VERMONT FISH AND WILDLIFE DEPARTMENT

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Distributed Electronically

January 29, 2021

Low Impact Hydropower Institute Office
1167 Massachusetts Ave
Arlington, MA 02467

Re: Deerfield Project (LIHI Certificate #90)
Comments on Low Impact Hydropower Recertification

Dear Ms. Ames,

A LIHI Certified® hydropower facility is one that is sited, designed, and operated to be compatible with environmental and social resources. Currently, Great River Hydro is seeking recertification of the Deerfield River Project as low impact. As a resource agency, the Vermont Agency of Natural Resources appreciates the opportunity to comment on the recertification of the Deerfield Project under LIHI.

According to the recertification website, "the Deerfield River Project is located on the Deerfield River, a major tributary to the Connecticut River, in Bennington and Windham Counties in Vermont, and in Berkshire and Franklin Counties in Massachusetts. It consists of eight developments: Somerset, Searsburg, Harriman, Sherman, Deerfield No. 5, Deerfield No. 4, Deerfield No. 3 and Deerfield No.2, having a total installed capacity of 86 megawatts (MW). All dam operations and generation operations are controlled remotely from the Deerfield River Control Center in Monroe Bridge Massachusetts, located near the Deerfield No. 5 Dam.

The Project area encompasses about a 65-mile reach of the river, including reservoirs. Two other developments not owned by the company are also located within this area. They are Brookfield Renewable Power's Bear Swamp Project located downstream of the Deerfield No. 5 development; and Consolidated Edison's Gardner Falls Project located downstream of the Deerfield No. 3 development."

Three of the Deerfield River Project's facilities are wholly located in Vermont: Somerset, Searsburg, and Harriman. A portion of the impoundment created by the Sherman project is also located in Vermont. All projects are licensed by the Federal Energy Regulatory Commission (FERC) under license number P-2323 which was issued in 1997 and expires in 2037. The project also is regulated under a Water Quality Certification (P.L. 92-500, Section 401) by the State of Vermont that was issued on January 30, 1995 covering the duration of the FERC license.

The Deerfield River is known as a hard-working river. Along its course to the Connecticut River, the Deerfield has a dam every seven miles on average. As a result of the Settlement Agreement in 1994, long bypass reaches that were previously dry received minimum flows. Limits on drawdowns at reservoirs to protect loons and other aquatic life were established. Recreationalists saw more boating and hiking

opportunities. The eight developments that make up Great River Hydro's Deerfield Project were deemed in compliance with water quality standards, and 401 water quality certifications were issued by Vermont and Massachusetts. As a result of the Settlement Agreement, the Deerfield Project was issued a FERC license with a term of 40 years.

But, 24 years into the license term, the fact remains that the Deerfield Project is not low impact. In Vermont, the flow regime of the Deerfield River is highly modified by the Somerset, Searsburg, Harriman and Sherman projects. The Somerset Dam of the East Branch Deerfield River does not generate any power but is used to deliver inflows to the Searsburg Project downstream. Both the Searsburg and the Harriman projects have long bypass reaches, much longer than the sections of free-flowing river before the next impoundment. While these bypass reaches have minimum flow standards, they lack a natural flow regime that is essential to a functioning and healthy riverine ecosystem. In other words, they lack an ecological flow regime. In Vermont, none of the three dams have upstream or downstream fish passage. Both the Somerset and Harriman impoundments stratify, resulting in hypoxic zones in the reservoirs. According to Vermont's 2020 List of Priority Surface Water, several waterbodies impacted by the Deerfield Project have TMDLs for mercury in fish tissue (Harriman Reservoir, Sherman Reservoir, East Branch Deerfield River below Somerset Dam, Somerset Reservoir, Upper Deerfield River Below Searsburg Dam, and Searsburg Reservoir). Somerset Reservoir also has a TMDL for pH. The Lower Deerfield River below Harriman Reservoir is also listed as impaired by flow regulation.

Because of the high dam density, water quality concerns related to flow alteration, deoxygenated areas of Somerset and Harriman reservoirs contributing to elevated mercury in fish tissue, a highly modified flow regime, reservoir drawdowns impacting littoral community development, and lack of fish passage, the Vermont Agency of Natural Resources does not support the recertification of the Deerfield Project as low impact. Specific comments related to LIHI criteria are presented below.

Somerset Project

The Somerset Project, located on the East Branch of the Deerfield River, has a sole purpose of acting as a storage reservoir for the lower projects as it does not generate any hydropower. According to the 303(d) list, the East Branch Deerfield River below Somerset Dam is chronically acidified (https://dec.vermont.gov/sites/dec/files/documents/mp_PriorityWatersList_PartA_303d_2020.pdf). Extensive winter drawdowns at Somerset Reservoir also prevent the establishment of a healthy littoral community.

Zone 1: Somerset Impoundment

3.2.5 Criterion E – Watershed and Shoreline Protections- Although management of the impoundment complies with federal and state laws, extensive drawdowns prevent the establishment of littoral communities. Under the 401 Certification, the reservoir can fluctuate from a target during loon nesting season of 2128.58 ft to a low of 2107 ft, representing an annual drawdown of over 21 ft. While these drawdowns complied with the Water Quality Standards at the time of certification, the Agency does not consider them to be low impact. According to finding 219 of the 401, "The extensive drawdowns at Somerset and Harriman reservoirs are a major factor in preventing the establishment of beneficial wetland plant communities that would otherwise become established along the shoreline margins and in the shallow areas of the reservoirs."

Zone 2: Somerset Downstream Reach

3.2.1 Criterion A - Ecological Flow Regimes- The East Branch Deerfield River below Somerset Reservoir partially meets the A2 Standard of Agency Recommendation. Minimum flows in this section of the East Branch Deerfield River were established by an IFIM study conducted to support development of the 401. Minimum flows were set at 12 cfs from May 1- July 31 (or 9 cfs if inflows are < 12 cfs), 12 cfs from August 1- September 30, 30 cfs from October 1 – December 15, 48 cfs from December 16-February 28, and 30 cfs from March 1-April 30. While these minimum flows were determined to meet Vermont's Water Quality Standards over 25 years ago, the Agency does not agree that this constitutes an "Ecological Flow Regime" as defined by LIHI. An ecological flow regime as defined applies an ecosystem-based approach that supports fish and wildlife resources by considering base flows, daily, seasonal, and inter-annual variability, high-flow pulses, and short-term rates of change (Figure 2). The East Branch Deerfield below Somerset is a hydrologically altered system, primarily due to its lack of natural floods. It is not subject to daily peaking cycles or major low-flow extremes, and in many respects presents an overly static flow condition that theoretically could benefit salmonid recruitment and survival. However, it is unclear how the loss of floods and/or the presence of the dam has affected river morphology below Somerset Reservoir, and whether this exacerbates the system's naturally low productivity. Reduced peak discharges and generally stable flows produced by regulated water releases from flood control or storage reservoirs (Figure 1) inevitably impact natural stream processes including channel morphology and substrate composition. The Agency believes that such high level of flow alteration in the Deerfield watershed should not warrant certification under LIHI.

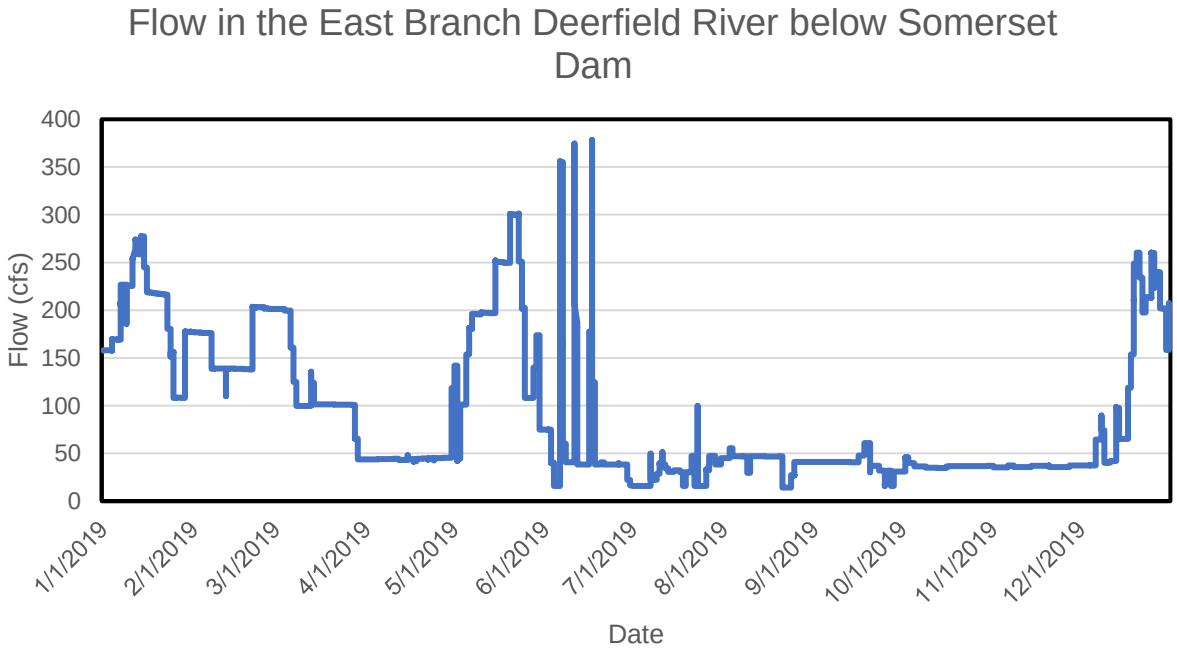

Figure 1. 2019 flows in the East Branch Deerfield River below Somerset Dam. Note the flat nature of the hydrograph, especially between July and December.

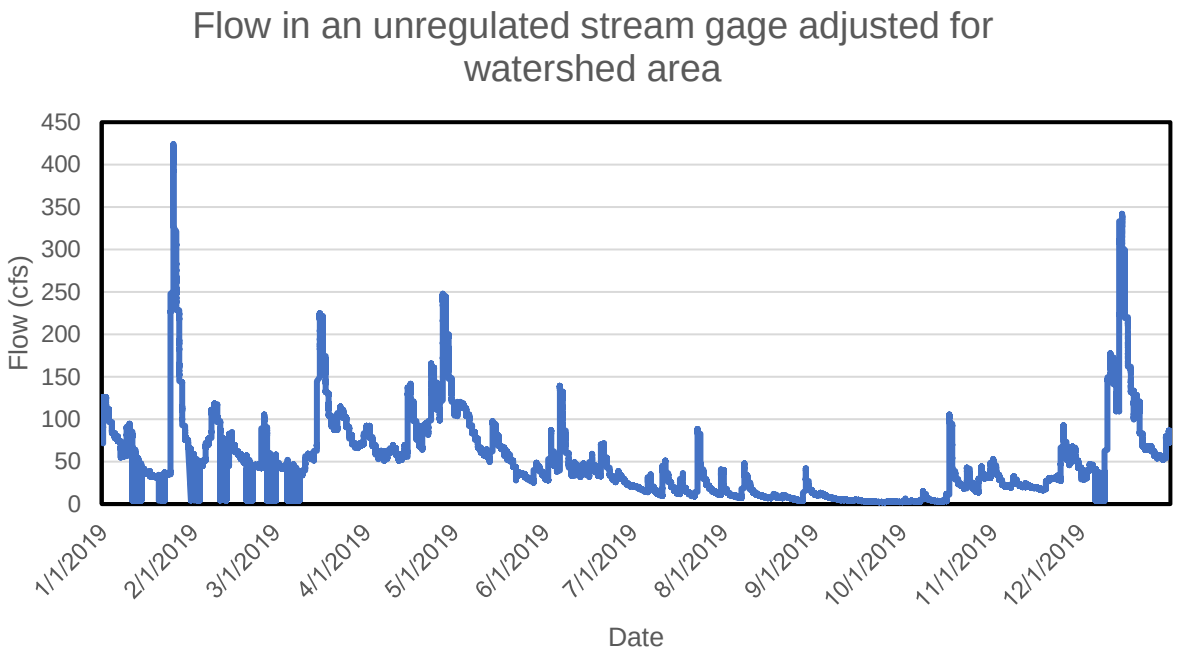

Figure 2. 2019 flows in Beaver Brook (USGS gage #010965852, watershed area= 47.8 mi^2). A correction factor of 0.6276 was applied to the data to approximate flow in the East Branch Deerfield (watershed area= 30 mi^2). Note the greater flow variability in the unregulated gage and its response to precipitation events compared to flows in the East Branch.

Searsburg Project

The Searsburg Project is the first mainstem river dam on the Deerfield River and is located at the confluence of the East Branch of the Deerfield River. The Searsburg Project is a peaking project with a 3.5-mile bypass reach.

Zone 3: Searsburg Impoundment

3.2.5 Criterion E – Watershed and Shoreline Protections- The 401 did not establish drawdown limits for this impoundment and the water quality certificate indicates, "the littoral zone is regularly dewatered and consequently is not conducive to production of aquatic life."

Zone 4: Searsburg Bypass Reach

3.2.1 Criterion A - Ecological Flow Regimes- The bypass reach below Searsburg dam partially meets the A2 Standard of Agency Recommendation. From June 1 to September 30, minimum flows in the 3.5-mile-long bypass are set at 35 cfs and from October 1 to May 31, minimum flow is set a 55 cfs. According to finding 163 in the water quality certificate, "much less habitat exists at 20 cfs and 40 cfs, compared to higher flows." This finding also indicates that habitat modeled in the bypass reach with WUA curves for juvenile and adult trout "increases nearly linearly with flows between 20 and 120 cfs." While these minimum flows are certainly preferable to a dewatered river, they do not constitute an ecological flow regime. Figure 3 displays the 2019 hydrograph for the bypass reach, and Figure 4 displays the hydrograph for an unregulated river with a similar drainage area (90 mi^2 vs. 89 mi^2, respectively). In the bypass reach, peak flows are higher and more frequent than in the unregulated river. For example, in the North River flows exceeded 2,000 cfs only on one occasion during spring where flows gradually increased in March

and then declined in June (Figure 4). While flows in the bypass reach tended to be lower overall, they were punctuated by peak flows approximately 1.5 times higher in the unregulated river (Figure 3). In the bypass reach below Searsburg Dam, such high flows could lead to scour and displace fish.

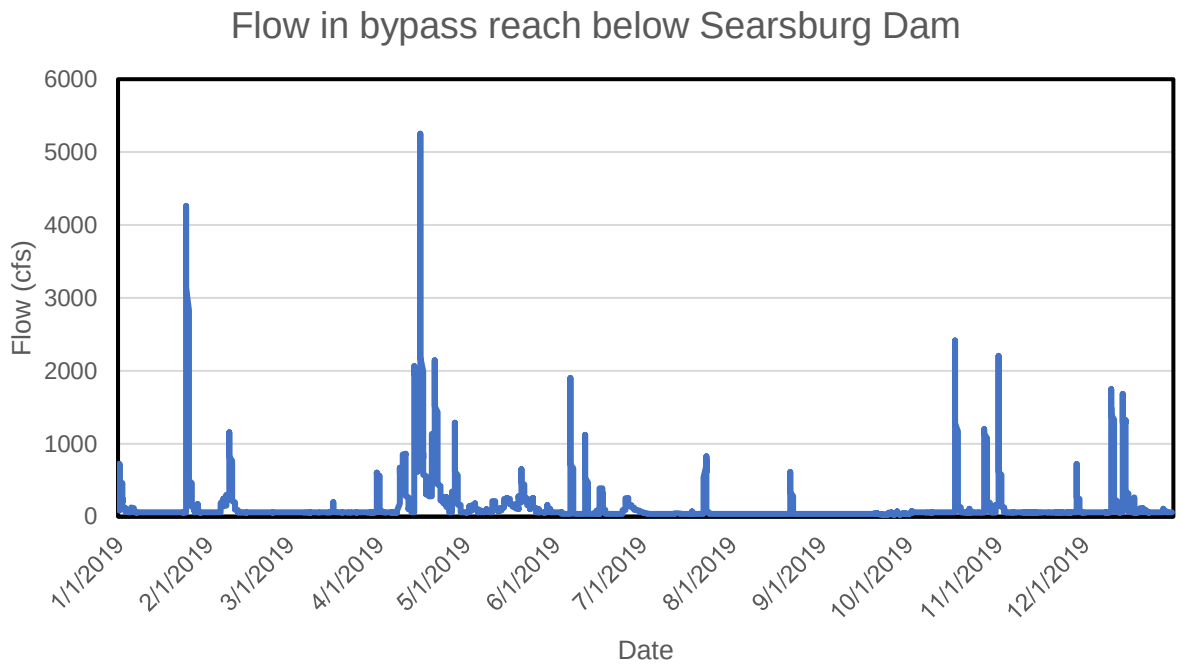

Figure 3. 2019 flows in the bypass reach of the Deerfield River below Searsburg Dam. Note the low base flows punctuated by periodically high spill flows.

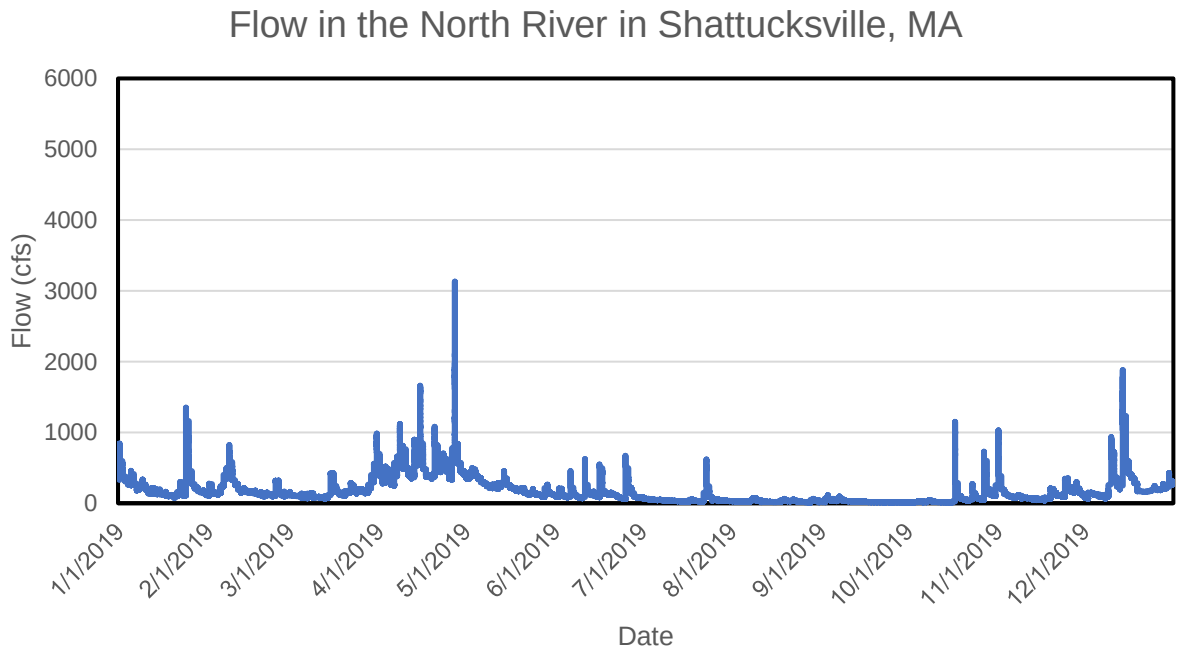

Figure 4. 2019 flows in the unregulated North River (USGS gage 01169000). Watershed area of the North River at the gage is 89 mi². The watershed area at Searsburg is similarly 90 mi².

3.2.3 Criterion C - Upstream Fish Passage

The bypass reach below Searsburg dam partially meets the standard C-1 Not Applicable/De Minimis Effect because although the dam does create a barrier to upstream passage, there are no migratory species located at the facility.

It should be noted that confining fish passage requirements to migratory fishes is an outdated approach. Aquatic connectivity has been clearly and consistently recognized as a critical ecological process and is supported by the Agency in a variety of regulatory procedures. Maintaining a connected system allows fish to seek the best available habitat for reproductive needs, food resources, thermal refuge, and cover. Aquatic connectivity also allows for the recolonization of upstream habitats after catastrophic events, such as floods or toxic discharges. Furthermore, free movement within a river system helps to maintain genetic diversity of aquatic populations.

Condition M of the Vermont 401 Water Quality Certificate dated 01/30/1995 states "*The applicant shall submit a plan for upstream fish passage at Searsburg Dam, including estimated design flows necessary for proper operation, to the Department of Fish and Wildlife for review within four months of a request. Upstream passage shall be provided March 15 -May 15 and October 1- November 15, with the period subject to adjustment based on knowledge gained about migration periods for migratory salmonids. Upstream fish passage facilities shall be installed so as to be operational within 18 months of a request by the Agency; the request will not occur any earlier than 20 years from the issuance date of this certification. The plan shall include an implementation/ construction schedule. The U.S. Fish and Wildlife Service and the Department of Fish and Wildlife shall be consulted during plan development. The plan shall include an erosion control and water management plan designed to assure compliance with water quality standards during construction. The Department of Fish and Wildlife may suspend the operation of upstream passage facilities at any time based on its fishery management needs".*

Providing upstream fish passage at Searsburg would allow riverine species such as brook and brown trout to access the headwaters of the Deerfield including tributary streams within this highly fragmented river system and should be considered.

Zone 5: Searsburg Downstream Reach

3.2.1 Criterion A - Ecological Flow Regimes- The downstream reach below the Searsburg bypass partially meets the A2 Standard of Agency Recommendation. In the 1.1- mile downstream reach of the Searsburg station, 175 cfs or inflow if less, is provided from April 20 to May 15 to provide riverine spawning habitat for smelt originating from the Harriman Reservoir. While these flows provide spawning habitat for smelt, this short river reach experiences flow fluctuations throughout the year because of daily peaking from Searsburg Station (Figure 5). While these spring flows mitigate the impact of hydropeaking on smelt spawning, they do not constitute an ecological flow regime because the frequency and magnitude of flow fluctuations in the tailrace are significantly higher than experienced in a natural flow regime (Figure 5). In the unregulated North River, for example, flows in October 2019 were at baseflow until precipitation events in the latter half of the month increased flows (Figure 7). Meanwhile in the Searsburg downstream reach, flows fluctuated daily in response to peaking operations (Figure 6). When the rains arrived in the latter half of month, flow peaks were significantly higher in the Searsburg downstream reach than in the North River which has a similar drainage area. While flows in the Searsburg downstream reach complied with the Water Quality Standards at the time of certification, the increased frequency and magnitude of peak flows represents a departure from the natural flow regime that impacts the ecological integrity of the river.

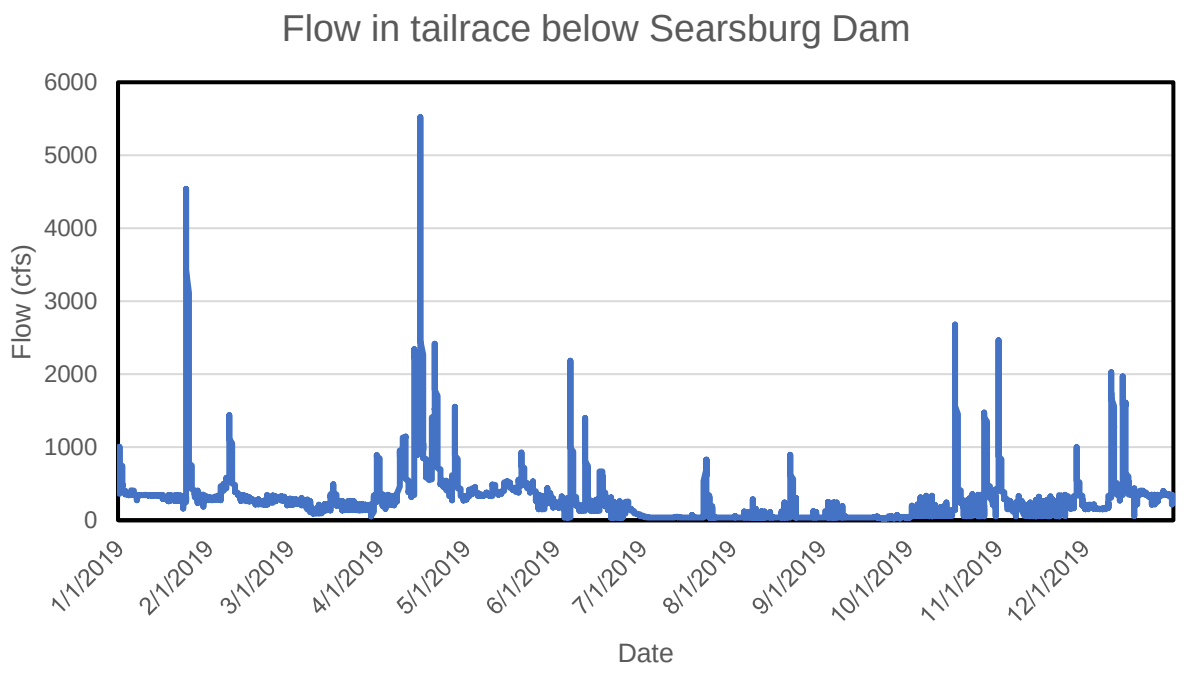

Figure 5. 2019 flows in the tailrace of the Deerfield River below Searsburg Dam. Note the higher frequency of flow fluctuations as compared to the unregulated North River (Figure 4).

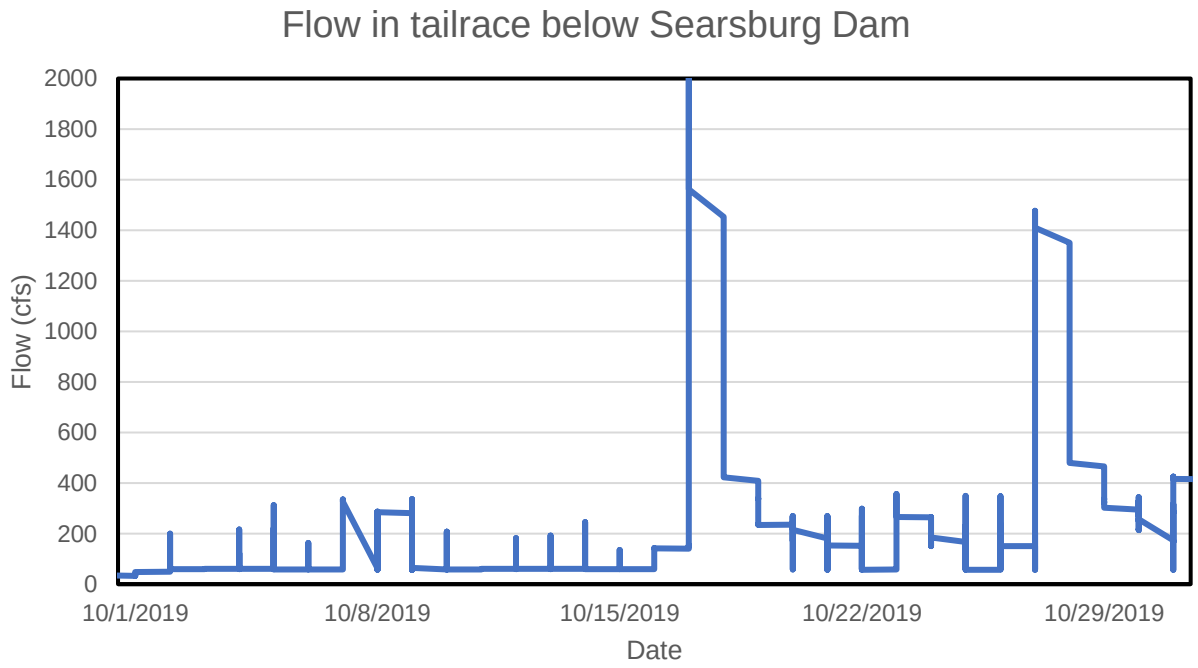

Figure 6. October 2019 flow in the tailrace of the Deerfield River below Searsburg Dam (hourly data). Note the daily flow fluctuations from baseflow provided to the bypass reach and generation flow (daily peaking) from the powerhouse.

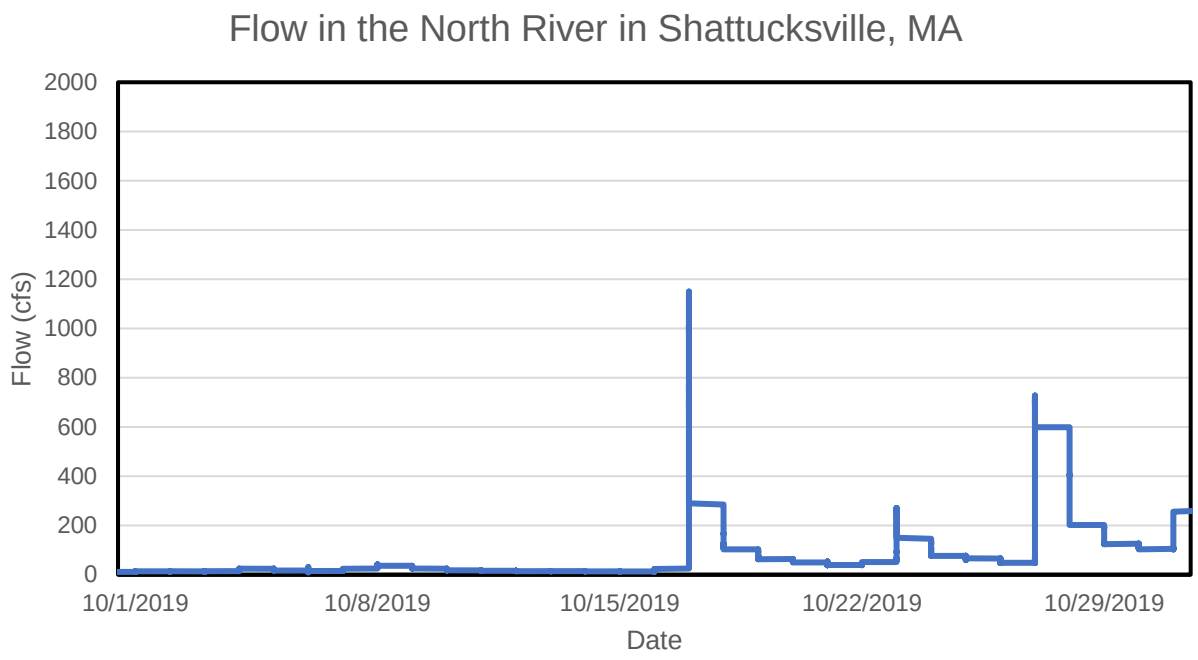

Figure 7. October 2019 flows in the unregulated North River (USGS gage 01169000). Note the low baseflows in the first part of the month followed by increasing flows in response to precipitation events in the latter half of the month.

Harriman Project

The Harriman Project is operated in a peaking and seasonal storage basis. The impoundment is the second largest waterbody in Vermont and has a useable drawdown of 86 ft. Below the impoundment, there is a 4.4-mile-long bypass reach. The tailrace flows directly into the Sherman impoundment.

Zone 6: Harriman Impoundment

4.5 Criterion E – Watershed and Shoreline Protections- The Harriman impoundment partially meets the E-2 Agency Recommendation Standard. Harriman Reservoir is not only the largest body of water occurring in the Deerfield River Project, but also, when full, is the second largest water body contained in the state of Vermont. While the Settlement Agreement limited drawdowns until November 1 to 1475 ft, winter drawdowns are limited to 1440 ft. Winter drawdown of 35 ft impact littoral habitat and should not be considered low impact. Finding 281 in Vermont's water quality certificate indicates, "the winter drawdown and water level management at other times of the year will prevent the establishment of a functional littoral community. Reservoir productivity will continue to be affected."

Zone 7: Harriman Bypass Reach

3.2.1 Criterion A - Ecological Flow Regimes- The bypass reach below Harriman dam partially meets the A2 Standard of Agency Recommendation. In this 4.4-mile-long bypass reach, the minimum flow is set at 70 cfs from October 1 through June 30. From July 1 through September 30, the minimum flow is set to 57 cfs. These flows were set based on the visual habitat assessment work to provide high quality habitat conditions in the bypass reach. While these flows met water quality standards and restored flows to a previously dewatered river reach, they do not provide flow variability that is indicative of an ecological flow regime (i.e., Figures 9 and 10) or a low impact project. While flow in the New Haven River

(adjusted for watershed area) fluctuated between 5 and 23,040 cfs during 2019 (Figures 9 and 10), flows in the bypass reach remained constant (Figure 8). Median flows in the New Haven River adjusted for watershed area were 347 cfs compared to 72 cfs in the bypass reach below Harriman Dam. Right below this long bypass, the tailrace is influenced by the backwater from Sherman Reservoir.

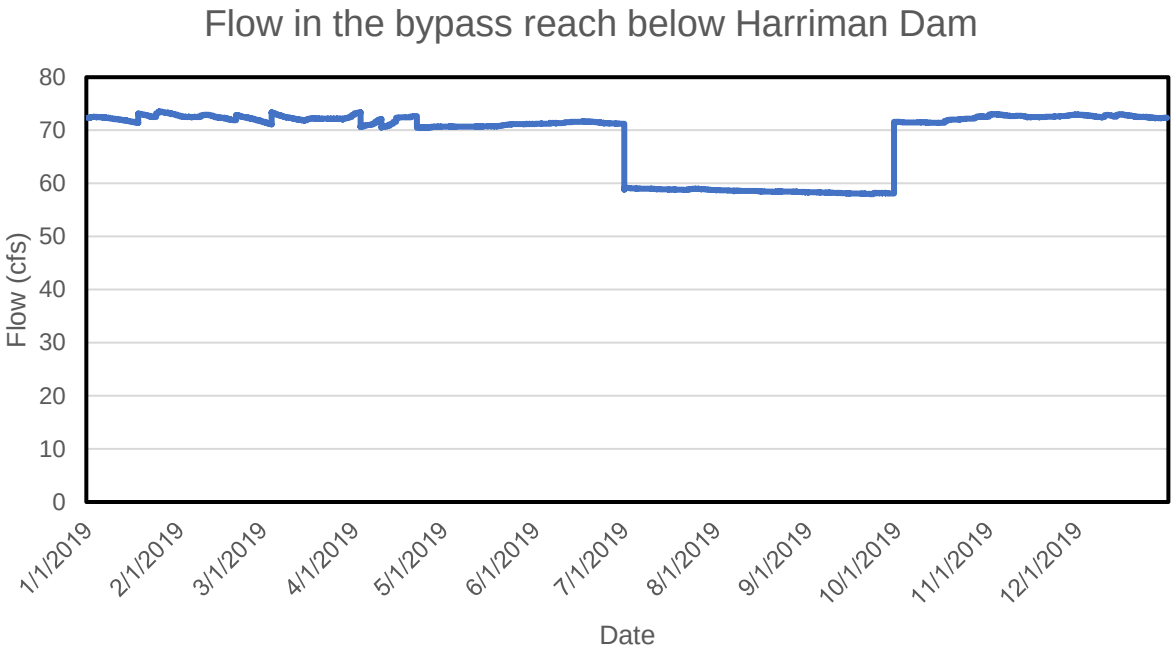

Figure 8. 2019 flows in the bypass reach of the Deerfield River below Harriman Dam. Note the stable flows lacking variability.

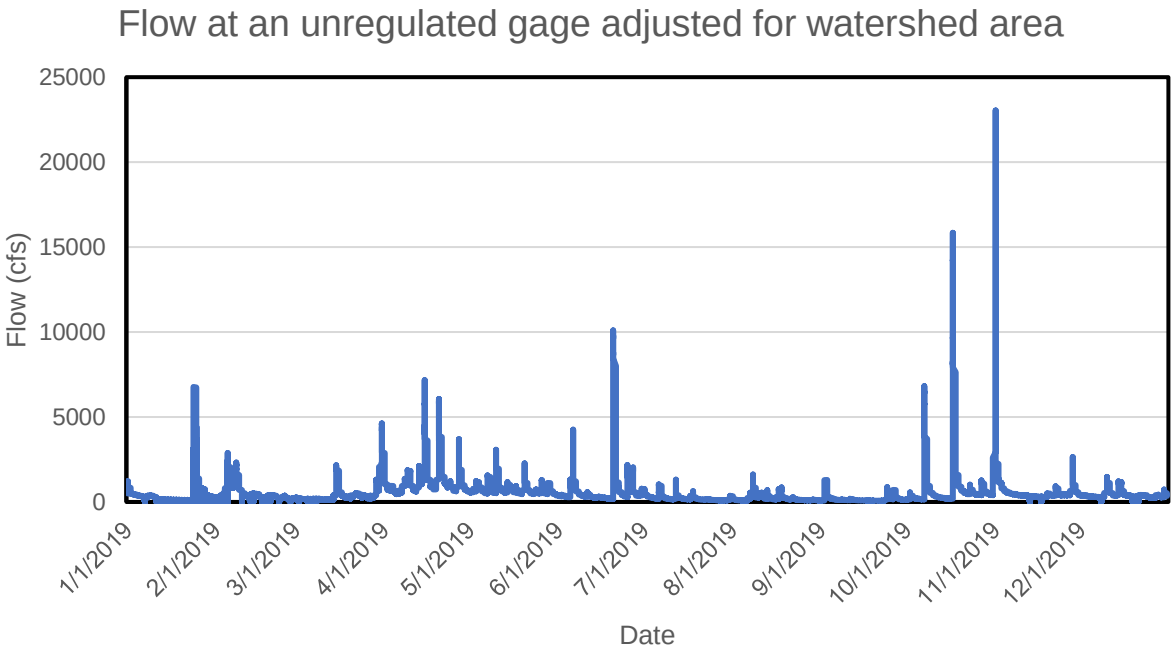

Figure 9. 2019 flows in the unregulated New Haven River (USGS gage 04282525, watershed area= 115 mi^2). A correction factor of 1.6 was applied to the data to approximate flow in the Deerfield River below Harriman Dam (watershed area= 184 mi^2). Note

the dramatically different scales and the greater flow variability in the unregulated gage compared to flows in bypass reach of the Deerfield River below Harriman Dam.

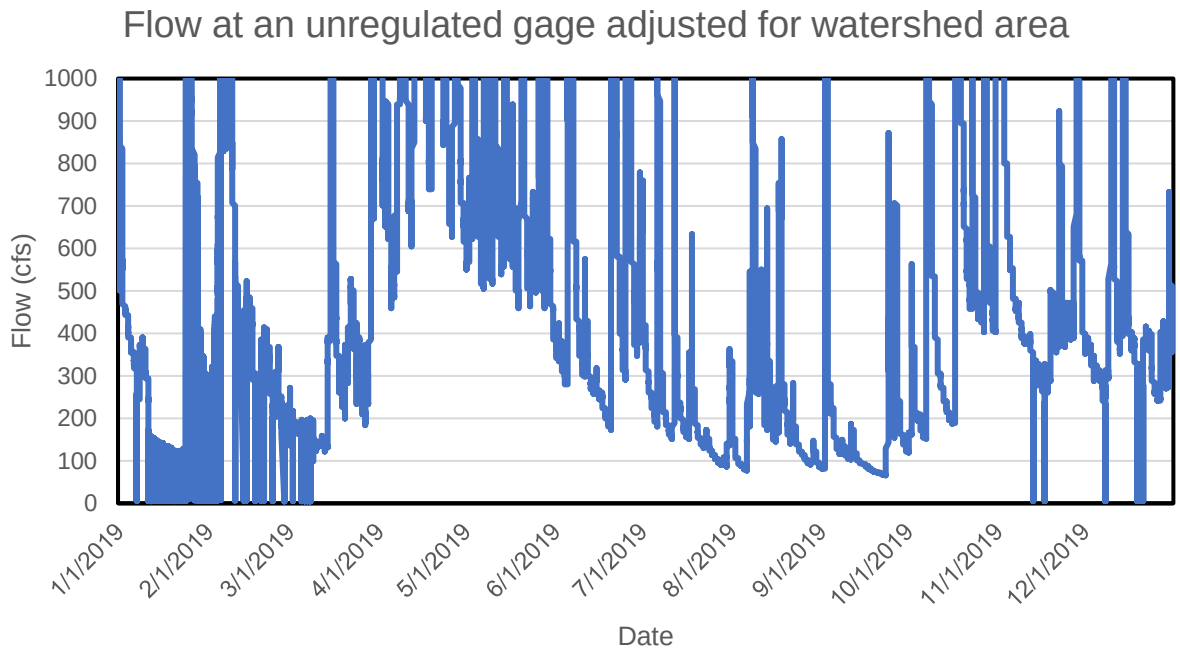

Figure 10. 2019 flows in the unregulated New Haven River (USGS gage 04282525, watershed area= 115 mi^2). A correction factor of 1.6 was applied to the data to approximate flow in the Deerfield River below Harriman Dam (watershed area= 184 mi^2). The scale is cropped to display highly variable flows below 1000 cfs.

Zone 8: Harriman Tailrace

3.2.1 Criterion A - Ecological Flow Regimes- The tailrace below Harriman dam partially meets the A2 Standard of Agency Recommendation. The tailrace of Harriman Dam flows directly in the Sherman impoundment. There is no free-flowing section of river between the Harriman and Sherman projects. This interferes with natural river processes and is not consistent with a low impact project.

3.2.2 Criterion B - Water Quality- Fish with tissue levels of mercury above water quality standards occur in Somerset, Harriman, Sherman and Searsburg Reservoirs, and below Somerset and Searsburg Reservoirs. While mercury does enter the system through atmospheric deposition, it can accumulate because of the presence of the reservoirs[1]. Both Somerset and Harriman reservoirs thermally stratify and have hypoxic zones in their hypolimnions. These hypoxic zones contribute to the methylation of mercury. According to finding 72 of Vermont's 401 certificate, "thermal stratification of Somerset and Harriman reservoirs during the summer create oxygen-depleted conditions in the deeper zones of the reservoirs. The intake elevations are sufficiently low that there exists a potential for withdrawal of oxygen-deficient water from the reservoirs and discharge of that water downstream into the river proper." While enough aeration occurs to comply with water quality standards for dissolved oxygen below the dams, methylation of mercury can occur in these hypoxic zones. Methylated mercury can then be mobilized downstream by these deep-water intakes.

[1] Evers, D. C. and P. Reaman. 1998. A comparison of mercury exposure and risk between artificial impoundments and natural lakes measured in Common Loons and their prey, 1996-97. Rept. Submitted to Central Maine Power Co., Augusta, ME.

Additional Comments

The introduction to standards under Criteria A- Ecological Flow Regimes, is that "In all locations, appropriate flow management should apply an ecosystem-based approach that supports fish and wildlife resources…" However, the LIHI standards accept that the impoundment area can be considered de minimis in all circumstances. The Agency believes this is a contradiction to the overall goal of an ecosystem approach that supports fish and wildlife.

There has been substantial research to date that indicates the harms to both habitat and aquatic biota because of impoundment drawdowns.[2] These include but are not limited to, impacts on immobile biota such as mussels[3], and decreasing macrophyte cover[4,5] , which has effects on fish spawning and macroinvertebrate densities[6]. While this LIHI 2nd edition handbook does not give the Agency an opportunity to speak to these impacts directly given "All impoundment zones can apply Criterion A-1 to pass this criterion", consideration of these impacts are necessary to understand the effect of a project on fish and wildlife resources. The Applicant does speak to instances where water level fluctuations within the impoundment zone are managed to provide ecological benefits in portions of the year (loon nesting, smelt spawning) but they do not speak to how the operations of the Project affect fish and wildlife resources for the remainder of the year.

Additionally, the Vermont Water Quality Standards have changed since 1995 Deerfield Certification specifically surrounding water level fluctuations. Current standards include hydrology criteria for not only streamflow protection (§29A-304(b)) but also water level fluctuations (§29A-304(d)).

Article 418 of the FERC license requires the Applicant "Within 180 days from the date of the issuance of this license, the Licensee shall file with the Commission, for approval, a plan to monitor the effectiveness of the existing trashracks at the Searsburg development in reducing fish impingement and entrainment at the intake… If the results of the monitoring indicate that changes in project structures or operations, including alternative flow releases, are necessary to protect fish resources, the Commission may direct the Licensee to modify project structures of operations."

The Agency reviewed both the FERC record and state records and could not confirm that a fish impingement and entrainment study took place. LIHI should evaluate whether this occurred, and if there were any changes to operations or project structures as a result.

Thank you for consideration of our comments.

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[2] Carmignani, J.R., and A.H Roy. 2018. Ecological impacts of winter water level drawdowns on lake littoral zones: a review. Aquatic Sciences. doi:10.1007/s00027-017-0549-9

[3] Carmignani, J.R., A.H Roy, P.D. Hazelton, and H. Giard. 2019. Annual Winter water level drawdowns limit shallow-water mussel densities in small lakes. Freshwater Biology. 00:1-15.

[4] Leira, M., and M. Cantonati. 2008. Effects of water-level fluctuations on lakes: an annotated bibliography. Ecological Effects of Water-Level Fluctuations in Lakes. pp. 171-184.

[5]Aroviita, J., and H. Hämäläinez. 2008. The impact of water-level regulation on littoral macroinvertebrate assemblages in boreal lakes. Ecological Effects of Water-Level Fluctuations in Lakes. pp. 45-56.

[6] Stoffels, R. J., K.R. Clarke, and G.P. Closs. 2005. Spatial scale and benthic community organisation in the littoral zones of large oligotrophic lakes: potential for cross-scale interactions. Freshwater Biology. *50*(7), 1131-1145.

Sincerely,

Hannah Harris

CC

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