Commissioner Pat Keliher, Department of Marine Resources
c/o Ms. Amanda Ellis
dmr.rulemaking@maine.gov
Sent via electronic mail

January 29, 2021

Dear Commissioner Keliher:

The Kennebec Coalition strongly supports the Department of Marine Resources' (DMR) proposed amendment to the Kennebec River Management Plan entitled "Kennebec River Management Plan Diadromous Resources Amendment." We applaud DMR's recommendation to remove both the Shawmut and Lockwood dams. We also agree with DMR's characterization of both the quality and quantities of habitat for diadromous species above Lockwood and the problems with the lack of fish passage at the four dams between Waterville and Skowhegan. We support DMR's intention to submit this plan to FERC as a Comprehensive Management Plan Amendment.

In addition, we urge DMR to strengthen the restoration recommendations in this plan and urge the removal of all four dams between Waterville and Skowhegan. Brookfield and previous dam owners have had 22 years since signing the 1998 Kennebec Hydro Developers (KHDG) Agreement to build effective fish passage at the four dams between Waterville and Skowhegan. This agreement, which remains in effect, was intended:

> to accomplish the following purposes: to achieve a comprehensive settlement governing fisheries restoration, for numerous anadromous and catadramous species, that will rapidly assist in the restoration of these species in the Kennebec River after the termination on December 31, 1998 of the existing agreement between the State of Maine and the Kennebec Hydro Developers Group…[1]

The dam owners, including Brookfield, have done almost nothing to meet this requirement. The engineered fish passage at Lockwood has been a dismal failure since 2006, and Brookfield has not fixed it. The result is that Atlantic salmon, now critically endangered, still cannot swim to the first significant spawning and rearing habitat in the Sandy River. American shad and blueback herring, which are plentiful below Lockwood, also cannot reach the 60% of their historic spawning habitat above Lockwood. The four dams also block 90% of the historic spawning and rearing habitat for sea lamprey. The dam owners have had decades to install effective engineered fish passage and have not. Their time should be up, and DMR should recommend removing all four dams.

We also know how badly engineered fish passage systems have failed elsewhere in Maine and on the East Coast. Brookfield's fishway at the Brunswick Dam on the Androscoggin is even less effective that the Lockwood lift. Shad and salmon restoration efforts using engineered fish passage have failed dismally on the Susquehanna, the Connecticut, and the Merrimack rivers, including at Brookfield's dams. We cannot afford the same outcome on the Kennebec. There is no record of successful Atlantic salmon and American shad restoration on any large river above more than one dam. All four of Brookfield's antiquated dams between Waterville and Skowhegan should go.

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[1] 1998. KHDG Agreement. Page 2. Accessible at https://1drv.ms/u/s!AkLlihAdyxqVklBuZIG6A5l9pnd8?e=sWgbBm.

The Kennebec Coalition also contracted with Don Pugh to look specifically at fish passage issues at the Weston Dam. His analysis is attached to this letter as Attachment A. He concludes that downstream passage at Weston is inadequate to meet DMR passage standards in the proposed amendment. He also concludes that the Brookfield's proposed upstream fishlift will likely fail. The reasons for this include:

- Flows from other parts of the facility will overwhelm attraction flows from the lift during much of the migration season causing fish to be unable to find the fishlift entrance.
- Spill from the north dam will cause false attraction to fish during much of the migration season.
- During higher flows, fish will move upstream along the river edges. Fish moving up the north edge would then need to move across the powerhouse to find the fishlift entrance. Fish moving up the south edge at high flows would need to move across a wide and deep jet of water from the downstream sluice to find a fishlift.

Moreover, the Weston impoundment is more than 11 miles long. This unnatural habitat favors warmwater predators of salmon smolts and the young of other of other anadromous species, making it difficult for juveniles to migrate downstream. The higher temperatures and reduced oxygen levels in this impoundment will also likely reduce survival of migratory fish.

For these reasons, DMR should clearly recommend the removal of Weston. Engineered fish passage at this facility, especially given Brookfield's unsuccessful record with fish passage construction and operation, is unlikely to succeed.

In addition, the Kennebec Coalition respectfully requests that DMR not take the results of the Normandeau downstream smolt passage studies at face value. DMR appears to do so on page 20 of the proposed amendment, although DMR did adjust these values based on the number of fish that pass within 24 hours. Again, the Kennebec Coalition contracted with Don Pugh to review these Normandeau studies as part of our comments on the Shawmut relicensing application to FERC. He concluded that the paired release methodology that Normandeau used in years 2013-2015 of its studies greatly inflates the number of smolts that appear to survive downstream passage and is inappropriate to use with such small sample sizes (paired release studies require approximately 1000 fish or more)[2]. Brookfield's calculation of overall smolt survival as a product of the survival at each individual dam also inflates overall survival because it does not account for the effects of the impoundments on smolt survival. The Kennebec Coalition contracted with Don Pugh to analyze these downstream studies for our August 2020 comments on the Shawmut license application. We have attached Mr. Pugh's analysis of these problems with the Normandeau studies in its entirely as Attachment B.

The Kennebec coalition also concurs with DMR that Brookfield's four dams do not generate sufficient electricity to justify the damage they do to what was once Maine's most productive river. As DMR has stated:

> While hydropower is an important resource for the State of Maine, the four lowermost projects in the Kennebec River, including the Shawmut Project, have a disproportionately large impact on

[2] Zydlewski, J., D. Stich and D. Sigourney. 2017. Hard choices in assessing survival past dams – a comparison of single- and paired-release strategies. Can. J. Fish. Aquat. Sci. 74(2): 178-190.

> the natural resources in comparison to their authorized capacity because of their location relative to spawning and rearing habitat… [3]
>
> The State of Maine supports domestic hydropower as an important component of energy in the State and a renewable source of energy critical to meeting climate goals. However, the State also believes that the best approach to meet our management goals for the Kennebec River is to decommission and remove some or all of the dams in the Lower Kennebec and is in the process of developing an amendment to the 1993 Kennebec Management Plan to submit to FERC as a comprehensive plan that will include dam decommissioning and removal.[4]

The four dams between Waterville and Skowhegan represent only six percent (46.9 MW out of 742 MW total[5])of Maine's overall hydroelectric capacity. Factor in Maine's 93 MW[6] of solar generation and its 923 MW of installed wind generation, and the percentage of renewable capacity of the four projects becomes smaller still. Moreover, Maine's solar generation capacity is expected to grow by an additional 1,128 MW over the next 5 years.[7] Even assuming that the capacity factor of the Kennebec dams is 67%[8] and only 15%[9] for solar, expected new solar generation capacity dwarfs the capacity of Brookfield's four Kennebec dams by about 5 to 1.

In conclusion, the Kennebec Coalition strongly supports DMR's proposed Kennebec River Management Plan and looks forward to DMR's submission of it to FERC as a Comprehensive Management Plan Amendment. The Kennebec Coalition also believes that DMR should strengthen the plan by recommending removal of all four dams between Waterville and Skowhegan. Brookfield and its predecessors have had 22 years to install effective fish passage at these dams and have made no meaningful progress in all that time. These archaic and damaging dams must go.

Sincerely,

Nick Bennett
Staff Scientist
Natural Resources Council of Maine, on behalf of the Kennebec Coalition

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[3] DMR. 2020. MDMR Response to the Ready for Environmental Analysis (REA) Preliminary Terms and Conditions, and Preliminary Fishway Prescriptions for the Shawmut Project (P-2322-069). August 28, 2020. P.5. Accessible at https://1drv.ms/u/s!AkLlihAdyxqVklBuZIG6A5l9pnd8?e=sWgbBm

[4] *Ibid.*, P. 2. https://1drv.ms/u/s!AkLlihAdyxqVklBuZIG6A5l9pnd8?e=sWgbBm

[5] Kleinschmidt Associates. 2015. Maine Hydropower Study. Prepared for Maine Governor's Energy Office. Tables 1-1 and 2-1. Accessed at https://www.maine.gov/energy/publications_information/001%20ME%20GEO%20Rpt%2002-04-15.pdf.

[6] Solar Energy Industries Association. Accessed at https://www.seia.org/state-solar-policy/maine-solar.

[7] *Ibid*.

[8] 2020. Kleinschmidt Associates. Brookfield White Pine Hydro LLC. Application for New License for Major Water Power Project – Existing Dam. Shawmut Hydroelectric Project (FERC No. 2322). January 30. P. B-2. Accessible at https://1drv.ms/u/s!AkLlihAdyxqVklBuZIG6A5l9pnd8?e=sWgbBm

[9] Energy Information Administration. Accessed at https://www.eia.gov/todayinenergy/detail.php?id=39832.

Attachment A

Project Review: Weston Hydroelectric Project (#2325)
Donald Pugh
1/18/21

Weston Project

Downstream passage

Downstream passage was evaluated with radio tagged smolts from 2012 to 2015. Radio tagged smolts were released approximately 2.0 miles above the project. The numbers of smolt arriving at the Weston project and detected at the telemetry stations below the project are from the study reports prepared by Normandeau Associates, Inc. [1234] (Tables 12-15 and Appendix A in the 2012 report and Appendices C in the 2013 to 2015 reports).

Fish that approached the project within approximately 250 meters were considered to have entered the project area. Monitors downstream of the project are used to assess survival. They were located 5.5 miles downstream in 2012 and 7.25 miles in 2013, 2014 and 2015. The number of fish at the downstream stations is the number detected plus fish not detected at that station but subsequently detected at multiple downstream monitors. The number of fish that arrived at the project and the percent of those that survived to the downstream monitor station is listed in Table 1. Downstream passage survival does not meet agency criteria.

Table 1. Number of fish released, that arrived at the Weston project, that were detected at the downstream monitoring station, and the percent that survived passage at the project.

Year	Released	Arrive at Dam	Survive	% Survive
2012	120	115	88	76.5
2013	102	100	88	88.0
2014	102	100	87	87.0
2015	102	98	87	88.8
		413	350	84.7

[1] Normandeau (Normandeau Associates, Inc.). 2013. Downstream passage effectiveness for the passage of Atlantic salmon smolts at the Weston, Shawmut and Lockwood projects, Kennebec River, Maine. Prepared for FPL Energy Maine Hydro LLC and The Merimil Limited Partnership.

[2] Normandeau (Normandeau Associates, Inc.). 2014. Evaluation of Atlantic salmon Passage at the Weston, Shawmut, Hydro Kennebec, and Lockwood Projects, Kennebec River and Brunswick Project, Androscoggin River, Maine, Spring 2013. Prepared for Brookfield White Pine Hydro LLC and The Merimil Limited Partnership.

[3] Normandeau (Normandeau Associates, Inc.). 2015. Evaluation of Atlantic salmon Passage at the Weston, Shawmut, Hydro Kennebec, and Lockwood Projects, Kennebec River and Brunswick Project, Androscoggin River, Maine, Spring 2014. Prepared for Brookfield White Pine Hydro LLC and The Merimil Limited Partnership.

[4] Normandeau (Normandeau Associates, Inc.). 2016. Evaluation of Atlantic salmon Passage at the Weston, Shawmut, and Lockwood Projects, Kennebec River and Pejepscot and Brunswick Projects, Androscoggin River, Maine, Spring 2015. Prepared for Brookfield White Pine Hydro LLC and The Merimil Limited Partnership.

Fish Lift

The proposed fishlift at the Weston project is located between the powerhouse and the downstream sluice. The entrance to the fish lift is where the 'Fish Lift' label is located in Figure 1. Attraction water is delivered by the structure to the right extending to the headpond and ending upstream of the fish lift entrance. The hopper dumps fish directly into the fish lift exit pipe which discharges fish into the head pond approximately 60 feet from the downstream sluice. [Dashed black lines are the coffer dam and turbidity curtain]

Figure 1. South Weston dam showing, from left to right, the powerhouse, proposed fish lift with the fish lift exit pipe, attraction water structure, downstream sluice, stanchion and concreate dam sections.

As a part of fish lift design, a CFD model was developed by the Alden Research Lab[5]. River flows of 2,500, 6,100, 11,200, and 20,300 cfs were modeled. Model results show high velocities at 11,200 and 20,300 cfs throughout the river downstream of the project. High flows will cause problems with fish moving upriver and finding the lift entrance with the multiple competing higher magnitude flows than the lift entrance (220 – 300 cfs). Downstream sluice flows of 2,500 cfs occur once river flows reach 8,500 cfs. Flow of 2,500 cfs from the downstream sluice produce a narrow high velocity stream

[5] Alden Research Lab, Inc. 2017. Hydraulic Modeling at Weston Hydroelectric Project (P-2325). 93 pgs.

extending to the footbridge and beyond (Appendix A[6]). Very high velocities across the river occur with flow of 11,200 cfs (Appendix A). These flows are exceeded 28% of the time May through June and over 40% of the time in May (Table 2). May and June are the months that alosids would be expected to pass at the Weston project.

Flow Exceedance

Flow exceedance at the Weston project was calculated for by combining the Madison gage on the Kennebec River with the Mercer gage on the Sandy River. The Sandy River enters the Kennebec approximately a mile below the Madison gage. May and June were selected for analysis as these are the months that alosids pass at the Lockwood project.

Table 2 lists the exceedance flows for full generation (6,000 cfs) plus 8% bypass flow, full generation plus full downstream bypass (2,500 cfs), the flow of 11,2000 cfs modeled in by the Alden Research Lab, and full generation plus full downstream bypass, plus one north dam Taintor (5,000 cfs) for the months of May, June and May and June combined.

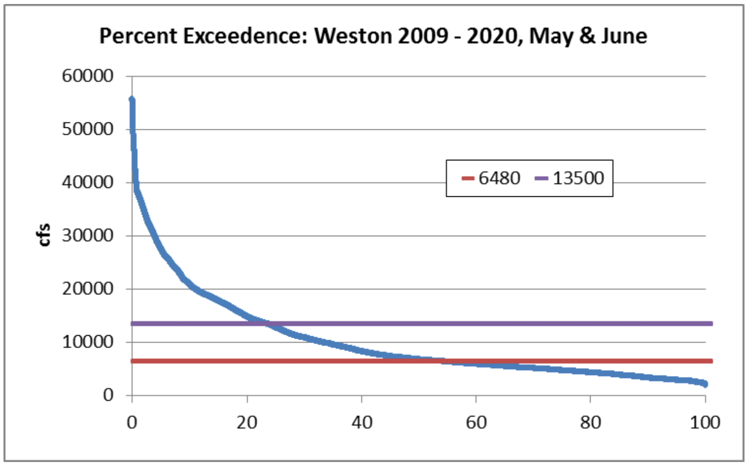
Figure 2 shows the percent exceedance for the years 2009 to 2020 and lines of 6,480 and 13,500 cfs, full generation plus 0.08% bypass flow and full generation plus full bypass flow plus one north dam Taintor respectively. [Madison gage data begins in 2009]

Table 2. Percent exceedance for flows at the Weston project (Madison and Mercer gages combined) for May, June and May and June combined, 2009 to 2020.

	Percent of Time		
Exceed cfs	May	June	May + June
6,480	64.0	38.5	51.4
8,500	52.3	24.6	38.7
11,200	40.4	15.7	28.3
13,500	34.3	11.2	22.9

Figure 2. Percent exceedance at the Weston project (Madison and Mercer gages combined) and flows of 6,480 and 13,500 cfs, 2009 to 2020.

[6] Appendix A is horizontal slices from Case 3 of the 2017 Alden Lab report. Case 3 models full generation, 2,500 cfs at the downstream sluice and 2,700 cfs spill at the north dam (total 11,200 cfs). Slices are at elevations 116, 118, 120, and 124 ft. Tailwater elevation is 125.3 ft.



Upstream fish passage

The primary problem with the fish lift at the Weston project is that the entrance to the lift is obscured during high flow. Full high flow in the downstream sluice and competing flow from the units will overwhelm attraction flow from the fish lift. At 8,500 cfs, all units will be a full capacity (6,000 cfs) and the downstream bypass will discharge 2,500 cfs. Appendix A shows those discharges combined with 2,400 cfs spill from the north dam. [8,500 cfs was not modeled] For the months of May and June, 8,500 cfs is exceeded 38% of the time and 11,200 cfs, the condition in Appendix A, is exceeded 28% of the time (Table 2).

Specific problems:

- Spill from the north dam creates flow on the opposite side of the river from the fish lift. Fish that move to the north dam have no means of passing upstream at that location. False attraction created by spill at the north dam will occur when river flow exceeds 8,500 cfs (38.7% of May and June, Table 2).
- Fish attracted to spill from the north dam that fall back will likely have difficulty finding the fish lift entrance as discharge from the units will be between them and the fish lift. Appendix A shows velocities of 4 – 6 ft/sec or greater across the powerhouse.
- Fish are likely to move upriver at the river's edge during high flow. Fish moving upriver on the north side (river left) need to move across the powerhouse discharge to find the fish lift entrance. River flow of 6,500 cfs, 4 units operating, occurs over 50% of the time in May and June (Table 2).
- At river flow of 8,500 cfs or greater, fish moving upriver on the south side (river right) need to cross a wide and deep high velocity jet from the downstream sluice to reach the fish lift entrance. Velocities with 2,500 cfs in the sluice are greater than 10 ft/sec and extend downriver past the footbridge creating a barrier to fish moving to the lift entrance (Appendix A).
- CFD study shows high flow (>6 cfs) dominate the center of the river at a river flow of 11,200 cfs with large areas with velocities >10 ft/sec.

- With whole river flow of 8,500 cfs (4 units plus 2,500 cfs downstream bypass) flows of greater than 10 ft/sec extend downstream past the footbridge (~475’). High velocities may result in fish not reaching the lift or being delayed.
- Entrance to lift is ~25 feet downstream of the downstream bypass flow and ~60 feet from the powerhouse discharge. Fish may bypass the lift entrance moving upstream into these flows.
- Attraction flow from lift of 220-300 cfs is likely to be hard to distinguish from flow from the units (each 1,500 cfs) and the downstream bypass at 8% of unit flow (480 cfs) resulting in delay in entering or not entering at all.
- The fish lift design incorporates a standard design for the crowder V-gates which has been shown at other projects to allow shad that have passed through the V-gate to then pass downstream and drop out of the fish lift.
- Fish lift exit pipe is over 150’ with one 90° sweep and two 90° bends. Fish dumped from the hopper will enter the pipe in all aspects (head up, head down or across) and may suffer injury or descaling.

Appendix A

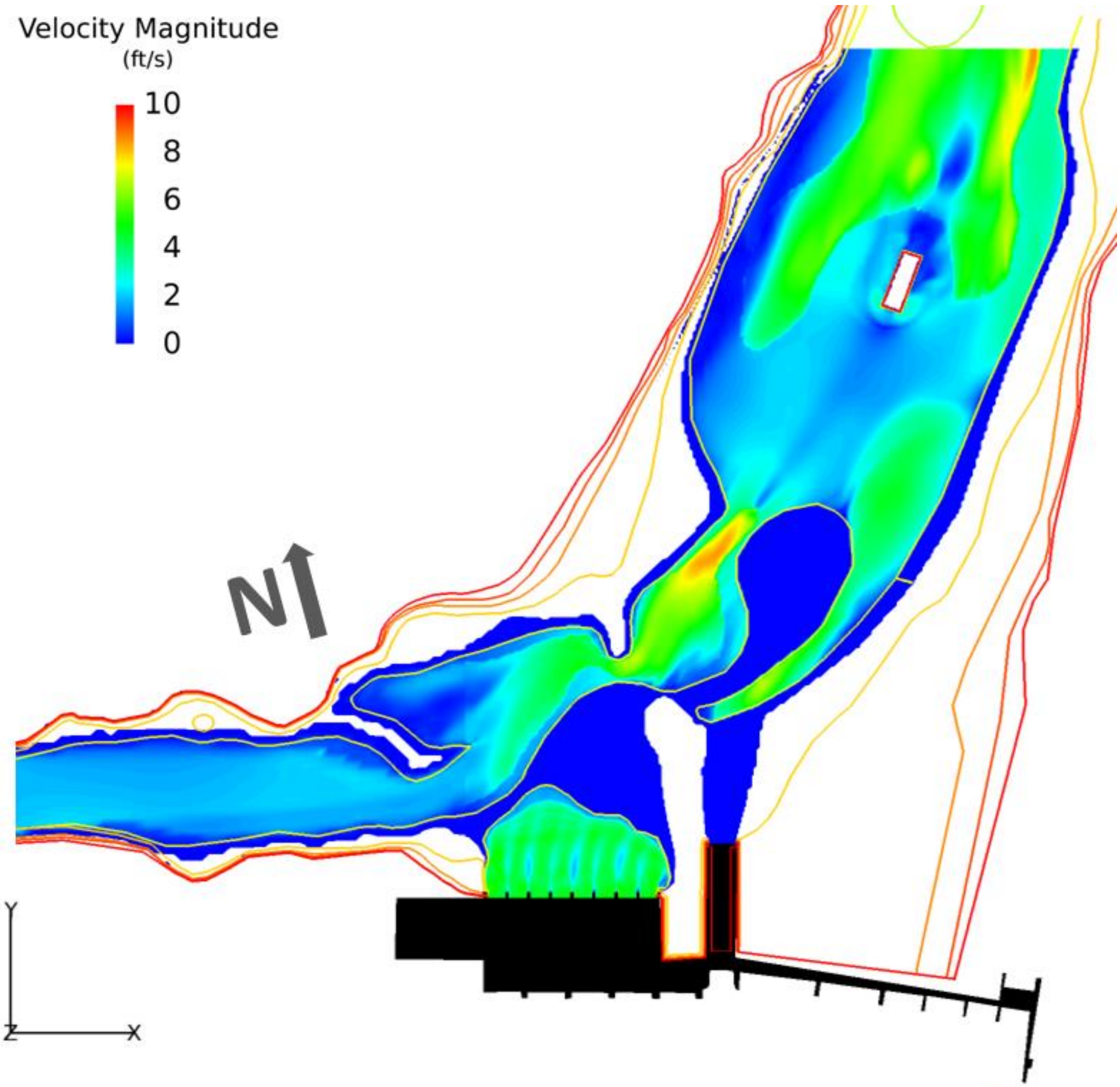


Figure E - 1 Velocity at Elevation 116' (Case 3)

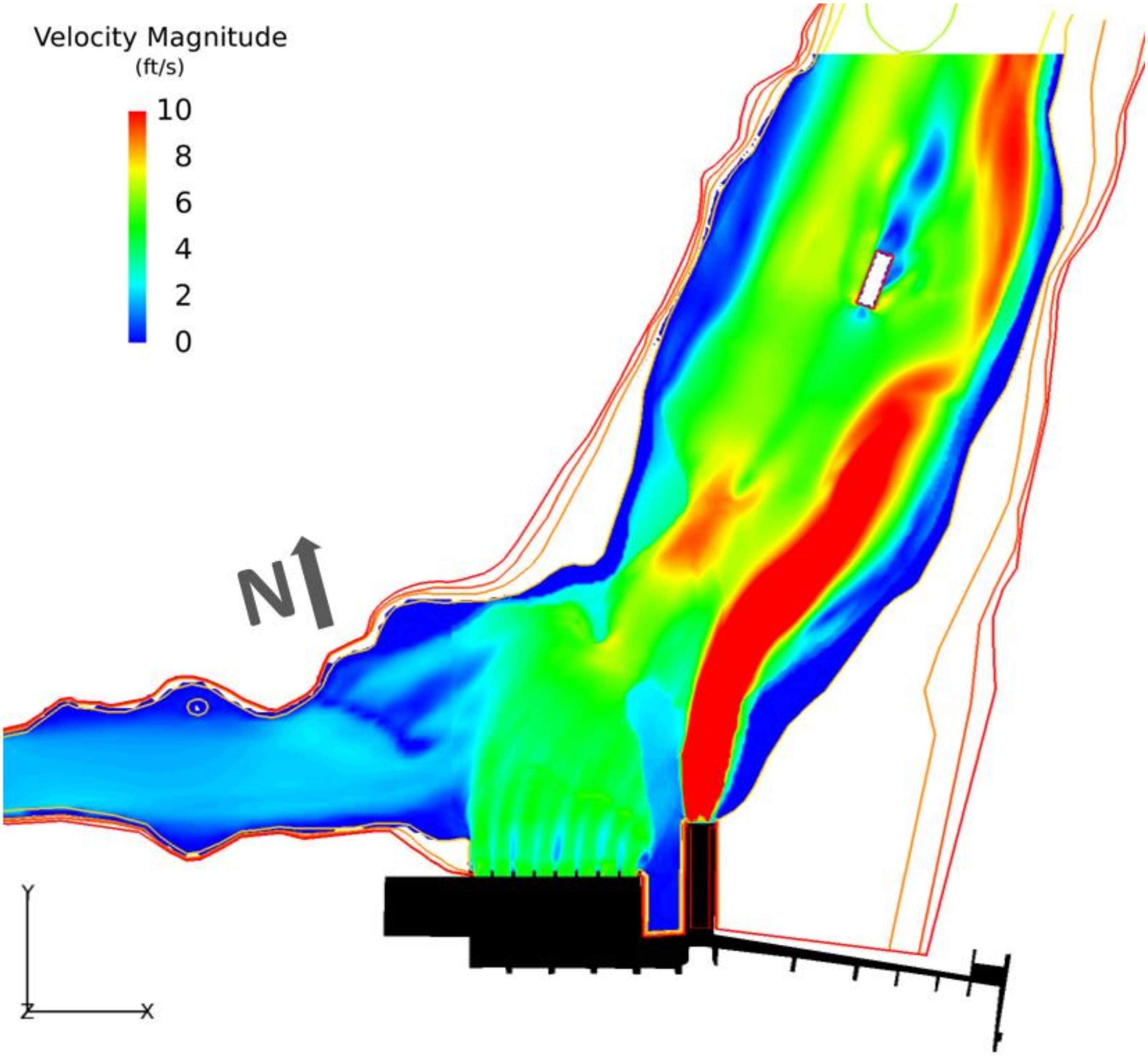


Figure E - 2 Velocity at Elevation 118' (Case 3)

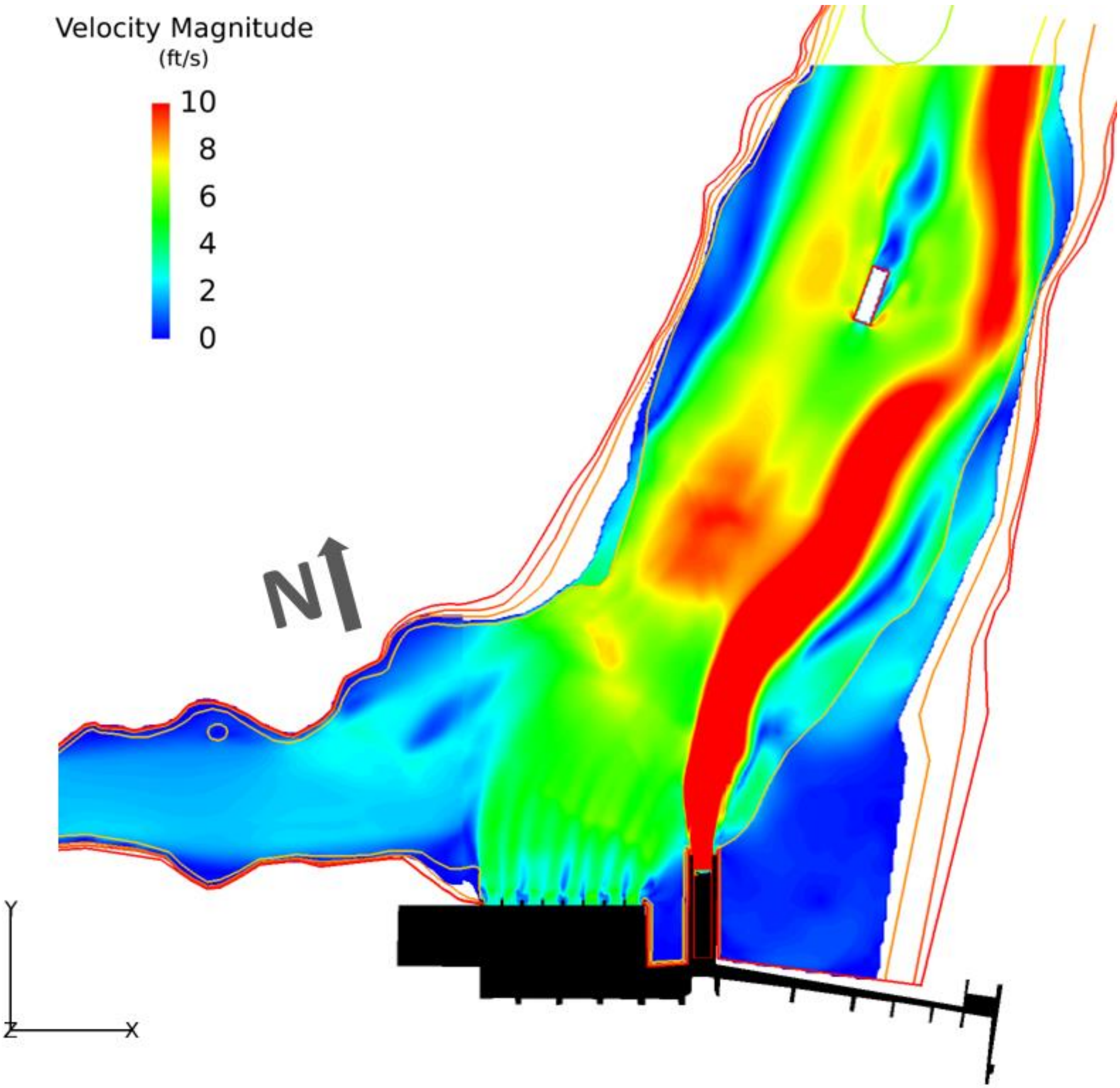


Figure E - 3 Velocity at Elevation 120' (Case 3)

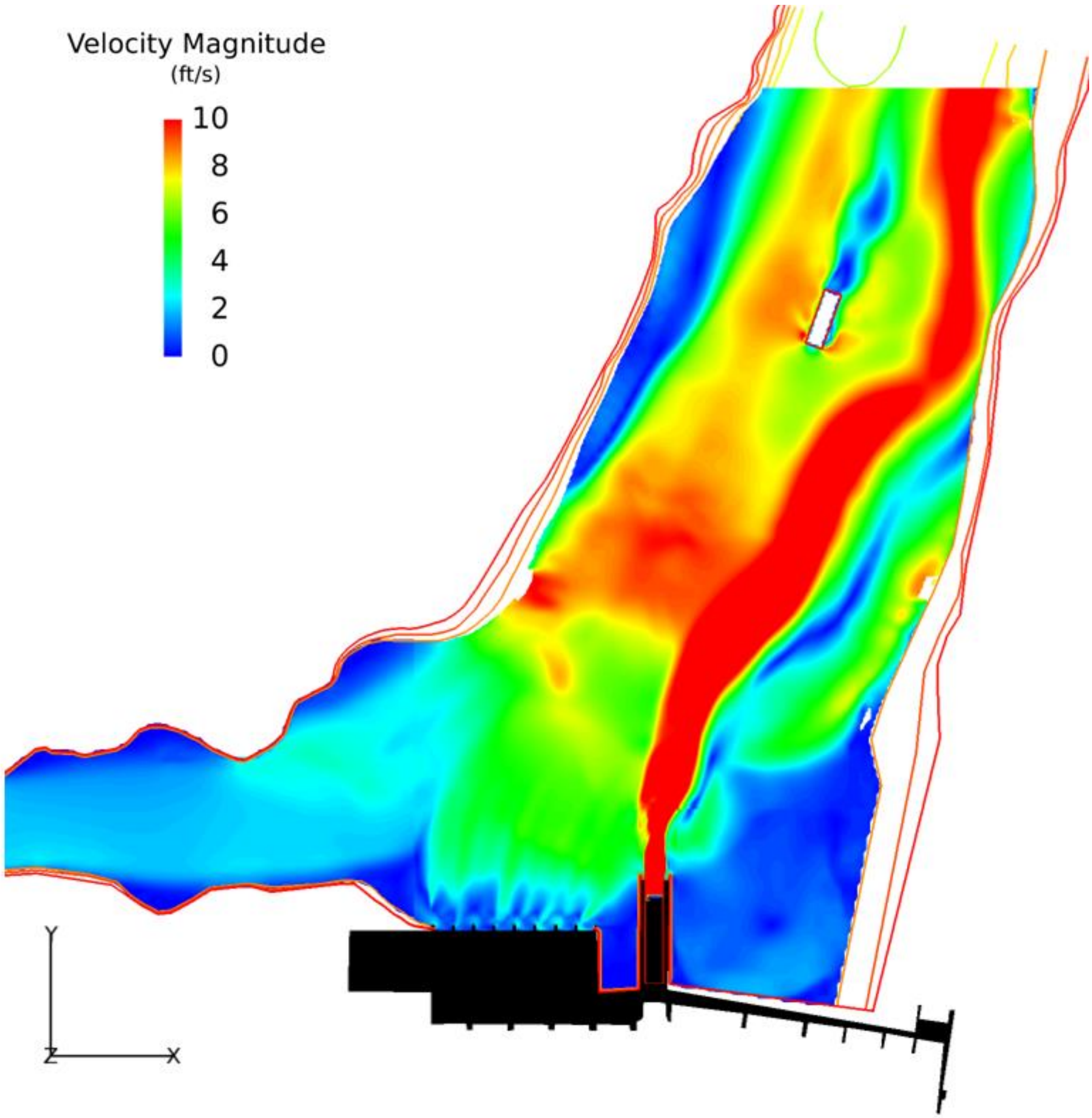


Figure E - 4 Velocity at Elevation 124' (Case 3)

ATTACHMENT B

D. There is no evidence that Brookfield's proposed fish passage at Shawmut would work effectively by itself or in combination with fish passage at the three other lower Kennebec dams.

i. There is no record of successful Atlantic salmon or American shad restoration involving engineered fish passage facilities at multiple large dams on large rivers.

Atlantic salmon are an endangered species in the Kennebec, and the first significant spawning and rearing habitat for these fish is in the Sandy River and its tributaries above the Weston Project's dam and impoundment. The Kennebec River above the Shawmut Project also has excellent spawning and rearing habitat for shad. There has been no successful Atlantic salmon recovery program where adult fish need to get above four dams to spawn and smolts need to pass downstream over or through four dams to reach the ocean. Salmon restoration efforts on the Connecticut River and Merrimack River based on engineered fish passage facilities at multiple large dams have failed spectacularly. On both these rivers and on the Susquehanna, shad restoration efforts based on engineered fish passage systems have shown similarly poor results.[47]

ii. Brookfield's assessment of downstream fish passage effectiveness for salmon is flawed.

Based on the results of salmon smolt studies conducted in 2012-2015, and a 2019 "desktop analysis" of improved downstream passage success from installing a guidance

[47] See Declaration of John Waldman [attached at FERC Accession No. 20171103-5100] [and submitted attached hereto with correspondence to Secretary Bose (FERC) from John Waldman, Queens College, CUNY dated August 27, 2020].

boom in the Shawmut forebay, Brookfield concludes that "[c]ontinued operation of the downstream passage facilities at Shawmut with the proposed modifications will provide out-migrating smolts with safe, timely and effective passage."[48] This finding relies on a very narrow definition of fish passage success that evaluates only passage from immediately above the dam to the dam tailrace, ignoring the impacts of the Shawmut Project's 12-mile-long impoundment, delayed mortality as fish move downstream from the Project tailrace, and the cumulative impacts of passing the Weston, Hydro-Kennebec, and Lockwood projects, in addition to Shawmut, as the fish migrate from the Sandy River to the ocean.

Atlantic salmon downstream smolt radio telemetry studies were conducted on the Kennebec River from 2012 to 2015. Analysis of fish that arrived at the Weston Project and were detected at the lowest telemetry station below the Lockwood project (end-of-pipe) showed a combined four-year, overall survival of 56.3%. Yearly survival varied from 30 to 70 percent (Table 1). For the years 2013 to 2015, an evaluation was of smolt survival specific to the Shawmut project showed a combined survival of 78.3% with yearly survival varying from 68 to 84 percent (Table 2).

Brookfield analyzed only passage survival at each dam. Whole river survival (end-of-pipe) is then calculated as the product of the four project's individual dam survivals. Aside from the problems of using a paired release analysis for dam survival, described below, this calculation neglects other project effects, primarily the impoundments behind the dams and the cumulative effect of multiple project passages.

[48] 2020. Kleinschmidt Associates. Brookfield White Pine Hydro LLC. Application for New License for Major Water Power Project – Existing Dam. Shawmut Hydroelectric Project (FERC No. 2322). January 30. P. E-4-72. FERC Accession No. 20200131-5356.

Whole river baseline survival, calculated from the 2013 to 2015 Normandeau reports, is 86.7%, 80.2%, and 85.0% respectively.[49] The estimates of fish passing four dams grossly overestimates the actual survival for fish passing four projects (Table 1).

Brookfield's claimed dam survival estimates for the Shawmut project of 96.3%, 93.6%, and 90.6%, average 93.5%,[50] similarly overestimate actual survival of fish that pass the Shawmut project. For fish released above Shawmut passing to the telemetry station above the Hydro-Kennebec, dam survival was much lower, 78.3%.

The numbers of smolt arriving at the Weston project and detected at the telemetry stations below the projects are from the study reports prepared by Normandeau Associates, Inc.[51] [52] [53] [54] Tables 12-15 and Appendix A in the 2012 report and Appendices C in the 2013 to 2015 reports list the number of fish that arrived at the

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[49] 2015 Hydro-Kennebec is estimated as 96.1%, average of 2013 and 2014.

[50] 2020. Kleinschmidt Associates. Brookfield White Pine Hydro LLC. Application for New License for Major Water Power Project – Existing Dam. Shawmut Hydroelectric Project (FERC No. 2322). January 30. P. E-4-52.

[51] Normandeau (Normandeau Associates, Inc.). 2013. Downstream passage effectiveness for the passage of Atlantic salmon smolts at the Weston, Shawmut and Lockwood projects, Kennebec River, Maine. Prepared for FPL Energy Maine Hydro LLC and The Merimil Limited Partnership.

[52] Normandeau (Normandeau Associates, Inc.). 2014. Evaluation of Atlantic salmon Passage at the Weston, Shawmut, Hydro Kennebec, and Lockwood Projects, Kennebec River and Brunswick Project, Androscoggin River, Maine, Spring 2013. Prepared for Brookfield White Pine Hydro LLC and The Merimil Limited Partnership.

[53] Normandeau (Normandeau Associates, Inc.). 2015. Evaluation of Atlantic salmon Passage at the Weston, Shawmut, Hydro Kennebec, and Lockwood Projects, Kennebec River and Brunswick Project, Androscoggin River, Maine, Spring 2014. Prepared for Brookfield White Pine Hydro LLC and The Merimil Limited Partnership.

[54] Normandeau (Normandeau Associates, Inc.). 2016. Evaluation of Atlantic salmon Passage at the Weston, Shawmut, and Lockwood Projects, Kennebec River and Pejepscot and Brunswick Projects, Androscoggin River, Maine, Spring 2015. Prepared for Brookfield White Pine Hydro LLC and The Merimil Limited Partnership.

Shawmut and Weston projects and that were detected below each of the projects, at the Hydro-Kennebec station, and at the lowermost telemetry station below the Lockwood dam. On behalf of the Kennebec Coalition, Donald Pugh[55] calculated survival as the number of fish detected at the lowermost telemetry station below Lockwood (Weston arrivals) or at the Hydro-Kennebec dam, divided by the number of smolts arriving at a project (Weston or Shawmut), times one hundred. Fish that are released above Weston encounter the Weston dam and the downstream projects similar to naturally outmigrating smolts. This estimate is conservative when compared to wild smolts as it does not include the impact of the Weston impoundment.

Table 1. Number of smolt arriving at the Weston project, number detected at the lowermost telemetry station below the Lockwood project and the percent survival for each of four years and the combined survival.

Year	Arrive Weston	Detected Lowest Station	%
2012	115	34	29.6
2013	100	70	70.0
2014	99	69	69.7
2015	98	59	60.2
All	412	232	56.3

[55] Mr. Pugh is a fish passage expert who has more than 20 years of fish passage experience and formerly worked on both up- and downstream passage at the S.O. Conte Anadromous Fish Research Laboratory.

Table 2. Number of smolt arriving at the Shawmut project, number detected arriving at the Hydro-Kennebec station and the percent survival for each of three years and the combined survival.

Year	Arrive Shawmut	Detected Hydro-K	%
2013	102	86	84.3
2014	100	82	82.0
2015	93	63	67.7
All	295	231	78.3

Brookfield proposes the whole river (end-of-pipe) survival as a multiplication of the immediate dam survival estimates at each project. Rather, an analysis of fish that pass all four projects provides a more accurate picture of smolt survival, as it accounts for project impacts in addition to dam passage. These impacts include increased water temperature in the impoundments[56] [57]; reduced migration speed through the

[56] Marschall, E., M.Mather, D.Parish, G.Allison, and J. McMenemy. 2011. Migration delays caused by anthropogenic barriers: modeling dams, temperature, and success of migrating salmon smolts.
Ecological Applications, 21(8), pp. 3014-3031.

[57] McCormick, S., D.Lerner, M.Monette, K.Nieves-Puigdoller, J.Kelly, and B.Bjornsson. 2009. Taking It with you when you go: how perturbations to the freshwater environment, including temperature, dams, and contaminants, affect marine survival of salmon. American Fisheries Society Symposium 69:195–214.

impoundments[58] [59] [60] [61] [62] [63]; increased predation in the impoundment and tailraces[64] [65] [66] [67]; and the cumulative impacts of injury during dam passage[68] [69]. Each of these impacts

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[58] Babin, A., M.Ndong, K.Haralampides, S.Peake, R.Jones, R.Curry, and T.Linnansarri. 2020. Migration of Atlantic salmon (*Salmo salar*) smolts in a large hydropower reservoir. Can. J. Fish. Aquat. Sci. https://doi.org/10.1139/cjfas-2019-0395

[59] Havn, T., E. Thorstad, M.Teichert, S.Saether, L.Heermann, R.Hedger, M.Tambets, O.Diserud, j.Borcherding, and F. Økland. 2018. Hydropower-related mortality and behaviour of Atlantic salmon smolts in the River Sieg, a German tributary to the Rhine. Hydrobiologia 805**,** 273–290.

[60] Holbrook, C., M.Kinnison, and J.Zydlewski. 2011. Survival of migrating Atlantic salmon smolts through the Penobscot River, Maine: a prerestoration assessment. Trans. Am. Fish. Soc. 140:1255–1268.

[61] Marschall, E., M.Mather, D.Parish, G.Allison, and J. McMenemy. 2011. Migration delays caused by anthropogenic barriers: modeling dams, temperature, and success of migrating salmon smolts.
Ecological Applications, 21(8), pp. 3014-3031.

[62] Norrgard, J., L.Greenberg, J.Piccolo, and M.Schmitz. 2013. Multiplicative loss of landlocked Atlantic salmon *Salmo salar* L. smolts during downstream migration through multiple dams. Rivers Research and Applications, Vol.29, no 10, pp. 1306-1317.

[63] Stich, D. M. Kinnison, J.Kocki, and J.Zydlewski. 2015. Initiation of migration and movement rates of Atlantic salmon smolts in fresh water. Can. J. Fish. Aquat. Sci. 72: 1–13.

[64] Blackwell, B. and F.Juanes. 1998. Predation on Atlantic salmon smolts by striped bass after dam passage. North American Journal of Fisheries Management 18:936–939.

[65] Jepsen, N., K.Aarestrup, F Okland, and G. Rasmussen. 1998. Survival of radio-tagged Atlantic salmon (*Salmo salar* L.) and trout (*Salmo trutta* L.) smolts passing a reservoir during seaward migration. *Hydrobiologia* **371/372:** 347–353.

[66] Havn, T., E. Thorstad, M.Teichert, S.Saether, L.Heermann, R.Hedger, M.Tambets, O.Diserud, j.Borcherding, and F. Økland. 2018. Hydropower-related mortality and behaviour of Atlantic salmon smolts in the River Sieg, a German tributary to the Rhine. Hydrobiologia 805**,** 273–290.

[67] Økland, F., Teichert, M.A.K., Thorstad, E.B., Havn, T.B., Heermann, L., Sæther, S.A., Diserud, O.H., Tambets, M., Hedger, R.D. & Borcherding, J. 2016. Downstream migration of Atlantic salmon smolt at three German hydropower stations. NINA Report 1203: 1-47.

[68] Holbrook, C., M.Kinnison, and J.Zydlewski. 2011. Survival of migrating Atlantic salmon smolts through the Penobscot River, Maine: a prerestoration assessment. Trans. Am. Fish. Soc. 140:1255–1268.

[69] Zydlewski, J., G.Zydlewski, and G.Danner.2010. Descaling Injury Impairs the osmoregulatory ability of Atlantic salmon smolts entering seawater. Trans. Am. Fish. Soc. 138:129-136.

can negatively affect survival. Outmigration must be considered as a complete movement past all four projects, not as the subset of only passage from the lower end of the impoundment to the base of a single dam. A direct analysis of smolt survival from arrival at the Weston project to detection below the Lockwood project accounts for these factors—and shows survival rates much lower than Brookfield reports.

Brookfield's analysis is further undermined by inappropriately using "paired release" analysis to determine survival in 2013, 2014, and 2015. The paired release analysis is designed to determine the 'natural', no dam in place, mortality from immediately above the dam to below it and adjust dam passage survival at the project to account for this 'natural' mortality. A paired release analysis is not appropriate for the Kennebec studies as the sample sizes were too low. Zydlewski et al. state that "…a paired release is generally not advantageous at release sizes less than 1000."[70] Multiple tables in the reports from 2013 to 2015 show a paired survival estimate greater than either survival for S1 or S2 (test release and tailrace release survivals) for both group releases and all releases combined for a project (e.g. 2013 - Tables 40, 41 & 46, 2015 - Tables 4-11 & 4-15). In essence the paired release calculation in these instances 'makes' fish. Table 4-15 (Weston 2015 whole station survival estimates) combined releases survivals for S1 and S2 are 0.888 and 0.850. The calculated paired release survival is 100.0% (S1 ÷ S2 * 100). Similarly, the 2013 report estimated Lockwood survival is 100% when both S1 and S2 are 0.95. In neither release did all fish survive yet the estimate is that all survived.

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[70] Zydlewski, J., D. Stich and D. Sigourney. 2017. Hard choices in assessing survival past dams – a comparison of single- and paired-release strategies. Can. J. Fish. Aquat. Sci. 74(2): 178-190.

The Kennebec presents a particularly egregious example of the impact of impoundments – the still waters created by dams. Between Lockwood and the confluence of the Sandy River, 85% of the river is impounded – nearly 30 river miles from the upper end of the Weston impoundment to the Lockwood dam. NMFS notes that impoundments constitute a serious risk to Atlantic salmon and states so clearly in its 2013 Biological Opinion:

> Impoundments created by these dams limit access to habitat, alter habitat, and degrade water quality through increased temperatures and lowered dissolved oxygen levels. Furthermore, because hydropower dams are typically constructed in reaches with moderate to high underlying gradients, significant areas of free-flowing habitat have been converted to impounded habitats in the Kennebec and Androscoggin River watersheds Coincidently, these moderate to high gradient reaches, if free-flowing, would likely constitute the highest value as Atlantic salmon spawning, nursery, and adult resting habitat within the context of all potential salmon habitat within these reaches. [71]

Brookfield's analysis of downstream fish passage effectiveness for salmon for the years 2012 to 2015 does not consider any of the above effects. Rather it is designed to assess survival merely from arrival to below the dam. For the four projects combined,

[71] National Marine Fisheries Service (NMFS). 2013. Endangered Species Act Biological Opinion, Amendment of the Licenses for the Lockwood (2574), Shawmut (2322), Weston (2325), Brunswick (2284), and Lewiston Falls (2302) Projects. July 19, 2013. Page 46 [FERC Accession No. 20130723-0012].

this is just over a half of a river mile, less than 2% of length of the four project's impact on smolts.

iii. Brookfield lacks evidence to show that the location of its proposed Shawmut fish passage facility is acceptable.

Although an express purpose of the ISPP was to allow Brookfield to study and test methods for passing fish at Shawmut and other dams, Brookfield has done almost nothing to study this issue since the ISPP went into effect in 2013 (it has now expired). Brookfield has selected the location and type of fish passage facility without evidence indicating where salmon or shad downstream of Shawmut would congregate below the dam. The single study on which Brookfield has apparently based the location of its proposed fishway was a one-time release of 150 tagged alewives in 2016.[72] Such a small study in a limited set of flow conditions does not provide adequate data on which to base the location of fish passage that must work for decades. Brookfield cannot point to any empirical evidence that the location and type of fish passage facility are appropriate for salmon and shad at Shawmut, and there is only extremely limited evidence for river herring. A similar lack of pre-construction study has had disastrous results at the Lockwood fish lift. That project does not pass shad[73] or salmon[74] adequately. Nevertheless, Brookfield has refused to take steps to provide effective fish passage at

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[72] 2020. Kleinschmidt Associates. Brookfield White Pine Hydro LLC. Application for New License for Major Water Power Project – Existing Dam. Shawmut Hydroelectric Project (FERC No. 2322). January 30. Pp. E-4-48-49; FERC Accession No. 20200131-5356.

[73] MDMR. Intervention letter from Commissioner Keliher to Secretary Bose, FERC (May 2, 2014) at 2 [FERC Accession No. 20140502-5080].

[74] Letter from Dan Kircheis (Acting ESA Fish Recovery Coordinator, NMFS Greater Atlantic Regional Fisheries Office) to Secretary Bose, FERC re NOAA Fisheries comments on the draft 2017 KHDG report (March 27, 2018) at 1 [FERC Accession No. 20180329-5166].

Lockwood since the construction of the "interim" fish lift in 2006. Brookfield has essentially no empirical evidence to support the construction of the Shawmut fish passage facility, and it has demonstrated at Lockwood that it would likely do nothing to remedy future fish passage failures at Shawmut.

iv. There are further questions about the proposed fish passage facility design at Shawmut.

As noted above, the Kennebec Coalition has consulted with Don Pugh, a fish passage expert who has more than 20 years of fish passage experience and formerly worked on both up- and downstream passage at the S.O. Conte Anadromous Fish Research Laboratory. He believes that the proposed attraction flow adjacent to the fish lift entrance could create a false attraction delaying both salmon and shad passage, particularly for fish moving across the face of the dam. The fish lift design incorporates a standard design for the crowder V-gates, which has been shown at other projects to allow shad that have passed through the V-gate to then pass downstream, contrary to the design plan to contain fish prior to lifting. Regarding the "fish ladder" portion of the proposed facility, designed to move fish attracted to units 7 and 8 to the tailrace of units 1-6, Mr. Pugh has expressed concern that shad would have difficulty navigating the turbulent tailrace waters. There are also questions concerning the ability for fish to find the "fish ladder" entrance. The ladder is expected to pass roughly 100 cfs. Adjacent to it, the taintor gate will pass 600 cfs for downstream fish passage. Units 7 and 8 each can pass