

VIA ELECTRONIC FILING

February 1, 2021

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

**RE: BIF III HOLTWOOD LLC (FERC NO. 1881-054 and 1881-074)
ARTICLES 47 AND 55 - 2020 ANNUAL FISH PASSAGE REPORT**

Dear Secretary Bose:

Pursuant to Article 47 and 55 of its license for the Holtwood Hydroelectric Station, BIF III Holtwood LLC (Brookfield), licensee of the Project, hereby submits its 2020 Annual Fish Passage Report.

Fish passage reports and data were compiled into several presentations, and discussed with the Fish Passage Technical Advisory Committee (FPTAC) at the annual meeting held at the Susquehanna River Basin Commission office on December 8 and 9, 2020. The FPTAC meeting summary describes the status of fish passage and studies conducted during the 2020 season. Copies of the 2020 Annual Fish Passage Report, the FPTAC meeting summary, and the presentations are enclosed.

Due to COVID-19 mandates, the beginning of fish passage season was delayed in 2020. Migratory fish passage season began on May 14 and ended on May 15 when SRAFRC requested Brookfield to shut down the lifts due to the passage of the invasive northern snakehead fish at the downstream dam. Resident passage did not occur in 2020. On May 18, PADEP requested that Brookfield suspend fish passage operations at the Holtwood facility immediately and through the remainder of the spring season due to invasive species.

The third year of Tier II fish passage studies were not completed at the project in 2020 due to COVID-19. As notified by letter dated March 30, 2020 and June 24, 2020, radio tags were purchased, and monitors were installed on March 19, prior to our operations being modified. With migratory fish passage season terminated early and fish not being tagged at the downstream Conowingo dam, we were unable to perform the study. Brookfield is prepared to complete the third year of radio telemetry studies in 2022.

Despite the shortened season in 2020, Brookfield continued with agreed upon projects including the repair and replacement of MOV's 4 and 5, and installation of instrumentation to collect data. While not being required, Brookfield took the initiative to study the Holtwood fish lift including commissioning a historical review of fish lift data and modifications, and a flow study to determine if the flows and current piping meet the requirements. Based on our findings, we have determined that the next beneficial step should be CFD modeling of the fish lift and then a revision of the operational matrix. We plan to test the matrix during spring 2021 to ensure proper flows are being met.

Brookfield submitted a letter to the FERC on January 5, 2021 requesting that fish passage at the Holtwood Dam be suspended for spring and fall of 2021. We also requested that year 3 of the Tier II radio telemetry study be deferred to 2022. Both PADEP and US Fish and Wildlife Service submitted letters of support, which were filed.



Should any additional information be required, please contact me by phone at 570-226-1371, by e-mail at kathleen.lester@brookfieldrenewable.com, or by mail at Brookfield Renewable, 126 Lambertson Lane, Hawley, PA 18428.

Sincerely,

A handwritten signature in black ink that reads "Kathleen E. Lester". The signature is written in a cursive style.

Kathleen E. Lester
Compliance Manager

Enclosures – 2020 FPTAC meeting summary and presentations, 2020 Fish Passage Report

cc: Cale Benard (Brookfield)
Amy Burnett (Brookfield)
Dustin Droege (Brookfield)



Brookfield Renewable
BIF III Holtwood LLC
Holtwood Station
482 Old Holtwood Road
Holtwood, PA 17532

VIA EMAIL

December 7, 2020

Sheila Eyster US Fish and Wildlife Service Mid-Atlantic Fish and Wildlife Conservation Office 177 Admiral Cochrane Drive Annapolis, MD 21401	Scott Williamson PA Dept. of Environmental Protection Waterways & Wetlands Program 909 Elmerton Avenue Harrisburg, PA 17110-8200
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RE: BIF III HOLTWOOD LLC – 2020 FISH PASSAGE REPORT

Dear PADEP and USFWS:

Pursuant to Articles 47 and 53 of its License, the Prescription for Fishways, and Conditions VI.A.2 and III.B.1 of the Water Quality Certificate (WQC) for the Holtwood Hydroelectric Station, BIF III Holtwood LLC (Brookfield), licensee of the Project, hereby submits the 2020 Holtwood Fishways Operations Report.

Should any additional information be required, please contact me by phone at 570-226-1371, by e-mail at kathleen.lester@brookfieldrenewable.com, or by mail at Brookfield Renewable, 126 Lambertson Lane, Hawley, PA 18428.

Sincerely,

Kathleen E. Lester
Compliance Manager

Enclosure – Holtwood 2020 Fishways Operations Report

cc: Cale Benard (Brookfield)
Amy Burnett (Brookfield)
Dustin Droege (Brookfield)
Bob Nikolaus (Brookfield)
Dan Stambaugh (Brookfield)
Holtwood FPTAC Resource Agencies

Holtwood 2020 Fishways Operations Report

History:

The Holtwood Project was built in 1910 and is located at River Mile 24 on the Susquehanna River. It is the second upstream hydroelectric facility on the river, with Conowingo Dam being located below and Safe Harbor Dam and York Haven Dam being located above.

In 1993, the Susquehanna River Fish Passage Settlement Agreement was signed, requiring the licensee of the Holtwood Project to provide migratory fish passage at their facility. The licensee began construction in 1995 and the fishway was placed into operation in April of 1997. The Holtwood fish lift has operated each spring since 1997, as well as fall of 2014, 2015, 2017, 2018 and 2019. 2020 marks the 24th year of operation.

Fishway Design:

The Holtwood fish lift design incorporates numerous criteria established by the USFWS and state resource agencies. Physical design parameters for the fishway are given in the 1998 Fishway Report (Normandeau Associates, Inc. 1998. Summary of the operation at the Holtwood Fish Passage Facility in 1997. Report prepared for PPL, Inc., Allentown, PA.) The fishway is designed to pass a population of 2.7 million American Shad and 10 million River Herring.

There are 2 lifts on the fishway, tailrace and spillway (see figure in Normandeau Associates, Inc. 1998). The tailrace lift has two entrances (gates A and B) and the spillway lift has one entrance (gate C). Each lift contains a mechanically operated crowder, picket screen(s), hopper, and hopper trough gate. Fish captured in the lifts are sluiced into one trough, which then leads into Lake Aldred. Attraction flows to the two fish lifts at Holtwood Dam are supplied via an attraction water piping system leading to five separate flow diffusers, with the flow distribution controlled by eight motor operated valves (MOVs). Generally, flows are introduced upstream of crowder in each lift and upstream of the three entrance gates. Entrance gates at the three lift entrances control the depth of flow within the lift channels. Fish that enter the tailrace and/or spillway entrances are attracted by water flow into the mechanically operated crowder chambers. Once inside, fish are crowded into the hoppers, lifted, and then sluiced into the trough. Fish swim upstream through the trough, past a counting window, and into the forebay through a 14 ft wide fish lift exit gate.

For more information on the design and operation of the lift, please reference the Fishways Operations Plan. This plan includes operating protocols and guidelines that are flexible and utilize experience gained during previous years of fish lift operation.

Regulatory Dates:

Resident spring fish passage season at the Holtwood fish lift is from April 1 through June 30. Migratory fish passage season timing is based on the passage of fish at the Conowingo Dam, located downstream. Resident fall fish passage season is from September 1 to October 15.

2020 Spring Fish Passage:

In early spring of 2020, pre-season equipment maintenance and calibrations were performed before spring fish passage season. However, the 2020 season was delayed and then shortened due to issues related to the COVID-19 pandemic and spread of Northern Snakeheads on the Susquehanna River.

By letter dated March 30, 2020, Brookfield notified resource agencies of certain modified operations due to the COVID-19 pandemic. Consistent with the State of Emergency in Pennsylvania and Centers for Disease Control guidelines, Brookfield took steps to meet the unprecedented conditions including modifying our operations staffing levels at the Holtwood station, allowing only essential personnel on site to protect our critical employees and ensure the continued critical service of generating electricity and maintaining dam safety. Agencies were notified that the beginning of fish passage season would be delayed but that once normal operations resumed, the lift would run as committed.

On May 11, Brookfield notified resource agencies that our Holtwood facility would begin resident fish passage season on May 18, when normal staffing levels would be resuming. On May 12, we were notified that Conowingo Dam began migratory fish passage that same day. Holtwood began migratory fish passage on May 14.

On May 15, Brookfield was requested by the Susquehanna River Anadromous Fish Restoration Cooperative (SRAFRC) to shut down our fish lifts immediately due to the passage of invasive northern snakehead fish at the downstream dam. Holtwood shut the lift down that same night. On May 18, the Pennsylvania Department of Environmental Protection (PADEP) requested that Brookfield suspend resident fish passage operations at the Holtwood lift immediately and through the remainder of the spring season. These actions were taken to minimize the spread of the invasive species into the Susquehanna River.

Please see Appendix A for fish passage numbers for spring 2020.

Upstream Shad Passage – Tier II Radio Telemetry:

2020 would have been year 3 of our Tier II radio telemetry study. Monitors were installed on March 19, prior to our operations being modified. Since fish passage did not occur in 2020, the radio telemetry study was deferred to 2021.

2020 Fall Fish Passage:

On June 24, PADEP requested that Brookfield forgo the 2020 fall resident fish passage operations at the Holtwood lift.

Maintenance/Upgrades:

- No maintenance issues were experienced in 2020 during the short season.
- The upstream debris boom was in place and functional for the season.
- At the request of agencies, instrumentation was installed, and data is now live in our pi system.
- Valves repaired for fish lift attraction flow.
- Hopper hoist maintenance including wheel alignment and greasing.
- Re-engineered MOV4 to give better flow control within the lift. Mechanically complete but electrical upgrade is ongoing.
- MOV5 is being upgraded. The new actuator is significantly larger and requires modifications. Electrical upgrades to support the load of the new actuator have been ordered.
- Both hopper hoists were removed pre-season and sent out to have new gears fabricated and installed. This has produced a significant reduction in noise during lifts.
- Access panels in bottom of A and B entrance gates were welded shut to reduce eddies.

Historical Data Summary:

In early 2020, Brookfield contracted with Gomez & Sullivan to conduct a detailed summary of historical fish lift data including significant testing, modification and failure modes of the fish lift during past fish passage seasons, and to identify any correlations between successful fish passage and conditions in and around the lift. The study concluded that generally, lower overall flows lead to higher numbers of fish passed upstream. Also, the study indicated that the number of fish moving upstream dropped off significantly through the fish lift structures.

Flow Study Update:

The second phase of the study included field measurements of flow velocities at various depths and locations within the lift. The primary areas of interest were at the hoppers, upstream of the crowder doors, downstream of the crowder doors, and at each entrance.

In 2020, Brookfield contracted with Gomez & Sullivan to conduct the flow study. The intent of study was to identify potential causes for less than ideal flow conditions which exist within the lift structure and may cause fish which enter the lift to stop moving upstream and to exit the lift. Potential hydraulic issues within the lifts were investigated utilizing a combination of measurements and observations during the July 21-22 site visit and an evaluation of the hydraulics of the lift structure.

Velocity measurements were taken at two depths within the water column to more accurately assess the average velocity. Measurements were taken at two-foot increments across the channel.

The flow study confirmed that the current valve matrix was not creating the recommended ideal flows as stated in the 2019 USFWS fish lift engineering guide and that additional measures would be necessary to correct this. The study also confirmed that for most river conditions, the lift will be able to produce acceptable flows using the existing equipment with an updated matrix. This was beneficial to have confirmed and will provide the framework for future priorities.

Future plans:

Brookfield has contracted with Gomez & Sullivan to complete a CFD model of the Holtwood fish lift, develop a new operating matrix, and field test for verification in 2021. CFD modeling will enable us to update the operating matrix to ensure proper flows are being provided. Those flows will be tested and refined. Once the operating matrix is updated, the Fishways Operating Plan will be updated.

APPENDIX A

NORMANDEAU FISH PASSAGE REPORT

Holtwood Fish Passage Spring, 2020

Prepared for:

Holtwood Hydro Electric Station
Brookfield Renewable U.S.
482 Old Holtwood Road
Holtwood, Pennsylvania 17532

Submitted On:

November 20, 2020

Prepared By:

Normandeau Associates, Inc.
1921 River Road
Drumore, Pennsylvania 17518

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DISCLOSURE STATEMENT

The data contained in all pages of this document have been submitted in confidence and contain trade secrets and/or privileged or confidential information, and such data shall be used or disclosed only for evaluation purposes, provided that if a contract is awarded to this proposer as a result of or in connection with the submission of this proposal, the client shall have the right to use or disclose the data herein to the extent provided in the contract. This document includes data that shall not be disclosed outside of the purposes of this submittal and shall not be duplicated, used, or disclosed--in whole or in part--for any purpose other than for evaluation purposes.

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Executive Summary

The 2020 Holtwood fish passage season was disrupted and shortened due to a series of events stemming from the Covid-19 pandemic and the passage of Northern Snakeheads into Conowingo Pond via the Conowingo East Fish Lift.

Per the settlement agreement for the Holtwood Redevelopment Project, 2020 marks the seventh year of fish passage operations at Holtwood for both resident and migratory fish species. After delays caused by the pandemic, fish lift operations commenced at Holtwood on May 14, 2020; one day after the Conowingo East fish lift passed 54 American Shad into Conowingo Pond. However, due to the passage of Northern Snakeheads into Conowingo Pond by the Conowingo East fish lift, the Resource Agencies requested that all fish lift operations cease at day's end on May 15, 2020. The introduction of invasive species into Conowingo Pond also cancelled the planned resident fish passage efforts scheduled to run through June 30, 2020 as well as fall resident fish passage operations scheduled for September 1 through October 15, 2020. The Holtwood facility only operated a total of 2 days in 2020 (May 14 and May 15) utilizing all three entrance gates (A, B and C) each day.

During the two days of operations, Holtwood passed 229 fish of nine taxa. Gizzard Shad dominated the catch, and comprised nearly 63.7% of the total fish collected and passed. American Shad represented the sole *Alosa* species collected and passed at Holtwood in 2020. Twenty-eight American Shad successfully passed by the Holtwood fish lift facility during the brief 2020 season.

The 2020 American Shad passage rate at Holtwood (5.8% of American Shad passing Conowingo passed Holtwood) was the third lowest rate observed since operations commenced in 1997. Due to the pandemic and the shortness of the season, researchers must use caution when comparing this passage value to previous annual American Shad passage values due to the lack of data.

This year was the twenty-fourth year of fish passage operations at the Holtwood fish passage facility.

1.0 Introduction

The first American Shad passed the Conowingo EFL on its second day of operations (May 13, 2020). On May 14, Holtwood passed its first American Shad during the 1400-1459 hr (Table 1). An additional 27 American Shad navigated their way over Holtwood Dam before the season was abruptly halted due to the passage of Northern Snakehead into Conowingo Pond.

2.0 Fishway Operation

2.1 Methods

Fish passing the counting window are identified to species and counted/estimated by a biologist or biological technician. The counting area is located immediately downstream of the main attraction water supply area in the trough. As fish swim upstream and approach the counting area, they are directed by a series of fixed screens to swim up and through a three ft wide, 12 ft long channel on the west side of the trough. The channel is adjacent to a four ft by ten ft window located in the counting room where fish are identified and counted. Passage from the fishway is controlled by one set of gates located just downstream of the viewing window. During the day, fish passage is controlled by the technician who opens/closes the set of gates downstream of the viewing window. At night, fish are denied passage from the fishway by closing these gates. When necessary, flow is maintained through the exit channel to ensure that adequate water quality exists for fish that may be in the trough overnight.

Fish passage data is handled by a single system that records and processes the data. The hourly data (species and numbers passed) is recorded on a worksheet by the biologist or biological technician as fish pass the viewing window. At the end of each hour, fish passage data is entered into a Microsoft Excel spreadsheet and saved. Data processing and reporting is PC-based and accomplished by program scripts, or macros, created within Microsoft Excel spreadsheet software.

At day's end, the data is checked and verified by the biologist or biological technician. After data verification is completed, a daily summary of fish passage is produced and distributed to plant personnel. Each day's data is backed up to a flash drive and stored off-site. Daily reports and weekly summaries of fish passage numbers are electronically distributed to members of the Holtwood FPTAC and other co-operators.

3.0 Migratory Fish Passage Results

3.1 Relative Abundance

The diversity and abundance of fishes collected and passed daily in the Holtwood fishway during the two days of operations of the spring 2020 migratory fish passage period (May 14 and May 15) is presented in Tables 1 and 2. A total of 229 fish of nine taxa passed upstream into Lake Aldred. Gizzard Shad (63.4% or 146 of 229), Smallmouth Bass (30), American Shad (28), and Shorthead Redhorse (19) comprised 97.4% of the total fish collected and passed.

3.2 American Shad Passage

A total of 28 American Shad passed during 2 days of operation at Holtwood in the abbreviated 2020 fish passage season. The majority of these fish (24) passed in the afternoon of the second and final day of operation on May 15, 2020 (Table 1). The majority of American Shad passed at Holtwood occurred between 1300 hrs and 1659 hrs. The highest hour of American Shad passage (5) occurred during four consecutive hours between 1300-1659 hr timeframe on May 15 (Table 1). The 28 American Shad passed Holtwood with river flows ranging between 40,950 and 43,700 cfs and with water temperatures between 54° F and 55.8° F.

The 2020 American Shad passage rate at Holtwood (5.8% of American Shad passing Conowingo passed Holtwood) was the third lowest rate observed since operations commenced in 1997, but due to the pandemic and the shortness of the season, this data should be excluded when comparing annual American Shad passage rates (Table 3).

3.3 Gizzard Shad and Other Alosids

In 2020, 146 Gizzard Shad passed through the Holtwood fish passage facility during the two days of operation, with consistent passage throughout the day. The hourly passage of Gizzard Shad is shown in Table 1. Gizzard Shad comprised nearly 63.7% of the total fish collected and passed in 2020.

No Hickory Shad or River Herring (Alewife or Blueback Herring) were observed during Holtwood fish passage operations this year.

3.4 Maryland DNR tag-recapture

Due to the COVID-19 pandemic, the Maryland DNR did not conduct the annual tag and recapture study of American Shad during the 2020 season. Additionally, no previous year floy-tagged American Shad were observed at any fish passage facility.

4.0 Resident Fish Passage

4.1 Spring

Due to the COVID-19 pandemic and the passage of Northern Snakeheads into Conowingo Pond, spring resident fish passage was not conducted before or after the 2-day operation for migratory fish in 2020.

4.2 Fall

The 2020 fall resident fish passage season was cancelled at the request of the Resource Agencies due to the presence of Northern Snakeheads in Conowingo pond.

5.0 Literature Cited

Normandeau Associates, Inc. 1998. Summary of the operation at the Holtwood Fish Passage Facility in 1997. Report prepared for PPL, Inc., Allentown, PA.

Normandeau Associates, Inc. 1999. Summary of the operation at the Holtwood Fish Passage Facility in 1998. Report prepared for PPL, Inc., Allentown, PA.

Tables

SUMMARY OF OPERATIONS AT THE HOLTWOOD FISH PASSAGE FACILITY, 2020

Table 1. Daily fish catch by hour for May 14 and 15, 2020.

Time Period:		0800-0859	0900-0959	1000-1059	1100-1159	1200-1259	1300-1359	1400-1459	1500-1559	1600-1659	1700-1759	Daily Total
SPECIES												
<i>American Shad</i>		0	0	0	0	0	0	1	0	0	3	4
<i>Gizzard Shad</i>		0	2	6	1	1	8	2	3	0	13	36
<i>Shorthead Redhorse</i>		0	0	0	0	0	0	0	0	0	3	3
<i>Channel Catfish</i>		0	0	0	0	0	0	0	0	0	1	1
<i>Smallmouth Bass</i>		0	0	0	0	1	0	1	0	0	1	3
<i>Walleye</i>		0	0	0	0	0	1	0	0	0	0	1
Totals		0	2	6	1	2	9	4	3	0	19	48

Time Period:		0800-0859	0900-0959	1000-1059	1100-1159	1200-1259	1300-1359	1400-1459	1500-1559	1600-1659	1700-1759	Daily Total
SPECIES												
<i>American Shad</i>		1	1	0	1	1	5	5	5	5		24
<i>Gizzard Shad</i>		12	10	16	10	27	9	10	4	12		110
<i>Muskellunge</i>		1	0	0	0	0	0	0	0	0		1
<i>Shorthead Redhorse</i>		1	0	2	0	1	2	4	0	6		16
<i>Channel Catfish</i>		0	0	1	0	0	0	0	0	0		1
<i>Bluegill</i>		0	0	0	0	1	0	0	0	0		1
<i>Smallmouth Bass</i>		1	5	5	3	2	4	5	0	2		27
<i>Largemouth Bass</i>		0	0	0	1	0	0	0	0	0		1
Totals		16	16	24	15	32	20	24	9	25		181

Table 2. Fish species and number passed during 2-day operation at Holtwood (May 14 and 15, 2020).

Species	# Collected/Passed
American Shad (<i>Alosa sapidissima</i>)	28
Gizzard Shad (<i>Dorosoma cepedianum</i>)	146
Muskellunge (<i>Esox masquinongy</i>)	1
Shorthead Redhorse (<i>Moxostoma macrolepidotum</i>)	19
Channel Catfish (<i>Ictalurus punctatus</i>)	2
Bluegill (<i>Lepomis macrochirus</i>)	1
Smallmouth Bass (<i>Micropterus dolomieu</i>)	30
Largemouth Bass (<i>Micropterus salmoides</i>)	1
Walleye (<i>Stizostedion vitreum</i>)	1
TOTAL FISH (9 Species)	229

Table 3. Summary of American Shad passage counts and percent passage values at Susquehanna River dams, 1997-2020.

	Conowingo East	Holtwood		Safe Harbor		York Haven	
		Number	% of C.E.L.	Number	% of Holt.	Number	% of S.H.
1997	90,971	28,063	30.8%	20,828	74.2%	-	-
1998	39,904	8,235	20.6%	6,054	73.5%	-	-
1999	69,712	34,702	49.8%	34,150	98.4%	-	-
2000	153,546	29,421	19.2%	21,079	71.6%	4,687	22.2%
2001	193,574	109,976	56.8%	89,816	81.7%	16,200	18.0%
2002	108,001	17,522	16.2%	11,705	66.8%	1,555	13.3%
2003	125,135	25,254	20.2%	16,646	65.9%	2,536	15.2%
2004	109,360	3,428	3.1%	2,109	61.5%	219	10.4%
2005	68,926	34,189	49.6%	25,425	74.4%	1,772	7.0%
2006	56,899	35,968	63.2%	24,929	69.3%	1,913	7.7%
2007	25,464	10,338	40.6%	7,215	69.8%	192	2.7%
2008	19,914	2,795	14.0%	1,252	44.8%	21	1.7%
2009	29,272	10,896	37.2%	7,994	73.4%	402	5.0%
2010	37,757	16,472	43.6%	12,706	77.1%	907	7.1%
2011	20,571	21	0.1%	8	38.1%	0	0.0%
2012	22,143	4,238	19.1%	3,089	72.9%	224	7.3%
2013	12,733	2,503	19.7%	1,927	77.0%	202	10.5%
2014	10,425	2,589	24.8%	1,336	51.6%	8	0.6%
2015	8,341	5,286	63.4%	3,896	73.7%	43	1.1%
2016	14,276	6,718	47.1%	4,242	63.1%	178	4.2%
2017	16,265	3,170	19.5%	2,007	63.3%	62	3.1%
2018	6,992	1,458	20.9%	661	45.3%	NA	NA
2019	4,787	571	11.9%	316	55.3%	NA	NA
2020*	485	28	5.8%	1	3.6%	NA	NA

*Holtwood operations delayed until May 14, 2020 due to COVID-19 Protocols
 Fish lift operations terminated on May 15, 2020 due to Northern Snakehead (Resource Agency request)

HOLTWOOD FISH PASSAGE TECHNICAL ADVISORY COMMITTEE (FPTAC)
2020 ANNUAL MEETING
MEETING HELD REMOTELY

ATTENDEES: Katie Lester (Brookfield Renewable)
Dustin Droege (Brookfield Renewable)
John McVaigh (Brookfield Renewable)
Bob Nikolaus (Brookfield Renewable)
Daniel Stambaugh (Brookfield Renewable)
Jon Rhoads (Brookfield Renewable)
Amy Burnett (Brookfield Renewable)
Ray Bleistine (Normandeau)
Adam Slowik (Normandeau)
Sheila Eyler (USFWS)
Rick McCorkle (USFWS)
Jesus Morales (USFWS)
Josh Tryniewski (PFBC)
Aaron Henning (SRBC)
Jeremy Miller (PA DEP)
Ron Eberts (PA DEP)
Shawn Seaman (MD DNR)
Emily Zollweg-Horan (NYSDEC)

DATE: December 9, 2020 at 12:30 p.m.

In December 2020, meetings were combined and held remotely due to COVID-19. On December 8th, agencies, consultants and licensees all came together to see presentations on fish passage numbers for 2020 as well as any studies that were occurring on the river system. On December 9th, Brookfield met with Normandeau staff and resource agencies to discuss fish passage operations specifically at Holtwood and Safe Harbor.

Katie Lester announced that Dan Stambaugh would be retiring on March 1, 2021 after 37 years of working at Safe Harbor Dam. His long years of service and expertise are appreciated and will certainly be missed. Dustin Droege has been promoted to Senior Operations Manager and will be managing Holtwood, Safe Harbor and Wallenpaupack.

2020 HOLTWOOD FISH PASSAGE

Due to COVID-19 mandates, the beginning of fish passage season was delayed in 2020. Migratory fish passage season began on May 14 and ended on May 15 with flows ranging from 40,950 cfs to 43,700 cfs. The season ended on May 15 when SRAFRC requested Brookfield to shut down the lifts due to the passage of the invasive northern snakehead fish at the downstream dam. Resident passage (6 hrs) did not occur in 2020. On May 18, PADEP requested that

Brookfield suspend fish passage operations at the Holtwood facility immediately and through the remainder of the spring season due to invasive species.

A total of 28 American shad and 229 total fish passed the Holtwood fishway in spring fish passage. Water temperatures ranged from 54.0°F to 55.8°F. Peak shad passage occurred on May 15 when 24 shad passed.

By email dated May 18, 2020, PADEP requested that Brookfield suspend fall fish passage in 2020 due to the possible spread of invasive species.

2020 FISH LIFT REPAIR & MAINTENANCE

The following maintenance and repairs were completed in 2020:

- No maintenance issues were experienced in 2020 during the short season.
- The upstream debris boom was in place and functional for the season.
- At the request of agencies, instrumentation was installed, and data is now live in our pi system.
- Valves repaired for fish lift attraction flow.
- Hopper hoist maintenance including wheel alignment and greasing.
- Re-engineered MOV4 to give better flow control within the lift. Mechanically complete but electrical upgrade is ongoing.
- MOV5 is being upgraded. The new actuator is significantly larger and requires modifications. Electrical upgrades to support the load of the new actuator have been ordered.
- Both hopper hoists were removed pre-season and sent out to have new gears fabricated and installed. Spillway side needs to be installed. This has produced a significant reduction in noise during lifts.
- Access panels in bottom of A and B entrance gates were welded shut to reduce eddies.

HISTORICAL DATA REVIEW & FIELD TESTING

Brookfield contracted with Gomez & Sullivan to perform a historical review of the fish lift that included reviewing historical reports from 2002 to 2019, identifying and constructing a timeline of modifications, breakdowns and studies completed by prior ownership, identifying contributing factors during years of high catch rates, analyzing passage success by entrance, and making recommendations for further testing. Snapshots from the analysis can be found in the powerpoint presentation.

During the field testing completed on July 21 and 22, 2020, various flow measurements were taken at entrance gates and crowdors. MOV settings were adjusted accordingly to test the flows and look for evidence of eddying.

The study concluded that flow on the river below station capacity is the largest contributing factor to far field attraction, flow within the entrance flumes are the primary cause of poor internal efficiency, spills greater than 8,000 cfs show significant negative impact to the spillway attraction, and that mechanical failures are a minor contributing factor.

Gomez & Sullivan recommended that a CFD model of the lift be completed and the operating matrix then be updated. This project has been awarded and is currently underway. Field testing will be done in 2021 to validate the new matrix to ensure that it meets USFWS criteria.

2021 FISH PASSAGE

Based on a call with agencies on October 20, 2020, Brookfield submitted a request on November 17, 2020 to suspend 2021 spring and fall fish passage as well as the Tier II radio telemetry study due to concerns with the spread of invasive species. If approved, Brookfield will need to file with FERC for review and approval.

Projects planned for 2021 include:

- MOV and limit torque inspection and rehabs – Several each year
- CFD modeling and flow testing/refinement
- Revised operating matrix
- FOP update

FUTURE FALL FISH PASSAGE OPERATION

By email dated May 18, 2020, PADEP requested the Brookfield suspend fall fish passage in 2020 due to the possible spread of invasive species. Based on a call with agencies on October 20, 2020, Brookfield submitted a request on November 17, 2020 to suspend 2021 fall fish passage due to concerns with the spread of invasive species.

Long term, Brookfield would like our earlier request to discontinue fall fish passage kept as an open action item.

BASIN-WIDE EEL STUDY

The USFWS is proposing to perform a basin-wide downstream eel study and has requested the participation of Brookfield with regards to providing operational data and managing a receiver array at both Holtwood and Safe Harbor projects. The location of the arrays has not been determined yet. Survival will not be assessed at each project and the study will be re-evaluated each year based on upstream eel numbers available. USFWS would like a decision from Brookfield by March of 2021.

ROUNDTABLE COMMENTS

Since the flow study seems to indicate that the biggest driver for fish passage at Holtwood is flows on the river, Sheila Eyler asked how spilling due to negative energy pricing could be mitigated in the future. Agencies may decide to approach PJM in the future about prioritization of certain projects during negative pricing during fish passage season.

The meeting ended at 2 p.m.

Holtwood 2020 FPTAC Meeting

KATHLEEN LESTER – COMPLIANCE MANAGER

DUSTIN DROEGE – SR MANAGER, OPERATIONS

12/09/2020

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Holtwood 2020

2020 Holtwood Passage – Spring Summary

Spring Fishway Operation

- Resident Fishway Operation (6hrs) occurred on 0 days
 - Season delayed due to COVID-19
 - On May 18, PADEP requested that Brookfield suspend fish passage operations at the Holtwood facility immediately and through the remainder of the spring season due to invasive species.
- Migratory Fishway Operation (10hrs) occurred on 2 days from May 14th – 15th
 - Flows ranged from 40,950cfs to 43,700cfs
 - On May 15, Brookfield was requested by the SRAFRC to shut down our fish lifts due to the passage of invasive northern snakehead fish at the downstream dam. Holtwood shut the lift down that same night.

Fish Passage on River 1997 - 2020

	Conowingo East	Holtwood		Safe Harbor		York Haven	
		Number	% of C.E.L.	Number	% of Holt.	Number	% of S.H.
1997	90,971	28,063	30.8%	20,828	74.2%	-	-
1998	39,904	8,235	20.6%	6,054	73.5%	-	-
1999	69,712	34,702	49.8%	34,150	98.4%	-	-
2000	153,546	29,421	19.2%	21,079	71.6%	4,687	22.2%
2001	193,574	109,976	56.8%	89,816	81.7%	16,200	18.0%
2002	108,001	17,522	16.2%	11,705	66.8%	1,555	13.3%
2003	125,135	25,254	20.2%	16,646	65.9%	2,536	15.2%
2004	109,360	3,428	3.1%	2,109	61.5%	219	10.4%
2005	68,926	34,189	49.6%	25,425	74.4%	1,772	7.0%
2006	56,899	35,968	63.2%	24,929	69.3%	1,913	7.7%
2007	25,464	10,338	40.6%	7,215	69.8%	192	2.7%
2008	19,914	2,795	14.0%	1,252	44.8%	21	1.7%
2009	29,272	10,896	37.2%	7,994	73.4%	402	5.0%
2010	37,757	16,472	43.6%	12,706	77.1%	907	7.1%
2011	20,571	21	0.1%	8	38.1%	0	0.0%
2012	22,143	4,238	19.1%	3,089	72.9%	224	7.3%
2013	12,733	2,503	19.7%	1,927	77.0%	202	10.5%
2014	10,425	2,589	24.8%	1,336	51.6%	8	0.6%
2015	8,341	5,286	63.3%	3,896	73.7%	43	1.1%
2016	14,276	6,718	47.0%	4,242	63.1%	178	4.2%
2017	16,265	3,170	19.5%	2,007	63.3%	62	3.1%
2018	6,992	1,458	20.9%	661	45.3%	NA	NA
2019	4,787	571	11.9%	316	55.3%	NA	NA
2020*	485	28	5.8%	1	3.6%	NA	NA

*Short season due to COVID-19 and spread of invasive species

2020 Fall Resident Fish Passage

- By email dated May 18, 2020, PADEP requested that Brookfield suspend fall fish passage in 2020 due to the possible spread of invasive species.



2020 Fish Lift Repair & Maintenance

2020 Fish Lift Repairs & Maintenance

- No maintenance issues were experienced in 2020 during the short season.
- The upstream debris boom was in place and functional for the season.
- At the request of agencies, instrumentation was installed, and data is now live in our pi system.
- Valves repaired for fish lift attraction flow.
- Hopper hoist maintenance including wheel alignment and greasing.
- Re-engineered MOV4 to give better flow control within the lift. Mechanically complete but electrical upgrade is ongoing.
- MOV5 is being upgraded. The new actuator is significantly larger and requires modifications. Electrical upgrades to support the load of the new actuator have been ordered.
- Both hopper hoists were removed pre-season and sent out to have new gears fabricated and installed. This has produced a significant reduction in noise during lifts.
- Access panels in bottom of A and B entrance gates were welded shut to reduce eddies.



Historical Data Review & Field Testing

Holtwood Fish Lift Study - 2020

Purpose

- Review historical reports (2002 – 2019)
- Identify modifications, breakdowns and studies completed by prior ownership
- Construct a visual timeline of the items above
- Identify contributing factors during years of high catch rates
- Analyze passage success by entrance (A, B &C)
- Recommend further modifications/testing to improve the passage of American Shad

Holtwood Fish Lift Study - 2020

Analysis

- Included:
 - River Conditions
 - Mechanical Conditions
 - Unit Operation
 - Overall efficiency
- Historical Data Used
 - Fish lift reports written by Normandeau Associates from 2002 to 2019
 - Tier II radio telemetry data
- Site Visit
 - Take real time flow measurements during various modes of operation

Holtwood Fish Lift Study - 2020

Tailrace Historical Analysis - 2018

Holtwood Hydro Electric Station, Brookfield Renewable

Table 3.1.2.3-2: 2018 Radio-Tagged American Shad Daily Upstream Movements in the Tailrace Channel

Color Key:

	Inflows less than 30,000 cfs (not colored)
	Inflows 30,000-40,000 cfs
	Inflows 40,001-62,000 cfs
	Inflows 62,001-90,000 cfs
	Inflows greater than 90,000 cfs
	Overall average for all flow bins

Date	Total Fish in the Study Area	Percent of Radio-Tagged American Shad							Project Inflow (cfs)	Tailrace Channel Flow ¹⁹ (cfs)
		In the Study Area Above the Mid-Point of the Tailrace ²²	Above the Midway Point in the Tailrace Detected:				Detected Entering Gates A or B			
			At the Entrance to the ZOP Channel ²³	Moving Upstream in the ZOP Channel ²⁴	At the Powerhouses from DS ²⁵	Entering Gates A or B ²⁶	Entering the Crowder V-Gates ²⁷	Passing Upstream ²⁸		
5/3/2018	15	7%	0%	0%	0%	0%	-	-	41,449	40,025
5/4/2018	27	26%	43%	57%	86%	43%	67%	33%	38,766	37,451
5/5/2018	23	61%	7%	21%	79%	36%	60%	20%	36,221	34,808
5/6/2018	18	56%	10%	20%	100%	30%	100%	0%	35,883	34,830
5/7/2018	20	30%	17%	17%	83%	33%	100%	50%	39,940	38,458
5/8/2018	12	67%	13%	25%	88%	13%	100%	0%	37,005	35,051
5/9/2018	14	57%	13%	25%	50%	0%	-	-	38,115	36,826
5/10/2018	40	23%	11%	44%	89%	89%	88%	0%	39,529	36,889
5/11/2018	48	46%	27%	23%	41%	5%	100%	0%	34,521	33,247
5/12/2018	53	34%	0%	17%	39%	33%	100%	50%	28,916	27,205
5/13/2018	67	21%	0%	29%	57%	29%	75%	25%	42,169	39,612
5/14/2018	76	7%	0%	0%	0%	0%	-	-	59,520	47,530
5/15/2018	54	11%	0%	0%	33%	0%	-	-	97,145	52,203
5/16/2018	38	5%	0%	0%	0%	0%	-	-	103,735	51,875
5/17/2018	25	4%	0%	0%	0%	0%	-	-	104,662	53,624
5/18/2018	13	23%	0%	0%	0%	0%	-	-	113,280	54,732
5/19/2018	10	0%	-	-	-	-	-	-	101,965	54,982
5/20/2018	15	7%	0%	0%	0%	0%	-	-	105,567	55,016
5/21/2018	16	6%	0%	0%	0%	0%	-	-	101,874	54,999
5/22/2018	24	25%	0%	17%	33%	0%	-	-	84,533	55,018
5/23/2018	16	31%	0%	20%	40%	0%	-	-	84,813	53,067
5/24/2018	15	7%	0%	0%	0%	0%	-	-	136,142	55,055
5/25/2018	7	0%	-	-	-	-	-	-	127,057	55,007
5/26/2018	8	38%	0%	0%	33%	0%	-	-	100,983	55,080
5/27/2018	16	6%	0%	0%	0%	0%	-	-	76,373	55,548
5/28/2018	7	29%	0%	0%	0%	0%	-	-	63,094	51,210
5/29/2018	7	0%	-	-	-	-	-	-	47,926	43,664
5/30/2018	28	4%	0%	0%	0%	0%	-	-	45,873	43,025
5/31/2018	19	0%	-	-	-	-	-	-	45,071	42,334
6/1/2018	21	10%	0%	100%	100%	0%	-	-	43,906	41,550
6/2/2018	15	33%	0%	40%	60%	20%	0%	0%	42,399	40,026
6/3/2018	13	31%	0%	50%	75%	25%	100%	100%	38,517	36,780
6/4/2018	10	40%	0%	25%	75%	25%	100%	0%	41,895	39,701
6/5/2018	26	12%	0%	33%	100%	0%	-	-	33,394	31,520
6/6/2018	20	10%	0%	100%	100%	100%	100%	0%	32,402	31,058
Average ²⁹	-	35%	14%	28%	68%	29%	88%	22%	36,101	34,510
Average	-	12%	0%	28%	50%	19%	67%	17%	45,579	41,941
Average	-	22%	0%	14%	29%	0%	-	-	77,203	53,711
Average	-	9%	0%	0%	17%	0%	-	-	109,241	54,257
Overall Average	-	21%	9%	24%	56%	22%	84%	21%	64,133	44,257

Source: Gomez & Sullivan, 2020

Holtwood Fish Lift Study - 2020

Spillway Historical Analysis - 2018

Holtwood Hydro Electric Station, Brookfield Renewable

Table 3.1.2.3-1 2018 Radio-Tagged American Shad Daily Upstream Movements in the Spillway Channel

Date	Total Fish in the Study Area	Percent of Radio-Tagged American Shad					
		In the Spillway Channel ¹⁶	In the Spillway Channel that Entered Gate C ¹⁷	That Entered Gate C		Project Inflow (cfs)	Spillway Channel Flow (cfs) ²⁰
				Detected Entering the Crowder V-Gates ¹⁸	That Passed Upstream ¹⁹		
5/3/2018	15	0%	-	-	-	41,449	1,100
5/4/2018	27	7%	50%	0%	0%	38,766	1,315
5/5/2018	23	30%	71%	100%	0%	36,221	1,414
5/6/2018	18	44%	88%	100%	14%	35,883	1,053
5/7/2018	20	20%	100%	100%	25%	39,940	1,482
5/8/2018	12	8%	0%	-	-	37,005	1,954
5/9/2018	14	29%	50%	100%	50%	38,115	1,289
5/10/2018	40	8%	0%	-	-	39,529	1,295
5/11/2018	48	6%	0%	-	-	34,521	1,273
5/12/2018	53	6%	67%	100%	0%	28,916	1,711
5/13/2018	67	13%	11%	100%	0%	42,169	2,116
5/14/2018	76	20%	53%	88%	0%	59,520	11,990
5/15/2018	54	4%	0%	-	-	97,145	47,296
5/16/2018	38	8%	0%	-	-	103,735	52,711
5/17/2018	25	0%	-	-	-	104,662	52,206
5/18/2018	13	0%	-	-	-	113,280	60,916
5/19/2018	10	0%	-	-	-	101,965	49,375
5/20/2018	15	0%	-	-	-	105,567	52,959
5/21/2018	16	6%	100%	0%	0%	101,874	49,303

Color Key:

	Inflows less than 30,000 cfs (not colored)
	Inflows 30,000-40,000 cfs
	Inflows 40,001-62,000 cfs
	Inflows 62,001-90,000 cfs
	Inflows greater than 90,000 cfs
	Overall average for all flow bins

Source: Gomez & Sullivan, 2020

Holtwood Hydro Electric Station, Brookfield Renewable

Date	Total Fish in the Study Area	Percent of Radio-Tagged American Shad				Project Inflow (cfs)	Spillway Channel Flow (cfs) ²⁰
		In the Spillway Channel ¹⁶	In the Spillway Channel that Entered Gate C ¹⁷	That Entered Gate C			
				Detected Entering the Crowder V-Gates ¹⁸	That Passed Upstream ¹⁹		
5/22/2018	24	8%	0%	-	-	84,533	32,022
5/23/2018	16	19%	0%	-	-	84,813	34,112
5/24/2018	15	0%	-	-	-	136,142	83,478
5/25/2018	7	0%	-	-	-	127,057	74,450
5/26/2018	8	13%	0%	-	-	100,983	48,404
5/27/2018	16	25%	25%	100%	0%	76,373	23,722
5/28/2018	7	29%	0%	-	-	63,094	11,884
5/29/2018	7	29%	0%	-	-	47,926	2,948
5/30/2018	28	0%	-	-	-	45,873	2,848
5/31/2018	19	5%	0%	-	-	45,071	2,737
6/1/2018	21	10%	100%	50%	0%	43,906	2,356
6/2/2018	15	47%	86%	67%	0%	42,399	2,373
6/3/2018	13	8%	100%	100%	0%	38,517	1,736
6/4/2018	10	20%	0%	-	-	41,895	2,194
6/5/2018	26	0%	-	-	-	33,394	1,874
6/6/2018	20	5%	100%	0%	0%	32,402	1,344
Average ²¹	-	12%	62%	91%	13%	36,101	1,478
Average	-	15%	45%	76%	0%	45,579	3,407
Average	-	17%	9%	100%	0%	77,203	25,435
Average	-	3%	14%	0%	0%	109,241	57,110
Overall Average	-	11%	45%	83%	7%	64,133	20,607

Holtwood Fish Lift Study - 2020

Historical Analysis – Tailrace 2019

Holtwood Hydro Electric Station, Brookfield Renewable

Table 3.1.2.4-2: 2019 Radio-Tagged American Shad Daily Upstream Movements in the Tailrace Channel

Date	Total Fish in the Study Area	Percent of Radio-Tagged American Shad									Project Inflow (cfs)	Tailrace Channel (cfs) ^(f)
		In the Tailrace Channel ^(a)	At or Above Station 16 Detected:					Detected Entering Gates A or B Detected:				
			At the Entrance to the ZOP Channel ^(b)	Moving Upstream in the ZOP Channel ^(c)	At the Powerhouses from DS ^(d)	Gates A or B Nearfield ^(e)	Entering Gates A or B ^(f)	Entering the Crowder V-Gates ^(g)	At the Crowder Channel ^(h)	Passing Upstream ⁽ⁱ⁾		
5/1/2019	0	-	-	-	-	-	-	-	-	-	62,909	52,924
5/2/2019	3	67%	50%	0%	0%	50%	0%	-	-	-	59,965	55,140
5/3/2019	23	39%	33%	0%	67%	89%	33%	100%	33%	0%	54,877	49,912
5/4/2019	50	36%	17%	11%	72%	83%	56%	70%	10%	0%	52,681	48,548
5/5/2019	42	45%	32%	16%	79%	95%	53%	80%	20%	10%	58,530	53,416
5/6/2019	40	40%	13%	0%	63%	88%	69%	73%	27%	0%	87,435	51,528
5/7/2019	49	20%	10%	10%	70%	100%	40%	100%	0%	0%	102,445	47,716
5/8/2019	51	25%	0%	23%	69%	69%	62%	88%	25%	0%	88,721	51,005
5/9/2019	55	22%	8%	8%	83%	83%	58%	86%	14%	0%	76,186	49,522
5/10/2019	47	13%	17%	0%	100%	83%	0%	-	-	-	64,689	50,701
5/11/2019	34	9%	33%	0%	100%	100%	33%	0%	0%	0%	59,642	52,224
5/12/2019	27	19%	20%	20%	60%	20%	0%	-	-	-	60,844	54,263
5/13/2019	25	4%	0%	0%	100%	100%	0%	-	-	-	105,013	49,856
5/14/2019	11	0%	-	-	-	-	-	-	-	-	150,973	54,422
5/15/2019	8	0%	-	-	-	-	-	-	-	-	167,002	54,726
5/16/2019	3	0%	-	-	-	-	-	-	-	-	157,587	55,066
5/17/2019	8	0%	-	-	-	-	-	-	-	-	130,625	55,544
5/18/2019	14	0%	-	-	-	-	-	-	-	-	104,945	53,796
5/19/2019	14	14%	50%	0%	100%	50%	0%	-	-	-	86,488	48,732
5/20/2019	11	18%	0%	0%	50%	100%	0%	-	-	-	80,060	42,069
5/21/2019	14	21%	0%	0%	67%	67%	0%	-	-	-	75,822	46,312
5/22/2019	10	0%	-	-	-	-	-	-	-	-	64,545	48,765
5/23/2019	6	0%	-	-	-	-	-	-	-	-	57,756	49,893

Color Key:

	Inflows 40,001-62,000 cfs
	Inflows 62,000-90,000 cfs
	Inflows greater than 90,000
	Overall average for all flow bins

Source: Gomez & Sullivan, 2020

Holtwood Fish Lift Study - 2020

Historical Analysis – Tailrace 2019

Holtwood Hydro Electric Station, Brookfield Renewable

Date	Total Fish in the Study Area	Percent of Radio-Tagged American Shad									Project Inflow (cfs)	Tailrace Channel (cfs) ⁴⁷
		In the Tailrace Channel ⁴⁸	At or Above Station 16 Detected:					Detected Entering Gates A or B Detected:				
			At the Entrance to the ZOP Channel ⁴⁹	Moving Upstream in the ZOP Channel ⁵⁰	At the Powerhouses from DS ⁴¹	Gates A or B Nearfield ⁴²	Entering Gates A or B ⁴³	Entering the Crowder V-Gates ⁴⁴	At the Crowder Channel ⁴⁵	Passing Upstream ⁴⁶		
5/24/2019	10	30%	0%	0%	100%	0%	0%	-	-	-	53,171	35,581
5/25/2019	31	42%	15%	0%	100%	77%	23%	67%	0%	0%	56,119	21,742
5/26/2019	33	45%	20%	0%	80%	80%	27%	100%	0%	0%	51,457	25,834
5/27/2019	27	26%	0%	0%	86%	100%	0%	-	-	-	42,496	27,407
5/28/2019	13	54%	29%	0%	86%	71%	14%	0%	0%	0%	46,334	40,973
5/29/2019	5	20%	0%	0%	0%	100%	100%	0%	0%	0%	49,713	47,567
5/30/2019	6	17%	0%	0%	100%	100%	0%	-	-	-	57,175	49,421
5/31/2019	12	33%	0%	25%	50%	100%	0%	-	-	-	89,581	40,358
6/1/2019	10	30%	33%	0%	100%	100%	0%	-	-	-	97,740	43,694
6/2/2019	11	18%	0%	0%	100%	50%	0%	-	-	-	91,250	41,501
6/3/2019	4	0%	-	-	-	-	-	-	-	-	84,537	44,642
6/4/2019	3	0%	-	-	-	-	-	-	-	-	72,820	41,664
6/5/2019	1	0%	-	-	-	-	-	-	-	-	62,952	43,345
Average	-	33%	21%	6%	79%	80%	32%	73%	12%	3%	54,340	43,709
Average	-	21%	11%	4%	73%	84%	40%	78%	22%	0%	75,669	46,730
Average	-	15%	7%	14%	76%	83%	41%	92%	17%	0%	119,630	50,732
Overall Average	-	25%	16%	7%	77%	81%	36%	78%	16%	2%	79,586	46,667

Color Key:

	Inflows 40,001-62,000 cfs
	Inflows 62,000-90,000 cfs
	Inflows greater than 90,000
	Overall average for all flow bins

Source: Gomez & Sullivan, 2020

Holtwood Fish Lift Study - 2020

Historical Analysis – Spillway 2019

- Lower in flows = Higher numbers

Holtwood Hydro Electric Station, Brookfield Renewable

Table 3.1.2.4-1: 2019 Radio-Tagged American Shad Daily Upstream Movements in the Spillway Channel

Date	Total Fish in the Study Area	Percent of Radio-Tagged American Shad						Project Inflow (cfs)	Spillway Channel (cfs) ¹⁾
		In the Spillway Channel ¹⁾	In the Spillway Channel Detected:		Entering Gate C Detected:				
			In the Gate C Nearfield ²⁾	Entering Gate C ³⁾	At the Crowder V-Gates ⁴⁾	At the Crowder Channel ⁵⁾	Passing Upstream ⁶⁾		
5/2/2019	3	33%	100%	0%	-	-	-	39,965	6,148
5/3/2019	23	70%	88%	50%	100%	88%	25%	34,877	6,709
5/4/2019	50	80%	90%	63%	88%	60%	28%	52,681	5,858
5/5/2019	42	67%	96%	61%	100%	85%	18%	58,530	6,806
5/6/2019	40	50%	70%	20%	75%	0%	0%	87,435	37,335
5/7/2019	49	27%	0%	0%	-	-	-	102,443	33,877
5/8/2019	51	24%	0%	0%	-	-	-	88,721	38,993
5/9/2019	55	27%	7%	0%	-	-	-	76,186	28,125
5/10/2019	47	19%	0%	0%	-	-	-	64,889	15,616
5/11/2019	34	32%	36%	27%	100%	67%	33%	59,642	8,880
5/12/2019	27	30%	50%	25%	100%	50%	0%	60,844	7,767
5/13/2019	25	4%	0%	0%	-	-	-	105,013	33,344
5/14/2019	11	9%	0%	0%	-	-	-	150,973	96,607
5/15/2019	8	0%	-	-	-	-	-	167,002	112,691
5/16/2019	3	33%	0%	0%	-	-	-	157,387	103,634
5/17/2019	8	25%	0%	0%	-	-	-	130,625	76,302
5/18/2019	14	21%	33%	33%	100%	100%	0%	104,945	52,663
5/19/2019	14	29%	0%	0%	-	-	-	86,488	39,307
5/20/2019	11	18%	50%	0%	-	-	-	80,060	39,051
5/21/2019	14	21%	0%	0%	-	-	-	75,622	30,511
5/22/2019	10	10%	0%	0%	-	-	-	64,345	16,858
5/23/2019	6	17%	0%	0%	-	-	-	57,756	9,136
5/24/2019	10	10%	0%	0%	-	-	-	53,171	18,833
5/25/2019	31	13%	0%	0%	-	-	-	56,119	35,509
5/26/2019	33	39%	23%	0%	-	-	-	51,457	26,872
5/27/2019	27	22%	33%	0%	-	-	-	42,496	16,338
5/28/2019	13	15%	100%	0%	-	-	-	46,334	6,866
5/29/2019	5	20%	100%	0%	-	-	-	49,713	3,432
5/30/2019	6	50%	67%	33%	0%	0%	0%	57,175	9,022
5/31/2019	12	8%	100%	100%	0%	0%	0%	89,581	50,082
6/1/2019	10	0%	-	-	-	-	-	87,740	34,902
6/2/2019	11	9%	0%	0%	-	-	-	91,250	30,593
6/3/2019	4	0%	-	-	-	-	-	84,537	40,705
6/4/2019	3	33%	0%	0%	-	-	-	72,820	32,123
6/5/2019	1	0%	-	-	-	-	-	62,952	20,411
Average	-	44%	71%	41%	93%	64%	23%	34,340	12,000
Average	-	27%	30%	9%	60%	0%	0%	75,669	30,090
Average	-	18%	3%	3%	100%	100%	0%	119,630	69,781
Overall Average	-	32%	51%	28%	90%	60%	21%	79,586	34,080

Color Key:

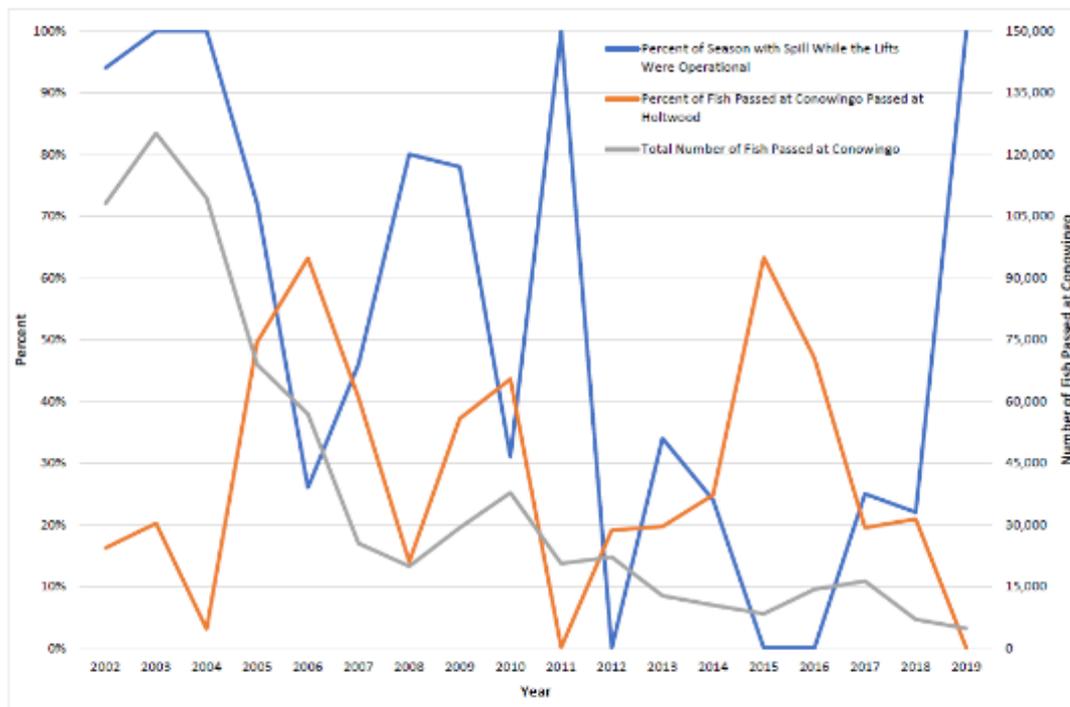
	Inflows 40,001-62,000 cfs
	Inflows 62,000-90,000 cfs
	Inflows greater than 90,000
	Overall average for all flow bins

Source: Gomez & Sullivan, 2020

Primary Finding – Site Level

Hollywood Hydro Electric Station, Brookfield Renewable

Figure 3.1.1.2-3: Yearly Spill Conditions and Fish Passage Efficiency Relative to Conowingo Passage



Hollywood Hydro Electric Station
FERC No. 1881

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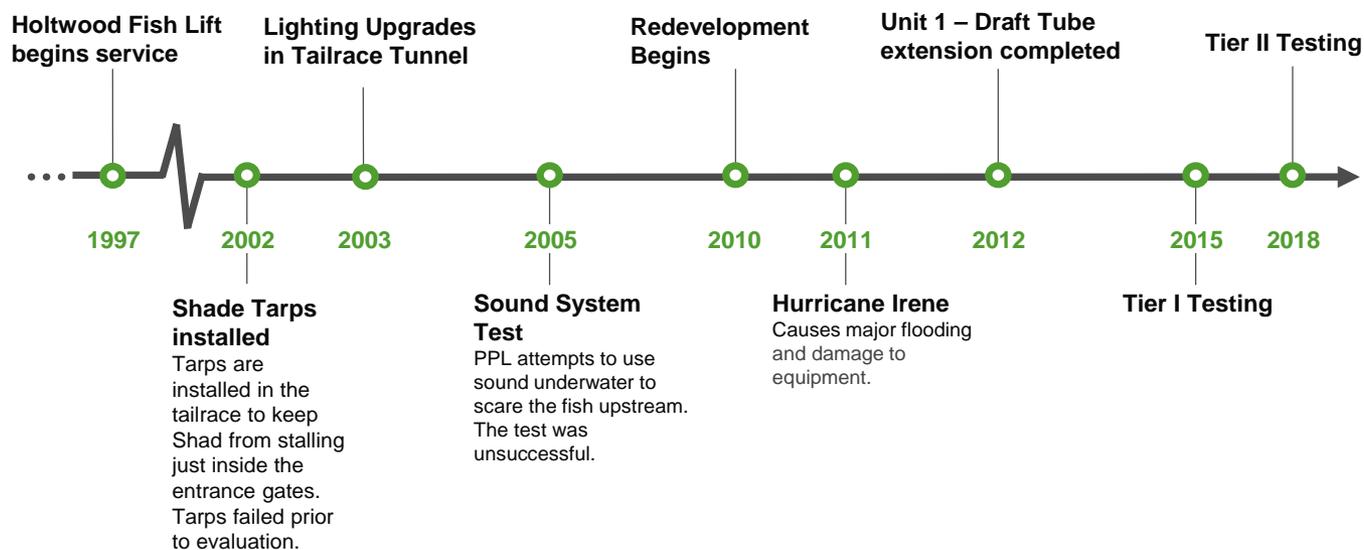
Historical Data Summary Report
June 2020

Source: Gomez & Sullivan, 2020

Direct correlation between **River Flow** and **Successful Passage**

Timeline – Holtwood Fish Lift

Tests and Events



Field Measurements – Entrance C (Spillway)

July 21st & 22nd 2020

- **Entrance C in service** – A/B out of service
 - Automatic mode using the existing valve matrix
 - MOV 5 at 32.5%
 - MOV 6 at 49.5%
- **Crowder Measurements**
 - Flow measurements taken at two depths in two foot increments across the crowder channel
 - Crowder channel average flow measurement was 1.6ft/s
 - USFWS target velocity is 1 to 1.5ft/s (low end is preferred)
 - Notable upwelling upstream of the crowder gates
- **Entrance Gate Measurements**
 - Flow measurements taken at one depth in two foot intervals across the entrance
 - Flows ranged from 4.4 to 4.7ft/s
 - USFWS target is 4 to 6ft/s
 - Flow looked good with little eddying, but notable upwelling just upstream of the gate

Field Measurements – Entrance C (Spillway)

July 21st & 22nd 2020

- **Manual Manipulation – Test 1**
 - Adjust MOV 5 to 100% & 6 stays at 49.5% to eliminate upwelling
 - Produced velocities of 2.2 to 3.3 ft/s at the crowder
 - Produced velocities of immeasurable amounts at the entrance
 - Eliminated upwelling at crowder and entrance



Photo 2: Entrance Gate Flow Observed with Matrix Settings



Photo 3: Upwelling along spillway lift channel wall downstream of turn with matrix settings



Photo 5: High Velocity, Turbulent Flow at Entrance Gate C with increased Crowder Flo

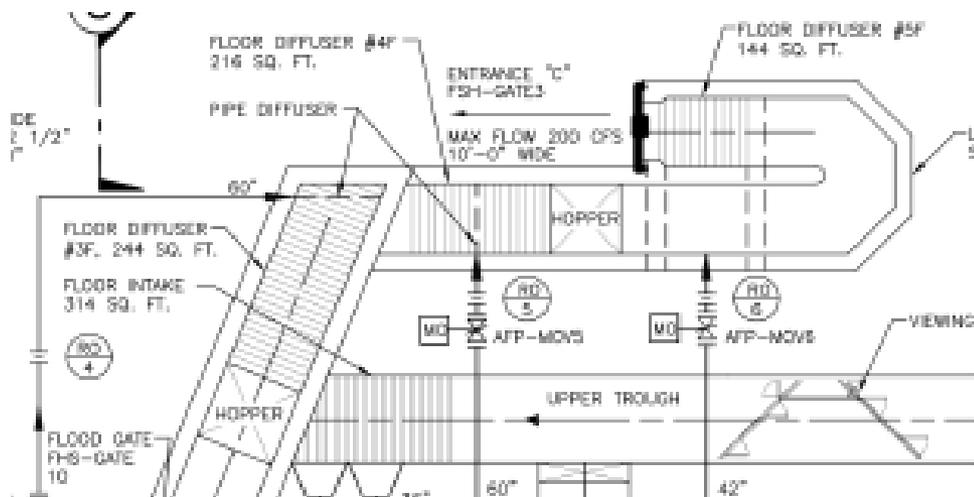
Source: Gomez & Sullivan, 2020

Field Measurements – Entrance C (Spillway)

July 21st & 22nd 2020

- **Manual Manipulation – Test 2**

- Adjust MOV's 5 (39.5% open) & 6 (49.5% open) to eliminate upwelling
 - Matrix = MOV 5 at 32.5% & MOV 6 at 49.5%
- Produced velocities of **0.9 to 1.7 ft/s** at the **crowder**
 - Target is 1 – 1.5ft/s
- Produced velocities of **3.4 to 5.5 ft/s** at the **entrance**
 - Target is 4 to 6ft/s



Field Measurements – Entrance C (Spillway)

July 21st & 22nd 2020

- **Entrances A,B & C in service**
 - Automatic mode using the existing valve matrix

- **Hopper Measurements**
 - Flow measurements taken at two depths in two foot intervals across the entrance
 - Flows ranged from 0.4 to 0.8ft/s
 - USFWS target is 0.5 to 1.5ft/s

- **Crowder Measurements**
 - Flow measurements taken at two depths in two foot increments across the crowder channel
 - Crowder channel average flow measurement was 0.3 to 0.8ft/s
 - USFWS target velocity is 1 to 1.5ft/s (low end is preferred)
 - Notable upwelling upstream of the crowder gates

- **Entrance Gate A Measurements**
 - Flow measurements taken at one depth due to high velocities
 - Flow was 6.6ft/s
 - USFWS target is 4 to 6ft/s
 - High turbulence and roller waves were visible during this measurement

Field Measurements – Entrance C (Spillway)

July 21st & 22nd 2020

- **Entrances A,B & C in service**
 - Automatic mode using the existing valve matrix
- **Entrance Gate B Measurements**
 - Flow measurements taken at one depth due to high velocities
 - Flow was 10ft/s
 - USFWS target is 4 to 6ft/s
 - High turbulence and roller waves were visible during this measurement
 - Eddying and upwelling were visible just upstream of both A&B gates
- **Manual Adjustment to Tailrace**
 - Lowered both gates to 6.5ft below water surface
 - MOV 4 opened until flow at the crowder reached 1.5ft/sec
 - Entrance A flow was 4.5ft/sec
 - Entrance B flow was 5.5ft/sec

Holtwood Fish Lift Study - 2020

Conclusions

- Flow on the Susquehanna below station capacity is the largest contributing factor to far field attraction
- Flow within the entrance flumes are the primary cause of poor internal efficiency
- Spill greater than 8,000cfs shows significant negative impact to the Spillway attraction (Masking)
- Mechanical failures are a minor contributing factor

- **Next Steps**
 - Complete CFD model and update operating matrix – Project awarded to G&S
 - Complete field testing to validate new matrix meets USFWS criteria

2021 Fish Passage

- **2021 Fish Passage:**
 - Based on a call with agencies on October 20, 2020, Brookfield submitted a request on November 17, 2020 to suspend 2021 spring and fall fish passage as well as the Tier II radio telemetry study due to concerns with the spread of invasive species.
 - If approved, Brookfield will need to file with FERC for review and approval.
- **2021 Planned Projects:**
 - MOV and limit torque inspection and rehabs – Several each year
 - CFD modeling and flow testing/refinement
 - Revised operating matrix
 - FOP update



Fall Resident Fish Passage Review

Fall Resident Fish Passage Requirement

- **Regulatory Requirements**

- Article 47 of FERC License
- USFWS Prescription for Fishways
- PA DEP 401WQC III.D
- 2018 was Year 5 of fall resident fish passage

- **401 Water Quality Cert Language**

- For a period of 5 years (excluding high flows), licensee shall operate the fish passage system from September 1 through October 15 in order to facilitate fall passage of resident fish.
- Up to 5 days per week and 6 hours per day
- At annual FPTAC meeting, licensee and agencies shall discuss the Sept/Oct passage
- If licensee demonstrates to DEP's satisfaction, in consultation with Resource Agencies, that the fall passage of resident fish presents a significant and unacceptable risk that the fish passage facilities will not be available for spring operation, then licensee may discontinue fall operation of the fish passage facilities upon receipt of written approval from the DEP.
- At the meeting preceding the end of this 5 year period, licensee and agencies shall discuss whether modifications to the fish passage system operation for resident fish species are necessary. A decision concerning operation of the system in Sept/Oct shall be based on monitoring results and licensee's experience with making repairs to any damage to the fish passage facility in time for spring operation.

Fall Resident Fish Passage Requirement

- **FERC License – Article 47**

- The licensee shall prepare an evaluation of the results of the fish lift operation to determine if additional fall operations are warranted, and file a report of this evaluation, along with its recommendations for any future fall operations with the Commission for approval. The licensee shall include with the final report documentation of consultation, copies of agency comments and recommendations, and a description of how the agency comments are accommodated in the analysis.
- The licensee shall allow a minimum of 30 days for the agencies to comment and to make recommendations before filing the report with the Commission for approval. If the licensee does not adopt a recommendation, the filing shall include the licensee's reasons, based on project-specific information. The Commission reserves the right to require changes to any plan for future fall fish lift operations. The plan shall not be implemented until the licensee is notified that the plan is approved by the Commission. Upon Commission approval, the licensee shall implement the plan, including any changes required by the Commission.

Fall Resident Fish Passage 2014-2019

- **2014**
 - September 2 to October 15 (34 days)
 - Low flow, limited turbine operation due to dredging in tailrace
 - Gizzard shad and minnows comprised 99.9% of total fish passed
- **2015**
 - September 1 to October 15 (35 days)
 - Low flow, limited turbine operation
 - Gizzard shad and minnows comprised 99.9% of total fish passed
- **2016**
 - No fall fish passage due to repairs to tailrace crowder and spillway hopper from June
- **2017**
 - 32 days
 - Tailrace fish lift only, spillway hopper failed May 24 and needed extensive repairs while dewatered
 - Gizzard shad and minnows comprised 99.9% of total fish passed
- **2018**
 - September 4 to September 27 (6 days)
 - High flows shut down lift, Gate 9 mechanical failure on 9/24
 - Comely shiners comprised 66% of total fish passed
- **2019**
 - September 3 to October 15 (33 days)
 - Tailrace lift only operated 15 of the 33 days
 - Low flows – Down to 5,700 cfs

Fish Lift - Data Summary

Six-year Summary of Holtwood Fall Resident Fish Passage Operations (2014-2019).

YEAR	2014	2015	*2016*	**2017	2018	2019
# Days of Operation	34	35	0	32	6	33
Hours of Operation (Tailrace)	182	201.2	0	184	34	61.3
# of Tailrace Lifts	224	229	0	200	40	67
Hours of Operation (Spillway)	191.5	222	0	0	34.1	186.5
# of Spillway Lifts	220	222	0	0	39	228
SPECIES						
Gizzard Shad	1,448,307*	603,331*		4,786	38	97,361*
American Eel		1				
Rainbow Trout	1					
Minnows (Notropis)	147,920*			12,060*		114,518*
Carp	57	32		7	3	7
Comely Shiner					900*	
Quillback				1		1
Shorthead Redhorse	4	1		1		1
Channel Catfish	550	301		88	201	317
Flathead Catfish	1	3		1		20
Striped Bass	1			1		
Rock Bass	1	1				1
Pumpkinseed	2					
Bluegill	47	34		6	19	349
Smallmouth Bass	31	19		79	198	113
Largemouth Bass	2			4		
White Crappie	2				2	
Black Crappie	1				2	
Walleye	232	87		4		8
Yellow Perch					1	
Hybrid Striped Bass	3					
Atlantic Needlefish		11				
Total # of Fish	1,597,162	603,821	0	17,038	1,364	212,696
Number of Species	16	11	0	12	9	10
Number of Hybrids	1	0	0	0	0	0

* Denotes estimated values due to large numbers of juvenile gizzard shad and minnows.

2016: No operation in Fall due to repair work stemming from equipment malfunctions in spring.

**2017: No operation of spillway lift due to repair work stemming from equipment malfunctions in spring.

Future Fall Resident Fish Passage

- Brookfield concerns:
 - Fall passage operation increases necessary maintenance which cannot be performed over winter for reliable operation for priority Spring Passage season. Winter work is not safe.
 - Less time to make repairs and maintain lift. Limited now to July/August and Nov-March. Once air or water temperatures near freezing the fish lift ices up, no work for safety reasons.
- Roundtable discussion on original intention and future of fall fish passage on Susquehanna River
- At the 2018 meeting, PADEP committed to follow up on this item and later responded on August 12, 2019 requesting the Brookfield operate the fall 2019 season and DEP will then reevaluate the fall fish passage program.
- By email dated May 18, 2020, PADEP requested the Brookfield suspend fall fish passage in 2020 due to the possible spread of invasive species.
- Based on a call with agencies on October 20, 2020, Brookfield submitted a request on November 17, 2020 to suspend 2021 fall fish passage due to concerns with the spread of invasive species.



Safe Harbor Hydro Facility, Pennsylvania, United States

Basin-wide Eel Study

Questions?



References

- Gomez & Sullivan Engineers. 2020. Holtwood Hydro Electric Project, Historical Data Summary Report Report. Report prepared for Brookfield Renewable. June 2020
- Gomez & Sullivan Engineers.2020. Holtwood Fish Passage Efficiency Evaluation – Hydraulic Evaluation Report. Report prepared for Brookfield Renewable. September 2020