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May 25, 2023

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

Re: Offer of Partial Settlement; Turners Falls Hydroelectric Project (FERC No. 1889-081) and Northfield Mountain Pumped Storage Project (FERC No. 2485-063)

Dear Secretary Bose:

On March 31, 2023, FirstLight MA Hydro LLC, owner and operator of the Turners Falls Hydroelectric Project ("Turners Falls Project") and Northfield Mountain LLC, owner and operator of the Northfield Mountain Pumped Storage Project ("Northfield Mountain Project") (collectively, "FirstLight") submitted an offer of partial settlement for the conditions of relicensing of the Turners Falls Project and Northfield Mountain Project related to flows and fish passage ("Offer").

Pursuant to Rule 602(f) of the Rules of Practice and Procedure of the Federal Energy Regulatory Commission ("FERC" or "Commission"), the Connecticut River Conservancy ("CRC") submits the attached comments with accompanying affidavits in opposition to certain license conditions proposed in the Offer.

Thank you for the opportunity to provide these comments. If you have any question regarding this submission, please contact the undersigned at kwentling@ctriver.org or 413-834-9777

Kelsey Wentling (*pronouns: she/her/hers*)
River Steward, MA
Connecticut River Conservancy

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

	)	
FirstLight Hydro MA LLC	)	Docket No. 1889-000
	)	
Northfield Mountain LLC	)	Docket No. 2485-000
	)	

COMMENTS OF THE CONNECTICUT RIVER CONSERVANCY IN OPPOSITION TO OFFER OF SETTLEMENT

Pursuant to Rule 602(f) of the Commission's Rules and Regulations,[1] the Connecticut River Conservancy ("CRC") submits these comments and accompanying attachments in opposition to the offer of settlement ("Offer") filed in this proceeding on March 31, 2023, by FirstLight Hydro MA, LLC and Northfield Mountain, LLC ("Applicant"). The Offer relates to Flows and Fish Passage at Turners Falls Hydroelectric Project ("Turners Falls Project") and Northfield Mountain Pumped Storage Project ("Northfield Mountain Project") (collectively "Relicensing Projects"). For the reasons detailed below and in the attached affidavits, CRC objects to certain proposed license conditions in the Offer, and the Settling Parties have not met their burden to show that those terms are supported by substantial evidence.[2] Because CRC and many other commenters have raised genuine issues of material fact, the Commission should determine the Offer is contested.[3] Rule 602(h)(1)(i) of the Commission's regulations provides that the Commission may decide the merits of a contested settlement only if "the record contains substantial evidence upon which to base a reasoned decision or the Commission determines that there is no genuine issue of material fact."[4] Because the provisions to which CRC objects below are not supported by substantial evidence and CRC (and others) have raised genuine issues of material fact, the Commission should not accept the contested provisions and establish procedures to resolve contested issues.

Since 1952, CRC has been working to protect and restore the Connecticut River and its tributaries. CRC represents thousands of members across four states and, as the only nonprofit organization dedicated to protecting the entire Connecticut River ecosystem, our comments consider not only the localized impact of the Offer, but also the watershed-wide implications of the proposed license articles. CRC has been engaged in the relicensing of Turners Falls Project (FERC No. 1889), and Northfield Mountain Project (FERC No. 2485) for the entirety of the relicensing process. By

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[1] 18 C.F.R. § 385.602.
[2] *See Policy Statement on Hydropower Licensing Settlements*, FERC Docket No. PL06-5-000 (Sept. 21, 2006) at ¶ 5 ("("To support a proposed license condition, then, it is necessary for the parties to develop a factual record that provides substantial evidence to support the proposed condition . . .") (hereinafter "Settlement Policy Statement").. .").
[3] 18 C.F.R. § 385.602(f)(4) ("Rule 602(f)(4)").
[4] 18 C.F.R. § 385.602(h)(1)(i) ("Rule 602(h)(1)(i)").).

actively participating in the relicensing process, CRC advocates for the sustainable management of these hydropower facilities, balancing the need for renewable energy generation with the preservation and restoration of the Connecticut River's health and ecological integrity.

4.5.2 Term of New Project License

CRC objects to the issuance of a 50-year license, and the Settling Parties have not provided substantial evidence to support such a long license term. In 2017, FERC adopted a policy stance of defaulting to a 40-year licensee term. FERC noted that comments from resource agencies and environmental groups on this policy indicated opposition to a 50-year term: "Several resource agencies argue that this option would provide little incentive for a license applicant to voluntarily propose or agree to mitigation measures because such measures would no longer factor into the Commission's license term decision. The resource agencies also contended that such policy would result in applicants focusing their license application study efforts on disproving project effects rather than on identifying potential mitigation measures."[5]

In the 2017 policy statement, FERC established three criteria to help guide determination of the length of license terms: (1) coordination with other projects in the same basin; (2) agreed upon timeframes included in a comprehensive settlement agreement; and (3) "significant measures" expected in the new license. This final consideration is contingent upon the first, meaning that the license term must still be coordinated with other projects in the basin. The Settling Parties have not shown that any of these criteria support the imposition of a 50-year license term.

1) Coordination: CRC has been an active party to settlement negotiations throughout the Applicant's relicensing process as well as throughout concurrent relicensing of upstream hydropower projects Wilder Dam (P-1892), Bellows Falls Dam (P-1855), and Vernon Dam (P-1904). While CRC supports FERC's policy to issue coordinated license terms among the five facilities undergoing relicensing, such coordination does not support a 50-year license term for the Relicensing Projects or any of the upstream facilities. As described below under bullet 3), Great River Hydro has indicated that they are not seeking a 50-year license term, so a 50-year license term for the Applicant is not supported by FERC's 2017 policy.
2) Timeframes: None of the timeframes contemplated in the Offer support the imposition of a 50-year license term. The Applicant failed to submit a comprehensive settlement agreement by the extended deadline of March 31, 2023. Instead, the Applicant filed a settlement offer related to flows and fish but does not include provisions for recreation (other than paddling), erosion or cultural resources. So, while all of the timeframes related to the Relicensing Projects are not yet known, there is no reason to believe that any timeframes established in any future agreements will support a 50-year license term.
3) "Significant Measures": FERC is given discretion to determine the meaning of "significant" or "moderate" measures included in a license to determine the appropriate license term. Previously, "moderate" measures have included fish passage facilities, environmental mitigation, recreation flow releases and recreational development, as well as fish monitoring. The Applicant has not demonstrated that measures in the Offer rise above "moderate" so as

[5] Policy Statement on Establishing License Terms for Hydroelectric Projects, 82 Fed. Reg. 49502 (Oct. 26, 2017).

> to justify a 50-year license term. In previous decisions, it has also been determined that, because costs fluctuate substantially over time, "costs can provide some indication of the extent of required measures, [but] costs alone are never entirely dispositive."[6] Therefore, while costs may be considered in determining the length of the license term, they cannot be the sole determining factor. In considering the 50-year license term the Applicant has requested, FERC also must consider the commitments made by Great River Hydro for Wilder Dam, Bellows Falls Dam, and Vernon Dam so as to coordinate license terms across the five facilities. In August 2022, Great River Hydro submitted an Offer of Settlement Agreement.[7] *Table D-1* demonstrates that Great River Hydro anticipates a 40-year period, which is associated with "moderate" measures in FERC's policy statement. Great River Hydro indicates in this timeline that they believe the measures in their agreement across its three facilities should be considered "moderate" measures. Great River Hydro will be providing improvements for fish passage to three different facilities that affect over 175 miles of river, with comparable measures. The Applicant's license term request of 50 years is not justified.

In their Explanatory Statement, the Settling Parties provide no justification for the proposed 50-year license term, much less any reference to the substantial evidence required. Instead, the Commission is asked to accept the 50-year license term simply because the Settling Parties have agreed to it among themselves. *See* Explanatory Statement at 27 ("Where settling parties so request, it is the Commission's policy to defer to the settling parties."). Not only is this conclusory statement inconsistent with the requirement to support a license condition with substantial evidence, the Settling Parties cite, for their proposition, the Commission's Settlement Policy Statement "at P 15." *Id.* at n.15. It is unclear whether the citation to the Settlement Policy Statement is to page or paragraph numbers, but in either case, the citation does not support the Settling Parties' proposition.[8]

Finally, the Applicant has been operating on a series of annual licenses since the expiration of its current licenses five years ago in April of 2018. The overdue environmental benefits included in the Offer have been long-delayed and the Applicant has been allowed to operate according to archaic standards. In doing so, the Applicant has delayed the implementation of environmental measures and prolonged the stress that outdated license requirements inflict on the Connecticut River. In the current public comment period, members of local communities impacted by the Applicant's operations have repeatedly and ardently urged FERC not to grant a 50-year license. CRC likewise opposes a 50-year license term and believes that the new license term must reflect the reality of a rapidly changing climate and the uncertainty associated with climate-driven changes over the next several decades.

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[6] *Duke Energy Carolinas, LLC., v. Fed. Energy Regul. Comm'n.*, 883 F.3d 923, 927 (D.C. Cir. 2018) (quoting Duke Carolinas, LLC., 156 FERC ¶ 61,010 (2016)).

[7] Offer of Settlement between Great River Hydro, LLC and the U.S. Department of Interior et. al, (P-1892, P-1855, P-1904), *available at* https://elibrary.ferc.gov/eLibrary/filelist?accession_number=20220803-5124&optimized=false.

[8] Paragraph 15 of the Settlement Policy Statement relates to Dispute Resolution/Enforceability and page 15 deals primarily with establishing project boundaries. *See* Settlement Policy Statement at ¶ 15 & page 15.

Article A110 Minimum Flows Below the Dam

CRC opposes the proposed minimum 500 cubic feet per second (cfs) flow from the dam between July 1 to November 15. This proposed minimum flow fails to protect habitat for fluvial species and macroinvertebrates, does not protect existing and designated uses, and does not adequately address concerns about potential impacts to cultural resources for the approximately one-mile river segment below Turner's Falls Dam (TFD) before the river reaches Station No. 1.

<u>The proposed minimum flow of 500 cfs fails to provide sufficient habitat for fluvial species and macroinvertebrates.</u>

The *Final Massachusetts Integrated List of Waters for the Clean Water Act 2018/2020 Reporting Cycle* lists the Connecticut River below Turners Falls Dam (MA 34-03) as impaired partially due to dewatering and flow regime modification.[9] As a result of the impairments caused by the Turners Falls Dam, fish habitat and water quality have been degraded in this segment of river. Fish community identification and classification are integral to determining if Aquatic Life Uses are being met. A study of fish communities in New England found that the river segment below the dam had the lowest Index of Biological Integrity (IBI) score of all river segments in the study. *See* Affidavit of Julian Burgoff (hereinafter "Burgoff Affidavit"), ¶ 8. The study found that the addition of increased flows below Station No. 1 increased the IBI score in this reach and that lack of stable fish communities and habitat below the dam are due to dewatering of this segment. ¶ 8,9

The proposed minimum 500 flow severely limits available habitat for species in the reach below the Turners Falls Dam and above Station No. 1, thereby prolonging impairments by preventing the Aquatic Life Uses from being met.

Flows of 500 cfs allow for only 10% of maximum available habitat for macroinvertebrates, see attached Affidavit of Donald Pugh (hereinafter "Pugh Affidavit"), ¶ 7, and less than 27% for several fish species. *Id.* ¶ 6. CRC is particularly concerned with the flows necessary to provide habitat for longnose dace and tessellated darters. These are fluvial species that require constant flow for all stages of their life cycle. *Id.* ¶¶ 5,6. The Massachusetts Consolidated Assessment and Listing Methodology uses the abundance of fluvial species to assess the ecological health of river systems, and so the availability of habitat for these species provides key insights into the restoration of this river segment *Id.* ¶ 6. The proposed flows of 500 cfs will provide only 27% and 18% of available habitat for juvenile and adult longnose dace and only 22% of available habitat for juvenile and adult tessellated darter *Id.* ¶ 6 Similarly, of the available habitat in this reach, only a tenth will be available for macroinvertebrates to fully use; macroinvertebrates are a key component of the food web, providing a source of food for fish species *Id.* ¶ 7.

Increases in the proposed flows from Turners Falls Dam will provide more habitat for the fluvial species and work to partially restore the dewatered and impaired river segment below the dam and above Station No. 1. CRC reviewed the Instream Flow Incremental Methodology (IFIM) analysis in Study 3.3.1 for this section of the river, which provides a Weighted Useable Area (WUA) under

[9] Massachusetts Division of Watershed Management Watershed Planning Program, *Final Massachusetts Integrated List of Waters for the Clean Water Act 2018/2020 Reporting Cycle* at 168 (Nov. 2021), *available at* https://www.epa.gov/system/files/documents/2022-02/2018-2020-ma-303d-list-report.pdf.

various flows. With an increase of flow from 500 cfs to 1,400 cfs, WUA for juvenile and adult longnose dace increases by 54% and 51%, respectively, for a total of 81.7% and 69.4%. *See* Pugh Affidavit, ¶ 13, Table 1. Likewise, for tessellated darter, an increase from 500 cfs to 1,400 cfs provides 84.5% WUA, a 63% increase. *Id.* Finally, for macroinvertebrates, this increase would provide 26% more WUA for a total of 36.1% WUA. *Id.* ¶ 13

In addition to the insufficient aquatic habitat at the proposed flow, 500 cfs does not even fill the river such that water covers the riverbed from bank to bank. Aquatic habitat can also be assessed according to the Wetted-Perimeter method, which measures the availability of habitat in a given cross section. *Id.* ¶ 14. Analysis of Transect 11, a study site in Study 3.3.1 approximately 0.8 miles below Turners Falls Dam, indicates that at flows of 470 cfs roughly 35% of the transect is dry or insufficiently wetted. *Id.* ¶ 15. With an increase of flows to 1,670 cfs, the entire width of the river is wetted and available habitat for fluvial species. *Id.* ¶ 15, Figure 2. This is further supported by a photograph taken at flows of 1,500 cfs depicting flowing waters over nearly the entire river width, while a photo of flows at 400 cfs show areas of exposed bedrock, indicating limited aquatic habitat. *Id.* ¶¶ 16, 17, Figures 3, 4.

The proposed 500 cfs minimum flow between July 1 to November 15 will continue to cause impairments due to dewatering and fails to provide sufficient habitat for fluvial species and macroinvertebrates; these insufficient flows prevent the restoration of habitat for species that would otherwise occupy this stretch of the Connecticut River. *Id.* ¶¶ 8, 18; *see also* Burgoff Affidavit, ¶¶ 4–12.

<u>The proposed minimum flow of 500 cfs does not provide sufficient water levels for recreation.</u>

The proposed minimum flow of 500 cfs fails to support the existing and designated use of primary and secondary contact recreation in this segment because the water level is too low to support recreational boating. According to the Applicant's 2021 Boating Navigability Study, the proposed summer flow of 500 cfs is not considered navigable. The minimum navigable flow required is 545 cfs from Bascule Gate #1, 71 cfs from Fall River, and 560 cfs from Station No. 1 for a total of 616 cfs below Peskeomskut Island (measured) and 1,007 cfs below Station No. 1. There is no justification for the proposed summer flow of 500 cfs and given that the Boating Navigability Study indicated that flows above 500 cfs are the *minimum* for navigating a boat in this river segment, the minimum flows must be considerably higher to protect the existing use of recreation.[10]

<u>The proposed minimum flow of 500 cfs does not adequately protect cultural resources.</u>

Finally, CRC supports the comments of the Nolumbeka Project,[11] which explain that the proposed summer flow of 500 cfs is insufficient to protect cultural resources in the river below the dam to Rawson Island. In 2008, the Department of Interior determined that the Sacred Ceremonial Hill complex, found within the area of the Turners Fall airport, is a federally recognized ceremonial district, which includes a 16-mile radius around this site, encompassing the Connecticut River below

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[10] Boating Navigability Study Report Turners Falls Hydroelectric Project (No. 1889) (December 2021).

[11] Comment Filed By: The Nolumbeka Project, Inc on 5/25/2023

the Turners Falls Dam.[12] The 2008 determination[13] makes reference to the numerous indigenous groups who gathered in this area, and the ceremonial activities that took place in and along the river near Great Falls. These activities contributed to the presence of cultural resources and artifacts in the Connecticut River today. The Chaubunagungamaug Band of Nipmuck Indians, the Elnu Abenaki tribe and the Nolumbeka Project are active participants in the relicensing of these projects and have expressed concern that flows of 500 cfs will expose the riverbeds and so also expose artifacts in the riverbed. Using photos taken from the Boating Navigability Study, it is clear that both Rawson Island and Peskeomskut Island remain accessible by foot at the proposed minimum flow. The following two photos are taken from the Applicant's Boating Navigability Study depicting Flow #3, which released a total of 545 cfs from the dam.[14]

Photo 3-17: Rawson Island – Center Channel Entrance – Downstream View

[12] Shutesbury Historical Commission, *Introduction to Indigenous Cultural Sites in Shutesbury, Massachusetts* at 19 (Mar. 2021), *available at* https://www.shutesbury.org/sites/default/files/offices_committees/historical/Introduction%20to%20Indigenous%20Cultural%20Sites%20in%20Shutesbury.pdf.

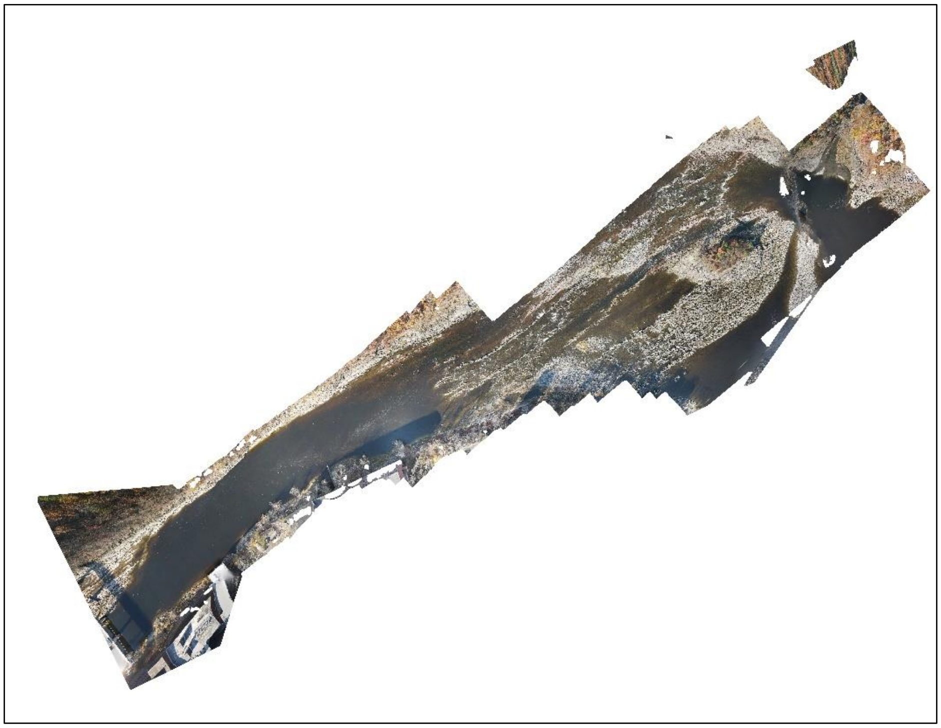
[13] United States Department of the Interior. 2008. "National Register of Historic Places Determination of Eligibility Comment Sheet: The Turners Falls Sacred Ceremonial Hill Site (Formerly, the Airport Improvement Project-Turners Falls Municipal Airport) Franklin Country, Massachusetts."

[14] Boating Navigability Study Report Turners Falls Hydroelectric Project (No. 1889) (December 2021).

Photo 3-05: Peskeomskut Island – Left Channel – North View

The two photos below, also taken at the flow of 545 cfs, provide an aerial view of the exposed riverbed at this flow. Maintaining water levels in the bypass that impede foot access to the riverbed is critical to protecting these artifacts and cultural resources. Through this comment, CRC would like to support the concerns expressed by Chaubunagungamaug Band of Nipmuck Indians, the Elnu Abenaki tribe and the Nolumbeka Project.[15]

[15] Comment Filed By: The Nolumbeka Project, Inc on 5/25/2023



Finally, in consultation with the Nolumbeka Project, it is CRC's understanding that a return to flows of a minimum of 1,600 cfs would allow for flows that would restore some amount of traditional fishing opportunity and ceremony for indigenous groups below the dam. CRC has not participated in negotiations related to culture resources, rather, through this comment, we support the concerns and priorities raised by participants representing cultural interests, who have indicated that a minimum flow of 1,600 cfs below the Turners Falls Dam is necessary to protect cultural resources in this area.[16]

CRC Notes a Discrepancy on page A-1 of Article A110

The table under Article A110, Minimum Flows below Turners Falls Dam, proposes minimum flows from April 1 – May 31 as 67% of the naturally routed flow (NRF) if the NRF is equal to or less than 6,500 cfs; this results in proposed flows of 4,355 cfs. When the NRF exceeds 6,500 cfs, the minimum flow is proposed to be 4,290 cfs. There is no explanation as to why there is a decrease in minimum flows when the NRF exceeds 6,500 cfs.

Article A120. Total Minimum Bypass Flows below Station No. 1

If the units used to maintain minimum flows from Station No. 1 become inoperable, the Applicant proposes to maintain the flow below Station No. 1 from the Turners Falls Dam Minimum Flow (dam or canal gate), Fall River, Turners Falls Hydro, LLC or Milton Hilton, LLC. There are three issues with this proposed condition. The first is that Fall River joins with Connecticut River below the Turners Falls Dam and is not a source of flow that the Applicant can justifiably consider in its

[16] Comment Filed By: The Nolumbeka Project, Inc on 5/25/2023

project minimum flow requirements. Second, in the Applicant's May 11, 2023, Response to FERC Additional Information Requests (Response to AIR), the applicant acknowledges that there is no agreement between the applicant and Turners Falls Hydro, LLC or Milton Hilton, LLC to release minimum flows from these sources. Since no agreement exists, this cannot be considered a viable option in a final license article. Third, the Applicant also acknowledges in the Response to AIR that it has no way to quantify flow from Fall River (which does not have a stream gage) nor either entity on the power canal, and so it has no way to know if these sources will meet the requirements for minimum flow below Station No. 1. Therefore, the Turners Falls Dam is the only viable backup to maintain flows below Station No.1. Accordingly, if Station No. 1 becomes inoperable, minimum bypass flows below Station No.1 must be calculated from the discharge from Turners Falls and not from Fall River, Turners Falls Hydro, LLC or Milton Hilton, LLC. The language in the article also states that the flows would come from the "Turners Falls Dam Minimum Flow," and it should simply read "Turners Falls Dam."

This condition is also included in Article A150, and CRC raises the same objects as stated above.

Article A150. Variable Releases from Turners Falls Dam and Variable Flow below Station No. 1

Variable releases described in Article A150 will enhance the experience of recreational boaters visiting the river. Footnote 2 under both *Variable Releases from Turners Falls Dam* and *Variable Flow Below Station No. 1* includes a list of stakeholders to be included in an annual meeting to determine the schedule for variable releases. CRC is the primary advocate for the Connecticut River watershed and the only NGO with a focus on increasing access to and stewarding the entire Connecticut River watershed. CRC regularly hosts public events on and along the river, as well as an annual volunteer day to rescue juvenile lamprey stranded in the power canal when it is dewatered for maintenance. We communicate with thousands of river users each year, relaying important information about river conditions. Therefore, it is critical that CRC be included in these scheduling meetings, and we request Article A150 be amended to include CRC under both footnotes, as well as the notification list for any temporary modifications described in the final paragraphs of this section.

Article A210. Flow Notification and Website

Provisions to report hourly data will increase the ability of boaters and visitors to the river to prepare for various flow conditions. Today, websites are a primary means of disseminating information, but this may not be the case throughout the life of the license. For example, previous documents for public comment have been made available to the public in hard copy at the Northfield Mountain Visitor's Center; such availability of a hard copy may be useful to an extent, but not nearly as accessible as online editions. As the Applicant has transitioned to making documents more easily accessible online, we may also expect that website access may decline in usefulness and accessibility over the life of the license. Language should be altered to reflect this uncertainty and include provisions to provide information on the website or the most used form of communication at the time. Likewise, Article A210 should be modified to require this information, and other educational and safety information, to be available in languages spoken predominantly in the region. This is in accordance with FEMA *Dam Safety Warning Signs Best Practices*.[17]

Article A190. Turners Falls Impoundment Water Level Management and Article B100. Project Operations

In Article A190 the Applicant proposes to maintain the existing Turners Falls Impoundment ("TFI") elevation range (measured at the dam) while, under Article B100, proposes to expand use of the upper reservoir. As discussed below, under the current TFI range, the Applicant's operations have resulted in TFI fluctuations which exacerbated erosion. When the Applicant pumps water up Northfield Mountain and lowers the TFI to its lower allowable limit, this also results in stranded boats in Barton Cove. With the proposed expanded use of the upper reservoir, CRC anticipates that the Applicant would be able to increase the volume of water being withdrawn and returned to the TFI and increase the frequency that the Applicant uses the full extent of the TFI elevation range. The proposed operating range for the upper reservoir would induce further erosion along the TFI streambanks and so do not uphold the obligation of the Applicant and of FERC to avoid and minimize impacts on the Connecticut River ecosystem. Therefore, CRC opposes conditions under Article B100, specifically the Applicant's provision to operate the Northfield Mountain Project between elevation 1004.5 and 920 feet NGVD29.

In the explanatory statement a. Article B100. Project Operations, the Applicant states that it intends to increase usable storage of the Northfield Mountain Project upper reservoir and that this increase will have, "no adverse environmental effects." This conclusion is predicated on the results of BSTEM erosion modelling conducted in Relicensing Study 3.1.2 (Study 3.2.1) and the 2022 Supplemental BSTEM Modelling Report (the Report). Following the release of Study 3.2.1, CRC contracted with Princeton Hydro to conduct a peer review of this study, which found that the Applicant's analysis overlooked several critical factors that contribute to streambank erosion. In particular, the peer review found that the study failed to consider the cyclical nature of streambank erosion and the relationship between hydraulic erosion at the toe of the bank and the resulting geotechnical failure, initiating a cycle of erosion along the streambanks of the impoundment. BSTEM analysis also failed to include how geotechnical conditions along the streambank would be altered if permanent vegetation was established on the bank. In addition to flaws with the BSTEM analysis, the peer review found that the analysis included data gaps (failure to include entire reaches of streambank) and that the extrapolation methodology included arbitrary thresholds that potentially bias the study. This peer review is attached to CRC's comments, see Attachment C.

Since the Relicensing Study 3.1.2, the Applicant has released supplemental BSTEM modelling reports intended to model existing and future operations but carried forward the flaws of the earlier Study 3.1.2; the reports continue to neglect basic principles of the erosion process. The reports also modeled proposed conditions under the Fisheries and Flow Agreement in Principle, which are included in the Offer. The reports use modeled conditions to determine the difference between current and future impacts of expanded upper reservoir use on streambank erosion. However, the

[17] Fed. Emergency Mgmt. Agency P-2188, *Dam Safety Warning Signs Best Practices: Prompting Public Awareness and Preventing Loss of Life* at 14-16 (Sept. 2021), *available at* ://www.fema.gov/sites/default/files/documents/fema_p-2188-dam-safety-warning-signs-best-practices.pdf.

reports solely draw on modeled conditions and not actual conditions, meaning that the baseline scenario used in the reports are not representative of real conditions. Finally, the BSTEM report provided by the Applicant in the AIR does not sufficiently describe how proposed operations will impact fluctuation in the TFI. As a result, the collective Reports fail to include any analysis of existing impacts from the Northfield Mountain Project and nullifies comparisons between the report and Study 3.1.2.

Further, a 1991 Army Corps of Engineers Study found that while shear stress contributes to erosion in the TFI, "the larger [Turners Falls] pool fluctuations and flow reversals caused by the present hydropower operation all contribute to the documented bank instabilities. It was noted that pool fluctuations, on the order of 5 feet, as experienced in the Turners Falls pool, are at least twice as destructive to banks as 1 to 3 foot fluctuations in other hydropower pools studied."[18] As a result of this study and the ongoing erosions issues in the TFI, the previous owners of the Northfield Mountain Project, as well as the Applicant, undertook streambank restoration efforts, most of which did not successfully withstand the continued erosive forces in the TFI; please see the comments of Michael Bathory and Maryanne Gallagher for further details on these efforts.[19] FERC has previously required the licensee to monitor, mitigate and repair areas of substantial erosion. At a minimum, these provisions must be carried forward into a new license.

The Applicant concludes in the Explanatory Statement (page 16) that, "the dominant causes of erosion would continue to be natural high flows at most locations and boat waves in the Barton Cove area." This conclusion, based on the results of Study 3.1.2 and the Report, is conditioned upon incomplete analysis and flawed methodology. The Applicant's assertion that boat wake is responsible for erosion speaks to its further culpability in intensifying the cycle of erosion, as it is the Turners Falls Dam and the increase in the TFI elevation for Northfield Mountain that create the conditions for motorboating in Barton Cove.

As CRC has noted on several occasions, the sections of the Connecticut River that make up the TFI are impaired Class B waters under CWA § 303(d), in part due to flow regime modification and streambank modification. Given the role the Northfield Mountain Project plays in eroding streambanks in the TFI, the proposed conditions for the expanding operating range are not justified. The operating regime of the last 50 years has allowed time for the streambank along TFI and Connecticut River to adjust, to some extent, to current operating conditions. An increase in this range to 1004.5 and 920 feet NGVD29 would instigate a new round of erosion along streambanks, bringing with it disastrous impacts for the ecosystem and local landowners along the river.

Under existing license conditions, the elevation range in which the Applicant manages the TFI leads to drawdowns that dewater Barton Cove and prevent boaters and anglers from accessing the river.

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[18] U.S. Army Corps of Engineers, New England Division (Corps). 1991. General Investigation Study, Connecticut River Streambank Erosion: Connecticut River - Turners Falls Dam to State Line, MA. July 1991.

[19] Comments of Michael Bathory, et al. re FirstLight Hydro Generating Company's Relicensing Application for the Northfield Mountain Pumped Storage Project under P-2485. Filing Description for Accession Number 20230504-5022. https://elibrary.ferc.gov/eLibrary/filelist?accession_number=20230504-5022&optimized=false

On several occasions between June 1, and August 31, 2007, Barton Cove was drained "down to mud" and the public boat ramp was inaccessible due to low water levels. CRC received numerous public concerns about the low water levels and contacted FERC and the Applicant about the TFI conditions leading to this lower water elevation in the cove. In response, the Applicant confirmed that they were operating in compliance with the license obligations to maintain water surface elevation between 176.0 - 185.0 feet and that the TFI never went below 177.5 NVGD.[20] Again, in June of 2021, the Applicant drew down the TFI within its licensed range, stranding boats in Barton Cove and inhibiting recreation on the river.[21,22] With the proposed expanded use of the upper reservoir, CRC anticipates that fluctuations in TFI elevation could become more frequent and use the allowable elevation range more fully than the Applicant has in the past; CRC is concerned that this would lead to a decrease in public access and recreation in the TFI.

CRC opposes the Applicant's proposed expansion of the upper reservoir due to the impact these increases will have in instigating further erosion and reducing public access to the Connecticut River due to excessive drawdowns in the TFI.

Article A300. Fish Passage Facilities and Consultation

CRC opposes the unnecessarily long timeframes proposed for the installation of upstream and downstream fish passage under Articles A300. Both upstream and downstream facilities will enhance the ability of migratory species to migrate throughout this portion of the Connecticut River, replacing the outdated and ineffective technologies that have created long-standing issues for migratory fish.[23] However, the Applicant has not sufficiently justified the timeframes proposed to construct these facilities nor the sequencing of prioritization of downstream facility construction before upstream facility construction. The Applicant's explanatory statement indicates that prioritizations of downstream facilities is aligned with the Connecticut River American Shad Management Plan; however, the plan does not include a stated preference for downstream prioritization and so cannot be used as justification for the proposed sequencing. *See* attached Affidavit of Edwin T. Zapel (hereinafter "Zapel Affidavit"), ¶ 4, Attachment D.

Additionally, the Applicant fails to justify why construction of both upstream and downstream fish passage cannot happen simultaneously. *See* Zapel Affidavit, ¶ 6.

The Offer acknowledges that improved fish passage is necessary to enhance shad passage and that, for the last 50 years, migratory fish populations have been prevented from reaching spawning

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[20] FirstLight Hydro Generating Co. Response to Letter of Sept. 6, 2007 from FERC Staff Regarding "Complaint on the Operation of the Northfield Mountain PS Project" (P-2485) at 1, (filed Sept. 27, 2007) *available at* https://elibrary.ferc.gov/eLibrary/filelist?accession_number=20071001-0084&optimized=false.
[21] FERC Alleged Noncompliance Response (P-1889-094) – Massachusetts/New Hampshire/Vermont Turners Falls Hydroelectric Project June 13, 2021 Low Impoundment Levels at 1 (filed June 23, 2021), *available at* https://elibrary.ferc.gov/eLibrary/filelist?accession_number=20210623-5086&optimized=false.
[22] Low water levels for parts of Connecticut River in Franklin County, WWLP (June 15, 2021) https://www.wwlp.com/news/local-news/franklin-county/low-water-levels-for-parts-of-connecticut-river-in-franklin-county/ (last visited May 23, 2023).
[23] Connecticut River Atlantic Salmon Commission, *Connecticut River American Shad Management Plan, Addendum – Fish Passage Performance* at 1–2 (Feb. 28, 2020), *available at* https://www.fws.gov/sites/default/files/documents/CRASC-Shad-Plan-and-Addendum-3_2_2020.pdf

habitat above the Turners Falls Dam due to the deficiencies of existing infrastructure. The inadequacy of the existing fish passage not only limits the mobility of migrating species, but also contributes to fish mortalities. Article A300 proposes to continue these conditions for 5-9 years after license issuance, at which point the Applicant will already have been operating under license conditions 5+ years expired. Simultaneous construction of upstream and downstream fish passage facilities is necessary to expeditiously restore shad populations that have been adversely impacted by antiquated infrastructure.

If sequencing were necessary for the fish passage construction, upstream passage would provide far greater benefit to American Shad by at least three orders of magnitude. Passing shad above Turners Falls Dam allows the species to recolonize habitat above the dam, which is not being fully used under current conditions. Shad reproduce readily and can rapidly colonize a new available habitat, meaning that an increase in spawning habitat above Turners Falls Dam will provide greater opportunity for successful reproduction. Upstream survival and spawning will increase the number of shad out-migrating, regardless of downstream survival rates, whereas downstream improvements will only serve to improve survival for the current population able to successfully pass Turners Falls Dam and spawn. *See* Zapel Affidavit, ¶¶ 6–8. The proposed timelines and construction sequencing in Article A300 are not grounded in the biology and behavior patterns of the shad population and the Offer lacks substantial evidence to justify the prioritization of downstream fish passage. *See id.* ¶ 21.

(a) CRC opposes the timeline for the Spillway Lift at Turners Falls Dam, which is proposed to be operational by Year 9. The proposed fish lift is modeled on existing infrastructure and the Applicant is not proposing a novel or emerging technology that will take a burdensome amount of time to design and construct. Design and construction of the Spillway Lift, which is similar to fish lifts in other river systems, could be completed within a much shorter time period, as few as 4 to 6.5 years. *See* Zapel Affidavit, ¶¶ 10–11, 20.

(b) CRC opposes the timeline for rehabilitation of the Gatehouse Trapping Facility, which is proposed to be operational by Year 9. No new structures are proposed to be installed and the Applicant does not provide substantial evidence or otherwise justify the excessive length of time to complete this activity, given that the majority of the work will be to upgrade existing infrastructure. *See* Zapel Affidavit, ¶ 12.

(f)(g) CRC opposes the timeline for rehabilitation of the Cabot Station trashrack structure, which is proposed to be operational by Year 4. In similar projects that include replacing and upgrading an existing trashrack, design and implementation took approximately one year. With additional agency input into design, the process may take longer. However, the applicant fails to justify why the design and installation would take longer than three years. *See* Zapel Affidavit, ¶ 15. Similarly, CRC opposes the timeline for rehabilitation of the Station No. 1 bar rack, which is proposed to be operational by Year 4. As with the Cabot Station trashrack, the Applicant has not provided substantial evidence that design and implementation should take four years. *See* Zapel Affidavit, ¶ 16.

(h) CRC opposes the timeline for the Turners Falls Dam plunge pool, which is proposed to be operational by Year 9. The plunge pool construction is proposed to be done in conjunction with the fish lift. As previously described, the timeline for fish lift is not supported by substantial evidence or otherwise justified and therefore the plunge pool construction can likewise be completed on a much faster timeline. *See* Zapel Affidavit ¶17.

Article A310. Schedule of Initial Effectiveness Testing, Consultation Process on Effectiveness Testing Study Plans, and Fish Passage Performance Goals and Article A320. Downstream Fish Passage- Initial Effectiveness Studies, Adaptive Management Measures and Subsequent Effectiveness Studies

CRC's comments on Article A310, A320 and A330 refer to the proposed Years for Adaptive Management Measures "(AMM") as described in the Offer. However, as discussed above, since the proposed timelines for fish passage construction are unnecessarily long, the timelines for AMMs should be adjusted accordingly.

Depending on the quarter in which the final license is issued, the Applicant proposes to conduct a shakedown year for the Station No. 1 rack and Cabot Rack either in Year 4 or Year 5 after License issuance. For all other fish passage construction projects, the Applicant proposes to complete installation and the shakedown year within the same year or season; this should also be the case for the Station No. 1 rack and Cabot Rack.

Initial effectiveness studies to evaluate the Station No. 1 rack and Cabot Rack are proposed to happen in Years 6 and 7 with final reports by February 1 of Years 7 and 8 for adult shad, and juvenile shad and adult eel, respectively. The Applicant does not explain why reporting will take longer for juvenile shad and adult eels and CRC disagrees that downstream passage reporting would reasonably take between 1-2 full years. Additionally, it is unclear why no AMM effectiveness testing is done in Year 9. Effectiveness testing could begin in the same year that the Round 1 AMMs are implemented; this applies to further rounds of effectiveness testing for AMMs in Years 12, 13 and 17.

For the Turners Falls Dam Plunge Pool, initial effectiveness testing is proposed in Year 10 – 11 and Round 1 AMM effectiveness testing is proposed in Years 14 and 15. Round 1 AMMs include modifying the bascule gate setting and resultant spill. Essentially, this includes increasing the minimum flow and the bascule gates from which flow is provided; this AMM can be implemented at any time without significant effort on the part of the Applicant, so it is unclear why this would not happen in Year 12 and 13.

Article A330. Upstream Fish Passage Initial Effectiveness Studies, Adaptive Management Measures and Subsequent Effectiveness Testing

For upstream fish passage, Tier 2 AMMs are proposed to be implemented in Years 15 and 16 with a shakedown year in Year 17. For most of the proposed fish passage measures, the shakedown year takes place within the same year of construction or modification. The Applicant does not justify the need for an additional year to implement Tier 2 AMMs. The Applicant proposes that all AMMs and reporting will be completed by Year 20 and that state and federal agencies may not proposed new AMMs until Year 25, creating a 5-year gap between the end of reporting and the beginning of any new possible AMMs. CRC strongly objects to this condition, as explained at the end of this section.

The Connecticut River Shad Management Plan sets the following upstream Fish Passage Performance Criteria for adult and juvenile shad for hydroelectric projects in the Connecticut River basin:

- Upstream adult passage minimum efficiency rate of 75%, based on the number of shad that approach within 1 kilometer of a project area
- Upstream adult passage time-to-pass (1 kilometer threshold) is 48 hours or less[24]

The performance goals outlined in Article A310 comply with these objectives. However, under Article A330, the Applicant proposes that after Tier 1 and Tier 2 AMMs have been implemented, if the performance goal of 75% passage within 48 hours is still unmet, but fish passage efficiency is only 65% within 60 hours, the regulatory agencies forfeit any reserved or regulatory authority to require any further fish passage measures or operational changes. This proposed condition disregards the objectives defined in the Connecticut River Shad Management Plan, which are grounded in the most recently available science related to shad migration in the Connecticut River. The management plan is supported by "... advances on shad population status and dynamics, physiology and energetics, reproduction, movement/behavior, fishway use/passage, fishway design/modification, and both fishway and facility operation and flow management."[25] Clearly, the objectives laid out in the management plan are derived from a scientific perspective, yet the Applicant provides no ecological or scientific justification for lowering overall passage efficiency to 65% within 60 hours. If the Applicant cannot meet the performance targets outlined in Article A310, then the Applicant must be required to include additional AMMs that incorporate advances in technology or change its operations to meet the proposed fish passage goals of passage minimum efficiency of 75% within 48 hours.

CRC strongly opposes the condition under Article A320 and A330 that resource agencies are not permitted to exercise their reserved or regulatory authority regarding downstream and upstream passage in the first 25 years of the license. Massachusetts Division of Fisheries and Wildlife ("MDFW"), National Marine Fisheries Service ("NMFS") and U.S. Fish and Wildlife Service ("USFWS") have an obligation to protect the natural resources in the Connecticut River. As new technologies evolve and data become available from effectiveness testing, these agencies must have the ability to draw on their regulatory authority to ensure that the Applicant is meeting necessary criteria to enhance and protect species in the Connecticut River.

Article A350. Fish Passage Facilities Operation and Maintenance Plan

Article A350 describes the implementation of a Facilities Operations and Maintenance Plan (FOMP), which will include details of fish operations and maintenance activities. This will include an annual report submitted to resource agencies and will be drafted in consultation with these agencies. CRC is the sole and primary NGO advocating for the continued conservation and restoration of the entire Connecticut River watershed. As a part of this work, we run numerous programs, in coordination with the U.S. Fish and Wildlife Service and state agencies, to collect data on migratory

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24 Connecticut River Atlantic Salmon Commission, *Connecticut River American Shad Management Plan, Addendum – Fish Passage Performance* at 1–2 (Feb. 28, 2020), *available at* https://www.fws.gov/sites/default/files/documents/CRASC-Shad-Plan-and-Addendum-3_2_2020.pdf.

25 Connecticut River Atlantic Salmon Commission, *Connecticut River American Shad Management Plan*, at 3.

fish species in the river. Our programs to monitor fish species and restore their habitat are done in coordination with hydropower operators throughout the watershed, including Holyoke Gas & Electric, where we hold a seat on the cooperative consultation team (CCT). We request that Article A350 be amended to include CRC in these processes and communications.

Article A400. Bald Eagle Protection Plan

CRC supports the measures included in the Bald Eagle Protection Plan, but we do not believe these measures adequately protect the species. The dams create pond-like conditions in the impoundment, which are well suited for the proliferation of invasive aquatic plants.[26] In the TFI, a particular concern to the survival of bald eagles is *Hydrilla verticillata* (hydrilla), which is an invasive plant that forms dense stands that crowd out natural vegetation, alter the chemistry of the water[27] and are proven to host a cyanobacterial neurotoxin that is deadly to bald eagles. A study of mass mortality of bald eagles in the southeast United States found that hydrilla and treatment of hydrilla are the causes for these mass bald eagle mortalities and that increased awareness and monitoring should be implemented.[28] Hydrilla, first found in the lower Connecticut River watershed in 2016, has spread rapidly throughout the lower watershed, now covering well over 700 acres of the Connecticut River watershed.[29] While hydrilla has not yet been observed in the Connecticut River north of Agawam, its transport mechanisms (fragmentation, transport via boat/trailers) indicate that it is likely to travel readily throughout the watershed unless more aggressive monitoring and prevention is undertaken. The Applicant, in its operation of Turners Falls Dam, maintains conditions that are extremely conducive to the proliferation of hydrilla in the TFI. Specifically, the pond-like conditions created by the Turners Falls Dam, paired with increased motorboat access because of these conditions, make the TFI a likely location for the introduction of hydrilla. Due to the conditions maintained by Turners Falls Dam and the potential impact of toxins on bald eagles, the proposed bald eagle protection plan does not sufficiently account for the known threats to the health of the population in the Connecticut River corridor.

Article B200. Fish Intake Protection and Consultation

Article B200 indicates that the intake barrier net will be in place from June 1 – November 15. Initially, the Amended Final License Application proposed a shorter installation period of August – November due to concerns about the impact of the Northfield Mountain Project's operation on out-migrating fish species. Article A340 indicates that the Applicant will operate downstream passage from April 4 – November 15; the installation of the barrier net should be expanded to match the stated out-migration period under A340. There is no explanation of why it should be limited to the proposed timeframe.

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[26] Johnson, P.T., Olden, J.D. and Vander Zanden, M.J. (2008), Dam invaders: impoundments facilitate biological invasions into freshwaters. Frontiers in Ecology and the Environment, 6: 357-363. https://doi.org/10.1890/070156

[27] https://www.nae.usace.army.mil/Missions/Projects-Topics/Connecticut-River-Hydrilla/

[28] Steffen Breinlinger et al. (2021). Hunting the eagle killer: A cyanobacterial neurotoxin causes vacuolar myelinopathy. Science, 371: 1-7. https://www.science.org/doi/10.1126/science.aax9050.

[29] Hydrilla in the CT River Watershed, .

Additionally, CRC opposes the timeline for the installation of the Northfield Mountain Project intake barrier net, which is proposed to be operational by Year 7. While CRC is concerned about the shortcomings of the barrier net, described in our comments below, it will provide some relief to species out-migrating past the Northfield Mountain Project intake. However, the proposed timeframe is unjustified and far too long, meaning that benefits to the species of concern will not be felt for nearly a decade. At a pumped storage facility in Michigan (P-2680), a recent FERC license required the replacement of part of the barrier net, totaling over 4,000 linear feet of barrier net. The barrier net at Ludington (P-2680) is far larger than the proposed net at the Northfield Mountain Project (roughly 1,000 ft). While the Northfield barrier net will need to undergo design specific to the facility, the installation of the Ludington panels within the first year of the license demonstrates the feasibility of installing the barrier net long before year 7 of the license. Likewise, very large barrier nets at the Shannon-Lower Banker Lake hydropower facility in NW Washington State were designed and installed within three years of license issuance, even though those nets were much deeper and the reservoir experiences much more significant water level variations than at the Northfield Mountain Project. *See* Zapel Affidavit, ¶ 19. If design begins upon license issuance, it can be completed within a year and installed in the following two years, as has been done at facilities with greater water level fluctuation. *See id.* ¶¶ 19, 23.

The results of the 2016 Relicensing Study 3.3.20, which were updated in the 2017 Addendum to reflect the impact of potential expanded operations, indicate that annual operations of the Northfield Mountain Project operations will result in the entrainment of 1,296 juvenile shad, 175 adult shad, 3 million shad eggs and 500,000 shad larvae (the mortality of shad larvae and eggs are not updated from the 2016 study).[30] The Applicant acknowledges the premature mortality its facility inflicts on the local shad and fish populations but does little to prevent and mitigate this impact.

The Applicant field tested several 2 x 2 ft. net panels in 2018 to investigate the amount of "debris loading and biofouling," at three different depths, that may clog up the open spaces in the net.[31] These nets were deployed between August 1 and November 15, which is the original proposed season; the Applicant now proposes to extend the net installation from June 1 to November 15, which is a duration that has not been tested. Different sets of screens were pulled at different time intervals and lab-tested for drag. The report from Alden Labs (2019)[32] indicated that drag increased at the top of the screen the longer the screen had been in the water. Alden also modeled the velocities at the net (a concern for impingement of fish) but used Connecticut River flows of 5,000 cfs called "low" in the study; 30,000 cfs called "medium"; and 50,000 cfs called "high." The Pre-Application Document (PAD) demonstrated that between the months of June and November, in most of these months, 30,000 cfs and 50,000 cfs are so high that they are not even on the flow duration curves and are not representative of typical conditions. (see Figures 4.3.1.2-19 to -21 in the

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[30] Ichthyoplankton Entrainment Assessment at the Northfield Mountain Pumped Storage Project Addendum 1 (July 2017).
[31] Northfield Mountain Generation Station CFD Modeling for Fish Exclusion Net Forces Alden Report No. : 1175QNorthfieldNet (January 2018)
[32] Northfield Mountain Generation Station (FERC No. 2485), CFD Modeling for Fish Exclusion Net Forces Alden Report No. : 3184NMPSPBN (June 2019)

PAD).[33] Moreover, the water elevation for the 5,000 cfs flow was modeled at 179 ft. and 181.4 ft. at the Northfield Mountain tailrace, an elevation that is exceeded at least 95% of the time according to PAD Figures 4.3.1.3-13 through -18.[34] Therefore, the barrier net study never modeled any flow and elevation conditions that actually represent conditions for the time of year the net will be deployed. It is unclear if fish will be impinged against the net during pumping operations, then spit back out during generation operations. It's unclear how long the net will withstand field conditions, and how holes in the net would ever be found and fixed mid-season.

For this reason, it is critical that the barrier net be accompanied by AMMs that include alternatives to the barrier net as the sole mechanism to prevent fish entrainment.

Article B210. Initial Intake Protection Effectiveness Testing and Fish Passage Performance Goals

The Applicant proposes to install the Northfield Mountain Project barrier net in June of Year 7, which would include a shakedown year, with initial effectiveness testing in Year 10 and Year 11. The Applicant does not include an explanation for the two-year gap between the shakedown year and the beginning of effectiveness testing; this testing should begin the season immediately following the shakedown year.

Article B220. Downstream Fish Passage- Initial Effectiveness Studies, Adaptive Management Measures and Subsequent Effectiveness Studies

For Article B220, CRC refers to the Years for AMM implementation as described in the Offer; however, given the unnecessarily long timeframe proposed for fish passage installation, the AMMs should likewise be modified accordingly. Article B210 indicates that reporting on initial effectiveness testing will be complete by April of Year 12, yet Round 1 AMMs are not implemented until Year 14. The proposed AMMs include altering the arrangement and size of the net panels and modifying maintenance practices; these changes do not merit the proposed gap between initial effectiveness testing and Round 1 AMMs.

The AMMs described in license Article B220 propose very little in the case that the performance targets in Article B120 are unmet. The two AMMs noted in the Offer are to alter the arrangement and size of net panels and improve maintenance measures for the net. Barrier nets for pump storage hydropower have been in use for decades, offering examples of operating and maintenance procedures.[35] The AMMs defined in the Offer are activities that should be integrated into the Fish Passage Facilities Operation and Maintenance Plan (FOMP) for the barrier net, as described in Article B240 and are not sufficient as stand-alone AMMs.

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[33] Pre-Application Document For The Turners Falls Hydroelectric Project (No. 1889) and Northfield Mountain Pumped Storage Project (No. 2485) (October 30, 2012).

[34] Pre-Application Document For The Turners Falls Hydroelectric Project (No. 1889) and Northfield Mountain Pumped Storage Project (No. 2485) (October 30, 2012).

[35] Ludington Pumped Storage Project Fish and Aquatic Resources Study Phase 2 Report Evaluation of Entrainment Abatement at Sections 4.2 – 4.3. https://www.consumersenergy.com/-/media/CE/Documents/company/ludington/ludington-pumped-storage-project-initial-study-report-12-02-2015.ashx

Additional AMMs are necessary in the final license articles. Downstream AMMs proposed in Article A320 include additional behavior barriers and it is not clear why these would not be implemented at the Northfield Mountain Project intake. At other pumped-storage projects, FERC has approved requirements to conduct a periodic study of developing technologies to reduce fish mortality. The recent Ludington Pumped Storage Project (P-2680) Final License Application includes such a requirement: "The Licensees will conduct a review of fish entrainment abatement technologies every 5 years throughout the course of the new license. The first review will be conducted 5 years after the new license is issued. The goal of this review will be to determine if any technologies are technically and economically practicable for use... either in conjunction with or in lieu of the barrier net to substantively reduce fish entrainment relative to the existing barrier net program."[36]

A final license should include the addition of AMMs to routinely study alternative technologies to improve fish survival, as well as studies that examine the possible use of multi-technology behavior systems to reduce entrainment and impingement. CRC is particularly concerned about the continued high rate of entrainment for eggs and larvae at the Northfield Mountain Project and AMMs should include a review of aquatic microfiltration barrier systems, or other emergent technologies, which have shown to be effective in specifically protecting eggs and larvae from entrainment.[37] The Applicant should also be responsible for the costs of these studies, a requirement FERC has included for other pumped storage facilities.[38] Finally, studies to examine technologies should also include a feasibility study of a closed loop system. Such a study was omitted in pre-licensing studies but is the most certain way to prevent not only fish impingement and entrainment, but to also eliminate the erosion caused by NFM's operations.

Ultimately, if the Applicant cannot meet agreed upon performance target within five years of operating the barrier net, it is necessary and justifiable to require pumping restrictions or operational changes until the Applicant can meet these targets. Such adaptive management precedent exists the case of North Umpqua Hydroelectric Project (FERC No. 1927) 401 water quality certificate which stipulates adaptive measures "... to investigate, and based upon such investigation, propose options for modification to facilities or Pumped Storage Project operations to prevent any violation of water quality standards."[39] Reduced pumping during the season in which fish migrate past the Northfield Mountain Project intake would be expected to reduce entrainment. The Applicant has an obligation to first avoid harmful impacts to the ecosystem and operational changes are the most effective means currently available to the Applicant to meet this obligation.

To mitigate mortalities caused by the Northfield Mountain Project's operations, the Applicant has proposed an off-license Ichthyoplankton Mitigation Fund of $1,296,281 over the span of 50 years. This sum, over the proposed span of the license does little to account for the biodiversity loss due to entrainment at the Project site. In P-2680 by contrast, annual funding for mitigation fund for fish loss at Ludington is estimated to be $2,722,000. The proposed sum of under $1.3 million total over

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36 https://www.consumersenergy.com/-/media/CE/Documents/company/ludington/ludington-final-license-application.ashx, at E-4-60–61.

37 *See generally* https://www3.epa.gov/region1/npdes/merrimackstation/pdfs/ar/AR-257.pdf.

38 https://www.consumersenergy.com/-/media/CE/Documents/company/ludington/ludington-service-agreement.ashx at Exhibit 1 page 8-9.

39 https://www.oregon.gov/deq/wq/Documents/NUHPFishCreek401mod.pdf, at 3.

50 years is not a justifiable cap and should be based on the actual and full costs of specific mitigation activities.

Finally, CRC again strongly opposes the condition under Article B220 that resource agencies are not permitted to exercise their reserved or regulatory authority regarding passage within the first 25 years of the license. We further object to the condition that agencies are not required to request or require pumping restrictions at any time over the life of the license. If the Applicant cannot, under proposed operations, sufficiently reduce fish mortality to achieve the performance targets of Article B120, then the Applicant must modify operations until it can sufficiently satisfy these goals. The federal and state agencies that oversee the protection and restoration of fish species in the Connecticut River must have the freedom to impose further measures to reach these performance targets if necessary to protect that public trust.

Invasive Species

The Offer includes no mention of the Applicant's responsibility to monitor and control invasive species in the Turners Falls Project Boundary. As stated above in our comments, the conditions created by Turners Falls Dam create slow-moving waters that promote the growth and spread of aquatic invasive species.[40] In turn the presence of these species leads to impairments of the Connecticut River in the TFI. Segment 34-02 (segment between Rout 10 bridge and Turners Falls Dam, excluding Barton Cove) and segment MA34122 (Barton Cove) are both impaired, in part due to aquatic invasive plants including curly-leaf pondweed, Eurasian water milfoil, fanwort and water chestnut. Relicensing Study 3.5.1 includes results of surveys conducted of native and invasive Submerged Aquatic Vegetation (SAV). The report found that, "... 41 of the mapped 107 SAV beds had some level of infestation by exotic species, which accounts for 38% of the SAV beds. The majority of the exotic species occur immediately upstream of the Turners Falls Dam with fewer occurrences upstream of the French King Bridge." Table 4.1-2 from this study lists the aquatic invasive species identified in the survey, making clear the abundance of invasive plants in the TFI. If left unchecked, these invasive plants have the potential to spread rapidly throughout the TFI and greater Connecticut River watershed, limiting recreational opportunity, degrading water quality and supplanting native species and habitat, thereby contributing to biodiversity loss.

[40] Johnson, P.T., Olden, J.D. and Vander Zanden, M.J. (2008), Dam invaders: impoundments facilitate biological invasions into freshwaters. Frontiers in Ecology and the Environment, 6: 357-363. https://doi.org/10.1890/070156

Table 4.1-2: Wetland and Aquatic Invasive Plant Species

Scientific Name	Common Name	Lifeform Type	Notes
Cabomba caroliniana	Carolina Fanwort	Aquatic herb	Chokes waterways
Iris pseudacorus	Yellow Iris	Perennial herb	Wetland habitats, primarily in flood plain areas, grows in full sun to full shade
Lysimachia nummularia	Creeping Jenny	Perennial herb	Problematic in flood plains forms dense mats
Lythrum salicaria	Purple Loosestrife	Perennial herb	Overtakes wetlands, high seed production
Myriophyllum heterophyllum	Variable water-milfoil	Aquatic herb	Chokes waterways, spreads by humans, boat traffic, and possibly birds
Myriophyllum spicatum	Eurasian water-milfoil	Aquatic herb	Chokes waterways, spreads by humans, boat traffic, and possibly birds
Phalaris arundinacea	Reed Canary Grass	Perennial grass	Forms dense stands
Potamogeton crispus	Curly Pondweed	Aquatic herb	Forms dense mats in the spring and persists vegetatively
Trapa natans	Water-chestnut	Aquatic herb	Forms dense floating mats on water

In its 2020 Amended Final License Application, the Applicant drafted an Invasive Plant Management Plan for the Turners Falls Project Boundary (Project Boundary), but this plan lacked any concrete monitoring and/or management conditions.

FERC has established that invasive species monitoring and removal as a requirement of hydropower licensing on the Connecticut River. Under Article 417(d) of the Holyoke Gas and Electric (HG&E) Settlement Agreement (P-2004), FERC approved requirements for HG&E to conduct invasive species monitoring; this was further revised in 2019[41]. Additionally, FERC required HG&E to contribute to the cost of water chestnut control in the project area in cooperation with state and federal agencies. Monitoring requirements under the license include, "(1) data from the previous two years of monitoring for invasive species; (2) invasive species maps that shall identify found populations of invasive species in relation to the project features as well as all the bordering wetlands and banks within the project boundary; (3) the total quantity of each invasive species found within the surveyed areas each year; (4) any control measures implemented; (5) the total quantity of each invasive species controlled or removed each year; (6) documentation of the annual meeting that occurred with the resource agencies; and (7) agency comments and recommendations on the monitoring results."

Financial Assurances for Decommissioning and Removal

While this Offer is not a comprehensive settlement agreement and therefore does not include all license terms, CRC would be remiss if we did not mention the absence of any financial assurances for future decommissioning and removal of the Relicensing Projects. The Settling Parties are requesting a 50-year license term. As detailed above, CRC opposes such a lengthy term, and the Settling Parties have not provided substantial evidence to support it. Even if the license is issued for

[41] Report of Holyoke Gas & Electric under P-2004. Revised Invasive Species Plan. Filing Description for Accession Number 20190614-5045. https://elibrary.ferc.gov/eLibrary/filelist?accession_number=20190614-5045&optimized=false

a shorter period, it is likely that both Relicensing Projects will reach the end of their useful lives before the expiration of the licenses. Even a 40-year license term will put the Northfield Mountain Project close to a century old by the time its next license expires.

The presence of these facilities continues, and will continue, the impairments of several segments of the Connecticut River in Massachusetts and, upon the end of their operations, they must be removed to fully restore the Connecticut River to meet designated and existing uses and to comply with the Clean Water Act and Massachusetts water quality standards. Nearly 30 years ago, FERC announced that it had the authority to require financial assurances as part of its license.[42] As FERC's policy contemplates, imposing financial assurances during relicensing, "would help assure that the funds are available to do the job when the time for decommissioning arrives, thereby avoiding the possibility that State or Federal taxpayers might, by default, be compelled to pay them because the licensee lacks the resources."[43]

In 2021, FERC issued a Notice of Inquiry regarding Financial Assurance Measures for Hydroelectric Projects and solicited comments.[44] FERC received several comments from federal resource agencies, including USFWS and NMFS, two of the signatories to the Offer, that supported the idea of FERC requiring financial assurances to address decommissioning costs and removal of hydroelectric projects:

> FWS: The Service also recommends that financial assurances address decommissioning costs, including the removal of project infrastructure and the restoration of habitat when a licensee or exemptee surrenders its license or otherwise voluntarily abandons a project. This would ensure projects that are abandoned do not pose a risk to the environment and would reduce the risk that taxpayers and ratepayers would have to pay to remove project infrastructure and restore habitat if a project is abandoned.[45]
>
> NMFS: NMFS supports FERC requiring financial assurances from licensees. Financial assurance from licensees should support mechanisms that promote environmental conservation, forward planning, flexibility in terms of types of hydroelectric projects, and equity for communities affected by or reliant on hydroelectric projects.[46]

Because the Applicant maintains and operates the project and will benefit from these operations, it is the responsibility of the Applicant to take steps to decommission and remove its facilities when they reach the end of their useful life. Accordingly, the final license should include conditions for the Applicant to create a decommissioning plan and require financial assurances to ensure the ability of the Applicant to complete this work. CRC looks forward to future opportunities to comment

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[42] Project Decommissioning at Relicensing; Policy Statement, Federal Energy Regulatory Commission, 60 Fed. Reg. 339 (Jan. 4, 1995).
[43] 60 Fed. Reg. at 346.
[44] Financial Assurance Measures for Hydroelectric Projects, Federal Energy Regulatory Commission, 86 Fed. Reg. 7,081 (Jan. 26, 2021).
[45] FWS Comments in Response to FERC's Notice of Inquiry, at Answer to Question 1 (attached).
[46] NMFS Comments in Response to FERC's Notice of Inquiry, at 1–2 (attached) (describing hydroelectric projects that would have benefited from financial assurances: "If financial assurance mechanisms had been required by FERC to address fish passage and dam removals, then the environmental harm caused by these projects and others would have been mitigated").

further on the need and appropriateness of financial assurance conditions for the Relicensing Projects.

Attachments:

Attachment A Burgoff Affidavit
Attachment B Pugh Affidavit
Attachment C Princeton Hydro Peer-Review of Relicensing Study 3.1.2
Attachment D Zapel Affidavit
Attachment E U.S. Fish and Wildlife Service Comments on the Federal Energy Regulatory Commission's Notice of Inquiry on Financial Assurance Measures
Attachment F National Marine Fisheries Service Office Comments on Financial Assurance Mechanisms

Attachment A

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

	)	
FirstLight Hydro MA LLC	)	Docket No. 1889-000
	)	
Northfield Mountain LLC	)	Docket No. 2485-000
	)	

AFFIDAVIT OF JULIAN BURGOFF
ON BEHALF OF THE CONNECTICUT RIVER CONSERVANCY

1. My name is Julian Burgoff. I received a Bachelor of Science degree with honors from UMass-Amherst in Natural Resources Conservation with a concentration in Fisheries Ecology and Conservation in 2021. I worked as a seasonal fisheries technician for the U.S. Fish and Wildlife Service Connecticut River Conservation Office during the spring and summer of 2022, and I am currently a master's student at the University of Massachusetts-Amherst in the Environmental Conservation department with the Massachusetts Cooperative Fish and Wildlife Research Unit. My research investigates juvenile river herring productivity, growth and habitat use in a series of coastal watersheds in eastern Massachusetts.

2. The purpose of my affidavit is to explain the Connecticut River Conservancy's ("CRC") opposition to the offer of settlement ("Offer") as it relates to minimum flows below Turners Falls Dam during the summer and fall months and the effects of those flows on native fluvial fish communities in that segment of the river ("Bypass Reach").

3. To provide this affidavit testimony, I reviewed the Offer and the Settling Parties' Explanatory Statement, Relicensing Studies pertaining to flows and fish assemblages in the Bypass Reach, Massachusetts water quality policy, and various journal articles within the scientific literature that pertain to the effects of hydropower operations on native fish communities. I have listed the literature cited at the end of this affidavit.

4. Alterations to river flow below hydroelectric dams have significant implications for downstream fish communities, where flow diversions and stochastic water releases can reduce the diversity of resident fish populations (Bain et al. 1988). Kinsolving and Bain (1993) found a spatial gradient of fish community composition downstream of a hydroelectric facility in Alabama, where the reaches immediately downstream of the dam were dominated by fish species that tolerate a wide variety of aquatic habitats (macrohabitat generalists) with fewer fish species present that are dependent on flowing-water habitats (fluvial specialists) compared with reaches farther downstream with more stable flow conditions.

5. As a means of quantifying impacts to native riverine fish assemblages, The Massachusetts Executive Office of Energy and Environmental Affairs (Mass EOEA) made recommendations to conduct fish community assessments in mainstem rivers as part of their Water Policy in 2004. Mass EOEA subsequently funded the development of Target Fish Communities for Massachusetts rivers in conjunction with the Massachusetts Division of Fisheries and Wildlife in 2009. An excerpt from the Target Fish Communities Technical Report summarizes the classification of Massachusetts fish species into various tolerance and habitat use categories:

Species were classified into three habitat-use categories and three tolerance categories. Habitat Use Categories were adopted as in Bain and Meixler (2008) with regional modification: fluvial specialist (FS) species that require flowing water for all of their life-history requirements; fluvial dependent (FD) species that require flow for at least some portion of their life history; and macrohabitat generalist (MG) species that can meet all of their life-history requirements in lentic conditions. Rivers that are dominated by macrohabitat generalist species likely have impairments to stream flow or are dominated by impounded habitat.

Three tolerance categories following Plafkin et al. (1989) (Table 2): intolerant (I), moderately tolerant (M), and tolerant (T), reflect the species observed tolerance to environmental degradation. Water quality concerns should likely be addressed in rivers that are dominated by tolerant individuals or have lost intolerant species entirely.

6. The Target Fish Communities Technical Report assigned habitat use and tolerance classifications to Massachusetts fishes as depicted in the table below.

Table 2. Massachusetts fish species with their Origin (Hartell et al. 2002), habitat-use categories (HUC) based on Bain (1992 – and modified for regional application), and tolerance (Plafkin et al. 1989).

Species	Scientific Name	Origin[a]	Habitat-Use Category[b]	Tolerance[c]
American eel	*Anguilla rostrata*	N	MG	T
Atlantic salmon	*Salmo salar*	N	FS	I
Banded killifish	*Fundulus diaphanus*	N	MG	T
Banded sunfish	*Enneacanthus obesus*	N	MG	I
Black crappie	*Pomoxis nigromaculatus*	I	MG	M
Blacknose dace	*Rhinichthys atratulus*	N	FS	T
Bluegill	*Lepomis macrochirus*	I	MG	T
Bluntnose Minnow	*Pimephales notatus*	I	MG	T
Bridle shiner	*Notropis bifrenatus*	N	MG	I
Brook trout	*Salvelinus fontinalis*	N	FS	I
Brown bullhead	*Ameiurus nebulosus*	N	MG	T
Brown trout	*Salmo trutta*	I	FS	I
Chain pickerel	*Esox niger*	N	MG	M
Channel catfish	*Ictalurus punctatus*	I	MG	M
Common carp	*Cyprinus carpio*	I	MG	T
Common shiner	*Notropis cornutus*	N	FD	M
Creek chub	*Semotilus atromaculatus*	N	FS	T
Creek chubsucker	*Erimyzon oblongus*	N	FS	I
Cutlip Minnow	*Exoglossum maxillingua*	I	FS	I
Fallfish	*Semotilus corporalis*	N	FS	M
Golden shiner	*Notemigonus crysoleucas*	N	MG	T
Green sunfish	*Lepomis cyanellus*	I	MG	T
Landlocked salmon	*Salmo salar*	I	FD	
Largemouth bass	*Micropterus salmoides*	I	MG	M
Longnose dace	*Rhinicthys cataractae*	N	FS	M
Longnose Sucker	*Catostomus catostomus*	N	FD	I
Northern pike	*Esox lucius*	I	MG	I
Pumpkinseed	*Lepomis gibbosus*	N	MG	M
Rainbow trout	*Oncorhynchus mykiss*	I	FS	I
Redbreast sunfish	*Lepomis auritus*	N	MG	M
Redfin pickerel	*Esox americanus americanus*	N	MG	M

Development of Target Fish Community Models for Massachusetts Mainstem Rivers

Table 2. (Continued)

Species	Scientific Name	Origin[a]	Habitat-Use Category[b]	Tolerance[c]
Rock bass	*Ambloplites rupestris*	I	MG	M
Slimy sculpin	*Cottus cognatus*	N	FS	I
Smallmouth bass	*Micropterus dolomieu*	I	MG	M
Spottail shiner	*Notropis hudsonius*	N	MG	M
Swamp Darter	*Etheostoma fusiforme*	N	MG	I
Tesselated darter	*Etheostoma olmstedi*	N	FS	M
White perch	*Morone americana*	N	MG	M
White sucker	*Catostomus commersoni*	N	FD	T
Yellow bullhead	*Ameiurus natalis*	I	MG	T
Yellow perch	*Perca flavescens*	N	MG	M

[a]- Origin categories: N = Native, I = Introduced
[b]- Habitat-use categories: FS = fluvial specialist, FD = fluvial dependent, MG = macrohabitat generalist
[c]-Tolerance categories: T = Tolerant, M = Moderately Tolerant, I = Intolerant

7. The Massachusetts Consolidated Listing and Assessment Methodology (CALM) Guidance Manual, updated Fall of 2022, uses fish community classifications as a metric for determining the attainment of Aquatic Life Use. An excerpt from page 19 of the CALM specifies fluvial fish presence as a key metric for determining Aquatic Life Use support:

For waters designated as a Class B Warm Water Fishery, or those waters otherwise undesignated: in moderate to high gradient streams (riffle/run prevalent streams) the fish community should include two or more fluvial specialist/dependent species (see Appendix B) or at least one fluvial specialist/dependent species in moderate abundance to fully support the Aquatic Life Use. The absence of fluvial fish in these streams will result in an impairment decision.

In low gradient streams (glide/pool prevalent streams) the fish community should include at least one fluvial specialist/dependent species or macrohabitat generalist species which are intolerant or moderately tolerant to environmental perturbations to fully support the Aquatic Life Use. If fish are absent in these streams, or if only tolerant macrohabitat generalist species are present, the Aquatic Life Use will be assessed as impaired.

8. A study of fish assemblages in large rivers of New England conducted by the Midwest Biodiversity Institute included fish sampling of multiple reaches downstream of the Turners Falls dam in 2009. 1 Km long electrofishing surveys in the Bypass Reach beginning at river mile 67.9 (directly downstream of the dam, upstream of Station No. 1) and 66.9 (downstream of Station No. 1) revealed the adverse effects of water diversion on the fish assemblages present in the upper Bypass Reach. The study applied a series of 12 Index of Biological Integrity (ME IBI) metrics that were developed to assess the quality of fish communities in moderate-high gradient rivers in Maine (Yoder et al. 2008). Metrics included measures of native species richness, proportional abundance of non-native species such as black bass, proportional abundance of fluvial fishes and other metrics that aim to quantify the integrity of riverine fish assemblages. Scores from the 12 IBI metrics were combined to determine an overall ME IBI score for each survey reach. The ME IBI score for the 1 km reach in the upper bypass was of the lowest of all New England rivers included in this study, but improved in the lower Bypass Reach with the

flows provided by Station No. 1. The improvements in IBI metrics in the lower Bypass Reach were associated with fewer non-native species and more native species, higher proportional abundance of Cyprinid fishes such as Spottail Shiner and Longnose Dace and lower proportional abundance of macrohabitat generalists such as Smallmouth Bass.

9. The table below from Yoder et al. (2015) depicts the IBI scores for reaches downstream of the Turners Dam. The color of the cells corresponds to the Biological Condition Gradient conceptual model (adapted from Davies and Jackson 2006) that ranks the condition of the fish community from 1 (purple, least impaired) through 6 (red, most impaired). The overall ME IBI score for the 1 km reach downstream of the Turners Dam corresponded to a level 6 Biological Condition Gradient, indicating significant impairment of the fish communities in this reach due to lack of consistent flows from the Turners Falls dam.

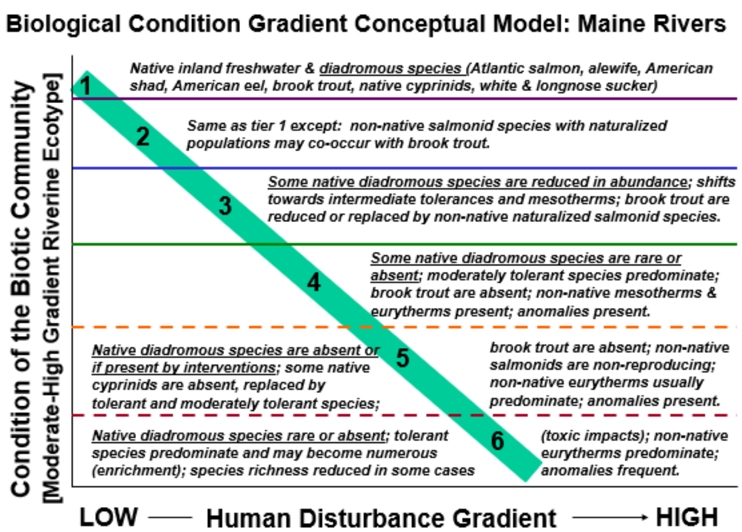

Table 27. Fish sampling results in and downstream from the Turners Falls bypass reach in the Connecticut River and in the vicinity of the Cabot hydropower project in 2009 showing Maine IBI and DIBI scores and Maine IBI metric results. Gray shaded NELR REMAP sites were "embedded" within the preceding NRSA site (site numbers are from NRSA, NELR REMAP, and Connecticut River intensive survey designations). Color shading in the cells corresponds to the BCG level for each result (see Table 24).

River Mile	Site Number	Distance (Km)	Maine IBI (BCG)	Maine DIBI (BCG)	Native Species	Steno-therms	Alien Sp.	Non-guarding Lithophils	%Cyprini-dae	Native Salmon-ids	Benthic Insecti-vores	% Black-bass	Fluvial Special-ist	Macro-habitat General-ists	White/Long-nose Suckers[1]	%DELT
67.9 (NRSA)	FW08MA 021	3.81	34 (5)	39.5 (5)	3	1	6	2	27	0	21	51	29	68	NA	0
67.9 (REMAP)	FW08MA 021	1.0	10 (6)	25.1 (5)	2	0	3	0	0	0	9	44	9	62	0	2.4
66.9	CTR-46	1.0	57 (4)	74.4 (3)	5	1	2	2	18	10	19	13	26	17	22	0
66.1 (NRSA)	FW08MA 020	4.0	29 (6)	36.7 (5)	4	0	3	1	15	0	8	37	33	60	NA	0
66.1	CTR-47A1	1.0	22 (6)	34.3 (6)	6	0	5	2	52	0	4	27	12	85	0	0.4
65.5	CTR-46A	1.0	38 (5)	56.5 (4)	6	1	4	2	7	1	3	48	18	57	9	2.3

[1] This is a biomass based metric and it could not be calculated for the NRSA method.

10. In 2016, First Light released Relicensing Study 3.3.11 Fish Assemblage Assessment which included electrofishing surveys during the summer of 2015 of the same reaches downstream of the Turners Dam sampled in 2009 by the Midwest Biodiversity Institute. Table 4.2.3.1-1 depicts the species abundances at various sites downstream of the Turners Dam. Overall, the fish communities sampled in 2015 are comparable to those sampled in 2009, with high proportional abundance of macrohabitat generalist smallmouth bass and low proportional abundance of native fluvial specialist fishes.

Northfield Mountain Pumped Storage Project (No. 2485) and Turners Falls Hydroelectric Project (No. 1889)
FISH ASSEMBLAGE ASSESSMENT

Table 4.2.3.1-1: Species Abundance at Each Boat Electrofishing Station within the Turners Falls Bypass Reach during Late Summer 2015

Species	Plunge Pool	Pool-Run Above Station No. 1	Riffle-Run Below Station No. 1	Pool Above Rock Dam	Total	% of Total
Smallmouth Bass	48	67	30	23	168	62.5%
American Eel	16	1	7	2	26	9.7%
Bluegill Sunfish	12	9		1	22	8.2%
Pumpkinseed	8	8			16	5.9%
White Sucker	10		2	1	13	4.8%
Tessellated Darter	4	2	2	4	12	4.5%
Sea Lamprey	1		1	1	3	1.1%
Largemouth Bass	1				1	0.4%
Yellow Perch				1	1	0.4%
Spottail Shiner				1	1	0.4%
Mimic Shiner				1	1	0.4%
Walleye	1				1	0.4%
Northern Pike				1	1	0.4%
Brown Bullhead				1	1	0.4%
Hybrid Sunfish		1			1	0.4%
Longnose Dace			1		1	0.4%
Total	**101**	**88**	**43**	**37**	**269**	

11. According to the fish sampling data from 2009 and 2015, the Bypass Reach is home to fluvial specialist fishes including Longnose Dace, Tessellated Darter, and White Sucker. According to the 2015 survey data, however, only two individuals of a single species of fluvial specialist (Tessellated Darter) were present in the pool-run reach above Station No. 1 (a moderate to high gradient river reach). This fish community does not meet the standards for Aquatic Life Use in moderate to high gradient streams as defined by the Massachusetts CALM, which states that two or more fluvial fish species or one fluvial fish species in moderate abundance must be present. The extremely low proportional abundance of fluvial specialist fishes and the proportional dominance of the fish community by macrohabitat generalist fishes as determined by both the 2009 and 2015 surveys for the upper Bypass Reach fail to meet the criteria for Aquatic Life Use attainment as defined by the Massachusetts CALM.

12. Relicensing Study 3.3.1 Instream Flow Habitat Assessments in the Bypass Reach and below Cabot Station derived Weighted Usable Area (WUA) calculations for fish species in Reach 1 (Table 7.1.1.2-2). Under previous summer minimum flows of 120 cfs from the

Turners Dam, the WUA for Juvenile and Adult Longnose Dace is 13.0% and 9.3% respectively and 12.2% for Juvenile/Adult Tessellated Darter, which explains the extremely low proportional abundance of these fish species documented in the upper Bypass Reach during 2009 and 2015 electrofishing surveys. The proposed summer minimum flows from the Turners Dam of 500 cfs only provide 27.7% and 18.5% WUA for Juvenile and Adult Longnose Dace respectively and 22% WUA for Juvenile/Adult Tessellated Darter, representing a meager increase in usable habitat by 9.2-14.7% for Longnose Dace and 9.8% for Tessellated Darter. Maximum WUA for these species and life stages occurs at flows of 1800-2000 cfs. Thus, significantly higher minimum flows from the Turners Dam would be necessary to provide enough usable habitat for these fluvial specialist fishes in the upper Bypass Reach and to strengthen the integrity of the fish community immediately downstream of the dam to meet Aquatic Life Use standards.

Northfield Mountain Pumped Storage Project (No. 2485) and Turners Falls Hydroelectric Project (No. 1889)
INSTREAM FLOW HABITAT ASSESSMENTS IN THE BYPASS REACH AND BELOW CABOT STATION STUDY REPORT

Table 7.1.1.2-2: Percentage of the Maximum Weighted Usable Area (WUA) for Various Flows within Reach 1 (Transects 10 & 11) for High Backwater Condition

Species	Life stage	Months Present	Maximum WUA Flow (cfs)	Maximum WUA (ft²)	120 (cfs)	150 (cfs)	200 (cfs)	250 (cfs)	400 cfs)	500 (cfs)	600 (cfs)	700 (cfs)	800 (cfs)	1000 (cfs)	1200 (cfs)	1400 (cfs)	1600 (cfs)	1800 (cfs)	2000 (cfs)	3000 (cfs)	4000 (cfs)	5000 (cfs)
					0.02 (cfsm)	0.02 (cfsm)	0.03 (cfsm)	0.03 (cfsm)	0.06 (cfsm)	0.07 (cfsm)	0.08 (cfsm)	0.1 (cfsm)	0.11 (cfsm)	0.14 (cfsm)	017 (cfsm)	0.2 (cfsm)	0.22 (cfsm)	0.25 (cfsm)	0.28 (cfsm)	.42 (cfsm)	0.56 (cfsm)	0.7 (cfsm)
American Shad	Spawning/Incu	May-June	7,500	898,488	17.6%	18.7%	20.6%	22.5%	27.2%	29.1%	30.6%	32.2%	33.7%	36.6%	40.9%	45.5%	49.8%	54.5%	59.8%	72.4%	81.9%	89.0%
American Shad	Juvenile	June-Oct	2,000	668,444	43.9%	47.7%	53.5%	58.6%	52.9%	55.3%	57.5%	59.2%	61.2%	64.6%	74.4%	83.0%	88.7%	94.4%	100.0%	95.5%	88.1%	80.6%
American Shad	Adult	May-June	7,500	695,459	23.1%	24.0%	25.7%	27.2%	29.1%	30.1%	31.1%	32.2%	33.3%	35.2%	37.7%	40.7%	43.1%	46.3%	50.3%	66.2%	80.2%	90.7%
Shortnose Sturgeon	Spawning	April-May	6,000	893,383	0.5%	1.6%	5.6%	9.7%	23.1%	27.9%	31.0%	32.6%	33.5%	35.0%	39.6%	45.4%	52.3%	60.8%	70.8%	87.7%	96.0%	99.5%
Shortnose Sturgeon	Egg-Larvae	May	3,000	1,360,780	38.9%	43.8%	51.1%	57.5%	42.9%	46.9%	51.0%	55.0%	59.3%	66.6%	77.6%	85.8%	91.5%	95.9%	99.9%	100.0%	100.0%	99.7%
Shortnose Sturgeon	Fry	May	500	64,776	44.5%	54.9%	71.4%	85.1%	99.3%	100.0%	99.9%	99.8%	99.9%	98.3%	94.8%	93.8%	91.8%	91.3%	92.4%	73.1%	56.9%	43.5%
Fallfish	Spawning/Incu	May-June	120	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Fallfish	Fry	May-June	150	25,172	96.3%	100.0%	99.7%	98.5%	87.3%	82.4%	75.3%	61.6%	50.7%	39.0%	32.6%	28.2%	24.3%	20.9%	17.8%	6.1%	1.8%	1.0%
Fallfish	Juvenile	Year Round	1,800	260,011	57.8%	63.6%	71.2%	77.0%	73.3%	74.3%	76.2%	77.6%	79.5%	82.8%	89.5%	93.4%	98.0%	100.0%	99.5%	80.4%	61.6%	44.0%
Fallfish	Adult	Year Round	2,000	549,907	67.5%	70.9%	76.2%	80.6%	75.7%	75.7%	71.2%	67.1%	63.5%	59.8%	70.4%	80.6%	86.7%	93.4%	100.0%	89.6%	74.3%	60.5%
Longnose Dace	Juvenile	Year Round	1,800	155,504	13.0%	16.4%	22.0%	27.6%	23.1%	27.7%	31.3%	34.2%	37.4%	44.0%	64.0%	81.7%	95.7%	100.0%	94.9%	39.8%	12.7%	3.6%
Longnose Dace	Adult	Year Round	2,000	413,608	9.3%	11.7%	15.8%	19.8%	16.1%	18.5%	20.4%	22.8%	25.4%	31.5%	51.4%	69.4%	84.2%	94.0%	100.0%	54.4%	17.0%	4.2%
White Sucker	Spawning/Incu	Apr-May	120	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
White Sucker	Fry	May-June	120	1,000,248	100.0%	99.6%	97.6%	95.7%	84.7%	79.3%	75.2%	74.9%	76.4%	79.7%	75.7%	66.4%	51.8%	36.6%	20.8%	4.3%	1.0%	0.8%
White Sucker	Adult/Juvenile	Year Round	250	362,803	75.0%	85.5%	95.4%	100.0%	82.0%	71.1%	60.5%	50.9%	43.7%	45.5%	63.6%	77.0%	78.1%	73.4%	63.4%	29.9%	8.2%	2.6%
Walleye	Spawning	April-May	3,000	139,817	14.5%	14.9%	15.5%	16.2%	19.3%	21.4%	25.8%	29.8%	35.2%	45.0%	51.0%	55.9%	59.7%	64.4%	62.8%	100.0%	96.3%	85.7%
Walleye	Fry	April-May	120	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Walleye	Juvenile	Year Round	120	870	100.0%	82.4%	52.9%	32.4%	26.5%	23.5%	17.6%	14.7%	11.8%	8.8%	4.7%	3.5%	3.5%	2.4%	2.9%	0.0%	0.0%	0.0%
Walleye	Adult	Year Round	120	36,453	100.0%	80.4%	48.8%	24.5%	19.4%	15.8%	13.0%	12.9%	12.9%	13.1%	13.5%	14.1%	14.6%	14.9%	15.6%	20.0%	14.3%	4.4%
Tessellated Darter	Adult/Juvenile	Year Round	1,800	133,736	12.2%	15.4%	20.9%	26.5%	18.0%	22.0%	26.7%	31.9%	36.7%	45.3%	66.1%	84.5%	98.2%	100.0%	96.7%	28.7%	0.9%	0.0%
Sea Lamprey	Spawning/Incu	May-June	1,800	3,870	0.0%	0.0%	0.0%	0.3%	41.4%	56.6%	69.4%	62.8%	59.0%	69.8%	56.4%	74.0%	91.3%	100.0%	94.8%	34.9%	12.3%	2.3%
Macroinvertebrates	Larva	Year Round	4,000	918,412	0.0%	0.1%	0.4%	0.9%	6.0%	10.0%	14.0%	17.7%	21.3%	26.9%	30.4%	36.1%	44.7%	55.2%	67.1%	91.6%	100.0%	97.6%
Shallow Slow	Shallow Slow	Year Round	700	818,354	93.6%	94.1%	95.4%	97.1%	96.6%	97.5%	98.3%	100.0%	100.0%	93.0%	80.8%	78.2%	75.5%	71.7%	68.0%	21.5%	0.0%	0.0%
Shallow Fast	Shallow Fast	Year Round	1,600	535,297	24.8%	30.7%	40.4%	49.7%	26.1%	31.1%	36.2%	41.7%	49.0%	63.3%	83.5%	96.4%	100.0%	97.1%	88.9%	32.3%	9.1%	2.9%
Deep Slow	Deep Slow	Year Round	500	615,160	90.7%	91.4%	93.3%	95.7%	96.1%	100.0%	88.5%	65.6%	59.0%	67.0%	73.3%	78.9%	80.3%	64.2%	54.8%	22.2%	3.6%	1.2%
Deep Fast	Deep Fast	Year Round	3,000	124,411	2.4%	6.7%	15.0%	23.1%	37.8%	53.4%	69.1%	79.4%	82.8%	89.5%	88.3%	89.1%	91.6%	94.4%	99.6%	100.0%	89.8%	52.9%

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UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

FirstLight Hydro MA LLC	)	Docket No. 1889-000
Northfield Mountain LLC	)	Docket No. 2485-000

DECLARATION

JULIAN BURGOFF states that I prepared the affidavit to which this declaration is attached and that the statements contained therein are true and correct to the best of my knowledge and belief.

Pursuant to Rule 2005(b)(3) (18 CFR § 385.2005(b)(3), citing 28 U.S.C. § 1746), I further state under penalty of perjury that the foregoing is true and correct.

Executed on May 23, 2023.

/s/ *Julian Burgoff*

Julian Burgoff

Attachment B

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

	)	
FirstLight Hydro MA LLC	)	Docket No. 1889-000
	)	
Northfield Mountain LLC	)	Docket No. 2485-000
	)	

AFFIDAVIT OF DONALD PUGH
ON BEHALF OF THE CONNECTICUT RIVER CONSERVANCY

1. My name is Donald Pugh. I am an independent consultant with more than 20 years of experience, study and expertise in analyzing fish passage at hydroelectric projects, including projects going through licensing proceedings before the Federal Energy Regulatory Commission ("FERC"). I formerly worked on both up- and downstream passage at the U.S. Geological Survey's S.O. Conte Anadromous Fish Research Laboratory, which is located on the Connecticut River just downstream of Turner's Falls Dam. I have been engaged in numerous fish passage projects or consultations, during which I have examined and analyzed fish passage requirements including aquatic habitat quality and use and minimum flow needs. In 2021, I provided expert testimony in a federal case involving four hydroelectric projects on the Kennebec River in Maine, *Atlantic Salmon Federation U.S., et al. v. Brookfield Renewable Partnerships, L.P., et al.* Case No. 1:21-cv-00257-JDL (D. Me. 2021). The subject matter of my testimony in that case was fish passage, fish mortality caused by the hydroelectric operations, and analysis of measures needed to reduce fish passage mortality. These projects, cases, my publication credits, and presentations are set forth in the attached CV, current as of May 2023. *See* **Exhibit A**. My business address is 10 Old Stage Rd., Wendell MA 01379.

2. The purpose of my affidavit is to explain the Connecticut River Conservancy's ("CRC") opposition to the offer of settlement ("Offer") as it relates to minimum flows below Turners Falls Dam, during the summer and fall months.

3. To provide this affidavit testimony, I reviewed the Offer and the Settling Parties' Explanatory Statement, and Relicensing Study 3.3.1 (Study 3.3.1)[1] including individual Habitat Suitability Indices ("HSI").

4. Based upon my review and analysis of the above documents, my familiarity with the site, and my experience and expertise in analyzing fish passage issues at hydroelectric projects, I have reached an opinion on the sufficiency of proposed minimum flow below Turner's Falls Dam between July 1 and November 15. The proposed minimum flow of

[1] Instream Flow Habitat Assessments in the Bypass Reach and below Cabot Station, Final Study Report, Northfield Mountain Pumped Storage Project (No. 2485) and Turners Falls Hydroelectric Project (No. 1889), October 2016.

500 cfs from the dam provides insufficient habitat for the species and life stages identified as important during consultation between FirstLight, the state and federal agencies and non-government stakeholders. Five hundred cfs is not enough water to even fill the river bank to bank from the dam to Station 1, which is located approximately one mile below the dam.

THE OFFER'S PROPOSED MINIMUM FLOWS OF 500 CFS IN REACH 1 BELOW TURNERS FALLS DAM IS INSUFFICIENT TO PROVIDE A SUITABLE AMOUNT AND QUALITY OF HABITAT FOR MOST AQUATIC SPECIES INHABITING THAT REACH

5. The Offer's proposed minimum flow below Turners Falls Dam from July 1 to November 15 are 500 cfs with the qualification that if the Naturally Routed Flow ("NRF") is equal to or less than 500 cfs, flow from the dam will be the NRF. *See* Offer, Appendix A, at A-1 (proposed Article A110). Relicensing Study 3.3.1 identified target species, which were used in the habitat analysis. The proposed minimum flow is insufficient to provide a suitable amount and quality of habitat for most aquatic species inhabiting the reach of the Connecticut River between Turners Falls Dam and Station 1. Fluvial species including longnose dace (*Rhinicthys cataractae*) and tessellated darter (*Etheostoma olmstedi*) are most particularly affected by the proposed minimum flow given the low percentage of weighted usable area available for their habitat. Longnose dace and tessellated darter are fluvial specialist species with a moderate tolerance classification (CALM 2022) and, together with, macroinvertebrates, are provided the least habitat by the proposed flows. While the available habitat to each target species varies depending on flow, an increase in flows to 1,400 cfs provides significantly more habitat for most target fish species and life stages and for macroinvertebrates.

6. The proposed flow of 500 cfs provides limited habitat for longnose dace and tessellated darters, with only 27 and 18% longnose dace juvenile/adult and 22% juvenile and adult tessellated darters available (Table 7.1.1.2-2, Study 3.3.1). Longnose dace and tessellated darter are fluvial specialists, requiring flowing water for all life stages. The relative abundance of fluvial specialist species is used as an indicator of ecological health for rivers in Massachusetts (CALM 2022). The Massachusetts CALM indicates that in high gradient streams (riffle/run prevalent), the fish community should include at least two fluvial specialist/dependent species; fallfish, longnose dace, white sucker and tessellated darter are each classified as fluvial specialist species. The proposed flow of 500 cfs severely limits the habitat for both longnose dace and tessellated darter. Total habitat (square feet) for the four fluvial specialists would increase 47% with a flow of 1,400 cfs versus 500 cfs. When macroinvertebrates are included in the analysis, their habitat is increased 65%. Total habitat for the fluvial species and macroinvertebrates (**Exhibit B**) was calculated from Table 7.1.1.2-2 by multiplying the Maximum WUA for each species and life stage by the percent of Maximum WUA for each species and life stage at each flow.

7. Macroinvertebrate habitat at 500 cfs is only 10% of the maximum available. As shown in Figure 2 below, at 500 cfs much of the river would not provide the flow (velocity and/or

depth) necessary to support fluvial species, the expected fish species in Reach 1, or macroinvertebrates. Macroinvertebrates are an important part of the food web feeding on plant matter and algae and providing food for numerous species and life stages of fish. The Massachusetts CALM relies on aquatic macroinvertebrate communities to determine the biological health of a stream. When data are available from multiple indicators, biological community data carry more weight in decision-making regarding the attainment of Aquatic Life Use; biological community data generated by an Index of Biological Integrity (IBI) are considered the best measure of Aquatic Life Use. Maintaining sufficient flow for macroinvertebrates not only provides for an important part of the food web, but also works towards the attainment of Aquatic Life Use.

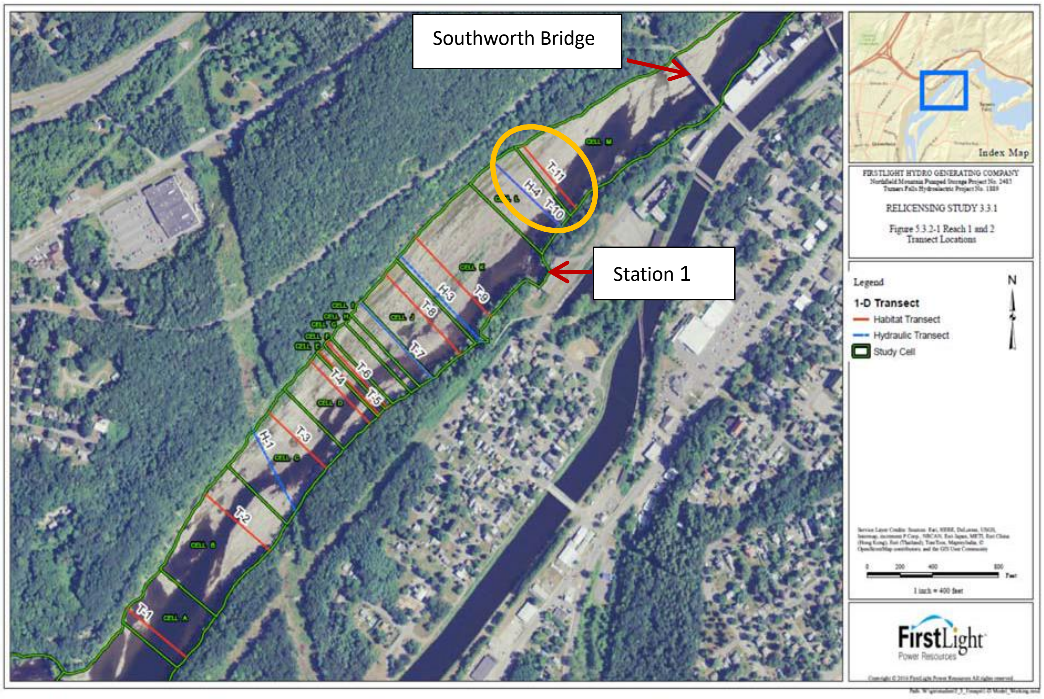
8. The Offer provides no evidence that a flow of 500 cfs during summer and fall is sufficient to support a return of the bypass to a riverine state supporting fluvial species and macroinvertebrates. This reach of the river has been degraded for decades by inadequate flows due to the presence and operations of the dam. The presence of the dam and its operation directing virtually all water out of the "bypass" portion of the river has severely compromised the physical and biological integrity of this reach. A higher minimum flow below Turner's Falls Dam is needed to maintain and restore aquatic life in the one-mile stretch of river below the dam from July 1 to November 15, as demonstrated below.

A MORE SCIENTIFICALLY JUSTIFIABLE MINIMUM FLOW FOR REACH 1 BELOW TURNERS FALLS DAM FROM JULY 1 TO NOVEMBER 15 IS 1,400 CFS

9. Weighted Useable Area ("WUA") is an output of the Instream Flow Incremental Methodology analysis of available habitat under different flow conditions. It is a commonly used means of habitat analysis in hydroelectric relicensing proceedings. WUA is defined as "...the total surface area having a certain combination of hydraulic conditions, multiplied by the composite probability of use for that combination of conditions. This calculation is applied to each cell within the multidimensional matrix" (Bovee and Cochnauer, 1977). Hydraulic conditions are depth and velocity. These are combined with substrate to determine habitat suitability. HSI curves for each species and life stage were agreed to by FirstLight, state and federal agencies and non-governmental stakeholders.

10. Study 3.3.1 analyzed transects 10 and 11 for habitat (WUA) in Reach 1 of the "bypass channel" below the immediate area of the dam. Figure 1, below, shows the area of the transect analysis.

Figure 1. Relicensing Study 3.3.1, Figure 5.3.2-1



11. Both low and high backwater conditions were evaluated (Station 1 not operating or operating at full capacity, respectively). As Station 1 will be operating during the summer/fall period, Table 7.1.1.2-2 (high backwater) is used in the following analysis. That table is attached as **Exhibit C**.

12. Fallfish, longnose dace, tessellated darter (fluvial specialist) and white sucker (fluvial dependent), were identified during initial stakeholder consultations as important species to analyze as Reach 1 of the river has a higher gradient than the river below the Cabot Station, the preferred habitat for fluvial species. As such it is a unique habitat in Massachusetts. Similarly, a different flow dependent suite of macroinvertebrates will be present in the bypass.

13. A flow of 1,400 cfs provides significantly more habitat for fluvial species and macroinvertebrates than 500 cfs. Using Table 7.1.1.2-2 (attached here as **Exhibit C**) from Study 3.3.1, I calculated the change in percentage of WUA when flows are increased from 500 cfs to 1,400 cfs, which is reflected in Table 1 below. "Delta 500 to 1400" is the difference in percent of WUA between the two flows. In all cases, the increased flow resulted in increased WUA, which in turn resulted in more available habitat for the fluvial species identified as important for the relicensing study and for macroinvertebrates.

Table 1. Species, life, stage percentage of maximum Weighted Useable Area, and the difference in WUA between 500 cfs and 1,400 cfs, from Table 7.1.1.2-2 Relicensing Study 3.3.1.

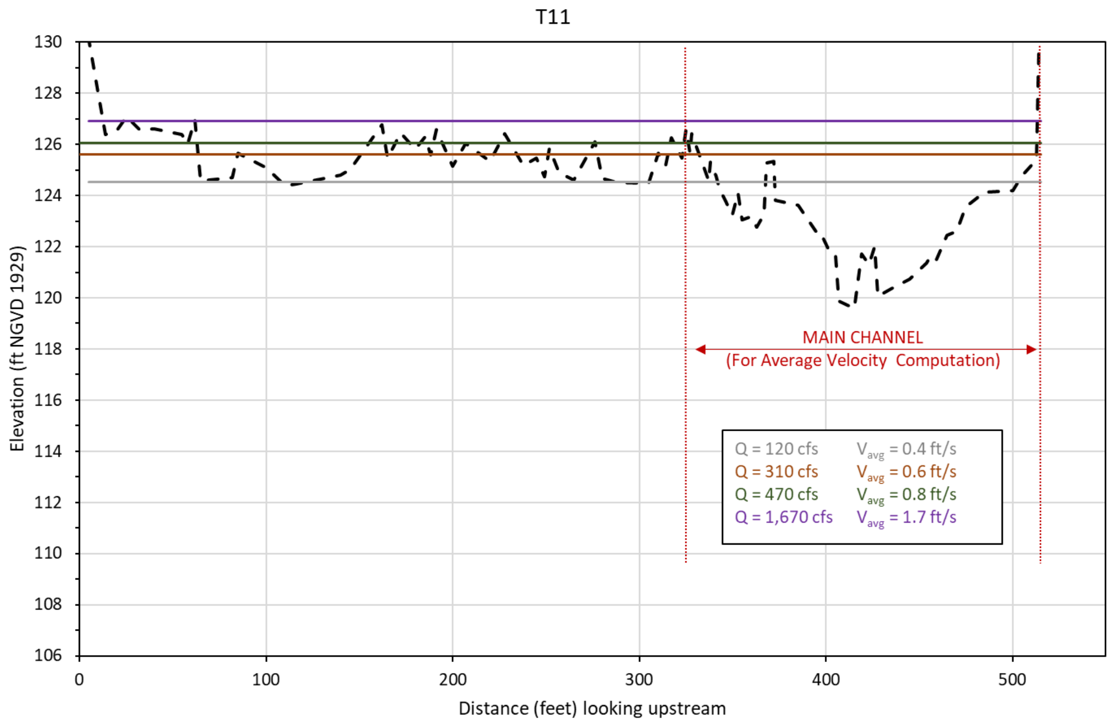
Species	Life stage	WUA 1400 (cfs)	Delta 500 to 1400
American Shad	Juvenile	83.0%	28%
Fallfish	Juvenile	93.4%	19%
Fallfish	Adult	80.6%	5%
Longnose Dace	Juvenile	81.7%	54%
Longnose Dace	Adult	69.4%	51%
White Sucker	Adult/Juvenile	77.0%	6%
Walleye	Juvenile	3.5%	-20%
Walleye	Adult	14.1%	-2%
Tessellated Darter	Adult/Juvenile	84.5%	63%
Macroinvertebrates	Larva	36.1%	26%

14. Another recognized method for analyzing the amount of available habitat for aquatic species in a particular stretch of a river is the Wetted Perimeter method. The Wetted-Perimeter method is based on the assumption that there is a direct relation between the wetted perimeter in a riffle and fish habitat in streams (Annear and Conder, 1984; Lohr, 1993). The wetted perimeter of a stream, defined as the width of the streambed and stream banks in contact with water for an individual cross section, is used as a measure of the availability of aquatic habitat over a range of discharges (Annear and Conder, 1984; Nelson, 1984).

15. Water levels at Transect 11 are shown for four flows in Figure 2 below. At 470 cfs (green line) approximately 35% of the transect is either dry or minimally wetted. At 1,670 cfs (purple line) the full river width is wetted increasing habitat for juvenile fish and macroinvertebrates. Based on the slope of the vertical right bank and near vertical left bank, a flow of 1,400 cfs would closely resemble that of 1,670 cfs (purple line).[2]

[2] Right and left bank references here refer to the figure whereas all other river references are looking downstream.

Figure 2. CRC letter dated June 13, 2022 to Secretary Bethany Card, Massachusetts Executive Office of Energy and Environmental Affairs.



16. On November 17, 2015, FirstLight provided demonstration flows of 125 cfs, 1,500 cfs, 2,500 cfs and 4,000 cfs. I took the photographs in Figures 3 and 4 below, from the Southworth Bridge, which is 0.6 miles below Turner's Falls Dam (*see* Figure 1 above). In the photographs, transects 10 and 11, as shown in Figure 1, are in the distance before the river bends to the left. I took the photograph in Figure 3 during the 1,500 cfs demonstration flow on November 17, 2015. It shows flowing water over most of the river width. Flows of 1,500 cfs demonstrably increase the wetted area and the available aquatic habitat in this reach. This is further supported in Study 3.3.1 which concluded that in the left channel immediately below the dam, "Bypass flow releases less than 1,500 cfs wet only the right-most 300-ft portion of the channel (looking downstream), whereas higher flow wets the leftmost 150 feet of the transect."[3] Increasing the amount of riverbed covered with flowing water will increase habitat for fluvial specialist species and macroinvertebrates.

17. The photograph labeled Figure 4 was taken on May 16, 2023, from the same vantage point (Southworth Bridge), during the upstream fish passage flow of 400 cfs. That photograph shows a narrow area on river left and notable areas of uplifted bedrock on river right. Habitat for both fluvial species and macroinvertebrates at 400 cfs is limited to the channel on river left. Considering the Wetted-Perimeter analysis, the photo further

[3] 6.1.1.3 Reach 1-Left Channel

demonstrates that flows of 400 cfs expose a greater width of the streambed and stream banks, thereby limiting the available aquatic habitat.

Figure 3. Reach 1 below the Southworth Bridge at 1,500 cfs (D.Pugh photo).

Figure 4. Reach 1 below the Southworth Bridge at 400 cfs (D.Pugh photo).

18. Both the Weighted Useable Area and the Wetted-Perimeter analysis demonstrate that 500 cfs is inadequate for the species and life stages that would normally inhabit this reach of the river. While 1,400 cfs does not provide for 100 percent of available habitat for fluvial

species and macroinvertebrates, that level of flows increases habitat significantly above flows of 500 cfs. At 1,400 cfs the full width of the river is wetted with flowing water. As recorded downstream at the Montague USGS stream gage (42.5802222, -72.5745) over a 40-year period, a flow of 1,400 cfs is exceeded over 99% of the time from July 1 to November 15.[4] Accordingly, a flow of 1,400 cfs returns the "bypass reach" to its minimum riverine condition restoring bank to bank habitat and sufficiently maintaining and restoring aquatic life uses there.

References

Annear, T.C., and Conder, A.L., 1984, Relative bias of several fisheries instream flow methods: North American Journal of Fisheries Management, v. 4, p. 531-539.

Bovee, K.D. and T. Cochnauer. 1977. Development and evaluation of weighted criteria, probability-of-use curves for Instream flow assessments: fisheries. Instream Flow Information Paper 3. United States Fish and Wildlife Service FWS/OBS-77/63. 38pp.

Massachusetts Consolidated Assessment and Listing Methodology (CALM) Guidance Manual (2022). https://www.mass.gov/doc/2022-consolidated-assessment-and-listing-methodology-guidance/download

Nelson, F.A., 1984, Guidelines for using the wetted perimeter (WETP) computer program of the Montana Department of Fish, Wildlife, and Parks: Bozeman, MT, Montana Department of Fish, Wildlife, and Parks, variously paged.

[4] USGS Montague Gage #01170500, 1980 to 2020.

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

	)	
FirstLight Hydro MA LLC	)	Docket No. 1889-000
	)	
Northfield Mountain LLC	)	Docket No. 2485-000
	)	

DECLARATION

DONALD PUGH states that I prepared the affidavit to which this declaration is attached and that the statements contained therein are true and correct to the best of my knowledge and belief.

Pursuant to Rule 2005(b)(3) (18 CFR § 385.2005(b)(3), citing 28 U.S.C. § 1746), I further state under penalty of perjury that the foregoing is true and correct.

Executed on May 24, 2023.

/s/ *Donald Pugh*

Donald Pugh

Exhibit A

Donald H. Pugh, Jr.
10 Old Stage Road
Wendell, MA 01379
Telephone 978 544 7438 Office
413 387 9439 Cell

Work History:

Self Employed

Current projects:

Maryland Power Plant Research Project – relicensing of Conowingo Project (FERC # 405) on the Susquehanna River and post-license studies at Holtwood (FERC # 1881) and York Haven (FERC # 1888) upstream of Conowingo. Principle areas of responsibility include: up- and downstream fish passage, telemetry data analysis, fish biology, habitat-flow analysis, American eel passage, fisheries management plans, and fish passage facilities development.

SWCA, Inc. – Shortnose and Atlantic sturgeon habitat and protection plans for sewer line crossing construction on the Connecticut River, Springfield, Massachusetts.

Maine Rivers – relicensing of three projects on the Mousam River (FERC # 14856).

Kennebec Coalition – review and data analysis of downstream smolt radio telemetry studies (2012 – 2015) at four hydroelectric projects and the upstream fish passage plan at the Shawmut project on the Kennebec River (FERC #s 2574, 2611, 2322 & 2325).

Atlantic Salmon Federation – assist ASF with FERC relicensing of hydro projects on the Penobscot River, Maine (FERC #s 4202, 5912 & 2600). Review of study reports FERC filings for all listed projects and ongoing consultation with agencies and Brookfield Renewable Partners L.P.

Natural Resource Council of Maine – review and analysis of Biological Assessments, Species Protection Plans and Biological Opinions for Atlantic salmon on the Kennebec River, Maine.

Geosyntec consultants - Shortnose and Atlantic sturgeon habitat and protection plans for river bank stabilization on the Merrimack River, Haverhill, Massachusetts.

Member of the Holyoke Cooperative Consultation Team for the Holyoke Hydroelectric Project (FERC #2004). Post-licensing downstream fish passage planning including configuration of the downstream passage protection structure, review of CFD analysis, analysis of telemetry data of American shad, shortnose sturgeon, and American eel during post licensing studies.

Connecticut River Conservancy, February 2016 to May 2018

Relicensing of First light hydroelectric projects on the Connecticut River at Turners Falls (FERC # 1889) and the Northfield Mountain Pumped Storage Station (FERC #2485). Reviewed study plans, study reports, IFIM review, shortnose sturgeon spawning flow needs analysis, and shad telemetry analysis. Participated in settlement talks with company, state and federal agencies, and NGOs.

Santo Antônio , January 2010 to June 2011

TIRIS PIT tag installation, data analysis, and fish passage consultation for an experimental fish passage flume on the Rio Maderia, Brazil.

American Rivers, April 2010 to November 2011

Represented American Rivers for the relicensing of three projects on the Susquehanna River – Conowingo Dam, Muddy Run Pumped Storage Project and York Haven Dam. Participated in study plan development, reviewed study reports and prepared comment letters, attended meetings with the project owners, the FERC, state and federal agencies, and NGO's. Developed and independent analysis of American shad telemetry data at York Haven and Conowingo.

University of Massachusetts, Amherst MA January 1997 to January 2009

Research Assistant in the Department of Natural Resource Conservation working at the Silvio O. Conte Anadromous Fish Research Center. Areas of research include the behavior and movement of adult Atlantic salmon in the Westfield River in Massachusetts using radio telemetry, upstream passage of sturgeons and riverine fishes in a spiral fishway, spawning behavior of shortnose sturgeon in an artificial 'stream, and downstream passage of sturgeons at a bar rack and louver system with a low level bypass entrance.

Massachusetts Cooperative Fisheries and Wildlife Research Unit, University of Massachusetts, Amherst MA
March 1991 to January 1997

Project Leader for Anadromous Fish Investigations project. Duties include: hire and supervise technicians staffing the Holyoke, Turners Falls, and Westfield River fish passage facilities; conduct recreational angler creel surveys, Atlantic salmon habitat assessment, and juvenile growth and survival estimates; supervise stocking of Atlantic salmon fry for the Connecticut River basin in Massachusetts; coordinate Unit operations with utility companies and state and federal agencies; and prepare budgets and reports.

Education:

Undergraduate

Trinity College
Hartford, CT 1967-71, B.A.
Major: History
Specialty: American History

Continuing Ed.

Greenfield Community College
- Photography I, II & III, Fall 1980-81
- Engineering Drawing, Fall 1978
- Drafting for Engineers, Spring 1979
- Programming Principles and Concepts, Fall 2002
- Advanced Basic for Programmers, Spring 2002
- Database Programming and Procedures, Spring 2005
- Advanced Database Programming, Spring 2006

University of Massachusetts, Amherst
- Principles of Management, Fall 1981
- Microeconomics, Fall 1980
- Macroeconomics, Spring 1981
- Social Conflicts and Natural Resources, Spring 1991
- Biological Limnology, Fall 1991

Anadromous Fish, Fall 1991
Biostatistics, Fall 1991
Intermediate Biostatistics, Spring 1992
GIS, Spring 1992
Population Dynamics, Fall 1992
Animal Movement and Migration, Fall 1992
Coastal Zone Management, Spring 1993
Ichthyology, Fall 1993
Principles of Fisheries Stock Assessment, Spring 1994
Aquatic Invertebrates, Fall 1994
Freshwater Fisheries Management, 1997
Inland Fisheries Management, Spring 1999
Imaging in Fisheries Science, Fall 2000
Natural Resource Modeling, Spring 2001

American Fisheries Society Workshops
Fish Ageing, 1995
Stream Habitat Assessment, 1996

USFWS - National Education and Training Center
Principles and Techniques of Electrofishing, 1996

DOI-USGS – Motorboat Operator Certification Course, 2000

Certified S.O. Conte Anadromous Research Center dive team member

S.O. Conte Fish Research Projects:

Atlantic salmon behavior and movements in the Westfield River, Massachusetts 1996 to 1998 – wild adult Atlantic salmon returning to the Westfield River were internally radio tagged and released into the upper Westfield River. Fish were tracked with fixed stations and with manual tracking. Movement, habitat choice, spawning, and post-spawning behavior were evaluated. Domestic broodstock Atlantic salmon were also radio tagged and released to assess their spawning potential to contribute to the salmon restoration effort in the Connecticut River basin.

Spiral fishway 2001 to 2007 – evaluation of a spiral, side baffle fishway designed for upstream sturgeon fish passage. Sturgeon, a benthic fish, need a fishway that allows upstream movement while maintaining close proximity to the bottom of the fishway. The spiral uses side baffles to reduce velocity and provide depth allowing fish to move in a sinusoidal curve along the bottom of the channel. Sturgeon movement was evaluated with a PIT tag system detecting fish at the entrance and exit of the fishway and at four points along each of two loops. Riverine fish were also evaluated in the spiral fishway.

Shortnose sturgeon spawning behavior 2002 to 2008 – the spawning behavior of wild Connecticut River shortnose sturgeon was evaluated in an artificial stream. Mating behavior, mate choice, velocity preference, egg to larvae survival, and embryo and larval dispersal timing were evaluated.

Downstream passage and behavior studies of shortnose sturgeon 2004 and 2005 – yearling, juvenile and adult shortnose sturgeon were evaluated for swimming depth, behavior at and movement along a bar rack, entrainment and impingement, and willingness to enter an opening in the bar rack at three different approach velocities. Pressure sensitive (depth) and radio tags were used to assess swimming depth for both upstream and downstream movement in a 20’ by 120’ flume with a velocity of 1 ft/sec. PIT tags and video were used to assess individual fish movement and behavior at a bar rack oriented 90º to flow at velocities of 1, 2 and 3 ft/sec.

Downstream movement of yearling shortnose sturgeon 2004 and 2006 – yearling shortnose sturgeon (Connecticut River stock in 2004 and Savannah River stock in 2006) were evaluated in a large outdoor oval channel with a river stone substrate to determine the timing, frequency and duration of upstream and downstream movements. Fish were tested for 48 hours on a monthly basis from June through November. PIT tags and five antennas were used to determine movement.

Low level orifice use of sturgeon at an angled bar rack and louver 2006 to 2008 – green, lake, Savannah and Connecticut River shortnose sturgeon of different year classes were tested in a 10' by 120' flume at two bar rack angles (45º and 30º) and one louver angle (26º) with two velocities at the orifice. Approach velocity (2 ft/sec) and water depth (7.5') remained constant for all trials. Fish were tested both day and night. Video and PIT tags were used to determine individual fish movement, behavior at the bar rack and passage through the orifice and pipe which transported fish downstream to a holding area.

Past Relicensing Projects:

Bear Swamp Hydroelectric Project – FERC # 2669

Relicensing of project through the ILP.

Deerfield River Project – FERC # 2323, License issued 1997

Deerfield River Compact – precursor to relicensing, all stakeholders in relicensing, including New England Power Co., met on a regular basis to discuss issues. Final report issued.

Deerfield River Settlement – followed the conclusion of the Deerfield River Compact with similar discussions as to the issues involved in relicensing with the goal of reaching agreement on environmental mitigation prior to issuing or license. Represented Trout Unlimited in meetings with state and federal agencies, New England Power Co. and other NGO's which reached an agreement that was incorporated into and was the basis of relicensing by the FERC.

Holyoke – FERC # 2004, Connecticut River

Relicensing of project – bypass minimum flows, downstream fish passage (salmon smolts, adult Atlantic salmon, American eels, clupeids, and riverine fish), upstream passage (adult Atlantic salmon, clupeids, American eels, and riverine fish) freshwater mussel protection, flow priorities (bypass reach, canal, up- and downstream fish passage, hydrogenation, run of river protection of federally threatened tiger beetle), and disabled angler fishing access.

Comments to both company and the FERC concerning above listed issues.

Participant in CCT meetings representing Trout Unlimited concerning above listed issues. CCT consists of Holyoke Gas & Electric (project owners), state and federal agencies, and NGO's (Trout Unlimited and Connecticut River Watershed Council).

Indian River – FERC # 12462, Westfield River

Licensing of project – bypass minimum flows, freshwater mussel protection, downstream fish passage (salmon smolts, adult Atlantic salmon, American eels, riverine fish), upstream passage for American eels.

Participation in ongoing fish passage discussions regarding both up- and downstream passage issues.

L.S. Starrett Co. – FERC # UL09-01, Millers River

Installation of new turbine initiated local Conservation Commission and Massachusetts Department of Environmental Protection actions presently on hold due to a FERC order of jurisdiction dated October 21, 2009.

Intervened in Massachusetts Department of Environmental Protection appeal by Starrett of a Superseding Order of Conditions.

Commented to the FERC concerning Starrett Motion for Stay of Order of Jurisdiction regarding downstream fish passage.

Muddy Run Pumped Storage Project – FERC # 2355, Susquehanna River. Contracted by Maryland Power Plant Project to provide biological and fish passage assistance during relicensing and post licensing. Principle issues are entrainment and the impact of the project on river flows.

New Home Dam Project – FERC # 6096, Millers River

Post licensing flow issues - run of river requirement.

Northfield Mountain Pumped Storage Project – FERC # 2485, Connecticut River

License amendment allowing more storage in upper pond. River bank erosion concerns. Amendment application withdrawn.

Woronoco – FERC # 2631, Westfield River

Relicensing of project and 401 certification – bypass minimum flows, freshwater mussel protection, downstream fish passage (salmon smolts, adult Atlantic salmon, American eels, riverine fish), upstream passage for American eels, and recreation issues.

Analyzed telemetry data from downstream smolt test to provide independent review of results.

York Haven – FERC # 1888, Susquehanna River

Contracted by Maryland Power Plant Project to provide biological and fish passage assistance during relicensing. Relicensing is currently involved in settlement discussions with project owner, Olympus Power. Principle issues are up- and downstream fish passage for American shad and American eel and bypass flows.

Publications:

Kynard, B., D. Pugh, and T. Parker. 2003. Development of a fish ladder to pass lake sturgeon. Great Lakes Foundation, Final Report, Lansing Michigan.

Kynard, B., E. Parker, D. Pugh, T. Parker. 2007. Use of laboratory studies to develop a dispersal model for Missouri River pallid sturgeon early life intervals. J. Appl. Ichthyol. 23(4), 365-374.

Kynard, B., M. Horgan, D. Pugh, E. Henyey and T. Parker. 2008. Using juvenile sturgeon as a substitute for adults: a new way to develop fish passage for large fish. American Fisheries Society Symposium 61: 1-21.

Kynard, B., M. Kieffer, E. Parker, D. Pugh and T. Parker. 2012. Lifetime movements by Connecticut River sturgeon. In Life history and behavior of Connecticut Rver shortnose sturgeon and other sturgeons. B. Kynard, P. Bronzi, and H. Rosenthal Editors. World Sturgeon Conservation Society: Special Publication #4. Norderstedt, Germany.

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Exhibit B

Table 7.1.1.2-2: Percentage of the Maximum Weighted Usable Area (WUA) for Various Flows within Reach 1 (Transects 10 & 11) for High Backwater Condition

Species	Life stage	Months Present	Maximum WUA Flow (cfs)	Maximum WUA (ft2)	120 (cfs)	150 (cfs)	200 (cfs)	250 (cfs)	400 cfs)	500 (cfs)	600 (cfs)	700 (cfs)	800 (cfs)	1000 (cfs)	1200 (cfs)	1400 (cfs)	1600 (cfs)	1800 (cfs)	2000 (cfs)	3000 (cfs)	4000 (cfs)	5000 (cfs)
					0.02 (cfsm)	0.02 (cfsm)	0.03 (cfsm)	0.03 (cfsm)	0.06 (cfsm)	0.07 (cfsm)	0.08 (cfsm)	0.1 (cfsm)	0.11 (cfsm)	0.14 (cfsm)	017 (cfsm)	0.2 (cfsm)	0.22 (cfsm)	0.25 (cfsm)	0.28 (cfsm)	.42 (cfsm)	0.56 (cfsm)	0.7 (cfsm)
American Shad	Juvenile	June-Oct	2,000	668,444	43.9%	47.7%	53.5%	58.6%	52.9%	55.3%	57.5%	59.2%	61.2%	64.6%	74.4%	83.0%	88.7%	94.4%	100.0%	95.5%	88.1%	80.6%
Fallfish	Juvenile	Year Round	1,800	260,011	57.8%	63.6%	71.2%	77.0%	73.3%	74.3%	76.2%	77.6%	79.5%	82.8%	89.5%	93.4%	98.0%	100.0%	99.5%	80.4%	61.6%	44.0%
Fallfish	Adult	Year Round	2,000	549,907	67.5%	70.9%	76.2%	80.6%	75.7%	75.7%	71.2%	67.1%	63.5%	59.8%	70.4%	80.6%	86.7%	93.4%	100.0%	89.6%	74.3%	60.5%
Longnose Dace	Juvenile	Year Round	1,800	155,504	13.0%	16.4%	22.0%	27.6%	23.1%	27.7%	31.3%	34.2%	37.4%	44.0%	64.0%	81.7%	95.7%	100.0%	94.9%	39.8%	12.7%	3.6%
Longnose Dace	Adult	Year Round	2,000	413,608	9.3%	11.7%	15.8%	19.8%	16.1%	18.5%	20.4%	22.8%	25.4%	31.5%	51.4%	69.4%	84.2%	94.0%	100.0%	54.4%	17.0%	4.2%
White Sucker	Adult/Juvenile	Year Round	250	362,803	75.0%	85.5%	95.4%	100.0%	82.0%	71.1%	60.5%	50.9%	43.7%	45.5%	63.6%	77.0%	78.1%	73.4%	63.4%	29.9%	8.2%	2.6%
Walleye	Juvenile	Year Round	120	870	100.0%	82.4%	52.9%	32.4%	26.5%	23.5%	17.6%	14.7%	11.8%	8.8%	4.7%	3.5%	3.5%	2.4%	2.9%	0.0%	0.0%	0.0%
Walleye	Adult	Year Round	120	36,453	100.0%	80.4%	48.8%	24.5%	19.4%	15.8%	13.0%	12.9%	12.9%	13.1%	13.5%	14.1%	14.6%	14.9%	15.6%	20.0%	14.3%	4.4%
Tessellated Darter	Adult/Juvenile	Year Round	1,800	133,736	12.2%	15.4%	20.9%	26.5%	18.0%	22.0%	26.7%	31.9%	36.7%	45.3%	66.1%	84.5%	98.2%	100.0%	96.7%	28.7%	0.9%	0.0%
Macroinvertebrates	Larva	Year Round	4,000	918,412	0.0%	0.1%	0.4%	0.9%	6.0%	10.0%	14.0%	17.7%	21.3%	26.9%	30.4%	36.1%	44.7%	55.2%	67.1%	91.6%	100.0%	97.6%
Shallow Slow	Shallow Slow	Year Round	700	818,354	93.6%	94.1%	95.4%	97.1%	96.6%	97.5%	98.3%	100.0%	100.0%	93.0%	80.8%	78.2%	75.5%	71.7%	68.0%	21.5%	0.0%	0.0%
Shallow Fast	Shallow Fast	Year Round	1,600	535,297	24.8%	30.7%	40.4%	49.7%	26.1%	31.1%	36.2%	41.7%	49.0%	63.3%	83.5%	96.4%	100.0%	97.1%	88.9%	32.3%	9.1%	2.9%
Deep Slow	Deep Slow	Year Round	500	615,160	90.7%	91.4%	93.3%	95.7%	96.1%	100.0%	88.5%	65.6%	59.0%	67.0%	73.3%	78.9%	80.3%	64.2%	54.8%	22.2%	3.6%	1.2%
Deep Fast	Deep Fast	Year Round	3,000	124,411	2.4%	6.7%	15.0%	23.1%	37.8%	53.4%	69.1%	79.4%	82.8%	89.5%	88.3%	89.1%	91.6%	94.4%	99.6%	100.0%	89.8%	52.9%

Exhibit C

Habitat in square feet for species and life stages present in Reach 1 from July 1 to November 15 as calculated from Table 7.1.1.2-2 (Exhibit B).

Species	Life stage	Months Present	Maximum WUA Flow (cfs)	Maximum WUA (ft2)	120 (cfs)	150 (cfs)	200 (cfs)	250 (cfs)	400 cfs)	500 (cfs)	600 (cfs)	700 (cfs)	800 (cfs)	1000 (cfs)	1200 (cfs)	1400 (cfs)	1600 (cfs)	1800 (cfs)	2000 (cfs)	3000 (cfs)	4000 (cfs)	5000 (cfs)
					0.02 (cfsm)	0.02 (cfsm)	0.03 (cfsm)	0.03 (cfsm)	0.06 (cfsm)	0.07 (cfsm)	0.08 (cfsm)	0.1 (cfsm)	0.11 (cfsm)	0.14 (cfsm)	017 (cfsm)	0.2 (cfsm)	0.22 (cfsm)	0.25 (cfsm)	0.28 (cfsm)	.42 (cfsm)	0.56 (cfsm)	0.7 (cfsm)
American Shad	Juvenile	June-Oct	2,000	668,444	293,447	318,848	357,618	391,708	353,607	369,650	384,355	395,719	409,088	431,815	497,322	554,809	592,910	631,011	668,444	638,364	588,899	538,766
Fallfish	Juvenile	Year Round	1,800	260,011	150,286	165,367	185,128	200,208	190,588	193,188	198,128	201,769	206,709	215,289	232,710	242,850	254,811	260,011	258,711	209,049	160,167	114,405
Fallfish	Adult	Year Round	2,000	549,907	371,187	389,884	419,029	443,225	416,280	416,280	391,534	368,988	349,191	328,844	387,135	443,225	476,769	513,613	549,907	492,717	408,581	332,694
Longnose Dace	Juvenile	Year Round	1,800	155,504	20,216	25,503	34,211	42,919	35,921	43,075	48,673	53,182	58,158	68,422	99,523	127,047	148,817	155,504	147,573	61,891	19,749	5,598
Longnose Dace	Adult	Year Round	2,000	413,608	38,466	48,392	65,350	81,894	66,591	76,517	84,376	94,303	105,056	130,287	212,595	287,044	348,258	388,792	413,608	225,003	70,313	17,372
White Sucker	Adult/Juvenile	Year Round	250	362,803	272,102	310,197	346,114	362,803	297,498	257,953	219,496	184,667	158,545	165,075	230,743	279,358	283,349	266,297	230,017	108,478	29,750	9,433
Walleye	Juvenile	Year Round	120	870	870	717	460	282	231	204	153	128	103	77	41	30	30	21	25	0	0	0
Walleye	Adult	Year Round	120	36,453	36,453	29,308	17,789	8,931	7,072	5,760	4,739	4,702	4,702	4,775	4,921	5,140	5,322	5,431	5,687	7,291	5,213	1,604
Tessellated Darter	Adult/Juvenile	Year Round	1,800	133,736	16,316	20,595	27,951	35,440	24,072	29,422	35,708	42,662	49,081	60,582	88,399	113,007	131,329	133,736	129,323	38,382	1,204	0
Macroinvertebrates	Larva	Year Round	4,000	918,412	0	918	3,674	8,266	55,105	91,841	128,578	162,559	195,622	247,053	279,197	331,547	410,530	506,963	616,254	841,265	918,412	896,370
Shallow Slow	Shallow Slow	Year Round	700	818,354	765,979	770,071	780,710	794,622	790,530	797,895	804,442	818,354	818,354	761,069	661,230	639,953	617,857	586,760	556,481	175,946	0	0
Shallow Fast	Shallow Fast	Year Round	1,600	535,297	132,754	164,336	216,260	266,043	139,713	166,477	193,778	223,219	262,296	338,843	446,973	516,026	535,297	519,773	475,879	172,901	48,712	15,524
Deep Slow	Deep Slow	Year Round	500	615,160	557,950	562,256	573,944	588,708	591,169	615,160	544,417	403,545	362,944	412,157	450,912	485,361	493,973	394,933	337,108	136,566	22,146	7,382
Deep Fast	Deep Fast	Year Round	3,000	124,411	2,986	8,336	18,662	28,739	47,027	66,435	85,968	98,782	103,012	111,348	109,855	110,850	113,960	117,444	123,913	124,411	111,721	65,813

Princeton Hydro

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Resource Management

December 7, 2016

MEMORANDUM

To: Andrea Donlon, CRWC
David Deen, CRWC

From: Laura Wildman, P.E., Princeton Hydro, LLC
Paul Woodworth, Fluvial Geomorphologist, Princeton Hydro, LLC
Melinda Daniels, PhD, Fluvial Geomorphologist, Stroud Water Research Center

Re: FERC Re-Licensing Process for FirstLight Power Resources Inc.
Peer-Review of Relicensing Study 3.1.2 Northfield Mountain / Turners Falls Operations Impact on Existing Erosion and Potential Bank Instability Study Report (October 2016)
Princeton Hydro Bullet List of Major Points

The Connecticut River Watershed Council (CRWC) is a stakeholder and participant in the re-licensing process of the Federal Energy Regulatory Commission (FERC) for two hydropower facilities owned by FirstLight Power Resources Inc. on the Connecticut River, Northfield Mountain and Turners Falls Operations. Princeton Hydro, with the Stroud Water Research Center, was retained by CRWC to complete a peer-review of Relicensing Study 3.1.2, Northfield Mountain / Turners Falls Operations Impact on Existing Erosion and Potential Bank Instability Study Report, Volume I – Executive Summary and Summary Report, Volume II – Main Report, and Volume III – Appendices, dated October 2016. As part of this work, we reviewed the Revised Study Plan (RSP), dated August 14, 2013, and the FERC Study Plan Determination dated September 13, 2013. Revisions to the approved RSP were made by FirstLight to incorporate an analysis of the effects of icing (see Initial Study Report dated September 15, 2014). In addition, the Updated Study Report dated September 14, 2015 indicated that the study methods for the boat wave analysis deviated from the RSP, and that boat wave sensors were installed along the river[1].

FRAMEWORK FOR THIS PEER REVIEW

Our comments have been structured to address the questions outlined within the Integrated Licensing Process (ILP) regulations 18 CFR § 5.15(d)(1) regarding Conduct of Studies, specifically:

Were the studies completed as per the Revised Study Plan?

1. Were the objectives set in the Revised Study Plan (RSP) met?
2. Was the analysis described in the RSP conducted? And if not, what was omitted.
3. Were the methods described in the RSP utilized?
4. Was the Study conducted in a manner consistent with generally accepted scientific practice?

[1] Our review was limited to the RSP and Relicensing Study 3.1.2, Volumes I through III. No field work was conducted as part of our review, so we cannot comment if the observations stated in the study accurately reflect field conditions within the project reach, and if the observations were applied in an impartial manner. In addition, we did not review the numerous other studies submitted to FERC as part of FirstLight's recent submittal.

5. Were the conclusions of the study consistent with the scientific evidence presented?
6. Were the deliverables promised in the RSP included in the final study report submittal?

As stated in the RSP, the goal of Study 3.1.2 is to "evaluate and identify the causes of erosion in the Turners Falls Impoundment and to determine to what extent they are related to Project operations." Due to the complexity of the study and the length of the report volumes, our review primarily focused on two of the objectives to meet the study goal:

- "Identify the causes of erosion present in the Turners Falls Impoundment, the forces associated with them, and their relative importance at a particular location. Conduct various data analyses to gain a better understanding of these causes and forces"
- "Conduct detailed studies and analyses of erosion processes at the fixed riverbank transects"
- "Evaluate the causes of erosion using the field collected data and the results of the proposed data analyses This evaluation will include quantifying and ranking all causes present at each fixed riverbank transect as well as in the Turners Falls Impoundment in general."

We have focused this memorandum summarizing our peer review into four primary categories. These categories are:

1. **Problems with the Analysis** – This section reviews specific problem areas regarding how the analysis proposed in the RSP was conducted.
2. **Omissions in the Analysis** – This section relates to omissions in the analysis.
3. **Problems with the Extrapolation Methodology** – This section reviews the methodology proposed and then how it was applied and expanded from the RSP.
4. **Validity of the Study Conclusions** – This section reviews the validity and impartiality of the conclusions resulting from the field data collection, analysis and methodology applied to synthesize and summarize the data.

For ease of review of this memorandum we have italicized, placed in quotes, and referenced page numbers for any text taken directly from the Revised Study Plan (RSP) and the Relicensing Study 3.1.2.

PROBLEMS WITH THE ANALYSIS

The Bank-Stability and Toe-Erosion Model (BSTEM) was used in the Relicensing Study 3.1.2 to understand the effects of hydraulic shear stress due to flowing water and the impact of water level fluctuations as related to the constant wetting and drying of the banks, and to quantify the relative percentages due to different causes of erosion, and to compare the results for the different causes analyzed. The use of BSTEM is consistent with the analysis proposed in the RSP. We agree that a BSTEM analysis is a generally accepted scientific practice appropriate for the proposed analysis.

However, we did find several problem areas with the BSTEM analysis. These either prevent us from being able to evaluate whether or not the work is consistent with generally accepted scientific practice, or indicate to us that the study goals were not met. We offer the following comments regarding the application of the BSTEM model by FirstLight and their consultants to assess the causes of erosion for the Turners Falls Impoundment (TFI).

1. **Difficult to review:** It was difficult to review the results of the BSTEM model without actually being given the input and output files, as well as the version of the program used for this assessment. There were multiple output graphs missing that might have helped in a more detailed review of this modeling effort, as discussed throughout this review.

In addition, the low resolution of multiple figures, particularly in Section 5 of Volume II, made them nearly impossible to read. Specifically, bank cross-section figures presented in Section 5.4.3 BSTEM Simulation Results were too pixelated and of low resolution to discern where the lines were overlapping or not, for the different model runs/simulations. The figure on page 364 of Volume II is an important figure to demonstrate impacts of water surface elevation (WSE) fluctuation but again was hard to read and does not seem to be repeated for all the cross-sections (also on page 410). This makes understanding and interpreting these results extremely difficult.

Recommendation: In order to facilitate stakeholder and FERC review of the study, many of the BSTEM figures should be regenerated at a higher resolution and submitted again. Where model results overlap so significantly that it is hard to differentiate each scenario run, the hidden and overlapping runs should be called out with leader lines and an explanation, to clarify what the figure is presenting.

2. **The Comparison of Erosion Rates by Volume of Material Eroded, Disregards Cyclical Erosion Process:** BSTEM analysis distinguishes 'hydraulic erosion' from 'geotechnical erosion' and calculates the volume eroded by each separately (Volume 1, page 43 and PDF page 51). The Relicensing Study 3.1.2 then takes these volumetric results and assesses each as a percent contribution to erosion (i.e. the larger the volume of sediment eroded from the bank for a given cause, the larger the percentage it is granted as a contributing cause). However, this approach seems to overlook the cyclical nature of this process, and disregards the causal relationship between the two modes of erosion. Specifically, hydraulic erosion at the toe of a bank can lead to geotechnical failure, which in turn can re-set the erosion process whereby hydraulic erosion then becomes dominant again, as noted on Figure 5.1.3-7, Volume II, page 5-22 [PDF page 305]). The importance of one mode of erosion (i.e. causes that initiate erosion at the toe of the bank) should not be dismissed based solely on the volume of material eroded, especially when it may instigate or perpetuate the cycle of erosion that later leads to a bank failure, for which this assessment would attribute only to a high flow event. Figure 5.1.3-7 in the Relicensing Study 3.1.2 also depicts how lower bank hydraulic erosion leads to upper bank geotechnical failure; therefore without lower bank erosion, the upper bank would remain stable. The volumetric approach transferred to percentages does not seem to allow for an assessment of the connectivity of causes.

   Recommendation: Because of the interconnected nature of various types of streambank erosion, toe erosion, which results in a small quantity of sediment eroded, can instigate a more significant bank failure during periods of high flow, resulting in larger quantity of sediment eroded. Specifically minor toe erosion caused by daily operational water surface fluctuations can instigate more significant erosion volumetrically during high flows. We recommend that the analysis be revised to include the causal nature of each contributing factor. Otherwise, the study goals and objectives from the approved RSP cannot be met, and a critical element of the cycle of erosion has been overlooked in this study.

3. **WSE Fluctuation Precludes Riverbank Vegetation:** Daily water surface fluctuations can preclude the establishment of stabilizing vegetation. The BSTEM analysis conducted did not include the likely change in geotechnical conditions of the bank if permanent vegetation were allowed to become established. This lack of vegetation likely occurs at the toe of the bank or the lower bank, where hydraulic erosion is likely greatest even at higher flows.

   Recommendation: We recommend that the BSTEM analysis be rerun to determine if the preclusion of vegetative growth due to operational induced WSE fluctuation is a contributing factor to streambank erosion.

4. **Upper and Lower Bank Terms are Used Inconsistently:** The report states that WSE fluctuation only acts on lower bank, or what the Study refers to as the beach area on page 5-208 and 5-217 in Volume II, but multiple graphs show it acting at toe of bank, "the intersection of upper and lower bank" according to their definitions.

   In addition, the lower bank definition used throughout the report is problematic. The beach-like lower bank identified, is not a bank feature but instead is a wave-cut terrace platform resulting from long-term erosion at the water surface. Water stage fluctuations correspond to this "lower bank" surface as indicated by plots of stage versus bank profiles. Photographs of these features clearly show ripples parallel to the upper, true, bank indicating wave motion and sediment transport perpendicular to the upper bank. The water contact point at the junction between upper and "lower" banks will continue to be a focus for wave/ice erosion.

   Recommendation: We recommend that this inconsistency between the analysis and report discussion be corrected. In addition, we recommend that the lower and upper bank definition be revised to correspond with the definitions consistent with general scientific practice, which typically include the toe of the bank within the lower bank.

OMISSIONS IN THE ANALYSIS

We offer the following comments regarding omissions in the analysis as prepared for the Relicensing Study 3.1.2., as per what was proposed for analysis in the Revised Study Plan (RSP).

5. **No Model Run Isolates the Effects of the Turners Falls Operations:** While the primary objective of this study was to "evaluate and identify the causes of erosion in the Turners Falls Impoundment (Connecticut River) and to determine to what extent they are related to Northfield Mountain and Turners Falls Project Operations" (Volume 1, page *i* [PDF page 2]), there was no analysis of data or a numerical modeling run that specifically targeted (e.g. by isolation or exclusion) the impacts of Turners Falls operations (Volume 1, page 26 [(DF page 34]). Hydraulic modeling and the Bank Stability Toe Erosion Model (BSTEM) was utilized to analyze existing conditions, along with the impacts of waves, and the Northfield Mountain Project operations, which were isolated in "Scenario 1". Northfield Mountain operations account for only 2 feet of WSE fluctuation during low flow (Volume 1, page 19). While the label "Scenario 1" implies that subsequent scenarios should follow, no comparable model run was performed that specifically targeted Turners Falls operations that would have provided a basis for comparison. Nor was there a run with all operation related WSE fluctuation "turned off", such that the impacts of the combined operational WSE fluctuations could be assessed. Without analyzing this additional modeling scenario (e.g. a "Scenario 2" or "Scenario 3"), the overall conclusions of this study are incomplete. Analysis of the effects of Turners Falls throughout the impoundment is simply dismissed by interpretation of the Energy Grade Line. The Energy Grade Line is not an absolute determination of the limit of influence of dam operations; wherever water levels fluctuate from dam operations, there is a potential for an impact.

   In addition we propose that a scenario be run that assesses the "instigating" role of toe erosion on proceeding streambank erosion under high flow scenarios (i.e. how toe erosion, relating to operational WSE fluctuation and associated ground water differentials, instigates additional bank failure during high flows). This additional scenario could be assessed by isolating erosion caused by high flows from its co-dependence on destabilizing toe erosion. For example, a scenario should be run where the toe of bank is stabilized for each site, compared to Baseline Conditions for all sites (excluding the restored versions of the sites) such that erosion rates can be assessed where relatively minor erosion at the toe is instigating future erosion at high flows. In absence of creating a scenario where all the toes of the streambank have been artificially stabilized, this could perhaps be assessed by comparing the sites that have both pre-stabilization and post-stabilization data, and determine if the toe stabilization implemented at these sites did, in fact, reduce the sites potential for erosion during both low and high flows.

Recommendation: We recommend that the entire Turners Falls Impoundment (TFI) be analyzed for impacts due to Turners Falls Dam, and at a minimum, this modeling scenario must be incorporated into the study prior to completion. Further, additional scenarios should also be completed that isolate (i) both Northfield Mountain Project Operations and Turners Falls Operations combined, (ii) the operations of Vernon Dam (e.g. a "Scenarios 3 and 4")., and (iii) the "instigating" role of toe erosion on proceeding streambank erosion.

6. **Large Portions of the Turners Falls Impoundment Remain Unassessed**:
Multiple additional runs and analysis seem to still be needed in BSTEM in order to complete the assessment proposed in the Revised Study Plan, see gaps shown in the table below. Many of these gaps were justified in the Study 3.1.2 Report under the rationale that operations only impacted the reach in which they were designated because of the use of the Energy Grade Line and the report's focus on the impacts of high flow. As previously stated, we do not agree with the application of the EGL assessment to justify the exclusion of reaches from analysis and we do not agree that operational WSE impacts are limited to the reaches where the facilities exist, since the analysis shows these impacts extending throughout the TFI. See table below that highlights the reaches not assessed in the Study 3.1.2 Report.

Primary Cause of Erosion	***Reach 1*** ***(Near Turners Falls Dam)***	***Reach 2*** ***(Vicinity of NFM tailrace)***	***Reach 3***	***Reach 4*** ***(Downstream of Vernon Dam)***
Moderate or High Flows	Assessed	Assessed	Assessed	Assessed
Boat (Waves)	Assessed	Assessed	Assessed	Assessed
Vernon Operations	Not Assessed	Not Assessed	Not Assessed	Assessed (but discounted for lower half of reach)
Northfield Mountain Operations	Not Assessed	Assessed (but discounted, even though model output showed significant impact)	Not Assessed	Not Assessed
Turners Falls Operations	Assessed, qualitatively, without BSTEM	Not Assessed	Not Assessed	Not Assessed
Land Use	Assessed qualitatively only			
Ice	Assessed qualitatively by visual observation only			

Recommendation: The analysis should be extended to include assessment of all the reaches for all of the primary causes of erosion. Segmenting the river into the four reaches and only looking at particular influences in that reach is not acceptable and does not meet the study goals laid out in the RSP.

7. **2D Modeling Not Used:** Previous comments were submitted by USFWS dated 1/12/16 regarding channel roughness and the use of the 2D modeling prepared for Study 3.3.9. It is unclear in reading

the Relicensing Study 3.1.2. if these corrections relating to the calibration of the roughness coefficients were implemented for the River2D model proposed for use in the RSP for this study. These corrections are critical, especially as they related to composite friction coefficients and the near bank velocity and shear stress computations. In addition, the USDA also conducted a peer review, comments dated 11/28/16, that explain how the River2D modeling results were not utilized to verify the hydraulic shear stresses estimated by BSTEM. Our review as well has noted the lack of integration of the 2D modeling results within the analysis.

The RSP in Task 5a stated on page 3-41 that, *"Both HEC-RAS and RIVER2D modeling will be used to analyze near-bank velocity to determine shear stress along the bed and riverbanks. RIVER2D computes velocity vectors showing the magnitude and direction of velocity across the channel at each node representing the channel geometry. Of particular interest are the velocity vectors in the near-bank region where the flow of water directly affects the bank. At the fixed riverbank transects, the velocity vectors will be determined over a range of flow conditions…. Results of RIVER2D will allow the analysis to focus on the region of the flow next to the banks where flowing water exerts hydraulic forces that directly affect the riverbanks."* However based on our peer review of the Study 3.1.2 Report, we cannot determine how or whether RIVER2D was used to revise near bank velocities and shear stresses, and if so, what values were used. In addition, RIVER2D appears to have been developed only for high flows, which is inconsistent with the RSP.

Recommendation: We recommend that FirstLight provide more information that would aid in stakeholder review, and we suggest that the USFWS and USDA recommendations be included in a revised analysis which incorporates the results of the 2D modeling to more accurately assess roughness and near bank velocities and shear stress.

8. **Key Figures are Not Provided:** Figures for each cross-section do not overlay the range of WSE fluctuation, which is a key component in interpreting bank erosion. In addition, no figure is provided comparing the WSE fluctuation for the Baseline Conditions versus Scenario 1. This figure would be important since it would highlight the fact that there was no scenario run that excluded daily WSE fluctuations associated with hydro-electric operations.

   Recommendation: We recommend that these additional figures be included in a revised Relicensing Study 3.1.2 so as to be in compliance with Task 4c of the RSP.

9. **Groundwater Analysis:** Based on the limited groundwater investigation described in the Study 3.1.2 Report, the observed groundwater level was approximately 1 foot above the river's water surface elevation. The USDA (11/28/16) review comments pointed out that this groundwater differential indicates "persistent movement of groundwater towards the TFI during lower flows, which may weaken the bank materials" and potentially "reduce the suction forces in the upper part of the bank". The USDA reviewer, who was one of the developers of BSTEM, states that based on his peer review it appears that "this reduction in bank-material shear-strength was not simulated" in BSTEM. We agree with the concerns stated in the USDA review and feel that this potentially critical reduction in bank material strength and suction forces needs to be integrated into the analysis in order to appropriately assess the impacts of daily operational WSE fluctuations. It is also noted that these field observation were conducted at one location only, approximately 50 feet away from the Connecticut River.

   Recommendation: We recommend a quantitative analysis be conducted to determine if the seepage force or increased pore-water pressure could not only weaken the bank material over a height of 1 foot above the water surface elevation of the river, but also reduce the suction forces in the upper part of the bank, as per the USDA observations, over the full length of the TFI.

10. **No Assessment of Downstream Impacts:** Given that the Study 3.1.2 Report includes an analysis and determination of impacts due to the upstream Vernon Dam operations on the TFI, it would follow that WSE fluctuations cause by the releases at the Turners Falls Dam are potentially impacting reaches downstream of the Turners Falls Dam. While the study added an assessment of the Vernon operation, the study does not assess the impacts on bank erosion that the Turners Falls Dam operations have on the reach downstream of Turners Falls Dam, and we recognize that assessment of the downstream reach was not included in the RSP. However because the Study 3.1.2 results do demonstrate that the Vernon operations impact streambank erosion within the TFI, it would follow that in a complete assessment of operational impacts due to TF and NFM on streambank erosion would include the reach downstream of Turners falls Dam..

    Recommendation: Any discussions of impacts downstream of Vernon Dam operations could be expanded to include potential impacts downstream of Turners Falls Dam and the power canal.

PROBLEMS WITH THE EXTRAPOLATION METHODOLOGY

In the Study 3.1.2 Report, the BSTEM analysis at each of the transects was extrapolated out into the entire reach of the streambanks between the Turners Falls Dam and the Vernon Dam. The RSP in Task 6 stated simply that, "This evaluation will include quantifying and ranking the primary causes of erosion present at each fixed riverbank transect as well as in the Turners Falls Impoundment in general." Therefore, the RSP provided no detail as to the methodology of the extrapolation process. Our review focuses on this methodology and identifies several flaws.

The following section regarding our review of the extrapolation methodology is divided into 7 sections, based on the 8 steps included in the extrapolation methodology utilized in the Relicensing Study 3.1.2, (summarized on pages 45-51 of Volume I); the final two steps have been grouped into one section. We start each section by briefly describing the methodology included for the step we are reviewing (shown in italics under the bolded name of the step), followed by our peer review comments regarding the implementation of the methodology for that step and our recommendations.

11. **Step 1: Analyze the variability of hydraulic forces throughout the TFI**
    This step defines the hydraulic reaches and limits the analysis based on them

    We do not agree with the determination that operations only impact the reach in which they have been allotted to in the Relicensing Study 3.1.2 (i.e. TF to Reach 1, NFM to Reach 2, and Vernon to Reach 4). The Energy Grade Line (EGL) approach described appears to only apply when looking at impacts associated with high flow (>37,000) where the 1-dimensional velocity and sheer stresses determined through HEC-RAS play a dominant role in erosion. The report is clear that for flows below 37,000 cfs (moderate and low flows as per their definition), which occur over 90% of the time according to Figure 4.3.1.2-17 from the October 30, 2012, PRE-APPLICATION DOCUMENT (see figure that follows), the hydroelectric operations of Turners Falls and Northfield Mountain are both controlling factors for the WSE elevation fluctuation throughout the entire TFI, and that for flows below 17,130 cfs, Turners Falls, Northfield Mountain, and Vernon operations are the dominant influence controlling WSE fluctuation throughout the entire TFI. The analysis should not be limited based on hydraulic reaches that only seem applicable for high flows when over 90% of the time the flows in the TFI are lower than the defined high flow, and almost all of the WSE fluctuation caused by the combined hydropower operations is happening below the defined high flow, which is only equaled or exceeded less than 10% of the time.

Figure 4.3.1.2-17 from the October 2012 Pre-Application Document: Shows the Annual Flow Duration Curve for the Connecticut River at Turners Falls Dam. We have overlain the high moderate and low flow thresholds, as described by the Relicencing Study 3.1.2 and their associated percentage of time equaled or exceeded.

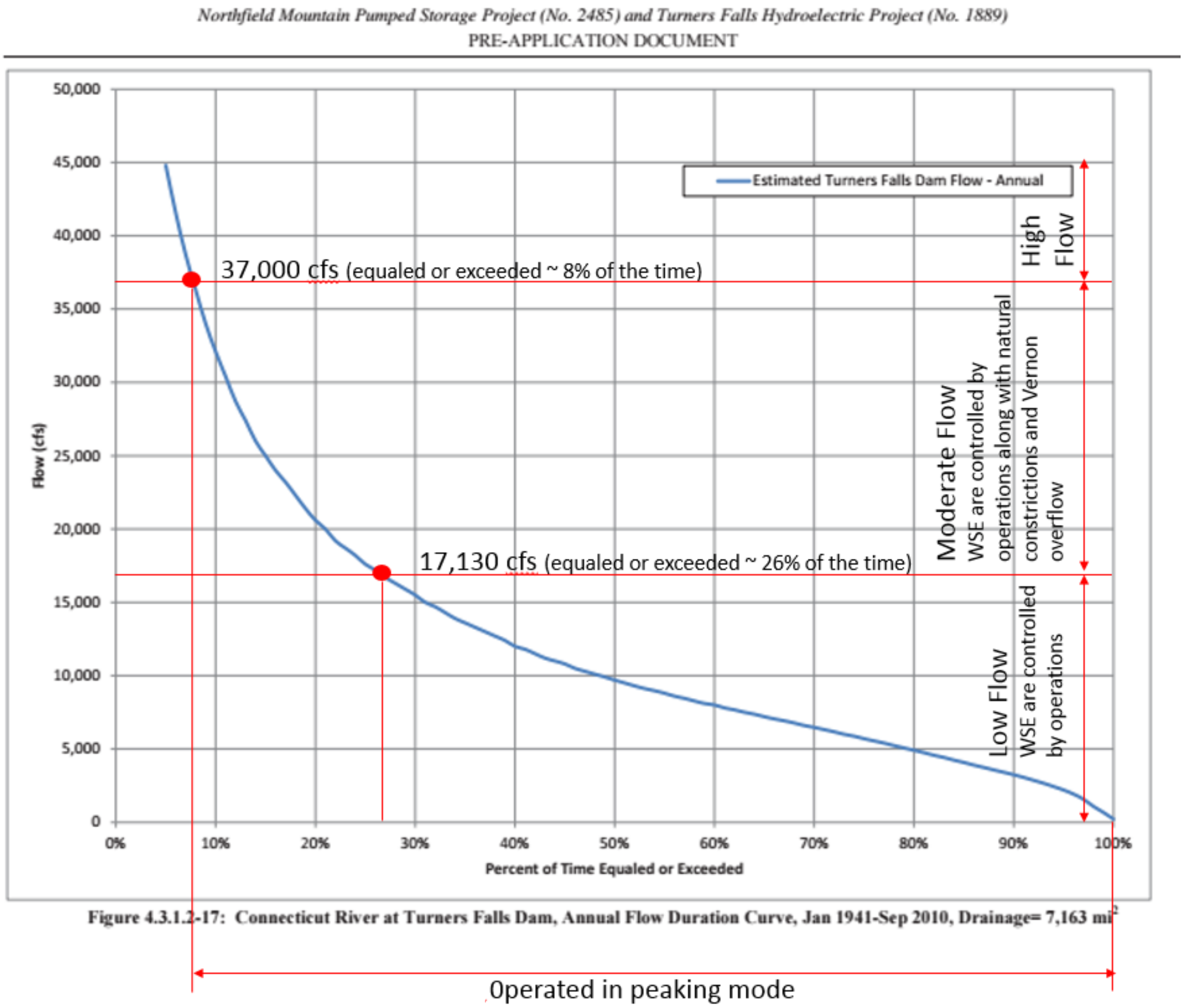


Figure 4.3.1.2-17: Connecticut River at Turners Falls Dam, Annual Flow Duration Curve, Jan 1941-Sep 2010, Drainage= 7,163 mi²

The assessment of the hydraulics and determination of hydraulic reaches using an energy grade line assessment, also did not incorporate the near-bank data that was supposed to have been developed from the 2D hydraulic modeling once the friction coefficients were corrected as per USFWS recommendations (1/12/16). Once corrected the 2D analysis would have provided more accurate near-bank hydraulic forces.

In addition, since stage-discharge relationships could not be determined for the Turners Falls Dam operations and limited study site data was available in the lower reach, the Turners Falls Dam operations were not assessed in a similar manner to Northfield Mountain operations, where operations were turned "off" or "on" and scenarios were then directly compared. Instead the TF operations were completely ruled out based on a series of assumptions and observations that were not quantifiable. This has been discussed in our comments #6 and #7 as well. Furthermore the USDA (11/28/16) review letter, written by one of the principal designers and developers of BSTEM, states that the development of stage-discharge rating curves to convert hourly stage values to discharge values, is not an appropriate method and cannot adequately represent the significant scatter in the flow versus depth data. It is noted that this inappropriate rating curve method was also used to set the threshold flows based on 10,000 cfs intervals (see page 30 Volume I). USDA also recommends that the accuracy of the BSTEM results would be improved if the flows and stage output from the HEC-RAS analysis had been used and that this would allow for the Turner Falls operations to be analyzed in a similar manner as was the Northfield Mountain operations.

The use of the energy grade line approach to segment reaches and assess only the reaches where the operations were located, was not included as part of the methodology described in the Revised Study Plan (page 3-40 to 3-41). Nor was the conversion of stage values to discharge values, to calculate erosion exceedance probabilities, included in the RSP. Therefore these two approaches within the methodology were not previously reviewed or agreed upon by the stakeholders.

Recommendation: For Step 1 in the methodology, we recommend that the impacts of operation be assessed throughout the entire impoundment reach and not be limited to the single reach the facilities are in, especially when assessing impacts during moderate and low flows. We therefore recommend that the delineation of 4 reaches, based on the EGL assessment under high flows, be disregarded, and not used to limit the analysis of impacts throughout the TFI. Our recommendation is supported by the fact that Study 3.1.2 makes it clear that the hydroelectric operations of Turners Falls and Northfield Mountain are both controlling factors for the WSE elevation fluctuation throughout the entire TFI for flows that occur over 90% of the time.

We recommend that the results from the 2D modeling be incorporated into the analysis to better calibrate the near-bank data utilized.

We recommend that the method of converting hourly stage into discharge, and then using the resulting hourly discharge erosion records to calculate erosion exceedance probabilities, be discarded. The BSTEM model should then be run with the stage and discharge data from the HEC-RAS modeling, thereby eliminating the error associated with this approach (as described in the USDA 11/28/16 review memo) and allowing for a BSTEM analysis of the impacts of the TF operations to be conducted.

12. **Step 2: Analyze and review the site specific BSTEM results**

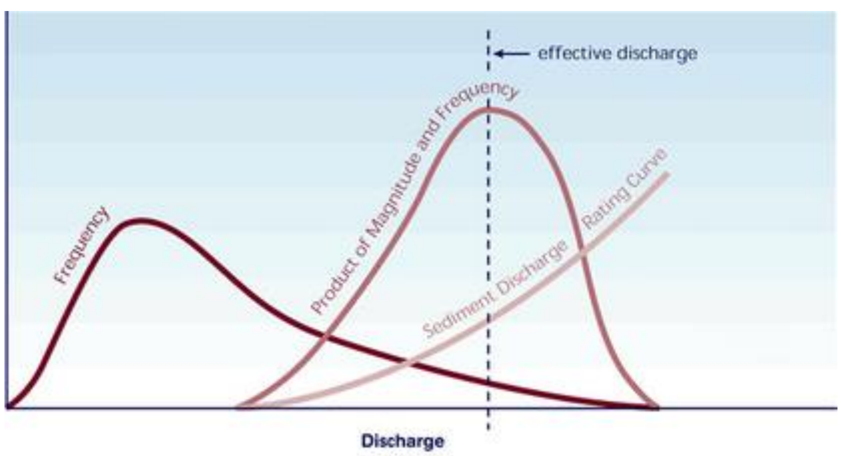
This step defines which study sites are dominant or contributing

While the RSP stated that both primary and secondary causes of erosion would be assessed, it did not give a definition of those terms. The Relicensing Study 3.1.2 now renames these causes to dominant primary, contributing primary and secondary causes (page 621-622 of Vol II). It then arbitrarily defines the dominant primary as “one that is responsible for 50% (or >50%) of the erosion at a cross-section” and the contributing primary as being responsible for between 50% and 5% of the erosion at a cross-section. This was not described in the Revised Study Plan, nor was it agreed to by the stakeholders. These definitions are arbitrary in nature, lead to dismissing lesser but still important causes, and disregard multiple site specific impact results that come very close to the 5% limit that are associated with operational WSE fluctuations. Once a cause has been dismissed as not being a “dominant primary cause” it is then interpreted as 0% in the subsequent steps of the assessment. This is just one example where the Relicensing Study 3.1.2 uses arbitrarily assigned thresholds, not included in the Revised Study Plan, that potentially introduce bias to the results and limit what is truly being assessed (other examples include the flow thresholds, and the delineation of hydraulic reaches). Later in the Relicensing Study 3.1.2 (as shown on page 38 Vol 1) the document classifies the sites having “measurable/significant rates of bank erosion” by stating “[I]in order to be classified as having measurable/significant rates of bank erosion, the rate of erosion at a given site must be greater than the erosion rate that represents the lowest 5% of all rates or 0.163 ft3/ft/yr.” Again the threshold applied seems arbitrary and in this case includes restored sites with little erosion post stabilization of the toe of bank.

It is noted that the use of these arbitrary thresholds to define dominant primary and contributing causes, as well as to define what are measurable/significant rates of bank erosion, was not included as part of the methodology described in the Revised Study Plan, and therefore the use of these thresholds was never agreed upon by the stakeholders or FERC.

In addition, step 2 of the methodology weighs anthropogenic factors against the significant river-forming natural processes, which significantly biases the results because the volumetric values associated with erosion of a particular type (i.e. WSE fluctuation) are converted to relative percentages and compared against the contributing percentages that are associated with natural river-forming processes. This approach ends up dismissing anthropogenic impacts such as WSE fluctuation merely because volumetrically they do not compare to the natural forming processes of a river. This approach also does not seem to adequately account for key causes that initiate larger bank stability issues as described in our review comment #2 and #6.

By lumping natural sediment transport/erosion processes (i.e. the effects of high flow events) with anthropogenic causes of erosion (i.e. WSE fluctuation due to operations) when determining the final percentages, and basing these percentages on a comparison of volumetric estimates of erosion, critical anthropogenic causes are discounted just because they do not compare in magnitude to the natural forming processes of a river. While the RSP does says they will assess the impacts of high flow, the final result is that they have proved that rivers are primarily formed by flow, and that the highest percentage of channel formation (i.e. sediment transport and erosion) is accounted for during higher flow events. These are all things we already know about rivers based on simplified theories of effective discharge (see graph below).



From Wolman and Miller, 1960. Fig. 7.5 – Effective discharge determination from sediment rating and flow duration curves. In Stream Corridor Restoration: Principles, Processes, and Practices, 10/98. Interagency Stream Restoration Working Group (FISRWG)(15 Federal agencies of the US).

However, studies conducted under the Integrated Licensing Process (ILP) are geared towards evaluating impacts of project operations on streambank erosion and if these impacts instigate additional long-term erosion. For example we know that the sun heats the earth, we also know that climate change due to anthropogenic impacts is a reality. However, if we were to compare the percent increase in warming due to climate change to the percent of daily warming that the sun provides, and then state that the causes only matter if the account for more than 50% of the solar warming, we would basically end up concluding that the anthropogenic effects of climate change are negligible and therefore, should not be addressed.

Recommendation: We recommend that Step 2 of the study methodology (and any other steps where arbitrary thresholds not listed in the RSP were utilized) be reanalyzed after agreed upon thresholds have been vetted and approved by the stakeholders and FERC. We also suggest that an additional "cause of erosion" be defined and included in the analysis that looks at potential "instigating" causes of erosion, not solely based on volumetric comparisons of the percent of erosion to value contributing significance. This may allow for a better distinction between natural erosion and channel forming processes and how anthropogenic impacts (such as operational WSE fluctuations) might be inducing additional long-term stream bank erosion.

13. **Step 3: Analyze the Riverbank Features, Characteristics, and Erosion Conditions**

This step identifies which segments are "similar" to the studied sites

It is difficult for us to review this step in any detail, since no field verification was included in our peer-review budget and tight timeline and data referenced from 1998 were not shown in the Study 3.1.2 Report. However the analysis for this step seems to show significant bias, relating to how the analysis was limited to comparisons to specific hydraulic reaches, (even when the Qe_{95} was low), and how the results to other segments were subjectively compared (only within given reaches and seemingly only considered similar when they were near exact matches) to extrapolate river lengths impacted by varying causes. An example of this potential bias has been extracted below:

> *"A similar analysis was then conducted for Site 8BR-Pre. Due to the fact that 8BR is a restoration site, the riverbank features and characteristics as observed during the 1998 FRR were compared against the features and characteristics identified during the 2013 FRR for all riverbank segments found in reach 2 to <u>determine if similarities exist</u> at other locations within the reach. <u>No riverbank segments were found</u> in reach 2 with the <u>same</u> characteristics as were observed at Site 8BR in 1998. Although <u>no</u> riverbank segments were <u>found to be an exact match</u>, three FRR segments were identified as having <u>very similar characteristics</u> – 75, 87, and 109."* (Page 47 Vol I; emphasis added)

This paragraph from the report above shows how the results of this step of the extrapolation methodology can be easily subjectively biased toward a specific outcome. The report stated that they would determine if "similar" reaches existed, they then state none were found based on their conclusion that the segments were not the "same" (meaning an exact match), and then they report there were however three that were "very similar". This type of summary and assessment make us, as peer reviewers, question if this report was prepared in an impartial manner when they were identifying segments with similar characteristics. This comparison and assessment is a critical part of their extrapolation to determine the "% of river reach" impacted, and if not conducted in an impartial manner, could significantly skew the report's final conclusions. The RSP also did not state that the 1998 erosion data would be compared against 2013 data. We have no knowledge as to whether the data are actually comparable.

Recommendation: We recommend that a random detailed review of a portion of the studied sites and the segments described in the FRR, conducted by a third-party reviewer (perhaps a state or federal scientist), to provide a second opinion on what seems to be a potentially subjective process. A period of time and funding may need to be provided for this third party review such that stakeholders are not burdened with the cost of this verification of impartiality. Rationale for comparison of years, and methodology for the earlier data set along with that data set needs to be provided to stakeholders.

14. **Step 4: Assign each riverbank segment dominant and contributing causes of erosion**

    This step applies the dominant and contributing causes to river segments

    This analysis only looked only at Reach 4 and 2, limiting potential impacts associated with Vernon operations to Reach 4, and potential impacts associated with Northfield Mountain to Reach 2. We do not agree with the limitations the report is applying to its assessment, as previously stated in our review comments #6, #7, #11. Application of results relating to segments seems arbitrary and biased against demonstrating any operational impacts. The determination of dominant and contributing causes by river segment are not always based on similar characteristics, and defaults to splitting a segment halfway between downstream and upstream apparently whenever adequate information was unavailable.

    It is also unclear how data from study sites that have undergone riverbank stabilization and restoration were or were not incorporated into the final determinations and contributing percentages of erosion. It would seem to make intuitive sense to base this analysis on only pre-stabilized sites and not the sites that have since been modified with engineered stabilization, since the results are primarily being extrapolated to non-stabilized river segments. By including the stabilized sites in the data, the results could demonstrate a bias towards less impact associated with operational WSE fluctuations, since typically the restoration work focused on stabilizing the toe of the riverbank.

    This potential bias in the extrapolation methodology and report results is perhaps best characterized by comparing the results of the BSTEM analysis listed in Table 5.4.2.2-2 on page 5-73 of Volume II and Table 13 on page 40 of Volume I, to the summary table of project results, Tables 15 and 16 on pages 51 and 52 in Volume I. While Table 5.4.2.2-2 shows multiple sites relating to NFM operations that would qualify as a dominant primary cause (i.e. demonstrate percentages of contributing erosion greater than 50%) and Table 13 actually lists NFM as a dominant primary cause, NFM operations are not listed in Table 15 as a dominant primary cause of erosion, and NFM operations are only listed as a contributing cause in Table 16 responsible for 4% of total riverbank length. The summary tables therefore do not accurately reflect the analysis results, due to the bias incorporated into the extrapolation methodology In fact it appears that Figure 5.4.3-1 on page 5-88 of Volume II, which summarized the erosion rates at all study sites for both baseline and Scenario 1 (NFM turned off), demonstrates that site 8BR-pre has the highest and most significant change in erosion rates based on a comparison of the two scenarios, and this erosion is associated solely to NFM operational impacts, but later disregarded in the summary tables.

    Recommendation: A random detailed review of step 4 must be included in the recommended review of step 3 in our comment #13, to ensure that the study has been conducted in an impartial manner. We also recommend that the analysis be conducted on all reaches of all operational impacts under all flows conditions, as previously stated, and that previously stabilized sites not be included in summaries of contributing percentages of erosion.

15. **Step 5: Conduct supplemental hydraulic and geomorphic analyses in Reach 1 to determine the impact, if any, of Turners Falls Project operations**

    This step assesses the potential impacts of the Turners Falls Operation only in Reach 1

    According to the Study 3.1.2 Report the analysis for TF operations can't be assessed the same way NFM operations were assessed, because FirstLight's consultants were unable to develop stage-discharge relationships and did not have enough studied sites in the reach. They conclude that TF operations have no impact on Reach 1 (or any other reach) and that WSE management during high flows may even aid in the prevention of erosion of Reach 1 (page 49 Volume I), based on little data and multiple subjective assumptions. We do not agree with this conclusion based on the data they provided. Please refer to our review comment #11 relating to why the stage discharge relationships developed in the study are not appropriate for use in analysis and how the TF operations can be assessed with BSTEM if the original HEC-RAS stage and discharge data is utilized.

It is noted that the exclusion of the TF operational impact assessment from the BSTEM analysis, was not discussed in the Revised Study Plan. The RSP stated that all operational impacts would be assessed using a similar analysis and methodology.

In addition, the study's comments relating to bedrock seem justified at first (although we have not conducted a field investigation to confirm these observations), but the only WSE fluctuation graph of Reach 1 included in the Relicensing Study 3.1.2, Figure 5.4.1.1-4, does not seem to support the conclusion that the WSE fluctuation is almost always on the lower bank, which they have stated is bedrock dominated. If in fact, the WSE fluctuation is not all limited to the lower bank, as seems to be demonstrated in Figure 5.4.1.1-4, then the study's concluding assumptions may not be valid.

Recommendation: Please confirm with the results of the hydraulic modeling and gaging that the operational WSE fluctuation is limited only to what is defined as the lower bank and does not reach the toe of the bank or any portion of the upper bank. If this cannot be confirmed, then the conclusion of step 5 needs to be reassessed. In addition, it is clear after reading the USDA (11/28/16) review, prepared by a principal designer and developer of BSTEM, that the HEC-RAS stage and discharge data should be utilized and that a BSTEM analysis of the TF operations, similar to what was completed for the NFM operations, can be conducted. It therefore also follows that a scenario could be run with both the TF and NFM operations turned "off". We recommend that this additional scenario be included in the BSTEM analysis, along with a scenario that looks at just TF operations turned "off", as per our review comment #5.

16. **Step 6: Analyze land-use and width of riparian buffers**

This step assesses impacts associated with land use

The analysis of land use utilizes a completely different methodology and yet still results in "percentage of total riverbank length" that is then directly compared and included with the total percentages calculated with volumetric results from BSTEM. This direct comparison seems misleading.

Recommendation: We recommend that the analysis prepared for step 6 of the extrapolation methodology not be compared directly in this manner with the results determined through the BSTEM analysis.

17. **Steps 7 and 8: Create a map identifying the causes of erosion and calculate summary statistics**

This step maps the results by river segment and provides the summary statistics in table format

As previously discussed in our review comment #14, NFM operations are shown to be a dominant cause of erosion and are even listed as such in Table 13 on page 40 of Volume I. However the concluding statements from the study, as included below, completely contradicts the analysis results and reflects a potential bias in the extrapolation of the results and the study's conclusions. The study also states that since high flows were such a dominant cause that most of the sites have no contributing cause, which also seems contradicted by Table 13 on page 40 of Volume I. This study conclusion also relates back to our concern that by comparing natural river-forming processes to anthropogenic impacts in a volumetric only manner, the report disregards the additional long term impacts that can be initiated by facility operations.

"Once the extrapolations steps were complete, the dominant and contributing primary causes of erosion were quantified based on the total number of FRR segments, the total length of those segments (in both feet and miles), and the % of total TFI riverbank length for each primary cause (excluding ice)." page 51 Vol I

"the dominant and contributing primary causes of erosion were quantified using relative percentages for every TFI riverbank segment identified during the 2013 FRR" page 52

"Northfield Mountain operations were not found to be a dominant cause of erosion at any riverbank segment in the TFI." page 52 Vol I

Recommendation: We recommend that the summary tables be revised to reflect the changes in methodology and analysis that we have recommended in our review comments #1 through #17, and that the final tables and figures reflect a consistent summary of the results.

VALIDITY OF THE STUDY CONCLUSIONS

18. **Historic Geomorphic Conclusion is Incomplete:** The FERC Study Plan determination stated, "To provide more detailed methodology (section 5.9(b)(6)), we recommend that FirstLight's perform its historic geomorphic assessment using available mapping such as the 1970 vintage ground survey of the impoundment as a base map, comparing it against more recent aerial imagery and available survey data to analyze trends in bank position within the Turners Falls impoundment. We estimate the costs of the recommended study modification to be $20,000." However, the geomorphic assessment within Relicensing Study 3.2.1 is based heavily on former reports that were not part of the FERC process and therefore not reviewed and edited. The assessment looked at 20 cross-sections where erosion was already present and that were likely selected for that reason. This assessment of historic erosion appears to be limited and does not seem to analyze the before and after operation data in a meaningful way. The Relicensing Study 3.1.2 therefore does not appear to comply with FERC's determination.

    Recommendation: We recommend that an analysis be prepared that compares past aerial photos with current aerials as requested by FERC, fully understanding that there are some limitation to this approach but agreeing with the utility of this comparison. See, for example, Appendix C to TransCanada's Study 1.

19. **Operational Water Surface Elevation Fluctuation Characterized Incorrectly**: Page 24 Vol 1 of the Relicensing Study inaccurately states that "operations can result in water level fluctuations up to 4 feet at a given location over the course of a day", when the daily fluctuation appears, based on the data, to range from 4 to 6 feet with regular peaks in fluctuation closer to 9 feet. In fact, 9 feet of WSE fluctuation is currently allowed based on the FERC license, and yet there was no analysis to show potential erosion on riverbanks if FirstLight exercised the full 9 feet of WSE fluctuation allowed by their existing license on a regular basis in the future.

    The study also states that "during low to moderate flow periods the water surface in the TFI typically rests on the lower bank" however Figures 5.4.1.1-4 to 6 of the cross sections included in the study on pages 5-58 to 5-60 in Volume II demonstrate otherwise. These figures show that the WSE fluctuations straddle the toe of the upper bank and extend into both the lower and upper bank.

    Recommendation: We recommend that the study conclusions regarding WSE fluctuations be revised to match the data provided. In addition it would be important to model the full 9 feet of WSE fluctuation allowed based on the FERC license, in the event that FirstLight chooses to exercise the full 9 feet of WSE fluctuation on a regular basis during the course of their new license period.

20. **Inaccurate Conclusion on Erosion Commencement:** Page 24 Vol 1 of the Relicensing Study states that "it is not until the water surface reaches the upper bank that erosion processes can potentially commence". This statement only makes sense if you consider the toe of bank as being part of the upper bank, since WSE fluctuations clearly impact the toe of the bank. The Relicensing Study then continues by stating that "even then the flow threshold to initiate erosion process was found to be greater than 37,000 cfs at the majority of detailed study sites". We question how this statement can be accurate since that would mean that there was basically no undercut bank formation (i.e. toe erosion) and even if there was that this toe erosion was not considered the initiation of the erosion process. This is counter-intuitive based on the cycle of erosion and the visual observations of multiple cross sections where undercut bank is evident, as well as on other cross sections where the toe of the bank was stabilized due to historic observations of undercut banks. In addition, the written descriptions of the individual cross-sections specifically note erosion observed at the toe of the bank.

    Recommendation: The conclusions stated in the Relicensing Study should be revised to reflect the cross-sectional observations of toe erosion as well as the understanding that the cyclical process of fluvial erosion and mass failure, whereby erosion at the toe of a bank can initiate additional bank failure.

21. **Counter-intuitive Conclusion Regarding WSE Fluctuation Impacts:** An increase in the WSE fluctuation range due to operations increases the vertical range on the streambank where both boat waves and ice can now impact the streambank, however the study concludes the opposite (in the lower reach at least), claiming that a decreased WSE fluctuation increases the impact of waves on the bank, by stating "the impact of waves in reach 1 can be attributed to the general lake-like conditions found in the lower TFI where water surface elevations vary across a narrow range. The narrow band of water surface elevation fluctuations focuses wave impacts in the zone where the beach/toe intersect the lower-most part of the upper bank." (Volume 1, page 28). This conclusion is counter-intuitive.

    Recommendation: We recommend that the Relicensing Study provide further support for their reasoning behind this statement, due to the fact that it seems counter-intuitive and the study does not include enough data to prove otherwise.

22. **Inaccurate Conclusion:** Page 28 Vol 1 of the Relicensing Study states "The operational difference between the two scenarios was determined to identify the change in erosion rates resulting from operations at Northfield Mountain. The results of this analysis showed very small effects at every detailed study site indicating that Northfield Mountain operations are not a dominant cause of erosion at any location." But the study then states: "except at 8BR-Pre", which they dismiss as significant because it has been stabilized, even though it contributed to 74% of erosion at that site. However recent stabilization of a site does not mean that WSE fluctuations were not impacting the site. Their dismissal of the significance of this impact was then applied across the entire TFI to similar sites that have not been stabilized. They also then state that sites 7L and 119BL also have minor impact due to NFM operations but fail to mention that Table 7 shows that 19 of the sites show some sort of impact due to NFM operations, 7 of them contributing to over 3.7% of the total erosion and 3 of those contributing over 5% of the total erosion. And yet the final concluding Tables show 0% (for dominant) and 4% (for contributing) for NFM operational impacts.

    Recommendation: We recommend that the results that show operation impacts not be dismissed as insignificant for subjective reasons, and therefore not be applied along reaches that were not included as study sites.

23. **Conclusion Misleading:** The Relicensing Study's conclusions that most of erosion occurs during high discharges oversimplifies/ignores the bank weakening processes active at lower flow stages (ice, freeze/thaw, wave, etc.). Large flows are likely simply removing material that has been weakened at lower flows.

    Recommendation: We recommend the study incorporate discussion of the cyclical processes of erosion and, as previously stated, modify their extrapolation methodology and conclusions to reflect that understanding.

24. **Conclusion Regarding Ice Potential:** The Relicensing Study largely cast aside ice as a major erosion factor despite clear photographic evidence of cracked ice sheets/blocks active along the channel margins within the stage-fluctuation ("toe" and "lower bank") zones. These ice blocks will jostle and move with stage changes, abrading the bank surface in the process. They may also detach/reattach to sediments as they move with operationally influenced stage fluctuations.

    Recommendation: We recommend that the study investigate the potential for increased ice impacts due to operational WSE fluctuations.

SUMMARY OF OUR PEER REVIEW

Based on our review of the Relicensing Study 3.1.2 Volumes I, II, and III, our review team has made 23 recommendations as discussed earlier in this memorandum.

In general, we have identified several areas where the study was not done according to generally accepted scientific practice, or did not follow a methodology described in the RSP. We also believe that a number of erroneous assumptions have been made that may severely skew the results. Without recommended revisions, the Study 3.1.2 Report does not accomplish the overall study goal to "evaluate and identify the causes of erosion in the Turners Falls Impoundment and to determine to what extent they are related to Project operations."

Most critically, we find that the Relicensing Study 3.1.2 did not include an analysis of any scenarios without operational WSE fluctuations. Both the Baseline Conditions and Scenario 1 include significant WSE fluctuation due to operations impacts. The Baseline Conditions include the daily WSE fluctuation from Vernon, NFM and TF, and Scenario 1 includes the daily WSE fluctuation from Vernon and TF. A non-fluctuating WSE run was not developed or analyzed to compare what the baseline conditions prior to the current operational impacts might have been. See review comment #6.

There are significant gaps in the analysis for the Relicensing Study 3.1.2 including entire reaches where no analyses was completed, as well as no BSTEM analysis completed to assess the operational impacts of Turners Falls, even though we believe this analysis is possible to conduct, contrary to what the study suggests, by utilizing the HEC-RAS data for stage and discharge. See review comment #7 & #11.

The extrapolation methodology utilized in the Relicensing Study 3.1.2 includes multiple arbitrary definitions and thresholds, not included in the RSP and therefore not agreed upon in advance, that potentially bias the study results. The extrapolation methodology also includes subjective observations that appear to not maintain impartiality, and may also be biasing the study results. See review comments #11 through #17.

The Relicensing Study's comparison of percentages of erosion based solely on a volumetric interpretation of the erosion rates, ignores the cyclical processes of erosion, whereby a small amount of toe erosion due to anthropogenic causes (i.e. WSE fluctuation along with its resulting groundwater and vegetation impacts, and boat waves) can instigate more significant erosion and accelerate bank failure due to natural causes (i.e. high flow).

FirstLight should revise the Relicensing Study 3.1.2 or issue an Addendum to the study that includes the revisions as per the recommendations set forth in this peer review, as well as the USDA (11/28/16) recommendations.

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

FirstLight Hydro MA LLC	)	Docket No. 1889-000
Northfield Mountain LLC	)	Docket No. 2485-000

AFFIDAVIT OF EDWIN T. ZAPEL
ON BEHALF OF THE CONNECTICUT RIVER CONSERVANCY

1. My name is Edwin T. Zapel. I am a Senior Hydraulic Engineer for Northwest Hydraulic Consultants. I am a civil engineer with 36 years of experience in hydraulic, hydrologic, and fisheries engineering developed in a variety of engineering assignments throughout the western United States, Alaska, and Canada. These include such projects as spillway designs, sluice gate designs, high pressure valves and outlet works, small hydropower facilities, water temperature control withdrawal structures, energy dissipation structures, river intake structures, reservoir hydropower intake and outlet structures, and river sediment control structures. I have designed numerous fish exclusion, guidance, and screening and bypass systems for low and high-head dams and reservoirs for both juvenile and adult salmonids up to 5,000 cfs capacity. My experience also includes a variety of river engineering projects, including sedimentation and erosion analysis and management, debris flows, fish passage barrier removal and channel restoration, habitat enhancement, and general fisheries engineering. In addition to my consulting practice, I spent 13 years as a hydraulic engineer and Water Management Section Chief with the U.S. Army Corps of Engineers' Seattle District. My current business address is: Northwest Hydraulic Consultants Inc, 12787 Gateway Drive S., Tukwila, Washington 98168. My curriculum vitae is attached as **Exhibit A**.

2. I have participated in dozens of hydroelectric projects in various capacities that have been before the Federal Energy Regulatory Commission ("FERC"), including: Eugene Water and Electric Board (EWEB) - Carmen-Smith Project, FERC Project No. 2242-078; Portland Water Bureau (PWB) - Bull Run Dam No. 1 (FERC Project No. 2821); Southeast Alaska Power Association (SEAPA) - Swan Lake Dam (FERC Project No. 2911); Seattle City Light (SCL) - Diablo Dam (FERC Project No.553); Susitna-Watana Hydroelectric Project, Alaska (FERC Project No. 14241-000).

3. To provide this affidavit testimony, I reviewed the 31 March 2023 First Light Offer and the Settling Parties' Explanatory Statement, the Connecticut River American Shad Management Plan, the 11 May 2023 First Light Response to FERC Additional Information Request, the March 2018 Barrier Net Study Plan for Northfield Mountain Tailrace, the October 2016 First Light Fish Entrainment and Turbine Passage Mortality

Study Report, the March 2017 First Light Evaluation of Downstream Passage of American Eel Study Report, and the February 2016 First Light Evaluation of Upstream Passage of American Eel at the Turners Falls Project Study Report. I also reviewed the 'FishBase' species summary for American Shad for specific biology and lift history traits of American Shad extent on the east coast of North America.

4. The purpose of my affidavit is to provide technical support to the Connecticut River Conservancy's ("CRC") opposition to the offer of settlement ("Offer") as it relates to the timing of construction of upstream and downstream fish passage at the Turners Falls Dam. The Offer proposes several operational and structural modifications to the Turner's Falls project, two categories of which relate to fish passage through the various features of the project. These are divided into upstream passage facilities and downstream passage facilities, for the apparent purpose of establishing a preferred construction schedule for completion of each system. In the Settling Parties' Explanatory Statement, they state that the preference to construct the downstream passage facilities first, followed by the upstream passage facilities at Cabot Station and at Turner's Falls Dam "is consistent with the fish and wildlife agency objective to recruit as many repeat adult shad spawners as possible to the lower Connecticut River to enhance overall shad population." Explanatory Statement at 20. The Statement cites the Connecticut River American Shad Management Plan as having an objective of achieving an adult shad stock structure repeat spawner component of 15% for each sex. *Id*. at n.13. However, there is no stated preference cited from this Plan for downstream passage over upstream passage specific to Turner's Falls, and thus the Plan does not actually support the Settling Parties' sequencing preference. Further, it is not clear from the Offer why prioritizing downstream passage over upstream passage would increase repeat shad spawner populations in the lower Connecticut River below Turner's Falls Dam.

5. The Explanatory Statement states that the downstream passage features would be constructed first, followed by 20 years of monitoring for effectiveness. Similarly, the Statement also states that the upstream passage facilities would be constructed next, followed by 25 years of monitoring. Of the two fish passage facilities, the upstream passage facilities represent a much more extensive construction effort, resulting in the construction of a modern fish lift at Turner's Falls Dam, abandonment of the Cabot Station fish ladder, and enhancement of passage flows through the "bypass reach" between Turner's Falls Dam and Cabot Station. The Settling Parties acknowledge that upstream passage success is necessary to enhancement of shad passage, and that the existing facilities have well-documented and well-defined deficiencies. The downstream passage deficiencies have also been documented, though these deficiencies likely require less capital investment to correct even though First Light does not explicitly state this in the Offer.

6. As explained below, there does not appear to be substantial evidence in the record that would preclude construction on upstream and downstream fish passage facilities simultaneously. To the contrary, based on my experience and understanding of the proposed modifications, it appears that it would be feasible to undertake both the upstream and downstream facility modifications simultaneously, with the possible

exception of the potential in-water work area isolation conflicts between the plunge pool construction and fish lift construction.

7. Further, if any sequencing is necessary, the Settling Parties have not provided substantial evidence to support prioritizing downstream fish passage over upstream fish passage as proposed in the schedule for implementation, and, in fact, such prioritization is counter-intuitive, especially as it relates to American Shad, the primary species for which the fish passage is being upgraded. American Shad are known to be iteroparous, and may repeat their migration up to several times from the ocean to fresh water to spawn and then return to the ocean to rejuvenate their spawning fitness.[1] They are known to be fecund, with average egg production ranging from 30,000 to as many as 150,000 eggs per spawn. They prefer sandy river bed and very small gravels in shallow areas for spawning, and do not cover their eggs with substrate. They are not necessarily known to exhibit preference for natal homing to return to the site of their emergence during upstream spawning migration, unlike some other important anadromous species are. Shad will readily colonize accessible habitat, and when introduced can quickly establish viable populations where they did not previously exist (such as the Sacramento River and the Columbia River on the west coast of the United States). In the Connecticut River, available spawning habitat preferred by shad occurs throughout the river system above and below Turner's Falls dam, except for the higher elevations in the watershed where suitable small substrate and shallow slackwater areas are not readily available for spawning. Given the species' proclivity for rapid colonization, significant fecundity, and lack of natal homing, the notion that increasing downstream passage of juvenile and outmigrant adult shad through the Turner's Falls project will increase recruitment of repeat spawners in the lower Connecticut River more readily than enhancing upstream passage to achieve more upriver spawning and consequently significantly greater juvenile production and subsequent outmigration to the ocean appears counterintuitive and begs additional justification and material support from physical data and observations.

8. Further, since repeat spawner escapement (regardless of upriver or downriver natal origin) and resulting recruitment contributing to the lower Connecticut River spawning population represent a rather small proportion of the total population of spawning shad in the lower River, it is unclear how an increase in downstream passage would be any more beneficial than an increase in upstream passage in the near term, and I am unaware of any record evidence that would substantiate this. This is especially true if current upstream passage is inhibited and functions to limit the numbers of successful spawners reaching upstream of Turner's Falls Dam, a fact which the Offer acknowledges and which is addressed in their proposed upstream fish passage improvements. *See* Explanatory Statement, at 22 ("The Turners Falls Project includes a complex of facilities that impose potential barriers to upstream fish passage."). The Settling Parties' stated preference for constructing the downstream passage facility prior to the upstream passage facility is not supported by the biology and behavior of the shad population, or more specifically by its spawning and repeat spawning behavior. Both upstream and downstream passage improvements are acknowledged by the Settling Parties' to be necessary to enhance the overall Connecticut River shad population.

[1] *See* https://www.fishbase.us/summary/SpeciesSummary.php?ID=1584&AT=american+shad, n.d..

THE PROPOSED IMPLEMENTATION SCHEDULE FOR UPSTREAM FISH PASSAGE FACILITIES AT TURNER'S FALLS APPEARS LONGER THAN NECESSARY

9. First Light has proposed several elements of the upstream fish passage system at Turner's Falls, listed as follows:
   a) Within 9 years of license issuance, construct a Spillway Fish Lift at the Turner's Falls Dam
   b) Within 9 years of license issuance, rehabilitate the Gatehouse Trapping/sampling Facility
   c) Retire or remove the Cabot Station fish ladder within 2 years after the Spillway Fish Lift becomes operational
   d) Within 1 year of license issuance, install and operate interim upstream eel passage in the vicinity of the existing Spillway Ladder
   e) Conduct up to 2 years of eelway siting studies after the Spillway Fish Lift becomes operational.

10. If design commences on issuance of the license, it is reasonable that the new fish lift could be designed within about 2 to 2.5 years, given that fish lift design typically follows standard guidance derived for previous prototype configurations within the proposed 30%, 60%, 90%, and final design milestones. In other words, fish lifts like the one proposed have been designed and implemented under fairly predictable schedules of lesser duration than that proposed here, with few construction or design unknowns that would necessitate the 9-year timeline proposed in the Offer. Construction of the lift system would require cofferdamming and isolation of the work area from the tailwater pool below the spillway, and would likely be constrained to in-water work windows mediated by high river flows and fish passage seasons. However, that is the lone element of the fish passage features proposed that would likely be affected by or constrained by construction of other elements and require an extended schedule for completion.

11. I am familiar with similarly complex fish passage facilities on the Columbia River federal hydropower dams, constructed under similar conditions and constrained by similar in-water work window limitations, that have been completed within 2 to 4 years. Unless the fish lift design would require an uncertain and lengthy amount of review and negotiation with the design staff at the regulatory agencies at each of the proposed 4 design milestones (30%, 60%, 90%, and final), 9 years to full implementation is particularly conservative. Based on previous fish passage facility design and implementation, a schedule for full implementation could be approximately 4–6.5 years, depending on the timeliness of agency reviews and First Light design consultant competence and availability. Since the construction of the proposed plunge pool below bascule gate No. 1 would not be constructed until the fish lift was completed, full implementation of the plunge pool could be completed within 6 to 8.5 years after license issuance.

12. Rehabilitation of the Gatehouse Trapping facility could reasonably be accomplished within about 2 to 3.5 years (versus the proposed 9 years), given that no new structures should be necessary, and upgrades would likely be limited to interior spaces, conveyance

channels and hydraulic control features, and electrical upgrades with modern equipment replacing old equipment. Though no details are provided in the Offer, my experience with rehabilitation of hatchery and fish passage sampling and monitoring stations in the Pacific Northwest suggests that the process should be expected to require about 1 to 2 years for design and adaptation to existing facilities, with about 1 to 1.5 years of construction to reach full implementation.

13. The relative simplicity and small size of eel passageways suggest that a 1-year full implementation schedule for the interim upstream eel passage system is reasonable.

THE PROPOSED IMPLEMENTATION SCHEDULE FOR DOWNSTREAM FISH PASSAGE FACILITIES AT TURNER'S FALLS APPEARS LONGER THAN NECESSARY

14. The Settling Parties have proposed several elements of the downstream fish passage system at Turner's Falls Dam, listed as follows:
    a) Within 4 years of license issuance, replace the existing Cabot Station trashrack structure with a new full-depth trashrack with 1-inch clear spacing and multiple openings to pass downstream migrant fish into the existing trash trough and an entrance and conduit to pass fish from the left intake wall to the trash trough.
    b) Within 4 years of license issuance, construct a ¾-inch clear spacing bar rack at entrance to Station No. 1 branch canal.
    c) Within 9 years of license issuance, construct a plunge pool downstream of the Turner's Falls Dam bascule gate No. 1 as part of the upstream passage Spillway Fish Lift.

15. If design commences on issuance of the license, it is reasonable that the new trashrack could be designed within about 2 years, with fabrication and installation to occur in the third year. I am familiar with a similar deep trashrack replacement that is currently underway at Seattle City Light's Diablo Dam project to mitigate damage from trashrack clogging and a structural failure of the original trashrack. The accelerated design commenced in the late summer of 2022 and fabrication has already been initiated, with construction and installation scheduled for the summer of 2023. Given that no agency input was required on the Diablo trashrack design, it was possible to accelerate the full implementation schedule to about 1.5 years. With agency review and input on the proposed Cabot Station trashrack expected and included, the design schedule could likely be completed within 2 years and fabrication and construction could reasonably be completed within an additional year to 1.5 years, depending on construction schedule constraints due to in-water work periods. Therefore, it seems reasonable to expect that full implementation of the Cabot Station trashrack might be possible within 3 years to 3.5 years of license issuance.

16. Similarly, the proposed trashrack at the Station No. 1 branch canal could be completed in about 3 years. Although the new trashrack may be smaller than at Cabot Station, new support structures would be required, all of which would need to be constructed in water and include moderate depth caissons or cofferdams to enable construction. Therefore, it is

reasonable to expect that full implementation of the Station No. 1 branch canal trashrack could also be fully implemented within 3 years from license issuance.

17. The Offer describes the third downstream fish passage element plunge pool below the Turner's Falls Dam bascule gate as being connected with the fish lift upstream passage element. Based on that connection, the construction and full implementation would logically follow after the schedule developed for the fish lift element, though, as explained above, the fish lift implementation schedule should not require 9 years and therefore the plunge pool can also be constructed on a faster timeline consistent with the faster timeline described above for the fish lift.

THE PROPOSED IMPLEMENTATION SCHEDULE FOR BARRIER NET AT NORTHFIELD MOUNTAIN PUMPED STORAGE INTAKE APPEARS LONGER THAN NECESSARY

18. The Settling Parties have proposed an element of fish protection at the Northfield Mountain Pumped Storage system intake above Turner's Falls Dam, listed as follows:
    a. Within 7 years of license issuance, construct a barrier exclusion net to prevent entrainment of fish into the pump-turbine units

19. If design commences on issuance of the license, it is reasonable that the new barrier net could be designed within a single year and implemented within the following 2 years. I am familiar with similar very large barrier exclusion nets currently deployed in the Lake Shannon- Lower Baker Lake hydropower facility in NW Washington State that were designed within about 2 years of license issuance and constructed the following year, even though they are much deeper (more than 200 feet) and the reservoir experiences much more significant water level variations (which is one of the most problematic design issues with barrier nets).

CONCLUSIONS AND SUMMARY STATEMENTS

20. Based on the reviewed documents and background information available to me, it appears that the proposed 9-year implementation schedule for upstream fish passage features is unnecessarily long and could potentially be reduced by as much as 2.5 to 5 years.

21. Based on the reviewed documents specifically and on shad biology generally, there appears to be little justification for prioritizing implementation of downstream passage features over the upstream passage features. Both could be commenced concurrently, and implementation of the upstream passage features would potentially have greater positive impact on increasing shad populations above the Turners Falls project more immediately than would the downstream passage features.

22. Based on the reviewed documents and background information available to me, it appears that the proposed 4-year implementation schedule for downstream fish passage

features is unnecessarily long and could potentially be reduced by as much as 0.5 to 1 year.

23. Based on the reviewed documents and familiarity with other constructed barrier net projects, it appears that the proposed 7-year implementation schedule for downstream fish passage features is unnecessarily long and could potentially be reduced by as much as 4 to 4.5 years.

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

FirstLight Hydro MA LLC	)	Docket No. 1889-000
Northfield Mountain LLC	)	Docket No. 2485-000

DECLARATION

EDWIN T. ZAPEL states that I prepared the affidavit to which this declaration is attached and that the statements contained therein are true and correct to the best of my knowledge and belief.

Pursuant to Rule 2005(b)(3) (18 CFR § 385.2005(b)(3), citing 28 U.S.C. § 1746), I further state under penalty of perjury that the foregoing is true and correct.

Executed on May 18, 2023.

Edwin T. Zapel, M.S., P.E.

EXHIBIT A

nhc northwest hydraulic consultants

EDWIN T. ZAPEL, M.S., P.E.

Senior Hydraulic Engineer

Education

B.S. in Civil Engineering, Washington State University, 1984 (Honors)

M.S. in Civil Engineering, Washington State University, 1987 (Cum Laude)

*Ph.D. studies Fisheries Science, University of Washington (dissertation not completed)

License/Affiliations

Registered Professional Engineer; Washington, Alaska, and Idaho

Member, American Society of Civil Engineers (ASCE)

Member, American Fisheries Society (AFS)

Member, American Water Resources Association (AWRA)

Years of Experience

36

Areas of Expertise

Hydraulic Design

Fisheries Engineering

River Engineering

Water Intakes

Sediment Transport

Physical Modeling

Mr. Zapel is a civil engineer with 36 years of experience in hydraulic, hydrologic, and fisheries engineering developed in a variety of engineering assignments throughout the western United States, Alaska, and Canada. These include such projects as spillway designs, sluice gate designs, high pressure valves and outlet works, small hydropower facilities, water temperature control withdrawal structures, energy dissipation structures, river intake structures, reservoir hydropower intake and outlet structures, and river sediment control structures. Mr. Zapel has also designed numerous fish exclusion, guidance, and screening and bypass systems for low and high-head dams and reservoirs for both juvenile and adult salmonids up to 5,000 cfs capacity. His experience also includes a variety of river engineering projects, including sedimentation and erosion analysis and management, debris flows, fish passage barrier removal and channel restoration, habitat enhancement, and general fisheries engineering. Mr. Zapel's experience includes more than twenty-one years in private consulting practice and thirteen years as a hydraulic engineer and Water Management Section Chief with the U.S. Army Corps of Engineers' Seattle District.

Selected Project Experience

USACE, BUREC, TVA, and other Independent Expert Project Reviews and Board of Consultants Work

Carmen-Smith Hydropower Project Board of Consultants, OR: Currently serving on FERC Board of Consultants as the hydraulics expert for planned upgrades to the Carmen-Smith projects on the McKenzie River in western Oregon state. Project upgrades currently under design or analysis includes spillway upgrades, overtopping protection, foundation and plunge pool scour analysis, geotechnical deficiency correction, and other features.

Cave Buttes Dam Outlet Structure IEPR Project Review, Phoenix, AZ: Cave Buttes Dam is an existing flood control embankment dam constructed by the USACE on Cave Buttes Creek, north of Phoenix, Arizona for Maricopa County Flood Control District. A new outlet structure and discharge tunnel is required to enable the impoundment to be drawn down within the required time frame under Department of Dam Safety rules. The new outlet facilities include a new intake structure, a new tunnel under the left dam abutment in rock, and an impact-type discharge structure for energy dissipation.

Baltimore District - Raystown Dam Outlet Gates Value Engineering: VE Workshop and study of potential cost savings for low level sluice outlets for Raystown Dam in Pennsylvania. The technical leads for the project are in the Portland District of the USACE, and this evaluation is intended to help upgrade and modernize the 50+ year old multipurpose dam.

Kansas City District – Swope Park Levee, MO IEPR Project Review: IEPR Review of USACE plans for new ring levee around Swope Park industrial development near Kansas City, MO.

Kansas City District – St. Joseph, MO levee upgrade IEPR Project Review: IEPR Review of USACE levee upgrade for right and left banks of the Missouri River at St. Joseph, MO. Review included design of several local drainage release structures penetrating levee embankment.

Edwin T. Zapel, M.S., P.E.

Total Dissolved Gas Analysis and Mitigation

Rocky Reach Dam TDG Analysis, WA: Review of historical database for TDG at Rocky Reach and Rock Island Dams for Chelan PUD to determine if distribution of flow between the powerhouse and the spillway could be modified through operational changes to reduce effective TDG below the Rocky Reach dam.

Structural Gas Abatement Feasibility Design for all eight Corps of Engineers Lower Columbia and Snake River Dams: Feasibility level design of auxiliary spillway, sluice, and turbine modifications for each of the eight Corps dams on the Columbia and Snake River Dams. Spillway structures included stepped, smooth, baffled, and conventional deflected spillway types. Submerged sluices, additional spillway bays, and powerhouse modifications were also examined.

Boundary Dam Dissolved Gas Analysis: Development of methodology to evaluate and analyze dissolved gas production at Boundary Dam on the Pend O-Reille River in NE Washington. Dissolved gas is either entrained or reduced in the tailrace by spillway discharge, depending on upstream ambient dissolved gas levels and spillway/powerhouse discharge combinations.

Columbia and Snake River Gas Abatement Structural Alternatives: Feasibility-level design development for wide range of structural dissolved gas abatement alternatives for application at all eight lower Snake and Columbia River Corps of Engineers dams.

Stepped Spillway Model – Dissolved Gas Abatement: Project manager and lead technical engineer for a physical model of a stepped spillway for Lower Columbia River projects. This model study was a part of the U.S. Army Corps of Engineers dissolved gas abatement studies.

Bonneville Dam TDG Abatement Alternatives: Involved in the development of TDG abatement alternatives specifically designed for Bonneville Dam. Proposed concepts included new spillway gate configurations, new spillway chutes, new spillway structures, and others.

Chief Joseph Dam Spillway Deflector Testing and Evaluation: Evaluation of foundation pressure readings throughout spillway monolith footprint to determine critical seepage path and evaluate potential sealing program alternatives, in conjunction with spillway tests of recently constructed flow deflectors on Chief Joseph Dam on the Columbia River. Flow deflectors were installed to reduce the entrainment of atmospheric gases at depth, which results in high Total Dissolved Gas (TDG) levels and gas bubble embolism disease in fishes inhabiting the tailrace and downstream areas of the river.

Long Lake Dam Conceptual Spillway Alternatives Development: Development of conceptual alternatives for auxiliary spillway structures for Long Lake Dam on the Spokane River, WA. Purpose of the auxiliary spillways is to reduce atmospheric gas entrainment into high velocity spillway flow, which elevates Total Dissolved Gas concentration in downstream river flow. High TDG levels are detrimental to fish survival.

Dam Overtopping and Rock Scour Assessments

Talbott and Townes Dams Overtopping and Rock Scour Assessment Review, NC: Senior technical hydraulic reviewer for review of rock erosion and scour assessment for Talbott Dam and Townes Dam, both owned by the City of Danville, North Carolina. Previous work by other consultants had identified potential scour of the dam foundation and abutment toe resulting from significant overtopping arising from very large PMF flood events (between 15 and 16 feet over the parapet wall for both dams). Both dams are structural arch concrete dams founded on rock of fair to good quality and are regulated under the Federal Energy Regulatory Commission's (FERC) authority, as both are associated with hydropower plants.

Bull Run Dam No. 1 Overtopping and Scour Analysis, OR. (2021): Portland Water Bureau. Senior technical advisor and hydraulic design lead for the evaluation of overtopping scour at the Bull Run Dam No. 1, a nearly 100 year old concrete gravity arch-type water supply dam operated by the Portland (OR) Water Bureau. Recent PMF studies indicate that the dam crest and parapet wall may be overtopped by up to 5 feet during a PMF event, due to inadequate spillway capacity. The dam is founded on basalt.

Edwin T. Zapel, M.S., P.E.

Eagle's Nest Dam Spillway Evaluation and Overtopping Scour Analysis, NM (2020-2021): New Mexico Department of Game and Fish. Senior technical advisor and hydraulic design lead for the evaluation of the existing 100+ year old concrete gravity arch-type water supply dam in New Mexico for the Department of Game and Fish. The existing dam has an undersized abutment spillway, and a recent stability analysis suggests that overtopping scour from dam overtopping may erode the dam foundation toe and put the structure at risk of failure. Recent PMF analysis suggests that the dam may be overtopped by several feet during a PMF event**.**

Laprele Dam Spillway Design and Overtopping Scour Analysis, WY. (2020-2021): Wyoming Dam Safety Office. Senior technical advisor and hydraulic design lead for the evaluation of the existing 100+ year old concrete Ambursen buttress and slab-type water supply dam on Laprele Creek in Wyoming, and development of spillway design for replacement RCC and embankment dam alternatives to rehabilitating the existing deteriorated dam structure. Recent PMF analysis suggests that the spillway is inadequately sized and the dam may be overtopped by as much as 12 to 16 feet during an extreme PMF event. The dam is founded on sandstone and limestone.

Skookumchuck Dam Spillway Capacity and Sidewall Overtopping and Rock Erosion Analysis, WA: Technical advisor for development of hydraulic model for Skookumchuck Dam spillway in southwestern Washington State, and using rock erosion and scour modeling tools to determine extent of potential rock erosion during PMF flood events. Approach included use of 2D numerical model tool, with Annandale rock erosion methodology and the most recently developed block plucking and uplift for basalt channel wall erosion assessment.

Oroville Dam Flood Control Spillway Emergency Scour Assessment, Oroville, CA: Emergency response development of predictive spillway slab failure and erosion calculations and modeling to assist with the mitigation measures to address failure of the Oroville Flood Control Outlet spillway. Coordinated selection of emergency response hydraulic analysis team with colleagues George Annandale and Henry Falvey to assist California DWR with 24/7 development and refinement of predictive model to estimate the progression of erosion and continued slab failure as the event unfolded. Determined initial cause of failure and assisted with development of design of repairs to spillway.

Spillways & Stilling Basins

Moccasin Dam Emergency Spillway Modifications, CA (2019-2023: Preliminary evaluation of Moccasin Dam emergency spillway capacity and alternatives development for the Moccasin Reservoir reregulating reservoir for San Francisco Public Utilities Commission, including a physical scale hydraulic model study in NHC's Vancouver, B.C. laboratory. The spillway was determined to be inadequately sized, and suffered considerable damage during recent flood events, and the utility has engaged the study of alternatives to increase the spillway capacity.

Laprele Dam Spillway and Dam Design, WY (2019-2023): Evaluation of inadequate existing spillway for PMF and Spillway Design Floods and development of spillway design for replacement Roller Compacted Concrete dam. Hydraulic evaluation and technical development included routing analysis to determine appropriate PMF and spillway design. Study has progressed into Feasibility Level design, and hydraulic design work continues, including construction of a 1:40 scale physical hydraulic model study at NHC's laboratory in Seattle..

Iron Canyon Dam Spillway Hydraulic Analysis (2022-2023): Hydraulic evaluation of the Iron Canyon Dam spillway in California using the BUREC's EM-42 numerical hydraulic model. PG&E engaged the study of the hydraulic capacity of the Iron Canyon Dam spillway to determine the risk of cavitation and hydraulic uplift (i.e. 'slab jacking') for the project's spillway structure, which includes a semi-circular ogee crest and a converging chute and tunnel with superelevated exit channel.

McCloud Dam Spillway Hydraulic Analysis (2022-2023): Hydraulic evaluation of the McCloud Dam spillway in California using the BUREC's EM-42 numerical hydraulic model. PG&E engaged the study of the hydraulic capacity of the McCloud Dam spillway to determine the risk of cavitation and hydraulic uplift (i.e. 'slab jacking') for the project's spillway structure, which includes a multiple-gated spillway, converging chute, and steeply sloping exit section with flip bucket.

Big Creek Dam Spillway and Outlet Works Design, OR (2018-2022): Evaluation of Big Creek watershed hydrology, water supply potential, and spillway design to pass PMF and Spillway Design Flood. The existing dam owned by the City of Newport is structurally deficient and a new Roller Compact Concrete dam is proposed to address seismic instability of the existing embankment dam.

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New Exchequer Dam Spillway Hydraulic Analysis (2018-2019): Technical review of hydraulic evaluation of the New Exchequer Dam spillway in California. The spillway is an earthen spillway channel cut into the native bedrock and controlled by an uncontrolled ogee crest structure with multiple open discharge bays. Rock erosion has been noted as a result of periodic spillway events, and the Merced Irrigation District was tasked to determine the rate of erosion and the potential for future progressive erosion that might jeopardize the stability of the control crest structure. The analysis was accomplished using Computational Fluid Dynamic modeling, the results of which were used to quantify expected rock scour and erosion.

Charlotte Airport Detention Storage Reservoir Spillway and Outlet Works, NC (2020-2021): Charlotte Airport Authority. Senior technical advisor and hydraulic design reviewer for roughened rock spillway chute and terminal energy dissipator basin. The spillway structure provides overflow discharge capacity for a detention storage reservoir providing flood control for the watershed above the Charlotte airport. The spillway width and the footprint of the energy dissipation basin were physically constrained by existing topography and infrastructure, requiring maximizing unit discharge, slope, and pushed the limits of roughened rock spillway design.

Scotts Flat Dam Spillway Evaluation and Physical Modeling, CA (2020-2021): Nevada Irrigation District. Senior technical advisor and hydraulic design lead for the evaluation of the trapezoidal shaped spillway chute for Scotts Flat Dam in California, owned by the Nevada Irrigation District. The spillway terminal structure is founded on weak material and has been determined to be at high risk of undercutting and failure during a large spill event. The work included preliminary analysis of the existing spillway, followed by physical modeling of the spillway at Northwest Hydraulic Consultants' laboratory. The modeling confirmed that the spillway chute is inadequate to safely pass the PMF event without overtopping the trapezoidal chute sidewalls and eroding the foundation material under the terminal plunge pool lip structure. Physical modeling was used to refine and confirm the hydraulic design performance of chute modifications to resolve the sidewall overtopping issue and modify the terminal structure to reduce the potential for erosion of the foundation.

Pyramid Dam Service Spillway Hydraulic Uplift and Cavitation Analysis, CA (2018-2021): California DWR. Senior technical advisor and hydraulic analysis lead for the assessment and evaluation of the Pyramid Dam service spillway chute and slab. Following a field inspection and structural assessment of the Pyramid Dam service spillway, a number of deficiencies were identified in the chute slabs and joints that could place the integrity of the spillway at risk under high spillway discharges. A numerical hydraulic model was assembled and executed to evaluate hydraulic uplift forces that might arise from poorly functioning underdrains, stagnation pressure on slab joints, and cavitation, with the results used to recommend repairs and monitoring efforts to gage spillway performance. The work also included the selection and installation of under-slab pressure monitoring equipment to measure slab uplift pressures.

Clarke County Reservoir and Dam Design, IA: Senior technical advisor for development of design of hydraulic structures for proposed new earthfill dam in Iowa for Clarke County water utility. The new dam will be approximately 60 feet in hydraulic height, with a morning glory principal spillway structure and an earthen auxiliary spillway channel on the left abutment. The dam is founded on glacial loess and till soils and will provide several thousand acre feet of storage.

Conklingville Dam Spillway Rating Curve Review, NY: Senior technical review of project PMF discharge rating curve by previous consultant for the Conklingville Dam project on the Hudson River in New York. FERC's response to filings by the project owner required an independent review of the development of the project discharge rating curve for the hydro development, which includes a spillway, several deeply submerged valve release outlets, siphon spillway, powerhouse, and log chute. All outlets are fed by a single, narrow forebay channel, which develops highly complicated and turbulent, mixed regime flow conditions approaching the spillway and other outlet structures, and tailwater conditions for the siphon spillways are adversely affected by the adjacent spillway flow jet and large vortices that form in the immediate vicinity of the submerged outlet valves. The original design discharge capacity cannot be met due to these adverse conditions, and as a result the reservoir impoundment maximum PMF water surface elevation would be higher than originally planned in order to drive the necessary PMF outflow capacity.

Lake Leon Emergency Spillway Modification, TX: Senior technical advisor for the development of design for modifications to an existing inadequate capacity excavated earthen and rock spillway channel across the left reservoir rim. The existing spillway flooded severely several years ago, washing out a major state highway and causing considerable damage. The redesign considered erosive material of the chute, and determined a design that is anticipated to be stable during events across a range of recurrence intervals using a combination of vegetated channel surface, riprap roughened chute, and preformed scour and launching toe at the base of the emergency spillway.

Frenchman Dam, Antelope Dam, and Grizzly Valley Dam Spillway Chute Inspection and Cavitation/Uplift Preliminary Analysis, CA: Senior technical advisor for physical inspection and hydraulic evaluation of the service spillway chutes for these three dams on the upper Feather River watershed, all owned by the California Department of Water Resources. These dams are an integral part of the California DWR's Water Project, authorized in the late 1950's and constructed across the state throughout the 1960's and 1970's. They provide storage of the snowmelt runoff from the high Sierras for use in water storage for irrigation, municipal, and environmental purposes.

Pyramid Dam Service and Emergency Spillway Hydraulic and Erosion, CA: Lead hydraulic engineer for detailed evaluation of gated service spillway chute for cavitation and uplift analysis for chute slabs. Technical advisor role for spillway chute hydraulic modeling for both the gated service spillway and also the adjacent unlined rock-cut emergency spillway chute.

Turkey Peak Dam Spillway and Stilling Basin Design, TX: Technical guidance and direction for final design of spillway and stilling basin for new water supply dam in Texas. Spillway is designed as a stepped spillway for typical high recurrence interval spill events, with the stilling basin energy dissipation characteristics designed as a conventional spillway with hydraulic jump energy dissipation basin at the toe. The project footprint is constrained by a downstream highway and other infrastructure limiting the available area for the downstream spillway channel conveyance to the receiving stream for spillway flow.

Fordyce Dam Spillway Capacity Analysis, CA: Preliminary hydraulic analysis of the Fordyce Dam spillway capacity to carry the expected PMF event. Led hydraulic analysis of the gated and flashboarded hybrid spillway to determine maximum capacity and develop modifications to prevent dam embankment overtopping during PMF event.

Upper Black Bear Reservoir Outlet Structure Design, OK: Development of design for new intake and outlet system for Upper Black Bear Reservoir in Oklahoma, and earthen excavated emergency spillway design. Existing dam hydraulic structures could not pass the required PMF flow, which required redesign of the inlet riser and discharge conduit as well as the construction of a new excavated emergency spillway.

Chehalis Flood Control Storage Study – Chehalis Dam, WA: Preliminary design of proposed new flood storage and flow augmentation dam on the Chehalis River in southwest Washington State. The project is being designed to mitigate significant flooding in the Chehalis River valley by controlling runoff from the Chehalis River upper watershed area. Two alternatives have been proposed; the first that only stores water during flood events and another that includes reservoir storage to augment low stream flows and enhance salmon habitat during summer months in addition to flood storage. Project design includes multiple high-head outlet sluices, spillway, and energy dissipation facilities.

Big Creek Dam Replacement Spillway Design, Newport, OR: Development of spillway and outlet works design for new Roller Compacted Concrete dam for the City of Newport, Oregon to replace two aging and inadequate embankment dams on Big Creek. The reservoir provides municipal water supply for the City of Newport.

Cedar Springs Spillway Cavitation and Uplift Analysis, CA: Review of Cedar Springs Dam spillway chute inspection reports, development of preliminary evaluation of cavitation potential and uplift.

Pyramid Dam Spillway Chute Uplift and Cavitation Assessment, CA: Preliminary evaluation of the Pyramid Dam chute spillway slab and sidewall uplift and cavitation potential, and comparison to spillway inspection reports for forensic evidence of adverse hydraulic conditions.

Calero Dam Spillway Analysis, San Jose, CA: Development of alternatives for increasing the capacity of existing spillway at Calero Dam to accommodate increased anticipated PMF discharge. Existing spillway structure dates from the early 1930's and has been found inadequate to pass the expected Probable Maximum Flood (PMF) discharge. Potentially unstable hydraulic control, inadequate crest length, and inadequate energy dissipation at the toe of the spillway chute were identified as deficiencies. Duties included technical guidance and review of hydraulic analysis and design modifications.

Osceola Dam Spillway and Outlet Culvert, Des Moines, IA: Technical guidance and review for analysis of existing semi-circular spillway weir and discharge box structure for small flood storage dam in Des Moines, Iowa. Analysis focused on flow regime and hydraulic control transitions between outlet conduit, outlet conduit entrance structure, control weir, and reservoir approach.

Antero Dam Emergency Spillway Design, Hartsel, CO: Development of erodible spillway design for service/emergency spillway for Antero Dam, a water storage dam and reservoir located in central Colorado, providing augmentation to the South Platte River and the City of Denver water supply. Design included a trapezoidal spillway crest section and trapezoidal roughened riprap spillway chute channel, scour cutoff wall, and overtopping containment dikes. Project included construction engineering and review/observation of spillway construction to ensure design intent was met.

Scoggins Dam Spillway and Outlet Works Design, OR: Development of new spillway design for Scoggins Dam Alternative 3, an RCC replacement of an existing at-risk embankment dam on Scoggins Creek in northwestern Oregon State. Rehabilitation of the existing embankment dam and outlet works, and replacement of the existing dam at a downstream site are under consideration for the project. Project also included design of new outlet works facilities for the new RCC dam alternative to provide low flow capacity and water supply connection to an existing pipeline.

Swan Lake Reservoir Raise and Spillway Plunge Pool Analysis, AK: Development of design for a reservoir raise of 15 feet for Swan Lake Dam near Ketchikan, Alaska. Swan Lake is a thin arch dam on the Swan River, built in the early 1970's to supply power to the Southeast Alaska Power Authority's grid serving Ketchikan, Wrangell, and the surrounding communities. Existing dam had a narrow ungated ogee with flip bucket casting the spillway jet into a deep bedrock plunge pool. Design included an operational vertical gate with new pier and guides to manage all typical spill events up to the 20 year recurrence interval, and the remainder of the spillway provided with 15 foot high flashboards with innovative tipping mechanism triggered by the reservoir rising higher than a predetermined amount. Spillway plunge pool erosion scour estimates were developed using historical surveys, Annandale Erodibility Index method, and Mason and Arumugam Jet scour method. Project has been constructed. The project underwent an FERC Board of Consultants review, in which the design proposed met with full approval.

Scott Dam Spillway Capacity Evaluation & Design, CA: Physical modeling of Scott Dam Spillway on the Eel River in northern California to determine existing spillway capacity and develop design for modification to increase capacity up to PMF event.

Highfield Dam Spillway Alternatives Design: Provided technical review and senior engineering expertise in the development of the design of several spillway alternatives for the Highfield Dam, a water storage reservoir near Regina, Saskatchewan. The existing outlet works and spillway capacity were determined to be inadequate to pass the expected maximum flood event, and enlargement or replacement of the spillway was necessary to meet the desired regulatory criteria. From the conceptual design alternatives, a preferred option was selected and carried through feasibility design, including estimated construction costs.

Arundell Dam Spillway Analysis: Evaluation of a side channel and closed portal spillway design for a flood control dam in Southern California in a physical scale model in the laboratory. The existing spillway capacity was insufficient to carry the expected PMF event, and was determined to be limited by the outlet portal conduit dimensions and the side channel spillway configuration. Minor modifications to the spillway, approach area, and discharge conduit were successful in increasing the capacity to the desired level.

Lower Monumental Dam Spillway Stilling Basin Erosion Analysis: Analytical evaluation of stilling basin erosion damage at Lower Monumental Dam on Snake River. Assessed risk to spillway structure resulting from continued erosion by analyzing historical spillway discharge data and periodic bathymetry surveys over the project's entire period of operation. Developed empirical relationship between rate of erosion and spillway discharge operation to predict future erosion damage and quantify relative risk to spillway structure integrity.

Arroyo Pasajero: Conducted feasibility level hydraulic designs for flood control project elements on the Arroyo Pasajero, Central San Joaquin valley. Designs included uncontrolled overflow spillways and a spillway controlled by fusegates.

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Pump Stations and Pumps - General

Lake Kachess Emergency Drought Relief Pump Station Conveyance Design, WA. (2019-2021): Roza Irrigation District. Design of pump discharge conveyance system to carry pumped flows from Lake Kachess to the existing Kachess Dam outlet tower. The Roza Irrigation District is developing an emergency drought relief pump station to overdraft Lake Kachess below the level of the existing dam outlet works such that the deep glacially formed lake could supply additional flow to the Yakima River for downstream irrigation uses during emergency drought years. The pump station requires a combination of buried discharge pipelines from the 6 large lift pumps, a hydraulic energy dissipation structure, and an open channel canal to allow the pumped flow to reach the outlet tower forebay.

Flathead River Pumping Plant, MT (2019): Flathead Irrigation District. Field assessment of vibration in several large high head vertical shaft pumps lifting irrigation water from Flathead Lake to the Flathead Irrigation System canal near St. Ignatius, Montana. One of the three large 3,000 hp pumps in the lift pump station experienced severe vibration and subsequent bearing failure, which caused it to shut down during the early portion of the irrigation season. An emergency field visit was conducted to investigate the potential cause and possible consequences of the damaging vibration. The damaged pump bearing was replaced and vibration monitoring equipment was deployed. The investigation revealed a resonant frequency problem originating in the pump machinery and extending through the lift penstocks, causing them to vibrate as well, causing fatigue in the steel penstocks. A more detailed vibration analysis was then conducted and a suite of potential solutions were developed to mitigate the problem.

Pond Creek Flood Control Pump Station Pump Failure Assessment and Repair, KY (2018-2019): Louisville Flood Control District. Assessment of bearing failure and vibration of large, 4,000 Hp low head lift pumps installed at the Pond Creek Pump Station, part of the flood protection system for Louisville, Kentucky. Pump #2 had experienced extreme vibration following a lower bearing carrier failure. The pump impeller, bowl assembly, and shaft were disassembled and shipped to the contractor's repair facilities in Kansas City, where shop inspection and evaluation of potential causes of the apparent misalignment and bearing failure could be made. Upon detailed inspection, it was determined that the impeller casting was cracked and required eventual replacement. A repair and refit plan was developed for Pump #2 and subsequently Pump #3 to realign the pump shaft, bowl assembly, bearings, and bearing carriers for temporary replacement until a new pump impeller could be manufactured.

Pumped Storage Hydropower Projects

Iowa Hills Pumped Storage Inlet/ Outlet Works Hydraulic Design, CA: Development of layout and design of pumped storage inlet/outlet structure for upper reservoir and lower inlet/outlet in Slab Creek Reservoir. Upper reservoir structure included vertical shaft leading to powerhouse constructed deep inside the hill side below the upper reservoir. Lower reservoir structure included a horizontal tunnel discharging into and expansion and diffuser inlet/outlet designed to minimize net approach and exit velocities. The narrow setting of the Slab Creek reservoir and the noted slope instability of the reservoir shoreline and submerged valley walls were of concern to the client. This concern was addressed through the development and refinement, including the use of CFD modeling, of the inlet/outlet configuration to minimize the possibility of a concentrated jet impacting the submerged reservoir flank, leading to erosion and potential failure of upper slopes.

Confidential Pumped Storage Projects, Western US: Lead hydraulic engineer for development of conceptual designs for intake, conveyance, and powerhouse facilities for several pumped storage projects for confidential client in the western US. Project power plant sizes ranged from 100 to 1100 MW, with conveyance sizes up to 28 feet diameter tunnel and multiple turbine-generator units.

Municipal Intakes

City of Fort Collins Poudre River Intake Reach Stabilization, CO: Senior technical advisor for development of river training and bedload sediment exclusion guide wall structures for mitigating sediment entrainment into the City's municipal water supply intake structure on the Poudre River above Fort Collins, CO. The severe wildfire damage throughout the watershed in 2019 and 2020 is expected to result in significantly increased volumes of sediment passing through the reach immediately upstream of the City's intake structure and diversion dam. Training structure consisted of riprap dikes and temporary bedload sediment guidance structures to reduce entrainment.

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Yellowstone River Water Supply Intake River Training Works: Development of design of river training works in the Yellowstone River near Billings, MT to maintain a deep thalweg adjacent to the planned new water supply intake for the City of Billings. The project included numerical modeling of the river channel, desktop and numerical sediment transport evaluations, and design of stone training structures to maintain a favorable channel alignment to encourage sediment throughput, minimize deposition in front of the intake, and protect infrastructure upstream and downstream from the intake location, including a state highway bridge.

Middle Fork Nooksack River Diversion Dam Removal and Replacement Water Intake, WA: Revisitation of the Middle Fork Nooksack River diversion dam removal and intake replacement study for the City of Bellingham in which a new intake alternative was developed and the existing diversion dam is removed to enable fish passage to the upper reaches of the watershed.

City of Longview Water Intake Design: Development of feasibility level designs and construction cost estimates for replacement of troublesome municipal water intake for the city of Longview, Washington, on the Cowlitz River. Continuous aggradation and very high sediment transport rates in the Cowlitz River in response to watershed disturbance caused by the 1980 eruption of Mt. St. Helens frequently renders the existing intake facility useless due to sedimentation. Study included development of five alternative remediation concepts, and included river training structures, intake modifications, and fish protection and passage features to protect salmonids and surf smelt.

White River Water Diversion Dam and Lake Tapps Water Intake Fish Passage Facilities: Development of new fish passage design and diversion dam design for the White River diversion into Lake Tapps below Mud Mountain Dam, near the city of Enumclaw, Washington. The existing diversion dam and intake originally provided water supply to an artificial lake and hydropower facility, but has suffered from high maintenance cost since construction in the early 20th century. Project included development of design for the new dam, control gates, surface water diversion screens and juvenile bypass facilities, and adult fish ladder and trap and haul facilities, in conjunction with design of new water supply intake for the adjacent hatchery complex operated by the Muckleshoot Indians.

Edwards Municipal Water District Intake Modification: Development of feasibility level designs and construction cost estimates for replacement or modifications to the existing failing water intake structure on the Eagle River, Colorado, near the city of Vail. The existing intake suffers from high rates of sediment entrainment, screen failure, and fish losses into the pumped water supply system. In addition, it lacks capacity to provide the necessary raw water supply to the cities of the Vail valley.

Glendale Weir Water Intake Diversion Design: Design of new diversion and intake screening structure for Truckee River in Reno, Nevada that incorporates adult and juvenile fish bypass features for Cui-ui and Lahontan Cutthroat Trout.

Middle Fork Nooksack Diversion Dam Removal and Intake Replacement Final Design, WA: Project manager and lead designer for final design plans and specifications for removal of existing diversion dam on the Middle Fork Nooksack River in NW Washington State for the City of Bellingham's active municipal water intake and diversion tunnel. The existing dam is a fish passage barrier, and has been under study for removal for nearly 20 years, and the final design plans include replacement of the existing tunnel intake with a new intake structure upstream that does not require a dam. The old dam is being removed in 2020 and 2021, and the project should be completed in late 2021.

Middle Fork Nooksack River Diversion New Intake Preliminary Engineering Design: Design and management of preliminary engineering study for new intake system for City of Bellingham's Middle Fork Nooksack River diversion. Capacity of diversion 160 cfs; new design utilized unique artificial constriction and scour pool formation with flush intake screens in abutment structures and penstock to existing aqueduct tunnel entrance.

Middle Fork Nooksack River Intake Siphon Conceptual Design Study: Hydraulic design and analysis of proposed siphon intake concept to divert flow from the Middle Fork Nooksack River into the City of Bellingham's existing diversion tunnel and aqueduct. The existing intake diversion dam is in poor repair, and is a complete barrier to anadromous fish passage upstream to available spawning habitat, and the City has investigated a number of concepts to replace its aging intake with a different concept that can include removal of the existing dam structure. The siphon would withdraw flow from an existing deep scour pool immediately below the existing dam, and would discharge into a modified rock tunnel and aqueduct.

Middle Fork Nooksack Diversion Dam Alternatives and Fish Ladder Studies: Project manager for the design of a fish ladder to provide upstream fish passage at a diversion dam. Project is located in a remote location and along a very steep reach of the river. Second phase of project included an alternative intake analysis study. Managed physical model of the new intake structure. Model included a moveable bed to study the impacts on sedimentation and the impact to the new intakes.

Skagit PUD Pump Intake: Hydraulic design of fish exclusion screening facility and intake structure for large municipal water supply pump intake facility on the Skagit River. Intake utilized Formed Suction Intakes for the five pumps, with embedded high pressure water jet cleaning nozzles to remove accumulated silt and glacial flour deposited each year during the off-pumping season.

Hatchery & Irrigation Intakes

Kennewick Irrigation District Intake Design: Development of the design and civil layout of a new intake structure for a moderate sized pump station withdrawing water directly from the Yakima River near Benton City. The new intake facility pumps flow to the Red Mountain vineyard area of southeast Washington State. The facility includes a series of inclined screens within a large intake structure, constructed along the south bank of the Yakima River. An air burst cleaning system provides capacity for clearing debris from the screens, which are designed to meet current NOAA Fisheries and WDFW screening criteria for juvenile salmonids. RH2 Engineering provided the final design and construction plans and specifications, and Mr. Zapel participated in the commissioning phase of the project.

Issaquah Creek Hatchery Intake Design: Development of the design and civil layout, and development of construction cost estimates for a new hatchery water intake structure on Issaquah Creek, near the City of Issaquah, Washington. The original antiquated intake dam and screen system afforded very poor passage success, and was in jeopardy of failure. Analysis included dam removal alternatives design, conceptual design of a new intake, physical modeling of the proposed structure to refine the design and improve sediment and debris passage, and final design and construction plans and specifications for the new structure and the boulder weir grade control for the downstream 800 feet of channel. The completed project provides unimpeded passage of endangered Puget Sound Chinook salmon.

Muckleshoot Indian Tribal Hatchery Water Intake Design: Development of conceptual design alternatives for replacement of existing intake structure supplying water to the tribal fish hatchery on the White River, near Buckley, Washington. The existing intake suffers from significant sediment entrainment and sedimentation, and requires frequent dredging to keep it open. The Tribe is interested in finding alternatives to the existing intake that require less maintenance and can reduce the volume of glacial silt and sand entrained into their pumps and raceways.

Soos Creek Hatchery Intake Design: Provided technical guidance and review for design of new water intake structure and channel reach modifications for the Soos Creek Hatchery upgrade project for Washington Department of Fish & Wildlife. The existing Soos Creek intake entrains significant volumes of sediment from Soos Creek, and is located in a less-than-ideal location to provide consistent water supply to the existing hatchery complex. The new intake was modeled in the laboratory, and sediment transport characteristics were assessed for purposes of refining the final intake design.

Antoine Creek Irrigation Intake Design: Provided analysis and design through construction for precast modular intake and screen structures to supply screened irrigation withdrawals without need for a dam or diversion weir. Existing dam was removed, affording unobstructed steelhead passage to upper watershed habitat areas.

Skookum Creek Hatchery Intake Alternatives Design: Design of new intake facility and boulder-roughened downstream channel grade control for Skookum Creek salmon hatchery operated by the Lummi Indian Nation.

Dungeness River Hatchery Intake Design: Design of new water intake and fish screening system for WDFW's Dungeness River salmon hatchery on the Dungeness River, Sequim, Washington. The study was in support of a comprehensive water supply plan for the hatchery complex.

Vern Freeman Diversion Fish Passage: Development of fish passage improvements to the Vern Freeman diversion and water intake dam on the Santa Clara River in southern California. The existing diversion dam does not provide adequate passage for adult steelhead, and provides sub-criteria juvenile fish screening protection from entrainment into the intake. The study provided supporting engineering for the NOAA Fisheries Biological Opinion, which requires the project operator to modify the facility to ensure safe and timely passage for adult and juvenile salmonids.

Icicle/Peshastin Irrigation District: Water conservation study for Icicle/Peshastin Irrigation District in Cashmere, Washington. Field inspection and review of all facilities. Development of facility rehabilitation and water conservation plans and construction schedules.

Elwha Tribal Hatchery Intake Evaluation and Feasibility Design: Investigation of Elwha Tribal Hatchery intake structure adequacy for anticipated high sediment loads resulting from future Elwha and Glines Canyon dam removal. Feasibility level design of new hatchery intake structure and flood protection works.

Hydropower Intakes, Outlet Works & Hydraulic Structures

Folsom Dam Hydropower Intake Water Temperature Control Shutter System Design (2022-2023): The hydropower intake system at Folsom Dam on the American River in California includes three individual intake towers with a system of vertical panel bulkheads, or 'shutters' that are used to adjust the elevation at which water is drawn into the intakes in order to manage the temperature of the powerhouse outflows. The existing shutter and intake system is cumbersome and difficult to manage, and adjustments require considerable labor to make gate changes to maintain the required downstream water temperature. The new design required the determination of anticipated static and dynamic hydraulic loads on the shutter panels, the towers themselves, and the hoist cable system. In addition to consideration of steady-state loads as a result of powerhouse operation, the wire rope hoist system was analyzed for vibration to determine if mitigation measures would be necessary.

Diablo Dam Hydropower Intake Trashrack Hydraulic Analysis (2022-2023): The Diablo Dam hydro intake on the Skagit River in NW Washington state is protected from debris entrainment by a very deep inclined trashrack structure which experienced structural failure of the trashrack assembly due to excessive debris accumulation. Seattle City Light convened a team of structural engineers and NHC to evaluate the cause of the failure of the existing trashrack and develop a design for a new trashrack system. An analysis of hydraulic head losses through the existing failed rack system with and without debris was accomplished, and the results used to determine an appropriate design for a new trashrack. In addition, a vibration analysis of the proposed new trashrack system was accomplished to reduce the potential for flow-induced vibration which could damage the new rack system under clean and clogged conditions where debris is collected against the new rack system in varying amounts.

Electron Diversion Hydropower Intake Rehabilitation / Physical Modeling: Development of scale physical hydraulic model of the Electron diversion on the Puyallup River near Electron and Orting, Washington, which was originally constructed in 1904. The intake and diversion sill is undergoing rehabilitation to enable another 120 years of operation providing clean renewable hydropower generation to improve sediment exclusion systems and improve fish passage and fish exclusion from the 11 mile long flume that carries diverted flow to the head pond 860 feet above the powerplant. The project is of historical significance, as it was one of the first large scale hydropower projects in western Washington state, utilizing the rapidly falling Puyallup River gradient and high runoff to generate electric power. A modern juvenile fish screen and several innovative sediment exclusion and handling systems are being modeled in the lab to optimize performance at returning the significant volume of fine sediment generated by the Puyallup River back to the stream at the diversion, and also excluding juvenile salmonids from the flume by screening then bypassing them back to the river at the diversion rather than at the head pond 11 miles downstream.

Snoqualmie River Plant #2 Intake Structure Flow Line Hydraulic Assessment, WA: Hydraulic evaluation of the new Snoqualmie River Plant #2 intake structure and flow line for Puget Sound Energy's Snoqualmie development. The new intake cannot supply the full desired plant capacity of 2,000 cfs due to excessive head losses through various features of the intake. Design of replacement fine debris screen system to reduce head losses and enable full performance of the system.

Deer Creek Dam New Outlet Works and Intake Tower, UT: Development of new intake tower conceptual design and connection to existing pressure tunnel at Deer Creek Dam on the Provo River in Utah. The existing outlet works includes two large slide gates that have never been repaired and have been damaged. The new intake tower would permit withdrawal of reservoir water from different temperature strata, enable mixing and control of downstream release water temperatures, and permit inspection and evaluation of the tunnel connection and appurtenant structures.

Tazimina River Hydro Project New Trashracks and Diversion Repair, AK: Development of design for new, glycol-heated trashrack assemblies for existing hydro plant intake on Tazimina River, Alaska. Sub-arctic environment results in considerable ice development, including frazil ice prior to complete freeze up. New trashracks designed to melt ice and shed frazil accumulations, as well as withstand impact and shearing loads from sheet ice during spring breakup events.

Glacier Creek Diversion Sediment Sluice and Closure Gate Repair, AK: Design of repair system for concrete sediment sluice channel and control gate for hydropower intake at King Cove, Alaska. The Glacier Creek intake structure, constructed about 25 years previously, had experienced significant concrete abrasion damage and erosion as a result of stream sediments sluiced through the purpose-built sediment sluice gate and sluiceway. The diversion operates on a very flashy, high sediment load glacial runoff stream and requires regular operation of the sluice to clear sediment deposits from the turbine intake. A UHMW liner plate design and anchor system was developed to repair the sluiceway, and a new gate and thimble assembly was selected. The project is to be constructed by Public Works staff for the City of King Cove, an important fishing and fish processing village located near the far western end of the Alaskan Peninsula about 800 air miles from Anchorage.

Jackson Project Hydropower Tunnel Rock Trap Repair, WA: Hydraulic analysis and design of repair to timber crib separation bulkheads and deck lids for compartmented rock trap for the Jackson Hydropower Development on the Sultan River, near Monroe, Washington. The rock trap deck lid connections had failed due to corrosion and fatigue. The cause of the unexpected hydraulic loads was determined, and a new design to avoid future failure was developed and will be fabricated and installed in the spring of 2018.

Sunset Falls Hydro Intake Design: Development of layout and design of new intake structure proposed for a new hydro intake on the Skykomish River near Index, Washington. The proposed intake structure is designed to limit sediment entrainment while withstanding the high flow flood conditions, heavy floating debris loads, and large sediment transport capacity through the intake reach. Design efforts included 1D and 2D flow modeling, as well as physical modeling of the intake and the associated river reach, including sediment transport characteristics, in the laboratory to refine the design.

Bull Run Intake Tower Modifications: Hydraulic design and physical modeling of proposed modifications to the north and south intake towers at Bull Run Dam #2 to accommodate temperature withdrawal from different reservoir strata. The existing outlet works cannot withdraw flow from surface or mid-elevation reservoir locations and cannot meet downstream desire water temperature requirements. Physical model constructed and tested to verify the efficacy of the proposed tower modifications.

Mud Mountain Dam: Design of high head intake and outlet works for the Dam Safety Modification Program at Mud Mountain Dam on the White River. Hydraulic design of flood control water passages and regulating gates. Coordination and management of physical model study conducted at Waterways Experiment Station, Vicksburg, Mississippi. Conducted miscellaneous construction inspections during Phase I construction.

Skookumchuck Dam Flood Control Outlet Value Engineering Study: Technical Value Engineering Study to revisit previous flood control tunnel outlet works design to achieve sufficient cost savings to achieve a net benefit-to-cost ratio of 1:1 or greater. Project was intended to enable reservoir to be drawn down for flood control storage well below the spillway crest. Original estimated construction costs were about $25 million, and the resulting design revision achieved the same level of flood control storage (including draw down and additional surcharge with the addition of spillway gates) for less than $15 million.

Owen Gorge Hydropower Plant Turbine Pressure Relief Valve Cavitation Analysis: Senior hydraulic engineer for analysis of cavitation damage to needle valve pressure relief valves (PRV's) for three high head hydroturbines on the Owen River project for Los Angeles Department of Water and Power. The existing PRV's were in use in sustained operation as bypass outlets for 600 foot plus head turbine units during regular maintenance and repair activities. Severe cavitation damage had occurred within the energy dissipation structure and valve body, and LADWP wished to develop alternative energy dissipation facilities to enable long-term bypass operation safely without jeopardizing plant integrity.

Potter Valley Hydro Plant Energy Dissipation and Bypass Control Valve Analysis & Design: Hydraulic design of 135 cfs high head energy dissipation structure modifications to reduce residual energy entering tailrace channel of recently constructed turbine flow bypass system. The newly constructed system failed to perform as designed as a result of unexpected upstream air entrainment, excessive and unacceptable vibration, and poor performance. Emergency retrofit design effort focused on eliminating as much upstream air entrainment as practical, and adding energy dissipation with the most basic modifications to the stilling vault.

Spaulding Hydro Plant Energy Dissipation and Bypass Pressure Relief Valve Erosion and Cavitation Analysis, Design, and Modeling, CA: Hydraulic analysis and evaluation of cavitation and erosion damage of Spaulding Hydro Plant turbine pressure relief valve energy dissipation chamber, and physical modeling of energy dissipation chamber. Senior technical advisory role in development of alternatives to provide effective energy dissipation for pressure relief valve that had destroyed cauldron-type dissipation chamber. This project included physical modeling of the existing valve and dissipation chamber, with modifications as proposed.

Cedar Falls Powerhouse Energy Dissipator: Design and prototype testing of energy dissipator for tailrace pool at Cedar Falls powerhouse on the Cedar River, Washington. Turbine load rejection bypass valve and bursting plate operation previously caused dewatering of tailwater pool, allowing high velocity jet to exit tailrace structure barrier weir and rise to greater than 90 feet elevation and collapse upon substation switch gear and transformer structure. Prototype tests of simple energy dissipator structure eliminated dewatering effect and contained high velocity jet within tailrace pool.

Canyon Dam Outlet Tunnel Hydraulic Analysis: Rigorous mathematical and numerical hydraulic analysis of hydraulic conditions causing serious vibration problems within outlet tunnel and tower at Canyon Dam on the Feather River in northern California.

Minne Lusa Storm Sewer Tunnel Hydraulic Analysis: Hydraulic analysis and design of large storm water tunnel in Omaha, NE. Evaluation included determination of capacity, flow regime, minimum and maximum allowable velocities, sediment transport, energy dissipation, and transient analysis. Tunnel design was tested in a physical scale model in the laboratory to verify criteria and operating characteristics.

Los Angeles Reservoir Drop Shaft Design: Design and physical scale model analysis of drop shaft design for Los Angeles Reservoir. Drop shaft provides energy dissipation for flow entering Los Angeles Reservoir from the California Aqueduct.

Bahia Lagoon Lock and Lagoon Filling and Drainage System Design: Design of small boat navigation lock for Bahia Lagoon and fish exclusion and screening system for lagoon filling and water exchange system on the Petaluma River.

Hiram Chittendon Locks: Design of new salt water drain intake facility for Lake Washington Ship Canal Hiram Chittendon Locks facility.

Napa Creek Flood Control Bypass Culvert: Hydraulic evaluation of proposed flood control bypass culverts on Napa Creek in northern California. The US Army Corps of Engineers had developed a conceptual design for the proposed bypass culverts, which were then evaluated in a physical scale model setting in the laboratory, which determined that the capacity and flow characteristics of the bypass culverts could not meet the desired capacity. Subsequent design development and analysis determined that intake improvements and culvert crown raise would permit the desired capacity to be reached and even increased. The concept was tested and its efficacy verified in the physical model.

Guadalupe River Downtown Reach Flood Damage Reduction: Hydraulic design of large bypass conduit for conveying Guadalupe River flood flows through downtown San Jose, California. Capacity of the bypass was about 75% of the total river design flow of up to 20,000 cfs. Bypassed reach included very sensitive riparian and anadromous fish habitat features that required 100% preservation.

Lummi Sea Ponds Tide Gate Structure Feasibility Design: The Lummi Tribe operates a man-made saltwater aquaculture facility in Lummi Bay, consisting of a three mile long dike, with a half dozen large inflow and outflow tide channel structures. Severe deterioration of the steel and concrete structures have left the Sea Pond facility vulnerable to loss of water volume and possible oil contamination in the event of an oil spill in Puget Sound. A feasibility level design for replacement of these structures was completed.

Port Stanley Tide Gate: Design and preparation of construction plans and specifications for tide gate on Port Stanley lagoon drainage culvert on Lopez Island. Effort included construction supervision of installation of tide gate and adjustment over a season as observations of performance clarified the desired gate settings.

Edison and McElroy Slough Tide Gates: Development of design and construction plans and specifications for side hinged swing type tidal control gates for tidal prism restoration project on Edison Slough and McElroy Sloughs in Skagit County.

South Aberdeen – Cosmopolis Flood Control Project: Developed hydraulic design of tidal control gates for new flood control levee and interior salt marsh restoration project. Design included hydrologic evaluation of interior flood storage, estuarine exchange processes, and development of unique and innovative adjustable side hinged swing gate system for passing salmonids into restored salt marsh and achieving closure for flood control purposes.

Northwest Hydropower Facilities: Responsible for review and technical comments on FERC license, permit, and exemption documents for all proposed and existing hydropower facilities in the Northwest.

Gates, Valves, Sluices, Energy Dissipators, and Rotating Hydraulic Machines

Westminster Pump Station Isolation Valve Selection and Specification, CO: Assessment of applicability for limited clearance, 48 inch diameter double acting isolation valve for Westminster Pump Station in Westminster, CO. Specifications included 200 psi valve, 48 inch diameter, with less than 8 inch face-to-face allowable dimension. Specified valve was a 48 inch bonneted knife gate valve with resilient seats.

Sepulveda Feeder Pipeline Isolation Valve Rehabilitation, CA: Metropolitan Water District of Southern California (MWD) requested a workshop to assist in assessing alternatives for replacement or rehabilitation of existing pipeline isolation valves, and addition of two new isolation valves for the Sepulveda main feeder pipeline in Los Angeles. The feeder pipeline ranges in size from 7 feet to 12 feet, and the valves in question are rated for pressures up to 300 psi and 100 fps flow velocity during closure. MWD currently relies upon cone-type plug valves for the pipeline, but was interested in alternatives capable of similar pressure and velocity ratings. Workshop required development of suite of valve types and available manufacturers for each of the multiple isolation valve locations and presentation of those alternatives within a workshop setting to discuss the pros and cons of each.

Glacier Creek Diversion Sediment Sluice and Closure Gate Repair, AK: Design of repair system for concrete sediment sluice channel and control gate for hydropower intake at King Cove, Alaska. The Glacier Creek intake structure, constructed about 25 years previously, had experienced significant concrete abrasion damage and erosion as a result of stream sediments sluiced through the purpose-built sediment sluice gate and sluiceway. The diversion operates on a very flashy, high sediment load glacial runoff stream and requires regular operation of the sluice to clear sediment deposits from the turbine intake. A UHMW liner plate design and anchor system was developed to repair the sluiceway, and a new gate and thimble assembly was selected. The project is to be constructed by Public Works staff for the City of King Cove, an important fishing and fish processing village located near the far western end of the Alaskan Peninsula about 800 air miles from Anchorage.

New Exchequer Dam Outlet Bypass Fixed Cone Valve Discharge Chamber Emergency Repair, CA: Provided technical guidance and review for emergency repair of steel liner for large 108 inch diameter Howell Bunger fixed cone valve for powerhouse bypass discharge chamber. The steel liner in the 23 foot diameter discharge chamber for the valve failed and was destroyed by the high velocity flow emanating from the valve. Potential causes of the liner failure were assessed, and a new liner assembly was designed. Particular attention was devoted to the anchorage requirements for the new liner plating attaching it to the interior of the valve discharge chamber to resist the very high potential pore pressure uplift forces. The liner plate anchor stud attachment detail included consideration of potential cavitation where the liner plate might be exposed to very high jet velocities.

Lay Dam and Jordan Dam Headgate Downpull/Uplift Analysis, AL: Senior technical advisor leading the evaluation of penstock closure headgates for Lay Dam and Jordan Dam for Alabama Power Company. The existing gates date from the early 20th century and are scheduled to be replaced and the hoisting system rehabilitated or replaced. Analysis evaluated the uplift and downpull thrust reversals throughout the range of gate motion to determine if the gate weight needed to be increased the gate motion to overcome seal friction and to enable closure under flow, and then the capacity of the hoist to lift the weighted gate. All three dams are very similar in design, as are the general headgate arrangements.

Martin Dam Spillway Gate Downpull/Uplift Analysis, AL: Analysis of downpull and uplift forces on vertical lift spillway gate for Martin Dam. Existing vertical lift gates are being rehabilitated, to include new seals and seat beam, support rollers, and dogging devices. Analysis of downpull and uplift forces through the range of gate motion was necessary to assess gate hoist loads that may occur with the new gate lip design that extends the base of the gate down and resolves the current hoist capacity limitation imposed by the potential downpull.

Folsom Dam Emergency Closure Gate Uplift/Downpull Analysis: Baseline evaluation of potential uplift/downpull forces on proposed new emergency closure cable hung slide gates for Folsom Dam new outlet structure on the American River in central California. In addition, led workshop evaluation of proposed design and provided technical support and critical review of USACE-Sacramento District Hydraulic Design staff analysis.

Pyramid Dam Low Level Outlet Valve Study, CA: Development of preliminary design and selection of new 78" fixed cone valve to provide low level outlet regulation for Pyramid Dam.

Agnew and Gem Lake Dams New Bypass Valve Design, CA: Development of design for new high pressure bypass valve on high head penstock at Agnew Lake for Southern California Edison during extremely high snowmelt runoff in spring 2017 to provide additional hydraulic capacity for Gem and Agnew Lakes hydropower plant near Mammoth, CA. Record high snowpack and spillway operation restriction prevented spillway use and required considerable additional capacity to maintain reservoir elevations below FERC-mandated restriction.

Thermalito Dam Low Flow Outlet Valve Spillway Erosion Assessment, CA: Preliminary review of historical erosion damage to existing spillway apron resulting from long-term discharge of high velocity flow and spray from existing fixed cone valve passing discharge across spillway apron. Concrete erosion mapping, hydraulic characteristics of the cone valve jet, and time of exposure data were used to analyze the rate of erosion and develop potential modifications to the valve to reduce or eliminate the erosion processes on the concrete spillway apron surface.

Lake Mathews Forebay Energy Dissipation and Flow Bypass System Design, CA: Development of design for new bypass system for Lake Mathews flow distribution facility in Riverside, CA for Metropolitan Water District of Southern California. Facility is the terminus of Colorado River Aqueduct and serves to route all CRA water to member agencies and water treatment plants throughout southern California. Design included development of design requirements and valve selections for large, high capacity energy dissipating valves, bypass control gates and valves, weirs, and penstocks.

Don Pedro Dam Low Flow Outlet Works Rating Curve Development, CA: The Turlock Irrigation District (TID) was interested in development of a precise discharge rating curve for the low flow outlet valves at Don Pedro Dam. A field measurement and testing program consisting of the design and fabrication of a Replogle Flume and instrumentation was conducted to carefully and precisely measure outflows from each of the three low level release slide gates in the outlet tunnel. Measurements were collected at several approximate flow settings, and the resulting discharge data were correlated with the precise valve settings during each test. The results were summarized to TID in a detailed Technical Memorandum that included approximate accuracy, the field measurement program, and the summary rating curves for each valve.

Spaulding Hydro Plant Energy Dissipation and Bypass Pressure Relief Valve Erosion and Cavitation Analysis, Design, and Modeling, CA: Hydraulic analysis and evaluation of cavitation and erosion damage of Spaulding Hydro Plant turbine pressure relief valve energy dissipation chamber, and physical modeling of energy dissipation chamber. Senior technical advisory role in development of alternatives to provide effective energy dissipation for pressure relief valve that had destroyed cauldron-type dissipation chamber. This project included physical modeling of the existing valve and dissipation chamber, with modifications as proposed.

Fish Passage, Screening, & Collection Systems

Nelson Dam Removal, WA: Physical modeling of Nelson Dam, on the Naches River, and development of dam removal concept. Nelson Dam has been used to divert flow from the Naches River in southeast Washington State for more than a century, but has been identified as a partial barrier to anadromous salmonid upstream migration. Conceptual design of the dam removal and water intake modification to enable continued diversion of municipal and irrigation water preceded a physical scale model that was used to verify the concept.

Lower Baker Lake Floating Fish Collector Hydraulic Deficiency Correction, Concrete, WA: Determined several deficiencies in the final constructed floating fish collector for Lower Baker Lake for Puget Sound Energy. Specifically, identified hydraulic short-circuiting of collector screens due to excess open perforated plate head loss control panels. Additionally, corrected effects of mis-registration of HDPE sliding perforated control plate against stainless steel control plate through methodical calculation of open area and effective head for each of more than one hundred screen panel control sections by applying several different simple closure tabs to eliminate excess perforations. Work included initial and follow up collector velocity data collection to verify flow distribution correction.

White River Water Diversion Dam and Lake Tapps Water Intake Fish Passage Facilities, Enumclaw, WA: Development of new fish passage design and diversion dam design for the White River diversion into Lake Tapps below Mud Mountain Dam, near the city of Enumclaw, Washington. The existing diversion dam and intake originally provided water supply to an artificial lake and hydropower facility, but has suffered from high maintenance cost since construction in the early 20th century. Project included development of design for the new dam, control gates, surface water diversion screens and juvenile bypass facilities, and adult fish ladder and trap and haul facilities, in conjunction with design of new water supply intake for the adjacent hatchery complex operated by the Muckleshoot Indians.

Susitna River – Watana Dam Fish Passage Facilities Conceptual Design, AK: Participated in scientific advisory role for agency review of proposed fish passage facilities for proposed Watana Dam on the upper Susitna River in Alaska. Work involved collaborative Design Team workshops, design development, and construction cost development for both upstream and downstream anadromous and resident fish species for proposed 700-foot high concrete hydropower dam on the Susitna River. Species included anadromous salmonids, burbot, adfluvial whitefish, bull trout, suckers, and other species

Soda Springs Dam Fish Screen and Fish Ladder Balancing: Balancing and adjustment of new fish screen for hydro intake and new fish ladder AWS system for Soda Springs Dam on the North Umpqua River near Roseburg, Oregon. Work included approach velocity measurement at screens with ADV probe and flow measurements with Swoffer and Price AA meters.

Mill Creek Fish Ladder, CA: Senior technical review for new fish ladder to be constructed on the Mill Creek irrigation diversion dam, near Redding, California.

Lower Deer Creek Falls Fish Ladder, CA: Development of fish ladder design alternatives for remote site on Deer Creek near Lassen Park in northern California. These included slot-type, denil, pool-and-weir, and pool-and-chute ladder designs. The site limitations suggest a modified slot type with upstream head control would function best, and a design was prepared. The project would require all materials and equipment to be aerially lifted to the site, and largely hand work to construct.

California Department of Water Resources Bioengineering Research: Various projects in the Sacramento River Delta region to improve understanding of fish behavior and fish protection at DWR intakes, Delta Cross Channel, Yolo Bypass Toe Drain, Clifton Court forebay intake structure.

Wynoochee Dam Fish Passage: Design of downstream migrant juvenile anadromous fish passage facility for high head, widely-variable forebay elevation, flood control, hydropower, and water supply dam.

Albeni Falls Fish Bull Trout Monitoring: Assisted with the bull trout monitoring plan for the USACE Albeni Falls project on the Pend Oreille River. Project will require fish trap and haul facilities in the future.

Cedar Falls Powerhouse – Tailrace Fish Barrier: Managed the hydraulic design for tailrace fish barriers for Cedar Falls. Also managed the construction and testing of the design in a physical hydraulic model. Evaluated the hydraulic characteristics of the proposed fish barrier weirs.

Cushman Dam Upstream Fish Collection Facility: Fisheries engineer providing support to conceptual design of fish collection facility options at a high head dam. Facility includes a trap and haul design as well as new turbine units to supply the auxiliary water supply for the fish facility.

Edwin T. Zapel, M.S., P.E.

Cougar Dam Fish Passage: Fisheries engineering involved in the development of fish collection and passage system for high head flood control and water supply dam. Alternatives addressed both adult Chinook and Bull Trout passage, and juvenile downstream passage and collection concepts.

Omak Creek Steelhead Broodstock Collection Trap: Design and construction management of semi-permanent floating picket weir, trap, and holding area for steelhead recovery broodstock collection facility for the Colville Confederated Tribes.

Okanogan River Adult Fish Collection Weir: Design of an adult salmon collection weir facility for the Colville Confederated Tribes' anadromous fish hatchery and harvest management program for the Okanogan River. The Tribes will use this weir to monitor and evaluate the summer Chinook salmon migration up the Okanogan River, in addition to the collection of broodstock for their Chief Joseph Dam Hatchery, which will be constructed in 2011. Surplus hatchery fish may be harvested at the weir as well. The project is a key component of the Tribes' efforts to restore the extirpated Chinook and steelhead populations that once proliferated throughout the Okanogan River watershed prior to settlement in the later 1800's.

Cedar River Broodstock Collection Weir: Design and management of overall feasibility design of sockeye salmon broodstock collection weir for the City of Seattle's hatchery facilities on the Cedar River.

Okanogan Rotary Smolt Trap Design: Design and installation of pilot rotary trap installations on the Okanogan River for downstream migrant sampling. Effort included development of anchorage system and debris handling.

Swift Dam Floating Surface Collector: Fisheries engineering support for the design of a floating surface collector for juvenile fish. Providing technical input and fisheries criteria guidance to team. Providing ITR on hydraulic design aspects of project.

Baker Lake Juvenile Fish Collection System Value Engineering Study: Technical Value Engineering study of proposed Baker Lake juvenile fish migrant collector. Study was conducted in order to discover and configure cost-savings measures over the course of the week-long evaluation. Study cost savings achieved were on the order of $50 million out of an original estimated total construction cost of more than $150 million. Juvenile fish collector is barge-mounted, with up to 1000 cfs pumped inflow capacity.

East Tonasket Smolt Rearing Pond Design: Design and construction of new fish release outlet system for East Tonasket Irrigation Settling Pond for use as winter rearing facility for spring Chinook salmon. Effort included retrofitting an existing irrigation pump system inlet such that winter flows could be released directly to the Okanogan River, and juvenile chinook salmon could be released through a surface spill directly into the river in spring.

Mayfield Dam Louvered Intake – CFD Modeling, Data Collection: Managed the development of a computation fluid dynamics model of the louvered intake at Mayfield Dam. Also managed velocity measurement program to verify model and fish tracking done by HTI. Compared fish tracking results to hydrodynamic flow field. Provided input on potential modifications to the intake.

The Dalles Dam Juvenile Fish Bypass & Combined System Outfall: Design of combined purpose high flow Ice and Trash Sluice outfall and juvenile fish collection and passage outfall for The Dalles Dam. Feature Design Memorandum level design of this combined purpose outfall included high capacity dewatering system (up to 2,500 cfs), and high capacity juvenile fish outfall capacity (up to 5,000 cfs). Worked extensively with the agencies to develop the high flow outfall design. Also managed physical models of the bypass system.

Little Goose Dam and Lower Granite Dam Fishways: Hydraulic evaluation of the adult fishway systems at Little Goose and Lower Granite Dams. Development of numerical models of the fishway systems. Completed field pump tests to determine the performance of the existing AWS pumps. Model development included collecting field data to calibrate model. Completed a hydraulic evaluation of the existing fishway and studied a proposed change to the Little Goose Fishway auxiliary water supply system.

High Capacity Juvenile Fish Collection and Outfall for Bonneville Dam Second Powerhouse: Preliminary design of modification and extension of the existing Ice and Trash Sluice for use as high capacity juvenile fish passage outfall. Features included modification of existing control gate, weir crest, and outfall channel.

Lower Monumental Emergency Auxiliary Water Supply (AWS) Study: Hydraulic evaluation of the adult fishway system. Development of a numerical computer model of the fishway and fish ladder system at Lower Monumental Dam. Fishway system includes two ladders and fishway transportation channels. Completed field pump tests to develop pump curves for the existing AWS pumps (three pumps, rated capacity of 800 cfs). Numerical model development included collecting field data and calibrating model. Numerical model used to develop emergency water supply concepts for the fishway system in the event of a pump failure.

Little Goose Dam and Lower Granite Dam Fishways: Hydraulic evaluation of the adult fishway systems at Little Goose and Lower Granite Dams. Development of numerical models of the fishway systems. Completed field pump tests to determine the performance of the existing AWS pumps. Model development included collecting field data to calibrate model. Completed a hydraulic evaluation of the existing fishway and studied a proposed change to the Little Goose Fishway auxiliary water supply system.

Granlees Dam Fish Ladder: Technical review of fish ladder design for Granlees Dam on the Mokelumne River.

Bonneville Fish Ladder AWS Study: Development of numerical model of Bonneville Dam adult fishway system, and use of this model to study hydraulic changes in the fishway associated with modifications to the auxiliary water supply system. Documented criteria violations in fishway. Developed an operation manual for the fishway for emergency operating conditions when one of the turbine supply sources fails. Collected field velocity measurements and water surface elevations in fishway.

Bonneville Dam Second Powerhouse Forebay Corner Collector: Hydraulic design of upstream surface-oriented fish collection and bypass system. Included design and evaluation of physical hydraulic model study of collection system.

John Day Dam Fish Ladder Modifications: Development of numerical model of adult fishway system at John Day Dam on the Columbia River, and hydraulic analysis of adult fishway system with this model. Also included development of potential modifications to the fish ladders and auxiliary water supply system.

Stilliguamish River Cook Slough Flow Distribution Weir Fish Passage Design: Provided technical guidance and design for boulder-roughened fishway to remediate low-flow fish barrier created by USACE flow distribution weir on Cook Slough of the lower Stilliguamish River near Arlington, Washington.

Yolo Bypass Toe Drain Fish Collection Trap: Final design of collection and sampling facility for sturgeon, salmonid, and other large body fishes in the Yolo Bypass Toe Drain. Facility included sheet pile abutments, floating pickets, adaptable and adjustable concentration section, holding area, access walkways, and release chute system. Project was designed for the California Department of Water Resources.

Mission Creek Flood Control Channel Fish Passage Alternatives Physical Modeling: Consultation to laboratory staff and development of modeling approach for laboratory testing of various passage alternatives identified in previous feasibility study. Physical modeling included moveable bed materials, with which the sediment transport characteristics of the proposed passage alternatives were evaluated and their impacts on flood control channel capacity were determined.

San Jose Creek Flood Control Channel Fish Passage Alternatives Analysis: Development of fish passage channel modifications to the existing concrete paved San Jose Creek channel in Goleta, California. Existing paved channel is considered impassable to anadromous steelhead. Channel modifications were evaluated to determine relative passage success potential, sediment transport characteristics, and flood discharge capacity.

Howard Hanson Dam Fish Passage: Design of downstream migrant juvenile anadromous fish passage facility for high head, widely-variable forebay elevation, flood control and water supply dam. Included high flow exclusion screen system and bypass. Three-year study required significant resource agency coordination effort and design formulation and presentation from reconnaissance level design through feasibility level design.

Robles Diversion Dam Intake Fish Passage & Sediment Passage: Development of conceptual level designs for rehabilitation of adult fish passage facilities at the Robles diversion and water intake on the Ventura River in southern California, near the city of Ojai as part of the larger project to reconstruct the dam and gate control structures to allow passage of expected large quantities of sediment once Matilija Dam is removed. Adult steelhead passage through the dam structure and diversion works was the primary focus of the study, which is ongoing at present.

Santa Ynez River Fish Passage: As a continuation of previous work to identify fish passage alternatives for Bradbury Dam on the Santa Ynez River, this work consisted of participation in a team working environment with agency staff and consultant engineering staff to develop conceptual upstream and downstream fish passage facilities for Bradbury Dam and two additional dams in the upper watershed of the Santa Ynez. The study report proposed verification studies and design work to validate or invalidate each alternative presented, or to identify modifications necessary to ensure complete success in passage both adults and juvenile steelhead.

Barnaby Creek Culvert Fish Passage Modification Analysis: Development of passage modification alternatives for perched culvert outlet to Barnaby Creek, a tributary to Lake Roosevelt, the reservoir impounded by Grand Coulee Dam on the Columbia River. Currently, at low lake levels, the culvert outflow tumbles down a large riprap roadway embankment with as much as 40 feet of vertical drop. At all but high lake levels, the existing culvert is entirely impassable to trout and other adfluvial fishes.

Omak Creek Culvert Replacement: Design and construction monitoring of two large bottomless culvert replacement projects on Omak Creek in North-Central Washington. The two road crossings replaced inadequately sized culverts that were subject to ice jams, woody debris blockage, and road washouts, and were significant fish passage barriers.

Lake Gardiner Outlet Access Roadway Culvert Replacement: Field design and construction monitoring of replacement of undersized culvert with prefabricated bridge structure to alleviate fish passage barrier problems.

Salmon Creek Culvert Replacement Project: Design of grade control weirs and bank stabilization downstream of formerly perched and impassable large paired box culverts over Salmon Creek.

Antoine Creek Culvert Replacement: Design and analysis of various alternatives for replacement of critically undersized road culvert on Antoine Creek in north central Washington State, a tributary to the Okanogan River. The existing culvert had been identified as a significant impairment to fish passage and a source of fine sediments which damage spawning beds when high flows continually wash out the existing roadway. Selected design incorporated an aluminum plate type bottomless box culvert with precast concrete footings and natural stone abutment and erosion protection.

River Engineering & Habitat Restoration

Roy G Park stream channel stabilization and restoration Drop Structure Design, TX: Review of design of channel stabilization and grade drop structures for ephemeral stream channel in Austin, Texas where large flood events have caused significant damage and initiated headcutting that is further destabilizaing the stream channel and damaging surrounding public park space. Design concepts developed included a hybrid stepped spillway and labyrinth cycle weir to reduce gradient and arrest the headcutting process.

Somis Drain Drop Structure Design Review, Camarillo, CA.: Design review of replacement grade drop structures for the Somis Drain upstream from its confluence with the Calleguas Creek stream near Camarillo, CA. The Somis Drain is a constructed channel with riprap revetments along both banks, and a sand bed channel that mobilizes during flow events. The existing drop structures are inadequate and need to be replaced

Wallace River Streambank Stabilization: Design and construction monitoring of extensive bank stabilization works on Wallace River below Wallace Falls. Project was constructed entirely with mechanically anchored large woody debris.

Skook Creek Culvert Replacement and Grade Control Structures: Hydraulic design and configuration of perched culvert replacement with bottom concrete arch culvert and several hundred feet of channel stabilization using boulder grade control structures and Large Woody Debris (LWD) structures to provide channel boundary roughness and create complex instream habitat.

American River Site 5 Erosion Protection: Design of erosion protection measures for 2000 foot reach of right descending bank line site on American River. Design featured habitat enhancement with Large Woody Debris and riparian restoration.

Pilchuck River Diversion Dam Fish Passage Barrier Removal: Developed design from planning phase through Preliminary Engineering for the removal of an anadromous fish passage barrier created by a municipal water diversion dam on the Pilchuck River near Granite Falls, Washington. The City of Snohomish has diverted municipal water supplies from the dam since the early 1900's, but the facility was identified in regional fishery restoration plans as a significant passage barrier to adult salmon returning to the upper Pilchuck River watershed to spawn. The study developed several concepts for removing the dam or rebuilding it with passage, or replacing it with another intake system that did not require a physical barrier. An alternatives assessment workshop was conducted, and the preferred concept was selected through a matrix evaluation process, and carried through to the Preliminary Design stage.

Swift Bypass Reach Habitat Restoration: Preliminary design of habitat restoration and habitat channel design for Swift hydropower project bypass reach on the Lewis River, Washington.

Hope Creek Restoration Design: Design and construction of extensive juvenile passage structures and wetland rehabilitation for Hope Creek coho overwintering habitat.

Hanaford Creek Bank Stabilization and Habitat Restoration: Design of boulder and Large Woody Debris Toe stabilization structure for bridge replacement project. Project provided structural protection for eroding bankline upstream of new bridge and created overhanging and submerged woody habitat features.

Guadalupe Creek Restoration: Design and review of Large Woody Debris features and channel stabilization measures for restoration of Guadalupe Creek in San Jose.

Lower Guadalupe River Flood Damage Reduction: Design of setback levees, low flow channel, channel stabilization, bridge stabilization structures. Designs incorporated habitat enhancement and restoration features such as overbank riparian restoration, grade control structures, fish passage low flow channels, etc.

Nooksack River Comprehensive Flood Damage Reduction Study: Hydraulic analysis and design of flood damage reduction features for comprehensive basin-wide study of the Nooksack River floodplain.

Mill Creek (Michigan) Drain Flood Damage Reduction Study: Unsteady flow modeling of agricultural lands flooding throughout the Mill Creek drainage basin. Developed alternatives for reduction of flood damage and accommodated environmentally sensitive conveyance capacity increase. Selected alternative included bank and floodway vegetation thinning and selected clearing of accumulated sediment throughout various reaches of the Mill Creek drainage basin. Later phases of the project included construction monitoring to ensure compliance with design intent for minimal disturbance to the naturally maturing riparian forest cover and enhancement of climax forest characteristics, especially prescribed forest thinning operations and sediment removal from channel

Sycamore Phase II Issaquah Creek Restoration: Design of large woody debris placement, overbank flooding relief channels, channel modifications to restore previously dredged, riprapped, and widened reach of Issaquah Creek to natural channel regime. Large wood habitat complex structures were included to encourage sediment feature generation to enhance spawning substrate diversity.

Sauk River Erosion Protection Design: Design of bank stabilization on Sauk River in Darrington, Washington. Project included mechanically anchored large woody debris engineered log jams designed to stabilize eroding bank line and provide submerged and overhanging wood cover elements.

Pilchuck River Bridge Replacement and Habitat Enhancement: Design of bank and pier stabilization project for bridge replacement project. Design included design of mechanically anchored large woody debris engineered log jams and barb structures to stabilize upstream bank line and enhance spawning and juvenile cover.

Franklin Creek Alluvial Fan Flood Damage Reduction and Fish Passage Restoration: Feasibility scoping of stream restoration techniques for Franklin Creek on the South Coast of California. Franklin Creek flows through a concrete flood control channel across the historic alluvial fan through the City of Carpinteria. Poor water quality, complete blockage of fish passage, and interest in restoration of the channel for environmental benefit to the public spurred the development of conceptual alternatives to the concrete channel for transporting the large quantities of sediment and high flood discharges to the Pacific Ocean while at the same time providing fish passage and environmental benefits during low flow periods.

North Fork Newaukum River Boulder Grade Control and Boundary Roughness Structures: Hydraulic design and configuration of boulder and grade control and bank stabilization for severely degraded reach upstream of County road bridge crossing.

Lower Cedar River Sedimentation: Sediment transport and hydraulic analysis of the lower two miles of the Cedar River, Washington, for flood damage reduction study, including levee design and initial construction and maintenance dredging.

North Fork Skykomish River Bank Protection Design: Design and construction monitoring of mechanically anchored Large Woody Debris (LWD) revetment and groin structures protecting several hundred feet of bank and several residences along the North Fork Skykomish River above Index.

Okanogan River Channel Flow Distribution Structure Conceptual Design: Development of conceptual design for a flow distribution structure to divide Okanogan River flows between the Similkameen River and the Okanogan River near Oroville, Washington. The shifting Similkameen River channel and an enlarging cross channel between the two rivers has been starving the Okanogan River of flow, and has left several miles of prime steelhead and chinook spawning habitat unavailable. A conceptual design for a large flow and sediment distribution structure to provide assured hydrology to the Okanogan River channel was developed for the Colville Tribes.

Silver Creek Alluvial Fan Flood Damage Reduction: Conceptual analysis and design of alternatives for managing sediment deposition and flooding on large alluvial fan tributary to the Cowlitz River, near Randall, Washington. The alluvial fan of Silver Creek is the site of the town of Randall, including a large lumber mill, city and government offices, and a public school. Persistent flooding caused by chronic sediment deposition had previously been alleviated by periodic dredging of the channel, at significant environmental and fiscal cost to the lumber mill owners and the County. Potential solutions included sediment diversion, compound channel design, and channel efficiency improvements.

North Fork Thornton Creek Habitat Enhancement and Bank Stabilization: Development of design and construction monitoring for a habitat restoration, spawning bed enhancement, and failing bank protection project on North Fork Thornton Creek in a highly urbanized watershed at the northern boundary of the City of Seattle, Washington. Project design innovations included no use of riprap revetment, and included only natural wood, log, and rootwad construction materials, using mechanical anchorage systems.

Salinas River Flood Control Reconstruction: Design of abandonment and/or reconstruction of flood damage reduction setback levee systems for Salinas River following large floods of the winter of 1994-1995. Various levee projects extended over more than 100 miles of the river from near Castroville upstream to San Ardo, numbering several dozen individual levee systems.

Santa Ana River Flood Control Levee and Groundwater Recharge Cross Levee Inspection: Inspection and development of flood damage reduction levee system rehabilitation following 1995 floods.

Poway Creek Flood Control Channel Inspection: Inspection and development of flood damage reduction conveyance infrastructure for Poway Creek.

Bank Stabilization Design: Design and construction of numerous streambank erosion protection projects throughout Washington, Idaho, Montana, and California.

Sediment Transport

Snoqualmie River Basin Alluvial Fan Remediation Alternatives: Development of conceptual designs for remediation of sedimentation problems on several alluvial fan assemblages within the Snoqualmie River Basin in western Washington State. Large flood events have carried extreme sediment loads from steep, unstable watershed areas on tributary streams onto the Snoqualmie River floodplain, leading to destruction of access roadways, stream channel avulsion, fish habitat destruction, and passage corridor abandonment. Designs included sediment retention basins, diversions, ejectors, and compound channel configurations to enable more effective regular maintenance and removal of deposited materials.

Mission Creek Flood Control Channel Sediment Transport Analysis: Hydraulic modeling and sediment transport modeling of the Mission Creek flood control channel in Santa Barbara, California in support of feasibility design of channel modifications to improve flood capacity.

San Jose Creek Flood Control Channel Sediment Transport Analysis: Hydraulic modeling and sediment transport modeling of the San Jose Creek flood control channel in Goleta, California in support of feasibility design of channel modifications to improve flood capacity.

Montecito Creek Debris Basin Fish Passage Modifications: Development of conceptual designs and evaluations for several alternatives for modifying the existing debris basin on Montecito Creek in Santa Barbara County, California. The existing debris basin is provided with a fish ladder, but sediment is currently recruited into the ladder, filling it quickly and rendering it largely impassable during flood events. Designs included natural roughened boulder spillways of several different slopes and configurations, and various sediment extraction alternatives for the existing ladder.

Lake Mills Dredge Disposal Slurry Pipeline Conceptual Design: Design of proposed dredge slurry pipeline to carry lake deposits to the Straits of Juan De Fuca prior to breaching and demolition of Elwha Dam on the Elwha River. Analysis of several different pipeline materials and configuration in highly abrasive environment.

Water Management & Reservoir Operations, Water Quality

International Joint Commission: Directed staff of hydrologists, hydraulic engineers, and technicians as the Chief of Water Management Section of the Seattle District of the US Army Corps of Engineers (from 2006 to 2009) in the analysis and execution of Columbia River Basin watershed reservoir control and water management. Tasks and studies under direct supervision included water supply and flood control reservoir operations on cross-border tributaries to the Columbia River, specifically the Kootenai and Okanogan Rivers. Duties included technical review of staff engineering products, and support to the US Representative to the IJC; the District Engineer of the Seattle District of the US Army Corps of Engineers, and Division and Headquarters command offices.

Libby Dam Operations: Directed staff of hydrologic and hydraulic engineers and engineering technicians (as Chief, Water Management Section) in the annual operation of Libby Dam on the Kootenai River. The Kootenai River flows into Libby Reservoir (Lake Koocanusa) from the Rocky Mountains of eastern British Columbia, Canada, and then through Idaho and back into Canada into the Kootenay Lake complex. From there, the Kootenai joins the Upper Columbia River at Castlegar, B.C., and then flows south into the Grand Coulee Reservoir (Lake Roosevelt) in northeast Washington State. Operation of the reservoir at Libby satisfies multiple stakeholders by providing hydropower generation, flood storage during the spring snowmelt, and water supply during the later summer, fall, and winter. Complex hydrologic and hydraulic analyses are required to forecast snow pack, runoff potential, and downstream river discharges, as well as hydropower demand and storage reserves. Subsequent coordinated project operations achieve primary flood control in the Bonners Ferry area of north Idaho and in the Kootenay Lake area of B.C., as well as coordinated hydropower generation in the United States and Canada.

Albeni Falls Dam Operation: Directed staff of hydrologic and hydraulic engineers and engineering technicians (as Chief, Water Management Section) in the annual operation of Albeni Falls Dam on the Pend Oreille River, in coordination with US Bureau of Reclamation operation of Kerr Dam and Hungry Horse Reservoir on the Flathead River. The Pend Oreille River flows through Albeni Falls Dam from Lake Pend Oreille, which is controlled during low to moderate flows by Albeni Falls Dam. Outflows from the Dam pass into Canada through several utility generation dams, joining the Upper Columbia River just north of the international border with Canada, and back into the Grand Coulee Dam Reservoir (Lake Roosevelt) in northeast Washington State. Operation of Albeni Falls Dam satisfies multiple stakeholders by providing hydropower generation, flood storage in Lake Pend Oreille during the spring snowmelt, and water supply and recreation during the summer. Complex hydrologic and hydraulic analyses are required to forecast snow pack, runoff potential, and downstream river discharges, as well as hydropower demand and storage reserves. Subsequent coordinated project operations achieve primary flood control in the Newport area of northeast Washington, as well as coordinated hydropower generation in the United States and Canada.

Chief Joseph Dam Operations: Directed staff of hydrologic and hydraulic engineers and engineering technicians (as Chief, Water Management Section) in the annual operation of Chief Joseph Dam on the Columbia River, in coordination with US Bureau of Reclamation operation of Grand Coulee Dam and upstream reservoirs in Canada and the United

States. Chief Joseph Dam provides a small amount of flood control storage, and primarily acts as a regulating reservoir below Grand Coulee Dam. It has the largest US Army Corps of Engineers' hydropower generation capacity in the United States. Operations at Chief Joseph Dam are coordinated with the Bonneville Power Administration and multiple public utility districts on the middle Columbia and the Snake River to generate power and provide flood control in the Lower Columbia at Portland, OR and Vancouver, WA. Complex hydrologic and hydraulic analyses are required to forecast snow pack, runoff potential, and downstream river discharges, as well as hydropower demand.

Puget Sound Tributaries Flood Control Operations: Directed staff of hydrologic and hydraulic engineers and engineering technicians (as Chief, Water Management Section) in the annual operations of Mud Mountain Dam on the White River, Howard Hanson Dam on the Green River, and several other utility-owned storage and hydropower dams across the Puget Sound region (Seattle City Light's Upper Skagit River projects, Puget Sound Energy's Baker River projects, Tacoma Power's Wynoochee River project) to achieve flood control objectives and meet water supply needs. In addition, staff provided real-time flood coordination efforts on all unregulated rivers in the Puget Sound and Grays Harbor basins, as well as streams draining the Olympic Peninsula and east slope of the Cascade Mountains to assist local and regional flood emergency response agencies. Water Management flood control operations provided primary information to US Army Corps of Engineers' flood fighting crews actively engaged in emergency flood protection and response across Western Washington and the East slopes of the Cascades. Complex hydrologic and hydraulic analyses by Water Management staff were required to forecast flood runoff potential, downstream river discharges, and anticipated river flood stage.

Water Control Data Collection: Directed staff of engineering technicians and hydrologic engineers in the installation, maintenance, and operation of numerous snow pack measurement, rainfall gauges, stream gauges, and water quality (temperature and turbidity) throughout Washington, Idaho, and Montana owned by the US Army Corps of Engineers. These environmental monitoring stations provide real-time data for use in the coordinated operations of the multiple US Army Corps of Engineers (and other coordinating agencies) reservoirs and dams throughout the Pacific Northwest, and are essential to the successful operation of US Army Corps of Engineers project throughout the region. In addition, directed Water Management Hydromet Data processing staff in the processing, distribution, and archiving of all data collected as part of Water Management Section operations. Was directly responsible for data quality, computer equipment and network transmission of these data through critical staff at the Seattle District.

Pend O'Reille River Temperature Modeling Review: Technical review of Pend O'Reille water temperature modeling analysis with CEQUAL-W2. Temperature modeling was accomplished in support of USACE coordination with Idaho Department of Environmental Quality and the proposed temperature TMDL for the Pend O'Reille River.

Icicle/Peshastin Irrigation District: Water conservation study for Icicle/Peshastin Irrigation District in Cashmere, Washington. Field inspection and review of all facilities. Development of facility rehabilitation and water conservation plans and construction schedules.

Selected Publications

A.R. Firoozfar, **E.T. Zapel**, A.L. Strain, and N.B. Adams (2019), "Dam and Spillway Rehabilitation to Accommodate Increased Design Flood: Calero Dam." Proceedings of the 2019 ICOLD Symposium, Ottawa, Canada, 2019.

A.R. Firoozfar, K.C. Moen, **E.T. Zapel**, K.S. Dosanjh, T. Ford, (2018) Generalized Programmatic Framework for Spillway Inspection and Potential Failure Modes Assessment." USSD Dams and Levees, Fall 2018, Issue No. 176.

D. Hinton, B. Hughes, and **E.T. Zapel** (2015), "Scott Dam Spillway – Comparing Physical Model Study Results." HydroVision 2015, Portland, OR.

Zapel, E.T., H. Nelson, B.R. Hughes, S. Fry (2014), "Options for Reducing Total Dissolved Gas at the Long Lake Hydroelectric Facility." HydroVision 2014, Nashville, Tennessee, July, 2014.

Zapel, E.T. (2014). "Innovative Hybrid Design of Issaquah Creek Hatchery Water Supply Intake Using Physical Scale Modeling as a Collaborative Tool." International Conference on Engineering and Ecohydrology for Fish Passage 2014, Madison, WI.

Edwin T. Zapel, M.S., P.E.

Zapel, E.T, M. Whitman, D. Crowder, M. McGoogan, K. Harrison, J. Frye; “Constructed Flood Control Channels – Fish Passage Modifications: San Jose Creek, Mission Creek, Montecito Creek Physical Models.” American Fisheries Society, 140th Annual Meeting, Pittsburgh, September 2011**.**

Larson, L.W., **Zapel, E.T.**, S. J. Schlenker, R.T. Lee, S.C. Milligan; “Predictive Numerical Computer Models of Adult Fishways and Application at US Army Corps of Engineers Dams.” Proceedings of the Bioengineering Symposium at 132nd Annual American Fisheries Society Meeting. Baltimore, Maryland, August, 2002.

M.P. Gellis, **E.T. Zapel**, and M.Whitman (2009). “A Physical Model of Modifications to Concrete Flood Control Channels for Fish Passage.”

Zapel, E.T., T.R. Molls, S.V. Johnston, P.A. Nealson, M.A. Timko, and M. G. LaRiviere; “Juvenile Salmonid Acoustic Tracking Correlation with CFD-Model Predicted Velocity Fields at the Mayfield Dam Louvered Intake.” Proceedings of the Bioengineering Symposium at 132nd Annual American Fisheries Society Meeting. Baltimore, Maryland, August, 2002.

Ahmann, M.L., and **E.T. Zapel**, "Stepped Spillways, a dissolved gas abatement alternative." Proceedings of the International Workshop on Hydraulics of Stepped Spillways. Zurich, Switzerland, March, 2000.

Zapel, E.T., F.A. Goetz, and P.J. Hilgert. "Development of a Downstream Fish Passage System for Anadromous Salmonids at a High-Head Dam." Proceedings of Symposium at 127th Annual American Fisheries Society Meeting. Monterey, California, August, 1997.

Zapel, E.T. "Howard A. Hanson Dam Juvenile Fish Bypass System." Fish Passage Workshop. Milwaukee, Wisconsin, May, 1997.

United States Department of the Interior

FISH AND WILDLIFE SERVICE

5275 Leesburg Pike
MS-ES
Falls Church, Virginia 22041

In Reply Refer To:
FWS/AES/DER/BER/074532
ER 21/0036

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

Re: U.S. Fish and Wildlife Service Comments on the Federal Energy Regulatory Commission's Notice of Inquiry on Financial Assurance Measures for Hydropower Projects, Docket RM21-9-000

Dear Ms. Bose:

The U.S. Fish and Wildlife Service (Service) would like to thank the Federal Energy Regulatory Commission (Commission) for seeking comment on whether and how the Commission should require additional financial assurance mechanisms in the licenses and other authorizations it issues for hydroelectric projects. The Service engages in the Commission's authorization processes for hydroelectric projects through the following authorities, as amended: the Federal Power Act (16 U.S.C. §791 et seq.), the Fish and Wildlife Coordination Act (16 U.S.C. §661 et seq.), the Endangered Species Act (ESA; 16 U.S.C. §1531 et seq.), and the Migratory Bird Treaty Act (16 U.S.C. §§703–712).

The Service agrees with the need to require financial assurance measures in all of the Commission's hydroelectric project authorizations to ensure that licensees and exemptees can afford required environmental measures. Requiring financial assurances will help reduce the risk of project failure and the resulting environmental hazards. The Service recommends that the amount of assurances should be proportional to the estimated risk for a given project.

The Commission has requested responses to specific questions and three potential options for establishing financial assurance mechanisms in hydroelectric licenses. The Service's responses and comments are in the enclosed attachment. The Service provides these comments for the purpose of offering technical assistance and notes that these comments do not necessarily represent the views and comments of the Department of the Interior. If you have any questions on the Service's comments, please contact Ms. Frankie Green, National Hydropower Program Manager, at either frankie_green@fws.gov or (703) 358-1884.

Sincerely,

CRAIG AUBREY
Digitally signed by CRAIG AUBREY
Date: 2021.03.26 08:50:05 -04'00'

Craig Aubrey
Chief, Division of Environmental Review
Ecological Services Program

Attachment

Attachment

U.S Fish and Wildlife Service Responses to RM21-9-000

Notice of Inquiry on Financial Assurance Measures for Hydropower Projects

<u>Federal Energy Regulatory Commission Questions</u>

1. How and when the Commission should require financial assurance from licensees.

Specifically, should a financial assurance requirement be included in original licenses and/or on relicense? If on relicense, should such a requirement be included in both new licenses for major projects and subsequent licenses for minor projects? Should the Commission also require financial assurance requirements in other authorizations, such as all exemptions, amendment requests, and transfers? Should the Commission reopen licenses to impose financial assurance measures?

Response: The Service recommends that the Commission require financial assurances for all projects (i.e., original licenses, relicensing, exemptions, amendment requests, and transfers) to ensure the protection of fish and wildlife and the preservation of other aspects of environmental quality throughout the duration of the license. In its Notice of Inquiry, the Commission mentions that approximately 88 projects under the Commission's jurisdiction are non-operational, often due to a lack of financial resources. The Service notes that a number of these projects, and others, are also out of compliance with license conditions related to Service trust resources. Environmental effects occur at both major and minor projects and financial assurances should be required to ensure that licensees can afford to implement the environmental mitigation measures that are required in the license. For license transfers, the Service also recommends that transferees demonstrate, prior to the transfer, that they have adequate financial assurance for required environmental measures, including mitigation. Transferees are responsible for all of the provisions of the existing license, and thus should demonstrate the financial capacity to implement measures needed to protect environmental resources. In terms of addressing environmental impacts, the Service recommends that financial assurance mechanisms be required for amendment requests requiring substantial additional investment where fish passage or other fish and wildlife concerns are central to the request. Based on projects' compliance records, the Commission should consider reopening licenses or exemptions as necessary to require financial assurance measures.

Because exemptions are issued in perpetuity, the Service strongly recommends that financial assurance mechanisms be required for all exemptions and exemptees. Ensuring the long-term capacity of the operator to maintain the project in good working order is particularly important. The Service recognizes that it is typically smaller projects that qualify for exemptions but notes that these projects may have potentially significant environmental impacts. For example, the Elba Hydroelectric Project (P-10691) on the Pea River in southern Alabama was granted an exemption in 1989 and has been inoperable since the dam was breached by a major flood in December 2015. The portion of the Pea River downstream of the dam is listed as critical habitat for Gulf Sturgeon, and both the upstream and downstream reaches are listed as critical habitat for three listed freshwater mussel species. Although negotiations with the owner and various stakeholders to decommission the dam and restore the habitat are ongoing, outside funding may be required, as it appears there are insufficient financial resources to repair the facility. Requiring financial assurances in the case of exemptions would reduce the likelihood of similar situations arising in the future, which would clearly be in the public interest.

The Service also recommends that financial assurances address decommissioning costs, including the removal of project infrastructure and the restoration of habitat when a licensee or exemptee surrenders its license or otherwise voluntarily abandons a project. This would ensure projects that are abandoned do not pose a risk to the environment and would reduce the risk that taxpayers and ratepayers would have to pay to remove project infrastructure and restore habitat if a project is abandoned.

2. Potential Options identified by Commission staff for establishing financial assurance mechanisms in hydroelectric licenses.

A. Bonds: Requiring licensees to obtain bonds to cover the costs of safety measures and project operation and maintenance: ***Should the Commission require licensees to obtain bonds as a financial assurance mechanism?***

Response: If bonds are selected as a financial instrument, the amount of the bond should reflect the potential costs to maintain the comprehensive development standard for that waterway, including the adequate protection of fish and wildlife and their habitats. The Service recognizes that bonds may not be within the resources of all licensees or exemptees so the Commission should consider which financial assurance mechanism is best for small hydroelectric projects.

B. Trusts: Establishing an industry-wide trust or remediation fund or requiring licensees to maintain an individual trust, escrow, or remediation fund: ***Should the Commission establish an industry-wide trust or fund as a financial assurance mechanism?***

Response: If an industry-wide mechanism were employed the Service recommends that it should be structured so that only projects that meet their comprehensive development standard qualify for financial assurance support. Systems in support of a trust, similar to the Oil Spill Liability Trust Fund authorized in the Oil Pollution Act of 1990, could be established to encourage licensees and exemptees to maintain adequate financial assurance for maintenance, fish passage, and environmental mitigation, or removal of project infrastructure.

C. Insurance: Requiring licensees to obtain insurance policies for unforeseen safety hazards or dam failures.

Response: The Service notes that insurance would be a project-specific financial assurance mechanism that would not put an undue burden on any one sector of the industry.

General Comments

Non-operational or non-compliant projects pose risks to more than just human health and safety. Licenses are often issued with measures that are supposed to protect or mitigate damage to fish and wildlife resources and their habitats. When licensees do not comply or cease to comply with those measures, the fish and wildlife resources and their habitats may be put at risk. Requiring financial assurances of licensees is an additional mechanism that the Commission could use in exercising its authorities and fulfilling responsibilities to the public.

Financial assurance mechanisms employed by the Commission should not support projects where the protection of environmental resources outweighs their benefit. In its 1994 Decommissioning at Relicensing Policy Statement the Commission encourages licensees to plan accordingly for unforeseen circumstances and for projects that have reached the end of their utility but that continue to prevent or reduce fish passage and/or that have other continuing environmental impacts. The Service agrees that financial assurance mechanisms should be used to ensure operation and maintenance of a project and be adequate to support the challenges of an aging fleet, such as providing fish passage or for removal of project infrastructure and mitigation of project impacts. Committing to financial assurances is critically important to ensure that licensees and exemptees can fund and address known and unanticipated future environmental concerns. The Service believes that carefully developed financial assurance mechanisms required by the Commission will address these trust resource considerations and could provide a sustainable path forward for Commission licensed hydroelectric projects.

Attachment F

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Silver Spring, MD 20910

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

Re: National Marine Fisheries Service Office of Habitat Conservation Comments on Financial Assurance Mechanisms for Federal Energy Regulatory Commission Licensed Hydroelectric Projects; Docket: RM21-9-000

Dear Ms. Bose:

The National Marine Fisheries Service (NMFS) would like to thank the Federal Energy Regulatory Commission (FERC) for the opportunity to provide feedback on the January 26th, 2021 Notice of Inquiry (NOI) on whether to require additional financial assurance mechanisms in the licenses and other authorizations FERC issues for hydroelectric projects. NMFS provides our comments under the following authorities that guide our interaction with hydropower development: the Federal Power Act (FPA), the Endangered Species Act (ESA), the Fish and Wildlife Coordination Act, and the Magnuson–Stevens Fishery Conservation and Management Act.

NMFS supports FERC requiring financial assurance from licensees. Financial assurance from licensees should support mechanisms that promote environmental conservation, forward planning, flexibility in terms of types of hydroelectric projects, and equity for communities affected by or reliant on hydroelectric projects.

- Conservation - Financial assurance mechanisms should help ensure licensees are financially able to carry out license terms and obligations for the protection and recovery of NOAA trust resources (i.e. FPA Section 18 prescriptions and 10(a) and 10(j) recommendations), and should include provisions to account for unforeseen circumstances, e.g., increasing severity of seasonal flooding and failure of antiquated infrastructure, which may require adjustments or new mitigation for trust resources.

- Forward planning - Mechanisms should help anticipate the long-term financial burden of multi-decadal projects and ensure that over its entire term, the license continues to reflect FERC's equal consideration balancing under FPA Section (4e) and FERC's assessment of a project's "best adapted to a comprehensive plan" standard for a waterway for the public's best interest is achieved (FPA Section 10(a)), including options for fish passage, environmental mitigation, decommissioning, and removal.

- Flexibility - Mechanisms should be available to address the diversity of hydroelectric projects, e.g., utility vs non-utility projects.

- Equity - Mechanisms should support equity in relation to communities affected by or reliant on hydroelectric projects.

Many past projects would have benefitted from requiring financial assurances. East Juliette (P-7019), Lower Mousam (P-14856), White River (P-2494) and Enloe (P-12569) are examples of projects where a trust or another mechanism may have helped reach a positive outcome for natural resources. East Juliette's license was revoked in 2014 because the licensee failed to comply with the license requirement to install fish passage. This project currently sits idle and continues to cause unmitigated harm to the environment. Lower Mousam was abandoned by the licensee because they could not afford to continue operation of the project. The project is now unpowered and remains a barrier to passage for diadromous trust species. The White River licensee, facing mounting costs to maintain their aging dam and fish collection facility, abandoned their project, which blocks upstream passage and threatens previous recovery efforts of Pacific salmonids in the watershed. Finally, the Enloe hydroelectric project was licensed to Public Utility District 1 of Okanogan County in 2013. The project has not produced power since 1954 and is a barrier to NOAA trust species such as migratory Summer Chinook Salmon and upper Columbia River Steelhead. If financial assurance mechanisms had been required by FERC to address fish passage and dam removals, then the environmental harm caused by these projects and others would have been mitigated.

The attached document provides detailed responses to the questions presented in the NOI for FERC's consideration. NMFS would welcome the opportunity to work with FERC on the development of this policy. If you have any questions or need additional information, please contact Mr. Nicholas Anderson at nick.anderson@noaa.gov or by phone at 301-427-8696.

Sincerely,

ROBINSON.CARRIE.DIANE.1365872135

Digitally signed by ROBINSON.CARRIE.DIANE.1365872135
Date: 2021.03.29 10:59:14 -04'00'

Carrie Robinson

Attachment

NMFS Comments on
The Commission's Options for Financial Assurance Mechanisms for Hydroelectric Projects (March 26th, 2021)

1. **How and when the Commission should require financial assurance from licensees.**

a. *Specifically, should a financial assurance requirement be included in original licenses and/or on relicense?*

Yes. Financial assurance requirements should be included in both the original and new licenses for hydroelectric projects. The diversity of Commission licensed projects underpins the need for multiple or flexible mechanisms for financial assurance(s) based on the specific characteristics of a project and covering different scenarios, e.g., general repair, environmental mitigation, disaster management. While NMFS does not recommend a specific financial assurance mechanism, we do recommend that FERC's requirements of each licensee be designed to achieve the same standards, i.e., consistent levels of financial assurance. NMFS offers the following recommendations in relation to how financial assurance mechanisms could be implemented by FERC.

Mechanisms should ensure sufficient funding to 1) complete and operate fish passage and protection facilities and other environmental mitigation measures required in the license, 2) remove project infrastructure and complete habitat restoration where licenses have been revoked or surrendered, and 3) maintain public safety for any remaining project infrastructure. Provisions should be incorporated into assurance mechanisms to provide for maintaining fish passage for diadromous species, including but not limited to ESA-listed species, and for mitigation for the species or their critical habitat to the extent required by the license and the provisions in any applicable biological opinion or incidental take statement under ESA section 7. Financial assurance requirements should also identify the distinct purpose for the use of all funds, e.g., maintenance, fish passage, or removal, and not exist as a general all-purpose fund.

NMFS believes that carefully developed financial assurance mechanisms required by FERC can address public safety and trust resource considerations and provide a sustainable path forward for Commission-licensed hydroelectric projects. For projects where hydropower is the best available option for a community, financial assurance measures should be adapted to support local communities (including tribes and rural communities), ratepayers, and public safety, as well as environmental resources.

b. *If on relicense, should such a requirement be included in both new licenses for major projects and subsequent licenses for minor projects?*

Yes. The requirement should apply to both original and subsequent licenses. Both major and minor projects have environmental impacts that need to be addressed in the license, and financial assurances should be required to ensure that environmental mitigation measures can be implemented in all cases.

c. *Should the Commission also require financial assurance requirements in other authorizations, such as all exemptions, amendment requests, and transfers?*

Yes, exempt projects have the same environmental and public safety concerns as licensed projects. These financial assurance requirements will require renewal as exemptions are in perpetuity. If a licensee/exemptee already has a financial assurance mechanism, we do not see the benefit in requiring an additional financial assurance mechanism during the amendment process. Finally, any license/exemption transfer should include all the existing financial assurances and other license requirements.

d. *Should the Commission reopen licenses to impose financial assurance measures?*

This depends on the financial assurance mechanism. Because exemptions are issued in perpetuity, NMFS strongly recommends that financial assurance mechanisms be required for all exemptions and exemptees, so they have financial assurance mechanisms for projects that may need to be repaired or removed to ensure public safety or to achieve sufficient mitigation or avoidance of impacts to environmental trust resources.

For license transfers, NMFS also recommends that new licensees demonstrate that they have adequate financial assurance for operation, maintenance, environmental mitigation, and eventual decommissioning prior to the transfer. As transferees are responsible for all of the provisions of the existing license, financial assurance obligations should also be transferred.

Not all amendment requests would require financial assurances; NMFS recommends financial assurances be required for amendment requests in which fish passage and/or dam safety issues that could require ongoing or future financial support are implicated by the request.

e. *Should the Commission require licensees to reaffirm or recertify that they have adequate financial assurance instruments every few years during their license term? If so, how often during a license term should the Commission require licensees to demonstrate that they still have adequate finances?*

Yes, FERC should require licensees to reaffirm or recertify that they have adequate financing to maintain the project and the capacity to reasonably address unforeseen circumstances. NMFS recommends that licenses should reaffirm or recertify that they have adequate financial assurance every 5 to 10 years, depending on the type of project. Given the multi-decadal length of licenses and increasing rate of environmental change due to a changing climate, the maintenance and mitigation requirements and conditions as well as the evolving status of NOAA trust species affected by a project make such periodic reaffirmation and recertification necessary.

f. *Should the Commission require licensees to notify the Commission if the circumstances underlying their financial assurance instruments have changed?*

Yes. Licensees should be required to keep FERC apprised of licensees' ability to provide financial assurances. Notifications that financial assurance mechanisms have changed should be filed in the docket, so that all parties to license approval are aware of changes.

2. Bonds

a. *Should the Commission require licensees to obtain bonds as a financial assurance mechanism?*

NMFS does not have a position on whether FERC should require licensees to obtain bonds in relation to other potential financial assurance mechanisms (see comments under 1.a.).

b. *If so, how should the Commission determine the amount of the bond or what factors should the Commission consider when determining the bond amount?*

If bonds were required, the amount of the bond should reflect the potential costs to maintain and operate the project over the license term, including all terms and conditions relating to fishery resources, and to assure that the project remains adapted for the public's best interest. NMFS does not recommend an algorithm based solely on project power generation or capacity for determining the amount of the bond as such an approach does not account for other important criteria such as environmental impacts and public safety.

c. *Are bonds within the resources of all licensees, including those of small hydroelectric projects. Could the Commission mitigate these expenses?*

NMFS agrees that this an important consideration with respect to how financial assurance may potentially burden small hydropower development. For this reason, NMFS maintains that FERC should be flexible with regard to which mechanisms are appropriate for which projects, with options available for all licensees.

d. *What other challenges would bond requirements pose to individual licensees, municipal licensees, the public, or the Commission?*

No comment.

3. Trusts

a. Should the Commission establish an industry-wide trust or fund as a financial assurance mechanism?

NMFS does not have a position on whether FERC should establish an industry-wide trust or fund in relation to other potential financial assurance mechanisms (see comments under 1.a.). However, if an industry-wide mechanism were employed, it should be structured so that only projects that equitably contribute to the trust and continue to serve the public's best interest, qualify for financial assurance support. A trust should not subsidize the rehabilitation of abandoned, license-revoked, or unsafe projects that can cause unmitigated harm to NOAA trust resources, and requirements to address these issues before they escalate would benefit mitigation of these projects.

b. If so, how should the Commission generate funds for the trust? Should the Commission consider using its annual charge authority to fund an industry-wide trust?

No comment.

c. How should the Commission determine the appropriate level of funds for an industry-wide trust?

No comment.

d. How should the Commission determine how funds are distributed?

NMFS recommends that FERC use criteria for distribution that take into account the goals reflected in the FPA's requirements to serve a broad array of public interests, including NOAA trust resource goals and equitable contributions by licensees that have been made to the trust. Distribution should also take into account equity and environmental justice concerns as they pertain to ratepayers and local communities.

e. Should the Commission require licensees to maintain an individual trust or escrow fund as a financial assurance mechanism?

Not necessarily. As aforementioned, NMFS is more concerned that appropriate financial mechanisms be required based on the specific needs of hydroelectric projects and their impact on public safety, environmental conditions, trust resources, etc. NMFS encourages FERC to consider that individual trusts may be a financial barrier for smaller (non-utility) projects, limiting their use as a financial assurance mechanism. Under these or similar circumstances, FERC could offer alternative mechanisms for financial assurance when appropriate.

f. For individual trusts, how should the Commission determine the appropriate level of the trust and what factors should the Commission consider in determining amounts?

No comment.

g. For individual escrows, should the Commission require licensees to retain a certain percentage of generation receipts in an escrow account?

No comment.

h. What other challenges would an industry-wide or individual trust pose on individual licensees, small hydroelectric project licensees, municipal licensees, the public, or the Commission?

Please see NMFS' comments in section 3.a. and 3.e. that describe the challenges we anticipate from using different types of trusts.

4. Insurance

a. Should the Commission require licensees to obtain insurance policies as a financial assurance mechanism for project maintenance?

NMFS does not have a position on whether FERC should require licensees to obtain insurance policies as financial assurance mechanisms for project maintenance in relation to other potential financial assurance mechanisms (see comments under 1.a.).

b. How should the Commission determine the amount of required coverage of an insurance policy or what factors should the Commission consider when determining the amount of coverage?

No comment.

c. What other challenges would a requirement to obtain an insurance policy pose on individual licensees, small hydroelectric project licensees, municipal licensees, the public, or the Commission?

No comment.