Brookfield
Renewable U.S.

January 15, 2024

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

RE: Milford (FERC No. 2534), Orono (FERC No. 2710), and Stillwater (FERC No. 2712) Projects; 2023 Diadromous Fish Passage Study Report

Dear Secretary Bose:

On behalf of the licensees for the Projects listed below, Black Bear Hydro Partners, LLC is filing this 2023 Diadromous Fish Passage Study Report for studies conducted at the Milford, Stillwater, and Orono hydroelectric projects, which are located on the Penobscot River in Maine:

- **Milford Project (FERC No. 2534),** licensed to Black Bear Hydro Partners, LLC
- **Orono Project (FERC No. 2710),** licensed to Black Bear Hydro Partners, LLC; Black Bear SO, LLC; and Black Bear Development Holdings, LLC
- **Stillwater Project (FERC No. 2712),** licensed to Black Bear Hydro Partners, LLC; Black Bear SO, LLC; and Black Bear Development Holdings, LLC (collectively, "Black Bear")

Background

Pursuant to Commission Orders "*Amending License and Revising Annual Charges*" for the Orono and Stillwater Projects (both dated September 14, 2012) and "*Approving Fish Passage Design Drawings Under Articles 407 and 408"* for the Milford Project (dated October 9, 2012), and consistent with the June 25, 2004 Lower Penobscot River Multiparty Settlement Agreement (Settlement Agreement), aspects of which were incorporated into the Orono Project license on December 8, 2005 and the Milford and Stillwater Project licenses on April 18, 2005, the licensees constructed and installed upstream and downstream fish passage systems at the Milford, Orono, and Stillwater (downstream only) Projects in 2013 and 2014 to facilitate the passage of diadromous fish species on the Penobscot River. Articles 409, 411, and 408 of the Milford, Orono, and Stillwater Project licenses, respectively, also require evaluations of the constructed fishways to determine their effectiveness at passing alosines (collectively American shad, blueback herring, and sea run alewives) and American eels. The Commission-approved Species Protection Plan (SPP) and National Marine Fisheries Service's (NMFS's) 2012 Biological Opinion (BiOp) outline the passage effectiveness requirements for upstream and downstream-migrating Atlantic salmon adults and outmigrating juveniles (smolts).

A summary of the quantitative monitoring studies conducted to date on the upstream and downstream Project fish passages are provided in Table 1 below. Additional diadromous fish passage studies conducted by the licensees at these Projects since 2014 for Atlantic salmon have been reported[1] separately to the Commission, as have the results of ongoing upstream eel monitoring efforts on the lower Penobscot River[2].

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[1] Annual Atlantic Salmon Species Protection Plan Report of Activities for Milford, Orono, Stillwater, West Enfield and Medway Projects are filed annually by March 30th.

[2] Annual Upstream Eel Fishway Operation, Monitoring, and Maintenance Report for Milford, Orono, Stillwater and West Enfield are filed with the Commission and the MDEP annually by March 31st.

Table 1 - Diadromous Fish Studies Conducted by Black Bear at the Stillwater, Orono and Milford Projects

Species	Stillwater Upstream	Stillwater Downstream	Orono Upstream	Orono Downstream	Milford Upstream	Milford Downstream
Salmon – juvenile	*NA*	2014-2018	*NA*	2014-2018	*NA*	2014-2018
Salmon - adult	*NA*	*10 yrs following smolt enhancements*	2014; 2015	*10 yrs following smolt enhancements*	2014; 2015	*10 yrs following smolt enhancements*
Shad - juvenile	*NA*	*By proxy - 2020 alosine study*	*NA*	*By proxy - 2020 alosine study*	*NA*	*By proxy - 2020 alosine study*
Shad - adult	*NA*	2017; 2018	--	2017; 2018	2022	2017; 2018
Herring - juvenile	*NA*	2020	*NA*	2020	*NA*	2020; 2021 (sensor fish)
Herring - adult	*NA*	2018	2015; 2021	2018	2015; 2019; 2021	2018
Eel - adult	*NA*	2016; 2021 reanalysis	*NA*	2016; 2021 reanalysis	*NA*	2016; 2021 reanalysis
Eel - juvenile	2014; 2016; 2017; 2022	*NA*	2014; 2016; 2022	*NA*	2008 – 2018	*NA*

In addition, the licensees have conducted several years of qualitative fish passage evaluation and continued collaboration with the Maine Department of Marine Resources (MDMR) to collect upstream fish lift tallies of migratory fish at the Milford and Orono Projects in 2023 (see Table 2), including the trucking of river herring (collectively, alewife and blueback herring) upriver from Orono.

Table 2 - Annual counts of American shad and river herring at the Milford and Orono Project fish lifts in the lower Penobscot River, Maine

	Milford		Orono	
	American shad	River Herring	American shad	River Herring
2014	812	187,429	0	2,075
2015	1,806	589,503	1	19,016
2016	7,862	1,259,384	6	78,700
2017	3,868	1,256,061	0	90,483
2018	3,958	2,174,745	6	93,939
2019	2,522	1,987,681	9	163,126
2020	11,276	1,952,537	2	111,518
2021	11,581	1,731,496	2	201,565
2022	7,582	2,852,037	2	230,738
2023	4,154	5,490,195	2	232,045
TOTAL	55,421	19,481,068	30	1,223,205

2023 Evaluations

Upstream passage studies of the Milford fish lift for adult river herring (2019 and 2021) and American shad (2022) have demonstrated a significant number of failed passage attempts, many of which occur in the vicinity of the floor diffuser and V-gate as the fish pass through the entrance flume on their way to the lifting hopper. As a result of discussions with the resource agencies and Penobscot Indian Nation (PIN) at fish passage study planning meetings held in late 2022, an ad hoc work group comprised of fish passage engineers from the National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (USFWS), and biologists from the MDMR, PIN, and Black Bear, was established to explore options for modifying operational parameters of the Milford fish lift facility to potentially improve internal fish passage efficiency.

Over the course of several virtual meetings held in early 2023, the ad hoc work group reviewed the Milford fish lift facility design and agreed that it is constructed and is being operated according to fishway engineering guidelines (USFWS 2019) and as intended. While the 180° turn in the fish lift entrance flume was an undesirable, but necessary, design feature, there is no evidence from the passage studies that the turn in the entrance flume is affecting fish passage at Milford. The work group considered laboratory and case studies focused on a variety of topics, including fish passage operations and reported passage results from other facilities with similar species, and they reviewed literature and best available science related to fish swimming abilities (burst, sustained, and long-term time periods). The group was not able to identify any other fish lifts with significantly or consistently higher passage results for alosine species of fish than what has been observed at Milford to date, including those with straight entrance flumes.

Based on the results of the fish passage studies conducted at Milford for river herring and shad, and considering the extensive review and discussions, the work group came to consensus that using underwater cameras to qualitatively evaluate swimming behavior and responses of fish in the entrance flume of the Milford fish lift to various operating conditions (with a focus on injection of the supplemental auxiliary attraction flow upstream of the hopper and through the floor diffuser), including conditions outside of the recommended fishway operating guidelines, may provide valuable insight as to potential permanent changes in operating parameters of the lift to improve the overall effectiveness of the facility.

As described in the study plan submitted to the Commission on March 8, 2023, an array of underwater cameras were installed in the entrance flume of the fish lift to monitor fish behavior in response to various attraction water, V-gate, and entrance gate settings. Real-time observations were made for each scenario, as well as reviews of recorded video. Based on observations from the 2023 study, Black Bear is recommending increases in the (1) maximum range of hopper flow to a velocity of 2.5 ft/s, (2) the maximum range of flow and head differential at the entrance to 7 ft/s and 1.25 ft., respectively, and (3) the width of the V-gate from 14.4 inches to 19.2 inches (i.e., changing the PLC setting for the V-gate from 6.0 to 8.0).

The increased hopper velocity will provide for more attraction water flow injected upstream of the hopper, thus reducing the impact of flow emitted through the floor diffuser. The increased flow velocity at the entrance of the lift (from a range of 4-6 ft/s up to 5-7 ft/s), together with an increase in head differential at the entrance (from a range of 0.5-1.0 ft up to 0.75-1.25 ft.), were also found to improve fish passage conditions. And finally, Black Bear intends to change the V-gate setting from 6.0 to 8.0 (from 14.4 to 19.2 inches) based upon the 2023 observations. However, Black Bear will defer to resource agency professional judgement if a different V-gate setting is preferred.

Please find attached a report covering the underwater video study conducted at the Milford Project in 2023. A draft of the report was distributed for agency and tribal review on November 14, 2023. A consultation meeting was then held virtually on December 13, 2023 with the resource agencies and PIN to present and review the study results and to answer questions. Responses to questions and comments received during the December 13th meeting are provided in Appendix B of the attached report, while correspondences associated with the agency reviews of the report and Black Bear's responses are respectively provided in Appendices C and D. Finally, a copy of the PowerPoint slides prepared and presented by FishTec, Inc at the December 13th meeting are attached in Appendix E of the report. Where appropriate, the report has been revised based on the comments received.

Please feel free to contact me by e-mail at Kevin.Bernier@brookfieldrenewable.com or by phone at (207) 951-5006 if you have any questions or comments.

Sincerely,

Kevin Bernier

Kevin Bernier
Senior Compliance Specialist

Attachment:

cc: S. Ledwin, M. Simpson, C. Clark, J. Valliere, L. Hammer; MDMR
D. McCaw, C. Loring, Jr.; PIN
H. Peterson, L. Rawlings; BIA
B. Sojkowski, J. Rosset, A. Cross; USFWS
J. Murphy, D. Dow; NMFS
J. Perry, K. Dunham, K. Gallant; MDIFW
L. Paye; MDEP
S. Michaud, D. Bates, B. Brochu, C. Goodhart, R. Dill, R. Dorman, L. Macomber,
D. Heidrich, S. Hill, R. Smith; Black Bear
M. Sears, FishTec, LLC

Black Bear Files:
Black Bear/Licensing & Compliance/Milford 2534/01 Brookfield Corres
Black Bear/Licensing & Compliance/Orono 2710/01 Brookfield Corres
Black Bear/Licensing & Compliance/Stillwater 2712/01 Brookfield Corres

2023 Upstream Fish Passage Monitoring Study Report:

Video monitoring of the entrance flume of the Milford fish lift.

Milford Hydroelectric Project (FERC No. 2534)

January 2024

Prepared by FishTec, LLC

Prepared for Black Bear Hydro Partners, LLC

Contents

Appendices

1.0 Introduction

Black Bear Hydro Partners, LLC (Black Bear or BBHP), an affiliate of Brookfield Renewable U.S. (Brookfield), is the licensee for the Milford Project (FERC No. 2534), which is located on the Penobscot River in Penobscot County, Maine, approximately 60 river kilometers upstream from Verona Island in Penobscot Bay. The Penobscot River provides habitat for several species of migratory (diadromous) fish, including Atlantic salmon, alosines (i.e., blueback herring, alewives, and American shad), sea lamprey and American eels.

Pursuant to the amended license for the Milford Project and a 2004 settlement agreement between the licensee, state and federal agencies, Penobscot Indian Nation (PIN), and other stakeholders, the licensee developed a comprehensive upstream and downstream fish passage program to facilitate the passage of diadromous fish species on the Penobscot River. Since installation the Milford Dam fish lift facility has passed upstream nearly 9,300 Atlantic salmon, an estimated 19.5 million river herring, and over 55,000 adult American shad.

By order dated April 18, 2005, FERC amended Article 409 of the Milford Project license to require the licensee to develop study plans to monitor the effectiveness of the fish passage facilities. Subsequently the licensee has conducted qualitative and quantitative upstream passage efficiency studies for diadromous fish present at the facility since 2014. As explained in further detail in the sections below, this study is a follow-up on previous studies and was designed to better understand and improve upstream passage efficiency at the Milford Dam fish lift.

1.1.1 Background

Black Bear conducted radio telemetry studies in 2019 and 2021 to evaluate upstream passage effectiveness at Milford for adult river herring (alewife and blue back herring, combined), and for adult American shad in 2022 (NAI 2020, NAI 2022, NAI 2023). These studies indicated that the overall passage efficiency, efficiency at the entrance of the fish lift, and internal passage efficiency were all higher for river herring than for shad (Table 1).

Table 1. Milford Fish Lift Passage Efficiencies and 95% CI Observed during Telemetry Studies.

	River Herring	River Herring	Shad
Passage Efficiency	2019	2021	2022
Nearfield	94.5 (88.2-97.5)	--	84.4 (73.4-91.4)
Entrance	92.2)85.1-96.0)	96.0 (89.9-98.5)	71.6 (58.5-81.9)
Internal	74.7 (66.3-83.0)	89.9 (83.1-95.6)	51.1 (34.9-66.6)
Overall	65.1 (56.9-73.8)	86.1 (79.0-92.8)	30.9 (20.5-43.0)

For the 2021 river herring and 2022 shad passage studies, a fine-scale detection telemetry array[1] was installed in the entrance flume of the fish lift, which allowed for the collection of highly accurate timing information needed to evaluate detections at the various antenna locations.

A significant number of failed passage attempts were observed for both species, the majority of which occurred in the vicinity of the floor diffuser and at the V-gate. Totals of 63 and 80 unsuccessful passage attempts to move through the entrance flume of the Milford fish lift were recorded for river herring and American shad, respectively, during the two study years. Figure 1 provides a comparison of the percentage of unsuccessful upstream passage attempts that did not reach the next upstream monitoring station. The percentages reported at each station are based on the number of successful passage attempts recorded at the adjacent downstream station (e.g., the 3% failure rate at the third detection station for American shad is based on the successful detection of 77 of the 79 passage attempts which were recorded at the second detection station).

When compared between species, a similar pattern is observed with 25% to 57% (river herring and shad, respectively) of the failed passage attempts occurring in the area of the floor diffuser. It is recommended that as much supplemental flow as possible from the auxiliary water system (AWS) be injected upstream of lifting hoppers, as flow provided via diffusers in the entrance flume downstream of lifting hoppers can create confusing currents (Larinier and Travade 2002; USFWS 2019). Other important fish passage criteria, such as velocity of flow through the hopper and the swimming abilities of the fish species to be passed, must be taken into consideration. In order to meet recommended fish passage guidelines (USFWS 2019), the AWS flow for the Milford fish lift has been injected at a rate of approximately 40% of the flow upstream of the hopper and 60% of the flow through the floor diffuser located downstream of the hopper. This reduces the likelihood of exceeding the flow velocity criteria of 1.5 ft/s through the hopper established in the USFWS 2019 primarily for blueback herring.

Based upon the observations of the adult river herring passage studies conducted in 2019 and 2021 and the adult shad study conducted in 2022, the highest fallback rate for alosine species when moving between two adjacent monitoring stations occurred from the V-gate to the hopper blocking screens (i.e., 69% of the failed river herring attempts and 95% of the failed shad passage attempts occurred in this area of the entrance flume). However, it should be noted that there is a gap in telemetry coverage for the area between the upstream side of the V-gate and roughly the middle of the hopper, so there is uncertainty as to the specific point in this area at which the fish are falling back (i.e., at the V-gate or immediately upstream of the V-gate).

A number of factors could be contributing to the fall back behavior by alosines in the entrance flume, including; (1) high density of fish in the entrance flume in the vicinity of the V-gate or V-gate opening; (2) the mechanical operation of the V-gate as it opens or closes during a lifting cycle;

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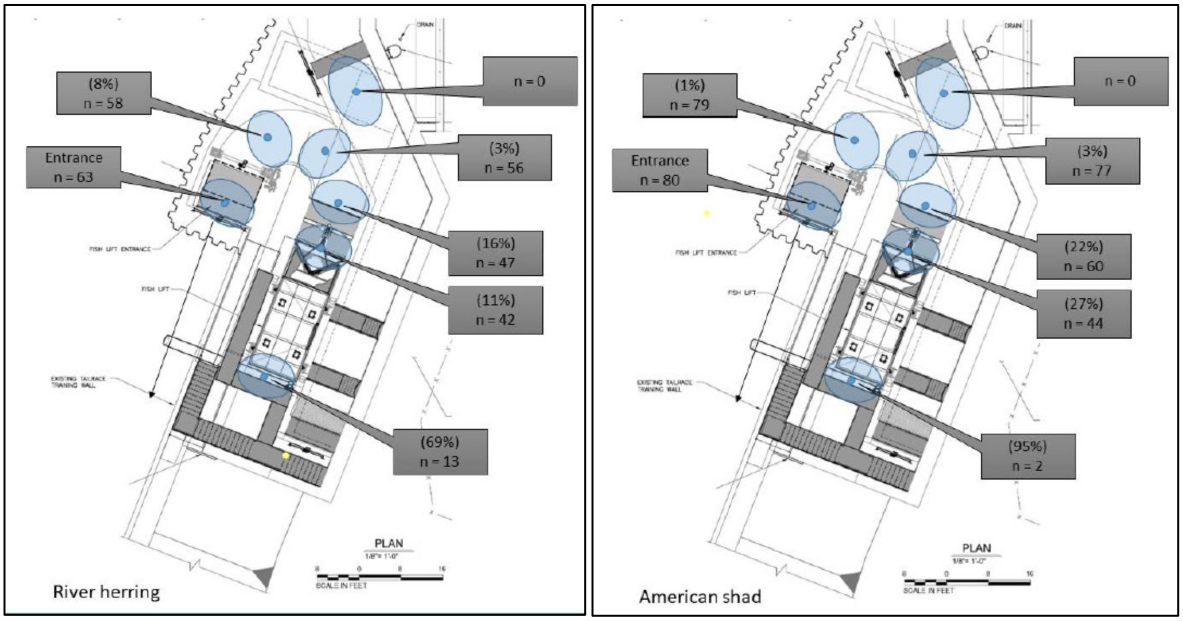
[1] A Hermes Coordinator, which utilizes a GPS signal to synchronize the internal clocks within a series of Sigma Eight Orion receivers to allow for the collection of the highly accurate timing information needed to evaluate detections at the various antenna locations.

and/or (3) the mechanical operation of the lifting hopper (the frequency of lifts ranges from a lift every 10 minutes to every 25 minutes in the spring, depending on fish density).

It is also possible that adult alosines in the Milford entrance flume may merely be responding to the behavior of other fish in the flume (i.e., following other fish that are backing downstream). Or that the presence of predatory species of fish (e.g., black bass or striped bass) within the entrance flume could be at times influencing adult alewives or shad, as well.

There was consensus to establish an ad hoc work group to further evaluate potential causes for unsuccessful upstream passage, and if there are any operational adjustments, optimized settings, or other modifications that may improve the internal passage efficiency in the lower flume of the Milford fish lift facility.



Note: Percentages are based on the number of unsuccessful passage attempts confirmed at the adjacent downstream station (NAI 2023).

Figure 1: Species Comparison of Upstream Passage Attempts at the Milford Fish Lift.

1.1.2 Milford Fish Lift Working Group

An ad hoc work group (work group) comprised of fish passage engineers from the National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (USFWS), and biologists from the Maine Department of Marine Resources (MDMR), PIN, and BBHP, was established in December 2022 to explore options for modifying operational parameters of the Milford fish lift facility to potentially improve internal fish passage efficiency. This group met virtually four times between December 22, 2022, and January 26, 2023, as well as corresponded on a regular basis via e-mail and met one-on-one, as needed.

The work group reviewed the Milford fish lift facility design and agreed that it is constructed and is being operated as intended and according to fishway engineering guidelines (USFWS 2019). While the 180° turn in the fish lift entrance flume was an undesirable but necessary design feature due to limitations of space, there is no evidence from the past passage studies that the turn is affecting fish passage at Milford.

The work group reviewed laboratory and case studies focused on a variety of topics, including fish passage operational parameters and reported passage results from other facilities with similar species, and reviewed literature and best available science related to fish swimming abilities (burst, sustained, and long-term time periods). The work group was not able to identify any other fish lifts with significantly or consistently higher passage results for alosine species of fish than what has been observed at Milford to date, including those with straight entrance flumes.

The work group came to consensus that using underwater cameras to qualitatively evaluate swimming behavior and responses of fish in the entrance flume of the fish lift to various operating conditions, including conditions outside of the recommended fishway operating guidelines, may provide valuable insight as to potential permanent changes in operating parameters of the lift to improve the overall effectiveness of the facility.

BBHP distributed a draft a study plan developed by the work group for agency review on February 7, 2023. Several meetings were held to finalize the study plan, and the study commenced in April of 2023. Appendix A includes the study plan and work group correspondence before and throughout the study.

1.1.3 Milford Dam Fish Lift Description

Upstream fish passage at Milford Dam is provided via a single entrance fish lift located immediately downstream from the powerhouse on the east side of the tailrace. A target of 190-210 cubic feet per second (cfs) is provided at the entrance of the fish lift through a combination of conveyance flow from the upper flume and the auxiliary water supply system, which adds supplemental flow in two areas: 1) upstream of the hopper, and 2) downstream of the hopper via a floor diffuser. The hopper can be operated manually or automatically (normal operating condition) using a programmable logic controller (PLC). The entrance consists of a manually adjusted “overshot” attraction flow gate (also referred to as the “flap gate”), an adjustable V-gate, and a blocking/diffusion screen upstream of the lifting hopper. The entrance flume is 10-feet-wide with a 180 degree turn leading to a 12-ft-wide by 17-ft-long, 4,600 gallon lifting hopper. The lifting hopper rises using a mechanical hoist approximately 20 feet, and then it discharges into a 10-foot-wide by 300-foot-long exit flume, which passes through the east end of the powerhouse to the headpond upstream of the outer trashracks. The operational parameters for the Milford fish lift align with USFWS and NMFS engineering guidelines for fish lifts that pass diadromous fish, taking into consideration the presence of alewife and blueback herring (river herring), including:

- 4.0 - 6.0 ft/s flow velocity at the entrance while maintaining a differential of 0.5 – 1.0 ft
- 1.5 - 4.0 ft/s entrance flume flow velocity
- 1.0 - 1.5 ft/s hopper flow velocity
- 1.0 - 1.5 ft/s exit flume flow velocity
- 14.4-inch-wide V-gate setting (determined previously in consultation with the agencies)

2.0 Study Objectives

In the study plan, the work group proposed that the following fish lift parameters will be the initial focus of the 2023 evaluations:

1. AWS flow distribution (hopper vs. floor diffuser)
    a. The majority of the AWS flow will be injected upstream of the hopper to reduce/eliminate undesirable flow characteristics in the area of the floor diffuser that may be confusing fish.
    b. The group will attempt to evaluate fish behavior across a range of AWS scenarios, starting with the baseline scenario (40% hopper / 60% floor diffuser).
    c. The velocity of flow through the hopper will be calculated for each scenario and recorded.

2. Velocity at the Entrance
    a. The range of acceptable velocity of flow at the fishway entrance will be increased to 5.0 – 7.0 ft/s (vs. recommended 4.0-6.0 ft/s for river herring) in an attempt to improve the fish lift's entrance efficiency.
    b. A minimum water depth of 3.0 ft over the flap gate will be targeted for all scenarios tested.

Additionally, the work group agreed that other secondary parameters/conditions may also be assessed during the 2023 fish passage season including, but not limited to:

a. Unit 6 being turned down or off
b. V-gate setting
c. Lift frequency

3.0 Methodology

Run timing data for river herring and shad since 2014 were used to determine the timing for this study (Table 2). The following outlines the general underwater video monitoring strategy/schedule agreed upon by working groups members in the study plan:

1. April 15th (or when river conditions allow) – the fish lift will be put into operation for the season.
    a. Operating parameters – start with baseline (status quo)
    b. Conduct initial ocular assessment for a range of AWS and entrance flow settings
2. By May 1 (prior to fish arrival) - cameras installed/wired/tested
    a. Conduct range of AWS and entrance flow assessments via the cameras
3. First week of river herring passage season
    a. Conduct video assessments of fish behavior across the range of AWS and entrance flow scenarios.
    b. Effort = the amount of time spent observing per day/week is as long as is needed to understand what is going on
    c. Report back to the work group for discussion and consensus on approach going forward
    d. Adapt approach (and potential fish lift settings) and conduct more video monitoring and assessments
    e. Second week of river herring passage season
        i. Implement work group suggestions/ make observations / report back/ adapt
4. Continue monitoring/assessments through the peak river herring and shad upstream passage periods.

Table 2. Median Run Dates for River Herring and Shad at Milford since 2014.

	Median Run Date		
Year	River Herring	Shad	Comments
2014	27-May	16-Jun	AWS - No bulkheads
2015	27-May	18-Jun	AWS - No bulkheads
2016	27-May	15-Jun	AWS - Bulkheads in place, but not effective
2017	23-May	18-Jun	AWS - Bulkheads in place and effective
2018	24-May	15-Jun	
2019	1-Jun	20-Jun	
2020	28-May	5-Jun	
2021	21-May	1-Jun	Very early spring - fish lift operating April 15
2022	21-May	5-Jun	Another early spring - fish lift operating April 15
2023	29-May	22-Jun	High water throughout passage season

A total of six Barlus-IP68 Underwater IP Cameras (Model: T5MP-1-1) with a 2.8mm lens, a 100° horizontal field of view and an image resolution of 5-megapixels were used for this study. The cameras were connected to the IP68 CCTV Underwater Security System Network Video Recorder (NVR) via power over ethernet (POE) cables.

The cameras were installed during the first several weeks of April, and initial testing was conducted on April 13th and April 20th, before the fish lift was operational on April 24th. Further testing and camera adjustments were conducted April 27th and April 28th, during the beginning of the river herring run. Testing included visual inspection of the live video feed to verify that an adequate portion of the water column was within view horizontally and vertically, as well an assessment of the viewing distance from the camera location. The cameras were mounted to aluminum poles with custom made brackets, and the poles were mounted to the guardrails in a manner to allow for camera adjustments to be made as tailwater elevations changed.

Cameras were installed at the following locations to observe fish behavior as they entered and passed through the lower flume, through the V-Gate and into the hopper.

1. Camera 1 – located outside of the lower flume entrance, aimed slightly upstream.
2. Camera 2 – located inside of the lower flume entrance, aimed slightly downstream.
3. Camera 3 – located near the floor diffuser, aimed downstream.
4. Camera 4 – located upstream of the floor diffuser, aimed across the flume.
5. Camera 5 – located downstream of the V-gate, aimed slightly downstream.
6. Camera 6 – located downstream of the V-Gate, aimed upstream.

Figure 2 below shows these camera locations and orientations within the lower flume, with the floor diffuser location depicted by the green-dashed area. Figure 3 through Figure 6 show photographs of all camera locations. All six cameras were connected to a central temporary video viewing station established on the walkway of the lower flume, which allowed for the viewing of live video feed from all six cameras simultaneously (Figure 7). The viewing station (Figure 8) was protected from weather and housed a large monitor, the NVR, and an external hard drive that backed up the video data recorded onto the NVR during observations throughout the study.

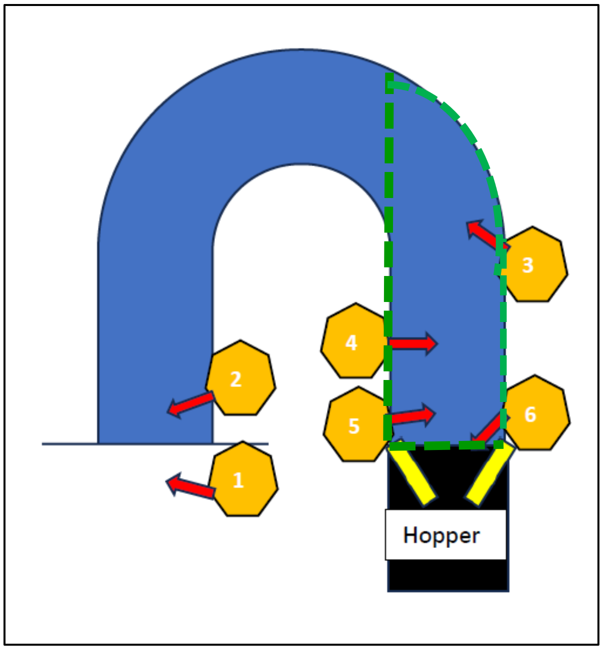


Figure 2. Camera Locations and Orientation in the Milford Fish Lift Lower Flume.

Figure 3. Camera Location 1: Outside of the entrance looking across the flap gate.

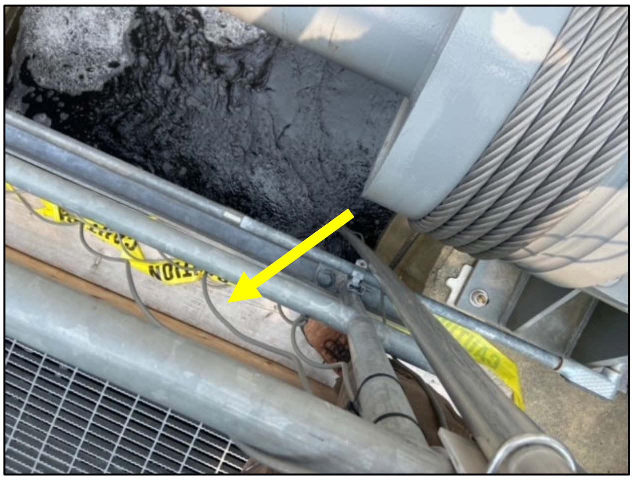


Figure 4. Camera Location 2: Inside of the lower flume entrance looking downstream to the flap gate.

Figure 5. Camera Locations 3 and 4: Looking across the floor diffuser.

Figure 6. Camera Locations 5 and 6: looking across and upstream at the V-Gate entrance

Figure 7. View of the Live Feed Monitor in the Temporary Viewing Station

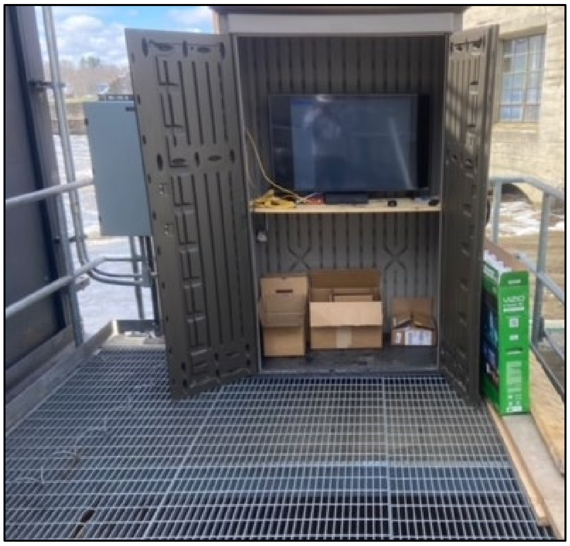


Figure 8. View of the Temporary Viewing Station Located at the Lower Flume.

Observation efforts began once the first river herring began to show up in early May. This included ten total days spent observing anadromous fish between May 4th and June 15th over twenty-six flow combinations. Table 3 details the flow settings tested on each day.

Table 3. Lower Flume Flow Settings Testing during Study Period.

Date	Scenario (Hopper Flow%/Floor Diffuser%)			
4-May	90/10	70/30	45/55	
9-May	100/0	52/48		
10-May	100/0	40/60		
12-May	40/60	80/20	70/30	100/0
17-May	75/25	50/50	25/75	
18-May	75/25	80/20	50/50	
24-May	80/20	60/40		
2-Jun	80/20	25/75	80/20	
14-Jun	80/20	20/80		
15-Jun	20/80	75/25		

Observations were conducted by viewing the live video feed for a minimum of 15 minutes from all six cameras simultaneously for each AWS setting. Viewing time was extended if needed to make a reasonable observation when not possible within 15 minutes. The viewing times ranged from 15 minutes to over an hour long. Fish appeared to resume upstream movements into and through the entrance flume very soon after the AWS flow setting adjustments were initiated. Observations for each scenario began when fish appeared to have resumed normal behavior (generally within 5-10 minutes following a change in AWS setting (i.e., following at least one lift cycle)), and the duration for each observation was 15 minutes at minimum, but longer in most cases. For example, on May 4th, each of the three AWS flow scenarios were observed for a minimum of 15-minutes each. An observation data sheet was completed for each AWS flow scenario, as well as a daily fishway inspection form to confirm that desired water flows and velocities were being attained.

Observations included a general assessment of visibility for each camera, as well as an assessment(s) of swimming characteristics at each monitoring site, including swimming direction, location in the water column, as well as a general assessment of fish behavior. Important notes and general observations were also recorded on the data sheets for each observation. The study concluded after the shad and river herring run slowed to the point where meaningful observations of fish behavior were no longer possible.

Observations were binned into one of three AWS flow settings: 1) high hopper flow setting (70% or greater of the overall flow through the hopper); 2) even flow settings (40-60% hopper flow, the traditional operational flow); and 3) low hopper flow (less than 40% of the overall flow through the hopper). Completed datasheets and fishway inspection forms are provided in Appendix B.

4.0 Results

4.1 Environmental Conditions

River flow during the 2023 fish passage season was normal to slightly below average during much of May, however the flow during most of June was above average. Figure 9 shows the total river flows between April 15 and July 15, 2023 (orange line) compared to the historical median flow (past 120 years; grey lines) from the West Enfield USGS gage (USGS Gage No. 01034500). Figure 10 show the total flow, spill, and station flows at the Milford Dam between April 15 and July 15, 2023. River temperature fluctuated with river flows through the study period, dipping significantly in early June with the increased river flow (Figure 11).

Figure 9. **Total Penobscot River Flows between April 15 and July 15, 2023 (orange line) and Historical Median Flow (grey lines) from the West Enfield USGS Gage (USGS Gage No. 01034500).**

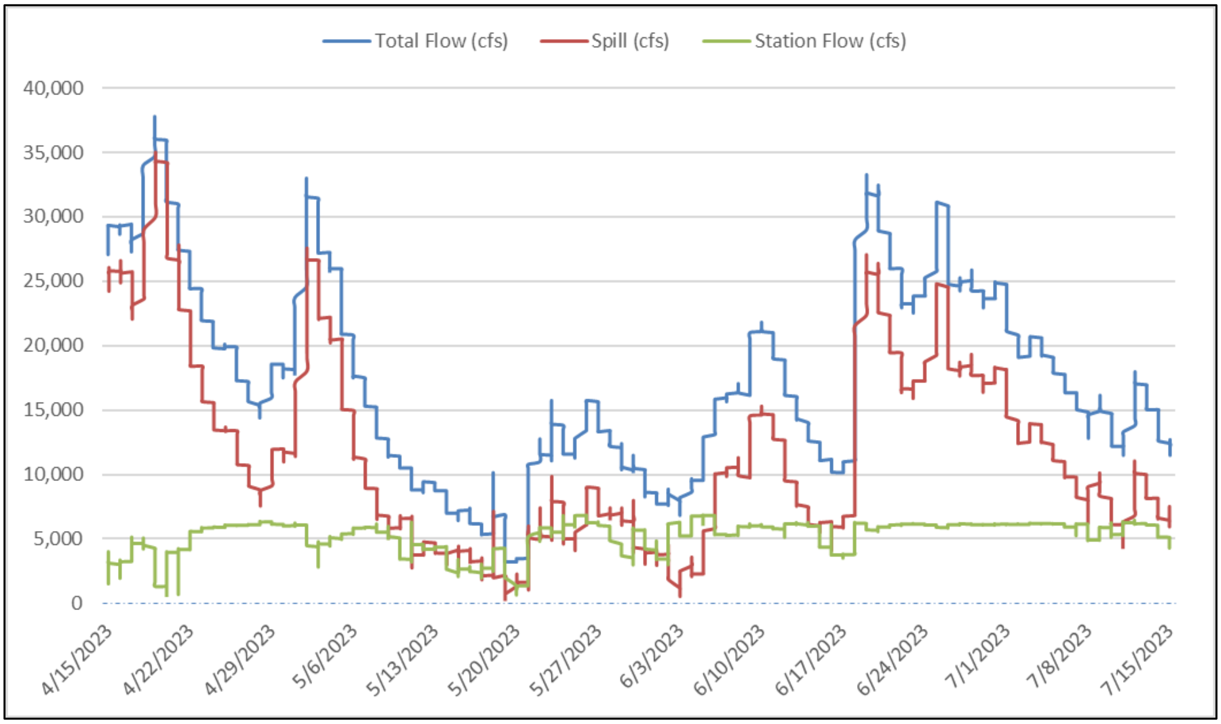


Figure 10. **Milford Dam Total Flow, Spill, and Station Flow from April 15 to July 15, 2023.**

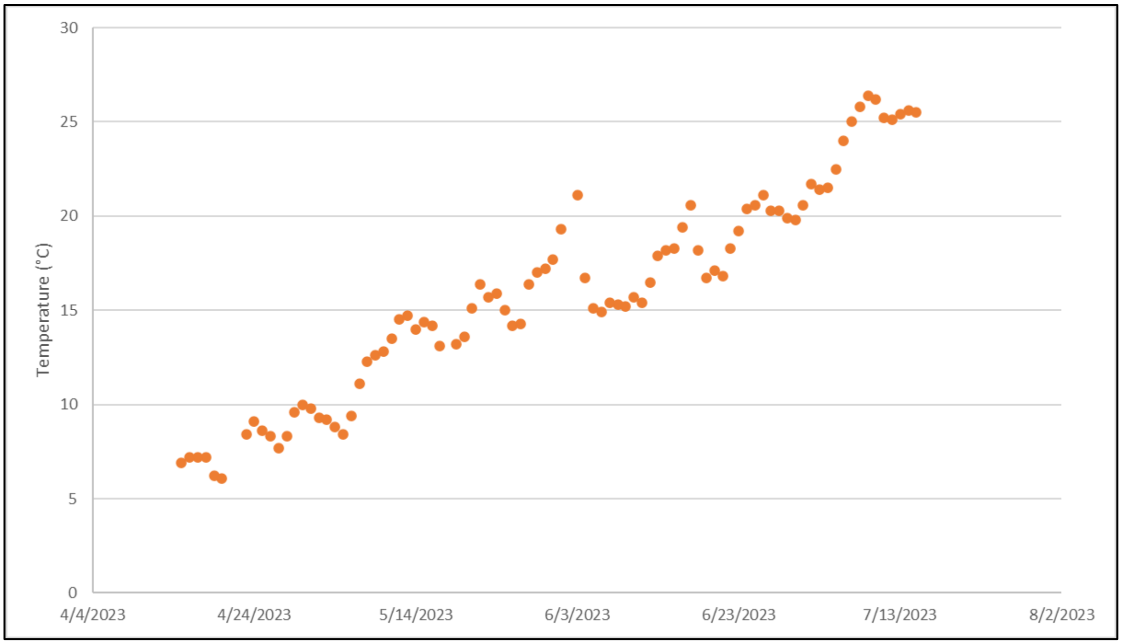


Figure 11. Discrete Daily Water Temperature (°C) Data from April 15 to July 15, 2023.

4.2 Video Monitoring Observations

Observations of fish movements were conducted on ten days between May 4th and June 15th for twenty-six flow settings. Completed datasheets are provided in Appendix B. Table 4 below displays the primary data from each observation, grouped by flow settings: 1) high hopper flow setting (70% or greater hopper flow; 2) even flow settings (40-60% hopper flow); and 3) low hopper flow settings (less than 40% of total flow through the hopper). Poor visibility was a chronic issue regardless of environmental conditions and limited the ability to make observations consistently.

4.2.1 High Hopper Flow Setting Observations

Fifteen of the twenty-six observations were conducted under high hopper flow conditions (>70% total fish lift flow through the hopper). The velocity of flow through the hopper under these conditions was generally between 1.5 to 2.4 ft/s, with a notable exception occurring on May 4th when the tailwater elevation was extremely high due to significant high river flow. The range of entrance velocity ranged from 4.10 to 7.10 ft/s across the high flow scenarios. Entrance drop ranged from 0.5 – 1.32 ft.

Fish appeared to navigate through the entrance flume quickly and orderly, especially around 75-80% hopper flow conditions. Visibility was best at all camera locations during high hopper flow observations, except for poor visibility at the V-gate during the 100% hopper flow setting due to increased entrained air extending through and well downstream of the V-gate. Higher numbers of river herring and Atlantic salmon were captured in the hopper during the higher hopper flow AWS settings, as determined by the observer during visual observations of hopper dumps into the upper flume following the observation of AWS flow scenario adjustments. Figure 12 shows the dominant fish behaviors that were observed in the entrance flume during the high hopper flow settings.

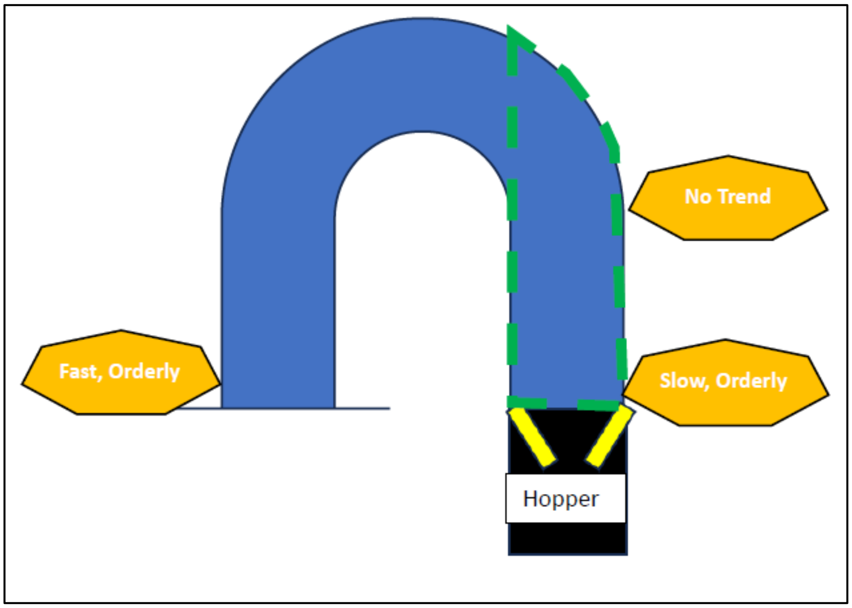


Figure 12. Dominant Fish Behaviors Observed in Lower Flume during High Hopper Flows.

At the higher hopper flow settings, river herring continued past the floor diffuser without notable difficulty. After passing over the floor diffuser, the upstream progress of river herring slowed at times as they approached the V-gate, with fish occasionally congregating just downstream of the V-gate for a short period of time before the group decided to continue to pass through the V-gate and into the hopper. Once this occurred, the majority of the river herring would then proceed into the hopper quickly and orderly. This was also verified through comparing video clips of the hopper dumping fish into the upper flume to the numbers of river herring observed during the high hopper flow video observations.

River herring were observed passing through the V-gate in the lower to middle portion of the water column during the high hopper flow observations, and tended to pass quickly through the V-gate as it was closing. Once the V-gate was closed, river herring that didn't make it into the hopper were observed holding immediately downstream of the V-gate and over the floor diffuser, while others were observed passing back downstream and out of the entrance flume. Most of those fish appeared to remain in the vicinity of the V-gate throughout a lifting cycle.

High densities of river herring in the entrance flume made it difficult to assess the passage behavior of other species present (salmon and shad). When river herring were less dense, salmon tended to swim upstream in an ordinally manner, often two or more traveling closely together. Salmon appeared at times to hesitate downstream of the V-gate before eventually swimming through it and into the hopper. This was also generally observed for shad; however, there were so few shad present during observations that any definitive observations of their behavior could not be made.

Only on a few occasions were striped bass observed, and only on the entrance cameras. There were no observations of predation or attempted predation on river herring or other fish during these observations.

4.2.2 Even Flow Setting Observations

The even flow observations, generally representing the "traditional operating conditions" of hopper flows ranging from 40 to 60% of the total flow, were assessed during 7 out of the 26 observations. The velocity of flow through the hopper under these conditions was between 1.3 to 1.55 ft/s, while the entrance velocity ranged from 4.90 to 5.7 ft/s, and the entrance drop ranged from 0.57 – 1.8 ft.

Visibility during the even flow scenarios was generally poor, likely due to increased upwelling and entrained air from the floor diffuser, with water color and turbidity also contributing factors as well. River herring were observed passing through the V-gate and into the hopper lower in the water column in comparison to the to the higher hopper flow observations. River herring swimming behavior was difficult to assess, but overall seemed slightly more chaotic in the area of the floor diffuser. Figure 13 shows the dominant fish behaviors that were observed in the even flow settings in the lower flume during the study.

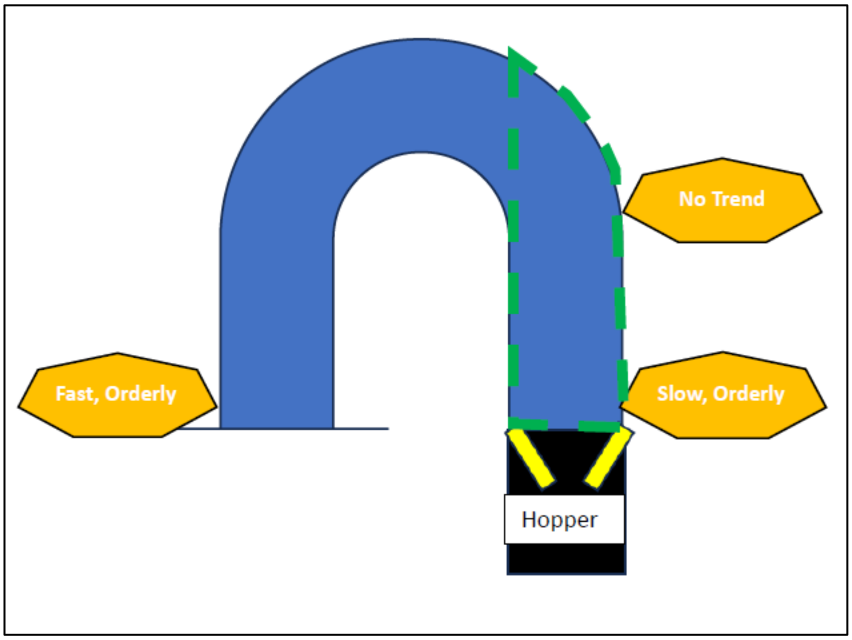


Figure 13. Dominant Fish Behaviors Observed in the Lower Flume during Even Flow Settings.

In general, it appeared that less fish may have been present within the lower flume during the even hopper flow settings when compared to observations during the higher hopper flow settings;

however, as noted previously, flow from the floor diffuser and visibility downstream of the V-gate were generally poor under these flow scenarios.

4.2.3 Lower Hopper Flow Setting Observations

Four observations were conducted when the hopper flow was less than 40% of the total attraction flow. The velocity of flow through the hopper ranged from 0.5 to 0.7 ft/s, and at the entrance ranged from 5.0 to 5.5 ft/s. The entrance drop ranged from 0.56 – 1.16 ft.

Under these low hopper flow scenarios visibility was again poor due to turbulence and entrained air/bubbles from the floor diffuser. River herring swimming behavior was characterized as chaotic/unorganized as they moved up through the entrance flume and over the floor diffuser. In the low hopper flow scenario, river herring tended to be lower in the water column when passing through the V-gate. Figure 14 shows the dominant fish behaviors that were observed in the even flow settings in the lower flume during the study.

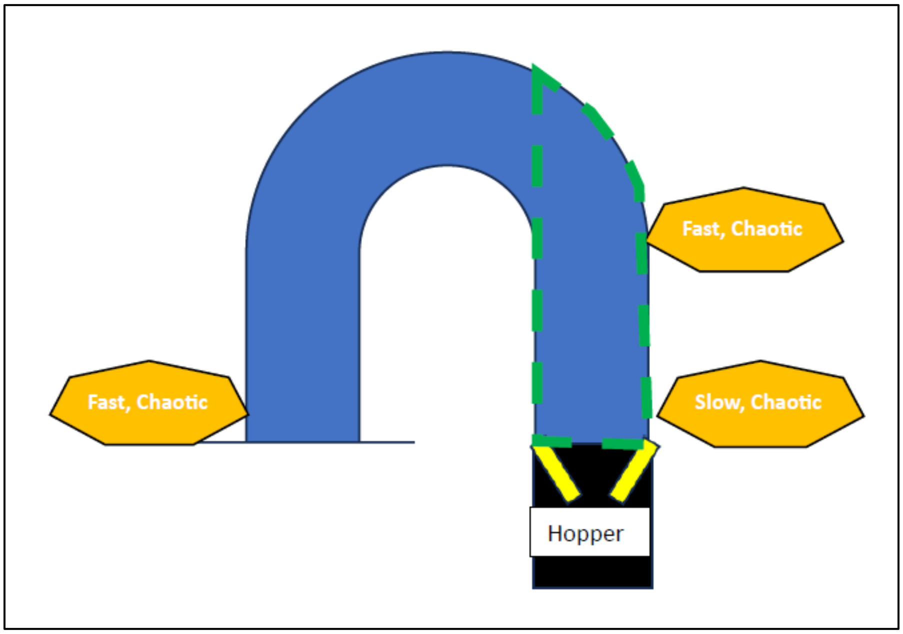


Figure 14. Dominant Fish Behaviors Observed in the Entrance Flume during Low Hopper Flow Settings.

The dominant behaviors observed during the low hopper flow settings suggest that the upward currents along with increased entrained air/bubbles created by the high floor diffuser flow settings could be having a negative impact (chaotic swimming behavior) on fish passing through the entrance flume. In addition, the dominant swimming behaviors noted during lower hopper flow setting observations in the vicinity of the V-gate were "slow" and "chaotic", compared to the dominant behavior of “slow” and “orderly” at this location during the higher hopper flow setting observations.

Video footage from the hopper surveillance camera suggests that overall, more fish were passing upstream under high hopper flow conditions. This was especially true for numbers of salmon and shad in the hooper fish dump video clips observed from mid-June.

4.2.4 V-Gate Setting Observations

Based upon guidance from the resource agencies and best profession judgement, the Milford fish lift V-gate has generally been set at a width of 14.4 inches since the lift went into operation in 2014[2]. During the 2022 upstream shad passage study, shad passage efficiency was not observed to be significantly different under the two V-gate scenarios of 6.0 (14.4 inches) and 10 (24.4 inches). The work group did agree that some further investigation of V-gate width would be warranted during the 2023 video monitoring evaluation. While the majority of the 2023 observations were conducted at the traditional V-gate setting of 6.0 (14.4 inches), a number of other V-gate settings were evaluated ranging from a low setting of 3.0 to a high setting of 10.0 (7.2 to 24.4 inches).

At a V-gate setting higher than 6.0 fish appeared to enter the hopper more freely, especially salmon, when compared to the lower setting (4.0 – 6.0). In particular, salmon were observed passing the floor diffuser cameras and the V-gate cameras into the hopper rather quickly (within a few minutes) and uniformly at the wider V-gate settings. Based on limited observations, it appeared that fish held within the hopper and lifted more successfully at settings ranging from 6.0-9.0. In comparison, fish appeared to leave the hopper more frequently when the V-gate was opened wider than 9.0. More river herring, salmon, and shad were also captured in the hopper during the wider V-gate setting trials compared to the lower V-gate setting, which was confirmed in observing hopper dump video files during these trials.

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[2] The width of the V-gate is determined by multiplying the V-gate setting observed on the Programmable Logic Controller by a correction factor of 2.4 inches. Therefore, the normal V-gate setting of 6.0 x 2.4 inches = 14.4 inches).

Table 4. Summarized Observation Data Grouped by Hopper Flows.

Date	AWS Flow Scenario	Scenario (%Hopper/%FD)	River Flow (cfs)	Weather	Water Temp (°C)	Time	Hopper flow (cfs)	FD flow (cfs)	V-Gate	Lift Freq (min)	Hopper vel. (fps)	Entrance vel. (fps)	Entrance diff. (ft)	Species obs.	Behavior			Notes
															Entrance	FD	V-Gate	
4-May	High	70/30	27,187	overcast/light rain	8.8	10:00	136	54	6.0	15	1.3	3.50	0.57	few RIV	NA	NA	NA	too few fish for observations
4-May	Even	45/55	27,187	overcast/light rain	8.8	9:30	85	102	6.0	15	0.8	3.50	0.57	few RIV	NA	NA	NA	low fish numbers and low visbility due to high flows
4-May	High	90/10	27,187	overcast/light rain	8.8	12:45	170	19	6.0	15	1.5	3.50	0.57	few RIV	NA	NA	NA	Higher Hopper flow created better visibility; low fish numbers and low visbility due to high flows
9-May	Even	52/48	13,098	sunny	12.6	10:30	108	98	6.0	15	1.3	5.70	1.00	RIV	RL, US, O, F	Poor vis	RL, US, O, M	RIV passing into Hopper in lower third of water column, few are moving out, holding RIV back down once hopper lifts.
9-May	High	100/0	13,098	sunny	12.6	12:00	148	0	6.0	15	1.8	4.90	0.90	RIV, ATS	RL/M, O	Poor vis	US	RIV passing in middle of water column, higher than last test and swimming faster thought the V Gate
10-May	High	100/0	11,540	sunny	12.5	9:00	152	0	6.0	15	1.95	4.90	0.63	RIV	US, RL, O	US, S	US, O, F	RIV moving through V Gate in lower water column, RIV rushed to closing V Gate and then dropped and held near or below FD during lift,
10-May	Even	40/60	11,541	sunny	12.5	12:30	83	123	6.0	15	1.1	5.50	0.95	RIV	Poor vis, RL, O, S	US, RL, M, C	US, M, O, F	Cameras adjusted bc of buddles at FD
12-May	Even	40/60	9,062	partly cloudy	14.5	7:00	80	118	6.0	15	1.1	5.00	0.80	RIV, SLP	Poor vis, US, F, O, RL	US, RL, M, O, F	good vis, US, M, O, F	RIV more toward lower water column when passing V Gate
12-May	High	80/20	9,062	partly cloudy	14.5	10:35	152	40	6.0	7	2.1	5.40	0.50	RIV, ATS, SLP	US, RL, F, O	US, RR, M, O	US, M, S, O	good visability throughout, RIV moving orderly through lower flume and into hopper, as well as few salmon
12-May	High	70/30	9,062	partly cloudy	14.5	12:40	160	56	6.0	7	2.4	5.65	0.70	RIV, SLP	US, RL, O, M	US, RR, O, S	US, M, O, S	more bubbles than higher FD flow settings. Similar behavior as 80/20, RIV hold near FD and stack up and then head into hopper in pulses and more toward lower water column when entering hopper. RIV not falling out of lower flume between cycles
12-May	High	100/0	9,062	partly cloudy	14.5	13:45	152	0	6.0	7	1.9	4.10	0.50	RIV, ATS, SLP	US, RL, F, O	US, ED, S, C	US, F,O	Lower flume seemed to fill with more RIV once FD flow was shut down
17-May	High	75/25	6,478	partly cloudy	13.1	8:00	133	44	6.0	30	2.1	6.00	1.00	RIV, ATS, SLP	US, RL, F, O	US, M, S, C, O	US, ED, S, O	RIV numbers picked up around 9:45, RIV generally move US quick and hold US of FD, then enter hopper quickly after a few leaders enter first. Lower tailwater than last week, cameras lowered.
17-May	Even	50/50	6,478	light rain	13.1	10:50	87	88	6.0	15	1.3	5.60	1.10	RIV, ATS	US, RL, F, O	US, M, S, O	US, M, S, O	Similar to the 75/25 but RIV lower in water column, less RIV moved into flume when it became overcast
17-May	Low	25/75	6,478	light rain	13.1	13:44	37	137	6.0	15	0.6	5.50	1.08	RIV, ATS	US, RL, F, C	Poor vis, US, F	US, M, ED, S, C	RIV moved slower near Vgate and lower in water column, schools hold and build up more noticable below Vgate before moving into hopper
18-May	High	75/25	5,281	sunny	12.5	9:00	133	45	6.0	15	2.1	7.10	1.32	RIV, AMS, ATS	US, RL, F, O	US, M, F, C	US, M, S, O	few RIV present, but shad present milling around FD, some entered hopper.
18-May	High	80/20	5,281	sunny	12.5	10:20	155	41	6.0	15	2.2	5.50	1.12	RIV, ATS	US, RL, F, O	US, M, S, C	US, M, F, O	Better vis than 75/25, but more bubbles near Vgate. RIV numbers increased after 11:15, schools build below vgate then move through. ATS as well.
18-May	Even	50/50	5,281	sunny	12.5	12:40	100	102	6.0	7	1.55	5.50	1.12	RIV, AMS	poor vis	poor vis	US, ED, S, O	Lots of bubbles at FD and downstream, increase lift freq bc more RIV. RIV milling below v gate until school builds up and then moves into hopper.
24-May	High	80/20	9,770	sunny	15.9	9:36	143	30	6.0	15	1.8	5.50	1.00	All	US, RL, F, O	US, RL/M, F, C	US, M, S, O	Similar high hopper flow obs for RIV and ATS, only a few shad seen on cameras and in lifts
24-May	Even	60/40	9,770	overcast/light rain	15.9	11:30	95	66	6.0	15	1.3	4.90	1.80	All	US, RL, F, O	US, RL/M,F, C	US, M, S, O	Few shad seen quickly passing cameras going US and DS before entering hopper. More fish overall likely bc ToD.
2-Jun	High	80/20	5,451	partly cloudy	21.3	9:40	143	41	6.0/10.0/3.0	15/10	2.2	5.10	0.92	All	US, RL, F, O	US, RL/M,F, C	US, M, S, O	Similar behavior as similar previous settings, More shad present, many in the 9:15 lift, more shad seen in cameras than in left, shad entering lift just before or after RIV schools did. V gate at 10.0 showed RIV, ATS and AMS did not hold as long before moving into hopper, but some fish moved out of hopper, 3.0 Vgate setting was not passing many fish.
2-Jun	Low	25/75	5,451	partly cloudy	21.3	10:00	46	134	9.0/6.0	10	0.7	5.00	0.68	All	US, RL, F, C	poor vis	US, M, F, O	More fish were obs leaving hopper at this setting and v gate at 9.0, so changed back to 6.0, all fish generally more reluctant to enter hopper at this setting compare to higher hopper flow and still leaving hopper at 6.0 setting too. Lift at 13:00 verified less fish.
2-Jun	High	80/20	5,451	partly cloudy	21.3	13:05	139	41	9.0	10	2.1	4.90	1.18	All	US, RL, F, O	US, RL/M,F, O	US, M, S, O	Back to morning test setting and V Gate at 9.0. Less fish due to ToD. At 13:42 several salmon moved into hooped freely and fast. Fish numbers started to increase and left it at this setting for the night. Seems wider V gate setting attracts more fish into the hopper.
14-Jun	High	80/20	13,310	light rain	18	9:38	177	40	9.0	15	1.55	5.10	0.98	All	US, RL, F, O	US, M, S, C	US, M, S, O	Low light and high water decreased vis. Unseasonable high water and low temps for past several weeks. Shad and salmon sporadically entering flume and hopper, but generall took 5-10min to reach hopper. Some salmon seen leaving hopper at 9.0. V Gate changed to 8.0 and appeared to still attract more fish into hopper and keep fish from leaving the hopper.
14-Jun	Low	20/80	13,310	light rain	18	10:30	41	138	8.0	15	0.5	5.00	0.56	All	US, RL, F, C	US, M, F, C	US, M, S, C	Low vis., not many fish present. Few shad present and seen in hopper, but overall less fish entering hopper.
15-Jun	Low	20/80	12,083	overcast	18.3	7:20	36	132	8.0	30/15	0.5	5.30	1.16	All	US, RL, F, C	US, M, F, C	US, M, S, C	Low vis., not many fish present. overall less fish entering hopper.
15-Jun	High	75/25	12,083	overcast	18.3	7:45	128	39	8.0	15	1.6	4.90	0.86	All	US, RL/M, F, O	US, M, S, C	US, M, S, O	Number of salmon entering flume and making it to the hopper increased noticably compared to last setting. Too few shad present to make observations

Legend: FD = Floor Diffuser; RR = River Right; RL = River Left; M = Middle; ED = Evenly Dispersed; US = Upstream; DS= Downstream; F = Fast; S = Slow; C = Chaotic, O = Orderly; RIV - River herring; ATS = Atlantic salmon; AMS = American shad; SLP = sea lamprey

5.0 Discussion

River flows were unseasonably high during the second half of the study period. This further impacted already difficult underwater viewing conditions due to the amount of turbidity. In addition, the cool river temperatures in June along with the high flow likely contributed to an inconsistent and low shad run. For example, peak American shad upstream migration is around 18.5°C (USFWS 2023), and it was not until late-June when water temperatures were consistently around or above 18.5°C (Figure 11 in Section 4 above), which was several weeks following the normal median run time for shad at the Milford Dam (Table 2 in Section 3 above).

The use of underwater cameras to observe and/or characterize the swimming behavior of diadromous fish in the entrance flume of the Milford fish lift was demonstrated to have low applicability given the consistent poor visibility that perpetuated throughout the study under most testing scenarios (including the normal flows in May), and across a range of environmental conditions. Water color (stained or tea color) and clarity (turbidity), lighting, entrained air, water currents, and even the presence of fish in high numbers created difficult viewing conditions.

Despite the difficult viewing conditions, the study objectives were mostly met through this effort in 2023 with a range of AWS flow scenarios tested, as well as a secondary objective of testing several V-gate settings. Observing fish passage with the closest unit to the fish lift (Unit 6) turned down or completely off was not tested. The primary species of focus for this evaluation was to be adult American shad, but due to generally low daily counts of shad in June, likely as a result of high river flow and cool river temperature, little to no meaningful behavior responses to different flow settings could be detected.

However, valuable insights were found from observations of river herring and Atlantic salmon, which could be inferred for American shad as well. Fish did appear to show a positive response to passing more of the AWS flow through the hopper and less through the floor diffuser than has been traditionally targeted. With more of the overall flow injected upstream of the hopper and less through the floor diffuser, there was less upwelling water currents, as well as less entrained air/bubbles emitted through the floor diffuser. Under these conditions, fish were observed swimming up through entrance flume (including over the floor diffuser) and through the V-gate and into the hopper in a more consistent and orderly manner. Water velocity greater than 1.5 ft/s through the hopper did not appear to negatively impact passage efficiency, nor did targeting a 1.0 ft drop at the fish lift entrance.

The wider V-gate (8.0 or 19.2-inches) opening appeared to benefit fish passage behavior at the V-gate, while not sacrificing retention in the hopper. One observation made during a high-volume river herring day was that as fish density in the hopper increased during a fishing cycle, the fish moving in toward the end of the cycle appeared to be responding to the behavior of the fish already in the hopper. As the fish in the hopper moved forwards and backwards as a group, so would the fish that were waiting just downstream of V-gate. These movements can generally be described as surging ahead and back, in a wavelike manner. The shorter lift cycles (7-10 minutes) benefit passage efficiency during peak river herring periods; however, we are unable to determine how shad respond to such conditions from this study.

It is important to note that time of day appeared to influence fish activity, as the number of fish entering the flume increased as each day progressed, generally starting in the late mornings, regardless of the AWS flow settings. In addition, the intensity of natural light (or shadows) in the entrance flume may be influencing river herring behavior. River herring appeared to be less chaotic when the flume was entirely shaded or when it was overcast; however, when it was bright out, river herring may have been slightly apprehensive to enter shaded areas within the flume.

The results of this study indicate that higher hopper flow (>60%) and lower floor diffuser flow (<40%) creates improved fish passage conditions for all target species in the entrance flume. In addition, the study included observations that when combining higher hopper flows with a V-gate setting of 8.0, 2.5 ft/s velocity through the hopper, and targeting an entrance drop of 1.0 ft, fish passage conditions may be improved further, especially for attracting higher numbers of Atlantic salmon into the entrance flume and into the hopper quickly.

6.0 Reference Materials

Larinier, M., Travade, F., Porcher, J. P. 2002. Fishways: biological basis, design criteria and monitoring. Bull. Fr. Peche Piscic. 364 supplement. 206 pp.

Normandeau Associates, Inc (NAI). 2020. Evaluation of upstream passage effectiveness for adult river herring at the Milford Fish Lift Facility-2019. Prepared for Brookfield Renewable and Black Bear Hydro Partners, Inc.

Normandeau Associates, Inc (NAI). 2022. 2021 Evaluation of upstream for adult river herring at the lower Penobscot River Projects Milford and Orono. Prepared for Brookfield Renewable and Black Bear Hydro Partners, Inc.

Normandeau Associates, Inc (NAI). 2023. 2022 Evaluation of upstream adult American shad passage at the Milford Fish Lift Facility-2022. Prepared for Brookfield Renewable and Black Bear Hydro Partners, Inc.

USFWS (U.S. Fish and Wildlife Service). 2019. Fish Passage Engineering Design Criteria. USFWS, Northeast Region R5, Hadley, Massachusetts.

USFWS. 2023. *American shad (Alosa sapidissima)*: U.S. Fish & Wildlife Service. FWS.gov. https://www.fws.gov/species/american-shad-alosa-sapidissima, Accessed Sept. 27, 2023.

Appendix A

From: Dill, Richard
Sent: Friday, April 28, 2023 3:17 PM
To: 'Donald Dow - NOAA Federal' <donald.dow@noaa.gov>; 'Dan McCaw' <Dan.McCaw@penobscotnation.org>; 'Bryan Sojkowski' <Bryan_Sojkowski@fws.gov>; 'Simpson, Mitch' <Mitch.Simpson@maine.gov>
Subject: Milford Working Group

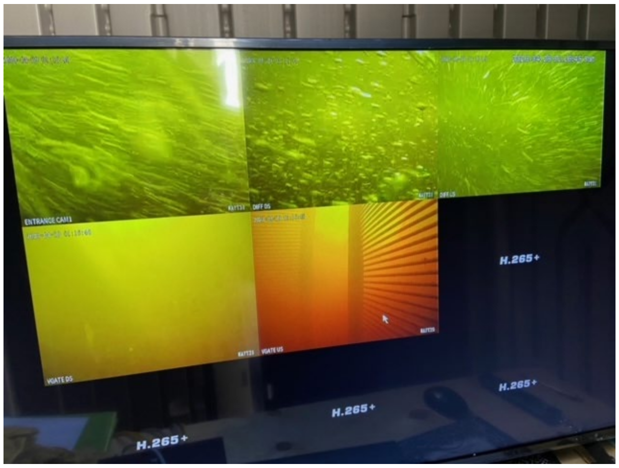
Thought I'd provide a quick update…

Fish Lift opened 4/24 due to high spring river flow

- Week of April 17th - Mike Sears Richard began installing camera's and working with NVR software. No testing of fish lift flows since the lift was not operational
- Week of April 24th –
    - Fish lift operational April 24.
    - A few alewives (less than 20) each day of the week.
    - Mike and Richard installed 5 camera's and did some initial flow testing.
    - Did initial test of 100% flow through the hopper (~209 cfs). Entrained air extends all the way through the hopper down to the V-gate – not surprised. Bubbles much reduced though by time flow reaches floor diffuser area and around 180° turn.
        - I've attached two videos
            - 100% hopper flow - test
            - 43% hopper flow – normal
    - Some issues with bulk head slide gates sticking – not surprised since they have never been opened that far above the hopper.
    - Bubbles will have an affect on visibility, but difficult to tell how much with background frame of reference (no fish to observe). I'm not surprised… figured this would be an issue.
    - Good visibility downstream of V-gate with less entranced air – (see photo below)
- Week of May 1st
    - River flow expected to increase with significant rains forecasted and increased discharge from West Branch which began today (7,500cfs)

    - Depending on tailwater conditions and underwater visibility (suspended sediment/turbidity likely to be an issue with high flow), plan to continue testing, camera installations/locations, etc.

5 camera set up



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[Message clipped] View entire message

One attachment • Scanned by Gmail

From: Dill, Richard
Sent: Friday, May 19, 2023 9:17 AM
To: Simpson, Mitch <Mitch.Simpson@maine.gov>; donald.dow <Donald.Dow@noaa.gov>; Dan McCaw <dan.mccaw@penobscotnation.org>; Sojkowski, Bryan <bryan_sojkowski@fws.gov>
Subject: RE: Milford Working Group

Another update… Lessons learned thus far (most of which should not be a surprise).

- Visibility with underwater camera's in the lower flume can be quite good or quite bad depending on a number of variables (location of the camera, turbulence, bubbles, water clarity, sun light, number of fish).
- Alewives are very determined, and on days when they pushing strong I'm not sure there is an AWS flow setting that will deter them.
    - AWS flow settings tested (Hopper / Floor Diffuser)
        - 100% / 0 %
        - 80% / 20%
        - 75% / 25 %
        - 60% / 40%
        - 50% / 50%
        - 40% / 60%
        - 25% / 75%
    - Other than being able to see lots of alewives in all the scenarios on at least some of the cameras, I don't believe we've been able to identify a discernable pattern. The behaviors do vary some in terms of where they travel in the lower flume in response to certain flow settings (e.g., right side / left side, bottom of water column / mid-water column), but numbers wise I don't think we're really having much of an impact.
    - The past week has been difficult to compare to the previous weeks tests, as the cold temps seems to have tempered the fish's motivation.
- The past few weeks have been a good "pre-season" for the upcoming shad run
    - We've learned about camera placement, the NVR software, and Mike Sears legs and shoulders are getting very toned as he has logged many miles as he has been traveling up and down the fish lift stairways and opening and closing AWS gates.
- When not testing, I've been targeting 75% / 25% AWS flow setting and a 1.0 foot drop at the entrance.

Richard Dill

Compliance Specialist, Fishery Biologist
Brookfield Renewable
Mobile: 207-951-2438

From: Dill, Richard <Richard.Dill@brookfieldrenewable.com>
Sent: Tuesday, May 9, 2023 6:32 PM
To: Simpson, Mitch <Mitch.Simpson@maine.gov>; donald.dow <Donald.Dow@noaa.gov>; Dan McCaw <dan.mccaw@penobscotnation.org>; Sojkowski, Bryan <bryan_sojkowski@fws.gov>
Subject: Re: Milford Working Group

Left entrance flume

Get Outlook for iOS

From: Dill, Richard <Richard.Dill@brookfieldrenewable.com>
Sent: Tuesday, May 9, 2023 6:30:09 PM
To: Simpson, Mitch <Mitch.Simpson@maine.gov>; donald.dow <Donald.Dow@noaa.gov>; Dan McCaw <dan.mccaw@penobscotnation.org>; Sojkowski, Bryan <bryan_sojkowski@fws.gov>
Subject: Re: Milford Working Group

Went to 30 minutes yesterday then to 15 min lifts this morning. I did not see the two salmon on the Hooper cam footage. They must have left the flume. I'm

Get Outlook for iOS

From: Simpson, Mitch <Mitch.Simpson@maine.gov>
Sent: Tuesday, May 9, 2023 6:05:14 PM
To: Dill, Richard <Richard.Dill@brookfieldrenewable.com>; donald.dow <Donald.Dow@noaa.gov>; Dan McCaw <dan.mccaw@penobscotnation.org>; Sojkowski, Bryan <bryan_sojkowski@fws.gov>
Subject: RE: Milford Working Group

Richard,

I forgot to check on the lift cycle today. I know it was at 1 hour lifts, but I know it has been changed to either 30 min or 15 min? And I don't know when it was changed?

BTW Jason never got the 2 salmon we saw swim into the entrance. Not sure if they are in the flume or if they left the fishway??? Are you recording camera footage? If so, it may be worth reviewing from 12:30 on, to see what they did?

Mitch

From: Dill, Richard <Richard.Dill@brookfieldrenewable.com>
Sent: Tuesday, May 9, 2023 4:03 PM
To: donald.dow <Donald.Dow@noaa.gov>; Dan McCaw <dan.mccaw@penobscotnation.org>; Sojkowski, Bryan <bryan_sojkowski@fws.gov>; Simpson, Mitch <Mitch.Simpson@maine.gov>
Subject: RE: Milford Working Group

EXTERNAL: This email originated from outside of the State of Maine Mail System. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Quick update…

Have been running the lift with 100% hopper flow and 0% floor diffuser flow since noon.

- Total Flow = 150cfs
- Hopper velocity = 1.8 ft/s
- Entrance velocity = 4.9 ft/s
- Depth over gate = 3.1
- Entrance drop = 0.9 ft

Alewife numbers have been great all day.   I'm going to run the lift this way the rest of today through tomorrow morning.

Richard Dill

Compliance Specialist, Fishery Biologist

Brookfield Renewable

Mobile: 207-951-2438

From: Dill, Richard
Sent: Tuesday, July 18, 2023 3:50 PM
To: 'Simpson, Mitch' <Mitch.Simpson@maine.gov>; 'donald.dow' <Donald.Dow@noaa.gov>; 'Dan McCaw' <dan.mccaw@penobscotnation.org>; 'Sojkowski, Bryan' <bryan_sojkowski@fws.gov>
Subject: RE: Milford Working Group

Brief summary of efforts and some observations.

A full draft report will follow late summer/early fall.

Richard Dill
Compliance Specialist, Fishery Biologist
Brookfield Renewable
Mobile: 207-951-2438

2023 Milford Fish Lift Underwater Video Monitoring Update

Camera installation began during the first several weeks of April, and initial camera testing was conducted on April 13th, 20th, 27th, and 28th. A total of six cameras were installed in the following locations to observe fish behavior as they entered and traveled through the lower flume, through the V-Gate and into the hopper. Figure 1 shows these camera locations and camera orientation within the lower flume.

1. Camera 1 – outside of the lower flume entrance looking across the fish lift entrance and flap gate
2. Camera 2 – inside of the lower flume entrance looking down stream to the flap gate
3. Camera 3 – downstream of the floor diffuser
4. Camera 4 – located directly upstream of the floor diffuser
5. Camera 5 – located directly downstream of the V-gate, oriented downstream
6. Camera 6 – located directly downstream of the V-gate, facing upstream

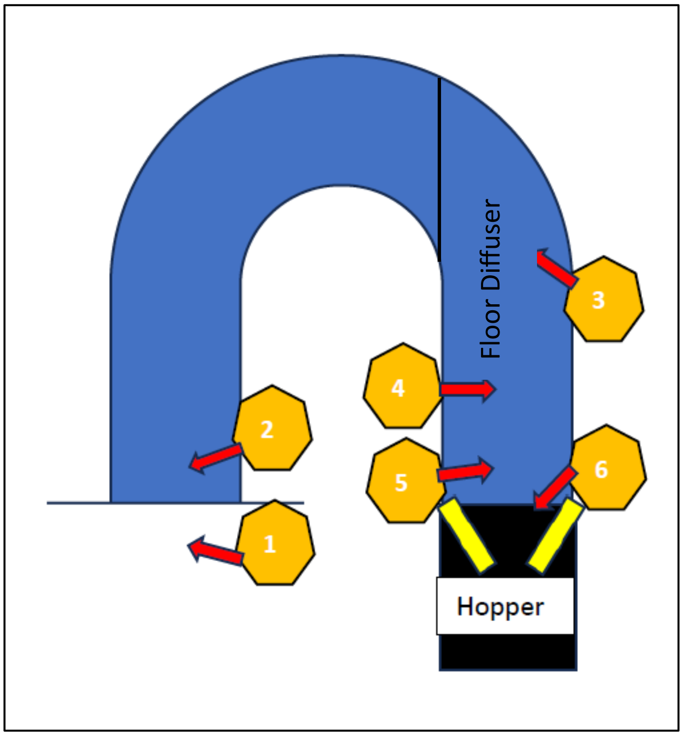

Figure 1. Camera Locations and Orientation in the Milford Fish Lift Lower Flume.

Observations began after the first river herring began to show up in early May. Ten total days were spent observing anadromous fish between May 4th and June 15th over various flow settings within the lower flume.

The following details the flow settings (H = Hopper Flow, FD = Floor Diffuser Flow) tested on each day:

1. May 4th – 45%H – 55% FD
   90% H - 10% FD
   70% H – 30% FD
2. May 9th – 100% H – 0% FD
   52% H – 48% FD
3. May 10th – 100% H – 0% FD
   40% H – 60% FD
4. May 12th – 40% H – 60% FD
   80% H – 20% FD
   70% H – 30% FD
   100% H – 0% FD
5. May 17th – 75% H – 25% FD
   50% H – 50% FD
   25% H – 75% FD
6. May 18th – 75% H – 25% FD
   80% H – 20% FD
   50% H – 50% FD
7. May 24th – 80% H – 20% FD
   60% H – 40% FD
8. June 2nd – 80% H – 20% FD (V-gate: 6 / 9 / 3)
   20% H – 80% FD
   80% H – 20% FD (V-gate: 9)
9. June 14th – 75% H – 25% FD (V-gate: 8)
   25% H – 75% FD (V-gate: 8)
10. June 15th – 20% H – 80% FD (V-gate: 8)
    75% H – 25% FD (V-gate: 8)

General Observations – Video quality (clarity and viewing distance) ranged from poor to average, and decreased in areas downstream of the floor diffuser significantly when floor diffuser flows were above 50% because of increased entrained air/bubbles. In addition to entrained air, other factors affecting the viewing quality included water color, turbidity and lighting. Fish appeared to navigate through the lower flume quicker and more orderly with proportionately higher hopper flows and lower floor diffuser flow (at least 75% hopper flow). This was noticeable especially for river herring and salmon and did appear to benefit the few shad that were present during observations. Some V-gate settings were also evaluated, and with a higher setting (9.0 - 10.0) fish generally appeared to enter the hopper more freely, especially salmon, when compared to lower V-gate settings (3.0 – 6.0) (multiply by 2.4 for width in inches). When the V-gate was opened wider than a setting of 10.0 (24 inches), fish tended leave the hopper more freely.

The low abundance of American shad this year along with sporadic/unpredictable upstream movements significantly affected our ability to assess shad behavior in response to various AWS settings in the first half of June. Opportunities to conduct observations during the second half of June and early July were impacted by high river flow and unseasonal warm temperatures, which also seemed to hamper the shad migration.

A complete draft report will be distributed later this summer or early fall for agency review.

Appendix B

2023 Milford Fish Lift Video Monitoring; Study Review with Agencies and PIN

Meeting Notes:

December 13, 2023, 11:00 – 12:00

Participants

NMFS: Don Dow, Jeff Murphy
DMR: Mitch Simpson, Jason Valliere, Casey Clark, Lars Hammer
USFWS: Bryan Sojkowski
BIA: Harold Peterson
DEP: Laura Paye, Kyle Olcott
PIN: Dan McCaw
Black Bear: Cameron Goodhart, Kevin Bernier, Richard Dill, Bob Brochu, Randy Dorman, Lance Macomber, Mike Osborne
FishTec LLC: Mike Sears

1.) Richard – Provided background.

2.) Mike – Presented study results using Powerpoint. Questions and responses are below.

3.) Richard presented a draft of recommended changes to the fish lift operating parameters based on observations of this study. These included injecting the majority of the AWS flow upstream of the hopper, increasing the maximum allowable hopper velocity to 2.5 ft/s, revising the target entrance flow velocity to 5.0-7.0 ft/s, and targeting a 1.0 ft drop at the entrance.
    a. There was consensus that these recommended changes should benefit fish passage at Milford and should be formalized. Richard distributed the draft changes to the meeting participants for further consideration/comment.

4.) Black Bear will schedule a meeting for mid-January 2024 to review the 2023 fish passage operations for Penobscot and Union River facilities, and to plan for the upcoming 2024 fish passage season at those same facilities.
    a. While BBHP currently has no proposals for fish passage studies in 2024, if agency staff have requests for studies, then those requests along with justification should be submitted prior to the meeting and will be discussed.

5.) Action items from today's meeting:
    a. Richard to distributed the Milford fish lift operating recommendations for consideration.
    b. Richard to distribute a doodle meeting poll to schedule the annual meeting to discuss:
        i. A recap of the 2023 Penobscot and Union River fish passage operations
        ii. 2024 fish passage operation plans for Penobscot and Union River fish passage operations.
    c. Agencies – Provide written comments to draft report and/or recommendations by December 22, 2023

Presentation Questions and Responses

Question: Did observations start immediately after each fish lift scenario change was made?

Response: Yes. Observations started shortly after the changes were made to see immediate responses of fish in the entrance flume.

Question: Were the observations of higher numbers of river herring/Atlantic salmon were seen for some scenarios a qualitative conclusion?

Response: Yes, that was a qualitative conclusion based on the density of fish observed in hopper dumps, it appeared that more fish were being passed. There is a timing disconnect between fish lift scenarios and daily counts of fish passing the sorting facility. So yes, these are qualitative/subjective conclusions.

Question: Could you tell if the bubbles were distributed throughout the water column or did they occur at different levels? And where were the fish in response to the bubbles.

Response: We did see entrained air higher in the water column, but not as much as near the floor diffuser. We couldn't determine if the fish were affected by the bubbles.

Question: The fish lift was operated outside of the fish lift design guidelines for some of the testing. Did it make any difference in passage success? We shad still passing through the flume when outside of the parameters?

Response: We did not see a setting where fish response was noticeably different. Yes, shad were observed passing through the flume and in hopper dumps at all of the tested conditions, including those outside of the guidelines

Question: What were the velocities associated with the higher flows through the hopper? Was a velocity at or near 2.5 ft/s reached/tested

Response: Just over 2 feet/second. The highest observed velocity through the hopper was ~2.2 ft/s

Question: Based on this study, is it better to put more flow above the hopper – 70/80% above vs. 20/30% below?

Response: Yes.

Question: Explain what a V-gate opening PLC setting of "8" equates to what?

Response: The PLC setting is multiplied by 2.4 inches to get the width of the V-gate opening. A PLC setting of 8 would be about 19.2".

Question: What is the current V-gate setting?

Response: The V-gate normally has been set at "6", which equals 14.4 inches.

Question: Does a difference in setting PLC setting (6 vs. 8) significantly affect lift cycle timing?

Response: No.

Question: If some of the fish lift operation parameters are changed (e.g., increased hopper velocity, entrance velocity, entrance drop, V-gate setting) , what are the requirements with regards to ESA-listed salmon? Would these changes require new upstream salmon passage studies?

Response #1: The recommended changes are still within the range fish lift passage guidelines for Atlantic salmon. The changes should only benefit salmon passage.

Response #2: There are likely to be other changes at the project in the future; testing would be conducted then.

Question: This was a qualitative assessment, does Black Bear foresee more quantitative assessments in the future?

Response: Black Bear has no studies planned for 2024 at this time. We are planning to have a meeting in January to review the 2023 fish passage season and plan for the upcoming 2024 fish passage season. Suggest requests with support documentation be submitted prior to that meeting.

Question: Do we have any ideas that would substantially improve passage [for shad] at Milford

Response: At this time we are not sure what can be done to improve passage at Milford. A number of other meeting participants responded that currently there are no other facilities or technologies known to have better passage results.

Appendix C

From: Dill, Richard
Sent: Tuesday, November 14, 2023 7:46 AM
To: Jeff Murphy - NOAA Federal <jeff.murphy@noaa.gov>; Donald Dow <donald.dow@noaa.gov>; Rosset, Julianne <julianne_rosset@fws.gov>; Sojkowski, Bryan <Bryan_Sojkowski@fws.gov>; Cross, Amanda S <amanda_cross@fws.gov>; Casey Clark (casey.clark@maine.gov) <Casey.Clark@maine.gov>; sean.m.ledwin@maine.gov; mitch.simpson@maine.gov; Hammer, Lars <Lars.Hammer@maine.gov>; Valliere, Jason <jason.valliere@maine.gov>; Charlie Loring, Jr. <Charlie.Loring.Jr@penobscotnation.org>; 'dan.mccaw@penobscotnation.org' <dan.mccaw@penobscotnation.org>; Olcott, Kyle <Kyle.Olcott@maine.gov>; Paye, Laura <Laura.Paye@maine.gov>; Dunham, Kevin (Kevin.Dunham@maine.gov) <Kevin.Dunham@maine.gov>; Gallant, Kevin <Kevin.Gallant@maine.gov>; Harold Peterson (harold.peterson@bia.gov) <harold.peterson@bia.gov>; Rawlings, Leonard D <Leonard.Rawlings@bia.gov>
Cc: Brochu, Robert <Robert.Brochu@brookfieldrenewable.com>; Goodhart, Cameron <Cameron.Goodhart@brookfieldrenewable.com>; Bernier, Kevin <Kevin.Bernier@brookfieldrenewable.com>; Dorman, Randy <Randy.Dorman@brookfieldrenewable.com>; Osborne, Michael <Michael.Osborne@brookfieldrenewable.com>; Macomber, Lance <Lance.Macomber@brookfieldrenewable.com>; Michael Sears <michael.sears@fishtec.org>
Subject: Draft 2023 Milford Entrance Flume Upstream Fish Passage Monitoring Study Report

Please find attached for your review the draft "2023 Milford Entrance Flume Upstream Fish Passage Monitoring Study Report".

Please provide any written comments on this draft report **Friday December 22, 2023**.

Please go to the doodle link provided below to indicate your availability for a virtual Microsoft Teams meeting to discuss this report. I'll be closing the meeting doodle poll at the end of the day **Friday, November 17th.**

https://doodle.com/meeting/participate/id/e19NB0Ve

Richard Dill
Compliance Specialist, Fishery Biologist

Brookfield Renewable
44 Davenport Street, Milford, ME 04461
Mobile: 207-951-2438
richard.dill@brookfieldrenewable.com
www.brookfieldrenewable.com

From: Jeff Murphy - NOAA Federal <jeff.murphy@noaa.gov>
Sent: Tuesday, December 19, 2023 9:22 AM
To: Dill, Richard <Richard.Dill@brookfieldrenewable.com>
Cc: Donald Dow <donald.dow@noaa.gov>; Rosset, Julianne <julianne_rosset@fws.gov>; Sojkowski, Bryan <Bryan_Sojkowski@fws.gov>; Cross, Amanda S <amanda_cross@fws.gov>; Casey Clark (casey.clark@maine.gov) <Casey.Clark@maine.gov>; sean.m.ledwin@maine.gov; mitch.simpson@maine.gov; Hammer, Lars <Lars.Hammer@maine.gov>; Valliere, Jason <jason.valliere@maine.gov>; Charlie Loring, Jr. <Charlie.Loring.Jr@penobscotnation.org>; dan.mccaw@penobscotnation.org; Olcott, Kyle <Kyle.Olcott@maine.gov>; Paye, Laura <Laura.Paye@maine.gov>; Dunham, Kevin (Kevin.Dunham@maine.gov) <Kevin.Dunham@maine.gov>; Gallant, Kevin <Kevin.Gallant@maine.gov>; Harold Peterson (harold.peterson@bia.gov) <harold.peterson@bia.gov>; Rawlings, Leonard D <Leonard.Rawlings@bia.gov>; Brochu, Robert <Robert.Brochu@brookfieldrenewable.com>; Goodhart, Cameron <Cameron.Goodhart@brookfieldrenewable.com>; Bernier, Kevin <Kevin.Bernier@brookfieldrenewable.com>; Dorman, Randy <Randy.Dorman@brookfieldrenewable.com>; Osborne, Michael <Michael.Osborne@brookfieldrenewable.com>; Macomber, Lance <Lance.Macomber@brookfieldrenewable.com>; Michael Sears <michael.sears@fishtec.org>
Subject: Re: Review of Draft 2023 Milford Entrance Flume Upstream Fish Passage Monitoring Study Report

Richard - Thank you for seeking our comments on the draft report concerning the 2023 upstream fish passage monitoring of the entrance flume of the Milford fish lift. We agree that information collected during monitoring should be used to make revisions to the Milford O&M plan. Specifically, we agree that the Milford fishlift should be operated to achieve the following parameters in 2024:

- Target 5.0 – 7.0 ft/s flow velocity at the entrance while maintaining a differential of 0.75-1.25 ft
- Target a hopper flow velocity of 1.0 - 2.5 ft/s
- Target a V-gate setting of 19.2—21.6 inches (PLC setting of 8.0 or 9.0)

On Wed, Dec 13, 2023 at 2:11 PM Dill, Richard <Richard.Dill@brookfieldrenewable.com> wrote:

Good afternoon,

I’ve attached a draft of the Milford fish lift operating recommendations that I had up on the screen during the end of today’s meeting.

Action items from today's meeting:

1. Richard to distributed the Milford fish lift operating recommendations for consideration.
2. Richard to distribute a doodle meeting poll to schedule the annual meeting to discuss
    a. A recap of the 2023 Penobscot and Union River fish passage operations
    b. 2024 fish passage operation plans for Penobscot and Union River fish passage operations.
3. Agencies – Provide written comments to draft report and/or recommendations by December 22, 2023

Please go to the link below to indicate your availability to meet in mid-January.

https://doodle.com/meeting/participate/id/enYDgqEd

From: Clark, Casey <Casey.Clark@maine.gov>
Sent: Friday, December 22, 2023 4:56 PM
To: jeff.murphy <jeff.murphy@noaa.gov>; Dill, Richard <Richard.Dill@brookfieldrenewable.com>
Cc: donald.dow <Donald.Dow@noaa.gov>; Rosset, Julianne <julianne_rosset@fws.gov>; Sojkowski, Bryan <bryan_sojkowski@fws.gov>; Cross, Amanda S <amanda_cross@fws.gov>; Ledwin, Sean M <Sean.M.Ledwin@maine.gov>; Simpson, Mitch <Mitch.Simpson@maine.gov>; Hammer, Lars <Lars.Hammer@maine.gov>; Valliere, Jason <Jason.Valliere@maine.gov>; Charlie Loring, Jr. <Charlie.Loring.Jr@penobscotnation.org>; Dan McCaw <dan.mccaw@penobscotnation.org>; Olcott, Kyle <Kyle.Olcott@maine.gov>; Paye, Laura <Laura.Paye@maine.gov>; Dunham, Kevin <Kevin.Dunham@maine.gov>; Gallant, Kevin <Kevin.Gallant@maine.gov>; Harold Peterson (harold.peterson@bia.gov) <harold.peterson@bia.gov>; Rawlings, Leonard D <Leonard.Rawlings@bia.gov>; Brochu, Robert <Robert.Brochu@brookfieldrenewable.com>; Goodhart, Cameron <Cameron.Goodhart@brookfieldrenewable.com>; Bernier, Kevin <Kevin.Bernier@brookfieldrenewable.com>; Dorman, Randy <Randy.Dorman@brookfieldrenewable.com>; Osborne, Michael <Michael.Osborne@brookfieldrenewable.com>; Macomber, Lance <Lance.Macomber@brookfieldrenewable.com>; Michael Sears <michael.sears@fishtec.org>
Subject: RE: Review of Draft 2023 Milford Entrance Flume Upstream Fish Passage Monitoring Study Report

Hi Richard,

Maine DMR appreciates the efforts of BBHP and consultants to collect information on the responses of alosines and Atlantic salmon to changing fish passage conditions within the Milford fishway. Our specific comments are attached. In general, 2023 was an abnormal year as reflected by high flow conditions, lower temperatures, and inconsistent fish runs. In particular, late and inconsistent American shad runs made the primary focus of this study (i.e., observations of American shad) difficult to impossible. Thus, very little information was gained on American shad responses to passage conditions at the project. While passing more of the AWS flow through the hopper and less through the floor diffuser appeared to promote passage for river herring and salmon, there were no quantifiable measurements of the effect size (i.e., how much improvement was there) and if these improvements may have been related to other simultaneous factors within (e.g., V-gate setting, lift frequency, time of day, and total entrance flume flow to a certain extent) or beyond (e.g., river flow, date, weather, water temp) BBHP's control. The latter is particularly apparent when analyzing changes to the V-Gate setting and is even more impactful given the small sample sizes within V-Gate settings. While there may be validity in the information presented, further quantitative studies are needed to understand if, and how much passage has been improved through implementation of these minor operational changes, particularly for American shad. Maine DMR looks forward to working with BBHP to fully assess the impacts of potential improvements to the Milford fishway.

Thank you,

Casey

Casey Clark (he/him)

Marine Scientist

Maine Department of Marine Resources

(207) 350-9791

From: Jeff Murphy - NOAA Federal <jeff.murphy@noaa.gov>
Sent: Tuesday, December 19, 2023 9:22 AM
To: Dill, Richard <Richard.Dill@brookfieldrenewable.com>
Cc: donald.dow <Donald.Dow@noaa.gov>; Rosset, Julianne <julianne_rosset@fws.gov>; Sojkowski, Bryan <bryan_sojkowski@fws.gov>; Cross, Amanda S <amanda_cross@fws.gov>; Clark, Casey <Casey.Clark@maine.gov>; Ledwin, Sean M <Sean.M.Ledwin@maine.gov>; Simpson, Mitch <Mitch.Simpson@maine.gov>; Hammer, Lars <Lars.Hammer@maine.gov>; Valliere, Jason <Jason.Valliere@maine.gov>; Charlie Loring, Jr. <Charlie.Loring.Jr@penobscotnation.org>; Dan McCaw <dan.mccaw@penobscotnation.org>; Olcott, Kyle <Kyle.Olcott@maine.gov>; Paye, Laura <Laura.Paye@maine.gov>; Dunham, Kevin <Kevin.Dunham@maine.gov>; Gallant, Kevin

<Kevin.Gallant@maine.gov>; Harold Peterson (harold.peterson@bia.gov) <harold.peterson@bia.gov>; Rawlings, Leonard D <Leonard.Rawlings@bia.gov>; Brochu, Robert <Robert.Brochu@brookfieldrenewable.com>; Goodhart, Cameron <Cameron.Goodhart@brookfieldrenewable.com>; Bernier, Kevin <Kevin.Bernier@brookfieldrenewable.com>; Dorman, Randy <Randy.Dorman@brookfieldrenewable.com>; Osborne, Michael <michael.osborne@brookfieldrenewable.com>; Macomber, Lance <Lance.Macomber@brookfieldrenewable.com>; Michael Sears <michael.sears@fishtec.org>
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https://doodle.com/meeting/participate/id/enYDgqEd

Richard Dill

Compliance Specialist, Fishery Biologist

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44 Davenport Street, Milford, ME 04461

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Jeff Murphy
NOAA's National Marine Fisheries Service
Maine Field Station
17 Godfrey Drive
Orono, Maine 04473
PH: (207)866-7379

From: Dill, Richard
Sent: Wednesday, December 13, 2023 2:10 PM
To: Jeff Murphy - NOAA Federal <jeff.murphy@noaa.gov>; Donald Dow <donald.dow@noaa.gov>; Rosset, Julianne <julianne_rosset@fws.gov>; Sojkowski, Bryan <Bryan_Sojkowski@fws.gov>; Cross, Amanda S <amanda_cross@fws.gov>; Casey Clark (casey.clark@maine.gov) <Casey.Clark@maine.gov>; sean.m.ledwin@maine.gov; mitch.simpson@maine.gov; Hammer, Lars <Lars.Hammer@maine.gov>; Valliere, Jason <jason.valliere@maine.gov>; Charlie Loring, Jr. <Charlie.Loring.Jr@penobscotnation.org>; 'dan.mccaw@penobscotnation.org' <dan.mccaw@penobscotnation.org>; Olcott, Kyle <Kyle.Olcott@maine.gov>; Paye, Laura <Laura.Paye@maine.gov>; Dunham, Kevin (Kevin.Dunham@maine.gov) <Kevin.Dunham@maine.gov>; Gallant, Kevin <Kevin.Gallant@maine.gov>; Harold Peterson (harold.peterson@bia.gov) <harold.peterson@bia.gov>; Rawlings, Leonard D <Leonard.Rawlings@bia.gov>; Brochu, Robert <Robert.Brochu@brookfieldrenewable.com>; Goodhart, Cameron <Cameron.Goodhart@brookfieldrenewable.com>; Bernier, Kevin <Kevin.Bernier@brookfieldrenewable.com>; Dorman, Randy <Randy.Dorman@brookfieldrenewable.com>; Osborne, Michael <Michael.Osborne@brookfieldrenewable.com>; Macomber, Lance <Lance.Macomber@brookfieldrenewable.com>; Michael Sears <michael.sears@fishtec.org>
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Richard Dill

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richard.dill@brookfieldrenewable.com

www.brookfieldrenewable.com

Appendix D

12-22-2023

Subject: Review of Draft 2023 Milford Entrance Flume Upstream Fish Passage Monitoring Study Report

Maine DMR appreciates the efforts of BBHP and consultants to collect information on the responses of alosines and Atlantic salmon to changing fish passage conditions within the Milford fishway. In general, 2023 was an abnormal year as reflected by high flow conditions, lower temperatures, and inconsistent fish runs. In particular, late and inconsistent American shad runs made the primary focus of this study (i.e., observations of American shad) difficult to impossible. Thus, very little information was gained on American shad responses to passage conditions at the project. While passing more of the AWS flow through the hopper and less through the floor diffuser appeared to promote passage for river herring and salmon, there were no quantifiable measurements of the effect size (i.e., how much improvement was there) and if these improvements may have been related to other simultaneous factors within (e.g., V-gate setting, lift frequency, time of day, and total entrance flume flow to a certain extent) or beyond (e.g., river flow, date, weather, water temp) BBHP's control. The latter is particularly apparent when analyzing changes to the V-Gate setting and is even more impactful given the small sample sizes within V-Gate settings. While there may be validity in the information presented, further quantitative studies are needed to understand if, and how much passage has been improved through implementation of these minor operational changes, particularly for American shad. Maine DMR looks forward to working with BBHP to fully assess the impacts of potential improvements to the Milford fishway.

1.) PDF Page 13: "Table 3. Lower Flume Flow Settings Testing during Study Period."

MDMR Comment: Please describe the duration of time between adopting a certain flow scenario and the viewing period. For example, were observations made immediately after switching flows or 30 minutes after? MDMR asked this question in the study review meeting and the response was that observations were made right away after changing the flow in the fishway, "as soon as possible". Please include this detail in the study report along with any documentation of when observations were delayed and the reason for the delay.

Response: The report text has been updated on page 14, to include: *"Fish appeared to resume upstream movements into and through the entrance flume very soon after the AWS flow setting adjustments were initiated. Observations for each scenario began when fish appeared to have resumed normal behavior (generally within 5-10 minutes following a change in AWS setting (i.e., following at least one lift cycle)), and the duration for each observation was 15 minutes at minimum, but longer in most cases. For example, on May 4th, each of the three AWS flow scenarios were observed for a minimum of 15-minutes each."*

No observation delays occurred.

2.) PDF Page 13: “Observations were conducted by viewing the live video feed for a minimum of 15 minutes from all six cameras simultaneously for each AWS setting.”

MDMR Comment: Please describe how this related to the scenarios represented in Table 3. For example, on May 4, were all three scenarios viewed for a minimum of 15 minutes, or was there a minimum of 15 minutes of viewing across the entire day?

Response: See response above.

3.) PDF Page 16: “Higher numbers of river herring and Atlantic salmon were captured in the hopper during the higher hopper flow AWS settings”

MDMR Comment: Please provide a description of observations of hopper dumps or other observations, which you described in the meeting as being used to qualify the qualitative observations in the flume.

Response: In addition to monitoring the underwater cameras in real-time, the observer also monitored some lifts at the hopper discharge to field verify what was being observed, i.e., that more fish (river herring) appeared to be passing through the lower flume and into the hopper. Making comparisons of the number of Atlantic salmon was simpler to determine than the other species, as the number of salmon per lift generally ranged from 0-10. Any perceived differences in the numbers of fish in the hopper dumps between AWS scenarios were noted on field observation datasheets.

4.) PDF Page 21: “Table 4. Summarized Observation Data Grouped by Hopper Flows.”

MDMR Comment: Please reorganize Table 4 such that observations are in a chronological order, with the first column representing scenario (i.e., high, even, low flows). This will greatly enhance readability of the table.

Response: Table revised in report.

5.) PDF Page 22: “However, valuable insights were found from observations of river herring and Atlantic salmon, which could be inferred for American shad as well.”

MDMR Comment: While some of the tested passage conditions may have qualitatively improved river herring and Atlantic salmon passage, it is inappropriate to assume that the same is true for American shad, particularly in light of the previous statement from the licensee: “The primary species of focus for this evaluation was to be adult American shad, but due to generally low daily counts of shad in June, likely as a result of high river flow and cool river temperature, little to no meaningful behavior responses to different flow settings could be detected.” Multiple direct observations of behavioral responses of shad to these conditions would be needed to infer improved passage. Furthermore, even if these observations had been made, they are qualitative in nature, not quantitative, which was one of the drawbacks of the study methods.

Response: Acknowledged, but Black Bear continues to believe the recommended operational changes based on observations made during the study will benefit American shad passage at Milford, as well. These recommendations are based not only on the observations made during the 2023 evaluation, but also from the findings of fish passage work group during literature and case-study reviews in support of the 2023 Milford lower flume study plan.

6.) PDF Page 22: “Fish did appear to show a positive response to passing more of the AWS flow through the hopper and less through the floor diffuser than has been traditionally targeted.”

MDMR Comment: Again, the drawback of this qualitative approach is that there is currently no way to use the study results to measure the effect size of these changes. Fish may have appeared to show a positive response, but it is unclear how much of a response was shown, or whether responses were related to covariates or extraneous variables.

Response: It’s important to recognize that this study was cooperatively developed utilizing fish passage experts from multiple agencies to take advantage of their expertise and professional judgment to improve upstream passage conditions at the lift. The qualitative nature of the study should not lessen the valuable and collaborative input that was received from these experts and incorporated into the study.

Black Bear agrees, there may be a host of other factors involved that could influence fish behavior during upstream fish passage; included amongst those should be that fish passage is dynamic throughout the migration window (daily, weekly, early run vs late run). While shad were *a* focus of the study, the ultimate goal was to ascertain whether more supplemental AWS flow could be injected upstream of the hopper (and less flow through the floor diffuser) without negatively affecting fish passage efficiency. And although qualitative, the 2023 evaluation demonstrated that this is possible, and it appears that the flow velocities through the hopper greater than the 1.5 ft/s maximum recommended for river herring (specifically blueback herring) can be exceeded without detrimental consequence to upstream fish passage. It should be noted that in early May, the Milford Fish Lift Work Group was briefed on preliminary observations of good fish passage at the higher hopper flows, and there was work group consensus to maintain the higher hopper flows as much as possible throughout the passage season, when not testing. In 2023, nearly 5.5. million river herring passed upstream (estimated) at Milford, almost double the record estimate of ~ 2.8 million river herring at Milford in 2022 and representing ~45% more river herring than the design capacity for the Milford fish lift. In addition, over 1,500 Atlantic salmon passed upstream at Milford in 2023 as well, which is the highest number on record since the lift became operational. Based on these numbers, it appears that the shift to more flow injected upstream of the hopper within the tested range of scenarios is at the very least inconsequential to upstream passage efficiency, if not beneficial.

And, although shad numbers at Milford were lower in 2023 compared to previous years, other rivers in Maine also observed lower than usual shad returns, which may be related to environmental conditions (e.g., high flows and low water temperatures in 2023), or could just be within the current range of natural variation of annual return for the species.

7.) PDF Page 22: "The wider V-gate opening appeared to benefit fish passage behavior at the V-gate, while not sacrificing retention in the hopper."

MDMR Comment: There were three "wide" settings investigated: 8, 9, and 10. Please describe which V- gate opening you are referring to and the opening amount which corresponds to the setting. Again, the study results do not allow us to measure the effect size of these changes, or whether these responses were related to other covariates (including flow scenario) or extraneous variables. Throughout the study period, there were three observations at a V-Gate settings of 8 and 9 (6 total). The trials with a setting of 9 were split among high (2 trials) and low flow scenarios (1 trial), lift frequencies (10 min vs 15 min), and the same can be said about trials of the 8 setting. While there may be validity to the idea that a wider V- gate opening benefits fish passage at the site, a much larger sample size, and more controlled conditions should be included in a study to validate this concept.

Response: BBHP agrees, and it is worth noting that during the 2022 shad study there was no significant difference in shad passage efficiency at two V-gate settings of 6.0 and 10.0 (14.4 inches and 24.4 inches, respectively). However, based on the observations from the 2023 camera monitoring, it appears there may be some benefit to setting the V-gate wider than the standard 6.0 setting that has been the target based on professional judgement back in 2014. Black Bear is proposing to set the V-gate to 8.0 (19.2 inches) until there is information to suggest otherwise, but appreciates agency professional judgement if there is another setting that is preferable.

8.) PDF Page 23: "The results of this study indicate that higher hopper flow (>60%) and lower floor diffuser flow (<40%) creates improved fish passage conditions for all target species in the entrance flume. In addition, the study included observations that when combining higher hopper flows with a V-gate setting of 8.0, 2.5 ft/s velocity through the hopper, and targeting an entrance drop of 1.0 ft, fish passage conditions may be improved further, especially for attracting higher numbers of Atlantic salmon into the entrance flume and into the hopper quickly.

MDMR Comment: As mentioned previously, the results of this study are qualitative, do not represent definitive conclusions, and unfortunately cannot be directly applied to American shad. The goal of the study was to focus on American shad, and yet we have learned very little about their specific behavior in response to changing passage conditions within the fishway. This is an understandable outcome, particularly with the abnormal water conditions this year. However, that does not negate the need for further information on improvements to American shad passage at the project, particularly with very low passage effectiveness reported in the 2023 report (30.9% overall; 21/66 shad passed)[1]. Please describe the anticipated next steps after obtaining the results of this study.

Response: A similar question was asked during the meeting on December 15th. Black Bear's response then, and remains the same here, is that at 30% passage effectiveness for American shad the Milford fish lift appears to be performing as well as other fish passage facilities on the East Coast (including other fish lifts). After 30 plus years of passage research, there does not appear to be a fishway design or operational setting that consistently passes shad at a high rate. During the meeting, BBHP posed the question as to whether there have been any new passage results, technology, or operational procedures that have been recently developed for American shad that Black Bear should be made aware of, to which the answer was there is nothing new to report at this time. Based on the 2023 observations, the recommended changes to the fish lift operating procedures should benefit overall upstream fish passage at Milford for all target species by reducing the amount of supplemental attraction water flow injected into the lower flume downstream of the hopper, thus reducing confusing hydraulics that occur in that area. However, it is unlikely that this alone will significantly improve overall passage effectiveness for shad at Milford. Other than implementing these recommending operational changes, Black Bear is not anticipating any new fish passage changes at Milford in 2024, and therefore, is not proposing quantitative upstream fish passage studies for any species in the coming year.

9.) PDF Page 23: “The results of this study indicate that higher hopper flow (>60%) and lower floor diffuser flow (<40%) creates improved fish passage conditions for all target species in the entrance flume. In addition, the study included observations that when combining higher hopper flows with a V-gate setting of 8.0, 2.5 ft/s velocity through the hopper, and targeting an entrance drop of 1.0 ft, fish passage conditions may be improved further, especially for attracting higher numbers of Atlantic salmon into the entrance flume and into the hopper quickly.

MDMR Comment: Please describe the flow and settings that BBHP is proposing to move forward with. It appears that an 80 hopper/20 FD split was tested most often, but there does not appear to be a method to determine which flow split was most effective within the high hopper flow range (>60%). Please describe whether BBHP is proposing to move forward with the other passage conditions indicated in the text (V-gate of 8.0, 2.5 ft/s velocity through hopper, entrance drop of 1.0 ft). MDMR notes that there is currently little evidence to indicate the degree of passage improvement resulting from changes in the above operational measures. Additionally, while the drawbacks to a qualitative study approach were known, more valuable information could have been produced if a larger sample size of observations and more controlled conditions were included. For example, maintaining conditions for 24 hours and documenting daily counts, with some caveats, to give some qualitative assessment to changes in operations.

At the study meeting, MDMR asked about the proposed settings that BBHP is intending to implement at the project and received the following response:

- 5-7 ft/s flow velocity at the entrance while maintaining a differential of 0.75-1/25 ft
- 1.0-2.5 ft/s hopper flow velocity
- 19.2-21.6 (PLC 8.0 or 9.0) inch-wide V-gate setting

Response: Correct, these are the recommended operating parameters that Black Bear is proposing for 2024. The range of acceptable entrance flow velocity would increase from 4-6 ft/s to 5-7 ft/s. The range in head differential at the entrance would increase from 0.5-1.0 ft to 0.75-1.25 ft. These recommendations are based upon both the findings fish passage work group during literature review in support of the 2023 study plan, and subsequently supported by observations made during the 2023 evaluation. BBHP is proposing to increase the maximum allowable hopper flow velocity from 1.5 ft/s up to 2.5 ft/s, however, based upon the 2023 evaluation it is unlikely that the hopper flow will reach higher than 2.2 ft/s. The increased allowable hopper velocity provides for more AWS flow injected upstream of the hopper, thus reducing the impact of flow emitted through the floor diffuser. Finally, Black Bear intends to change the V-gate setting from 6.0 to 8.0 (from 14.4 to 19.2 inches) based upon the 2023 observations. However, Black Bear will defer to resource agency professional judgement if a different V-gate setting is preferred.

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[1] Normandeau Associates, Inc (NAI). 2023. 2022 Evaluation of upstream adult American shad passage at the Milford Fish Lift Facility-2022. Prepared for Brookfield Renewable and Black Bear Hydro Partners, Inc.

Appendix E

2023 Milford Fish Lift Entrance Flume Video Monitoring Study

Milford Hydroelectric Project (FERC No. 2534)
December 13, 2023 - Agency Meeting

Prepared for:
Black Bear Hydro Partners, LLC
an affiliate of Brookfield Renewable U.S.

Brookfield

Prepared by:
FishTec, LLC

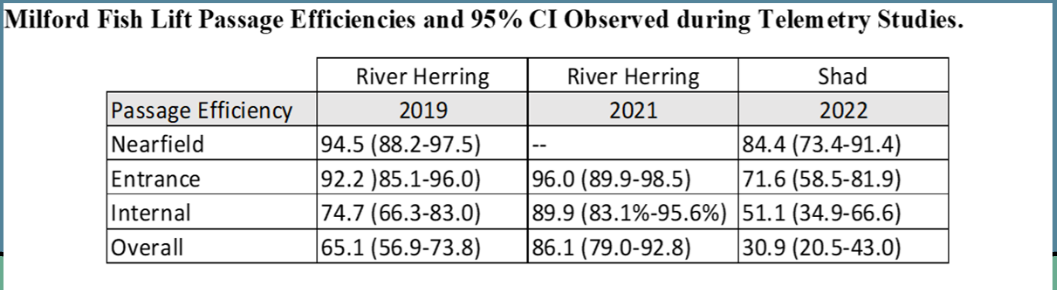
FISHTEC

Background – Milford Fish Lift Entrance Flume Operations

- AWS flow for the Milford fish lift - 40% flow upstream of hopper & 60% flow through floor diffuser, located downstream of the hopper.
    - Reduces the likelihood of exceeding the flow velocity criteria of 1.5 ft/s through the hopper established in the USFWS 2019 criteria, primarily for blueback herring.
    - However, it is recommended that as much supplemental flow released as possible from the auxiliary water system (AWS) upstream of lifting hoppers, as flow provided via diffusers in the entrance flume downstream of lifting hoppers can create confusing currents (Larinier and Travade 2002; USFWS 2019).
- The operational parameters for the Milford fish lift align with USFWS and NMFS engineering guidelines for fish lifts that pass diadromous fish, taking into consideration the presence of river herring (RH), including:
    - 4.0 - 6.0 ft/s flow velocity at entrance while maintaining a differential of 0.5 – 1.0 ft
    - 1.5 - 4.0 ft/s entrance flume flow velocity
    - 1.0 - 1.5 ft/s hopper flow velocity
    - 1.0 - 1.5 ft/s exit flume flow velocity
    - 14.4-inch-wide V-gate setting (determined previously in consultation with the agencies)

Background

- Nearly 9,300 Atlantic salmon, an estimated 19.5 million river herring, and over 55,000 adult American shad passed upstream since the Milford Fish lift was operational in 2014.
    - Qualitative and quantitative upstream passage efficiency studies conducted since 2014.
- Radio telemetry studies in 2019 and 2021 evaluated upstream passage effectiveness for adult river herring, and for adult American shad in 2022
    - Indicated that the overall passage efficiency, efficiency at the entrance of the fish lift, and internal passage efficiency were all higher for river herring than for shad.



Milford Fish Lift Passage Efficiencies and 95% CI Observed during Telemetry Studies.

	River Herring	River Herring	Shad
Passage Efficiency	2019	2021	2022
Nearfield	94.5 (88.2-97.5)	--	84.4 (73.4-91.4)
Entrance	92.2)85.1-96.0)	96.0 (89.9-98.5)	71.6 (58.5-81.9)
Internal	74.7 (66.3-83.0)	89.9 (83.1%-95.6%)	51.1 (34.9-66.6)
Overall	65.1 (56.9-73.8)	86.1 (79.0-92.8)	30.9 (20.5-43.0)

Background

- 2019-2022 Studies - Many failed passage attempts observed for both species - majority near floor diffuser and at V-gate.

- Potential causes of fall back behavior:

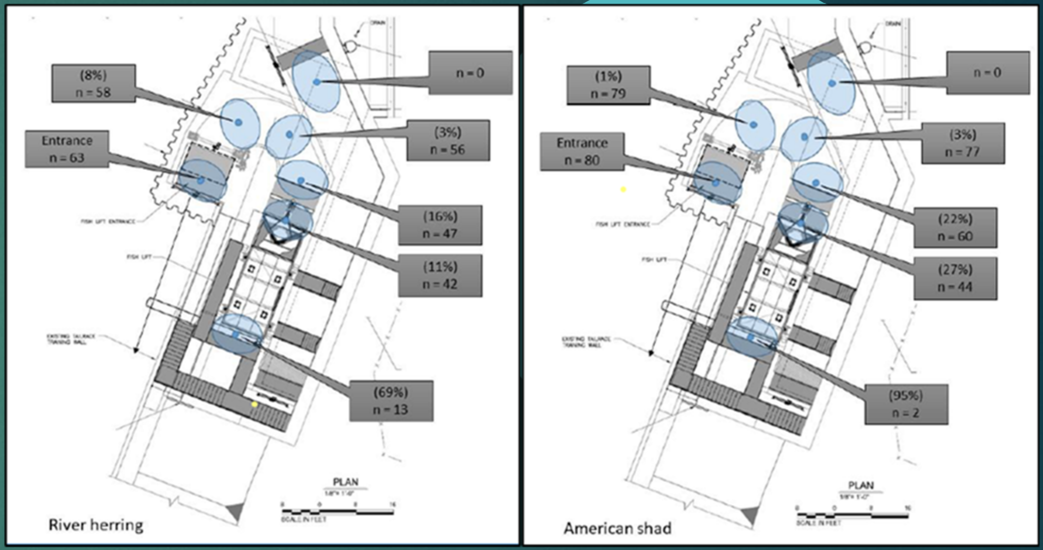
    - High density of fish in the entrance flume in the vicinity of the V-gate

    - Mechanical operation/noise of the V-gate

    - Mechanical operation of the lifting hopper (the frequency of lifts ranges from a lift every 10 minutes to every 25 minutes in the spring, depending on fish density).

    - Behavioral response to other fish in the flume (i.e., following other fish that are backing downstream)

    - Presence of predatory species



Note: Percentages are based on the number of unsuccessful passage attempts confirmed at the adjacent downstream station (NAI 2023).

Background

- Following the 2019 – 2022 studies there was consensus to establish an ad hoc work group to further evaluate potential causes for unsuccessful upstream passage, and if there are any operational adjustments, optimized settings, or other modifications that may improve the internal passage efficiency in the lower flume of the Milford fish lift facility.
- The ad hoc work group (work group): NMFS), USFWS, MDMR, PIN, and BBHP, was established in December 2022 to explore options for modifying operational parameters of the Milford fish lift facility. Met virtually four times between December 22, 2022, and January 26, 2023

➢ This study is a follow-up on previous studies and was designed by the work group to better understand and improve upstream passage efficiency at the Milford Dam fish lift.

Study Objectives

The work group proposed that the following fish lift parameters will be the initial focus of 2023 study

1. AWS flow distribution (hopper vs. floor diffuser)
   a. Majority of the AWS flow injected upstream of the hopper
   b. Evaluate fish behavior across AWS scenarios, starting with the baseline scenario (40% hopper / 60% floor diffuser).
   c. Calculate velocity of flow through the hopper for each scenario.
2. Velocity at the Entrance
   a. The range of acceptable fishway entrance velocity increased to 5.0 – 7.0 ft/s (vs. recommended 4.0-6.0 ft/s for river herring).
   b. Minimum water depth of 3.0 ft over the flap gate.

Additionally, the work group agreed that secondary conditions may be assessed including, but not limited to:

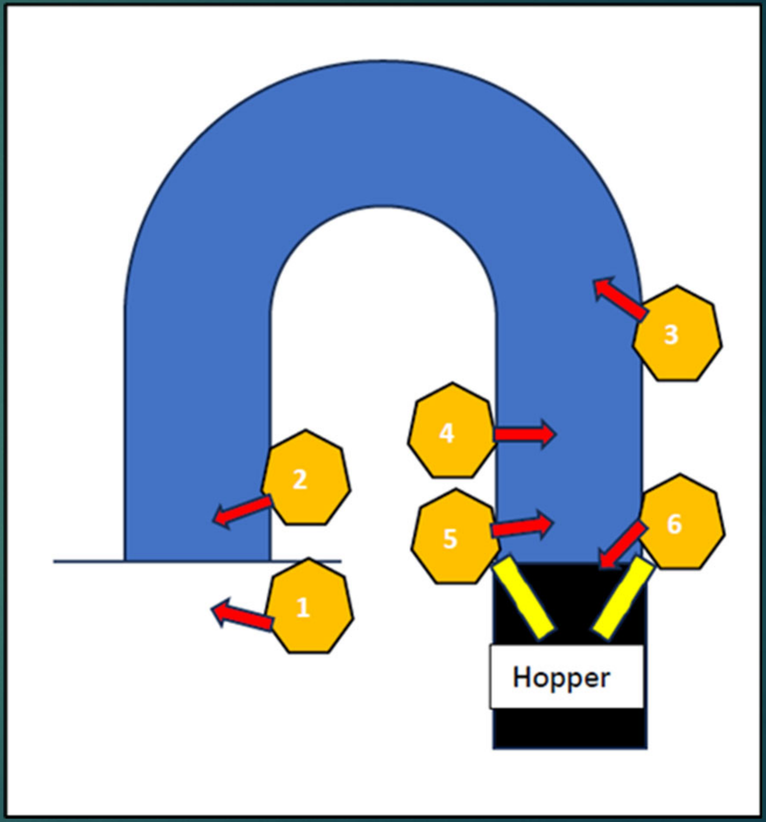
a. Unit 6 being turned down or off (not able to complete in 2023)
b. V-gate setting
c. Lift frequency

Methodology

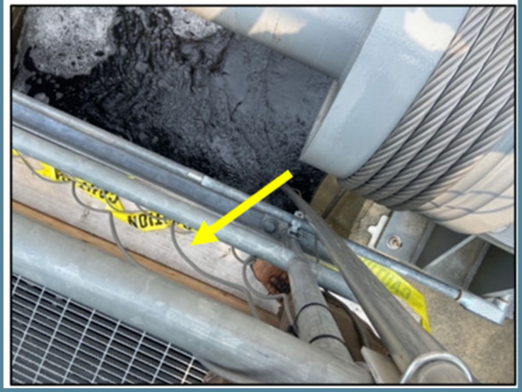
- **Run timing data (since 2014) determined study timing.**
- **April 15th (or when river conditions allow) – the fish lift put into operation for the season.**
    - **Operating parameters – start with baseline (status quo)**
    - **Conduct initial ocular assessment for a range of AWS and entrance flow setting**
- **By May 1 (prior to fish arrival) - cameras installed/wired/tested**
    - **Conduct range of AWS and entrance flow assessments via the cameras**
- **First week of river herring passage season**
    - **Conduct video assessments of fish behavior over AWS and entrance flow scen**
    - **Effort = the amount of time spent observing per day/week is as long as is need**
    - **Report back to the work group for discussion and consensus on approach**
    - **Adapt approach (and potential fish lift settings) and conduct more video evaluations**
- **Second week of river herring passage season**
    - **Implement work group suggestions/ make observations / report back/ adapt**
- **Continue evaluations through the peak river herring and shad upstream passage periods.**

Methodology

- 6 Barlus-IP68 Underwater IP Cameras (Model: T5MP-1-1), 2.8mm lens, 100° horizontal field of view, image resolution of 5-megapixels, connected to the IP68 CCTV Underwater Security NVR via POE cables.
- Cameras were mounted to aluminum poles with custom brackets all mounted guardrails.
- Cameras installed first weeks of April, initial testing conducted on April 13th and April 20th, before the fish lift was operational on April 24th
- Further testing and adjustments on April 27th and April 28th, during the beginning RH run.



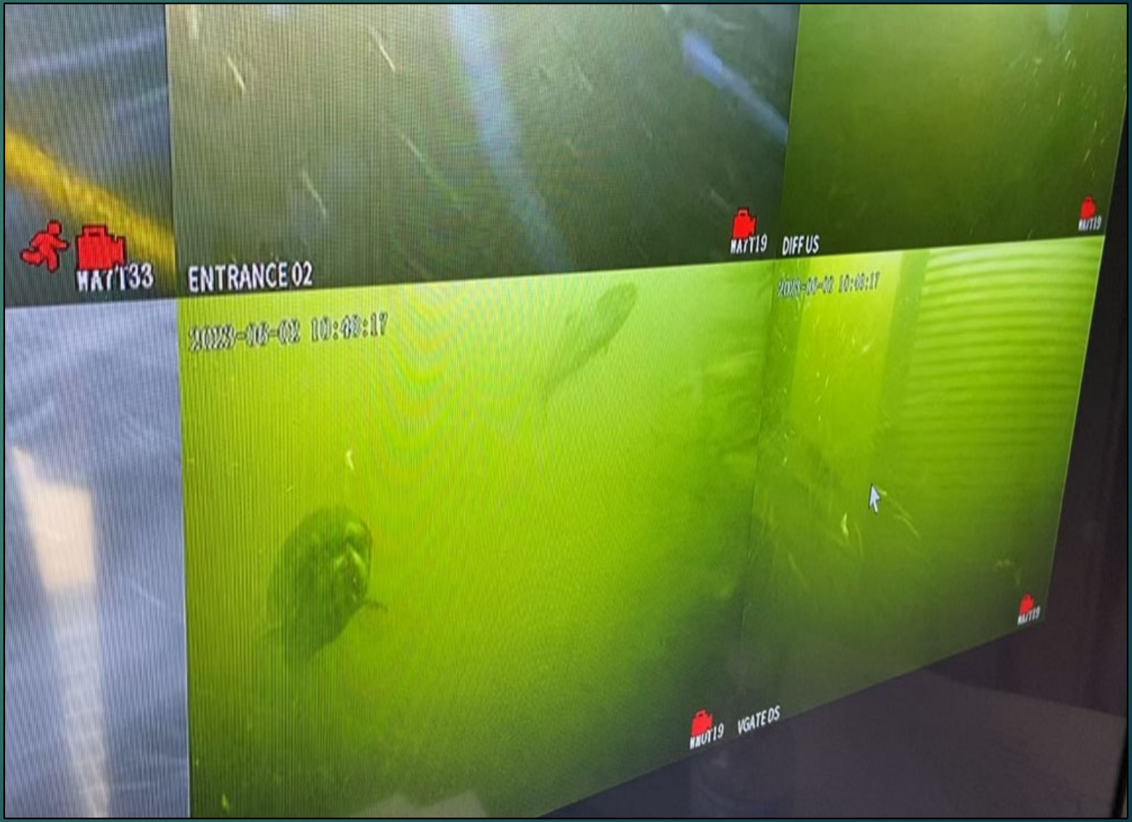
Camera 1 – Entrance (outside)



Camera 2 – Entrance (inside)

Camera 3&4 – Floor Diffuser

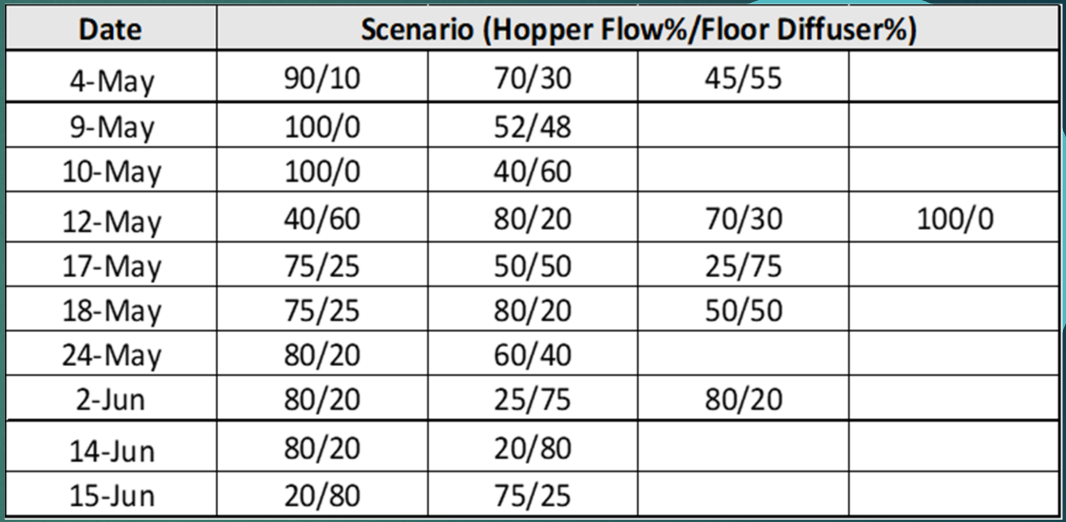
Camera 5&6 – V Gate


ENTRANCE 02
DIFF US
VGATE DS
2023-05-02 10:48:17

Methodology

- Observations began when RH began to show up in early May.
- 10 days spent observing fish - May 4th and June 15th;
- 26 flow scenario combinations observed.
- Observations included viewing the live video feed for 15 min at minimum from all 6 cameras simultaneously for each AWS setting
- Viewing times ranged from 15 min to over an hour long.
- An observation data sheet completed for each AWS flow scenario, as well as daily fishway inspection form to confirm that desired water flows and velocities were being attained.

Lower Flume Flow Settings Testing during Study Period



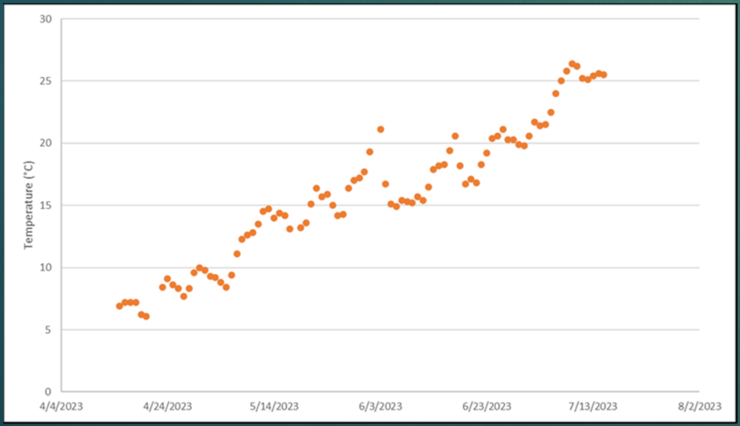
Date	Scenario (Hopper Flow%/Floor Diffuser%)			
4-May	90/10	70/30	45/55	
9-May	100/0	52/48		
10-May	100/0	40/60		
12-May	40/60	80/20	70/30	100/0
17-May	75/25	50/50	25/75	
18-May	75/25	80/20	50/50	
24-May	80/20	60/40		
2-Jun	80/20	25/75	80/20	
14-Jun	80/20	20/80		
15-Jun	20/80	75/25		

Methodology

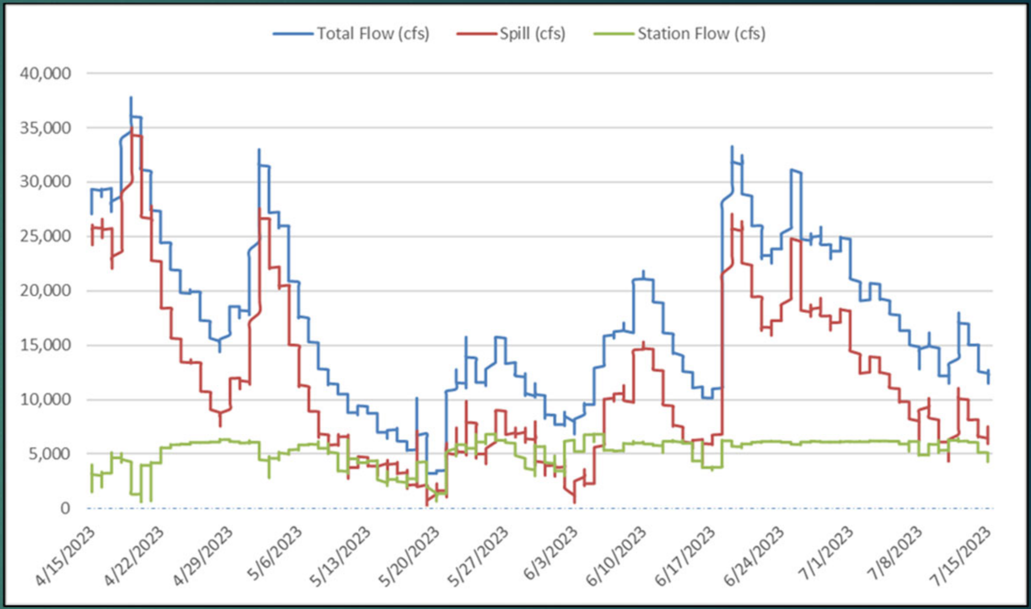
- Observations at each camera station included:
    - Camera visibility, of swimming characteristics, swimming direction, location in the water column, as well as a general assessment of fish behavior. Important notes and general observations were also recorded on the data sheets for each observation.
- The study concluded after the shad and river herring run slowed to the point where meaningful observations of fish behavior were no longer possible.
- Observations were binned into one of three AWS flow settings:
    - 1) high hopper flow setting (70% or greater of the overall flow through the hopper);
    - 2) even flow settings (40-60% hopper flow, the traditional operational flow); and
    - 3) low hopper flow (less than 40% of the overall flow through the hopper).

Results

Study Period Total River Flows



Study Period Daily Water Temperature (°C)



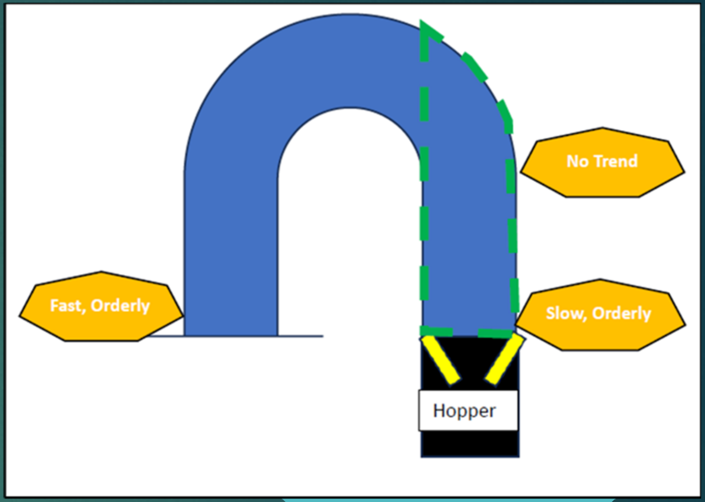
Milford Dam Total Flow, Spill, and Station Flow from April 15 to July 15, 2023.

	Date	Scenario (%Hopper/%FD)	River Flow (cfs)	Headpond Elevation	Tailwater Elevation	Weather	Water Temp (°C)	Time	Hopper flow (cfs)	FD flow (cfs)	Total Entrance Flume Flow (cfs)	V-Gate Setting	Lift Freq (min)	Hopper vel. (fps)	Entrance vel. (fps)	Water Depth at Flap Gate (ft)	Entrance drop (ft)	Species observed	Behavior			Notes
																			Entrance	FD	V-Gate	
High Hopper Flows	9-May	100/0	13,098	101.34	84.00	sunny	12.6	12:00	148	0	148	6.0	15	1.8	4.90	3.10	0.90	RIV, ATS	RL/M, O	Poor vis	US	RIV passing in middle of water column, higher than last test and swimming faster thought the V Gate
	10-May	100/0	11,540	101.35	83.57	sunny	12.5	9:00	152	0	152	6.0	15	1.95	4.90	3.20	0.63	RIV	US, RL, O	US, S	US, O, F	RIV moving through V Gate in lower water column, RIV rushed to closing V Gate and then dropped and held near or below FD during lift,
	12-May	100/0	9,062	101.32	83.10	partly cloudy	14.5	13:45	152	0	152	6.0	7	1.9	4.10	3.70	0.50	RIV, ATS, SLP	US, RL, F, O	US, ED, S, C	US, F, O	Lower flume seemed to fill with more RIV once FD flow was shut down
	4-May	90/10	27,187	102.40	87.43	overcast/light rain	8.8	12:45	170	19	189	6.0	15	1.5	3.50	5.40	0.57	few RIV	NA	NA	NA	Higher hopper flow created better visibility; low fish numbers and low visbility due to high flows
	12-May	80/20	9,062	101.32	83.10	partly cloudy	14.5	10:35	152	40	192	6.0	7	2.1	5.40	3.70	0.50	RIV, ATS, SLP	US, RL, F, O	US, RR, M, O	US, M, S, O	good vis throughout, RIV moving orderly through lower flume and into hopper, as well as few salmon
	18-May	80/20	5,281	101.27	81.38	sunny	12.5	10:20	155	41	196	6.0	15	2.2	5.50	3.70	1.12	RIV, ATS	US, RL, F, O	US, M, S, C	US, M, F, O	Better vis than 75/25, but more bubbl near v gate. RIV numbers increased afte 11:15, schools build below vgate then move through. ATS as well.
	24-May	80/20	9,770	101.35	82.30	sunny	15.9	9:36	143	30	173	6.0	15	1.8	5.50	3.30	1.00	All	US, RL, F, O	US, RL/M, F, C	US, M, S, O	Similar high hopper flow obs for RIV and ATS, only a few shad seen on cameras and in lifts
	2-Jun	80/20	5,451	101.26	81.58	partly cloudy	21.3	9:40	143	41	184	6.0/10.0/3.0	15/10	2.2	5.10	3.60	0.92	All	US, RL, F, O	US, RL/M,F, C	US, M, S, O	Similar behavior as similar previous settings, More shad present, many in the 9:15 lift, more shad seen in cameras than in left, shad entering lift just before or after RIV schools did. V gate at 10.0 showed RIV, ATS and AMS did not hold as long before moving into hopper. 3.0 V gate setting was not passing many fish.
	2-Jun	80/20	5,451	101.26	81.58	partly cloudy	21.3	13:05	139	41	180	9.0	10	2.1	4.90	3.80	1.18	All	US, RL, F, O	US, RL/M,F, O	US, M, S, O	Back to morning test setting and V Gate at 9.0. Less fish due to ToD. At 13:42 several salmon moved into hooped freely and fast. Fsh numbers started to increase and left it at this setting for the night. Seems wider V gate setting attracts more fish into the hopper.
	14-Jun	80/20	13,310	101.52	83.94	light rain	18	9:38	177	40	177	9.0	15	1.55	5.10	3.30	0.98	All	US, RL, F, O	US, M, S, C	US, M, S, O	Low light and high water decreased vis. Unseasonable high water and low temps for past several weeks. Shad and salmon sporadically entering flume and hopper, but generall took 5-10 to reach hopper. Some salmon seen leaving hopper. V Gate changed to 8.0.
	17-May	75/25	6,478	101.27	81.90	partly cloudy	13.1	8:00	133	44	177	6.0	30	2.1	6.00	3.00	1.00	RIV, ATS, SLP	US, RL, F, O	US, M, S, C, O	US, ED, S, O	RIV numbers picked up around 9:45, RIV generally move US quick and hold US of Diff, then enter hopper quickly after a few leaders enter first. Lower tailwater than last week, cameras lowered.
	18-May	75/25	5,281	101.27	81.38	sunny	12.5	9:00	133	45	178	6.0	15	2.1	7.10	2.80	1.32	RIV, AMS, ATS	US, RL, F, O	US, M, F, C	US, M, S, O	few RIV present, but shad present milling around diff, some entered hopper.
	15-Jun	75/25	12,083	101.38	83.64	overcast	18.3	7:45	128	39	167	8.0	15	1.6	4.90	3.70	0.86	All	US, RL/M, F, O	US, M, S, C	US, M, S, O	Number of salmon entering flume and making it to the hopper increased noticably compared to last setting. Too few shad present to make observations
	4-May	70/30	27,187	102.40	87.43	overcast/light rain	8.8	10:00	136	54	190	6.0	15	1.3	3.50	5.60	0.57	few RIV	NA	NA	NA	too few fish for obs
	12-May	70/30	9,062	101.32	83.10	partly cloudy	14.5	12:40	160	56	216	6.0	7	2.4	5.65	3.90	0.70	RIV, SLP	US, RL, O, M	US, RR, O, S	US, M, O, S	less bubbles than higher FD flow settings. Similar behavior as 80/20, RIV hold near FD and stack up and then head into hopper in pulses and more toward lower water column when entering hopper. RIV not falling out of lower flume between cycles
Even Flows	24-May	60/40	9,770	101.35	82.30	overcast/light rain	15.9	11:30	95	66	161	6.0	15	1.3	4.90	3.30	1.80	All	US, RL, F, O	US, RL/M,F, C	US, M, S, O	Few shad seen quickly passing cameras going US and DS before entering hopper. More fish overall likely bc time of day.
	9-May	52/48	13,098	101.34	84.00	sunny	12.6	10:30	108	98	206	6.0	15	1.3	5.70	3.60	1.00	RIV	RL, US, O, F	Poor vis	RL, US, O, M	RIV passing into hopper in lower third of water column, few are moving out, holding RIV back down once hopper lifts.
	17-May	50/50	6,478	101.27	81.90	light rain	13.1	10:50	87	88	175	6.0	15	1.3	5.60	3.10	1.10	RIV, ATS	US, RL, F, O	US, M, S, O	US, M, S, O	Similar to the 75/25 but RIV lower in water column, less Riv moved into flume when it became overcast
	18-May	50/50	5,281	101.27	81.38	sunny	12.5	12:40	100	102	202	6.0	7	1.55	5.50	3.70	1.12	RIV, AMS	poor vis	poor vis	US, ED, S, O	Lots of bubbles at diff and downstream, increase lift freq bc more RIV. RIV milling below v gate until school builds up and then moves into hopper.
	4-May	45/55	27,187	102.40	87.43	overcast/light rain	8.8	9:30	85	102	187	6.0	15	0.8	3.50	5.50	0.57	few RIV	NA	NA	NA	low fish numbers and low visbility due to high flows
	10-May	40/60	11,541	101.35	83.57	sunny	12.5	12:30	83	123	206	6.0	15	1.1	5.50	3.80	0.95	RIV	Poor vis, RL, O,	US, RL, M, C	US, M, O, F	Cameras adjusted bc of buddles at FD
	12-May	40/60	9,062	101.32	83.10	partly cloudy	14.5	7:00	80	118	198	6.0	15	1.1	5.00	4.00	0.80	RIV, SLP	Poor vis, US, F,	US, RL, M, O, F	good vis, US, M	RIV more toward lower water column when passing V Gate
Low Hopper Flows	17-May	25/75	6,478	101.27	81.90	light rain	13.1	13:44	37	137	171	6.0	15	0.6	5.50	3.00	1.08	RIV, ATS	US, RL, F, C	Poor vis, US, F	US, M, ED, S, C	RIV moved slower near V gate and lower in water column, schools hold an dbuild up more noticable below Vgate before moving into hopper
	2-Jun	25/75	5,451	101.26	81.58	partly cloudy	21.3	10:00	46	134	180	9.0/6.0	10	0.7	5.00	3.60	0.68	All	US, RL, F, C	poor vis	US, M, F, O	More fish were obs leaving hopper at this setting and v gate at 9.0, so changed back to 6.0, all fish generally more reluctant to enter hopper at this setting compare to higher hopper flow and still leaving hopper at 6.0 setting too. Lift at 13:00 verified less fish.
	14-Jun	20/80	13,310	101.52	83.94	light rain	18	10:30	41	138	179	8.0	15	0.5	5.00	3.60	0.56	All	US, RL, F, C	US, M, F, C	US, M, S, C	Low vis., not many fish present. Few shad present and seen in hopper, but overall less fish entering hopper.
	15-Jun	20/80	12,083	101.38	83.64	overcast	18.3	7:20	36	132	168	8.0	30/15	0.5	5.30	3.20	1.16	All	US, RL, F, C	US, M, F, C	US, M, S, C	Low vis., not many fish present. overall less fish entering hopper.

Legend: FD = Floor Diffuser; RR = River Right; RL = River Left; M = Middle; ED = Evenly Dispersed; US = Upstream; DS= Downstream; F = Fast; S = Slow; C = Chaotic, O = Orderly; RIV - River herring; ATS = Atlantic salmon; AMS = American shad; SLP = sea lamprey

Results

- High Hopper Flows Observation (>70% total fish lift flow through the hopper).:
  - 15 of 26 conducted under high hopper flow conditions
  - Velocity through the hopper generally between 1.5 to 2.4 ft/s; Entrance velocity ranged from 4.10 to 7.10 ft/s; Entrance drop ranged from 0.5 – 1.32 ft.
  - Fish appeared to navigate through the entrance flume quickly and orderly, especially around 75-80% hopper flow conditions.



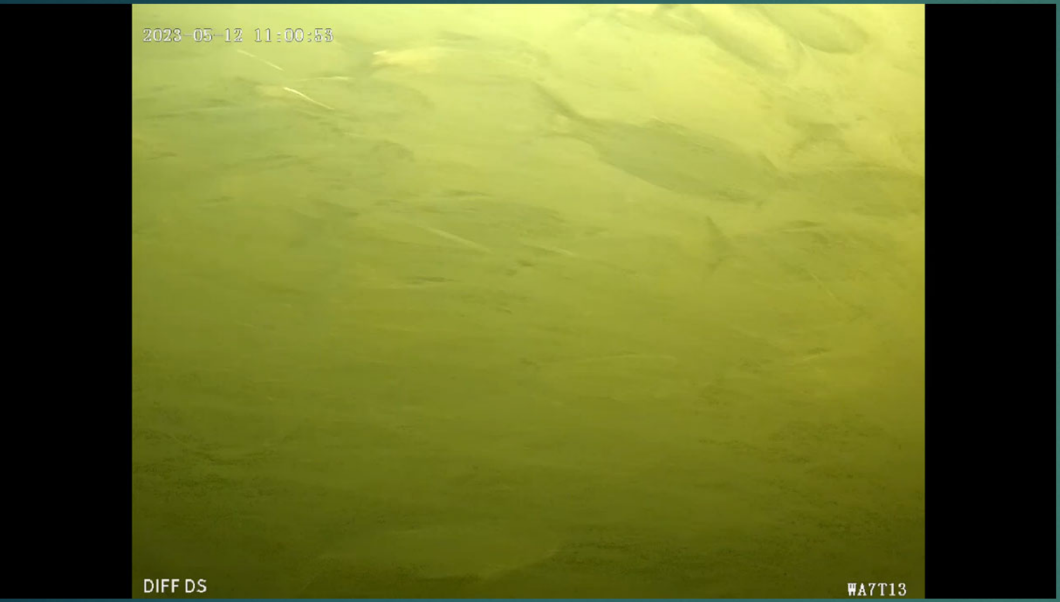
- Visibility was best during high hopper flow observations, except for poor visibility at the V-gate during the 100% hopper flow setting due to increased entrained air extending downstream of the V-gate.
- Higher numbers of RH and Atlantic salmon were captured in the hopper during the higher hopper flow AWS settings.
- RH generally passed FD easily until slowing at V-Gate, and occasionally schools accumulated here before all moving into hopper. Moved into hoper quickly and in lower to middle water column
- High densities of river herring in the entrance flume made it difficult to assess the passage behavior of other species present (salmon and shad); Salmon swam more orderly into hopper when RH less dense, and in groups of two or more.

Results – High Hopper Flow Video

Entrance

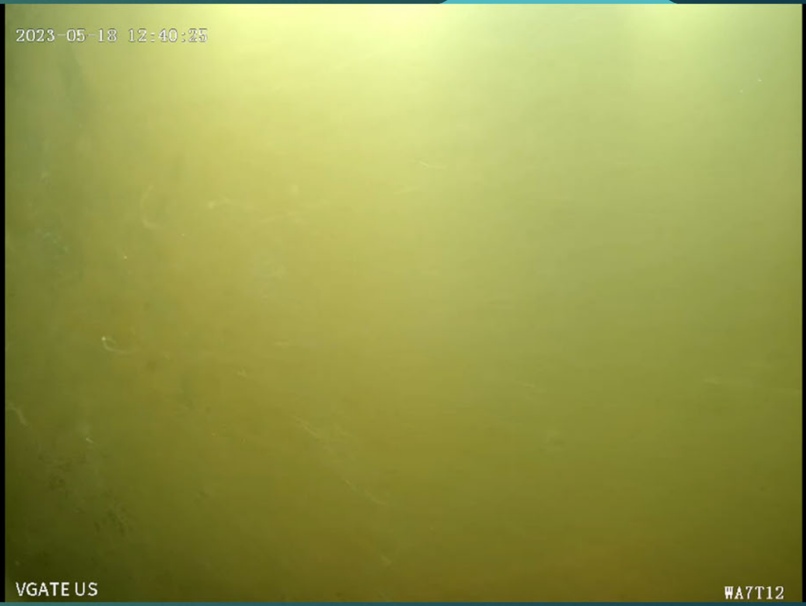
Results – High Hopper Flow Video

Floor Diffuser



Results – High Hopper Flow Video

V-Gate

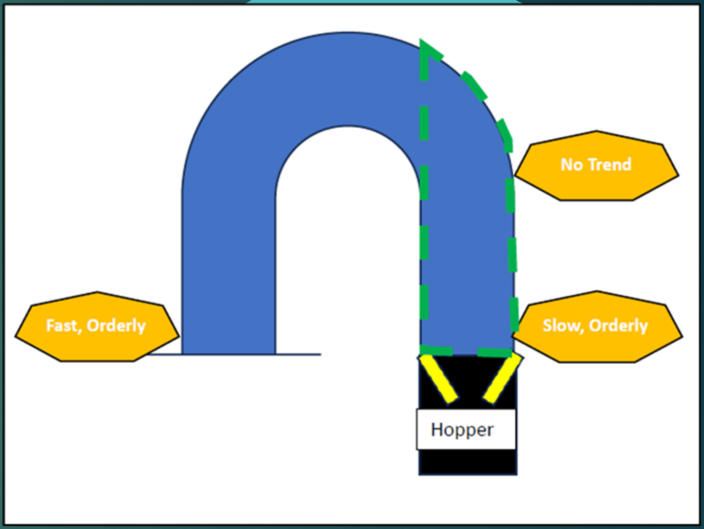


Results – High Hopper Flow Video

V-Gate

Results

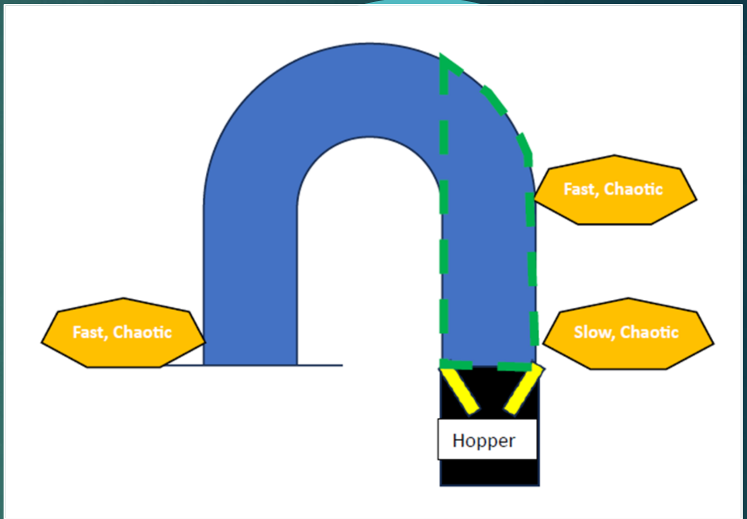
- Even Flow Observations ("traditional operating conditions" of hopper flows ranging from 40 to 60% of the total flow)
  - 7 out of the 26 observations.
  - Velocity through hopper between 1.3 to 1.55 ft/s; Entrance velocity ranged from 4.90 to 5.7 ft/s; Entrance drop ranged from 0.57 – 1.8 ft.
  - Visibility generally poor
  - RH passing into the hopper lower in the water column, and overall seemed slightly more chaotic in the area of the floor diffuser
  - In general, it appeared that less fish may have been present within the lower flume during the even hopper flow settings when compared to observations during the higher hopper flow settings; however, as noted previously, flow from the floor diffuser and visibility downstream of the V-gate were generally poor under these flow scenarios.



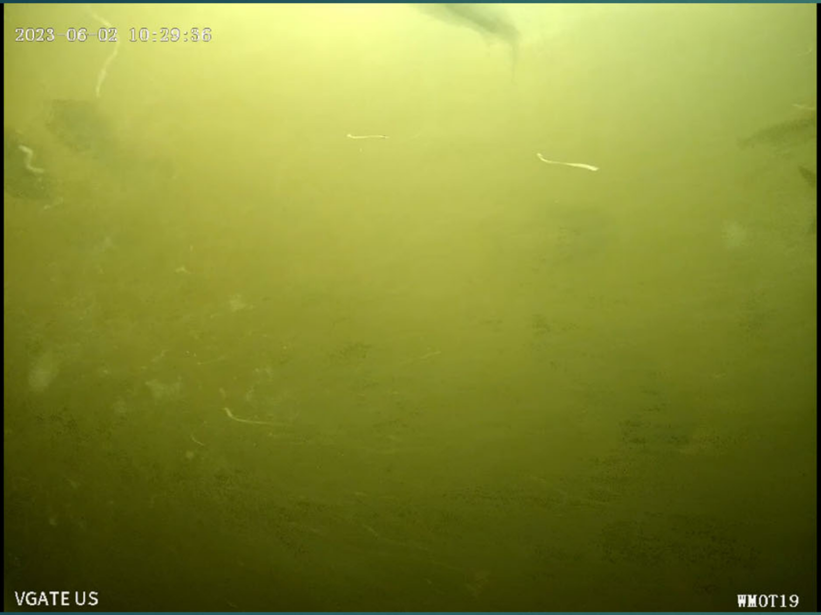
Results – Even Flow Video

Results

- Low Hopper Flow Observations {hopper flow < 40% of the total flow)
  - 4 out of the 26 observations.
  - Velocity through hopper ranged from 0.5 to 0.7 ft/s; Entrance velocity ranged from 5.0 to 5.5 ft/s; Entrance drop ranged from 0.56 – 1.16 ft.
  - Visibility was poor due to turbulence and entrained air/bubbles from the floor diffuser.
  - Less overall fish when compared to higher hopper flows.
  - RH swimming behavior chaotic as they moved through the entrance flume and over the floor diffuser, and tended to be lower in the water column through the V-gate, with slow and chaotic behavior.
  - The dominant behaviors suggest that the upward currents along with increased entrained air created by the high FD flow settings could be having a negative impact (chaotic swimming behavior)



Results – Low Hopper Flow Video



Discussion

- River flows unseasonably high during second half of study period – Exacerbated difficult viewing conditions
- Cool river temperatures and high flows in June contributed to an inconsistent and low shad run
- Water color and clarity (turbidity), lighting, entrained air, water currents, and high numbers of fish created difficult viewing conditions.
- Underwater cameras to observe and/or characterize the swimming behavior of diadromous fish in the entrance flume of the Milford fish lift was demonstrated to have low applicability given the consistent poor visibility throughout the study under most testing scenarios (including the normal flows in May), and across a range of environmental conditions.
- Despite viewing conditions, study objectives were mostly met
- American shad - generally low daily counts June, likely due to conditions, little meaningful behavioral responses detected.
- However, valuable insights of river herring and Atlantic salmon (inferred for American shad)
  - Overall positive response to more AWS hopper flow than floor diffuser flow
  - Less upwelling water currents and entrained air/bubbles emitted through the floor diffuser at higher hopper flows.
  - Fish swimming behavior through entrance flume, V-gate and into the hopper more consistent/orderly manner.
  - 1.5 ft/s through hopper and 1.0 ft drop at the fish lift entrance did not appear to negatively impact passage efficiency.

Discussion

- Wider V-gate opening (8.0) appeared to benefit passage into hopper, while not sacrificing retention in hopper.
- High-volume river herring periods – as fish density in the hopper increased during cycles, fish just outside tended to mimic wave-like swimming behavior of fish in the hopper.
- Shorter lift cycles (7-10 minutes) benefit passage efficiency during peak river herring periods; however, we are unable to determine how shad respond to such conditions from this study.
- Time of day influenced fish activity – fish numbers increased as day progressed, generally starting in late mornings.
- Intensity of natural light (or shadows) in the entrance flume may be influencing river herring behavior
  - Less chaotic when the flume was entirely shaded or when it was overcast;
  - However, when it was bright out, river herring may be slightly apprehensive to enter shaded areas within the flume.
- Overall – results suggest that;
  - Higher hopper flow (>60%) and lower floor diffuser flow (<40%) creates improved fish passage conditions for all target species in the entrance flume.
  - Combining higher hopper flows with a V-gate setting of 8.0, 2.5 ft/s velocity through the hopper, and targeting an entrance drop of 1.0 ft, fish passage conditions may be improved further, especially for attracting higher numbers of Atlantic salmon into the entrance flume and into the hopper quickly.

Appendix F

Milford Daily Fishway Inspection Form

1 of 3

Date: 5-4-23 Time: 8^15 Inspector: MK MG Hinged Gate Spill: [✓ Yes] / No

Head Pond Elevation: 102.40 River Flow (cfs): 27,187 Obermeyer Spill: [✓ Yes] / No

Tailwater Elevation: 87.43 Water Temp °C: 8.8 Log Sluice Spill: [✓ Yes] / No

Turbines On: (✓ or X) 1: Y 2: Y 3: N 4: Y 5: Y 6: Y

Upstream Eelway: Yes / [✓ No]

Denil Running: Yes / [✓ No]

Upstream Fishway *** Clean Debris Before Taking Measurements ***

1.) Fishway Debris:

a) Grizzly Rack ✓ Sorting Facility ✓ Punch Plate ✓ Hopper Block Screen ✓

2.) Fish Lift Operating Mode:

a) [✓ Automatic] / Manual Frequency: 60 (mins) V-gate 6.0

Lift Count Seasonal: 166

b) When unmanned, Sorting Facility Gates are: Open / [✓ Closed]

Daily: 3

3.) Upper Flume:

a) Weir: 102.1 (ft) Staff Gauge (S_P) 102.1 (ft) Staff Gauge (S_W) 5.8 (ft) Dist. Stop Logs (L) [✓ Open] / Closed Trash Pipe

b) Flume Velocity: = 50 cfs Flow (Weir + Pipe) = 0.9 fps Flume Velocity *Target: 1.0 – 1.5 fps*

4.) Aux. Water System:

a) Hopper Flow: 3 2 Bulkhead Panels₃ (rows) 9 (in) Gate 3 96 (ft) Backwater El.₃ = 85 cfs Hopper Flow = 0.8 fps Hopper Velocity *Target: 1.0 – 1.5 fps*

b) Floor Diffuser: 2 2 2 Bulkhead Panels₄ (rows) 24 (in) Gate 4 97 (ft) Backwater El.₄ = 102 cfs Floor Diffuser 187 cfs Total Flow *Target: 190 – 210 cfs*

5.) Lower Flume:

a) Entrance Drop: 82.5 (ft) Flap Gate 88.0 (ft) Staff Gauge (S_L) = 0.57 (ft) Entrance Drop = 3.5 fps Entrance Velocity *Target: 4 – 6 fps*

Does flow meet targets? Yes / [✓ No]

Downstream Fishway Open? Y / N

1.) Flow adequate: Y

2.) Entrances not blocked by debris: Y

3.) Eel Chimney open: -

Comments and Adjustments:

Fishway Mortalities:
(Count, Species, Location, Disposition)

Shad:

Riv:

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3.) Upper Flume Flow.

a) Weir Formula:

1.) Subtract the distance to the stoplogs (L) from the Benchmark Elevation (B_e) to find the Weir Elevation (W_e). The benchmark is the top of the rabbit for the weir on the shoreward side (surveyed at 106.67 ≈ 106.7).

106.7 (B_e) − 5.8 (L) = 100.9 (W_e)

2.) Subtract W_e (calculated above) from the Staff Gage just upstream of the weir (S_W) to find Depth at Weir (H).

102.1 (S_W) − 100.9 (W_e) = 1.2 (H)

3.) Using H (calculated above), look up Upper Flume Weir Flow from Chart 1: 26 cfs

Trash Pipe:

1.) Using the Pipe Staff Gauge (S_P), look up Pipe Flow from Chart 2: + 24 cfs

= 50 cfs

b) Upper Flume Velocity:

1.) Using the sum of the pipe and weir flows, and the Pipe Staff Gauge (S_P), look up the Upper Flume Velocity from Chart 3: *Round to the nearest tenth.*

Is velocity between 1.0 – 1.5 fps? Yes [✓ No]= Fix it = 0.9 fps Flume Velocity

4.) Auxiliary Water Supply:

a) Hopper Flow:

b) Floor Diffuser:

1.) Subtract the Backwater El. from the Lower Flume Staff Gauge (S_L) for both. *Round to the nearest foot.*

96 (Backwater El_3) − 88.0 (S_L) = 8 (Head of $Water_3$)

97 (Backwater El_4) − 88 (S_L) = 9 (Head of $Water_4$)

2.) Find the number of Sections of Holes open by summing the rows from each panel. Repeat for both bulkheads.

3 + 2 (Bulkhead $Panels_3$ (Rows)) = 5 (Sections $Holes_3$)

2 + 2 + 2 (Bulkhead $Panels_4$ (Rows)) = 6 (Sections $Holes_4$)

3.) Using the Head of Water, and Sections of Holes (calculated above), look up the Hopper Flow from Chart 4 and Floor Diffuser Flow from Chart 5.

= 85 Hopper Flow (45%)

= 102 Floor Diffuser (55%)

4.) Using the Hopper Flow (calculated above) and Lower Flume Staff Gauge (S_L), look up the Hopper Velocity from Chart 6:

Is the velocity between 1.0 – 1.5 fps? Yes / [✓ No]= Fix it! = 0.8 fps Hopper Velocity

5.) Lower Flume:

Is the Total Flow between 190 – 230 cfs? Yes [✓ No]= Fix it! = 187 cfs Total Flow

a) Entrance Drop and Depth:

1.) Find the difference between the Tailwater Elevation (read from the computer) and S_L for the Entrance Drop. Subtract the Flap Gate Elevation from S_L for the Entrance Depth. *Round to the nearest tenth.*

88 (S_L) − 87.43 (Tailwater El.) = 0.57 (Entrance Drop)

88 (S_L) − 82.5 (Flap Gate El.) = 5.5 (Entrance Depth)

2.) Using the Total Flow and Entrance Depth (both calculated above), look up Entrance Velocity from Chart 7.

Is the velocity between 4.0 – 6.0 fps? Yes [✓ No]= Adjust Flap Gate! = 3.5 Entrance Velocity

1 of 3

Date: 5/4/13	Observer:	MS	Weather:	Overcast
Water Temp:			River flow:	27,187

Test condition = 70H/30FD

Start time	10:25
Entrance Flow	190
Hopper Flow	136
Hopper Velocity	1.3
Diffuser Flow	54
Entrance Velocity	3.5
Depth over Flap gate	5.6
Drop	0.57
Tailwater Elevation	87.43
Lower Flume Elevation	88.00
Entrance Gate Setting	82.4

End Time	12:00
Hopper bulkhead	
Elevation	96
Rows of holes	8
Floor diffuser bulkhead	
Elevation	98
Rows of holes	3
Lift Frequency	15 min
Lift cycle time	
V-gate Width	6.0

Observation Time Start:___ ______ Time Stop: ________________

			Fish Observation (*dominate behavior)		
Camera Locations	Camera Visibility	Species observed	Direction	Location	Swimming Behavior
Entrance					
Diffuser Downstream					
Diffuser Upstream					
V-gate					

Comments:

- Not enough fish present to make observations
- Good visibility with cameras

Date: 5/4/23	Observer:	MS/RD	Weather: overcast	
Water Temp:	8.8		River flow:	27,187

Test condition = 45H/55FD

Start time	9:30
Entrance Flow	187
Hopper Flow	85
Hopper Velocity	0.8
Diffuser Flow	102
Entrance Velocity	3.5
Depth over Flap gate	5.5
Drop	0.57
Tailwater Elevation	87.43
Lower Flume Elevation	88.00
Entrance Gate Setting	82.5

End Time	10:20
Hopper bulkhead	
Elevation	96
Rows of holes	5
Floor diffuser bulkhead	
Elevation	97
Rows of holes	6
Lift Frequency	15 min
Lift cycle time	
V-gate Width	6.0

Observation Time Start:___ _______ Time Stop: _______________

			Fish Observation (*dominate behavior)		
Camera Locations	Camera Visibility	Species observed	Direction	Location	Swimming Behavior
Entrance					
Diffuser Downstream					
Diffuser Upstream					
V-gate					

Comments:

Saw a few RH quickly pass the "DIFF DS" camera. High river flows have created lower overall visibility

2 of 3

Milford Daily Fishway Inspection Form

Date: 5/4/23 Time: 1100 Inspector: RD

Head Pond Elevation: 102.33 River Flow (cfs): ______

Tailwater Elevation: 87.43 Water Temp °C: ______

Turbines On: (✓ or X) 1: Y 2: Y 3: Y 4: Y 5: Y 6: ______

Hinged Gate Spill: [✓ Yes] / No

Obermeyer Spill: [✓ Yes] / No

Log Sluice Spill: [✓ Yes] / No

Upstream Eelway: Yes / [✓ No]

Denil Running: Yes / [✓ No]

Upstream Fishway *** Clean Debris Before Taking Measurements ***

1.) Fishway Debris:

a) Grizzly Rack ✓ Sorting Facility ✓ Punch Plate ✓ Hopper Block Screen ✓

2.) Fish Lift Operating Mode:

a) **Automatic / Manual** Frequency: 15 (mins) V-gate 6.0

Lift Count

Seasonal: ______

b) When unmanned, Sorting Facility Gates are: **Open / Closed**

Daily: ______

3.) Upper Flume:

a) Weir: 101.8 (ft) Staff Gauge (S_P) 101.8 (ft) Staff Gauge (S_W) 6.2 (ft) Dist. Stop Logs (L) **Open / Closed** Trash Pipe

b) Flume Velocity: = 50 cfs Flow (Weir + Pipe) = 1.0 fps Flume Velocity *Target: 1.0 – 1.5 fps*

4.) Aux. Water System:

a) Hopper Flow: 4 4 Bulkhead Panels₃ (rows) 16 (in) Gate 3 96 (ft) Backwater El.₃ = 136 (71.5%) cfs Hopper Flow = 1.3 fps Hopper Velocity *Target: 1.0 – 1.5 fps*

b) Floor Diffuser: 1 1 1 Bulkhead Panels₄ (rows) 24 (in) Gate 4 98 (ft) Backwater El.₄ = 54 (28.5%) cfs Floor Diffuser

190 cfs Total Flow *Target: 190 – 210 cfs*

5.) Lower Flume:

a) Entrance Drop: 82.4 (ft) Flap Gate 88.0 (ft) Staff Gauge (S_L) = 0.57 (*) (ft) Entrance Drop = 3.5 (*) fps Entrance Velocity *Target: 4 – 6 fps*

Does flow meet targets? **Yes / No**

Downstream Fishway Open? [✓ Y] / N

1.) Flow adequate: ______

2.) Entrances not blocked by debris: ______

3.) Eel Chimney open: ______

Comments and Adjustments:

T_1 = 70% / 30%

(*) Flap gate all the way up. Tail water too high.

Fishway Mortalities:

(Count, Species, Location, Disposition)

Shad:

Riv:

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3.) Upper Flume Flow:

a) Weir Formula:

1.) Subtract the distance to the stoplogs (L) from the Benchmark Elevation (B_e) to find the Weir Elevation (W_e). The benchmark is the top of the rabbit for the weir on the shoreward side (surveyed at 106.67 ≈ 106.7).

106.7 (B_e) − 6.2 (L) = 100.5 (W_e)

2.) Subtract W_e (calculated above) from the Staff Gage just upstream of the weir (S_W) to find Depth at Weir (H).

101.8 (S_W) − 100.5 (W_e) = 1.3 (H)

3.) Using H (calculated above), look up Upper Flume Weir Flow from **Chart 1**: 29 cfs

Trash Pipe:

1.) Using the Pipe Staff Gauge (S_P), look up Pipe Flow from **Chart 2**: + 21 cfs

= 50 cfs

b) Upper Flume Velocity:

1.) Using the sum of the pipe and weir flows, and the Pipe Staff Gauge (S_P), look up the Upper Flume Velocity from **Chart 3**: ***Round to the nearest tenth.***

*Is velocity between 1.0 – 1.5 fps? **Yes / No = Fix it*** = 1.0 fps (Flume Velocity)

4.) Auxiliary Water Supply:

a) Hopper Flow: b) Floor Diffuser:

1.) Subtract the Backwater El. from the Lower Flume Staff Gauge (S_L) for both. ***Round to the nearest foot.***

96 (Backwater El_3) − 88 (S_L) = 8 (Head of $Water_3$)

98 (Backwater El_4) − 88 (S_L) = 10 (Head of $Water_4$)

2.) Find the number of Sections of Holes open by summing the rows from each panel. Repeat for both bulkheads.

4 + 4 (Bulkhead $Panels_3$ (Rows)) = 8 (Sections $Holes_3$)

1 + 1 + 1 (Bulkhead $Panels_4$ (Rows)) = 3 (Sections $Holes_4$)

3.) Using the Head of Water, and Sections of Holes (calculated above), look up the Hopper Flow from **Chart 4** and Floor Diffuser Flow from **Chart 5.**

= 136 (71.5%) (Hopper Flow)

= 54 (28.5%) (Floor Diffuser)

4.) Using the Hopper Flow (calculated above) and Lower Flume Staff Gauge (S_L), look up the Hopper Velocity from **Chart 6:**

*Is the velocity between 1.0 – 1.5 fps? **Yes / No = Fix it!*** = 1.3 fps (Hopper Velocity)

5.) Lower Flume:

*Is the Total Flow between 190 – 230 cfs? **Yes / No = Fix it!*** = 190 cfs (Total Flow)

a) Entrance Drop and Depth:

1.) Find the difference between the Tailwater Elevation (read from the computer) and S_L for the Entrance Drop. Subtract the Flap Gate Elevation from S_L for the Entrance Depth. ***Round to the nearest tenth.***

88 (S_L) − 87.43 (Tailwater El.) = 0.57 (Entrance Drop)

88.0 (S_L) − 82.4 (Flap Gate El.) = 5.6 (Entrance Depth)

2.) Using the Total Flow and Entrance Depth (both calculated above), look up Entrance Velocity from **Chart 7.**

*Is the velocity between 4.0 – 6.0 fps? **Yes / No = Adjust Flap Gate!*** = 3.5 (Entrance Velocity)

3 of 3

Date: 5/4/23	**Observer:** MS	**Weather:**	overcast-drizzle
Water Temp:	8.8	**River flow:**	27,187

Test condition = 90% H 10% FD

Start time	12:44
Entrance Flow	189
Hopper Flow	170
Hopper Velocity	1.5
Diffuser Flow	19
Entrance Velocity	3.5
Depth over Flap gate	5.4
Drop	0.57
Tailwater Elevation	81.43
Lower Flume Elevation	88
Entrance Gate Setting	82.6

End Time	1:30
Hopper bulkhead	
Elevation	96
Rows of holes	10
Floor diffuser bulkhead	
Elevation	99
Rows of holes	1
Lift Frequency	15 min
Lift cycle time	
V-gate Width	6.0

Observation Time Start: 12 45 **Time Stop:** 13:30

			Fish Observation (*dominate behavior)		
Camera Locations	**Camera Visibility**	**Species observed**	**Direction**	**Location**	**Swimming Behavior**
Entrance					
Diffuser Downstream					
Diffuser Upstream					
V-gate					

Comments:

- Not enough fish present yet for observations
- Good visibility, especially on downstream cameras

3 of 3

Milford Daily Fishway Inspection Form

Date: 5/4/23 Time: 12:45 Inspector: MS

Head Pond Elevation: 102.33 River Flow (cfs): 27,187

Tailwater Elevation: 87.43 Water Temp °C: 8.8

Turbines On: (✓ or X) 1 ✓ 2 ✓ 3 ✓ 4 ✓ 5 ✓ 6 ___

Hinged Gate Spill: [✓ Yes] / No

Obermeyer Spill: [✓ Yes] / No

Log Sluice Spill: [✓ Yes] / No

Upstream Eelway: Yes / [✓ No]

Denil Running: Yes / [✓ No]

Upstream Fishway *** Clean Debris Before Taking Measurements ***

1.) Fishway Debris:

a) Grizzly Rack ✓ Sorting Facility ✓ Punch Plate ✓ Hopper Block Screen ✓

2.) Fish Lift Operating Mode:

a) **[✓ Automatic] / Manual** Frequency: 15 (mins) V-gate 6.0

Lift Count

Seasonal: ______

b) When unmanned, Sorting Facility Gates are: **Open / Closed**

Daily: ______

3.) Upper Flume:

a) Weir: 101.7 (ft) Staff Gauge (S_P) 101.6 (ft) Staff Gauge (S_W) 65 (ft) Dist. Stop Logs (L) **Open / Closed** Trash Pipe

b) Flume Velocity: = 52 cfs Flow (Weir + Pipe) = 0.9 fps Flume Velocity *Target: 1.0 – 1.5 fps*

4.) Aux. Water System:

a) Hopper Flow: 4 6 Bulkhead Panels$_3$ (rows) 18 (in) Gate 3 96 (ft) Backwater El.$_3$ = 170 cfs Hopper Flow = 1.5 fps Hopper Velocity *Target: 1.0 – 1.5 fps*

b) Floor Diffuser: 0 0 1 Bulkhead Panels$_4$ (rows) 12 (in) Gate 4 99 (ft) Backwater El.$_4$ = 19 cfs Floor Diffuser 189 cfs Total Flow *Target: 190 – 210 cfs*

5.) Lower Flume:

a) Entrance Drop: 82.6 (ft) Flap Gate 88 (ft) Staff Gauge (S_L) = 0.57 (ft) Entrance Drop = 3.5 fps Entrance Velocity *Target: 4 – 6 fps*

Does flow meet targets? **Yes / No**

Downstream Fishway Open? **Y / N**

1.) Flow adequate: ______

2.) Entrances not blocked by debris: ______

3.) Eel Chimney open: ______

Comments and Adjustments:

90/10

Fishway Mortalities:

(Count, Species, Location, Disposition)

Shad:

Riv:

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3.) Upper Flume Flow:

a) Weir Formula:

1.) Subtract the distance to the stoplogs (L) from the Benchmark Elevation (B_e) to find the Weir Elevation (W_e). The benchmark is the top of the rabbit for the weir on the shoreward side (surveyed at 106.67 ≈ 106.7).

106.7 (B_e) – 6.5 (L) = 100.2 (W_e)

2.) Subtract W_e (calculated above) from the Staff Gage just upstream of the weir (S_W) to find Depth at Weir (H).

101.6 (S_W) – 100.2 (W_e) = 1.4 (H)

3.) Using H (calculated above), look up Upper Flume Weir Flow from **Chart 1**: 32 cfs

Trash Pipe:

1.) Using the Pipe Staff Gauge (S_P), look up Pipe Flow from **Chart 2**: +20 cfs

=52 cfs

b) Upper Flume Velocity:

1.) Using the sum of the pipe and weir flows, and the Pipe Staff Gauge (S_P), look up the Upper Flume Velocity from **Chart 3**: ***Round to the nearest tenth.***

Is velocity between 1.0 – 1.5 fps? Yes / No = Fix it = $\boxed{0.9}$ fps
Flume Velocity

4.) Auxiliary Water Supply:

a) Hopper Flow: b) Floor Diffuser:

1.) Subtract the Backwater El. from the Lower Flume Staff Gauge (S_L) for both. ***Round to the nearest foot.***

96 (Backwater El_3) – 88 (S_L) = 8 (Head of $Water_3$)

99 (Backwater El_4) – 88 (S_L) = 11 (Head of $Water_4$)

2.) Find the number of Sections of Holes open by summing the rows from each panel. Repeat for both bulkheads.

4 + 6 (Bulkhead $Panels_3$ (Rows)) = 10 (Sections $Holes_3$)

0 + 0 + 1 (Bulkhead $Panels_4$ (Rows)) = 1 (Sections $Holes_4$)

3.) Using the Head of Water, and Sections of Holes (calculated above), look up the Hopper Flow from **Chart 4** and Floor Diffuser Flow from **Chart 5.**

= 170 (90%) Hopper Flow

= 19 (10% Floor Diffuser

4.) Using the Hopper Flow (calculated above) and Lower Flume Staff Gauge (S_L), look up the Hopper Velocity from **Chart 6:**

Is the velocity between 1.0 – 1.5 fps? Yes / No = Fix it! = $\boxed{1.5}$ fps
Hopper Velocity

5.) Lower Flume:

Is the Total Flow between 190 – 230 cfs? Yes / No = Fix it! = $\boxed{189}$ cfs
Total Flow

a) Entrance Drop and Depth:

1.) Find the difference between the Tailwater Elevation (read from the computer) and S_L for the Entrance Drop. Subtract the Flap Gate Elevation from S_L for the Entrance Depth. ***Round to the nearest tenth.***

88 (S_L) – 87.43 (Tailwater El.) = 0.57 (Entrance Drop)

88 (S_L) – 82.6 (Flap Gate El.) = 5.4 (Entrance Depth)

2.) Using the Total Flow and Entrance Depth (both calculated above), look up Entrance Velocity from **Chart 7.**

Is the velocity between 4.0 – 6.0 fps? Yes / No = Adjust Flap Gate! = $\boxed{3.5}$
Entrance Velocity

Date: 5/9/23	Observer:	RD	Weather: Sunny	55°F
Water Temp:	12.6		River flow:	13,098

Test condition = 52% / 48%

Start time	10:30
Entrance Flow	206
Hopper Flow	108
Hopper Velocity	1.3
Diffuser Flow	98
Entrance Velocity	5.7
Depth over Flap gate	3.6
Drop	1.0
Tailwater Elevation	84.0
Lower Flume Elevation	85.0
Entrance Gate Setting	81.4

see TP form

End Time	1130
Hopper bulkhead	■
Elevation	94
Rows of holes	6
Floor diffuser bulkhead	■
Elevation	97
Rows of holes	5
Lift Frequency	15
Lift cycle time	
V-gate Width	6.0

Camera Visibility	Descriptor
Poor	P
Medium	M
Excellent	E

Fish Observations	Descriptor
Direction	
Upstream	U
Downstream	D
Location	
Right	R
Left	L
Middle	M
Evenly dispersed	ED
Swimming Behavior	
Slow	S
Fast	F
Orderly	O
Chaotic/Confused	C
Other	Other

Species observed	Descriptor
River herring	RIV
Shad	AMS
Salmon	ATS
Sea Lamprey	SLP
Striped bass	SB

Observation Time Start: 1030 Time Stop: 1130

			Fish Observation (*dominate behavior)		
Camera Locations	Camera Visibility	Species observed	Direction	Location	Swimming Behavior
E1 - Outside	M$^{\ominus}$	RIV	US	RL	O, F
E2 - Inside	P-bubbles				
DF-DS	P-bubbles				
DF-US	P-bubble				
② VG-RL	M$^{\ominus}$	RIV	US$^{\oplus}$, DS$^{\ominus}$	RL	O, M
① VG-RR	M	RIV	US$^{\oplus}$, DS$^{\ominus}$	RL	O, M

Comments:

① Turned this camera upstream so viewing V-gate as well

② Lowered this camera so covering more of full range of depth

- VG (Both) - Observed fish approaching V-gate on RL side of flume.
  - can see fish passing into hopper, and holding in the hopper.
  - RIV are approaching V-gate bottom third of water column
  - RIV observed swimming downstream out of hopper, but in small #'s (1-10 at a time)
  - RIV in the hopper observed milling back and forth just in front of the V-gate (upstream side).
- When the V-gate closes the fish on the D.S. side hold until the hopper breaks the surface of the water during a lift, then they back down out of site.

10

Milford Daily Fishway Inspection Form

Date: 5/9/23 Time: 07:30 Inspector: CP, MB Hinged Gate Spill: [✓ Yes] No

Head Pond Elevation: 101.34 River Flow (cfs): 13,098 Obermeyer Spill: Yes / [✓ No]

Tailwater Elevation: 84.0 Water Temp °C: 12.6C Log Sluice Spill: [✓ Yes] / No

Turbines On: (✓ or X) 1: Y 2: Y 3: Y 4: Y 5: Y 6: Y Upstream Eelway: Yes / [✓ No]

Denil Running: Yes / [✓ No]

Upstream Fishway *** Clean Debris Before Taking Measurements ***

1.) Fishway Debris:

a) Grizzly Rack ✓ Sorting Facility ✓ Punch Plate ✓ Hopper Block Screen ✓

2.) Fish Lift Operating Mode:

a) [✓ Automatic] / Manual Frequency: 30 (mins) V-gate 6.0

Lift Count Seasonal: 304

b) When unmanned, Sorting Facility Gates are: Open / [✓ Closed]

Daily: 11

3.) Upper Flume:

a) Weir: 101.1 (ft) Staff Gauge (S_P) 101.1 (ft) Staff Gauge (S_W) 6.8 (ft) Dist. Stop Logs (L) [✓ Open] / Closed Trash Pipe

b) Flume Velocity: = 37 cfs Flow (Weir + Pipe) = 0.9 fps Flume Velocity – LITTLE LOW

Target: 1.0 – 1.5 fps

4.) Aux. Water System:

a) Hopper Flow: 3 3 Bulkhead Panels$_3$ (rows) 12 (in) Gate 3 94' (ft) Backwater El.$_3$ = 108 cfs Hopper Flow = 1.3 fps Hopper Velocity

Target: 1.0 – 1.5 fps

b) Floor Diffuser: 1 2 2 Bulkhead Panels$_4$ (rows) 24 (in) Gate 4 97' (ft) Backwater El.$_4$ = 98 cfs Floor Diffuser 206 cfs Total Flow

Target: 190 – 210 cfs

5.) Lower Flume:

a) Entrance Drop: 81.4 (ft) Flap Gate 85.0 (ft) Staff Gauge (S_L) = 1.0 (ft) Entrance Drop = ~~3.6~~ 5.7 fps Entrance Velocity

Target: 4 – 6 fps

Does flow meet targets? Yes / No

Downstream Fishway Open? [✓ Y] / N

1.) Flow adequate: ✓

2.) Entrances not blocked by debris: ✓

3.) Eel Chimney open: X

Comments and Adjustments:

CHANGED FISH LIFT FREQ FROM 30 TO 15, LOTS OF RIV MOVING

Fishway Mortalities:

(Count, Species, Location, Disposition)

Shad:

Riv: 0

84.8 - 80.9

Please provide completed inspection forms to the Licensing and Compliance Group every Monday morning.

85.1 - 84 =

$S_L - T_W$ = 1.1 85.1 - $S_L - F_L$ 3.7

3.) Upper Flume Flow:

a) Weir Formula:

1.) Subtract the distance to the stoplogs (L) from the Benchmark Elevation (B_e) to find the Weir Elevation (W_e). The benchmark is the top of the rabbit for the weir on the shoreward side (surveyed at 106.67 ≈ 106.7).

106.7 − 6.8 = 99.9
B_e L W_e

2.) Subtract W_e (calculated above) from the Staff Gage just upstream of the weir (S_W) to find Depth at Weir (H).

101.1 − 99.9 = 1.2
S_W W_e H

3.) Using H (calculated above), look up Upper Flume Weir Flow from Chart 1: 26 cfs

Trash Pipe:

1.) Using the Pipe Staff Gauge (S_P), look up Pipe Flow from Chart 2: + 11 cfs

= 37 cfs

b) Upper Flume Velocity:

1.) Using the sum of the pipe and weir flows, and the Pipe Staff Gauge (S_P), look up the Upper Flume Velocity from Chart 3: *Round to the nearest tenth.*

Is velocity between 1.0 – 1.5 fps? Yes [✓ No] = Fix it = $\boxed{0.9}$ fps LITTLE LOW

Flume Velocity

4.) Auxiliary Water Supply:

a) Hopper Flow:

b) Floor Diffuser:

1.) Subtract the Backwater El. from the Lower Flume Staff Gauge (S_L) for both. *Round to the nearest foot.*

94 − 85 = 9
Backwater El_3 S_L Head of $Water_3$

97 − 85 = 12
Backwater El_4 S_L Head of $Water_4$

2.) Find the number of Sections of Holes open by summing the rows from each panel. Repeat for both bulkheads.

3 + 3 = 6
Bulkhead $Panels_3$ (Rows) Sections $Holes_3$

1 + 2 + 2 = 5
Bulkhead $Panels_4$ (Rows) Sections $Holes_4$

3.) Using the Head of Water, and Sections of Holes (calculated above), look up the Hopper Flow from Chart 4 and Floor Diffuser Flow from Chart 5.

= 108
Hopper Flow

= 98
Floor Diffuser

4.) Using the Hopper Flow (calculated above) and Lower Flume Staff Gauge (S_L), look up the Hopper Velocity from Chart 6:

Is the velocity between 1.0 – 1.5 fps? [✓ Yes] / No = Fix it! = $\boxed{1.3}$ fps

Hopper Velocity

Is the Total Flow between 190 – 230 cfs? [✓ Yes] / No = Fix it! = $\boxed{206}$ cfs

Total Flow

5.) Lower Flume:

a) Entrance Drop and Depth:

1.) Find the difference between the Tailwater Elevation (read from the computer) and S_L for the Entrance Drop. Subtract the Flap Gate Elevation from S_L for the Entrance Depth. *Round to the nearest tenth.*

85 − 84 = 1.0
S_L Tailwater El. Entrance Drop

85 − 81.4 = 3.6
S_L Flap Gate El. Entrance Depth

2.) Using the Total Flow and Entrance Depth (both calculated above), look up Entrance Velocity from Chart 7.

Is the velocity between 4.0 – 6.0 fps? [✓ Yes] No = Adjust Flap Gate! = $\boxed{5.7}$

Entrance Velocity

Pg. 2 of 2

Milford Daily Fishway Inspection Form Camera Test - 2

Date: 5/9/23 Time: 1200 Inspector: R. Dill

Hinged Gate Spill: [✓ Yes] / No

Head Pond Elevation: 101.4 River Flow (cfs): 13,098

Obermeyer Spill: Yes / [✓ No]

Tailwater Elevation: 83.8 Water Temp °C: 12.8

Log Sluice Spill: [✓ Yes] / No

Turbines On: (✓ or X)

1	2	3	4	5	6
Y	Y	Y	Y	Y	Y

Upstream Eelway: Yes / [✓ No]

Denil Running: Yes / [✓ No]

Upstream Fishway *** Clean Debris Before Taking Measurements ***

1.) Fishway Debris:
a) Grizzly Rack ✓ Sorting Facility ✓ Punch Plate ✓ Hopper Block Screen ✓

2.) Fish Lift Operating Mode:
a) **Automatic / Manual** Frequency: 15/45 (*) (mins) V-gate 6.0

Lift Count
Seasonal: ______
Daily: ______

b) When unmanned, Sorting Facility Gates are: **Open / Closed**

3.) Upper Flume:
a) Weir: 101.2 (ft) Staff Gauge (S_P) 101.1 (ft) Staff Gauge (S_W) 6.8 (ft) Dist. Stop Logs (L) [✓ Open] / Closed Trash Pipe

b) Flume Velocity: = 39 cfs Flow (Weir + Pipe) = 0.9 fps Flume Velocity
Target: 1.0 – 1.5 fps

4.) Aux. Water System:
a) Hopper Flow: 4 3 Bulkhead Panels$_3$ (rows) 21 (in) Gate 3 97 (ft) Backwater El.$_3$ = 148 cfs Hopper Flow = 1.8 fps Hopper Velocity
Target: 1.0 – 1.5 fps

b) Floor Diffuser: ____ ____ ____ Bulkhead Panels$_4$ (rows) 0 (in) Gate 4 0 (ft) Backwater El.$_4$ = 0 * cfs Floor Diffuser 148 cfs Total Flow
Target: 190 – 210 cfs

5.) Lower Flume:
a) Entrance Drop: 81.6 (ft) Flap Gate 84.7 (ft) Staff Gauge (S_L) = 0.9 (ft) Entrance Drop = 4.9 fps Entrance Velocity
Target: 4 – 6 fps

Does flow meet targets? Yes / No

Downstream Fishway Open? Y / N

1.) Flow adequate: ______
2.) Entrances not blocked by debris: ______
3.) Eel Chimney open: ______

Comments and Adjustments:

(*) Set to 0 cfs in support of entrance flume study.

(*) Lift frequency set to 45mins @ 8:00pm (R. Dill)

Fishway Mortalities:
(Count, Species, Location, Disposition)
Shad:
Riv:

Please provide completed inspection forms to the Licensing and Compliance Group every Monday morning.

3.) Upper Flume Flow:

a) Weir Formula:

1.) Subtract the distance to the stoplogs (L) from the Benchmark Elevation (B_e) to find the Weir Elevation (W_e). The benchmark is the top of the rabbit for the weir on the shoreward side (surveyed at 106.67 ≈ 106.7).

106.7 − 6.8 = 99.9
B_e L W_e

2.) Subtract W_e (calculated above) from the Staff Gage just upstream of the weir (S_W) to find Depth at Weir (H).

101.1 − 99.9 = 1.2
S_W W_e H

3.) Using H (calculated above), look up Upper Flume Weir Flow from Chart 1: 26 cfs

Trash Pipe:

1.) Using the Pipe Staff Gauge (S_P), look up Pipe Flow from Chart 2: + 13 cfs

= 39 cfs

b) Upper Flume Velocity:

1.) Using the sum of the pipe and weir flows, and the Pipe Staff Gauge (S_P), look up the Upper Flume Velocity from Chart 3: *Round to the nearest tenth.*

Is velocity between 1.0 – 1.5 fps? Yes / No = Fix it = 0.9 fps
Flume Velocity

4.) Auxiliary Water Supply:

a) Hopper Flow: b) Floor Diffuser:

1.) Subtract the Backwater El. from the Lower Flume Staff Gauge (S_L) for both. *Round to the nearest foot.*

97 − 84.7 = 12.3
Backwater El_3 S_L Head of $Water_3$

0 − 0 = 0
Backwater El_4 S_L Head of $Water_4$

2.) Find the number of Sections of Holes open by summing the rows from each panel. Repeat for both bulkheads.

4 + 3 = 7
Bulkhead $Panels_3$ (Rows) Sections $Holes_3$

~~+ + =~~ 0
Bulkhead $Panels_4$ (Rows) Sections $Holes_4$

3.) Using the Head of Water, and Sections of Holes (calculated above), look up the Hopper Flow from Chart 4 and Floor Diffuser Flow from Chart 5.

= 148 (100%)
Hopper Flow

= 0 (0%)
Floor Diffuser

4.) Using the Hopper Flow (calculated above) and Lower Flume Staff Gauge (S_L), look up the Hopper Velocity from Chart 6:

Is the velocity between 1.0 – 1.5 fps? Yes / No = Fix it! = 1.8 fps
Hopper Velocity

5.) Lower Flume: *Is the Total Flow between 190 – 230 cfs? Yes / No = Fix it!* = 148 cfs
Total Flow

a) Entrance Drop and Depth:

1.) Find the difference between the Tailwater Elevation (read from the computer) and S_L for the Entrance Drop. Subtract the Flap Gate Elevation from S_L for the Entrance Depth. *Round to the nearest tenth.*

84.7 − 83.8 = 0.9
S_L Tailwater El. Entrance Drop

84.7 − 81.6 = 3.1
S_L Flap Gate El. Entrance Depth

2.) Using the Total Flow and Entrance Depth (both calculated above), look up Entrance Velocity from Chart 7.

Is the velocity between 4.0 – 6.0 fps? Yes / No = Adjust Flap Gate! = 4.9
Entrance Velocity

Date: 5/9/23	Observer:	RD	Weather:	Sunny 55°F
Water Temp: 12.8			River flow:	13,098

Test condition = 100% / 0%

Start time	1200
Entrance Flow	148
Hopper Flow	148
Hopper Velocity	1.8
Diffuser Flow	0
Entrance Velocity	4.9
Depth over Flap gate	3.1
Drop	0.9
Tailwater Elevation	83.8
Lower Flume Elevation	84.7
Entrance Gate Setting	81.6

End Time	
Hopper bulkhead	
Elevation	97
Rows of holes	7
Floor diffuser bulkhead	
Elevation	0
Rows of holes	0
Lift Frequency	15
Lift cycle time	
V-gate Width	6.0

Camera Visibility	Descriptor
Poor	P
Medium	M
Excellent	E

Fish Observations	Descriptor
Direction	
Upstream	U
Downstream	D
Location	
Right	R
Left	L
Middle	M
Evenly dispersed	ED
Swimming Behavior	
Slow	S
Fast	F
Orderly	O
Chaotic/Confused	C
Other	Other

Species observed	Descriptor
River herring	RIV
Shad	AMS
Salmon	ATS
Sea Lamprey	SLP
Striped bass	SB

Observation Time Start: 12:15 Time Stop: 1250

			Fish Observation (*dominate behavior)		
Camera Locations	Camera Visibility	Species observed	Direction	Location	Swimming Behavior
E1 - Outside	M	RIV/ATS	US	RL	M/F/O
E2 - Inside	M^-	RIV/ATS	US - and holding	RL/M	S/M/O
DF - D.S.	P^+	RIV	US		
DF - U.S.	P	RIV	US		
VG - RL	M	RIV	US^+, DS		
VG - RR	M	RIV	US^+, DS		

Comments:

E1 -> RIV and 2 ATS observed passing RL side of flap gate
- RIV now spread 1/3 toward middle of flume as they enter.

E2 - RIV observed holding across flume immediately upstream of flap gate. More RIV entering, primarily RL side

VG 1+2 - RIV obsered approaching V-gate higher up in water column (mid depth) than previous test condition
- swimming faster through V-gate w/higher flow to overcome, but no issues.

VG-2 - RIV primarily RL side of flume.
(1300 hrs)

Lift Observation - RIV rushed to get thru V-gate as it was closing.
- RIV that didn't make it in to the hopper held downstream of V-gate until hopper brake surface of the water.
- During lift, RIV continued to enter flume and hold over flap gate

?
ATS (~1215) - 2 ATS were observed on E1 + E2 swimming upstream.
- Not observed on any other camera's
- Not lifted throughout the afternoon
- Not observed leaving on any camera's

1500hrs

- RIV now approaching V-gate primarily middle of flume
- Lower flow does not appear to be affecting attraction or overall #'s
- RIV observed backing downstream on VG 1+2 as well as DF-US/DS camera's during a hopper lift.

⊛ Going to run 100/0 overnight - sent to W.G.

1 of 2

Date: 5/10/23	Observer:	MS, RB	Weather: clear	
Water Temp:			River flow: 11,540	

Test condition = 100 H/0 FD

Start time	9am
Entrance Flow	152
Hopper Flow	152
Hopper Velocity	1.95
Diffuser Flow	0
Entrance Velocity	4.9
Depth over Flap gate	3.2
Drop	0.63
Tailwater Elevation	83.57
Lower Flume Elevation	84.2
Entrance Gate Setting	81

see 1000 form

End Time	1200
Hopper bulkhead	
Elevation	97.5
Rows of holes	7
Floor diffuser bulkhead	
Elevation	0
Rows of holes	0
Lift Frequency	15
Lift cycle time	
V-gate Width	6.0

Camera Visibility	Descriptor
Poor	P
Medium	M
Excellent	E

Fish Observations	Descriptor
Direction	
Upstream	U
Downstream	D
Location	
Right	R
Left	L
Middle	M
Evenly dispersed	ED
Swimming Behavior	
Slow	S
Fast	F
Orderly	O
Chaotic/Confused	C
Other	Other

Species observed	Descriptor
River herring	RIV
Shad	AMS
Salmon	ATS
Sea Lamprey	SLP
Striped bass	SB

Observation Time Start: 11 00 Time Stop: 1140

			Fish Observation (*dominate behavior)		
Camera Locations	Camera Visibility	Species observed	Direction	Location	Swimming Behavior
E1 - outside	M⁻	RIV	US	RL	O
E2 - inside	M	RIV	US	RL	O
DF - DS	M⁻	RIV	US+, DS+		S
DF - US	M⁻	RIV	US+, DS⁻		S
VG - RL	M⁻	RIV	US		O, F
VG - RR	M+	RIV	US	lower in WC	O, F

Comments: - vide footage recorded

① moved DF-DS camera ~~dowst~~cam across from upstream (DF-US) camera but pointed it downstream to get better image.

② VG - (Both) - RIV rushed to the closed V-Gate when hopper Starts to lift, and then drop and hold near diffuser cameras, RIV still move through while V-Gate is closing

③ E1 & E2 - RIV moving upstream along RL wall, Possibly more moving in when hopper moves up - obs. this on a few lift cycles

1 of 2

Milford Daily Fishway Inspection Form

Date: 5/6/23 Time: 10:00 Inspector: MS

Head Pond Elevation: 101.35 River Flow (cfs): 11,540

Tailwater Elevation: 83.57 Water Temp °C: ______

Turbines On: (✓ or X) 1 ✓ 2 ✓ 3 ✓ 4 ✓ 5 ✓ 6 ✓

Hinged Gate Spill: **Yes / No**

Obermeyer Spill: **Yes / No**

Log Sluice Spill: **Yes / No**

Upstream Eelway: **Yes / No**

Denil Running: **Yes / No**

Upstream Fishway *** Clean Debris Before Taking Measurements ***

1.) Fishway Debris:
  a) Grizzly Rack ✓ Sorting Facility ✓ Punch Plate ✓ Hopper Block Screen ✓

2.) Fish Lift Operating Mode:
  a) [✓ **Automatic**] **/ Manual** Frequency: 15 (mins) V-gate 6
  b) When unmanned, Sorting Facility Gates are: **Open /** [✓ **Closed**]

Lift Count
Seasonal: ______
Daily: ______

3.) Upper Flume:
  a) Weir: 101.4 (ft) Staff Gauge (S_P) 101.3 (ft) Staff Gauge (S_W) 6.8 (ft) Dist. Stop Logs (L) [✓ **Open**] **/ Closed** Trash Pipe
  b) Flume Velocity: = 49 cfs Flow (Weir + Pipe) = 1.1 fps Flume Velocity *Target: 1.0 – 1.5 fps*

4.) Aux. Water System:
  a) Hopper Flow: 3 4 Bulkhead Panels₃ (rows) 21 (in) Gate 3 97.5 (ft) Backwater El.₃ = 152 cfs Hopper Flow = 1.95 fps Hopper Velocity *Target: 1.0 – 1.5 fps*
  b) Floor Diffuser: 2 2 1 Bulkhead Panels₄ (rows) 0 (in) Gate 4 0 (ft) Backwater El.₄ = 0 cfs Floor Diffuser 152 cfs Total Flow *Target: 190 – 210 cfs*

5.) Lower Flume:
  a) Entrance Drop: 81 (ft) Flap Gate 84.2 (ft) Staff Gauge (S_L) = 0.63 (ft) Entrance Drop = 4.9 fps Entrance Velocity *Target: 4 – 6 fps*

Does flow meet targets? **Yes / No**

Downstream Fishway Open? [✓ Y] / N

1.) Flow adequate: ✓
2.) Entrances not blocked by debris: ✓
3.) Eel Chimney open: X

Comments and Adjustments:

Fishway Mortalities:
(Count, Species, Location, Disposition)
Shad:
Riv:

Please provide completed inspection forms to the Licensing and Compliance Group every Monday morning.

3.) Upper Flume Flow:

a) Weir Formula:

1.) Subtract the distance to the stoplogs (L) from the Benchmark Elevation (B_e) to find the Weir Elevation (W_e). The benchmark is the top of the rabbit for the weir on the shoreward side (surveyed at 106.67 ≈ 106.7).

106.7 (B_e) − 6.8 (L) = 99.9 (W_e)

2.) Subtract W_e (calculated above) from the Staff Gage just upstream of the weir (S_W) to find Depth at Weir (H).

101.3 (S_W) − 99.9 (W_e) = 1.4 (H)

3.) Using H (calculated above), look up Upper Flume Weir Flow from **Chart 1**: 32 cfs

Trash Pipe:

1.) Using the Pipe Staff Gauge (S_P), look up Pipe Flow from **Chart 2**: + 17 cfs

= 49 cfs

b) Upper Flume Velocity:

1.) Using the sum of the pipe and weir flows, and the Pipe Staff Gauge (S_P), look up the Upper Flume Velocity from **Chart 3**: ***Round to the nearest tenth.***

Is velocity between 1.0 – 1.5 fps? Yes / No = Fix it = 1.1 fps (Flume Velocity)

4.) Auxiliary Water Supply:

a) Hopper Flow: b) Floor Diffuser:

1.) Subtract the Backwater El. from the Lower Flume Staff Gauge (S_L) for both. ***Round to the nearest foot.***

97.5 (Backwater El_3) − 84.2 (S_L) = 13.3 (Head of $Water_3$)

0 (Backwater El_4) − 0 (S_L) = 0 (Head of $Water_4$)

2.) Find the number of Sections of Holes open by summing the rows from each panel. Repeat for both bulkheads.

3 + 4 (Bulkhead $Panels_3$ (Rows)) = 7 (Sections $Holes_3$)

~~___ + ___ (Bulkhead $Panels_4$ (Rows)) = ___ (Sections $Holes_4$)~~

3.) Using the Head of Water, and Sections of Holes (calculated above), look up the Hopper Flow from **Chart 4** and Floor Diffuser Flow from **Chart 5.**

= 152 (Hopper Flow)

= 0 (Floor Diffuser)

4.) Using the Hopper Flow (calculated above) and Lower Flume Staff Gauge (S_L), look up the Hopper Velocity from **Chart 6:**

Is the velocity between 1.0 – 1.5 fps? Yes / [✓ No] = Fix it! = 1.55 fps (Hopper Velocity)

Is the Total Flow between 190 – 230 cfs? Yes / [✓ No] = Fix it! = 152 cfs (Total Flow)

5.) Lower Flume:

a) Entrance Drop and Depth:

1.) Find the difference between the Tailwater Elevation (read from the computer) and S_L for the Entrance Drop. Subtract the Flap Gate Elevation from S_L for the Entrance Depth. ***Round to the nearest tenth.***

84.2 (S_L) − 83.57 (Tailwater El.) = 0.63 (Entrance Drop)

84.2 (S_L) − 81 (Flap Gate El.) = 3.2 (Entrance Depth)

2.) Using the Total Flow and Entrance Depth (both calculated above), look up Entrance Velocity from **Chart 7.**

Is the velocity between 4.0 – 6.0 fps? Yes / No = Adjust Flap Gate! = 4.9 (Entrance Velocity)

2 of 2

Date: 5/10/23	Observer:	MS	~~Weather:~~	Clear	
Water Temp:	12.5°C		River flow:	14,540	

Test condition =	40#/60FD
Start time	1230
Entrance Flow	206
Hopper Flow	63
Hopper Velocity	1.1
Diffuser Flow	123
Entrance Velocity	5.5
Depth over Flap gate	3.8'
Drop	0.95'
Tailwater Elevation	93.35
Lower Flume Elevation	84.3
Entrance Gate Setting	80.5

See 1400 form

End Time	14:01
Hopper bulkhead	
Elevation	96
Rows of holes	4
Floor diffuser bulkhead	
Elevation	97
Rows of holes	6
Lift Frequency	15
Lift cycle time	
V-gate Width	6.0

Camera Visibility	Descriptor
Poor	P
Medium	M
Excellent	E

Fish Observations	Descriptor
Direction	
Upstream	U
Downstream	D
Location	
Right	R
Left	L
Middle	M
Evenly dispersed	ED
Swimming Behavior	
Slow	S
Fast	F
Orderly	O
Chaotic/Confused	C
Other	Other

Species observed	Descriptor
River herring	RIV
Shad	AMS
Salmon	ATS
Sea Lamprey	SLP
Striped bass	SB

Observation Time Start: 13 45 Time Stop: 1415

			Fish Observation (*dominate behavior)		
Camera Locations	Camera Visibility	Species observed	Direction	Location	Swimming Behavior
E1 - out	P	/	/	/	/
E2 - in	P+	RIV	US	RL	O, S
DF-DS (RR)	M-	RIV	US+, DS-	RL+, M-	C
DF-US (RL)	P	/	/	/	/
VG-RL (DS)	E	RIV	US	M	O, F
VG-RR (US)	M+	RIV	US	M	O, F

Comments:

① DF-DS Camera was moved upstream to RR side, across from DF-US because of poor visibility from bubbles, ~~the~~ same place as last trial but angled across flume

② DF-US was moved upstream about 5' to get out of heavy bubbles created by floor difusser, angled slightly DS

③ Noticeable bubbles↑ at all locations downstream of V Gate

-All data backed up from 4/13 to external Drive

2 of 2

Milford Daily Fishway Inspection Form

Date: 5/10/23 Time: 1400 Inspector: MS

Head Pond Elevation: 101.35 River Flow (cfs): 11,540

Tailwater Elevation: 83.35 Water Temp °C: ______

Turbines On: (✓ or X) 1 ✓ 2 ✓ 3 ✓ 4 ✓ 5 ✓ 6 ✓

Hinged Gate Spill: **Yes / No**

Obermeyer Spill: **Yes / No**

Log Sluice Spill: **Yes / No**

Upstream Eelway: **Yes / No**

Denil Running: **Yes / No**

Upstream Fishway *** Clean Debris Before Taking Measurements ***

1.) Fishway Debris:
  a) Grizzly Rack ✓ Sorting Facility ✓ Punch Plate ✓ Hopper Block Screen ✓

2.) Fish Lift Operating Mode:
  a) [✓ **Automatic**] / **Manual** Frequency: 15 (mins) V-gate 6.0
  b) When unmanned, Sorting Facility Gates are: **Open** / [✓ **Closed**]

Lift Count
Seasonal: ______
Daily: ______

3.) Upper Flume:
  a) Weir: 101.4 (ft) Staff Gauge (S_P) 101.3 (ft) Staff Gauge (S_W) 6.8 (ft) Dist. Stop Logs (L) **Open / Closed** Trash Pipe
  b) Flume Velocity: = 49 cfs Flow (Weir + Pipe) = 1.1 fps Flume Velocity *Target: 1.0 – 1.5 fps*

4.) Aux. Water System:
  a) Hopper Flow: 2 2 Bulkhead Panels$_3$ (rows) 11 (in) Gate 3 96 (ft) Backwater El.$_3$ = 83 cfs Hopper Flow = 1.1 fps Hopper Velocity *Target: 1.0 – 1.5 fps*
  b) Floor Diffuser: 2 2 2 Bulkhead Panels$_4$ (rows) 29 (in) Gate 4 97 (ft) Backwater El.$_4$ = 123 cfs Floor Diffuser 204 cfs Total Flow *Target: 190 – 210 cfs*

5.) Lower Flume:
  a) Entrance Drop: 80.5 (ft) Flap Gate 84.3 (ft) Staff Gauge (S_L) = 0.95 (ft) Entrance Drop = 5.5 fps Entrance Velocity *Target: 4 – 6 fps*

Does flow meet targets? **Yes / No**

Downstream Fishway Open? [✓ Y] / N
1.) Flow adequate: ✓
2.) Entrances not blocked by debris: ✓
3.) Eel Chimney open: X

Comments and Adjustments:

Fishway Mortalities:
(Count, Species, Location, Disposition)
Shad:

Riv:

Please provide completed inspection forms to the Licensing and Compliance Group every Monday morning.

3.) Upper Flume Flow:

a) Weir Formula:

1.) Subtract the distance to the stoplogs (L) from the Benchmark Elevation (B_e) to find the Weir Elevation (W_e). The benchmark is the top of the rabbit for the weir on the shoreward side (surveyed at 106.67 ≈ 106.7).

106.7 – 6.8 = 99.9
B_e L W_e

2.) Subtract W_e (calculated above) from the Staff Gage just upstream of the weir (S_W) to find Depth at Weir (H).

101.3 – 99.9 = 1.4
S_W W_e H

3.) Using H (calculated above), look up Upper Flume Weir Flow from **Chart 1**: 32 cfs

Trash Pipe:

1.) Using the Pipe Staff Gauge (S_P), look up Pipe Flow from **Chart 2**: + 17 cfs

= 49 cfs

b) Upper Flume Velocity:

1.) Using the sum of the pipe and weir flows, and the Pipe Staff Gauge (S_P), look up the Upper Flume Velocity from **Chart 3**: ***Round to the nearest tenth.***

Is velocity between 1.0 – 1.5 fps? [✓ *Yes*] */ No = Fix it* = 1.1 fps
Flume Velocity

4.) Auxiliary Water Supply:

a) Hopper Flow: b) Floor Diffuser:

1.) Subtract the Backwater El. from the Lower Flume Staff Gauge (S_L) for both. ***Round to the nearest foot.***

96 – 84.3 = 11.7
Backwater El_3 S_L Head of $Water_3$

97 – 84.3 = 12.7
Backwater El_4 S_L Head of $Water_4$

2.) Find the number of Sections of Holes open by summing the rows from each panel. Repeat for both bulkheads.

2 + 2 = 4
Bulkhead $Panels_3$ (Rows) Sections $Holes_3$

2 + 2 + 2 = 6
Bulkhead $Panels_4$ (Rows) Sections $Holes_4$

3.) Using the Head of Water, and Sections of Holes (calculated above), look up the Hopper Flow from **Chart 4** and Floor Diffuser Flow from **Chart 5.**

= 83 40.3%
Hopper Flow

206

= 123 59.7%
Floor Diffuser

4.) Using the Hopper Flow (calculated above) and Lower Flume Staff Gauge (S_L), look up the Hopper Velocity from **Chart 6:**

Is the velocity between 1.0 – 1.5 fps? [✓ *Yes*]*/ No = Fix it!* = 1.1 fps
Hopper Velocity

5.) Lower Flume: *Is the Total Flow between 190 – 230 cfs?* [✓ *Yes*] */ No = Fix it!* = 206 cfs
Total Flow

a) Entrance Drop and Depth:

1.) Find the difference between the Tailwater Elevation (read from the computer) and S_L for the Entrance Drop. Subtract the Flap Gate Elevation from S_L for the Entrance Depth. ***Round to the nearest tenth.***

843 – 83,35 = 0.95
S_L Tailwater El. Entrance Drop

84.3 – 80.5 = 3.8
S_L Flap Gate El. Entrance Depth

2.) Using the Total Flow and Entrance Depth (both calculated above), look up Entrance Velocity from **Chart 7.**

Is the velocity between 4.0 – 6.0 fps? [✓ *Yes*] */ No = Adjust Flap Gate!* = 5.5
Entrance Velocity

2 of 4

Milford Daily Fishway Inspection Form

Date: 5/12/23 Time: 1148 Inspector: MS

Hinged Gate Spill: Yes / [✓ No]

Head Pond Elevation: 101.32 River Flow (cfs): 9062

Obermeyer Spill: [✓ Yes] / No

Tailwater Elevation: 83.1 Water Temp °C: 14.5°C

Log Sluice Spill: [✓ Yes] / No

Turbines On: (✓ or X) 1 ✓ 2 ✓ 3 ✓ 4 ✓ 5 ✓ 6 ✓

Upstream Eelway: Yes / [✓ No]

Denil Running: Yes / [✓ No]

Upstream Fishway *** Clean Debris Before Taking Measurements ***

1.) Fishway Debris:
  a) Grizzly Rack ✓ Sorting Facility ✓ Punch Plate ✓ Hopper Block Screen ✓

2.) Fish Lift Operating Mode:
  a) [✓ **Automatic**] / **Manual** Frequency: 7 (mins) V-gate 6.0
  b) When unmanned, Sorting Facility Gates are: **Open** / [✓ **Closed**]

Lift Count
Seasonal: ______
Daily: ______

3.) Upper Flume:
  a) Weir: 101.1 (ft) Staff Gauge (S_P) 101.1 (ft) Staff Gauge (S_W) 6.8 (ft) Dist. Stop Logs (L) **Open / Closed** Trash Pipe
  b) Flume Velocity: = 37 cfs Flow (Weir + Pipe) = 0.82 fps Flume Velocity *Target: 1.0 – 1.5 fps* X

4.) Aux. Water System:
  a) Hopper Flow: 4 4 Bulkhead Panels$_3$ (rows) 14 (in) Gate 3 93.5 (ft) Backwater El.$_3$ = 152 cfs Hopper Flow = 2.1 fps Hopper Velocity *Target: 1.0 – 1.5 fps* X
  b) Floor Diffuser: 1 1 0 Bulkhead Panels$_4$ (rows) 6 (in) Gate 4 96 (ft) Backwater El.$_4$ = 40 cfs Floor Diffuser 192 cfs Total Flow *Target: 190 – 210 cfs* ✓

5.) Lower Flume:
  a) Entrance Drop: 79.9 (ft) Flap Gate 83.6 (ft) Staff Gauge (S_L) = 0.5 (ft) Entrance Drop = 5.4 fps Entrance Velocity *Target: 4 – 6 fps* ✓

Does flow meet targets? **Yes / No**

Downstream Fishway Open? [✓ Y] / N
1.) Flow adequate: ✓
2.) Entrances not blocked by debris: ✓
3.) Eel Chimney open: ✓

Comments and Adjustments:

Tested:
79.1%H / 20.8% FD

Fishway Mortalities:
(Count, Species, Location, Disposition)
Shad:

Riv:

Please provide completed inspection forms to the Licensing and Compliance Group every Monday morning.

3.) Upper Flume Flow:

a) Weir Formula:

1.) Subtract the distance to the stoplogs (L) from the Benchmark Elevation (B_e) to find the Weir Elevation (W_e). The benchmark is the top of the rabbit for the weir on the shoreward side (surveyed at 106.67 ≈ 106.7).

106.7 (B_e) – 6.8 (L) = 99.9 (W_e)

2.) Subtract W_e (calculated above) from the Staff Gage just upstream of the weir (S_W) to find Depth at Weir (H).

101.1 (S_W) – 99.9 (W_e) = 1.2 (H)

3.) Using H (calculated above), look up Upper Flume Weir Flow from **Chart 1**: 26 cfs

Trash Pipe:

1.) Using the Pipe Staff Gauge (S_P), look up Pipe Flow from **Chart 2**: + 11 cfs

b) Upper Flume Velocity: = 37 cfs

1.) Using the sum of the pipe and weir flows, and the Pipe Staff Gauge (S_P), look up the Upper Flume Velocity from **Chart 3**: ***Round to the nearest tenth.***

Is velocity between 1.0 – 1.5 fps? Yes / [✓ No] = Fix it = 0.82 fps
Flume Velocity

4.) Auxiliary Water Supply:

a) Hopper Flow: b) Floor Diffuser:

1.) Subtract the Backwater El. from the Lower Flume Staff Gauge (S_L) for both. ***Round to the nearest foot.***

93.5 (Backwater El_3) – 83.6 (S_L) = 9.9 (Head of $Water_3$)

96 (Backwater El_4) – 83.6 (S_L) = 12.4 (Head of $Water_4$)

2.) Find the number of Sections of Holes open by summing the rows from each panel. Repeat for both bulkheads.

4 + 4 (Bulkhead $Panels_3$ (Rows)) = 8 (Sections $Holes_3$)

1 + 1 + 0 (Bulkhead $Panels_4$ (Rows)) = 2 (Sections $Holes_4$)

3.) Using the Head of Water, and Sections of Holes (calculated above), look up the Hopper Flow from **Chart 4** and Floor Diffuser Flow from **Chart 5.**

= 152 Hopper Flow

= 40 Floor Diffuser

4.) Using the Hopper Flow (calculated above) and Lower Flume Staff Gauge (S_L), look up the Hopper Velocity from **Chart 6:**

Is the velocity between 1.0 – 1.5 fps? Yes / [✓ No] = Fix it! = 2.1 fps
Hopper Velocity

5.) Lower Flume: *Is the Total Flow between 190 – 230 cfs? [✓ Yes] / No = Fix it!* = 192 cfs
Total Flow

a) Entrance Drop and Depth:

1.) Find the difference between the Tailwater Elevation (read from the computer) and S_L for the Entrance Drop. Subtract the Flap Gate Elevation from S_L for the Entrance Depth. ***Round to the nearest tenth.***

83.6 (S_L) – 83.1 (Tailwater El.) = 0.5 (Entrance Drop)

83.6 (S_L) – 79.9 (Flap Gate El.) = 3.7 (Entrance Depth)

2.) Using the Total Flow and Entrance Depth (both calculated above), look up Entrance Velocity from **Chart 7.**

Is the velocity between 4.0 – 6.0 fps? [✓ Yes] / No = Adjust Flap Gate! = 5.4
Entrance Velocity

2 of 7

Date: 5/12/23	Observer: MS	Weather:	partly cloudy
Water Temp: 14.5C		River flow:	9062

Test condition = 70/30 FD (~~74~~/26)

Start time	1240
Entrance Flow	216
Hopper Flow	160
Hopper Velocity	2.4
Diffuser Flow	56
Entrance Velocity	5.65
Depth over Flap gate	3.9
Drop	0.7
Tailwater Elevation	83.1
Lower Flume Elevation	83.8
Entrance Gate Setting	79.9

See 1240 form

End Time	1345
Hopper bulkhead	
Elevation	96.0
Rows of holes	7
Floor diffuser bulkhead	
Elevation	95.0
Rows of holes	3
Lift Frequency	7 min
Lift cycle time	
V-gate Width	6.0

Camera Visibility	Descriptor
Poor	P
Medium	M
Excellent	E

Fish Observations	Descriptor
Direction	
Upstream	U
Downstream	D
Location	
Right	R
Left	L
Middle	M
Evenly dispersed	ED
Swimming Behavior	
Slow	S
Fast	F
Orderly	O
Chaotic/Confused	C
Other	Other

Species observed	Descriptor
River herring	RIV
Shad	AMS
Salmon	ATS
Sea Lamprey	SLP
Striped bass	SB

Observation Time Start: 1300 Time Stop: 1330

			Fish Observation (*dominate behavior)		
Camera Locations	Camera Visibility	Species observed	Direction	Location	Swimming Behavior
E1 - in	M	RIV, SLP	US	RL+	O, M
E2 - out	M-	RIV, SLP	US	RL+	O, M
DIFF DS - RR	M	RIV	US+, DS-	RR+	O- S
DIFF US - RL	M+	RIV	US+, DS-	RR+	O- S
VGATE DS - RL	M+	RIV	US		O, S④
VGATE US RR	M+	RIV	US+, DS-		O, S①

Comments:

① visibility not as good with the lower hopper flow/higher FD flow

② Generally similar fish behavior as 80/20 scenario; fish holding around diffuser area on RR side of flume and then move into hopper in pulses, and then more move to the area from downstream

③ RIV still tend to be more closely located near bottom when passing through V-GATE.

④ RIV holding in DIFF area ds of Vgate between cycles, not falling back and out of lower flume.

3 of 4

Milford Daily Fishway Inspection Form

Date: 5/12/23 Time: 1240 Inspector: MS

Hinged Gate Spill: Yes / [✓ No]

Head Pond Elevation: 101.32 River Flow (cfs): 9062

Obermeyer Spill: [✓ Yes] / No

Tailwater Elevation: 83.1 Water Temp °C: ______

Log Sluice Spill: [✓ Yes] / No

Upstream Eelway: Yes / [✓ No]

Turbines On: (✓ or X)

1	2	3	4	5	6
✓	✓	✓	✓	✓	✓

Denil Running: Yes / [✓ No]

Upstream Fishway ***** Clean Debris Before Taking Measurements *****

1.) Fishway Debris:

a) Grizzly Rack ✓ Sorting Facility ✓ Punch Plate ✓ Hopper Block Screen ✓

2.) Fish Lift Operating Mode:

a) [✓ **Automatic**] / **Manual** Frequency: 7 (mins) V-gate 6.0

Lift Count

Seasonal: ______

b) When unmanned, Sorting Facility Gates are: **Open** / [✓ **Closed**]

Daily: ______

3.) Upper Flume:

a) Weir: 101.1 (ft) Staff Gauge (S_P) 101.1 (ft) Staff Gauge (S_W) 6.8 (ft) Dist. Stop Logs (L) **Open / Closed** Trash Pipe

b) Flume Velocity: = 37 cfs Flow (Weir + Pipe) = 0.82 fps Flume Velocity *Target: 1.0 – 1.5 fps*

4.) Aux. Water System:

a) Hopper Flow: 4 3 Bulkhead Panels$_3$ (rows) 20 (in) Gate 3 96.0 (ft) Backwater El.$_3$ = 160 cfs Hopper Flow = 2.4 fps Hopper Velocity *Target: 1.0 – 1.5 fps*

b) Floor Diffuser: 1 1 1 Bulkhead Panels$_4$ (rows) 9 (in) Gate 4 95 (ft) Backwater El.$_4$ = 56 cfs Floor Diffuser 216 cfs Total Flow *Target: 190 – 210 cfs*

5.) Lower Flume:

a) Entrance Drop: 79.9 (ft) Flap Gate 83.8 (ft) Staff Gauge (S_L) = 0.7 (ft) Entrance Drop = 5.65 fps Entrance Velocity *Target: 4 – 6 fps*

Does flow meet targets? **Yes / No**

Downstream Fishway Open? **Y / N**

1.) Flow adequate: ✓

2.) Entrances not blocked by debris: ✓

3.) Eel Chimney open: –

Comments and Adjustments:

160 H / 56 FP = 216 cfs

74% H / 25.9% FD

Fishway Mortalities:

(Count, Species, Location, Disposition)

Shad:

Riv:

Please provide completed inspection forms to the Licensing and Compliance Group every Monday morning.

3.) Upper Flume Flow:

a) Weir Formula:

1.) Subtract the distance to the stoplogs (L) from the Benchmark Elevation (B_e) to find the Weir Elevation (W_e). The benchmark is the top of the rabbit for the weir on the shoreward side (surveyed at 106.67 ≈ 106.7).

106.7 (B_e) – 6.8 (L) = 99.9 (W_e)

2.) Subtract W_e (calculated above) from the Staff Gage just upstream of the weir (S_W) to find Depth at Weir (H).

101.1 (S_W) – 99.9 (W_e) = 1.2 (H)

3.) Using H (calculated above), look up Upper Flume Weir Flow from **Chart 1**: 26 cfs

Trash Pipe:

1.) Using the Pipe Staff Gauge (S_P), look up Pipe Flow from **Chart 2**: + 11 cfs

b) Upper Flume Velocity: = 37 cfs

1.) Using the sum of the pipe and weir flows, and the Pipe Staff Gauge (S_P), look up the Upper Flume Velocity from **Chart 3**: ***Round to the nearest tenth.***

Is velocity between 1.0 – 1.5 fps? Yes / No = Fix it = 0.82 fps Flume Velocity

4.) Auxiliary Water Supply:

a) Hopper Flow: b) Floor Diffuser:

1.) Subtract the Backwater El. from the Lower Flume Staff Gauge (S_L) for both. ***Round to the nearest foot.***

96 (Backwater El_3) – 83.8 (S_L) = 12.2 (Head of $Water_3$)

95 (Backwater El_4) – 83.8 (S_L) = 11.2 (Head of $Water_4$)

2.) Find the number of Sections of Holes open by summing the rows from each panel. Repeat for both bulkheads.

4 + 4 (Bulkhead $Panels_3$ (Rows)) = 8 (Sections $Holes_3$)

1 + 1 + 1 (Bulkhead $Panels_4$ (Rows)) = 3 (Sections $Holes_4$)

3.) Using the Head of Water, and Sections of Holes (calculated above), look up the Hopper Flow from **Chart 4** and Floor Diffuser Flow from **Chart 5.**

= 160 Hopper Flow

= 56 Floor Diffuser

4.) Using the Hopper Flow (calculated above) and Lower Flume Staff Gauge (S_L), look up the Hopper Velocity from **Chart 6:**

Is the velocity between 1.0 – 1.5 fps? Yes / [✓ No] = Fix it! = 2.4 fps Hopper Velocity

5.) Lower Flume: *Is the Total Flow between 190 – 230 cfs? [✓ Yes] / No = Fix it!* = 210 cfs Total Flow

a) Entrance Drop and Depth:

1.) Find the difference between the Tailwater Elevation (read from the computer) and S_L for the Entrance Drop. Subtract the Flap Gate Elevation from S_L for the Entrance Depth. ***Round to the nearest tenth.***

83.8 (S_L) – 83.1 (Tailwater El.) = 0.7 (Entrance Drop)

83.8 (S_L) – 79.9 (Flap Gate El.) = 3.9 (Entrance Depth)

2.) Using the Total Flow and Entrance Depth (both calculated above), look up Entrance Velocity from **Chart 7.**

Is the velocity between 4.0 – 6.0 fps? Yes / No = Adjust Flap Gate! = 5.65 Entrance Velocity

7 of 7

Date: 5/12/23	Observer: Ms	Weather:	PC
Water Temp: 14.5		River flow:	9062

Test condition = 100 H/0 FD

Start time	1345
Entrance Flow	152
Hopper Flow	152
Hopper Velocity	1.9
Diffuser Flow	0
Entrance Velocity	~~152~~4.1
Depth over Flap gate	3.7
Drop	0.5
Tailwater Elevation	83.1
Lower Flume Elevation	83.6
Entrance Gate Setting	79.9

see 1345 form

End Time –	
Hopper bulkhead	
Elevation	96.5
Rows of holes	7
Floor diffuser bulkhead	
Elevation	0
Rows of holes	0
Lift Frequency	7
Lift cycle time	
V-gate Width	6.0

Camera Visibility	Descriptor
Poor	P
Medium	M
Excellent	E

Fish Observations	Descriptor
Direction	
Upstream	U
Downstream	D
Location	
Right	R
Left	L
Middle	M
Evenly dispersed	ED
Swimming Behavior	
Slow	S
Fast	F
Orderly	O
Chaotic/Confused	C
Other	Other

Species observed	Descriptor
River herring	RIV
Shad	AMS
Salmon	ATS
Sea Lamprey	SLP
Striped bass	SB

Observation Time Start: 1356 Time Stop: 1425

			Fish Observation (*dominate behavior)		
Camera Locations	Camera Visibility	Species observed	Direction	Location	Swimming Behavior
E1 - in	M+	RIV, SLP	US	RL+	F, O
E2 - out	M-	RIV	US	RL+	F, O
DIFF DS (RR)	E	RIV, SLP	US+, DS-	entire width	S+, C-
DIFF US (RL)	M	RIV	US+ DS-	" "	S+, C-
VGATE-DS (RL)	P+	RIV	US		F, O
VGATE US (RR)	E	RIV, ATS	US+, DS-		S, C-

Comments:

① Flume seems to fill with more RIV once FD flow is shut off, including more fish on both entrance cameras

② RIV still enter at high rate into entrance when VGATE is closed and hold near DIFF cameras, and behind closed VGATE

③ ATS seen ds of VGATE when closing

4 of 4

Milford Daily Fishway Inspection Form

Date: 5/12/23 Time: 1345 Inspector: MS Hinged Gate Spill: Yes / [✓ No]

Head Pond Elevation: 101.32 River Flow (cfs): 9062 Obermeyer Spill: [✓ Yes] / No

Tailwater Elevation: 83.1 Water Temp °C: 14.5 Log Sluice Spill: [✓ Yes] / No

Turbines On: (✓ or X) 1 ✓ 2 ✓ 3 ✓ 4 ✓ 5 ✓ 6 ✓ Upstream Eelway: Yes / [✓ No]

Denil Running: Yes / [✓ No]

Upstream Fishway *** Clean Debris Before Taking Measurements ***

1.) Fishway Debris:
   a) Grizzly Rack ✓ Sorting Facility ✓ Punch Plate ✓ Hopper Block Screen ✓

2.) Fish Lift Operating Mode:
   a) **[✓ Automatic] / Manual** Frequency: 7 (mins) V-gate 6.0

   b) When unmanned, Sorting Facility Gates are: **Open / [✓ Closed]**

Lift Count
Seasonal: ______
Daily: ______

3.) Upper Flume:
   a) Weir: 101.1 (ft) Staff Gauge (S_P) 101.1 (ft) Staff Gauge (S_W) 6.8 (ft) Dist. Stop Logs (L) **Open / Closed** Trash Pipe

   b) Flume Velocity: = 37 cfs Flow (Weir + Pipe) = 0.82 fps Flume Velocity *Target: 1.0 – 1.5 fps*

4.) Aux. Water System:
   a) Hopper Flow: 3 4 Bulkhead Panels₃ (rows) 20 (in) Gate 3 96.5 (ft) Backwater El.₃ = 152 cfs Hopper Flow = 1.9 fps Hopper Velocity *Target: 1.0 – 1.5 fps*

   b) Floor Diffuser: 0 0 0 Bulkhead Panels₄ (rows) 0 (in) Gate 4 0 (ft) Backwater El.₄ = 0 cfs Floor Diffuser 152 cfs Total Flow *Target: 190 – 210 cfs*

5.) Lower Flume:
   a) Entrance Drop: 79.9 (ft) Flap Gate 83.6 (ft) Staff Gauge (S_L) = 0.5 (ft) Entrance Drop = 4.1 fps Entrance Velocity *Target: 4 – 6 fps*

Does flow meet targets? **Yes / No**

Downstream Fishway Open? [✓ Y] / N
1.) Flow adequate: ✓
2.) Entrances not blocked by debris: ✓
3.) Eel Chimney open: ✓

Comments and Adjustments:

100% H 0% FD

Fishway Mortalities:
(Count, Species, Location, Disposition)
Shad:

Riv:

Please provide completed inspection forms to the Licensing and Compliance Group every Monday morning.

3.) Upper Flume Flow:

a) Weir Formula:

1.) Subtract the distance to the stoplogs (L) from the Benchmark Elevation (B_e) to find the Weir Elevation (W_e). The benchmark is the top of the rabbit for the weir on the shoreward side (surveyed at 106.67 ≈ 106.7).

106.7 (B_e) – 6.8 (L) = 99.9 (W_e)

2.) Subtract W_e (calculated above) from the Staff Gage just upstream of the weir (S_W) to find Depth at Weir (H).

101.1 (S_W) – 99.9 (W_e) = 1.2 (H)

3.) Using H (calculated above), look up Upper Flume Weir Flow from **Chart 1**: 26 cfs

Trash Pipe:

1.) Using the Pipe Staff Gauge (S_P), look up Pipe Flow from **Chart 2**: + 11 cfs

b) Upper Flume Velocity: = 37 cfs

1.) Using the sum of the pipe and weir flows, and the Pipe Staff Gauge (S_P), look up the Upper Flume Velocity from **Chart 3**: ***Round to the nearest tenth.***

Is velocity between 1.0 – 1.5 fps? Yes / No = ***Fix it*** = $\boxed{0.82}$ fps Flume Velocity

4.) Auxiliary Water Supply:

a) Hopper Flow: b) Floor Diffuser:

1.) Subtract the Backwater El. from the Lower Flume Staff Gauge (S_L) for both. ***Round to the nearest foot.***

96.5 (Backwater El_3) – 83.6 (S_L) = 12.9 (Head of $Water_3$)

0 (Backwater El_4) – 0 (S_L) = 0 (Head of $Water_4$)

2.) Find the number of Sections of Holes open by summing the rows from each panel. Repeat for both bulkheads.

3 + 4 (Bulkhead $Panels_3$ (Rows)) = 7 (Sections $Holes_3$)

— + — + — (Bulkhead $Panels_4$ (Rows)) = — (Sections $Holes_4$)

3.) Using the Head of Water, and Sections of Holes (calculated above), look up the Hopper Flow from **Chart 4** and Floor Diffuser Flow from **Chart 5.**

= 152 Hopper Flow

= 0 Floor Diffuser

4.) Using the Hopper Flow (calculated above) and Lower Flume Staff Gauge (S_L), look up the Hopper Velocity from **Chart 6:**

Is the velocity between 1.0 – 1.5 fps? Yes / No = ***Fix it!*** = $\boxed{1.9}$ fps Hopper Velocity

5.) Lower Flume: *Is the Total Flow between 190 – 230 cfs? Yes / No =* ***Fix it!*** = $\boxed{152}$ cfs Total Flow

a) Entrance Drop and Depth:

1.) Find the difference between the Tailwater Elevation (read from the computer) and S_L for the Entrance Drop. Subtract the Flap Gate Elevation from S_L for the Entrance Depth. ***Round to the nearest tenth.***

83.6 (S_L) – 83.1 (Tailwater El.) = 0.5 (Entrance Drop)

83.6 (S_L) – 79.9 (Flap Gate El.) = 3.7 (Entrance Depth)

2.) Using the Total Flow and Entrance Depth (both calculated above), look up Entrance Velocity from **Chart 7.**

Is the velocity between 4.0 – 6.0 fps? Yes / No = ***Adjust Flap Gate!*** = $\boxed{4.1}$ Entrance Velocity

1 of 4

Date: 5/2/23	Observer: MS	Weather:	partly cloudy
Water Temp:		River flow:	9062 cfs

Test condition = 40H/60FD

Start time	7 am (overnight)
Entrance Flow	198
Hopper Flow	80
Hopper Velocity	1.1
Diffuser Flow	118
Entrance Velocity	5.0
Depth over Flap gate	4.0'
Drop	0.8'
Tailwater Elevation	83.1
Lower Flume Elevation	83.9'
Entrance Gate Setting	79.9'

See 655 form

End Time	0945
Hopper bulkhead	
Elevation	95'
Rows of holes	4
Floor diffuser bulkhead	
Elevation	96'
Rows of holes	6
Lift Frequency	15 min
Lift cycle time	
V-gate Width	6.0

Camera Visibility	Descriptor
Poor	P
Medium	M
Excellent	E

Fish Observations	Descriptor
Direction	
Upstream	U
Downstream	D
Location	
Right	R
Left	L
Middle	M
Evenly dispersed	ED
Swimming Behavior	
Slow	S
Fast	F
Orderly	O
Chaotic/Confused	C
Other	Other

Species observed	Descriptor
River herring	RIV
Shad	AMS
Salmon	ATS
Sea Lamprey	SLP
Striped bass	SB

Observation Time Start: 0908 Time Stop: 1009

see

			Fish Observation (*dominate behavior)		
Camera Locations	Camera Visibility	Species observed	Direction	Location	Swimming Behavior
E1 - out	P+	SLP	US	RL	F, O+, C-
E2 - in	P+	RIV	US	RL	F, O
DF-DS (RR)	P	RIV	US+, DS-	RL+ M	O, F+, S-
DF-US (RL)	M-	RIV, SLP	US,	M	O, F+, S-
VG DS (RL)	E	RIV	US	M	O, F
VG US (RR)	M+	RIV	US+, DS-	M	O+, C-, M

Comments:

① VGATE US - camera turned to face downstream, VG DS is now looking at V-GATE (pointed more downward @0945) adjusted to only slightly ds @ 0927

② DIFF DS camera is pointed across flume from RR; DIFF US on RL pointed slightly downstream

③ Not alot of Fish moving right now. lift cycle was 5 min overnight (took RIV counted), then 7 min this morning. Changed to 15 min for this obs. b/c not many fish present currently.

④ more RIV seen on bottom when passing VGATE

- stopped recording @ 1009

Milford Daily Fishway Inspection Form

Date: 5/12/23 Time: 06:55 Inspector: CP

Hinged Gate Spill: Yes / [✓ No]

Head Pond Elevation: 101.32 River Flow (cfs): 9062

Obermeyer Spill: [✓ Yes] / No

Tailwater Elevation: 83.1 Water Temp °C: 14.5 C

Log Sluice Spill: [✓ Yes] / No

Turbines On: (✓ or X) 1 Y ⟶ 2 3 4 5 6

Upstream Eelway: Yes / [✓ No]

Denil Running: Yes / [✓ No]

Upstream Fishway *** Clean Debris Before Taking Measurements ***

1.) Fishway Debris:
a) Grizzly Rack ✓ Sorting Facility ✓ Punch Plate ✓ Hopper Block Screen ✓

2.) Fish Lift Operating Mode:
a) [✓ Automatic] / Manual Frequency: 30 (mins) V-gate 6.0
b) When unmanned, Sorting Facility Gates are: Open / [✓ Closed]

Lift Count
Seasonal: 414
Daily: 9

3.) Upper Flume:
a) Weir: 101.1 (ft) Staff Gauge (S_P) 101.1 (ft) Staff Gauge (S_W) 6.8 (ft) Dist. Stop Logs (L) [✓ Open] / Closed Trash Pipe
b) Flume Velocity: = 37 cfs Flow (Weir + Pipe) = 0.8 fps Flume Velocity *Target: 1.0 – 1.5 fps*

4.) Aux. Water System:
a) Hopper Flow: 2 2 Bulkhead Panels$_3$ (rows) 12 (in) Gate 3 95' (ft) Backwater El.$_3$ = 80 cfs Hopper Flow = 1.1 fps Hopper Velocity *Target: 1.0 – 1.5 fps*
b) Floor Diffuser: 2 2 2 Bulkhead Panels$_4$ (rows) 30" (in) Gate 4 96' (ft) Backwater El.$_4$ = 118 cfs Floor Diffuser 198 cfs Total Flow *Target: 190 – 210 cfs*

5.) Lower Flume:
a) Entrance Drop: 79.9' (ft) Flap Gate 83.9 (ft) Staff Gauge (S_L) = 0.8 (ft) Entrance Drop = 5.0 fps Entrance Velocity *Target: 4 – 6 fps*

Does flow meet targets? Yes / No

Downstream Fishway Open? [✓ Y] / N
1.) Flow adequate: ✓
2.) Entrances not blocked by debris: ✓
3.) Eel Chimney open: —

Comments and Adjustments:
△ FREQ TO 15 @ 7:00AM

Fishway Mortalities:
(Count, Species, Location, Disposition)
Shad:
Riv: 1 – RIV

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3.) Upper Flume Flow:

a) Weir Formula:

1.) Subtract the distance to the stoplogs (L) from the Benchmark Elevation (B_e) to find the Weir Elevation (W_e). The benchmark is the top of the rabbit for the weir on the shoreward side (surveyed at 106.67 ≈ 106.7).

106.7 (B_e) – 6.8 (L) = 99.9 (W_e)

2.) Subtract W_e (calculated above) from the Staff Gage just upstream of the weir (S_W) to find Depth at Weir (H).

101.1 (S_W) – 99.9 (W_e) = 1.2 (H)

3.) Using H (calculated above), look up Upper Flume Weir Flow from Chart 1: 26 cfs

Trash Pipe:

1.) Using the Pipe Staff Gauge (S_P), look up Pipe Flow from Chart 2: + 11 cfs

= 37 cfs

b) Upper Flume Velocity:

1.) Using the sum of the pipe and weir flows, and the Pipe Staff Gauge (S_P), look up the Upper Flume Velocity from Chart 3: *Round to the nearest tenth.*

Is velocity between 1.0 – 1.5 fps? Yes / No = Fix it = 0.8 fps (Flume Velocity)

4.) Auxiliary Water Supply:

a) Hopper Flow:

b) Floor Diffuser:

1.) Subtract the Backwater El. from the Lower Flume Staff Gauge (S_L) for both. *Round to the nearest foot.*

95' (Backwater El_3) – 83.9 (S_L) = 11.1 (Head of $Water_3$)

96' (Backwater El_4) – 83.9 (S_L) = 12.1 (Head of $Water_4$)

2.) Find the number of Sections of Holes open by summing the rows from each panel. Repeat for both bulkheads.

2 + 2 (Bulkhead $Panels_3$ (Rows)) = 4 (Sections $Holes_3$)

2 + 2 + 2 (Bulkhead $Panels_4$ (Rows)) = 6 (Sections $Holes_4$)

3.) Using the Head of Water, and Sections of Holes (calculated above), look up the Hopper Flow from Chart 4 and Floor Diffuser Flow from Chart 5.

= 80 (Hopper Flow)

= 118 (Floor Diffuser)

4.) Using the Hopper Flow (calculated above) and Lower Flume Staff Gauge (S_L), look up the Hopper Velocity from Chart 6:

Is the velocity between 1.0 – 1.5 fps? Yes / No = Fix it! = 1.1 fps (Hopper Velocity)

5.) Lower Flume:

Is the Total Flow between 190 – 230 cfs? Yes / No = Fix it! = 198 cfs (Total Flow)

a) Entrance Drop and Depth:

1.) Find the difference between the Tailwater Elevation (read from the computer) and S_L for the Entrance Drop. Subtract the Flap Gate Elevation from S_L for the Entrance Depth. *Round to the nearest tenth.*

83.9 (S_L) – 83.1 (Tailwater El.) = 0.8 (Entrance Drop)

83.9 (S_L) – 79.9 (Flap Gate El.) = 4.0 (Entrance Depth)

2.) Using the Total Flow and Entrance Depth (both calculated above), look up Entrance Velocity from Chart 7.

Is the velocity between 4.0 – 6.0 fps? Yes / No = Adjust Flap Gate! = 5 (Entrance Velocity)

2 of 4

Date: 5/12/23	Observer:	MS	Weather: partly cloudy		
Water Temp:			River flow:	9042	

Test condition =	80H / 20FD
Start time	1035
Entrance Flow	192
Hopper Flow	152
Hopper Velocity	2.1
Diffuser Flow	40
Entrance Velocity	5.4
Depth over Flap gate	3.7
Drop	0.5
Tailwater Elevation	83.1
Lower Flume Elevation	83.6
Entrance Gate Setting	79.9

[illegible] 1145 80rpm

End Time	1220
Hopper bulkhead	
Elevation	93.5
Rows of holes	8
Floor diffuser bulkhead	
Elevation	96
Rows of holes	2
Lift Frequency	7 min
Lift cycle time	
V-gate Width	6.0

Camera Visibility	Descriptor
Poor	P
Medium	M
Excellent	E

Fish Observations	Descriptor
Direction	
Upstream	U
Downstream	D
Location	
Right	R
Left	L
Middle	M
Evenly dispersed	ED
Swimming Behavior	
Slow	S
Fast	F
Orderly	O
Chaotic/Confused	C
Other	Other

Species observed	Descriptor
River herring	RIV
Shad	AMS
Salmon	ATS
Sea Lamprey	SLP
Striped bass	SB

Observation Time Start: 1045 Time Stop: 1125

			Fish Observation (*dominate behavior)		
Camera Locations	Camera Visibility	Species observed	Direction	Location	Swimming Behavior
E1 - in	M+	SLP, ~~RIV~~, ATS	US	RL+	F, O
E2 - out	M-	RIV, SLP	US	RL+	F, O
DIFF-DS - (RR)	E	RIV	US	RR+	M, O
DIFF US - (RL)	M+	RIV, ATS	US+, DS-	RR+	M, O
VGATE DS (RL)	E	RIV	US	M	S, O
VGATE US (RR)	M+	RIV, ATS	US	M	S, O
					S, O

Comments:

① Angled E1 & E2 downward at 1105 & 1115, respectively

② Much less bubbles, ↑ visibility, more fish being observed, including in hopper, so lift frequency was increased back to 7min.

③ RIV obs in all cameras moving US in orderly fashion and into hopper

④ ATS @11:30 - seen all w/in 1min on E1 → DIFF ~~DS~~ → VGATE US

Tested: 79.1% H | 20.8% FD

1 0 T 5

Date: 5/17/23	Observer:	Mg	Weather:	PC
Water Temp:	13.1		River flow:	6478

Test condition = 75H/25FD

Start time	4 8am
Entrance Flow	177
Hopper Flow	133
Hopper Velocity	~~2.1~~ 2.1
Diffuser Flow	44
Entrance Velocity	6.0
Depth over Flap gate	3.0
Drop	1.0
Tailwater Elevation	81.9
Lower Flume Elevation	82.9
Entrance Gate Setting	79.9

see 810 form

End Time	10:45
Hopper bulkhead	
Elevation	93
Rows of holes	7
Floor diffuser bulkhead	
Elevation	98
Rows of holes	2
Lift Frequency	30
Lift cycle time	
V-gate Width	60

Camera Visibility	Descriptor
Poor	P
Medium	M
Excellent	E

Fish Observations	Descriptor
Direction	
Upstream	U
Downstream	D
Location	
Right	R
Left	L
Middle	M
Evenly dispersed	ED
Swimming Behavior	
Slow	S
Fast	F
Orderly	O
Chaotic/Confused	C
Other	Other

Species observed	Descriptor
River herring	RIV
Shad	AMS
Salmon	ATS
Sea Lamprey	SLP
Striped bass	SB

Observation Time Start: 09 30 Time Stop: 10 30

			Fish Observation (*dominate behavior)		
Camera Locations	Camera Visibility	Species observed	Direction	Location	Swimming Behavior
E1 out (RL)	M	RIV, SLP, ATS	US	L+	f, o
E2 in (RL)	M	RIV, SLP, ATS	US	L+	f, o
DIFF DS (RL)	M	RIV, ATS	US+, DS-	M+	S o
Diff US (RL)	M-	RIV	US+, DS-	M+	S, o+, C-
VGATE DS (RL)	M+	RIV, ATS, SLP	US	ED	S+, O+, C-
VGATE US (RL)	M+	RIV, ATS	US	ED	S+, O

Comments:

① Obs. 2 ATS enter hopper @ 2 09:57

② More RIV moved into fishway starting around 0945

③ RIV generally enter quickly hold upstream of DIFF and then enter hopper. Tend to wait for a few to enter and then schools follow

④ tailwater lower than last week. E1 & VGATE DS lowered

101.7

Milford Daily Fishway Inspection Form

Date: 5/17/23 Time: 8:10 Inspector: MG

Hinged Gate Spill: Yes / [✓ No]

Head Pond Elevation: 101.27 River Flow (cfs): 6,478

Obermeyer Spill: [✓ Yes] / No

Tailwater Elevation: 81.9 Water Temp °C: 13.1

Log Sluice Spill: [✓ Yes] / No

Turbines On: (✓ or X)

1	2	3	4	5	6
N	N	N	Y	Y	Y

Upstream Eelway: Yes / [✓ No]

Denil Running: Yes / [✓ No]

Upstream Fishway *** Clean Debris Before Taking Measurements ***

1.) Fishway Debris:

a) Grizzly Rack ✓ Sorting Facility ✓ Punch Plate ✓ Hopper Block Screen ✓

2.) Fish Lift Operating Mode:

a) [✓ **Automatic**] / **Manual** Frequency: 30 (mins) V-gate 6.0

Lift Count

Seasonal: 801

b) When unmanned, Sorting Facility Gates are: **Open** / [✓ **Closed**]

Daily: 12

3.) Upper Flume:

a) Weir: 101.2 (ft) Staff Gauge (S_P) 101.2 (ft) Staff Gauge (S_W) 6.8 (ft) Dist. Stop Logs (L) [✓ ~~**Open**~~] / **Closed** Trash Pipe

b) Flume Velocity: = 42 cfs Flow (Weir + Pipe) = 0.9 fps Flume Velocity *Target: 1.0 – 1.5 fps*

4.) Aux. Water System:

a) Hopper Flow: 4 3 Bulkhead Panels₃ (rows) 12 (in) Gate 3 93 (ft) Backwater El.₃ = 133 cfs Hopper Flow = 2.1 fps Hopper Velocity *Target: 1.0 – 1.5 fps*

b) Floor Diffuser: 1 1 0 Bulkhead Panels₄ (rows) 24 (in) Gate 4 98 (ft) Backwater El.₄ = 44 cfs Floor Diffuser 177 cfs Total Flow *Target: 190 – 210 cfs*

5.) Lower Flume:

a) Entrance Drop: 79.9 (ft) Flap Gate 82.9 (ft) Staff Gauge (S_L) = 1 (ft) Entrance Drop = 6.0 fps Entrance Velocity *Target: 4 – 6 fps*

Does flow meet targets? Yes / [✓ No]

Downstream Fishway Open? [✓ Y] N

1.) Flow adequate: Y

2.) Entrances not blocked by debris: Y

3.) Eel Chimney open: —

Comments and Adjustments:

Fishway Mortalities:

(Count, Species, Location, Disposition)

Shad:

Riv: 1

Please provide completed inspection forms to the Licensing and Compliance Group every Monday morning.

3.) Upper Flume Flow:

a) Weir Formula:

1.) Subtract the distance to the stoplogs (L) from the Benchmark Elevation (B_e) to find the Weir Elevation (W_e). The benchmark is the top of the rabbit for the weir on the shoreward side (surveyed at 106.67 ≈ 106.7).

106.7 (B_e) – 6 8 (L) = 99.9 (W_e)

2.) Subtract W_e (calculated above) from the Staff Gage just upstream of the weir (S_W) to find Depth at Weir (H).

101.2 (S_W) – 99.9 (W_e) = 1.3 (H)

3.) Using H (calculated above), look up Upper Flume Weir Flow from **Chart 1**: 29 cfs

Trash Pipe:

1.) Using the Pipe Staff Gauge (S_P), look up Pipe Flow from **Chart 2**: + 13 cfs

= 42 cfs

b) Upper Flume Velocity:

1.) Using the sum of the pipe and weir flows, and the Pipe Staff Gauge (S_P), look up the Upper Flume Velocity from **Chart 3**: ***Round to the nearest tenth.***

Is velocity between 1.0 – 1.5 fps? ***Yes [✓ No] = Fix it*** = $\boxed{0.9}$ fps

Flume Velocity

4.) Auxiliary Water Supply:

a) Hopper Flow: b) Floor Diffuser:

1.) Subtract the Backwater El. from the Lower Flume Staff Gauge (S_L) for both. ***Round to the nearest foot.***

93 (Backwater El_3) – 82.9 (S_L) = 10.1 (Head of $Water_3$)

98 (Backwater El_4) – 82.9 (S_L) = 15.1 (Head of $Water_4$)

2.) Find the number of Sections of Holes open by summing the rows from each panel. Repeat for both bulkheads.

4 + 3 (Bulkhead $Panels_3$ (Rows)) = 7 (Sections $Holes_3$)

1 + 1 + 0 (Bulkhead $Panels_4$ (Rows)) = 2 (Sections $Holes_4$)

3.) Using the Head of Water, and Sections of Holes (calculated above), look up the Hopper Flow from **Chart 4** and Floor Diffuser Flow from **Chart 5.**

= 133 (Hopper Flow)

= 44 (Floor Diffuser)

4.) Using the Hopper Flow (calculated above) and Lower Flume Staff Gauge (S_L), look up the Hopper Velocity from **Chart 6:**

Is the velocity between 1.0 – 1.5 fps? Yes / [✓ No] = Fix it! = $\boxed{2.1}$ fps

Hopper Velocity

5.) Lower Flume: *Is the Total Flow between 190 – 230 cfs? Yes / [✓ No] = Fix it!* = $\boxed{177}$ cfs

Total Flow

a) Entrance Drop and Depth:

1.) Find the difference between the Tailwater Elevation (read from the computer) and S_L for the Entrance Drop. Subtract the Flap Gate Elevation from S_L for the Entrance Depth. ***Round to the nearest tenth.***

82.9 (S_L) – 81.9 (Tailwater El.) = 1 (Entrance Drop)

82.9 (S_L) – 79.9 (Flap Gate El.) = 3.0 (Entrance Depth)

2.) Using the Total Flow and Entrance Depth (both calculated above), look up Entrance Velocity from **Chart 7.**

Is the velocity between 4.0 – 6.0 fps? [✓ Yes] / No = Adjust Flap Gate! = $\boxed{6.0}$

Entrance Velocity

2 of 3

Date: 5/17/23	Observer:	MS	Weather: light rain	
Water Temp:	13.1		River flow:	4478

Test condition = 50/50

Start time	1050
Entrance Flow	175
Hopper Flow	87
Hopper Velocity	1.3
Diffuser Flow	88
Entrance Velocity	5.6
Depth over Flap gate	3.1
Drop	1.1
Tailwater Elevation	81.9
Lower Flume Elevation	83
Entrance Gate Setting	79.9

See 1300 form

End Time	1140
Hopper bulkhead	
Elevation	90
Rows of holes	4
Floor diffuser bulkhead	
Elevation	98
Rows of holes	4
Lift Frequency	15
Lift cycle time	
V-gate Width	6.0

Camera Visibility	Descriptor
Poor	P
Medium	M
Excellent	E

Fish Observations	Descriptor
Direction	
Upstream	U
Downstream	D
Location	
Right	R
Left	L
Middle	M
Evenly dispersed	ED
Swimming Behavior	
Slow	S
Fast	F
Orderly	O
Chaotic/Confused	C
Other	Other

Species observed	Descriptor
River herring	RIV
Shad	AMS
Salmon	ATS
Sea Lamprey	SLP
Striped bass	SB

Observation Time Start: 1105 Time Stop: 1140

			Fish Observation (*dominate behavior)		
Camera Locations	Camera Visibility	Species observed	Direction	Location	Swimming Behavior
E1 out (RL)	M-	RIV	US	L+	F, O
E2 in (RL)	P+	RIV, ATS	US	L+	F, O
Diff ds (RL)	M-	RIV	US+ DS-	M+	S, O
Diff us (RR)	M	RIV, ATS	US+ DS-	M+	S, O+, C-
VGATE DS (RR)	M+	RIV, ATS	US-	M - low	S+, O+, C-
VGATE US (RL)	M	RIV, ATS	US	M - low	S+, O

Comments:

① similar behaviors as 7/25 setting, but RIV lower in water column generally and less fish overall, some weather (light rain/sleet) moved in during obs.

② Fish stopped moving into lower flume around 11:25 after weather became more overcast and RIV in flume where lifted

③ started moving back in around 1135

4) ATS entered hopper @ 1135 - orderly behavior

2 of 3

Milford Daily Fishway Inspection Form

Date: 5/17/23 Time: 1300 Inspector: MS

Hinged Gate Spill: Yes / [✓ No]

Head Pond Elevation: 101.27 River Flow (cfs): 6478

Obermeyer Spill: [✓ Yes] / No

Tailwater Elevation: 81.9 Water Temp °C: 13 1

Log Sluice Spill: [✓ Yes] / No

Turbines On: (✓ or X) 1: X 2: X 3: y 4: y 5: y 6: y

Upstream Eelway: Yes / [✓ No]

Denil Running: Yes / [✓ No]

Upstream Fishway *** Clean Debris Before Taking Measurements ***

1.) Fishway Debris:
- a) Grizzly Rack ✓ Sorting Facility ✓ Punch Plate ✓ Hopper Block Screen ✓

2.) Fish Lift Operating Mode:
- a) **Automatic / Manual** Frequency: 15 (mins) V-gate 6.0
- b) When unmanned, Sorting Facility Gates are: **Open / Closed**

Lift Count
Seasonal: ______
Daily: ______

3.) Upper Flume:
- a) Weir: 101.2 (ft) Staff Gauge (S_P) 101.1 (ft) Staff Gauge (S_W) 6.8 (ft) Dist. Stop Logs (L) **Open / Closed** Trash Pipe
- b) Flume Velocity: = ______ cfs Flow (Weir + Pipe) = ☐ fps Flume Velocity *Target: 1.0 – 1.5 fps*

4.) Aux. Water System:
- a) Hopper Flow: 2 2 Bulkhead Panels$_3$ (rows) 13 (in) Gate 3 96 (ft) Backwater El.$_3$ = ______ cfs Hopper Flow = ☐ fps Hopper Velocity *Target: 1.0 – 1.5 fps*
- b) Floor Diffuser: 0 2 2 Bulkhead Panels$_4$ (rows) 35 (in) Gate 4 98 (ft) Backwater El.$_4$ = ______ cfs Floor Diffuser ☐ cfs Total Flow *Target: 190 – 210 cfs*

5.) Lower Flume:
- a) Entrance Drop: 79.9 (ft) Flap Gate 83 (ft) Staff Gauge (S_L) = ______ (ft) Entrance Drop = ☐ fps Entrance Velocity *Target: 4 – 6 fps*

Does flow meet targets? **Yes / No**

Downstream Fishway Open? **Y / N**
1.) Flow adequate: ______
2.) Entrances not blocked by debris: ______
3.) Eel Chimney open: ______

Comments and Adjustments:

50/50

Fishway Mortalities:
(Count, Species, Location, Disposition)
Shad:
Riv:

50/50
H 13' head, 4 holes – 96
FD 15' head, 4 holes – 98'

Please provide completed inspection forms to the Licensing and Compliance Group every Monday morning.

3.) Upper Flume Flow:

a) Weir Formula:

1.) Subtract the distance to the stoplogs (L) from the Benchmark Elevation (B_e) to find the Weir Elevation (W_e). The benchmark is the top of the rabbit for the weir on the shoreward side (surveyed at 106.67 ≈ 106.7).

106.7 (B_e) – 6.8 (L) = 99.9 (W_e)

2.) Subtract W_e (calculated above) from the Staff Gage just upstream of the weir (S_W) to find Depth at Weir (H).

101.1 (S_W) – 99.9 (W_e) = 1.2 (H)

3.) Using H (calculated above), look up Upper Flume Weir Flow from **Chart 1**: 26 cfs

Trash Pipe:

1.) Using the Pipe Staff Gauge (S_P), look up Pipe Flow from **Chart 2**: + 13 cfs

b) Upper Flume Velocity: = 39 cfs

1.) Using the sum of the pipe and weir flows, and the Pipe Staff Gauge (S_P), look up the Upper Flume Velocity from **Chart 3**: ***Round to the nearest tenth.***

*Is velocity between 1.0 – 1.5 fps? Yes / No = **Fix it*** = 0.9 fps
Flume Velocity

4.) Auxiliary Water Supply:

a) Hopper Flow: b) Floor Diffuser:

1.) Subtract the Backwater El. from the Lower Flume Staff Gauge (S_L) for both. ***Round to the nearest foot.***

96 (Backwater El_3) – 83 (S_L) = 13 (Head of $Water_3$)

98 (Backwater El_4) – 83 (S_L) = 15 (Head of $Water_4$)

2.) Find the number of Sections of Holes open by summing the rows from each panel. Repeat for both bulkheads.

2 + 2 (Bulkhead $Panels_3$ (Rows)) = 4 (Sections $Holes_3$)

0 + 2 + 2 (Bulkhead $Panels_4$ (Rows)) = 4 (Sections $Holes_4$)

3.) Using the Head of Water, and Sections of Holes (calculated above), look up the Hopper Flow from **Chart 4** and Floor Diffuser Flow from **Chart 5.**

= 87 Hopper Flow

= 88 Floor Diffuser

4.) Using the Hopper Flow (calculated above) and Lower Flume Staff Gauge (S_L), look up the Hopper Velocity from **Chart 6:**

*Is the velocity between 1.0 – 1.5 fps? Yes / No = **Fix it!*** = 1.3 fps
Hopper Velocity

5.) Lower Flume: *Is the Total Flow between 190 – 230 cfs? Yes / No = **Fix it!*** = 175 cfs
Total Flow

a) Entrance Drop and Depth:

1.) Find the difference between the Tailwater Elevation (read from the computer) and S_L for the Entrance Drop. Subtract the Flap Gate Elevation from S_L for the Entrance Depth. ***Round to the nearest tenth.***

83 (S_L) – 81.9 (Tailwater El.) = 1.1 (Entrance Drop)

83 (S_L) – 79.9 (Flap Gate El.) = 3.1 (Entrance Depth)

2.) Using the Total Flow and Entrance Depth (both calculated above), look up Entrance Velocity from **Chart 7.**

*Is the velocity between 4.0 – 6.0 fps? Yes / No = **Adjust Flap Gate!*** = 5.6
Entrance Velocity

2 of 2

Date: 5/11/23	Observer: MS	Weather:	mix precip
Water Temp: 13.1		River flow:	4478

Test condition = 25H/75FD

Start time	1344
Entrance Flow	171
Hopper Flow	37
Hopper Velocity	0.6
Diffuser Flow	137
Entrance Velocity	5.5
Depth over Flap gate	3.0
Drop	1.08
Tailwater Elevation	81.83
Lower Flume Elevation	82.9
Entrance Gate Setting	79.9

See 1344 form

End Time	1415
Hopper bulkhead	
Elevation	92.5
Rows of holes	2
Floor diffuser bulkhead	
Elevation	98.5
Rows of holes	6
Lift Frequency	15
Lift cycle time	
V-gate Width	6.0

Camera Visibility	Descriptor
Poor	P
Medium	M
Excellent	E

Fish Observations	Descriptor
Direction	
Upstream	U
Downstream	D
Location	
Right	R
Left	L
Middle	M
Evenly dispersed	ED
Swimming Behavior	
Slow	S
Fast	F
Orderly	O
Chaotic/Confused	C
Other	Other

Species observed	Descriptor
River herring	RIV
Shad	AMS
Salmon	ATS
Sea Lamprey	SLP
Striped bass	SB

Observation Time Start:___ ______ Time Stop: ________________

			Fish Observation (*dominate behavior)		
Camera Locations	Camera Visibility	Species observed	Direction	Location	Swimming Behavior
E1 out (RL)	M	RIV	US	RL	F, C
E2 in (RL)	M-	RIV, ATS	US	/	F
diff ds (RL)	P	RIV	US+, ds	/	F
Diff us (RR)	M-	RIV/ATS	US+, ds	/	F
VGATE DS (RR)	M+	RIV	US (side to side)	M	S, C
VGATE US (RL)	E	RIV	US	M, low	F, O

Comments:

① RIV generally more toward bottom with this setting, & moving slower near VGATE

② low visibility near diffusers cameras & entrance

~~③ Appears to be constant flow of RIV coming in entrance & into hopper~~

③ Schools build up more noticeably below (ds) of VGATE on this setting and then once several move into hopper the entire schools follows in orderly slow US swimming behavior.
- back and forth milling ds of VGATE as school builds up (side to side)

5 of 3

Milford Daily Fishway Inspection Form

Date: 5/17/23 Time: 1340 Inspector: MS

Head Pond Elevation: 101.27 River Flow (cfs): 6478

Tailwater Elevation: 81.82 Water Temp °C: 13.1

Turbines On: (✓ or X) 1: X 2: X 3: ✓ 4: ✓ 5: ✓ 6: ✓

Hinged Gate Spill: Yes / [✓ No]

Obermeyer Spill: [✓ Yes] / No

Log Sluice Spill: [✓ Yes] / No

Upstream Eelway: Yes / [✓ No]

Denil Running: Yes / [✓ No]

Upstream Fishway ** *Clean Debris Before Taking Measurements* **

1.) Fishway Debris:
  a) Grizzly Rack ✓ Sorting Facility ✓ Punch Plate ✓ Hopper Block Screen ✓

2.) Fish Lift Operating Mode:
  a) **Automatic / Manual** Frequency: 15 (mins) V-gate 6.0
  b) When unmanned, Sorting Facility Gates are: **Open / Closed**

Lift Count
Seasonal: ______
Daily: ______

3.) Upper Flume:
  a) Weir: 101.2 (ft) Staff Gauge (S_P) 101.2 (ft) Staff Gauge (S_W) 6.8 (ft) Dist. Stop Logs (L) **Open / Closed** Trash Pipe
  b) Flume Velocity: = 42 cfs Flow (Weir + Pipe) = 0.95 fps Flume Velocity *Target: 1.0 – 1.5 fps*

4.) Aux. Water System:
  a) Hopper Flow: 1 1 Bulkhead Panels₃ (rows) 2 (in) Gate 3 92.5 (ft) Backwater El.₃ = 37 cfs Hopper Flow = 0.6 fps Hopper Velocity *Target: 1.0 – 1.5 fps*
  b) Floor Diffuser: 2 2 2 Bulkhead Panels₄ (rows) 35 (in) Gate 4 98.5 (ft) Backwater El.₄ = 134 cfs Floor Diffuser 171 cfs Total Flow *Target: 190 – 210 cfs*

5.) Lower Flume:
  a) Entrance Drop: 79.9 (ft) Flap Gate 82.9 (ft) Staff Gauge (S_L) = 1.08 (ft) Entrance Drop = ~~5.5~~ fps Entrance Velocity *Target: 4 – 6 fps*

Does flow meet targets? **Yes / No**

Downstream Fishway Open? **Y / N**
1.) Flow adequate: ______
2.) Entrances not blocked by debris: ______
3.) Eel Chimney open: ______

Comments and Adjustments:

22% H / 78% FD

FD H
140 35
17', 6 holes 9', 2 holes
100' 92'

Fishway Mortalities:
(Count, Species, Location, Disposition)
Shad:
Riv:

Please provide completed inspection forms to the Licensing and Compliance Group every Monday morning.

3.) Upper Flume Flow:

a) Weir Formula:

1.) Subtract the distance to the stoplogs (L) from the Benchmark Elevation (B_e) to find the Weir Elevation (W_e). The benchmark is the top of the rabbit for the weir on the shoreward side (surveyed at 106.67 ≈ 106.7).

106.7 – 6.8 = 99.9
B_e L W_e

2.) Subtract W_e (calculated above) from the Staff Gage just upstream of the weir (S_W) to find Depth at Weir (H).

101.2 – 99.9 = 1.3
S_W W_e H

3.) Using H (calculated above), look up Upper Flume Weir Flow from **Chart 1**: 29 cfs

Trash Pipe:

1.) Using the Pipe Staff Gauge (S_P), look up Pipe Flow from **Chart 2**: + 13 cfs

= 42 cfs

b) Upper Flume Velocity:

1.) Using the sum of the pipe and weir flows, and the Pipe Staff Gauge (S_P), look up the Upper Flume Velocity from **Chart 3**: ***Round to the nearest tenth.***

Is velocity between 1.0 – 1.5 fps? Yes / No = Fix it = $\boxed{0.95}$ fps
Flume Velocity

4.) Auxiliary Water Supply:

a) Hopper Flow: b) Floor Diffuser:

1.) Subtract the Backwater El. from the Lower Flume Staff Gauge (S_L) for both. ***Round to the nearest foot.***

92.5 – 82.9 = 9.6
Backwater El_3 S_L Head of $Water_3$

98.5 – 82.9 = 15.6
Backwater El_4 S_L Head of $Water_4$

2.) Find the number of Sections of Holes open by summing the rows from each panel. Repeat for both bulkheads.

1 + 1 = 2
Bulkhead $Panels_3$ (Rows) Sections $Holes_3$

2 + 2 + 2 = 6
Bulkhead $Panels_4$ (Rows) Sections $Holes_4$

3.) Using the Head of Water, and Sections of Holes (calculated above), look up the Hopper Flow from **Chart 4** and Floor Diffuser Flow from **Chart 5.**

= 37 (22%)
Hopper Flow

= 134 (78%)
Floor Diffuser

4.) Using the Hopper Flow (calculated above) and Lower Flume Staff Gauge (S_L), look up the Hopper Velocity from **Chart 6:**

Is the velocity between 1.0 – 1.5 fps? Yes / No = Fix it! = $\boxed{0.6}$ fps
Hopper Velocity

5.) Lower Flume: *Is the Total Flow between 190 – 230 cfs? Yes / No = Fix it!* = $\boxed{171}$ cfs
Total Flow

a) Entrance Drop and Depth:

1.) Find the difference between the Tailwater Elevation (read from the computer) and S_L for the Entrance Drop. Subtract the Flap Gate Elevation from S_L for the Entrance Depth. ***Round to the nearest tenth.***

82.9 – 81.82 = 1.08
S_L Tailwater El. Entrance Drop

82.9 – 79.9 = 3
S_L Flap Gate El. Entrance Depth

2.) Using the Total Flow and Entrance Depth (both calculated above), look up Entrance Velocity from **Chart 7.**

Is the velocity between 4.0 – 6.0 fps? Yes / No = Adjust Flap Gate! = $\boxed{5.5}$
Entrance Velocity

1 of 3

Milford Daily Fishway Inspection Form

Date: 5-18-23 Time: 07:50 Inspector: MS

Head Pond Elevation: 101.27 River Flow (cfs): 5281

Tailwater Elevation: 81.38 Water Temp °C: 12.5

Turbines On: (✓ or X) 1: N 2: N 3: N 4: Y 5: Y 6: Y

Hinged Gate Spill: Yes / [✓ No]

Obermeyer Spill: Yes / [✓ No]

Log Sluice Spill: Yes / [✓ No]

Upstream Eelway: Yes / [✓ No]

Denil Running: Yes / [✓ No]

Upstream Fishway *** Clean Debris Before Taking Measurements ***

1.) Fishway Debris:

a) Grizzly Rack ✓ Sorting Facility ✓ Punch Plate ✓ Hopper Block Screen ✓

2.) Fish Lift Operating Mode:

a) **Automatic / Manual** Frequency: 15 (mins) V-gate 6.0

Lift Count

Seasonal: ______

b) When unmanned, Sorting Facility Gates are: **Open / Closed**

Daily: ______

3.) Upper Flume:

a) Weir: 101.3 (ft) Staff Gauge (S_P) 101.2 (ft) Staff Gauge (S_W) 6.8 (ft) Dist. Stop Logs (L) **Open / Closed** Trash Pipe

b) Flume Velocity: = 41 cfs Flow (Weir + Pipe) = 0.9 fps Flume Velocity *Target: 1.0 – 1.5 fps*

4.) Aux. Water System:

a) Hopper Flow: 3 4 Bulkhead Panels$_3$ (rows) 12 (in) Gate 3 93 (ft) Backwater El.$_3$ = 133 cfs Hopper Flow = 2.0 fps Hopper Velocity *Target: 1.0 – 1.5 fps*

b) Floor Diffuser: 1 1 1 Bulkhead Panels$_4$ (rows) 16 (in) Gate 4 99 (ft) Backwater El.$_4$ = 45 ~~[illegible]~~ cfs Floor Diffuser ~~[illegible]~~ 178 cfs Total Flow *Target: 190 – 210 cfs*

5.) Lower Flume:

a) Entrance Drop: 79.9 (ft) Flap Gate 82.7 (ft) Staff Gauge (S_L) = 2.8 (ft) Entrance Drop = 7.1 fps Entrance Velocity *Target: 4 – 6 fps*

Does flow meet targets? **Yes / No**

Downstream Fishway Open? **Y / N**

1.) Flow adequate: ______

2.) Entrances not blocked by debris: ______

3.) Eel Chimney open: ______

Comments and Adjustments:

75 H 25 FD

Fishway Mortalities:

(Count, Species, Location, Disposition)

Shad:

Riv:

Please provide completed inspection forms to the Licensing and Compliance Group every Monday morning.

3.) Upper Flume Flow:

a) Weir Formula:

1.) Subtract the distance to the stoplogs (L) from the Benchmark Elevation (B_e) to find the Weir Elevation (W_e). The benchmark is the top of the rabbit for the weir on the shoreward side (surveyed at 106.67 ≈ 106.7).

106.7 (B_e) – 6.8 (L) = 99.9 (W_e)

2.) Subtract W_e (calculated above) from the Staff Gage just upstream of the weir (S_W) to find Depth at Weir (H).

101.2 (S_W) – 99.9 (W_e) = 1.3 (H)

3.) Using H (calculated above), look up Upper Flume Weir Flow from **Chart 1**: 26 cfs

Trash Pipe:

1.) Using the Pipe Staff Gauge (S_P), look up Pipe Flow from **Chart 2**: + 15 cfs

= 41 cfs

b) Upper Flume Velocity:

1.) Using the sum of the pipe and weir flows, and the Pipe Staff Gauge (S_P), look up the Upper Flume Velocity from **Chart 3**: ***Round to the nearest tenth.***

Is velocity between 1.0 – 1.5 fps? ***Yes / No = Fix it*** = $\boxed{0.9}$ fps

Flume Velocity

4.) Auxiliary Water Supply:

a) Hopper Flow: b) Floor Diffuser:

1.) Subtract the Backwater El. from the Lower Flume Staff Gauge (S_L) for both. ***Round to the nearest foot.***

93 (Backwater El_3) – 82.7 (S_L) = 10.3 (Head of $Water_3$)

99 (Backwater El_4) – 82.7 (S_L) = 16.3 (Head of $Water_4$)

2.) Find the number of Sections of Holes open by summing the rows from each panel. Repeat for both bulkheads.

3 + 4 (Bulkhead $Panels_3$ (Rows)) = 7 (Sections $Holes_3$)

1 + 1 + 0 (Bulkhead $Panels_4$ (Rows)) = 2 (Sections $Holes_4$)

3.) Using the Head of Water, and Sections of Holes (calculated above), look up the Hopper Flow from **Chart 4** and Floor Diffuser Flow from **Chart 5.**

= 133 (Hopper Flow) 75%

= 45 (Floor Diffuser) 25%

4.) Using the Hopper Flow (calculated above) and Lower Flume Staff Gauge (S_L), look up the Hopper Velocity from **Chart 6:**

Is the velocity between 1.0 – 1.5 fps? ***Yes / No = Fix it!*** = $\boxed{2.0}$ fps

Hopper Velocity

5.) Lower Flume: *Is the Total Flow between 190 – 230 cfs?* ***Yes / No = Fix it!*** = $\boxed{178}$ cfs

Total Flow

a) Entrance Drop and Depth:

1.) Find the difference between the Tailwater Elevation (read from the computer) and S_L for the Entrance Drop. Subtract the Flap Gate Elevation from S_L for the Entrance Depth. ***Round to the nearest tenth.***

82.7 (S_L) – 81.38 (Tailwater El.) = 1.32 (Entrance Drop)

82.7 (S_L) – 79.9 (Flap Gate El.) = 2.8 (Entrance Depth)

2.) Using the Total Flow and Entrance Depth (both calculated above), look up Entrance Velocity from **Chart 7.**

Is the velocity between 4.0 – 6.0 fps? ***Yes / No = Adjust Flap Gate!*** = $\boxed{7.1}$

Entrance Velocity

1 of 2

Date: 5/18/23	**Observer:**	MS	**Weather:**	Clear 5
Water Temp:	12.5		**River flow:**	5281

Test condition = 75H/25FD

Start time	✓
Entrance Flow	178
Hopper Flow	133
Hopper Velocity	2.1
Diffuser Flow	~~68~~ 45
Entrance Velocity	7.1
Depth over Flap gate	2.8
Drop	1.32
Tailwater Elevation	81.38
Lower Flume Elevation	82.7
Entrance Gate Setting	79.9

see 150 form

End Time	1020
Hopper bulkhead	
Elevation	83
Rows of holes	7
Floor diffuser bulkhead	
Elevation	97
Rows of holes	3
Lift Frequency	15 min
Lift cycle time	
V-gate Width	6.0

Camera Visibility	Descriptor
Poor	P
Medium	M
Excellent	E

Fish Observations	Descriptor
Direction	
Upstream	U
Downstream	D
Location	
Right	R
Left	L
Middle	M
Evenly dispersed	ED
Swimming Behavior	
Slow	S
Fast	F
Orderly	O
Chaotic/Confused	C
Other	Other

Species observed	Descriptor
River herring	RIV
Shad	AMS
Salmon	ATS
Sea Lamprey	SLP
Striped bass	SB

Observation Time Start: 0825 Time Stop: 1015

			Fish Observation (*dominate behavior)		
Camera Locations	Camera Visibility	Species observed	Direction	Location	Swimming Behavior
E1-out (RL)	M		US	RL⁺	F, O
E2-in (RL)	M	ATS	US	RL⁺	F, O
DIFF US (RR)	M+	ATS, ATM, RIV	US, DS	M	F, C
Diff DS (RL)	M⁺	ATS, ATM, RIV	US, DS	M	F, C
VGATE US (RL)	M	ATS, ATM, RIV	US; DS	M	S, O
VGATE DS - (RR)	E	ATS	US⁺ DS	M	S, O
		ATS			

Comments:

0830 - 2 shad present on DIFF cameras
0841 - 2 salmon entered hopper, 1 salmon exited hopper @ 0846
① No salmon or shad seen in lift ~~after~~ around 845
0857 - shad (2) milling around DIFF cameras, & 1 salmon (entered hopper @ 858) then went back out soon after
0901 - ATS exited hopper & @0905
② Very few RIV present this morning
@909 2 shad back at Diff cameras (US) just as VGATE closing for next lift
- VGATE closed but lift stuck @ ~910 - salmon holding below VGATE near DIFF cameras
③ lift back running @ 1008 - salmon entered hopper @ 1010 & was lifted @ 1025

Date: 5/18/23	Observer: MS	Weather:	Clear
Water Temp:	12.5	River flow:	5281

Test condition = 80H/20FD

Start time	1020
Entrance Flow	196
Hopper Flow	155
Hopper Velocity	2.2
Diffuser Flow	41
Entrance Velocity	5.5
Depth over Flap gate	3.7
Drop	1.12
Tailwater Elevation	81.38
Lower Flume Elevation	82.5
Entrance Gate Setting	78.8

see 1035 form

End Time	1215
Hopper bulkhead	
Elevation	96
Rows of holes	1
Floor diffuser bulkhead	
Elevation	96
Rows of holes	2
Lift Frequency	15
Lift cycle time	
V-gate Width	6.0

Camera Visibility	Descriptor
Poor	P
Medium	M
Excellent	E

Fish Observations	Descriptor
Direction	
Upstream	U
Downstream	D
Location	
Right	R
Left	L
Middle	M
Evenly dispersed	ED
Swimming Behavior	
Slow	S
Fast	F
Orderly	O
Chaotic/Confused	C
Other	Other

Species observed	Descriptor
River herring	RIV
Shad	AMS
Salmon	ATS
Sea Lamprey	SLP
Striped bass	SB

Observation Time Start: 11 00 Time Stop: 1145

			Fish Observation (*dominate behavior)		
Camera Locations	Camera Visibility	Species observed	Direction	Location	Swimming Behavior
E1 out (RL)	E	ATS, RIV	US	RL	F, O
E2 in (RL)	M	ATS, RIV	US	RL	F, O
Diff us (RR)	M+	ATS, RIV	us^{+}, ds^{-}	M+, RR	S, C
Diff ds (RL)	M	ATS, RIV	us, +, ds^{-}	M+, RR	S, C
VGate US (RL)	M	ATS, RIV	us^{+}, ds^{-}	low	S, C
V Gate DS (RR)	M+	ATS, RIV	us^{+}	low	F, O

Comments:

① Noticeably better clarity even compared to 75/25 test - but more bubbles near V-GATE

@1102 Salmon entered hopper and was confirmed in lift @ 1106

@1115 salmon entered hopper - confirmed in 1125 lift

② Schools of RIV started moving in around 1115, lower in water column

③ Salmon obs holding below VGATE while lift coming back down; RIV as well

④ RIV - similar behavior observed at similar setting yesterday where the schools build ds of VGATE and then they all move through

entered hopper and seen in 1145 lift

2 of 3

Milford Daily Fishway Inspection Form

Date: 5/18/23 Time: 1035 Inspector: MS

Head Pond Elevation: 101.27 River Flow (cfs): 5,281

Tailwater Elevation: 81.38 Water Temp °C: 12.5

Turbines On: (✓ or X) 1: X 2: X 3: X 4: ✓ 5: ✓ 6: ✓

Hinged Gate Spill: **Yes** / [✓ **No**]

Obermeyer Spill: **Yes** / [✓ **No**]

Log Sluice Spill: **Yes** / [✓ **No**]

Upstream Eelway: **Yes** / [✓ **No**]

Denil Running: **Yes** / [✓ **No**]

Upstream Fishway *** Clean Debris Before Taking Measurements ***

1.) Fishway Debris:

a) Grizzly Rack ✓ Sorting Facility ✓ Punch Plate ✓ Hopper Block Screen ✓

2.) Fish Lift Operating Mode:

a) **Automatic / Manual** Frequency: 15 (mins) V-gate 6

b) When unmanned, Sorting Facility Gates are: **Open / Closed**

Lift Count

Seasonal: ______

Daily: ______

3.) Upper Flume:

a) Weir: 101.3 (ft) Staff Gauge (S_P) 101.3 (ft) Staff Gauge (S_W) 6.8 (ft) Dist. Stop Logs (L) **Open / Closed** Trash Pipe

b) Flume Velocity: = 47 cfs Flow (Weir + Pipe) = 1.05 fps Flume Velocity *Target: 1.0 – 1.5 fps*

4.) Aux. Water System:

a) Hopper Flow: 4 3 Bulkhead Panels$_3$ (rows) 21 (in) Gate 3 96 (ft) Backwater El.$_3$ = 155 cfs Hopper Flow = 2.2 fps Hopper Velocity *Target: 1.0 – 1.5 fps*

b) Floor Diffuser: 1 1 0 Bulkhead Panels$_4$ (rows) 10 (in) Gate 4 96 (ft) Backwater El.$_4$ = 41 cfs Floor Diffuser 196 cfs Total Flow *Target: 190 – 210 cfs*

5.) Lower Flume:

a) Entrance Drop: 78.8 (ft) Flap Gate 82.5 (ft) Staff Gauge (S_L) = 1.12 (ft) Entrance Drop = 5.5 fps Entrance Velocity *Target: 4 – 6 fps*

Does flow meet targets? **Yes / No**

Downstream Fishway Open? **Y / N**

1.) Flow adequate: ______

2.) Entrances not blocked by debris: ______

3.) Eel Chimney open: ______

Comments and Adjustments:

80 H/ 20 M

Fishway Mortalities:

(Count, Species, Location, Disposition)

Shad:

Riv:

Please provide completed inspection forms to the Licensing and Compliance Group every Monday morning.

3.) Upper Flume Flow:

a) Weir Formula:

1.) Subtract the distance to the stoplogs (L) from the Benchmark Elevation (B_e) to find the Weir Elevation (W_e). The benchmark is the top of the rabbit for the weir on the shoreward side (surveyed at 106.67 ≈ 106.7).

106.7 – 6.8 = 99.9
B_e L W_e

2.) Subtract W_e (calculated above) from the Staff Gage just upstream of the weir (S_W) to find Depth at Weir (H).

101.3 – 99.9 = 1.4
S_W W_e H

3.) Using H (calculated above), look up Upper Flume Weir Flow from **Chart 1:** 32 cfs

Trash Pipe:

1.) Using the Pipe Staff Gauge (S_P), look up Pipe Flow from **Chart 2:** + 15 cfs

= 47 cfs

b) Upper Flume Velocity:

1.) Using the sum of the pipe and weir flows, and the Pipe Staff Gauge (S_P), look up the Upper Flume Velocity from **Chart 3:** ***Round to the nearest tenth.***

Is velocity between 1.0 – 1.5 fps? Yes / No = ***Fix it*** = 1.05 fps
Flume Velocity

4.) Auxiliary Water Supply:

a) Hopper Flow: b) Floor Diffuser:

1.) Subtract the Backwater El. from the Lower Flume Staff Gauge (S_L) for both. ***Round to the nearest foot.***

96 – 82.5 = 13.5
Backwater El_3 S_L Head of $Water_3$

96 – 82.5 = 13.5
Backwater El_4 S_L Head of $Water_4$

2.) Find the number of Sections of Holes open by summing the rows from each panel. Repeat for both bulkheads.

3 + 4 = 7
Bulkhead $Panels_3$ (Rows) Sections $Holes_3$

0 + 1 + 1 = 2
Bulkhead $Panels_4$ (Rows) Sections $Holes_4$

3.) Using the Head of Water, and Sections of Holes (calculated above), look up the Hopper Flow from **Chart 4** and Floor Diffuser Flow from **Chart 5.**

= 155
Hopper Flow

= 41
Floor Diffuser

4.) Using the Hopper Flow (calculated above) and Lower Flume Staff Gauge (S_L), look up the Hopper Velocity from **Chart 6:**

Is the velocity between 1.0 – 1.5 fps? Yes / No = ***Fix it!*** = 2.2 fps
Hopper Velocity

5.) Lower Flume: *Is the Total Flow between 190 – 230 cfs? Yes / No =* ***Fix it!*** = 196 cfs
Total Flow

a) Entrance Drop and Depth:

1.) Find the difference between the Tailwater Elevation (read from the computer) and S_L for the Entrance Drop. Subtract the Flap Gate Elevation from S_L for the Entrance Depth. ***Round to the nearest tenth.***

82.5 – 81.38 = 1.12
S_L Tailwater El. Entrance Drop

82.5 – 78.8 = 3.7
S_L Flap Gate El. Entrance Depth

2.) Using the Total Flow and Entrance Depth (both calculated above), look up Entrance Velocity from **Chart 7.**

Is the velocity between 4.0 – 6.0 fps? Yes / No = ***Adjust Flap Gate!*** = 5.5
Entrance Velocity

Date: 5/18/23	Observer: MS	Weather:	clear
Water Temp: 12.5		River flow:	5281

Test condition = 50/50

Start time	1240
Entrance Flow	202
Hopper Flow	100
Hopper Velocity	1.55
Diffuser Flow	102
Entrance Velocity	5.5
Depth over Flap gate	3.7
Drop	1.12
Tailwater Elevation	81.38
Lower Flume Elevation	82.5
Entrance Gate Setting	78.8

see 1320 form

End Time	1340
Hopper bulkhead	
Elevation	92.5
Rows of holes	5
Floor diffuser bulkhead	
Elevation	95.5
Rows of holes	5
Lift Frequency	7 min
Lift cycle time	
V-gate Width	6.0

Camera Visibility	Descriptor
Poor	P
Medium	M
Excellent	E

Fish Observations	Descriptor
Direction	
Upstream	U
Downstream	D
Location	
Right	R
Left	L
Middle	M
Evenly dispersed	ED
Swimming Behavior	
Slow	S
Fast	F
Orderly	O
Chaotic/Confused	C
Other	Other

Species observed	Descriptor
River herring	RIV
Shad	AMS
Salmon	ATS
Sea Lamprey	SLP
Striped bass	SB

Observation Time Start: 1240 Time Stop: 1315

Camera Locations	Camera Visibility	Species observed	Fish Observation (*dominate behavior)		
			Direction	Location	Swimming Behavior
E1 - in (RL)	P	RIV	poor vis.	/	/
E2 - Out (RL)	P	RIV	poor vis.	/	/
Diff us (RR)	M-	RIV	poor vis	/	/
Diff ds (RL)	P	RIV	us / poor vis.	/	/
Vgate us (RL)	E	RIV, AMS	us+, ds-	side to side	S, O, C+
Vgate ds (RR)	E	RIV	us	low	S+, O

Comments: ① Clarity @ diff cameras and downstream significantly decreased b/c of bubbles
② More RIV present now, lift freq. changed to 7min
③ RIV holding below gate while lift comes back down
④ Shad obs just ds of Vgate while lift was up @ 1251
⑤ Again, RIV schools build ds of Vgate, then all tend to go together
↳ while milling back & forth

- Data backed up from 5/4 to present (5/18)
- Mike took external drive home to check video data

3 of 3

Milford Daily Fishway Inspection Form

Date: 5/18/23 Time: 1320 Inspector: MS

Hinged Gate Spill: Yes / [✓ No]

Head Pond Elevation: 101.27 River Flow (cfs): 5281

Obermeyer Spill: Yes / [✓ No]

Tailwater Elevation: 81.38 Water Temp °C: 12.5

Log Sluice Spill: Yes / [✓ No]

Turbines On: (✓ or X) 1: N 2: N 3: N 4: Y 5: Y 6: Y

Upstream Eelway: Yes / [✓ No]

Denil Running: Yes / [✓ No]

Upstream Fishway *** Clean Debris Before Taking Measurements ***

1.) Fishway Debris:

a) Grizzly Rack ✓ Sorting Facility ✓ Punch Plate ✓ Hopper Block Screen ____

2.) Fish Lift Operating Mode:

a) **Automatic / Manual** Frequency: 7 (mins) V-gate 6.0

Lift Count Seasonal: ____

b) When unmanned, Sorting Facility Gates are: **Open / Closed**

Daily: ____

3.) Upper Flume:

a) Weir: 101.4 (ft) Staff Gauge (S_P) 101.3 (ft) Staff Gauge (S_W) 6.8 (ft) Dist. Stop Logs (L) **Open / Closed** Trash Pipe

b) Flume Velocity: = 49 cfs Flow (Weir + Pipe) = 1.0 fps Flume Velocity *Target: 1.0 – 1.5 fps*

4.) Aux. Water System:

a) Hopper Flow: 3 2 Bulkhead Panels$_3$ (rows) 10 (in) Gate 3 93.5 (ft) Backwater El.$_3$ = 100 cfs Hopper Flow = 1.55 fps Hopper Velocity *Target: 1.0 – 1.5 fps*

b) Floor Diffuser: 1 2 2 Bulkhead Panels$_4$ (rows) 15 (in) Gate 4 95.5 (ft) Backwater El.$_4$ = 102 cfs Floor Diffuser 202 cfs Total Flow *Target: 190 – 210 cfs*

5.) Lower Flume:

a) Entrance Drop: 78.8 (ft) Flap Gate 82.5 (ft) Staff Gauge (S_L) = 1.12 (ft) Entrance Drop = 5.5 fps Entrance Velocity *Target: 4 – 6 fps*

Does flow meet targets? **Yes / No**

Downstream Fishway Open? **Y / N**

1.) Flow adequate: ____

2.) Entrances not blocked by debris: ____

3.) Eel Chimney open: ____

Comments and Adjustments:

Lift freq set to 15 min after test

Fishway Mortalities:

(Count, Species, Location, Disposition)

Shad:

Riv:

Please provide completed inspection forms to the Licensing and Compliance Group every Monday morning.

3.) Upper Flume Flow:

a) Weir Formula:

1.) Subtract the distance to the stoplogs (L) from the Benchmark Elevation (B_e) to find the Weir Elevation (W_e). The benchmark is the top of the rabbit for the weir on the shoreward side (surveyed at 106.67 ≈ 106.7).

106.7 – 6.8 = 99.9

B_e L W_e

2.) Subtract W_e (calculated above) from the Staff Gage just upstream of the weir (S_W) to find Depth at Weir (H).

101.3 – 99.9 = 1.4

S_W W_e H

3.) Using H (calculated above), look up Upper Flume Weir Flow from **Chart 1**: 32 cfs

Trash Pipe:

1.) Using the Pipe Staff Gauge (S_P), look up Pipe Flow from **Chart 2**: + 17 cfs

= 49 cfs

b) Upper Flume Velocity:

1.) Using the sum of the pipe and weir flows, and the Pipe Staff Gauge (S_P), look up the Upper Flume Velocity from **Chart 3**: ***Round to the nearest tenth.***

Is velocity between 1.0 – 1.5 fps? Yes / No = Fix it = 1.0 fps

Flume Velocity

4.) Auxiliary Water Supply:

a) Hopper Flow: b) Floor Diffuser:

1.) Subtract the Backwater El. from the Lower Flume Staff Gauge (S_L) for both. ***Round to the nearest foot.***

93.5 – 82.5 = 11

Backwater El_3 S_L Head of $Water_3$

95.5 – 82.5 = 13

Backwater El_4 S_L Head of $Water_4$

2.) Find the number of Sections of Holes open by summing the rows from each panel. Repeat for both bulkheads.

2 + 3 = 5

Bulkhead $Panels_3$ (Rows) Sections $Holes_3$

2 + 2 + 1 = 5

Bulkhead $Panels_4$ (Rows) Sections $Holes_4$

3.) Using the Head of Water, and Sections of Holes (calculated above), look up the Hopper Flow from **Chart 4** and Floor Diffuser Flow from **Chart 5.**

= 100

Hopper Flow

= 102

Floor Diffuser

4.) Using the Hopper Flow (calculated above) and Lower Flume Staff Gauge (S_L), look up the Hopper Velocity from **Chart 6:**

Is the velocity between 1.0 – 1.5 fps? Yes / No = Fix it! = 1.55 fps

Hopper Velocity

5.) Lower Flume: *Is the Total Flow between 190 – 230 cfs? Yes / No = Fix it!* = 202 cfs

Total Flow

a) Entrance Drop and Depth:

1.) Find the difference between the Tailwater Elevation (read from the computer) and S_L for the Entrance Drop. Subtract the Flap Gate Elevation from S_L for the Entrance Depth. ***Round to the nearest tenth.***

82.5 – 81.38 = 1.12

S_L Tailwater El. Entrance Drop

82.5 – 78.8 = 3.7

S_L Flap Gate El. Entrance Depth

2.) Using the Total Flow and Entrance Depth (both calculated above), look up Entrance Velocity from **Chart 7.**

Is the velocity between 4.0 – 6.0 fps? Yes / No = Adjust Flap Gate! = 5.5

Entrance Velocity

1 of 2

Date: 5/24/23	**Observer:** MS	**Weather:**	clear
Water Temp:	15.9	**River flow:**	9770

Test condition = ~~[illegible]~~ 80H/20FD

Start time	0936
Entrance Flow	173
Hopper Flow	143
Hopper Velocity	1.8
Diffuser Flow	30
Entrance Velocity	5.5
Depth over Flap gate	3.3
Drop	1
Tailwater Elevation	83.43
Lower Flume Elevation	84.4
Entrance Gate Setting	80.7

see 115 form

End Time	1000
Hopper bulkhead	
Elevation	97
Rows of holes	7
Floor diffuser bulkhead	
Elevation	96
Rows of holes	1.5
Lift Frequency	15m
Lift cycle time	[illegible]
V-gate Width	60

Camera Visibility	Descriptor
Poor	P
Medium	M
Excellent	E

Fish Observations	Descriptor
Direction	
Upstream	U
Downstream	D
Location	
Right	R
Left	L
Middle	M
Evenly dispersed	ED
Swimming Behavior	
Slow	S
Fast	F
Orderly	O
Chaotic/Confused	C
Other	Other

Species observed	Descriptor
River herring	RIV
Shad	AMS
Salmon	ATS
Sea Lamprey	SLP
Striped bass	SB

Observation Time Start: 0936 **Time Stop:** 1000

			Fish Observation (*dominate behavior)		
Camera Locations	**Camera Visibility**	**Species observed**	**Direction**	**Location**	**Swimming Behavior**
E1 out	M+	ATS, SB AMS, SLP RIV	U ST	RLt	F, O
E2 in	M	ATS, AMS, RIV	|	RLt	F, O
Diff us	M-	ATS RIV	|	RLT	F, C
Diff ds	M-	ATS AMS RIV	|	M	F, C
V gate us	M	ATS, AMS, RIV	|	|	S, O
V gate DS	M	ATS, AMS, RIV	↓	↓	S, O
		SLP			

Comments:

① Similar obs for RIV from previous obs at higher hopper flow settings where RIV school builds around diff cameras (ds of VGATE) then moves through VGATE, and repeats.

② ATS obs. ds of vgate @ 0945 & through - verified in 0950 lift as well as a shad

③ only a few shad briefly seen on cameras and in lift. No general obs. other than successful passage

1 of 2

Milford Daily Fishway Inspection Form

Date: 5/24/23 Time: 7:15 Inspector: CP

Hinged Gate Spill: Yes / [✓ No]

Head Pond Elevation: 101.35 River Flow (cfs): 9,770

Obermeyer Spill: [✓ Yes] / No

Tailwater Elevation: 83.43 Water Temp °C: 15.9 C

Log Sluice Spill: [✓ Yes] / No

Turbines On: (✓ or X) 1: N 2: Y 3 4 5 6 →

Upstream Eelway: Yes / [✓ No]

Denil Running: Yes / [✓ No]

Upstream Fishway *** Clean Debris Before Taking Measurements ***

1.) Fishway Debris:

a) Grizzly Rack ✓ Sorting Facility ✓ Punch Plate ✓ Hopper Block Screen ✓

2.) Fish Lift ~~Operating~~ Mode:

a) [✓ **Automatic**] / **Manual** Frequency: 30 (mins) V-gate 6.0

Lift Count

Seasonal: 1242

b) When unmanned, Sorting Facility Gates are: **Open** / [✓ **Closed**]

Daily: 10

3.) Upper Flume:

a) Weir: 101.0 (ft) Staff Gauge (S_P) 101.0 (ft) Staff Gauge (S_W) 7.2 (ft) Dist. Stop Logs (L) [✓ **Open**] / **Closed** Trash Pipe

b) Flume Velocity: = 46 cfs Flow (Weir + Pipe) = 1.1 fps Flume Velocity *Target: 1.0 – 1.5 fps*

4.) Aux. Water System:

a) Hopper Flow: 3 4 Bulkhead Panels_3 (rows) 18" (in) Gate 3 96' (ft) Backwater El._3 = 143 cfs Hopper Flow = 1.8 fps Hopper Velocity *Target: 1.0 – 1.5 fps*

b) Floor Diffuser: 0 1 0.5 Bulkhead Panels_4 (rows) 6" (in) Gate 4 97' (ft) Backwater El._4 = 30 cfs Floor Diffuser 173 cfs Total Flow *Target: 190 – 210 cfs*

5.) Lower Flume:

a) Entrance Drop: 81.1 (ft) Flap Gate or 81.0 94.4 (ft) Staff Gauge (S_L) = 0.97 (ft) Entrance Drop = 5.5 fps Entrance Velocity *Target: 4 – 6 fps*

Does flow meet targets? **Yes / No**

Downstream Fishway Open? [✓ **Y**] / **N**

1.) Flow adequate: ✓

2.) Entrances not blocked by debris: ✓

3.) Eel Chimney open: X

Comments and Adjustments:

△↑FREQ TO 15 FROM 30 @ 07:20

Fishway Mortalities:

(Count, Species, Location, Disposition)

Shad: 7

Riv: 12

X2 SLP

80+/20 FP

Please provide completed inspection forms to the Licensing and Compliance Group every Monday morning.

3.) Upper Flume Flow:

a) Weir Formula:

1.) Subtract the distance to the stoplogs (L) from the Benchmark Elevation (B_e) to find the Weir Elevation (W_e). The benchmark is the top of the rabbit for the weir on the shoreward side (surveyed at 106.67 ≈ 106.7).

106.7 – 7.2 = 99.5

B_e L W_e

2.) Subtract W_e (calculated above) from the Staff Gage just upstream of the weir (S_W) to find Depth at Weir (H).

101.0 – 99.5 = 1.5

S_W W_e H

3.) Using H (calculated above), look up Upper Flume Weir Flow from **Chart 1**: 36 cfs

Trash Pipe:

1.) Using the Pipe Staff Gauge (S_P), look up Pipe Flow from **Chart 2**: + 10 cfs

b) Upper Flume Velocity: = 46 cfs

1.) Using the sum of the pipe and weir flows, and the Pipe Staff Gauge (S_P), look up the Upper Flume Velocity from **Chart 3**: ***Round to the nearest tenth.***

Is velocity between 1.0 – 1.5 fps? [✓ Yes] / No = Fix it = 1.1 fps

Flume Velocity

4.) Auxiliary Water Supply:

a) Hopper Flow: b) Floor Diffuser:

1.) Subtract the Backwater El. from the Lower Flume Staff Gauge (S_L) for both. ***Round to the nearest foot.***

96 – 84.4 = 11.6

Backwater El_3 S_L Head of $Water_3$

97 – 84.4 = 12.6

Backwater El_4 S_L Head of $Water_4$

2.) Find the number of Sections of Holes open by summing the rows from each panel. Repeat for both bulkheads.

3 + 4 = 7

Bulkhead $Panels_3$ (Rows) Sections $Holes_3$

0 + 1 + 0.5 = 1.5

Bulkhead $Panels_4$ (Rows) Sections $Holes_4$

3.) Using the Head of Water, and Sections of Holes (calculated above), look up the Hopper Flow from **Chart 4** and Floor Diffuser Flow from **Chart 5.**

= 143

Hopper Flow

= 30

Floor Diffuser

4.) Using the Hopper Flow (calculated above) and Lower Flume Staff Gauge (S_L), look up the Hopper Velocity from **Chart 6:**

Is the velocity between 1.0 – 1.5 fps? Yes / [✓ No] = Fix it! = 1.8 fps

Hopper Velocity

5.) Lower Flume: *Is the Total Flow between 190 – 230 cfs? Yes / [✓ No] = Fix it!* = 173 cfs

Total Flow

a) Entrance Drop and Depth:

1.) Find the difference between the Tailwater Elevation (read from the computer) and S_L for the Entrance Drop. Subtract the Flap Gate Elevation from S_L for the Entrance Depth. ***Round to the nearest tenth.***

84.4 – 83.43 = 0.97

S_L Tailwater El. Entrance Drop

84.4 – 81.1 = 3.3

S_L Flap Gate El. Entrance Depth

2.) Using the Total Flow and Entrance Depth (both calculated above), look up Entrance Velocity from **Chart 7.**

Is the velocity between 4.0 – 6.0 fps? Yes / No = Adjust Flap Gate! = 5.5

Entrance Velocity

Date: 5/24/23	Observer:	MS	Weather:	overcast
Water Temp:	15.9		River flow:	9770

Test condition = ~~80/20FD~~ 60H/40FD

Start time	1130	
Entrance Flow	161	
Hopper Flow	95	
Hopper Velocity	1.3	
Diffuser Flow	46	see 1220 form
Entrance Velocity	4.9	
Depth over Flap gate	3.3	
Drop	1.8	
Tailwater Elevation	~~83~~ 82.3	
Lower Flume Elevation	84.1	
Entrance Gate Setting	80.8	

End Time	1220
Hopper bulkhead	▇
Elevation	94
Rows of holes	5
Floor diffuser bulkhead	▇
Elevation	89
Rows of holes	3
Lift Frequency	15
Lift cycle time	
V-gate Width	6.0

Camera Visibility	Descriptor
Poor	P
Medium	M
Excellent	E

Fish Observations	Descriptor
Direction	
Upstream	U
Downstream	D
Location	
Right	R
Left	L
Middle	M
Evenly dispersed	ED
Swimming Behavior	
Slow	S
Fast	F
Orderly	O
Chaotic/Confused	C
Other	Other

Species observed	Descriptor
River herring	RIV
Shad	AMS
Salmon	ATS
Sea Lamprey	SLP
Striped bass	SB

Observation Time Start: 1200 Time Stop: 1220

			Fish Observation (*dominate behavior)		
Camera Locations	Camera Visibility	Species observed	Direction ⟷	Location	Swimming Behavior
E1	M-	all	RL+	US+	F, O
E2	M-	↓	RL+	↓	F, O
Diff US	M	↓	RL+	↓	F, O-C+
Diff DS	M	↓	M	↓	F, O-, C+
VGATE US	E	↓	M	↓	S, O
VGATE DS	E	↓	M	↓	S, O

Comments:

① Few shad seen on cameras around 11:30 and seen if lift; generally seen quickly pass cameras both up & ds before deciding to enter hopper

② More fish over-all, likely bc time of day

③ Overcast weather seems to be impacting image quality on cameras.

2 of 2

Milford Daily Fishway Inspection Form

Date: 5/24/23 Time: 12:20 Inspector: MS

Hinged Gate Spill: Yes / [✓ No]

Head Pond Elevation: 101.35 River Flow (cfs): 9770

Obermeyer Spill: [✓ Yes] / No

Tailwater Elevation: 82.3 Water Temp °C: 15.9

Log Sluice Spill: [✓ Yes] / No

Turbines On: (✓ or X)

1	2	3	4	5	6
N	Y	Y	Y	Y	Y

Upstream Eelway: Yes / [✓ No]

Denil Running: Yes / [✓ No]

Upstream Fishway *** Clean Debris Before Taking Measurements ***

1.) Fishway Debris:
a) Grizzly Rack ______ Sorting Facility ______ Punch Plate ______ Hopper Block Screen ______

2.) Fish Lift Operating Mode:
a) **Automatic / Manual** Frequency: 15 (mins) V-gate 6
b) When unmanned, Sorting Facility Gates are: **Open / Closed**

Lift Count
Seasonal: ______
Daily: ______

3.) Upper Flume:
a) Weir: 101.1 (ft) Staff Gauge (S_P) 101.1 (ft) Staff Gauge (S_W) 7.2 (ft) Dist. Stop Logs (L) **Open / Closed** Trash Pipe
b) Flume Velocity: = 50 cfs Flow (Weir + Pipe) = 1.1 fps Flume Velocity *Target: 1.0 – 1.5 fps*

4.) Aux. Water System:
a) Hopper Flow: 4 1 Bulkhead Panels$_3$ (rows) 8 (in) Gate 3 94 (ft) Backwater El.$_3$ = 95 cfs Hopper Flow = 1.3 fps Hopper Velocity *Target: 1.0 – 1.5 fps*
b) Floor Diffuser: 1 1 1 Bulkhead Panels$_4$ (rows) 35 (in) Gate 4 99 (ft) Backwater El.$_4$ = 66 cfs Floor Diffuser 161 cfs Total Flow *Target: 190 – 210 cfs*

5.) Lower Flume:
a) Entrance Drop: 80.8 (ft) Flap Gate 84.1 (ft) Staff Gauge (S_L) = 1.8 (ft) Entrance Drop = 4.9 fps Entrance Velocity *Target: 4 – 6 fps*

Does flow meet targets? **Yes / No**

Downstream Fishway Open? **Y / N**
1.) Flow adequate: ______
2.) Entrances not blocked by debris: ______
3.) Eel Chimney open: ______

Comments and Adjustments:

G@oH 40%FD

Fishway Mortalities:
(Count, Species, Location, Disposition)
Shad:
Riv:

Please provide completed inspection forms to the Licensing and Compliance Group every Monday morning.

3.) Upper Flume Flow:

a) Weir Formula:

1.) Subtract the distance to the stoplogs (L) from the Benchmark Elevation (B_e) to find the Weir Elevation (W_e). The benchmark is the top of the rabbit for the weir on the shoreward side (surveyed at 106.67 ≈ 106.7).

106.7 (B_e) – 7.2 (L) = 99.5 (W_e)

2.) Subtract W_e (calculated above) from the Staff Gage just upstream of the weir (S_W) to find Depth at Weir (H).

101.1 (S_W) – 99.5 (W_e) = 1.6 (H)

3.) Using H (calculated above), look up Upper Flume Weir Flow from **Chart 1**: 39 cfs

Trash Pipe:

1.) Using the Pipe Staff Gauge (S_P), look up Pipe Flow from **Chart 2**: + 11 cfs

b) Upper Flume Velocity: = 50 cfs

1.) Using the sum of the pipe and weir flows, and the Pipe Staff Gauge (S_P), look up the Upper Flume Velocity from **Chart 3**: ***Round to the nearest tenth.***

Is velocity between 1.0 – 1.5 fps? Yes / No = Fix it = 1.1 fps Flume Velocity

4.) Auxiliary Water Supply:

a) Hopper Flow: b) Floor Diffuser:

1.) Subtract the Backwater El. from the Lower Flume Staff Gauge (S_L) for both. ***Round to the nearest foot.***

94 (Backwater El_3) – 84.1 (S_L) = 9.9 (Head of $Water_3$)

99 (Backwater El_4) – 84.1 (S_L) = 14.9 (Head of $Water_4$)

2.) Find the number of Sections of Holes open by summing the rows from each panel. Repeat for both bulkheads.

4 + 1 (Bulkhead $Panels_3$ (Rows)) = 5 (Sections $Holes_3$)

1 + 1 + 1 (Bulkhead $Panels_4$ (Rows)) = 3 (Sections $Holes_4$)

3.) Using the Head of Water, and Sections of Holes (calculated above), look up the Hopper Flow from **Chart 4** and Floor Diffuser Flow from **Chart 5.**

= 95 Hopper Flow 60%

= 46 Floor Diffuser 40%

4.) Using the Hopper Flow (calculated above) and Lower Flume Staff Gauge (S_L), look up the Hopper Velocity from **Chart 6:**

Is the velocity between 1.0 – 1.5 fps? Yes / No = Fix it! = 1.3 fps Hopper Velocity

5.) Lower Flume:

Is the Total Flow between 190 – 230 cfs? Yes / No = Fix it! = 161 cfs Total Flow

a) Entrance Drop and Depth:

1.) Find the difference between the Tailwater Elevation (read from the computer) and S_L for the Entrance Drop. Subtract the Flap Gate Elevation from S_L for the Entrance Depth. ***Round to the nearest tenth.***

84.1 (S_L) – 82.3 (Tailwater El.) = 1.8 (Entrance Drop)

84.1 (S_L) – 80.8 (Flap Gate El.) = 3.3 (Entrance Depth)

2.) Using the Total Flow and Entrance Depth (both calculated above), look up Entrance Velocity from **Chart 7.**

Is the velocity between 4.0 – 6.0 fps? Yes / No = Adjust Flap Gate! = 49 Entrance Velocity

1 of 2

Date: 6/2/23	Observer:	MS		Weather:	PC
Water Temp:	23			River flow:	5431
Test condition =	78%H/22%FD				

Start time	940
Entrance Flow	184
Hopper Flow	143
Hopper Velocity	2.2
Diffuser Flow	41
Entrance Velocity	5.1
Depth over Flap gate	3.6
Drop	0.92
Tailwater Elevation	81.82
Lower Flume Elevation	82.5
Entrance Gate Setting	78.9

[illegible] @925

End Time	1141
Hopper bulkhead	
Elevation	94
Rows of holes	7
Floor diffuser bulkhead	
Elevation	96
Rows of holes	2
Lift Frequency	5/10
Lift cycle time	
V-gate Width	6.0/~~10~~10.0/3.0

Camera Visibility	Descriptor
Poor	P
Medium	M
Excellent	E

Fish Observations	Descriptor
Direction	
Upstream	U
Downstream	D
Location	
Right	R
Left	L
Middle	M
Evenly dispersed	ED
Swimming Behavior	
Slow	S
Fast	F
Orderly	O
Chaotic/Confused	C
Other	Other

Species observed	Descriptor
River herring	RIV
Shad	AMS
Salmon	ATS
Sea Lamprey	SLP
Striped bass	SB

Observation Time Start: 9 40 Time Stop: 1030

			Fish Observation (*dominate behavior)		
Camera Locations	Camera Visibility	Species observed	Direction	Location	Swimming Behavior
E1 out	M	RIV, AMS, ATS	US-	RL+	F, O+, C-
E1 in	M		US+	RL+	F, O+
Diff US	M				F, C
Diff DS	M+			↓	F, C
[illegible]	M+			M	S, O
[illegible]	M			M	S, O

Comments: 1) Shad were present in good numbers, many seen in [illegible] around [illegible] On days [illegible]

2) changed from 5 min to 10 min lifts [illegible] (@ 950)

3) 1008 lift saw some shad, but many more [illegible] on cameras (Vgate and diff) before lift, as well as a few salmon,

4) @ [illegible] 10 [illegible] [illegible] [illegible] [illegible] 1033 [illegible] [illegible] [illegible]

5) [illegible] entered @ [illegible] [illegible] [illegible] lift

6) [illegible] [illegible] enter lift [illegible] after RIV schools enter lift, and also [illegible] holding [illegible] [illegible] salmon

8) Changed Vgate setting to 10 @ 1045

@ 1050 Salmon [illegible] entered hopper and [illegible] @ 1058

9 Seems RIV & ATS AMS don't hold as long with Vgate @10 and move into hopper faster

(10) VGATE at 10.0 @ 1100-~~1~~05 video shows many salmon at VGATE and re-entering hopper more freely, as well as RIV & AMS, but some do fall out of hopper.

★ 11:08 lift confirmed about a dozen large ATS & more shad passed compared to earlier lifts

(11) Similar obs in next lift cycle, RIV still held but not as long ds of vgate before moving into hopper, ATS, AMS, & SLP move more freely into hopper compared to all other settings so far.

- many shad shown entering hopper @ 1120 vid
- 1125 lift confirmed this

(12) VGATE set to 3.0 @ 1127

- noticeably more reluctance to enter hopper by all species at this setting - ATS (several) held ds of VGATE - see 1136 vid & shad on diff occasions holding
- confirmed less fish overall at the 1140 lift, changed VGATE to 10. Ended obs.

1 of 3

Milford Daily Fishway Inspection Form

Date: 6/2/23 Time: 0925 Inspector: MS

Head Pond Elevation: 101.26 River Flow (cfs): 5451

Tailwater Elevation: 81.58 Water Temp °C: 21.3

Turbines On: (✓ or X) 1: N 2: Y 3: Y 4: Y 5: Y 6: Y

Hinged Gate Spill: Yes / [✓ No]

Obermeyer Spill: Yes / [✓ No]

Log Sluice Spill: [✓ Yes] / No

Upstream Eelway: Yes / [✓ No]

Denil Running: Yes / [✓ No]

Upstream Fishway *** Clean Debris Before Taking Measurements ***

1.) Fishway Debris:

a) Grizzly Rack ✓ Sorting Facility ✓ Punch Plate ✓ Hopper Block Screen ✓

2.) Fish Lift Operating Mode:

a) **Automatic / Manual** Frequency: 15 (mins) V-gate 6.0

Lift Count

Seasonal: ______

b) When unmanned, Sorting Facility Gates are: **Open / Closed**

Daily: ______

3.) Upper Flume:

a) Weir: 100.7 (ft) Staff Gauge (S_P) 100.7 (ft) Staff Gauge (S_W) 7.2 (ft) Dist. Stop Logs (L) **Open / Closed** Trash Pipe

b) Flume Velocity: = 32 cfs Flow (Weir + Pipe) = 0.9 fps Flume Velocity *Target: 1.0 – 1.5 fps*

4.) Aux. Water System:

a) Hopper Flow: 3 4 Bulkhead Panels$_3$ (rows) 18 (in) Gate 3 94 (ft) Backwater El.$_3$ = 143 cfs Hopper Flow = 2.2 fps Hopper Velocity *Target: 1.0 – 1.5 fps*

b) Floor Diffuser: 1 1 0 Bulkhead Panels$_4$ (rows) 12.5 (in) Gate 4 96 (ft) Backwater El.$_4$ = 41 cfs Floor Diffuser 184 cfs Total Flow *Target: 190 – 210 cfs*

5.) Lower Flume:

a) Entrance Drop: 78.9 (ft) Flap Gate 82.5 (ft) Staff Gauge (S_L) = 0.92 (ft) Entrance Drop = 5.1 fps Entrance Velocity *Target: 4 – 6 fps*

Does flow meet targets? **Yes / No**

Downstream Fishway Open? **Y / N**

1.) Flow adequate: ______

2.) Entrances not blocked by debris: ______

3.) Eel Chimney open: ______

Comments and Adjustments:

78% H / 22% FP

Fishway Mortalities:

(Count, Species, Location, Disposition)

Shad:

Riv:

Please provide completed inspection forms to the Licensing and Compliance Group every Monday morning.

3.) Upper Flume Flow:

a) Weir Formula:

1.) Subtract the distance to the stoplogs (L) from the Benchmark Elevation (B_e) to find the Weir Elevation (W_e). The benchmark is the top of the rabbit for the weir on the shoreward side (surveyed at 106.67 ≈ 106.7).

106.7 – 7.2 = 99.5
B_e L W_e

2.) Subtract W_e (calculated above) from the Staff Gage just upstream of the weir (S_W) to find Depth at Weir (H).

100.7 – 99.5 = 1.2
S_W W_e H

3.) Using H (calculated above), look up Upper Flume Weir Flow from **Chart 1**: 26 cfs

Trash Pipe:

1.) Using the Pipe Staff Gauge (S_P), look up Pipe Flow from **Chart 2**: + 6 cfs

= 32 cfs

b) Upper Flume Velocity:

1.) Using the sum of the pipe and weir flows, and the Pipe Staff Gauge (S_P), look up the Upper Flume Velocity from **Chart 3**: ***Round to the nearest tenth.***

Is velocity between 1.0 – 1.5 fps? Yes / No = Fix it = $\boxed{0.9}$ fps
Flume Velocity

4.) Auxiliary Water Supply:

a) Hopper Flow: b) Floor Diffuser:

1.) Subtract the Backwater El. from the Lower Flume Staff Gauge (S_L) for both. ***Round to the nearest foot.***

94 – 82.5 = 11.5
Backwater El_3 S_L Head of $Water_3$

96 – 82.5 = 13.5
Backwater El_4 S_L Head of $Water_4$

2.) Find the number of Sections of Holes open by summing the rows from each panel. Repeat for both bulkheads.

4 + 3 = 7
Bulkhead $Panels_3$ (Rows) Sections $Holes_3$

0 + 1 + 1 = 2
Bulkhead $Panels_4$ (Rows) Sections $Holes_4$

3.) Using the Head of Water, and Sections of Holes (calculated above), look up the Hopper Flow from **Chart 4** and Floor Diffuser Flow from **Chart 5.**

= 143
Hopper Flow

= 41
Floor Diffuser

4.) Using the Hopper Flow (calculated above) and Lower Flume Staff Gauge (S_L), look up the Hopper Velocity from **Chart 6:**

Is the velocity between 1.0 – 1.5 fps? Yes / No = Fix it! = $\boxed{2.2}$ fps
Hopper Velocity

5.) Lower Flume: *Is the Total Flow between 190 – 230 cfs? Yes / No = Fix it!* = $\boxed{184}$ cfs
Total Flow

a) Entrance Drop and Depth:

1.) Find the difference between the Tailwater Elevation (read from the computer) and S_L for the Entrance Drop. Subtract the Flap Gate Elevation from S_L for the Entrance Depth. ***Round to the nearest tenth.***

82.5 – 81.58 = 0.92
S_L Tailwater El. Entrance Drop

82.5 – 78.9 = 3.6
S_L Flap Gate El. Entrance Depth

2.) Using the Total Flow and Entrance Depth (both calculated above), look up Entrance Velocity from **Chart 7.**

Is the velocity between 4.0 – 6.0 fps? Yes / No = Adjust Flap Gate! = $\boxed{5.1}$
Entrance Velocity

Date: 6/2/23	Observer:	MS	Weather:	pc
Water Temp:	21.3		River flow:	5451

Test condition = 25% H 75% FD

Start time	1200
Entrance Flow	180
Hopper Flow	46
Hopper Velocity	0.7
Diffuser Flow	134
Entrance Velocity	5.0
Depth over Flap gate	3.6
Drop	0.68
Tailwater Elevation	81.82
Lower Flume Elevation	82.5
Entrance Gate Setting	78.9

see sheet @ 1305

End Time	1305
Hopper bulkhead	
Elevation	97
Rows of holes	2
Floor diffuser bulkhead	
Elevation	98
Rows of holes	6
Lift Frequency	10 min
Lift cycle time	
V-gate Width	9.0/6.0

Camera Visibility	Descriptor
Poor	P
Medium	M
Excellent	E

Fish Observations	Descriptor
Direction	
Upstream	U
Downstream	D
Location	
Right	R
Left	L
Middle	M
Evenly dispersed	ED
Swimming Behavior	
Slow	S
Fast	F
Orderly	O
Chaotic/Confused	C
Other	Other

Species observed	Descriptor
River herring	RIV
Shad	AMS
Salmon	ATS
Sea Lamprey	SLP
Striped bass	SB

Observation Time Start: 1225 Time Stop: 1302

			Fish Observation (*dominate behavior)		
Camera Locations	Camera Visibility	Species observed	Direction	Location	Swimming Behavior
E1	M	All	US+, D-	RL	F, C
E2	M-	"	US, D-	RL	F, C
Diff us	P+	"	~~US~~ Chaotic	/	/
Diff ds	P	"	Chaotic	/	/
Vgate us	E-	"	US-, DS+	M	F, O
Vgate ds	E	"	US-, DS+	M	F, O

Comments:

① Generally fish seem to freely enter hopper (similar to last test) but more noticeably fish leaving hopper as well - more so than last tests - 1245 lift showed less fish
-VGATE decreased to 6.0 @ 1247

② ATS & AMS holding ds of vgate @ 1248/49

③ All fish generally more reluctant to enter hopper at this setting and mill around between Diff & vgate cameras
- some fish still leaving hopper as well
- 1300 lift verified much ~~[illegible]~~ less RIV, few shad, no salmon

VGATE set back to 9.0 @ 1302

2 of 3

Milford Daily Fishway Inspection Form

Date: 6/2/23 Time: 1305 Inspector: MS

Head Pond Elevation: 101.26 River Flow (cfs): 5451

Tailwater Elevation: 81.87 Water Temp °C: 21.3

Turbines On: (✓ or X) 1: N 2: Y 3: Y 4: Y 5: Y 6: Y

Hinged Gate Spill: Yes / No

Obermeyer Spill: Yes / No

Log Sluice Spill: Yes / No

Upstream Eelway: Yes / No

Denil Running: Yes / No

Upstream Fishway *** Clean Debris Before Taking Measurements ***

1.) Fishway Debris:

a) Grizzly Rack ______ Sorting Facility ______ Punch Plate ______ Hopper Block Screen ______

2.) Fish Lift Operating Mode:

a) **Automatic / Manual** Frequency: 10 (mins) V-gate 9.0

Lift Count

Seasonal: ______

b) When unmanned, Sorting Facility Gates are: **Open / Closed**

Daily: ______

3.) Upper Flume:

a) Weir: 100.9 (ft) Staff Gauge (S_P) 100.9 (ft) Staff Gauge (S_W) 7.2 (ft) Dist. Stop Logs (L) **Open / Closed** Trash Pipe

b) Flume Velocity: = 32 cfs Flow (Weir + Pipe) = 1.0 fps Flume Velocity *Target: 1.0 – 1.5 fps*

4.) Aux. Water System:

a) Hopper Flow: 1 1 Bulkhead Panels₃ (rows) 6 (in) Gate 3 97 (ft) Backwater El.₃ = 46 cfs Hopper Flow = 0.7 fps Hopper Velocity *Target: 1.0 – 1.5 fps*

b) Floor Diffuser: 2 2 2 Bulkhead Panels₄ (rows) 35 (in) Gate 4 98 (ft) Backwater El.₄ = 134 cfs Floor Diffuser 180 cfs Total Flow *Target: 190 – 210 cfs*

5.) Lower Flume:

a) Entrance Drop: 78.9 (ft) Flap Gate 82.5 (ft) Staff Gauge (S_L) = 0.68 (ft) Entrance Drop = 5.0 fps Entrance Velocity *Target: 4 – 6 fps*

Does flow meet targets? **Yes / No**

Downstream Fishway Open? **Y / N**

1.) Flow adequate: _____

2.) Entrances not blocked by debris: _____

3.) Eel Chimney open: _____

Comments and Adjustments:

25% H - 75% FD

Fishway Mortalities:

(Count, Species, Location, Disposition)

Shad:

Riv:

Please provide completed inspection forms to the Licensing and Compliance Group every Monday morning.

3.) Upper Flume Flow:

a) Weir Formula:

1.) Subtract the distance to the stoplogs (L) from the Benchmark Elevation (B_e) to find the Weir Elevation (W_e). The benchmark is the top of the rabbit for the weir on the shoreward side (surveyed at 106.67 ≈ 106.7).

106.7 – 7.2 = 99.5
B_e L W_e

2.) Subtract W_e (calculated above) from the Staff Gage just upstream of the weir (S_W) to find Depth at Weir (H).

100.9 – 99.5 = 1.4
S_W W_e H

3.) Using H (calculated above), look up Upper Flume Weir Flow from **Chart 1**: 32 cfs

Trash Pipe:

1.) Using the Pipe Staff Gauge (S_P), look up Pipe Flow from **Chart 2**: + 8 cfs

= 40 cfs

b) Upper Flume Velocity:

1.) Using the sum of the pipe and weir flows, and the Pipe Staff Gauge (S_P), look up the Upper Flume Velocity from **Chart 3**: ***Round to the nearest tenth.***

*Is velocity between 1.0 – 1.5 fps? **Yes / No = Fix it*** = 1.0 fps
Flume Velocity

4.) Auxiliary Water Supply:

a) Hopper Flow:
b) Floor Diffuser:

1.) Subtract the Backwater El. from the Lower Flume Staff Gauge (S_L) for both. ***Round to the nearest foot.***

97 – 82.5 = 14.5
Backwater El_3 S_L Head of $Water_3$

98 – 82.5 = 15.5
Backwater El_4 S_L Head of $Water_4$

2.) Find the number of Sections of Holes open by summing the rows from each panel. Repeat for both bulkheads.

1 + 1 = 2
Bulkhead $Panels_3$ (Rows) Sections $Holes_3$

2 + 2 + 2 = 6
Bulkhead $Panels_4$ (Rows) Sections $Holes_4$

3.) Using the Head of Water, and Sections of Holes (calculated above), look up the Hopper Flow from **Chart 4** and Floor Diffuser Flow from **Chart 5.**

= 46 (25%)
Hopper Flow

= 134 (75%)
Floor Diffuser

4.) Using the Hopper Flow (calculated above) and Lower Flume Staff Gauge (S_L), look up the Hopper Velocity from **Chart 6:**

*Is the velocity between 1.0 – 1.5 fps? **Yes / No = Fix it!*** = 0.7 fps
Hopper Velocity

5.) Lower Flume: *Is the Total Flow between 190 – 230 cfs? **Yes / No = Fix it!*** = 180 cfs
Total Flow

a) Entrance Drop and Depth:

1.) Find the difference between the Tailwater Elevation (read from the computer) and S_L for the Entrance Drop. Subtract the Flap Gate Elevation from S_L for the Entrance Depth. ***Round to the nearest tenth.***

82.5 – 81.82 = 0.68
S_L Tailwater El. Entrance Drop

82.5 – 78.9 = 3.6
S_L Flap Gate El. Entrance Depth

2.) Using the Total Flow and Entrance Depth (both calculated above), look up Entrance Velocity from **Chart 7.**

*Is the velocity between 4.0 – 6.0 fps? **Yes / No = Adjust Flap Gate!*** = 5.6
Entrance Velocity

Date: 6/2/23	Observer:	MS	Weather:	overcast
Water Temp:			River flow:	5451

Test condition = ~~[illegible]~~ 78% H 22% FD

Start time	1305
Entrance Flow	180
Hopper Flow	139
Hopper Velocity	2.1
Diffuser Flow	41
Entrance Velocity	4.9
Depth over Flap gate	3.8
Drop	1.18
Tailwater Elevation	81.82
Lower Flume Elevation	83
Entrance Gate Setting	79.2

see set @1345

End Time	1400
Hopper bulkhead	
Elevation	94
Rows of holes	7
Floor diffuser bulkhead	
Elevation	96
Rows of holes	2
Lift Frequency	10 min
Lift cycle time	
V-gate Width	9.0 ~~[illegible]~~

Camera Visibility	Descriptor
Poor	P
Medium	M
Excellent	E

Fish Observations	Descriptor
Direction	
Upstream	U
Downstream	D
Location	
Right	R
Left	L
Middle	M
Evenly dispersed	ED
Swimming Behavior	
Slow	S
Fast	F
Orderly	O
Chaotic/Confused	C
Other	Other

Species observed	Descriptor
River herring	RIV
Shad	AMS
Salmon	ATS
Sea Lamprey	SLP
Striped bass	SB

Observation Time Start: 1330 Time Stop: 1345

			Fish Observation (*dominate behavior)		
Camera Locations	Camera Visibility	Species observed	Direction	Location	Swimming Behavior
E1	P+	all	U+ D-	RL+	F, O
E2	P+	↓	↓	RL+	F, O
Diff US	P			M+, RL	S, O+, C-
Diff DS	P			M, RL	S, O+, C-
Vgate US	M			M	S, O
Vgate DS	M+			M	S, O

Comments:

① back to similar settings as this morning. Much less fish likely due to time of day - Testing wider V-gate settings

② around 1342 several salmon moved into hopper from diff cameras quickly & ~~f~~eely.

③ around 1344 more fish (mostly RIV) moving in and generally quickly to hopper -1348 lift seemed to show more fish than previous test -left at this setting

④ wider V-gate settings may be attracting fish into hopper quicker

3 of 3

Milford Daily Fishway Inspection Form

Date: 6/2/23 Time: 1345 Inspector: MS Hinged Gate Spill: Yes [✓ No]

Head Pond Elevation: 101.26 River Flow (cfs): 5451 Obermeyer Spill: Yes [✓ No]

Tailwater Elevation: 81.82 Water Temp °C: ______ Log Sluice Spill: Yes [✓ No]

Turbines On: (✓ or X) 1 ✓ 2 X 3 X 4 X 5 X 6 X Upstream Eelway: Yes [✓ No]

Denil Running: Yes [✓ No]

Upstream Fishway *** Clean Debris Before Taking Measurements ***

1.) Fishway Debris:
  a) Grizzly Rack ______ Sorting Facility ______ Punch Plate ______ Hopper Block Screen ______

2.) Fish Lift Operating Mode: Lift Count
  a) **Automatic / Manual** Frequency: 15 (mins) V-gate 9.0 Seasonal: ______
  b) When unmanned, Sorting Facility Gates are: **Open / Closed** Daily: ______

3.) Upper Flume:
  a) Weir: 100.7 (ft) Staff Gauge (S_P) 100.7 (ft) Staff Gauge (S_W) 7.2 (ft) Dist. Stop Logs (L) **Open / Closed** Trash Pipe
  b) Flume Velocity: = 32 cfs Flow (Weir + Pipe) = 0.9 fps Flume Velocity *Target: 1.0 – 1.5 fps*

4.) Aux. Water System:
  a) Hopper Flow: 3 4 Bulkhead Panels$_3$ (rows) 18 (in) Gate 3 94 (ft) Backwater El.$_3$ = ~~143~~ 139 cfs Hopper Flow = 2.1 fps Hopper Velocity *Target: 1.0 – 1.5 fps*
  b) Floor Diffuser: 1 1 0 Bulkhead Panels$_4$ (rows) 12.5 (in) Gate 4 96 (ft) Backwater El.$_4$ = ~~41~~ 41 cfs Floor Diffuser 180 cfs Total Flow *Target: 190 – 210 cfs*

5.) Lower Flume:
  a) Entrance Drop: 79.2 (ft) Flap Gate 83 (ft) Staff Gauge (S_L) = 1.18 (ft) Entrance Drop = 4.9 fps Entrance Velocity *Target: 4 – 6 fps*

Does flow meet targets? Yes / No

Downstream Fishway Open? Y / N

1.) Flow adequate: ______

2.) Entrances not blocked by debris: ______

3.) Eel Chimney open: ______

Comments and Adjustments:

77% H - 23% FD

Fishway Mortalities:
(Count, Species, Location, Disposition)

Shad:

Riv:

Please provide completed inspection forms to the Licensing and Compliance Group every Monday morning.

3.) Upper Flume Flow:

a) Weir Formula:

1.) Subtract the distance to the stoplogs (L) from the Benchmark Elevation (B_e) to find the Weir Elevation (W_e). The benchmark is the top of the rabbit for the weir on the shoreward side (surveyed at 106.67 ≈ 106.7).

106.7 (B_e) – 7.2 (L) = 99.5 (W_e)

2.) Subtract W_e (calculated above) from the Staff Gage just upstream of the weir (S_W) to find Depth at Weir (H).

100.7 (S_W) – 99.5 (W_e) = 1.2 (H)

3.) Using H (calculated above), look up Upper Flume Weir Flow from **Chart 1**: 26 cfs

Trash Pipe:

1.) Using the Pipe Staff Gauge (S_P), look up Pipe Flow from **Chart 2**: + 6 cfs

= 32 cfs

b) Upper Flume Velocity:

1.) Using the sum of the pipe and weir flows, and the Pipe Staff Gauge (S_P), look up the Upper Flume Velocity from **Chart 3**: ***Round to the nearest tenth.***

Is velocity between 1.0 – 1.5 fps? Yes / No = Fix it = 0.9 fps

Flume Velocity

4.) Auxiliary Water Supply:

a) Hopper Flow: b) Floor Diffuser:

1.) Subtract the Backwater El. from the Lower Flume Staff Gauge (S_L) for both. ***Round to the nearest foot.***

94 (Backwater El_3) – 83 (S_L) = 11 (Head of $Water_3$)

96 (Backwater El_4) – 83 (S_L) = 13 (Head of $Water_4$)

2.) Find the number of Sections of Holes open by summing the rows from each panel. Repeat for both bulkheads.

4 + 3 (Bulkhead $Panels_3$ (Rows)) = 7 (Sections $Holes_3$)

0 + 1 + 1 (Bulkhead $Panels_4$ (Rows)) = 2 (Sections $Holes_4$)

3.) Using the Head of Water, and Sections of Holes (calculated above), look up the Hopper Flow from **Chart 4** and Floor Diffuser Flow from **Chart 5.**

= 139 (Hopper Flow) (77%)

= 41 (Floor Diffuser) (23%)

4.) Using the Hopper Flow (calculated above) and Lower Flume Staff Gauge (S_L), look up the Hopper Velocity from **Chart 6:**

Is the velocity between 1.0 – 1.5 fps? Yes / No = Fix it! = 2.1 fps

Hopper Velocity

5.) Lower Flume:

Is the Total Flow between 190 – 230 cfs? Yes / No = Fix it! = 180 cfs

Total Flow

a) Entrance Drop and Depth:

1.) Find the difference between the Tailwater Elevation (read from the computer) and S_L for the Entrance Drop. Subtract the Flap Gate Elevation from S_L for the Entrance Depth. ***Round to the nearest tenth.***

83 (S_L) – 81.82 (Tailwater El.) = 1.18 (Entrance Drop)

83 (S_L) – 79.2 (Flap Gate El.) = 3.8 (Entrance Depth)

2.) Using the Total Flow and Entrance Depth (both calculated above), look up Entrance Velocity from **Chart 7.**

Is the velocity between 4.0 – 6.0 fps? Yes / No = Adjust Flap Gate! = 4.0

Entrance Velocity

Milford Daily Fishway Inspection Form

Date: 6/2/23 Time: 755 Inspector: R. Dill

Hinged Gate Spill: Yes [✓ No]

Head Pond Elevation: 101.26 River Flow (cfs): 5451

Obermeyer Spill: Yes / [✓ No]

Tailwater Elevation: 81.58 Water Temp °C: 21.3

Log Sluice Spill: [✓ Yes] / No

Turbines On: (✓ or X)

1	2	3	4	5	6
N	Y	Y	Y	Y	Y

Upstream Eelway: Yes / [✓ No]

Denil Running: Yes / [✓ No]

Upstream Fishway *** Clean Debris Before Taking Measurements ***

1.) Fishway Debris:
  a) Grizzly Rack ✓ Sorting Facility ✓ Punch Plate ✓ Hopper Block Screen ✓

2.) Fish Lift Operating Mode:
  a) [✓ **Automatic**] / **Manual** Frequency: 7/15/30 (mins) V-gate 6.0

Lift Count
Seasonal: 1687
Daily: 12

  b) When unmanned, Sorting Facility Gates are: **Open / Closed**

3.) Upper Flume:
  a) Weir: 100.8 (ft) Staff Gauge (S_P) 100.7 (ft) Staff Gauge (S_W) 7.2 (ft) Dist. Stop Logs (L) **Open / Closed** Trash Pipe

  b) Flume Velocity: = 32 cfs Flow (Weir + Pipe) = 0.9 fps Flume Velocity *Target: 1.0 – 1.5 fps*

4.) Aux. Water System:
  a) Hopper Flow: 1 2 Bulkhead Panels$_3$ (rows) 7 (in) Gate 3 94 (ft) Backwater El.$_3$ = 61 cfs Hopper Flow = 1.1 fps Hopper Velocity *Target: 1.0 – 1.5 fps*

  b) Floor Diffuser: 1 2 2 Bulkhead Panels$_4$ (rows) 24 (in) Gate 4 97 (ft) Backwater El.$_4$ = 108 cfs Floor Diffuser 169 cfs Total Flow *Target: 190 – 210 cfs*

5.) Lower Flume:
  a) Entrance Drop: 79.2 (ft) Flap Gate 82.5 (ft) Staff Gauge (S_L) = 0.9 (ft) Entrance Drop = 5.1 fps Entrance Velocity *Target: 4 – 6 fps*

Does flow meet targets? **Yes / No**

Downstream Fishway Open? **Y / N**

1.) Flow adequate: Y
2.) Entrances not blocked by debris: Y
3.) Eel Chimney open: —

Comments and Adjustments:

(*) initial setting, but did not make observation

35 x1 - 65 fD

Fishway Mortalities:
(Count, Species, Location, Disposition)

Shad: 5
Riv: 15
SLP: 3

Please provide completed inspection forms to the Licensing and Compliance Group every Monday morning.

3.) Upper Flume Flow:

a) Weir Formula:

1.) Subtract the distance to the stoplogs (L) from the Benchmark Elevation (B_e) to find the Weir Elevation (W_e). The benchmark is the top of the rabbit for the weir on the shoreward side (surveyed at 106.67 ≈ 106.7).

106.7 (B_e) − 7.2 (L) = 99.5 (W_e)

2.) Subtract W_e (calculated above) from the Staff Gage just upstream of the weir (S_W) to find Depth at Weir (H).

100.7 (S_W) − 99.5 (W_e) = 1.2 (H)

3.) Using H (calculated above), look up Upper Flume Weir Flow from **Chart 1**: 26 cfs

Trash Pipe:

1.) Using the Pipe Staff Gauge (S_P), look up Pipe Flow from **Chart 2**: + 6 cfs

= 32 cfs

b) Upper Flume Velocity:

1.) Using the sum of the pipe and weir flows, and the Pipe Staff Gauge (S_P), look up the Upper Flume Velocity from **Chart 3**: ***Round to the nearest tenth.***

Is velocity between 1.0 – 1.5 fps? ***Yes / No = Fix it*** = 0.9 fps

Flume Velocity

4.) Auxiliary Water Supply:

a) Hopper Flow: b) Floor Diffuser:

1.) Subtract the Backwater El. from the Lower Flume Staff Gauge (S_L) for both. ***Round to the nearest foot.***

94 (Backwater El_3) − 82.5 (S_L) = 11.5 (Head of $Water_3$)

97 (Backwater El_4) − 82.5 (S_L) = 14.5 (Head of $Water_4$)

2.) Find the number of Sections of Holes open by summing the rows from each panel. Repeat for both bulkheads.

1 + 2 (Bulkhead $Panels_3$ (Rows)) = 3 (Sections $Holes_3$)

2 + 2 + 1 (Bulkhead $Panels_4$ (Rows)) = 5 (Sections $Holes_4$)

3.) Using the Head of Water, and Sections of Holes (calculated above), look up the Hopper Flow from **Chart 4** and Floor Diffuser Flow from **Chart 5.**

= 61 (36%) Hopper Flow

= 108 (64%) Floor Diffuser

4.) Using the Hopper Flow (calculated above) and Lower Flume Staff Gauge (S_L), look up the Hopper Velocity from **Chart 6:**

Is the velocity between 1.0 – 1.5 fps? ***Yes / No = Fix it!*** = 1.1 fps

Hopper Velocity

5.) Lower Flume: *Is the Total Flow between 190 – 230 cfs?* ***Yes / No = Fix it!*** = 169 cfs

Total Flow

a) Entrance Drop and Depth:

1.) Find the difference between the Tailwater Elevation (read from the computer) and S_L for the Entrance Drop. Subtract the Flap Gate Elevation from S_L for the Entrance Depth. ***Round to the nearest tenth.***

82.5 (S_L) − 81.6 (Tailwater El.) = 0.9 (Entrance Drop)

82.5 (S_L) − 79.2 (Flap Gate El.) = 3.3 (Entrance Depth)

2.) Using the Total Flow and Entrance Depth (both calculated above), look up Entrance Velocity from **Chart 7.**

Is the velocity between 4.0 – 6.0 fps? ***Yes / No = Adjust Flap Gate!*** = 5.1

Entrance Velocity

Date: 6/14/23	Observer:	MS	Weather: overcast	
Water Temp:	18.0		River flow:	13,310

Camera Visibility	Descriptor
Poor	P
Medium	M
Excellent	E

Fish Observations	Descriptor
Direction	
Upstream	U
Downstream	D
Location	
Right	R
Left	L
Middle	M
Evenly dispersed	ED
Swimming Behavior	
Slow	S
Fast	F
Orderly	O
Chaotic/Confused	C
Other	Other

Species observed	Descriptor
River herring	RIV
Shad	AMS
Salmon	ATS
Sea Lamprey	SLP
Striped bass	SB

Test condition = 77% H/23% FD

Start time	9:38
Entrance Flow	177
Hopper Flow	137
Hopper Velocity	1,55
Diffuser Flow	40
Entrance Velocity	5.1
Depth over Flap gate	3.3
Drop	0.98
Tailwater Elevation	83.94
Lower Flume Elevation	85.0
Entrance Gate Setting	81.7

See 7/15 sheet

End Time	1030
Hopper bulkhead	
Elevation	96
Rows of holes	7
Floor diffuser bulkhead	
Elevation	98
Rows of holes	2
Lift Frequency	15
Lift cycle time	
V-gate Width	90

Observation Time Start: 0938 Time Stop: 10:05

			Fish Observation (*dominate behavior)		
Camera Locations	Camera Visibility	Species observed	Direction	Location	Swimming Behavior
E1 M	~~RIV, ATS, AMS~~ SLP	all	Ust DS	RL	F
E2 M-	~~RIV " "~~ "	↓	"	RL	F
Diff US M-	~~RIV "~~		"	M	C, S
Diff DS M-	~~RIV "~~		"	M	C, S
Vgate US M	~~RIV "~~		"	M	S*
Vgate DS E	~~RIV "~~	↓	"	M	S, O

Comments:

① Visibility not great due to overcast/low light conditions

② last few weeks have been unseasonably cool w/ higher than normal flows = slow shad run still

③ Shad & Salmon seen sporadically entering flume, then at diff cameras and then Vgate and entering hopper w/in 5-10 min span

④ Entrance gate lowered at 0951 - appears more shad entered & salmon (80.9)

⑤ Some fish (shad) seen swimming out of hopper, but appear to reentered

⑥ Several salmon entered hopper @ 0958 (×6) - Several shad & salmon confirmed in 10:03 lift

⑦ V gate changed to 8.0 @ 10:05

1 of 2

Milford Daily Fishway Inspection Form

Date: 6-14-23 Time: 7:15 Inspector: MK

Hinged Gate Spill: Yes / [✓ No]

Head Pond Elevation: 101.52 River Flow (cfs): 13,310

Obermeyer Spill: [✓ Yes] / No

Tailwater Elevation: 83.94 Water Temp °C: 18.2

Log Sluice Spill: [✓ Yes] / No

Turbines On: (✓ or X) 1: Y 2: Y 3: Y 4: Y 5: Y 6: Y

Upstream Eelway: Yes / [✓ No]

Denil Running: Yes / [✓ No]

Upstream Fishway ** *Clean Debris Before Taking Measurements* **

1.) Fishway Debris:
  a) Grizzly Rack ✓ Sorting Facility ✓ Punch Plate ✓ Hopper Block Screen ✓

2.) Fish Lift Operating Mode:
  a) **Automatic / Manual** Frequency: 15 (mins) V-gate 9.0

Lift Count
Seasonal: 2289
Daily: 13

  b) When unmanned, Sorting Facility Gates are: **Open** / [✓ **Closed**]

3.) Upper Flume:
  a) Weir: 101 (ft) Staff Gauge (S_P) 101 (ft) Staff Gauge (S_W) 7.2 (ft) Dist. Stop Logs (L) [✓ **Open**] / **Closed** Trash Pipe

  b) Flume Velocity: = ____ cfs Flow (Weir + Pipe) = 1.05 fps Flume Velocity *Target: 1.0 – 1.5 fps*

4.) Aux. Water System:
  a) Hopper Flow: 3 4 Bulkhead Panels$_3$ (rows) 18 (in) Gate 3 96 (ft) Backwater El.$_3$ = 137 cfs Hopper Flow = 1.55 fps Hopper Velocity *Target: 1.0 – 1.5 fps*

  b) Floor Diffuser: 0 1 1 Bulkhead Panels$_4$ (rows) 14" (in) Gate 4 98 (ft) Backwater El.$_4$ = 40 cfs Floor Diffuser 177 cfs Total Flow *Target: 190 – 210 cfs*

5.) Lower Flume:
  a) Entrance Drop: 81.7 (ft) Flap Gate 85 (ft) Staff Gauge (S_L) = .98 (ft) Entrance Drop = 5.1 fps Entrance Velocity *Target: 4 – 6 fps*

Does flow meet targets? **Yes / No**

Downstream Fishway Open? [✓ Y] / N

1.) Flow adequate: ✓

2.) Entrances not blocked by debris: ✓

3.) Eel Chimney open: —

Comments and Adjustments:

770H/ 237 FD

Fishway Mortalities:
(Count, Species, Location, Disposition)
Shad: 5 Rack @ Trash Pipe
Riv: 0

Please provide completed inspection forms to the Licensing and Compliance Group every Monday morning.

3.) Upper Flume Flow:

a) Weir Formula:

1.) Subtract the distance to the stoplogs (L) from the Benchmark Elevation (B_e) to find the Weir Elevation (W_e). The benchmark is the top of the rabbit for the weir on the shoreward side (surveyed at 106.67 ≈ 106.7).

106.7 (B_e) – 7.2 (L) = 99.5 (W_e)

2.) Subtract W_e (calculated above) from the Staff Gage just upstream of the weir (S_W) to find Depth at Weir (H).

101 (S_W) – 99.5 (W_e) = 1.5 (H)

3.) Using H (calculated above), look up Upper Flume Weir Flow from **Chart 1**: 36 cfs

Trash Pipe:

1.) Using the Pipe Staff Gauge (S_P), look up Pipe Flow from **Chart 2**: + 10 cfs

= 46 cfs

b) Upper Flume Velocity:

1.) Using the sum of the pipe and weir flows, and the Pipe Staff Gauge (S_P), look up the Upper Flume Velocity from **Chart 3**: ***Round to the nearest tenth.***

Is velocity between 1.0 – 1.5 fps? [✓ Yes] / No = Fix it = 1.05 fps

Flume Velocity

4.) Auxiliary Water Supply:

a) Hopper Flow: b) Floor Diffuser:

1.) Subtract the Backwater El. from the Lower Flume Staff Gauge (S_L) for both. ***Round to the nearest foot.***

96 (Backwater El_3) – 85.3 (S_L) = 10.7 (Head of $Water_3$)

98 (Backwater El_4) – 85 (S_L) = 13 (Head of $Water_4$)

2.) Find the number of Sections of Holes open by summing the rows from each panel. Repeat for both bulkheads.

3 + 4 (Bulkhead $Panels_3$ (Rows)) = 7 (Sections $Holes_3$)

0 + 1 + 1 (Bulkhead $Panels_4$ (Rows)) = 2 (Sections $Holes_4$)

3.) Using the Head of Water, and Sections of Holes (calculated above), look up the Hopper Flow from **Chart 4** and Floor Diffuser Flow from **Chart 5.**

= 137 Hopper Flow

= 40 Floor Diffuser

4.) Using the Hopper Flow (calculated above) and Lower Flume Staff Gauge (S_L), look up the Hopper Velocity from **Chart 6:**

Is the velocity between 1.0 – 1.5 fps? Yes / [✓ No] = Fix it! = 155 fps

Hopper Velocity

5.) Lower Flume: *Is the Total Flow between 190 – 230 cfs? Yes / [✓ No] = Fix it!* = 177 cfs

Total Flow

a) Entrance Drop and Depth:

1.) Find the difference between the Tailwater Elevation (read from the computer) and S_L for the Entrance Drop. Subtract the Flap Gate Elevation from S_L for the Entrance Depth. ***Round to the nearest tenth.***

85.3 (S_L) – 84.32 (Tailwater El.) = .98 (Entrance Drop)

85 (S_L) – 81.7 (Flap Gate El.) = 3.3 (Entrance Depth)

2.) Using the Total Flow and Entrance Depth (both calculated above), look up Entrance Velocity from **Chart 7.**

Is the velocity between 4.0 – 6.0 fps? [✓ Yes] / No = Adjust Flap Gate! = 5.1

Entrance Velocity

Date: 6/14/23	Observer: My	Weather:	light rain
Water Temp:	18.0	River flow:	13,310

Test condition = 23%H/77%FD

Start time	1030
Entrance Flow	179
Hopper Flow	41
Hopper Velocity	0.5
Diffuser Flow	138
Entrance Velocity	5.0
Depth over Flap gate	3.6
Drop	0.56
Tailwater Elevation	83.94
Lower Flume Elevation	84.5
Entrance Gate Setting	80.9

see 10:45 sheet

End Time	1:15
Hopper bulkhead	
Elevation	96
Rows of holes	4
Floor diffuser bulkhead	
Elevation	96.5
Rows of holes	7
Lift Frequency	15 m
Lift cycle time	[illegible]
V-gate Width	8.0

Camera Visibility	Descriptor
Poor	P
Medium	M
Excellent	E

Fish Observations	Descriptor
Direction	
Upstream	U
Downstream	D
Location	
Right	R
Left	L
Middle	M
Evenly dispersed	ED
Swimming Behavior	
Slow	S
Fast	F
Orderly	O
Chaotic/Confused	C
Other	Other

Species observed	Descriptor
River herring	RIV
Shad	AMS
Salmon	ATS
Sea Lamprey	SLP
Striped bass	SB

Observation Time Start: 10 36 Time Stop: 11:00

			Fish Observation (*dominate behavior)		
Camera Locations	Camera Visibility	Species observed	Direction	Location	Swimming Behavior
E1	M+	all	us+	RL	F
E2	M-	↓	us+	RL	F
Diff us	~~[illegible]~~ M	↓	us, ds	M	C
Diff ds	~~[illegible]~~ P	↓	us, ds	M	C
vgate us	M	↓	us+, ds	M	S
Vgate DS	M+	↓	us, ds	M	S

Comments:

① less clarity due to bubbles ~~[illegible]~~ @ diff cameras and E2.
② Not many fish present
③ A few shad obs. moving through flume & back and forth near diff cameras and just a couple seen moving into hopper, confirmed in 11:05 lift w/ two shad + 1 salmon

- left it at this setting for night. will observe again in morning
- Data backed up overnight

2 of 2

Milford Daily Fishway Inspection Form

Date: 6/14/23 Time: 1045 Inspector: MS

Head Pond Elevation: 101.52 River Flow (cfs): 13,310

Tailwater Elevation: 83.94 Water Temp °C: 18

Turbines On: (✓ or X) 1 Y 2 Y 3 Y 4 Y 5 Y 6 Y

Hinged Gate Spill: Yes / [✓ No]

Obermeyer Spill: [✓ Yes] / No

Log Sluice Spill: [✓ Yes] / No

Upstream Eelway: Yes / [✓ No]

Denil Running: Yes / [✓ No]

Upstream Fishway *** Clean Debris Before Taking Measurements ***

1.) Fishway Debris:
  a) Grizzly Rack ✓ Sorting Facility ✓ Punch Plate ✓ Hopper Block Screen ✓

2.) Fish Lift Operating Mode:
  a) **Automatic / Manual** Frequency: 15 (mins) V-gate 8.0
  b) When unmanned, Sorting Facility Gates are: **Open / [✓ Closed]**

Lift Count
Seasonal: ____
Daily: ____

3.) Upper Flume:
  a) Weir: 101.4 (ft) Staff Gauge (S_P) 101.4 (ft) Staff Gauge (S_W) 6.8 (ft) Dist. Stop Logs (L) **Open / Closed** Trash Pipe
  b) Flume Velocity: = 53 cfs Flow (Weir + Pipe) = 1.1 fps Flume Velocity *Target: 1.0 – 1.5 fps*

4.) Aux. Water System:
  a) Hopper Flow: 1 1 Bulkhead Panels₃ (rows) 2 Gate 3 (in) 96 (ft) Backwater El.₃ = 41 cfs Hopper Flow = 0.5 fps Hopper Velocity *Target: 1.0 – 1.5 fps*
  b) Floor Diffuser: 3 2 2 Bulkhead Panels₄ (rows) 15 Gate 4 (in) 96.5 (ft) Backwater El.₄ = 138 cfs Floor Diffuser 179 cfs Total Flow *Target: 190 – 210 cfs*

5.) Lower Flume:
  a) Entrance Drop: 80.9 (ft) Flap Gate 84.5 (ft) Staff Gauge (S_L) = 0.56 (ft) Entrance Drop = 5.0 fps Entrance Velocity *Target: 4 – 6 fps*

Does flow meet targets? **Yes / No**

Downstream Fishway Open? **Y / N**
1.) Flow adequate: ____
2.) Entrances not blocked by debris: ____
3.) Eel Chimney open: ____

Comments and Adjustments:

Fishway Mortalities:
(Count, Species, Location, Disposition)
Shad:
Riv: 23% H - 77% FD

Please provide completed inspection forms to the Licensing and Compliance Group every Monday morning.

3.) Upper Flume Flow:

a) Weir Formula:

1.) Subtract the distance to the stoplogs (L) from the Benchmark Elevation (B_e) to find the Weir Elevation (W_e). The benchmark is the top of the rabbit for the weir on the shoreward side (surveyed at 106.67 ≈ 106.7).

$$\underset{B_e}{106.7} - \underset{L}{\underline{6.8}} = \underset{W_e}{\underline{99.9}}$$

2.) Subtract W_e (calculated above) from the Staff Gage just upstream of the weir (S_W) to find Depth at Weir (H).

$$\underset{S_W}{\underline{101.4}} - \underset{W_e}{\underline{99.9}} = \underset{H}{\underline{1.5}}$$

3.) Using H (calculated above), look up Upper Flume Weir Flow from **Chart 1**: 36 cfs

Trash Pipe:

1.) Using the Pipe Staff Gauge (S_P), look up Pipe Flow from **Chart 2**: + 17 cfs

= 53 cfs

b) Upper Flume Velocity:

1.) Using the sum of the pipe and weir flows, and the Pipe Staff Gauge (S_P), look up the Upper Flume Velocity from **Chart 3**: ***Round to the nearest tenth.***

Is velocity between 1.0 – 1.5 fps? Yes / No = Fix it = $\boxed{1.1}$ fps

Flume Velocity

4.) Auxiliary Water Supply:

a) Hopper Flow:

b) Floor Diffuser:

1.) Subtract the Backwater El. from the Lower Flume Staff Gauge (S_L) for both. ***Round to the nearest foot.***

$$\underset{\text{Backwater El}_3}{\underline{96}} - \underset{S_L}{\underline{84.5}} = \underset{\text{Head of Water}_3}{\underline{11.5}}$$

$$\underset{\text{Backwater El}_4}{\underline{96.5}} - \underset{S_L}{\underline{\overset{84.5}{\cancel{96.5}}}} = \underset{\text{Head of Water}_4}{\underline{12}}$$

2.) Find the number of Sections of Holes open by summing the rows from each panel. Repeat for both bulkheads.

$$\underline{1} + \underline{1} = \underset{\text{Sections Holes}_3}{\underline{2}} \quad \text{Bulkhead Panels}_3\text{ (Rows)}$$

$$\underline{3} + \underline{2} + \underline{2} = \underset{\text{Sections Holes}_4}{\underline{7}} \quad \text{Bulkhead Panels}_4\text{ (Rows)}$$

3.) Using the Head of Water, and Sections of Holes (calculated above), look up the Hopper Flow from **Chart 4** and Floor Diffuser Flow from **Chart 5.**

= 41 23% (Hopper Flow)

= 138 77% (Floor Diffuser)

4.) Using the Hopper Flow (calculated above) and Lower Flume Staff Gauge (S_L), look up the Hopper Velocity from **Chart 6:**

Is the velocity between 1.0 – 1.5 fps? Yes / No = Fix it! = $\boxed{0.5}$ fps

Hopper Velocity

Is the Total Flow between 190 – 230 cfs? Yes / No = Fix it! = $\boxed{179}$ cfs

Total Flow

5.) Lower Flume:

a) Entrance Drop and Depth:

1.) Find the difference between the Tailwater Elevation (read from the computer) and S_L for the Entrance Drop. Subtract the Flap Gate Elevation from S_L for the Entrance Depth. ***Round to the nearest tenth.***

$$\underset{S_L}{\underline{84.5}} - \underset{\text{Tailwater El.}}{\underline{83.94}} = \underset{\text{Entrance Drop}}{\underline{0.56}}$$

$$\underset{S_L}{\underline{84.5}} - \underset{\text{Flap Gate El.}}{\underline{80.9}} = \underset{\text{Entrance Depth}}{\underline{3.6}}$$

2.) Using the Total Flow and Entrance Depth (both calculated above), look up Entrance Velocity from **Chart 7.**

Is the velocity between 4.0 – 6.0 fps? Yes / No = Adjust Flap Gate! = $\boxed{5.0}$

Entrance Velocity

10+2

Milford Daily Fishway Inspection Form

Date: 6/15/23 Time: 7:15 Inspector: MS

Hinged Gate Spill: Yes [✓ No]

Head Pond Elevation: 101.38 River Flow (cfs): 12,083

Obermeyer Spill: [✓ Yes] / No

Tailwater Elevation: 83.64 Water Temp °C: 18.3 °C

Log Sluice Spill: [✓ Yes] / No

Turbines On: (✓ or X) y 1 y 2 y 3 y 4 y 5 y 6

Upstream Eelway: Yes [✓ No]

Denil Running: Yes / No

Upstream Fishway *** Clean Debris Before Taking Measurements ***

1.) Fishway Debris:

a) Grizzly Rack ✓ Sorting Facility ✓ Punch Plate ✓ Hopper Block Screen ✓

2.) Fish Lift Operating Mode:

a) **Automatic / Manual** Frequency: 30/15 (mins) V-gate 8

Lift Count Seasonal: 2342

b) When unmanned, Sorting Facility Gates are: **Open / Closed**

Daily: 15

3.) Upper Flume:

a) Weir: 101.0 (ft) Staff Gauge (S_P) 101.0 (ft) Staff Gauge (S_W) 6.8 (ft) Dist. Stop Logs (L) **Open** / [✓ **Closed**] Trash Pipe

b) Flume Velocity: = 33 cfs Flow (Weir + Pipe) = 1.0 fps Flume Velocity *Target: 1.0 – 1.5 fps*

4.) Aux. Water System:

a) Hopper Flow: 1 1 Bulkhead Panels$_3$ (rows) 2 (in) Gate 3 93.5 (ft) Backwater El.$_3$ = 34 cfs Hopper Flow = 0.5 fps Hopper Velocity *Target: 1.0 – 1.5 fps*

b) Floor Diffuser: 3 2 2 Bulkhead Panels$_4$ (rows) 15 (in) Gate 4 96 (ft) Backwater El.$_4$ = 132 cfs Floor Diffuser 168 cfs Total Flow *Target: 190 – 210 cfs*

5.) Lower Flume:

a) Entrance Drop: 81.6 (ft) Flap Gate 84.8 (ft) Staff Gauge (S_L) = 1.16 (ft) Entrance Drop = 5.3 fps Entrance Velocity *Target: 4 – 6 fps*

Does flow meet targets? **Yes / No**

Downstream Fishway Open? Y [✓ N]

1.) Flow adequate: ✓

2.) Entrances not blocked by debris: ✓

3.) Eel Chimney open: ✓

Fishway Mortalities:

(Count, Species, Location, Disposition)

Shad: 4

Riv: 1

SLP: 4

Comments and Adjustments:

78.5% FD / 21.5% H

- Overnight setting for video monitoring study. Set back to 75%H/25% FD @8:40

Please provide completed inspection forms to the Licensing and Compliance Group every Monday morning.

3.) Upper Flume Flow:

a) Weir Formula:

1.) Subtract the distance to the stoplogs (L) from the Benchmark Elevation (B_e) to find the Weir Elevation (W_e). The benchmark is the top of the rabbit for the weir on the shoreward side (surveyed at $106.67 \approx 106.7$).

106.7 (B_e) − 6.8 (L) = 99.9 (W_e)

2.) Subtract W_e (calculated above) from the Staff Gage just upstream of the weir (S_W) to find Depth at Weir (H).

101.0 (S_W) − 99.9 (W_e) = 1.1 (H)

3.) Using H (calculated above), look up Upper Flume Weir Flow from **Chart 1**: 23 cfs

Trash Pipe:

1.) Using the Pipe Staff Gauge (S_P), look up Pipe Flow from **Chart 2**: + 10 cfs

= 33 cfs

b) Upper Flume Velocity:

1.) Using the sum of the pipe and weir flows, and the Pipe Staff Gauge (S_P), look up the Upper Flume Velocity from **Chart 3**: ***Round to the nearest tenth.***

*Is velocity between 1.0 – 1.5 fps? **Yes / No = Fix it*** = 1.0 fps

Flume Velocity

4.) Auxiliary Water Supply:

a) Hopper Flow:

b) Floor Diffuser:

1.) Subtract the Backwater El. from the Lower Flume Staff Gauge (S_L) for both. ***Round to the nearest foot.***

93.5 (Backwater El_3) − 84.8 (S_L) = 8.7 (Head of $Water_3$)

96 (Backwater El_4) − 84.8 (S_L) = 11.2 (Head of $Water_4$)

2.) Find the number of Sections of Holes open by summing the rows from each panel. Repeat for both bulkheads.

1 + 1 (Bulkhead $Panels_3$ (Rows)) = 2 (Sections $Holes_3$)

3 + 2 + 2 (Bulkhead $Panels_4$ (Rows)) = 7 (Sections $Holes_4$)

3.) Using the Head of Water, and Sections of Holes (calculated above), look up the Hopper Flow from **Chart 4** and Floor Diffuser Flow from **Chart 5.**

= 36 Hopper Flow

= 132 Floor Diffuser

4.) Using the Hopper Flow (calculated above) and Lower Flume Staff Gauge (S_L), look up the Hopper Velocity from **Chart 6:**

*Is the velocity between 1.0 – 1.5 fps? **Yes / No = Fix it!*** = 0.5 fps

Hopper Velocity

5.) Lower Flume:

*Is the Total Flow between 190 – 230 cfs? **Yes / No = Fix it!*** = 168 cfs

Total Flow

a) Entrance Drop and Depth:

1.) Find the difference between the Tailwater Elevation (read from the computer) and S_L for the Entrance Drop. Subtract the Flap Gate Elevation from S_L for the Entrance Depth. ***Round to the nearest tenth.***

84.8 (S_L) − 83.64 (Tailwater El.) = 1.16 (Entrance Drop)

84.8 (S_L) − 81.6 (Flap Gate El.) = 3.2 (Entrance Depth)

2.) Using the Total Flow and Entrance Depth (both calculated above), look up Entrance Velocity from **Chart 7.**

*Is the velocity between 4.0 – 6.0 fps? **Yes / No = Adjust Flap Gate!*** = 5.3

Entrance Velocity

Date: 6/15/23	Observer:	MS	Weather:		
Water Temp:	18.3		River flow:	12,083	
Test condition =	~~78~~ [illegible] 21.5% H / 78.5% FD				

Start time	715
Entrance Flow	168
Hopper Flow	36
Hopper Velocity	0.5
Diffuser Flow	132
Entrance Velocity	5.3
Depth over Flap gate	3.2
Drop	1.16
Tailwater Elevation	83.64
Lower Flume Elevation	84.8
Entrance Gate Setting	81.6

See 715 form

End Time 0840	
Hopper bulkhead	■
Elevation	93.5
Rows of holes	2
Floor diffuser bulkhead	■
Elevation	96
Rows of holes	7
Lift Frequency	30/15
Lift cycle time	/
V-gate Width	8

Camera Visibility	Descriptor
Poor	P
Medium	M
Excellent	E

Fish Observations	Descriptor
Direction	
Upstream	U
Downstream	D
Location	
Right	R
Left	L
Middle	M
Evenly dispersed	ED
Swimming Behavior	
Slow	S
Fast	F
Orderly	O
Chaotic/Confused	C
Other	Other

Species observed	Descriptor
River herring	RIV
Shad	AMS
Salmon	ATS
Sea Lamprey	SLP
Striped bass	SB

Observation Time Start: 720 Time Stop: 740

			Fish Observation (*dominate behavior)		
Camera Locations	Camera Visibility	Species observed	Direction	Location	Swimming Behavior
E1	P+	all	U+, D-	RL	F, C
E2	P+	all	"	RL	F, C
Diff US (RR)	P	/	"	/	/
Diff DS (RL)	P	/	"	/	/
Vgate US (RL)	M+	all	"	M	S, C
Vgate DS (RR)	E	all	"	M	S, C

Comments:

① Very few fish present

② 1 salmon obs entering hopper and confined during lift

③ High flows and low visibility - Not many fish moving in general

2 of 2

Milford Daily Fishway Inspection Form

Date: 6/15/23 Time: 0840 Inspector: MS

Hinged Gate Spill: Yes / [✓ No]

Head Pond Elevation: 101.38 River Flow (cfs): 12,083

Obermeyer Spill: [✓ Yes] / No

Tailwater Elevation: 83.64 Water Temp °C: 18.3

Log Sluice Spill: [✓ Yes] / No

Turbines On: (✓ or X) y 1 y 2 y 3 y 4 y 5 y 6

Upstream Eelway: Yes / [✓ No]

Denil Running: Yes / [✓ No]

Upstream Fishway *** Clean Debris Before Taking Measurements ***

1.) Fishway Debris:
a) Grizzly Rack ✓ Sorting Facility ✓ Punch Plate ✓ Hopper Block Screen ✓

2.) Fish Lift Operating Mode:
a) **Automatic / Manual** Frequency: 15 (mins) V-gate 8.0

Lift Count
Seasonal: 2345

b) When unmanned, Sorting Facility Gates are: **Open / Closed**

Daily: 17

3.) Upper Flume:
a) Weir: 100.7 (ft) Staff Gauge (S_P) 100.9 (ft) Staff Gauge (S_W) ~~3.0~~ 7.2 (ft) Dist. Stop Logs (L) **Open / Closed** Trash Pipe

b) Flume Velocity: = 32 cfs Flow (Weir + Pipe) = 0.7 fps Flume Velocity *Target: 1.0 – 1.5 fps*

4.) Aux. Water System:
a) Hopper Flow: 3 3 Bulkhead Panels$_3$ (rows) 22 (in) Gate 3 97 (ft) Backwater El.$_3$ = 128 cfs Hopper Flow = 1.6 fps Hopper Velocity *Target: 1.0 – 1.5 fps*

b) Floor Diffuser: 0 1 1 Bulkhead Panels$_4$ (rows) 35 (in) Gate 4 97.5 (ft) Backwater El.$_4$ = 39 cfs Floor Diffuser 167 cfs Total Flow *Target: 190 – 210 cfs*

5.) Lower Flume:
a) Entrance Drop: 80.8 (ft) Flap Gate 84.5 (ft) Staff Gauge (S_L) = 0.86 (ft) Entrance Drop = 4.6 fps Entrance Velocity *Target: 4 – 6 fps*

Does flow meet targets? **Yes / No**

Downstream Fishway Open? **Y / N**
1.) Flow adequate: ____
2.) Entrances not blocked by debris: ____
3.) Eel Chimney open: ____

Comments and Adjustments:

Fishway Mortalities:
(Count, Species, Location, Disposition)
Shad:

Riv:

Please provide completed inspection forms to the Licensing and Compliance Group every Monday morning.

3.) Upper Flume Flow:

a) Weir Formula:

1.) Subtract the distance to the stoplogs (L) from the Benchmark Elevation (B_e) to find the Weir Elevation (W_e). The benchmark is the top of the rabbit for the weir on the shoreward side (surveyed at 106.67 ≈ 106.7).

106.7 – 7.2 = 99.5
B_e L W_e

2.) Subtract W_e (calculated above) from the Staff Gage just upstream of the weir (S_W) to find Depth at Weir (H).

100.9 – 99.5 = 1.4
S_W W_e H

3.) Using H (calculated above), look up Upper Flume Weir Flow from **Chart 1**: 32 cfs

Trash Pipe:

1.) Using the Pipe Staff Gauge (S_P), look up Pipe Flow from **Chart 2**: + 8 cfs

= 40 cfs

b) Upper Flume Velocity:

1.) Using the sum of the pipe and weir flows, and the Pipe Staff Gauge (S_P), look up the Upper Flume Velocity from **Chart 3**: ***Round to the nearest tenth.***

Is velocity between 1.0 – 1.5 fps? Yes / No = Fix it = 0.7 fps
Flume Velocity

4.) Auxiliary Water Supply:

a) Hopper Flow: b) Floor Diffuser:

1.) Subtract the Backwater El. from the Lower Flume Staff Gauge (S_L) for both. ***Round to the nearest foot.***

97 – 84.5 = 12.5 97.5 – 84.5 = 12
Backwater El_3 S_L Head of $Water_3$ Backwater El_4 S_L Head of $Water_4$

2.) Find the number of Sections of Holes open by summing the rows from each panel. Repeat for both bulkheads.

3 + 3 = 6 0 + 1 + 1 = 2
Bulkhead $Panels_3$ (Rows) Sections $Holes_3$ Bulkhead $Panels_4$ (Rows) Sections $Holes_4$

3.) Using the Head of Water, and Sections of Holes (calculated above), look up the Hopper Flow from **Chart 4** and Floor Diffuser Flow from **Chart 5.**

= 128 = 39
Hopper Flow Floor Diffuser

4.) Using the Hopper Flow (calculated above) and Lower Flume Staff Gauge (S_L), look up the Hopper Velocity from **Chart 6:**

Is the velocity between 1.0 – 1.5 fps? Yes / No = Fix it! = 1.6 fps
Hopper Velocity

5.) Lower Flume: *Is the Total Flow between 190 – 230 cfs? Yes / No = Fix it!* = 167 cfs
Total Flow

a) Entrance Drop and Depth:

1.) Find the difference between the Tailwater Elevation (read from the computer) and S_L for the Entrance Drop. Subtract the Flap Gate Elevation from S_L for the Entrance Depth. *Round to the nearest tenth.*

84.5 – 83.64 = 0.86 84.5 – 80.8 = 3.7
S_L Tailwater El. Entrance Drop S_L Flap Gate El. Entrance Depth

2.) Using the Total Flow and Entrance Depth (both calculated above), look up Entrance Velocity from **Chart 7.**

Is the velocity between 4.0 – 6.0 fps? Yes / No = Adjust Flap Gate! = 4.6
Entrance Velocity

Date: 6/15/23	Observer:	MS	Weather:	overcast	
Water Temp:	18.3		River flow:	12,083	

Test condition = 75 H/25 FD

Start time	745
Entrance Flow	117
Hopper Flow	129
Hopper Velocity	1.6
Diffuser Flow	39
Entrance Velocity	4.9
Depth over Flap gate	3.7
Drop	0.86
Tailwater Elevation	83.04
Lower Flume Elevation	80.5
Entrance Gate Setting	80.8

See 0840 form

End Time	840
Hopper bulkhead	
Elevation	97
Rows of holes	6
Floor diffuser bulkhead	
Elevation	97.5
Rows of holes	2
Lift Frequency	15 min
Lift cycle time	-
V-gate Width	8.0

Camera Visibility	Descriptor
Poor	P
Medium	M
Excellent	E

Fish Observations	Descriptor
Direction	
Upstream	U
Downstream	D
Location	
Right	R
Left	L
Middle	M
Evenly dispersed	ED
Swimming Behavior	
Slow	S
Fast	F
Orderly	O
Chaotic/Confused	C
Other	Other

Species observed	Descriptor
River herring	RIV
Shad	AMS
Salmon	ATS
Sea Lamprey	SLP
Striped bass	SB

Observation Time Start: 745 Time Stop: 830

			Fish Observation (*dominate behavior)		
Camera Locations	Camera Visibility	Species observed	Direction	Location	Swimming Behavior
E1	M⁻	all	U+ , D⁻	RL+, M	F , O+
E2	M⁻	"	" "	RL+, M	F , O+
Diff US (RR)	M+	"	" "	M	S , C
Diff DS (RL)	M+	"	" "	M	S , C
V gate US (RL)	M	"	" "	M	S , O
V gate DS (RR)	E⁻	"	" "	M	S , O

Comments:

1) Salmon picked back up w/ it + is getting confirmed w/ 0800 lift w/ 6 salmon

② Several (but not many) shad seed at entrance but not moving all the way up to ~~diffuser~~ hopper: did see them on all other cameras

③ Too few shad present to make obs.