH) in the operation of the fishway and to assist the company toward meeting its FERC reporting requirements. MDMR staff prepared this report based on biological data, records, and daily logs that fishway staff record and maintain while stationed at the fishway. This includes information regarding daily inspections, fishway cleaning, fishway condition, fisheries data collection, and operational activities throughout the season, typically, May through October. BWPH acquired all the NextEra Energy Maine Operating Services hydro assets in 2014 including the Brunswick Project. The operation of the Brunswick fishway is one tool MDMR utilizes to implement the fisheries restoration program for the Androscoggin River. The goal and objectives of this program, along with any additional information not specifically associated with the actual operation of the fishway, are included in this report as a courtesy to provide FERC and BWPH with a broader perspective of the purpose, role, and usefulness of the fishway in the MDMR program. Several legal authorities and state and federal plans that guide state restoration programs include:

Legal Authorities:

Fish and Wildlife Coordination Act
Federal Power Act
Fish and Wildlife Act of 1956
Federal Aid in Fish Restoration Act (Dingell-Johnson Act)
Anadromous Fish Conservation Act
Title 12 M.R.S.A. §6021, §6022, §6051, §6052, §7701, §7702
Tille 38 M.R.S.A. §630-636

Guidance Documents :

Fishery Management Report No. 35 of the Atlantic States Marine Fisheries Commission - Amendment 1 to the Interstate Fishery Management Plan for Shad and River Herring, April 1999.

Atlantic States Marine Fisheries Commission - Amendment 2 to the Interstate Fishery Management Plan for Shad and River Herring, May 2009.

Atlantic States Marine Fisheries Commission - Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring, February 2010.

Maine Department of Marine Resources: State of Maine Recovery Plan for American Shad (*Alosa sapidissima*) and River Herring (*Alosa pseudoharengus* and *Alosa aestivalis*) for Amendment 1 to the Interstate Fishery Management Plan for Shad and River Herring, May 1999.

Maine Department of Marine Resources: American Shad Management Plan.

State of Maine Statewide River Fisheries Management Plan, 1982.

State of Maine Anadromous Alewife Restoration Program – A Report to the Joint Standing Committee on Inland Fisheries and Wildlife. Prepared by the Maine Department of Inland Fisheries and Wildlife and Maine Department of Marine Resources. February 1998.

BRUNSWICK FISHWAY MAINTENANCE AND OPERATION 2019

Personnel from the MDMR met with representatives of BWPH to review operations, safety procedures, problems occurring with the fishway and maintenance issues that remained from the fall of the 2018 season that required resolution prior to the startup of the fishway in April 2019.

Prior to the 2019 season, BWPH employees serviced the following items:

- 1) Cleared all fishway pools of debris
- 2) Replaced sections of grating in the fishway
- 3) Adjusted hoist limits for the two isolation gates
- 4) Replaced the existing storage shed
- 5) Cleaned attraction water intake grating & inspected blowback piping system

Prior to opening the fishway for the season, BWPH employees drained the lower section of the fishway to inspect and clear debris from the diffusion grating. The diffusion chamber grates and baffles were in good condition and did not need to be replaced.

In addition, BWPH supplied a 100-pound oxygen tank to provide oxygen to two overhead fish distribution tanks. This system allows fishway staff to increase the number of alewives held in the overhead tanks prior to distribution. Fishway staff used supplemental oxygen to aerate the water when Atlantic salmon occupied the overhead tanks.

Fishway Closures

There were few unexpected fishway closures at the Brunswick fishway during the 2019 fish passage season other than the late start due to high water. The river flows at the Brunswick fishway are often too high to open the fishway prior to the first week of May. Large woody debris can cause issues with the entrance weir gate or overtop the fishway and accumulate in the fishway pools during the early spring and late fall (Figures 4&5). Moderately high river flows occurred during early May and water temperatures were colder than normally observed during this time of year. Fortunately flows remained within acceptable levels to continually operate the fishway during the upstream migration of anadromous fish. Environmental conditions throughout most of the passage season precluded the flood conditions that often require the fishway to shut down during the spring. Typical high flow conditions during the fall did not occur until November 4, well after the fishway closed for the season.

- 1) Fishway opened on May 8, 2019
- 2) The fishway shut down from August 13 through August 23 for routine seasonal maintenance
- 3) Closed November 3 for the year due to high water

During the seasonal shutdown, BWPH employees serviced the following items:

- 1) Cleaned fish attraction grating
- 2) Washed viewing and counting windows
- 3) Provided and installed covers for overhead holding tanks
- 4) Removed debris from parking area
- 5) Installed employee parking signs for maintenance and stocking operations

RECOMMENDATIONS

1) Address the accumulation of debris on the fishway exit grate especially at all headpond levels so that fishway operations are not compromised. In the past, BWPH deployed a trash boom to prevent debris from entering the fishway and reduce clogging of the Fishway Attraction Water Gate. In 2011 and 2012, a new floating trash/fish boom was thoroughly evaluated using state of the art computer modeling techniques. Modeling proved that a floating/fish screen would not be cost effective and at this time, there are no plans to install one. Alternatively, a low water alarm was installed to warn on low water periods in the fishway to due to debris buildup. The alarm sounded so often that BWPH requested that the attraction water to the fishway tuned off to prevent the alarm and subsequent call out of BWPH staff. The fishway attraction water provides the attraction to the fishway entrance and needs to operate in order for the fishway to operate appropriately. Disabling and shutting off the attraction water to the fishway prevents fish from finding the fishway entrance and passing upstream in a safe and timely

manner. Due to the age and disrepair internal sections of the fishway grating even moderate amounts of debris were damaging the grating. The BWPH response was to open the fishway to free passage for all fish species, including invasive species, which jeopardizes the existing restoration program.

We recommend removing the alarm and keeping the racks clear enough to allow water flow through the fishway as designed.

2) We recommend an appropriate shutdown period during August for maintenance inspection of the fishway and time to make repairs as necessary to maintain the function of the fishway. The duration of the shutdown should be as long as necessary to make the required repairs while water temperature makes it unsafe to sample Atlantic salmon. The aging fishway and infrastructure requires a mid-season inspection to proactively address issues that may prevent closing the upstream fish passage during the operational window for this facility.

FISH PASSAGE

The fishway officially opened for its 37th consecutive season May 8, 2019. Personnel from the MDMR began staffing the fishway on May 8, 2019. BWPH personnel staffed the fishway from August 1 until the fishway closed for the season on November 3. The fish passage season was noteworthy for a couple of reasons; the returning numbers of American shad and the numbers of white catfish observed in the fishway.

River Herring

The maintenance crew of BWPH opened the Brunswick fishway on May 8, 2019 and MDMR project personnel staffed the fishway beginning the same day. The 81,025 river herring captured in 2019 was well below the record high of 170,040 river herring passed in 2018, and ranks 9th in the time series of river herring numbers passed at the fishway. The total number trapped at the fishway did exceed the 37-year annual average (1983-2019) of 55,935. During the past three years, the timely arrival and adequate number of Androscoggin River adults captured at the Brunswick fishway for transport and release was greater than the amount of

Year	Habitat* (hectares)	Run Size	Total Number Stocked (Androscoggin and Kennebec)	Average Fish / Hectare
2000	1,318	9,551	20,414	15.5
2001	1,846	18,196	23,459	12.7
2002	1,846	104,520	23,290	12.6
2003	1,846	53,732	20,392	11.0
2004	1,846	113,686	20,668	11.2
2005	1,886	25,896	16,867	8.9
2006	1,886	34,239	23,214	12.3
2007	1,886	60,662	23,369	12.4
2008	1,886	92,359	24,684	13.1
2009	1,886	44,725	22,057	11.7
2010	1,886	39,689	11,800	6.3
2011	1,886	54,886	20,907	11.1
2012	1,886	170,191	20,758	11.0
2013	1,886	69,104	21,442	11.4
2014	1,886	55,678	19,402	10.3
2015	1,886	71,887	22,983	12.2
2016	1,886	114,874	22,612	12.0
2017	1,886	49,923	21,360	11.3
2018	1,886	179,040	20,849	11.1
2019	1,886	81,025	20,714	11.0
* Habitat area does not include the Brunswick headpond.				

Table 1. Habitat availability for adult river herring, number captured, and distribution in Androscoggin River watershed lakes and ponds, 2000 – 2019.

upstream spawning and nursery habitat available at the stocking rate of six fish per surface acre of historical habitat. The adult release target for the Androscoggin watershed is 27,358 river herring into 1,846 ha of upstream habitat available for restoration (Figure 2).

A new program focused on the restoration of blueback herring started on the Androscoggin in 2016. For two years blueback herring from Lockwood were transported to the lower Androscoggin River and stocked in the river below Worumbo. The goal is to restore the run of blueback herring above Brunswick. Blueback herring are regularly observed below the fishway but do not ascend the fishway and pass upstream. There is a significant amount of blueback herring spawning habitat above the Brunswick fishway available for colonization.

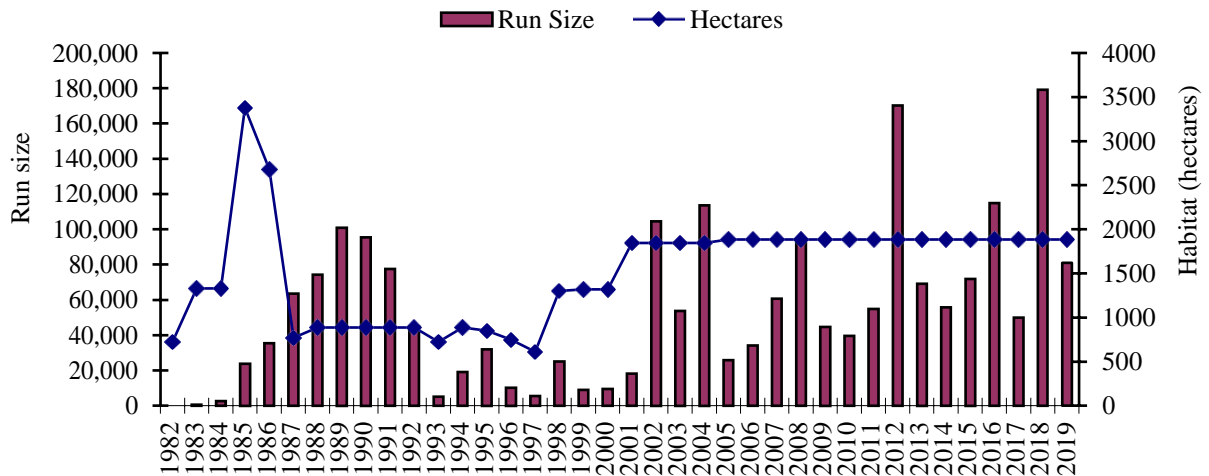


Figure 2. Adult river herring captured vs. habitat availability in the Androscoggin River Watershed, 1982 – 2019.

The first alewife observed in the control room viewing window occurred on May 10, more than three weeks after the fishway was required to be opened. The last river herring passed through the fishway was passed June 20, 2019. The run began at a water temperature of 10.6C and concluded when the water temperature reached 19.6C, with temperatures ranging during the migration period from 8.46C to 19.6C. Of the 81,025 adults that entered the trapping area, fishway staff transported 20,714 upstream to suitable lake or pond habitats. Staff released 44,501 into the Brunswick headpond, sacrificed 200 for biological sampling and counted 3 fishway and transport mortalities. Out-of-basin transfers to stock additional habitats in other watersheds required 15,607 individuals.

Project staff released 65,215 adult river herring into the Androscoggin River watershed, including 20,714 fish into six upstream habitats totaling 1,373 hectares, excluding the mainstems of the Androscoggin and Little Androscoggin rivers. Fishway staff distributed river herring to Sabattus, Little Sabattus, Lower Range, No Name, Marshall and Taylor ponds. These habitats exceeded the target stocking density of 14.83 fish per hectare (six fish per acre). Project staff stocked 28.5 fish per hectare into the Worumbo, Pejepsot, and Brunswick headponds via the Brunswick fishway. Out-of-basin transfers to other watersheds including Washington Pond, Wesserunsett Lake and Pleasant Pond required 12,602 river herring. There were 3,005 additional out of basin transfers trucked from Brunswick to Suncook Lake in New Hampshire by N.H. Fish and Game in 2019.

Downstream Passage

The typical downstream river herring migration occurs during the period of mid-July through October. The Department observed very little downstream river herring migration through September 2019. Fisheries staff did obtain samples of juvenile river herring on August. Fish ranged in length from 93mm to 108mm and weights from 7.7g to 11.4g. The largest number of juvenile fish passed downstream from Sabattus Pond during a 2-day period after they opened the gates to begin the annual lake level drawdown.

Upstream Passage Studies

Maine DMR staff assisted Brookfield and Normandeau staff collect and load alewives tagged at the Brunswick fishway and released upstream. The radio telemetry study project is part of an upstream efficiency study conducted for relicensing the Pejepscot hydropower project upstream of the Brunswick fishway. In June, Brookfield and Normandeau staff angled American shad from below the Brunswick fishway for a similar upstream fish passage efficiency study. Approximately 130 American shad were tagged and released at the canoe portage above the Brunswick fishway. Fishway staff observed dead American shad and at least one radio tagged on the trash rack upstream of the fishway. All radio tags that could be recovered were collected and given back to the contractor.

American Shad

Sixty-three American shad passed upstream at the fishway in 2019 compared to 32 passed in 2018 and 1 shad passed in 2017 (Table 2). Brunswick, there is a correlation between low river flows and passage numbers for years when river flows are below normal. The proportionally higher attraction flow appears to attract shad in greater numbers than years with higher flows and spill over the dam. This observation is not new and was the subject of a BWPH, Bowdoin College, Maine DMR, U.S. Fish and Wildlife Service, and Androscoggin River Alliance agreement in 2010 to investigate factors that may contribute to upstream passage inefficiencies for American shad at the Brunswick fishway.

Department staff are assigned to tend the ladder later into the afternoon and evening to determine if larger numbers of shad were passing during that

Date	Number	Water Temperature (c)	River Flow (cfs)
5-Jun	1	14.9	5,750
8-Jun	1	17.2	7,180
14-Jun	5	17.3	5,150
15-Jun	12	18.5	5,880
18-Jun	1	19.6	4,680
19-Jun	2	19.6	3,850
20-Jun	7	19.6	4,990
21-Jun	3	17.9	7,430
22-Jun	1	18.5	8,820
23-Jun	1	19.5	7,820
27-Jun	1	19.8	6,790
29-Jun	1	21.0	6,400
18-Jul	1	25.1	4,010
2-Jul	1	22.7	5,570
9-Jul	1	23.9	3,290
10-Jul	3	24.4	3,880
11-Jul	6	24.3	3,750
12-Jul	2	23.6	3,540
13-Jul	4	23.4	3,320
14-Jul	4	25.1	3,800
17-Jul	3	24.7	4,350
18-Jul	2	25.1	4,010
Total Number	63		
Mean		21.2	5,193.6
Min / Max	1 / 12	14.9/25.1	3,290/8,820

Table 2. American shad passed upstream at the Brunswick fishway in 2019.

time. Based on observations in 2018 and 2019 very few shad were attempting to ascend the ladder at any point during the day or evening.

American shad passed above Brunswick and into the headpond can migrate as far upstream as Lewiston-Auburn. Fish lifts at the next two upstream dams, Pejepscot and Worumbo respectively, provide passage that allow shad to migrate upstream as far as Lewiston Falls. Automated fish lifts at both Pejepscot and Worumbo, lift once every one to two hours from 8:00 a.m. through 4:00 p.m. daily.

American Shad Observed at the Brunswick Fishway

In 2019, MDMR recorded detailed visual observations from the fishway walk during the shad run (Figure 3). Fishway personnel monitored selected pools for 60-second intervals to standardize observations between individual pools and the river adjacent to the fishway.

Through July, fisheries personnel observed 290 shad in the fishway and 373 in the river immediately adjacent to the fishway. There were no shad observed during the months of May in 2019. A total of 663 shad were observed during all months in 2019 compared to 3,039 observations in



Figure 3. Brunswick fishway; (A) location of river observations, (B) Lower Fishway, (C) Corner Pool, (D) Pool 14, (E) Upper Fishway - Pool 31.

2018. All shad observations at the fishway occurred during June and July (Table 3).

Table 3. American shad observations at the Brunswick fishway in 2019.

Year / Month	Viewing windows	Upper fishway	Lower fishway	Corner pool	Outside fishway	Total Number	Mean Water Temp. (C) ¹
2019 May	0	0	0	0	0	0	-
June	0	0	108	55	62	225	18.1
July	0	0	107	20	311	438	24.8
August	-	-	-	-	-	-	-

¹ Mean water temperature at the time of shad observations.

Visual observations at the fishway provide an index of abundance for shad returning to the vicinity of the fishway but not ascending to the trap. These data, in conjunction with underwater video data collected in past years, and numbers of shad caught in the fish trap, assist in assessing the number of annual returns for the period the fishway has been in operation. In 2019 there were no juvenile American shad captured passing downstream.

Other Fish Species

From May 8 through August 1, 2019, fishway personnel observed 13 species of adult fish and counted 81,979 individual fish passing upstream at the Brunswick fishway (Table 4). The most common species in both May and June was alewife while white sucker was the second most abundant. White suckers arrive at the fishway in April and are the first species to ascend the fishway during their spawning run.

During the year 25 striped bass ascended the fishway and were passed into the headpond. Striped bass were seldom observed at the top of the fishway in years past and were kept from passing upstream when possible. During the past three years striped bass have become common in the fishway and are now passed upstream when captured in the trap. The striped bass passing upstream or observed in the fishway were small, averaging approximately 15 inches. The reason for so many striped bass in the fishway in 2016 through 2019 is unclear. Striped bass are most frequently observed in July and appear more abundant during period when juvenile alewives are passing downstream through the upstream fishway.

Fishway staff did catch 18 white catfish in the trap and observed many more in the fishway downstream of the trap. In past years underwater cameras have recorded their presence at several locations in the fishway, although most do not ascend to the trap at the top of the fishway. Based on the numbers observed over the past 3-year period, it is not clear why some years they migrate to the top of the fishway and some years they do not. There appears to be no obvious connection with flow or water temperatures.

Recreational anglers report catching increased numbers over the past several years with several large white catfish reported, an indication that this new species is thriving in Maine.

Fish Species	Species Total
American Eel (<i>Anguilla rostrata</i>)	1
Alewife (<i>Alosa pseudoharengus</i>)	81,025
American shad (<i>Alosa sapidissima</i>)	63
Atlantic Salmon (<i>Salmo salar</i>)	1
Black Crappie (<i>Pomoxis nigromaculatus</i>)	2
Brown Trout (<i>Salvelinus trutta</i>)	2
Landlocked Salmon (<i>Salmo salar</i>)	2
Sea Lamprey (<i>Petromyzon marinus</i>)	48
Smallmouth Bass (<i>Micropterus dolomieu</i>)	88
Striped Bass (<i>Morone saxatilis</i>)	25
Sunfish (spp)	1
White Catfish (<i>Ictalurus catus</i>)	18
White Sucker (<i>Catostomus commersoni</i>)	521
Grand total	81,797

Table 4. Numbers of adult fish, by species, captured while migrating upstream at the Brunswick fishway during 2019.

When the fishway staff captures a white catfish, they collect biological data, sample and tag them with a Floy tag prior to release downstream. Staff tagged and released 17 White catfish back into the tailrace of the Brunswick fishway in 2019. None of the tagged catfish were observed reentering the fishway or were captured at the top of the fishway in the trap. Fishway personnel record total length and apply the tag posterior to the dorsal fin on the right side of the fish. Tag returns will provide valuable information on growth and migration within the Androscoggin River/Merrymeeting Bay Estuary. White catfish are a non-indigenous species introduced into Maine waters and not passed upstream. Commercial fishermen first discovered white catfish in the Eastern River, a tributary of the Kennebec, in 1997, and they appear to be rapidly expanding their range. The exact rate and location of expansion and the

potential effects on native fish communities are undetermined. The current operation of the fishway after August 1 increases the likelihood of white catfish and carp passing upstream into the Androscoggin River Basin.

The fish trap captured only 1 American eel during the May – July sample period. However, the trap rarely captures eels because migrating juveniles are small enough to pass through the trap grating. American eels released above the Brunswick dam may use the fish passage facilities located at the next two dams to reach and utilize upstream habitat. Upstream migrating juvenile eels utilize these habitats for an average of 20 years to grow to adulthood before emigrating downstream to reproduce in the Sargasso Sea.

Atlantic salmon are currently listed as an endangered species on the Androscoggin River. However, there is not an active Atlantic salmon restoration program in place for the Androscoggin River other than providing upstream passage for wild and hatchery origin Atlantic salmon at the first three dams on the river.

Through October of the 2019 sample season, MDMR fishway staff observed one Atlantic salmon at the Brunswick fishway (Tables 5&6). Changes to staffing levels and coverage at the fishway allowed periods where Atlantic salmon could pass upstream undetected. Atlantic salmon have passed through the fishway undetected in past years, most likely during the period when the fishway is cleaned and the operator has the fishway racks open for cleaning. This operation may take as long as 15 minutes, allowing sufficient time for salmon to pass upstream. The number of Atlantic salmon that successfully passed upstream in 2019 is unknown.

Table 5. Atlantic salmon captured ascending the Androscoggin River at the Brunswick fishway, May 8 through October 31, 2019.

Date	Total Length (mm)	Fork Length (mm)	Clips/Marks	Water Temp. (C)
9-Jun	762		None	17.4
Total # of fish	1			
Mean	762			17.4
Min. T° (C)				17.4
Max. T° (C)				17.4

Table 6. Numbers, mean lengths, and origin of sea-run Atlantic salmon returning to the Androscoggin River and captured at the Brunswick fishway 2000 – 2019.

Year	Sea-Run Hatchery				Sea-Run Wild				Mean Fork Length (mm)	Total
	1SW	2SW	3SW	Repeat	1SW	2SW	3SW	Repeat		
2000	1	3	0	0	0	0	0	0	652	4
2001	1	4	0	0	0	0	0	0	718	5
2002	0	2	0	0	0	0	0	0	809	2
2003	0	3	0	0	0	0	0	0	724	3
2004	3	8	0	0	0	1	0	0	688	12
2005	3	7	0	0	0	0	0	0	684	10
2006	5	1	0	0	0	0	0	0	578	6
2007	7	11	0	0	1	2	0	0	651	21
2008	8	7	0	0	1	2	0	0	603	18
2009	3	18	0	0	0	3	0	0	735	24
2010	2	5	0	0	0	2	0	0	676	9
2011	2	25	0	0	1	16	0	0	741	44
2012	0	0	0	0	0	0	0	0	0	0
2013	0	0	0	0	0	1	0	0	660	1
2014	0	3	0	0	0	1	0	0	690	4
2015	0	0	0	0	1	1	0	0	622	2
2016	0	0	0	0	0	5	0	0	749	7
2017	0	0	0	0	0	0	0	0	0	0
2018	0	0	0	0	0	1	0	0	694	1
2019	0	0	0	0	0	1	0	0	762	1
Total	35	97	0	0	4	36	0	0	646	174

High water in the fall of 2017 caused the fishway to close earlier than the expected November 15 closing date. High water and heavy wood debris in the fall often cause significant issues and can delay upstream passage in the spring if the Rotorc gate or other fishway structures are damaged. The debris accumulated at the base of the dam needed to be cleared prior to the 2018 fish passage season. During the high-water event several the safety railings were also damaged and will need repair (Figures 4&5).



Figure 4. Damage to lower fishway railings during high river flows in October resulting in the closure of the fishway on October 30, 2017



Figure 5. Woody debris blocking fishway entrance caused by high river flows in October resulting in the closure of the fishway on October 30, 2017

Fish species observed using the Brunswick fishway 1983 – 2019.

American eel
American shad
Atlantic salmon
Brook trout
Brown trout
Chinook salmon
Coho salmon
Common Carp
Common Shiner
Crayfish
Creek chub
Emerald Shiner
Golden Shiner
Landlocked salmon
Landlocked alewife
Largemouth bass
Pumpkinseed Sunfish
Rainbow Smelt
Rainbow trout
River Herring
Sea lamprey
Smallmouth bass
Spottail Shiner
Striped bass
Sunfish (Bluegill)
White catfish
White perch
White sucker
Yellow perch
Black Crappie

Table 7. Brunswick fishway air and water temperatures and headpond levels, April 2019.

Day	Air Temp (°C)	Water Temp (°C)	Headpond Level	River Flow (cfs)
4/1				6,560
4/2				6,560
4/3				6,560
4/4				6,560
4/5				6,560
4/6				6,560
4/7				6,560
4/8				6,560
4/9				6,560
4/10				6,560
4/11				6,560
4/12				6,560
4/13				6,560
4/14				6,560
4/15				26,100
4/16				35,400
4/17				30,400
4/18				24,900
4/19				22,500
4/20				24,800
4/21				42,600
4/22				48,000
4/23				41,400
4/24				39,300
4/25				34,700
4/26				28,800
4/27				29,000
4/28				38,400
4/29				30,800
4/30				21,800
Mean		#DIV/0!	#DIV/0!	20,358
MIN.		0.0	0.0	6,560
MAX.		0.0	0.0	48,000

Table 8. Brunswick fishway air and water temperatures and headpond levels, May 2019.

Day	Air Temp (°C)	Water Temp (°C)	Headpond Level	River Flow (cfs)
5/1				16,500
5/2				15,000
5/3				15,400
5/4				16,000
5/5				15,700
5/6				14,700
5/7				14,500
5/8	11.0	9.5	40.5	14,800
5/9	10.5	10.4	40.0	15,400
5/10	9.0	10.6	40.7	13,700
5/11	12.0	10.6	40.5	20,000
5/12	11.5	10.0	40.2	20,800
5/13	10.0	9.4	40.0	19,200
5/14	6.0	8.8	40.8	18,800
5/15	6.0	8.7	40.5	17,900
5/16	9.5	8.4	40.5	16,000
5/17	10.0	8.5	40.7	13,500
5/18	14.0	9.2	40.8	12,900
5/19	12.0	9.5	40.4	10,500
5/20	11.0	9.9	40.8	10,700
5/21	14.0	10.6	40.7	17,100
5/22	12.0	10.7	40.5	16,700
5/23	12.5	12.0	40.0	14,900
5/24	13.0	12.1	40.5	13,500
5/25	11.0	12.1	41.0	13,900
5/26	12.5	12.8	41.0	14,500
5/27	18.0	13.4	40.5	14,300
5/28	11.5	13.6	40.8	11,400
5/29	9.0	13.1	40.6	11,400
5/30	11.0	13.6	40.5	12,000
5/31	13.8	13.8	40.0	8,770
Mean	11.3	10.9	40.5	14,854
MIN.	6.0	8.4	40.0	8,770
MAX.	18.0	13.8	41.0	20,800

Table 9. Brunswick fishway air and water temperatures and headpond levels, June 2019.

Day	Air Temp (°C)	Water Temp (°C)	Headpond Level	River Flow (cfs)
6/1	15.0	14.3	40.0	7,950
6/2	13.0	14.1	39.4	7,510
6/3	14.0	13.8	39.1	7,000
6/4	15.0	14.8	39.4	6,670
6/5	14.0	14.9	39.0	5,750
6/6	16.0	15.4	39.5	5,890
6/7	18.0	16.6	39.1	5,980
6/8	18.5	17.2	39.5	7,180
6/9	19.0	17.4	39.0	4,800
6/10	19.0	18.8	39.2	5,270
6/11	16.5	18.4	38.3	4,660
6/12	18.0	17.7	39.6	6,570
6/13	16.0	18.6	39.0	6,960
6/14	15.0	17.3	39.3	5,150
6/15	18.5	18.5	39.5	5,880
6/16	18.0	19.2	39.2	5,340
6/17	19.0	19.1	39.3	5,260
6/18	18.5	19.6	39.4	4,680
6/19	19.0	19.6	39.3	3,850
6/20	15.5	19.6	39.3	4,990
6/21	16.8	17.9	39.6	7,430
6/22	18.5	18.5	40.0	8,820
6/23	21.0	19.5	39.5	7,820
6/24	21.0	20.1	39.3	5,910
6/25	19.0	20.4	39.3	4,740
6/26	18.0	19.4	39.5	6,300
6/27	18.5	19.8	39.1	6,790
6/28	21.5	20.8	39.4	6,670
6/29	22.0	21.0	39.5	6,400
6/30	21.0	21.7	39.1	5,530
Mean	17.8	18.1	39.3	6,125
MIN.	13.0	13.8	38.3	3,850
MAX.	22.0	21.7	40.0	8,820

Table 9. Brunswick fishway air and water temperatures and headpond levels, July 2019.

Day	Air Temp (°C)	Water Temp (°C)	Headpond Level	River Flow (cfs)
7/1	23.0	21.3	39.3	5,610
7/2	23.0	22.7	39.0	5,570
7/3	25.8	23.5	39.0	5,290
7/4				5,230
7/5	26.0	24.3	39.3	5,180
7/6	25.0	24.2	39.0	3,820
7/7	21.5	24.0	38.8	3,290
7/8	24.0	23.9	39.4	3,270
7/9	24.0	23.9	39.3	3,290
7/10	25.0	24.4	39.1	3,880
7/11	21.5	24.3	38.6	3,750
7/12	20.8	23.6	39.2	3,540
7/13	24.0	23.4	39.0	3,320
7/14	24.5	25.1	39.1	3,800
7/15	25.0	25.2	38.9	3,980
7/16	25.5	25.0	38.9	3,910
7/17	23.8	24.7	38.7	4,350
7/18	24.0	25.1	39.3	4,010
7/19	21.0	24.2	38.7	3,630
7/20	27.5	26.2	39.5	3,840
7/21	28.0	27.0	39.0	3,310
7/22	25.5	26.1	39.2	3,320
7/23	19.0	25.1	39.2	2,620
7/24	23.0	25.2	38.9	2,350
7/25	20.5	23.9	39.0	2,220
7/26	24.0	24.9	39.0	2,200
7/27	24.0	25.5	39.0	2,250
7/28	23.5	26.4	39.0	2,180
7/29	26.0	26.4	38.8	2,180
7/30	26.0	26.8	39.2	2,650
7/31	27.3	27.2	38.7	2,190
Mean	24.1	24.8	39.0	3,549
MIN.	19.0	21.3	38.6	2,180
MAX.	28.0	27.2	39.5	5,610

Table 10. Brunswick fishway air and water temperatures and headpond levels, August 2019.

Day	Air Temp (°C)	Water Temp (°C)	Headpond Level	River Flow (cfs)
8/1	25.0	26.6	39.3	2,120
8/2	23.0	25.9	39.1	2,070
8/3	25.0	25.6	39.0	2,050
8/4	26.0	25.3	39.5	2,040
8/5	21.5	24.8	39.0	2,020
8/6	22.0	24.7	39.0	2,010
8/7	20.0	24.3	39.0	2,060
8/8	21.0	24.6	38.6	2,230
8/9	23.0	25.8	39.0	2,200
8/10	20.5	24.6	38.5	2,060
8/11	22.0	24.7	39.4	2,030
8/12	20.0	23.7	39.0	2,020
8/13	Fishway Closed			1,990
8/14				2,030
8/15				2,030
8/16				2,060
8/17				2,040
8/18				2,030
8/19				2,060
8/20				2,040
8/21				2,040
8/22				2,832
8/23	2,170			
8/24	19.0	23.3	39.0	2,160
8/25	19.0	22.7	39.5	2,180
8/26	18.0	21.8	38.8	2,190
8/27	19.0	21.8	39.0	2,200
8/28	19.0	22.2	39.0	2,170
8/29		22.2	39.0	2,830
8/30		22.5	39.0	2,910
8/31	18.0	22.5	39.0	2,120
Mean	21.2	24.0	39.0	2,161
MIN.	18.0	21.8	38.5	1,990
MAX.	26.0	26.6	39.5	2,910

Table 11. Brunswick fishway air and water temperatures and headpond levels, September 2019.

Day	Air Temp (°C)	Water Temp (°C)	Headpond Level	River Flow (cfs)
9/1	18.0	22.1	39.0	2,200
9/2	17.0	22.0	39.5	2,220
9/3	19.0	21.5	39.0	2,160
9/4	19.0	21.2	39.0	2,120
9/5	17.0	20.7	39.0	2,170
9/6				2,150
9/7	13.5	20.3	39.5	2,100
9/8	14.0	19.9	39.5	2,130
9/9	14.0	19.1	39.0	2,808
9/10	14.0	18.8	39.5	2,090
9/11	16.0	20.1	39.0	2,120
9/12	13.0	19.8	39.5	1,950
9/13	16.0	19.5	39.0	1,580
9/14	15.0	19.7	39.0	1,760
9/15	19.0	18.9	39.2	2,000
9/16	16.0	18.4	39.5	1,890
9/17	15.0	18.0	39.5	1,670
9/18	13.0	17.7	39.0	1,490
9/19	12.0	17.5	39.0	1,740
9/20	11.5	17.1	39.5	1,800
9/21	16.0	18.1	39.8	1,720
9/22	16.0	18.3	39.5	1,640
9/23	18.0	18.8	39.5	1,490
9/24	18.5	19.7	39.5	1,890
9/25	17.0	19.8	39.5	1,840
9/26	16.0	19.1	39.5	1,840
9/27	15.0	18.2	39.0	1,850
9/28	15.0	18.8	39.6	1,840
9/29	15.0	18.0	39.5	1,800
9/30	15.0	18.1	39.5	1,810
Mean	15.6	19.3	39.3	1,929
MIN.	11.5	17.1	39.0	1,490
MAX.	19.0	22.1	39.8	2,808

Table 12. Brunswick fishway air and water temperatures and headpond levels, October 2019.

Day	Air Temp (°C)	Water Temp (°C)	Headpond Level	River Flow (cfs)
10/1	13.0	17.7	39.5	1,960
10/2	15.0	17.3	40.0	3,270
10/3				3,530
10/4	9.0	16.0	39.3	4,110
10/5	9.0	15.5	39.0	3,560
10/6	10.0	15.2	39.5	3,130
10/7	13.0	15.1	39.5	2,990
10/8				4,390
10/9	10.0	14.7	39.5	4,000
10/10	10.5	14.0	39.5	3,600
10/11	10.0	13.6	39.0	3,100
10/12	10.0	13.1	39.3	2,060
10/13	11.0	13.3	39.5	1,950
10/14	13.0	13.7	39.5	2,640
10/15	12.0	14.2	39.5	3,140
10/16	6.0	13.2	39.5	3,270
10/17	11.0	12.4	40.0	3,740
10/18	10.0	17.0	39.2	5,980
10/19	8.0	11.6	40.7	7,330
10/20	8.0	11.7	40.3	6,340
10/21	9.0	11.8	39.5	5,610
10/22	9.0	11.6	39.5	4,640
10/23	10.0	11.0	39.5	5,760
10/24	9.0	10.5	40.0	7,880
10/25	10.0	10.5	40.5	8,320
10/26	10.0	10.4	40.0	7,600
10/27	9.0	9.5	40.0	7,710
10/28	8.0	9.4	41.0	7,820
10/29				11,000
10/30				8,240
10/31	12.0	9.8	40.0	7,960
Mean	10.2	13.1	39.7	5,053
MIN.	6.0	9.4	39.0	1,950
MAX.	15.0	17.7	41.0	11,000

Table 13. Brunswick fishway air and water temperatures and headpond levels, November 2019.

Day	Air Temp (°C)	Water Temp (°C)	Headpond Level	River Flow (cfs)
			(feet above sea level)	
11/1	11.0	10.5	40.5	8,220
11/2	5.0	9.3	40.5	12,800
11/3	8.0	9.5	41.5	10,300
11/4	Closed for the Season			
11/5				
11/6				
11/7				
11/8				
11/9				
11/10				
11/11				
11/12				
11/13				
11/14				
11/15				
11/16				
11/17				
11/18				
11/19				
11/20				
11/21				
11/22				
11/23				
11/24				
11/25				
11/26				
11/27				
11/28				
11/29				
11/30				
Mean	8.0	9.8	40.8	10,440
MIN.	5.0	9.3	40.5	8,220
MAX.	11.0	10.5	41.5	12,800

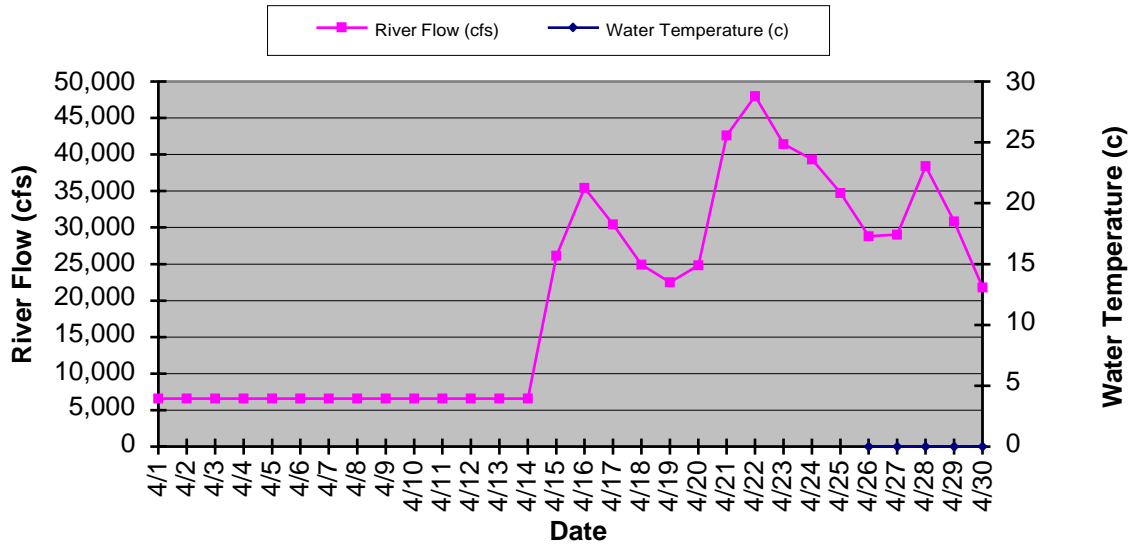


Figure 6. Water temperature and river flow recorded at the Brunswick fishway in April 2019

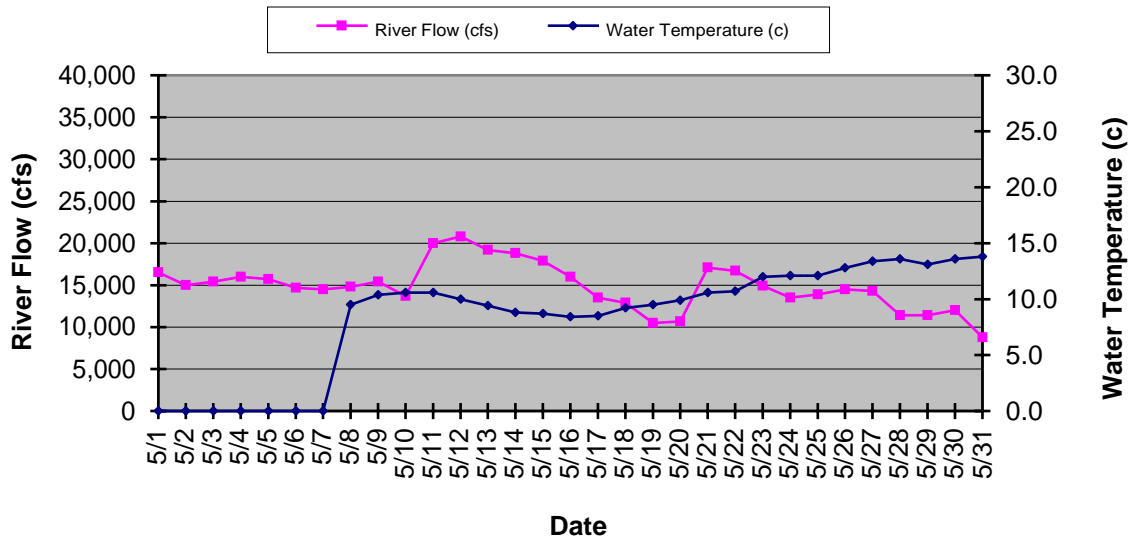


Figure 7. Water temperature and river flow recorded at the Brunswick fishway in May 2019

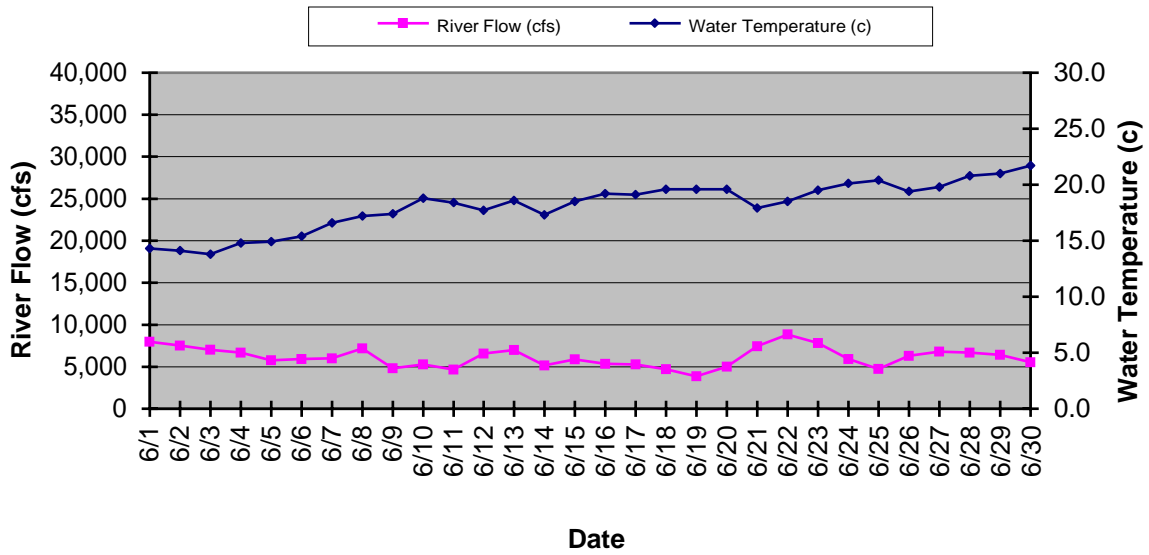


Figure 8. Water temperature and river flow recorded at the Brunswick fishway in June 2019

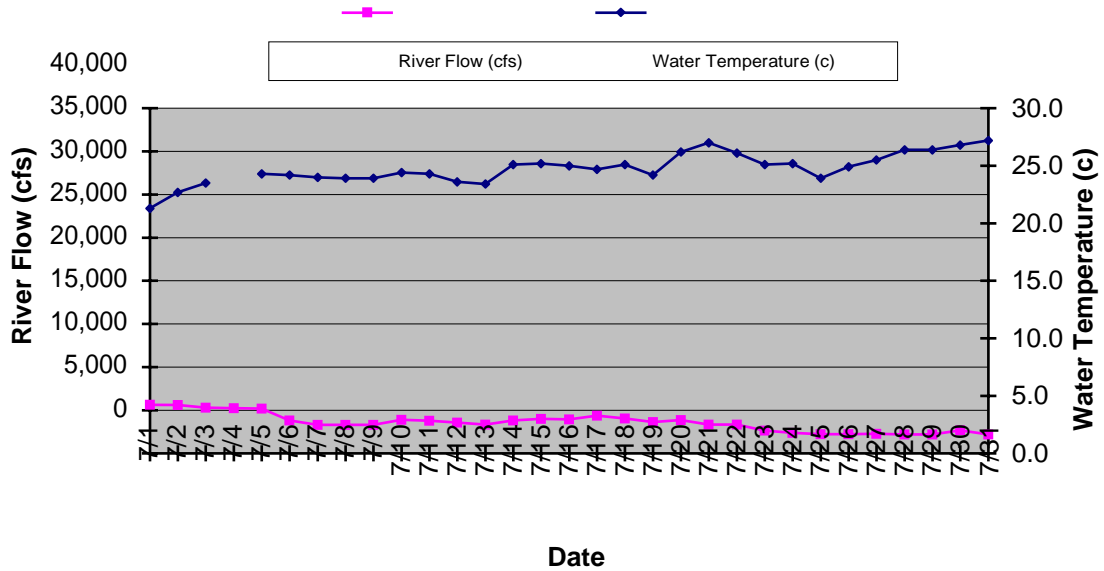


Figure 9. Water temperature and river flow recorded at the Brunswick fishway in July 2019

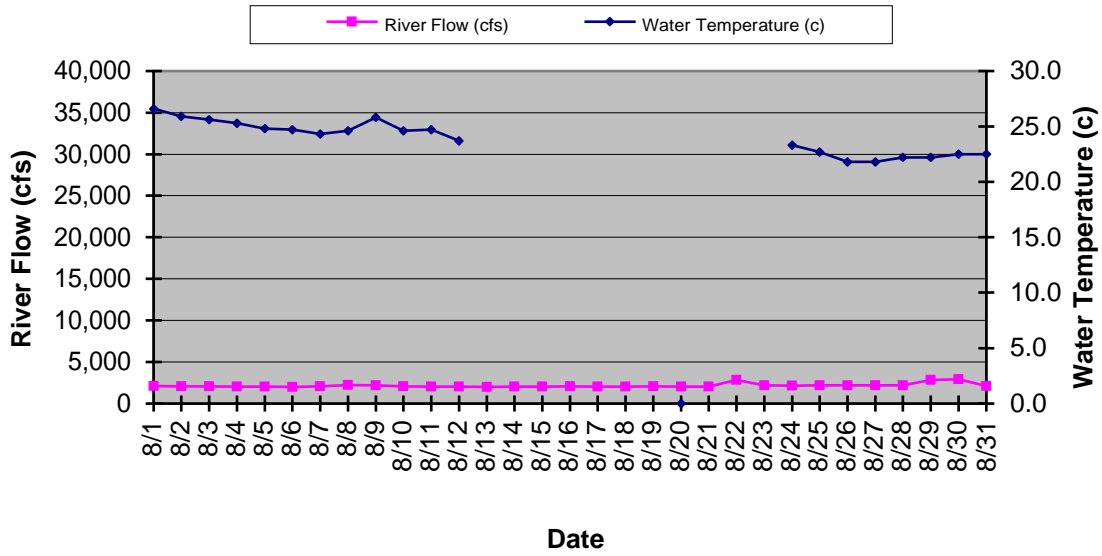


Figure 10. Water temperature and river flow recorded at the Brunswick fishway in August 2019

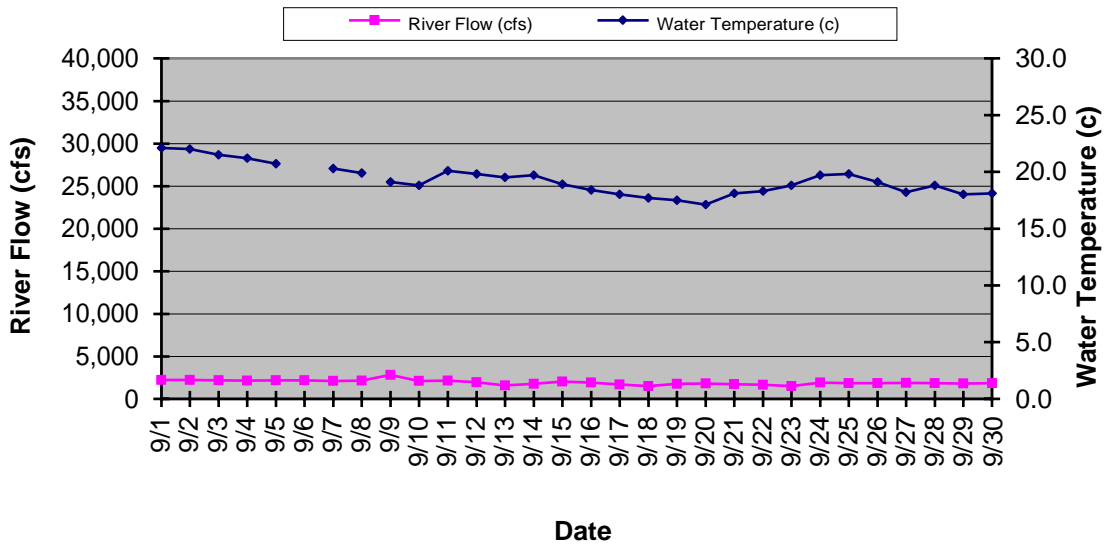


Figure 11. Water temperature and river flow recorded at the Brunswick fishway in September 2019

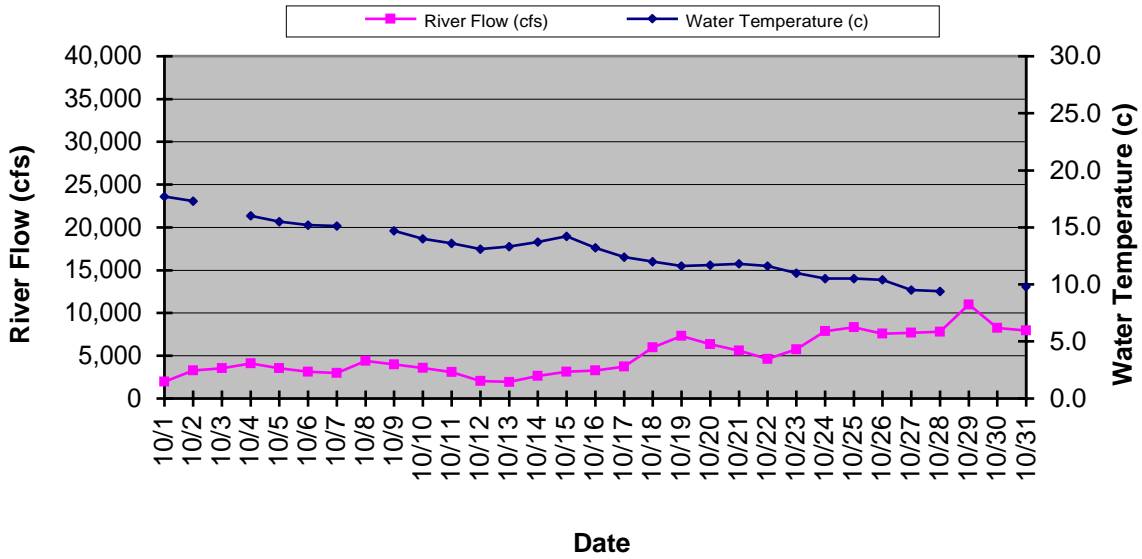


Figure 12. Water temperature and river flow recorded at the Brunswick fishway in October 2019

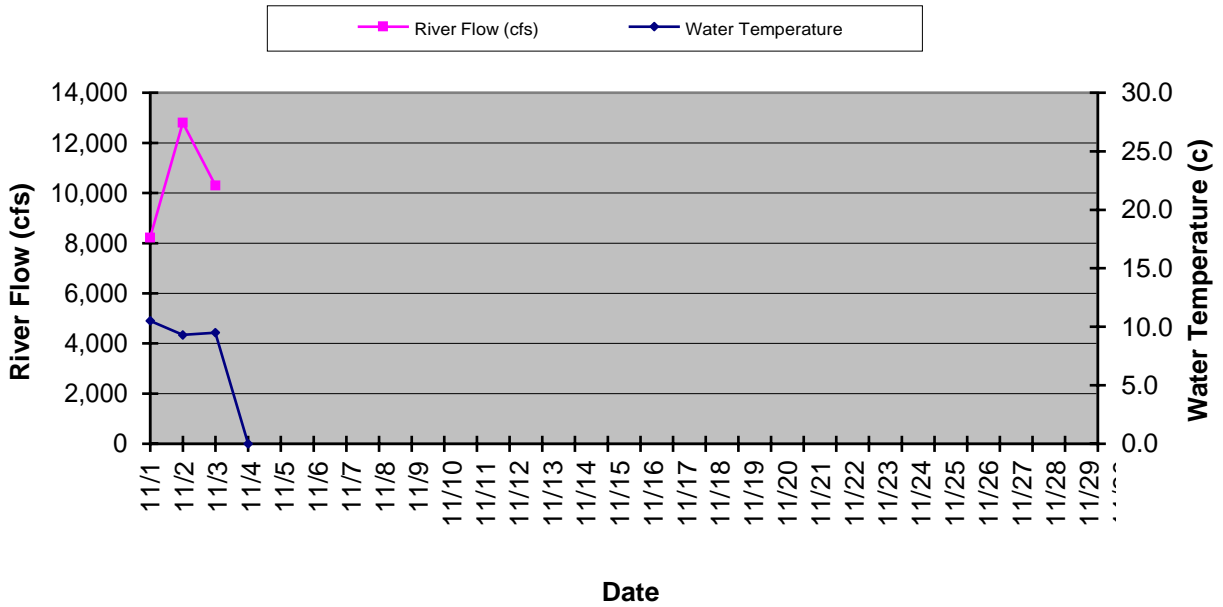


Figure 13. Water temperature and river flow recorded at the Brunswick fishway in November 2019

Brunswick Fishway Specifications

Type:	Vertical Slot
Description:	Reinforced concrete w/precast baffles
Overall Length:	570' +/-
Floor Elevations:	Elevation 34.0 at fishway exit Elevation -5.0 at fishway entrance
Floor Slope:	1 on 10
Pool Size:	8'-6"W x 10'-0"L with 11" wide slot
Drop per Pool:	12"
Design Populations:	85,000 shad per year 1,000,000 alewives per year
Fishway Operating Range:	Maximum headwater elevation 43.0 Maximum tailwater elevation 7.5 Q = 30,000 CFS Normal headwater elevation 39.4 Normal tailwater elevation 2.5 Q = 4,400 CFS Minimum headwater elevation 37.4 Minimum tailwater elevation -1.0 Q = 0 CFS
Design Flow:	30 CFS
Supplementary Attraction Flow:	70 CFS (gravity)
Total Attraction Flow:	100 CFS
Fishway Entrance Jet Velocity:	4.0 FPS to 6.0 FPS
Tailrace Velocity:	5.0 FPS maximum

Appurtenances:

Gates:

1 - 7' x 10' motorized & instrumented sluice gate at fishway exit. This gate to be closed when pond level reaches elevation 43.0+

1 - 4' x 10' motorized & instrumented sluice gate at entrance to downstream

Migrant passage on north side of powerhouse

Gates:

2 - 27" diameter motorized & instrument sluice gates at intake of supplementary attraction flow system

2 - pneumatic trap gates at fish trap
Stop logs at fishway entrance & exit

Trash rack: 1 10' x 12' at fishway exit with 5 3/4" clear bar spacing

Fish Crowder 1" x 4" grating on motorized trolley at fish trap

Fish Hopper 500-gallon capacity with electric hoist at fish trap

Related Work:

Existing Overflow Spillway Addition of flashboards (120 L.F.) to elevation 42.0 to prevent discharge into tailrace at river flow of 20,000 CFS

Fish Barrier Wall

Reinforced concrete semi-gravity type with top at elevation 21.0 to prevent discharge into tailrace at river flows up to 20,000 CFS. Elevation 21.0 to prevent discharge into tailrace at river flows up to 20,000 CFS

Overall Length	170' +/-
Maximum Height	30' +/-
Appurtenances	Sluice gate for dewatering intermediate pool

Document Content(s)

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