

**APPLICATION REVIEW FOR
LOW IMPACT HYDROPOWER INSTITUTE CERTIFICATION
of the
GREEN MOUNTAIN POWER
ESSEX 19 HYDROPOWER PROJECT NO. P-2513**



Application Reviewer: Patricia McIlvaine

April 1, 2017

Report updated and revised November 6, 2018, by Maryalice Fischer

REVIEW OF APPLICATION FOR CERTIFICATION BY THE LOW IMPACT HYDROPOWER INSTITUTE OF THE ESSEX 19 HYDROPOWER PROJECT

Prepared by: Patricia McIlvaine, April 1, 2017

Updated and revised November 6, 2018, Maryalice Fischer

I. INTRODUCTION AND OVERVIEW

This report reviews the original application submitted by Green Mountain Power (GMP or Applicant) on July 27, 2015 to the Low Impact Hydropower Institute (LIHI) for Low Impact Hydropower Certification for the Essex 19 Hydroelectric Project (Essex 19 or Project). A LIHI Intake Review was completed on August 25, 2015. The review was conducted under the April 2014 version of the LIHI Handbook since the application was submitted before the end of 2015. Green Mountain Power provided an updated application in response to the Intake Review on December 19, 2016 and provided additional data several times in March 2017 in response to subsequent inquiries from the application Reviewer.

Due to the ongoing nature of consultation between GMP and state and federal resource agencies during 2017, LIHI was unable to confirm that the Project met LIHI criteria under the then current LIHI Handbook. On April 27, 2017 LIHI issued a letter stating that given the uncertainty and lack of definitive data needed to determine compliance with flow and fish passage criteria at the Project, LIHI was unwilling to certify at that time. However, LIHI stated that if GMP could demonstrate that it had reached agreement with resource agencies over the issues raised in Vermont Department of Environmental Conservation's (VDEC) letter dated March 17, 2017, and that GMP has implemented appropriate solutions, then LIHI Certification could be granted. LIHI committed to holding the Essex 19 application open for one year until May 1, 2018. Per a GMP letter dated April 30, 2018 and a LIHI letter dated May 29, 2018, GMP was granted an extension of time, until November 1, 2018, to further consult with agencies and implement pre-certification measures.

The pre-certification measures set forth in VDEC's March 17, 2017 letter included the following:

Flows

1. GMP shall review the flow monitoring procedures at the Essex 19 Project and assess compliance with the approved flow monitoring plan including the refinements identified in GMP's 2000 refinement plan. In consultation with VDEC, GMP shall establish a plan for implementing modifications required under the approved plan and submit this plan to LIHI.
2. GMP shall conduct a review of the seasonal run-of-river operations at the Essex 19 project and determine if additional modifications are needed to ensure compliance with LIHI criteria. In consultation with VDEC, GMP shall establish a plan for implementing any modifications identified and submit this plan to LIHI.

Downstream Fish Passage

1. GMP shall re-initiate consultation on the downstream bypass facility with Vermont Department of Fish and Wildlife and U.S. Fish and Wildlife Service. GMP shall identify any modifications needed to conform with prior resource agency recommendations and develop a schedule for implementation.
2. GMP, in consultation with Vermont Department and Fish and Wildlife and U.S. Fish and Wildlife Service, shall evaluate the performance bypass facility to verify that downstream passage is safe and effective. Results of this evaluation shall be provided to LIHI. If results of this evaluation indicate issues with safety [i.e., safe passage of downstream migrating fish] or effectiveness, GMP shall commit to working with the agencies to identify reasonable measures to increase safety and effectiveness and shall document these efforts with an annual report to LIHI.

On October 31, 2018 GMP submitted to LIHI supplemental information that demonstrates that the Project meets the LIHI criteria (under the original Handbook and under the current 2nd Edition Handbook now in effect) with two conditions as described in Section VII below. The new information provided on October 31, 2018 is included in Appendix C and discussed in Section VIII below.

This final review report has been updated and revised to incorporate the new information submitted to LIHI during 2017 and 2018, the results of a FERC eLibrary review conducted on November 1, 2018, and information obtained by LIHI staff to supplement the original April 2017 reviewer report.

II. PROJECT'S GEOGRAPHIC LOCATION

Essex 19 is located at river mile (RM) 17.6 on the mainstem of the Winooski River, in the townships of Essex Junction and Williston, Chittenden County, Vermont. The Winooski River, flows to the northwest into Lake Champlain. The Project has a 1,011 square mile drainage basin. The dam is built at the Hubble Falls. The Essex 19 dam was constructed between 1913 and 1917, however a dam has been at this location since the late 18th century. The original dam washed out in 1798, and another dam was built just upstream of the current location. Sometime after 1830 a timber dam was built just downstream of the current dam location.

Appendix A contains maps and photographs of the Project. As shown on the map in Appendix A, nine dams are located upstream of the Essex 19 Project. In order from upstream to downstream, these dams are: Clarks Sawmill Dam; Farrington No. 1 Dam; Old Batchelder Dam at RM 71.1; Mill No. 2 Dam at RM 60.6; Winooski No. 8 Dam (FERC No. 6470) at RM 59.9; Montpelier No. 32 Dam at RM 57.4; Bailey Clothespin Dam at RM 56.1; **Middlesex Dam** at RM 49.4; and **Bolton Dam** (FERC No. 2879) at RM 39.7.

Two dams are located downstream: Hydroelectric Project: **Gorge No. 18** at RM 11.4; and Winooski One Dam (also called Chace Mill) (FERC No. 2756) at RM 10.4. The ones noted in

bold and underlined are also owned by GMP. Note that the Gorge 18 Project and Middlesex Dam are FERC non-jurisdictional. GMP also owns the Marshfield Dam, also not regulated by FERC, which is on Molly's Brook, just above the confluence of Molly's Brook and the Winooski River.

III. PROJECT AND IMMEDIATE SITE CHARACTERISTICS

The Essex 19 Project has a 495-foot-long concrete gravity dam consisting of a 66-foot-long by 50-foot-high south concrete abutment section, a 345-foot-long by 45-foot-high uncontrolled spillway section topped with 5-foot-high inflatable flashboards, and an 84-foot long by 45-foot-high tip section topped with 6.5-foot-high inflatable flashboards. Some inflatable flashboards were replaced in 2018.

An intake structure with a 36-foot-high headwall with two concrete wing walls contains a steel trashrack, timber platform, and vertical sliding wood gates. Two 3-foot-diameter steel/diversion penstocks and four 9-foot diameter steel/diversion penstocks extend from the dam to the powerhouse. The reinforced concrete and brick powerhouse is 156 feet long, 65 feet wide, and 55 feet high. The powerhouse contains four horizontal Francis-type turbines with an installed capacity of 2,223 kW each, and four horizontal shaft General Electric generators rated at 1,800 kW each, as well as a minimum flow unit which is a double horizontal Francis-type turbine with an installed capacity of 874 kW connected to a generator rated at 850 kW. The minimum flow unit was commissioned on March 3, 2008 and is used when flow conditions range from 100 cfs to 275 cfs. This unit increased the Project's total authorized installed capacity from 7,200 kW to 8,050 kW. The reported average annual generation from 2010 to 2014 was 42,925 MWh.

The Project impounds 352 acres at a normal maximum water surface elevation of 275.0 feet, United States Geologic Survey (USGS) datum. The impoundment has a gross storage capacity of about 1,950 acre-feet. A usable storage capacity of 905 acre-feet is available between impoundment elevations ranging from 275 to 272 feet USGS. The surface elevation of the Project impoundment is maintained between these elevations. The area occupied by primary Project features, not including the reservoir is 4.5 acres. A total of approximately 350 acres are included within the 200-foot zone extending around the Project impoundment.

GMP operates the Project largely as a modified peaking facility as provided in the 1995 FERC license, but with seasonal run-of-river operations, minimum flow releases, low-flow restrictions, and ramping rates. Details of unit operations and minimum flow requirements are discussed in **Section VIII, Criterion A – Flows**. Flows at Essex 19 are controlled by releases from three upstream peaking facilities, including the Bolton Project, another GMP facility, located immediately upstream of Essex 19. Operation of both hydropower projects downstream of Essex 19 are directly affected by Essex 19's peaking operation because the Winooski One Project is run-of-river and the Gorge No. 18 Project has a much smaller storage capacity than Essex 19.

IV. REGULATORY AND COMPLIANCE STATUS

FERC License

The original FERC license for the Project (FERC No. 2513) was issued on January 21, 1969 and expired on December 31, 1993. The Project operated under an annual license in 1994 and was issued a 30-year license on March 30, 1995. The license included articles requiring typical enhancements, such as downstream fish passage, cultural resource protection requirements and new recreational features.

On June 15, 2006, a license amendment was issued for the installation of a minimum flow generating unit. Concerns of the Vermont Agency of Natural Resources (VANR) associated with potential degradation of dissolved oxygen (DO) saturation levels due to less spillage over the dam were addressed via incorporation of Article 419 which required the installation of an aspiration system as discussed below. USFWS requested that monitoring be conducted at the intake area of the new unit when it is the only unit operating during the fall and spring fish passage seasons to determine if attraction to the downstream fish passage facility is compromised through its operation. Although no article was developed to address this concern, GMP proposed to concentrate attraction flow through the center bypass entrance of the downstream fish passage facility if fish are found to congregate in the left-hand corner of the intake. It does not appear that this monitoring was conducted. No changes were made to the other article requirements of the 1995 license.

As discussed further under **Section VIII, Criterion C – Fish Passage and Protection**, an Order issued by FERC to accept the results of two years of fish passage assessment and dismiss the need to conduct further testing was challenged via a re-hearing request issued by both the US Fish and Wildlife Service (USFWS) and VANR in April 1998. On December 24, 1998 FERC denied the request. On June 14, 2018, FERC approved in-kind replacement of two of the three inflatable flashboard sections. That work did not require license amendment and was completed on September 28, 2018.

Water Quality Certification

A Water Quality Certificate (WQC) issued by VANR on November 9, 1993 with 20 conditions. On November 24, 1993, an agreement to amend the WQC was entered into by GMP, VANR, and the Vermont Natural Resources Council. Formal amendment modified four conditions and was granted on January 1, 1995. The majority of the conditions were incorporated in the 1995 license.

When GMP sought to add the minimum flow unit in 2006, VANR agreed to waive its jurisdiction under Section 401 of the Clean Water Act (CWA) as it related to the amendment request, provided that GMP install an aspiration system with the new minimum flow unit designed to attain DO saturation values no less than 90 percent, or values equivalent to those currently produced by spillage if less, during the period from June 15 through September 15, from 10 pm to 8 am, whenever the minimum flow unit is the only operating unit. This requirement was incorporated into the amended FERC license as Article 419, thus the WQC was not amended.

Compliance Review

GMP's application identified three flow-related non-compliance events for the period of 2009 through September 2018. These are described under **Section VIII, Criteria A – Flows**. Review of FERC's eLibrary records confirmed these events along with one issue in 2010 associated with a reported non-compliance with the Landscape Management Plan, as identified by a resident. GMP apparently remedied this situation by replacement of trees around the substation that had died.

It appears from FERC's eLibrary review that numerous deviations from the flow requirements of the Project occurred for a number of years prior to 2009. GMP reported that the installation of the new minimum flow unit in 2008 would help to minimize these deviations. Challenges in compliance with the seasonal run-of-river and minimum flow requirements existed because the flow into the Project is controlled by outflow of three upstream peaking projects, including GMP's Bolton Project. A comment letter received by LIHI from VDEC, a department within VANR, suggested that other deviations from the operations requirements of WQC Conditions B and E occurred in 2015 and GMP may not be adhering to the refinements made to its Flow Monitoring Plan. Further discussion is found in sections **VII. General Conclusions and Reviewer Recommendation and VIII, Criteria A – Flows**.

The FERC record review showed that GMP has met its other environmentally-related filing requirements on a timely basis; only one extension of time was requested for submission of the annual report required by its Cultural Resource Management Plan (CRMP). This extension was requested because Tropical Storm Irene curtailed the monitoring required during the 2011 field season for this work. The 2018 update to this report included a review of the FERC eLibrary for 2017 and 2018. No reported instances of non-compliance with the license were found.

V. PUBLIC COMMENT RECEIVED BY LIHI

The deadline for submission of comments on the certification application was March 12, 2017. One comment letter was received from VDEC and is contained in Appendix B. A letter issued by USFWS dated February 24, 2016 was incorporated into GMP's LIHI application. A copy of it is also contained in Appendix B as it includes comments relative to the appropriateness of LIHI Certification at that time. The original reviewer contacted Eric Davis of VDEC and Melissa Grader of USFWS. Mr. Davis responded via his LIHI comment letter. While Ms. Grader emailed that she intended to reply, no response to the reviewer questions was received.

In the interim between the original reviewer report and this updated report, GMP had extensive consultation with VDEC and USFWS regarding flows and downstream fish passage. That consultation record is included in Appendix C and summarized in Section VIII below.

VI. SUMMARY OF COMPLIANCE WITH CRITERIA AND ISSUES IDENTIFIED

Criterion A - Flows – The Project operates as a modified peaking facility with specific requirements for seasonal run-of-river operations, minimum flow releases, low-flow restrictions, and ramping rates. GMP identified three deviations having occurred between 2009 and 2016 and the supplemental review in 2018 found no additional deviations, although comments provided by VDEC suggested others occurred in 2015. The original review report found that insufficient information had been provided by GMP to confirm compliance with the Project’s flow requirements in the WQC and license. The reviewer recommended delaying the final assessment of the certification review until GMP has an opportunity to address agency flow concerns. GMP provided additional information and documentation of consultation on flows during 2017 and 2018 and based on that information, this final review finds that the Project now meets this criterion subject to a condition that requires continued evaluation of flows.

Criterion B - Water Quality – Given the lack of any issues having been identified, it appears that the operation of the Project is not negatively affecting water quality. Compliance with flow and fish passage requirements of the WQC are discussed under Criteria A and C, respectively. The Winooski River in the vicinity of the Project is included on Vermont’s list of impaired streams and rivers pursuant to section 303(d) of the Clean Water Act, although the VT DEC determined that the Project is not responsible for the impairment.

Criterion C - Fish Passage and Protection – Anadromous species have been extirpated from the Lake Champlain Basin for about 150 years, long before the existing Essex 19 dam was constructed. It is unclear if American eel are using the Winooski River. Restoration of land-locked salmon has been ongoing since 1993, with the Essex 19 Project funding a portion of a trap and truck facility at the downstream Winooski One dam. Downstream passage is provided at Essex 19, however resource agencies raised concerns regarding its design and resulting effectiveness. LIHI staff recommended at the time of the original certification review to delay the final assessment until GMP has an opportunity to address agency downstream passage concerns. GMP provided additional information and documentation of consultation on downstream passage during 2017 and 2018 and based on that information, this final review finds that the Project now meets this criterion subject to a condition that requires implementation of permanent downstream passage measures.

Criterion D - Watershed Protection – There are no requirements for a buffer zone, shoreline protection fund, or shoreline management plan for the Facility and there are no ecologically significant lands associated with the facility.

Criterion E - Threatened and Endangered Species Protection – There two federally threatened bat species (northern long-eared bat, Indiana bat) and five state endangered species that are or could be present near the Project. It does not appear that Project operations have or would affect these species.

Criterion F - Cultural Resources – The Project is in compliance with its license-required Cultural Resource Management Plan which includes annual monitoring and reporting on erosion at or near identified sensitive areas in the impoundment.

Criterion G - Recreation – The Project is in compliance with its Recreation Management Plan requirements contained in its FERC license and WQC.

Criterion G - Facilities Recommended for Removal - No resource agencies have recommended dam removal.

VII. GENERAL CONCLUSIONS AND REVIEWER RECOMMENDATION

Initial Recommendation, 2017: Issues identified in the original 2017 reviewer report were based on the concerns expressed by VDEC in their March 12, 2017 LIHI comment letter. The information submitted by the applicant, review of FERC’s eLibrary records and public comments received by LIHI, led the reviewer and LIHI staff to determine that the Project should not be certified until the information was provided to confirm compliance with LIHI’s flow and fish passage criteria.

Final Recommendation, 2018: Substantial additional information was provided by GMP in 2017 and 2018 to support certification. While measures required for certification are not 100% implemented at this time, the remaining efforts depend upon agency responsiveness to recently submitted information, and the fact that permanent downstream passage construction could not be completed in 2018 due to changes in agency recommendations for design of the system. However, the ongoing productive consultation with VDEC and USFWS and GMP’s strenuous efforts to address agency concerns indicate that the Project now satisfies the LIHI criteria with the following conditions:

Condition 1: The facility Owner shall continue to work collaboratively with VDEC to determine any additional needs for ongoing monitoring and reporting of operations and flows, update the Project’s operations compliance plan in consultation with resource agencies, and upon agency concurrence, file that plan with FERC. The Owner shall file quarterly updates with LIHI on the status of these efforts until the final plan has been filed with and approved by FERC.

Condition 2: The facility Owner shall complete installation during the 2019 construction season of the permanent weir enhancements, including any needed plunge pool or rock modifications in consultation with VDEC and USFWS. The Owner shall file the revised downstream passage standard operating procedure (SOP) and agency-requested spring passage timing adjustment with FERC and provide a copy to LIHI. Upon commencement of passage operations and in consultation with resource agencies, the Owner shall implement the downstream passage monitoring and effectiveness testing in accordance with license Article 410 or associated updated requirements. The Owner shall report on the status of downstream passage in annual compliance statements submitted to LIHI.

VIII. DETAILED CRITERIA REVIEW

A. FLOWS

Goal: The Flows Criterion is designed to ensure that the river has healthy flows for fish, wildlife and water quality, including seasonal flow fluctuations where appropriate.

Standard: Under the 2014 LIHI Handbook, for instream flows a certified facility must comply with recent resource agency recommendations for flows. If there were no qualifying resource agency recommendations, the applicant can meet one of two alternative standards: (1) meet the flow levels required using the Aquatic Base Flow methodology or the “good” habitat flow level under the Montana-Tennant methodology; or (2) present a letter from a resource agency prepared for the application confirming the flows at the facility are adequately protective of fish, wildlife, and water quality.

Criterion:

- 1) Is the facility in Compliance with Resource Agency Recommendations issued after December 31, 1986 regarding flow conditions for fish and wildlife protection, mitigation and enhancement (including in-stream flows, ramping and peaking conditions, and seasonal and episodic instream flow variations) for both the reach below the tailrace and all bypassed reaches?**

2017 Review: POTENTIALLY NO. Several issues exist that currently suggest that the Project may not be in compliance with this criterion, as discussed below:

The 1995 FERC license and Water Quality Certificate authorizes operation as a modified peaking facility with specific requirements for seasonal run-of-river operations, minimum flow releases, low-flow restrictions, and ramping rates. The 2006 license amendment did not change these requirements. On December 8, 1995, FERC approved a Minimum Flow Monitoring Plan as required in Condition I of the Water Quality Certificate and Articles 403 and 404 of the 1995 License. The Project also has a Ramping Rate Plan, approved by FERC on November 21, 1995, as required in Condition F of the Water Quality Certificate and Article 406 of the 1995 License. The 1995 Ramping Rate Plan was approved by FERC contingent upon a field evaluation of its adequacy. On October 15, 1996 GMP submitted a Report on the Ramping Rate Demonstration that demonstrates how the plan adequately protects downstream fisheries and recreational resources. The study was a request of the VANR and was completed following a VANR approved study plan. Both plans provide means to ensure that minimum flows and ramping rates are in compliance with the 1995 License and Water Quality Certificate.

Flow related requirements are:

Minimum Flow Requirements

Time Period	Flow (or inflow, whichever is less)	Comment
April 1 – May 15	50 cfs	See note.
May 16 – June 15	1,000 cfs	Protection of sturgeon spawning and incubation habitat
June 16 – March 31	450 cfs	Protection of salmonid habitat

Note: The minimum flow of 50 cfs must be released into the bypassed reach via the fish passage facility. GMP reports that since installment of the minimum flow unit, GMP releases all flows less than 100 cfs to the bypassed reach via the downstream fish passage facility. Outflow approximates inflow on an instantaneous basis for the protection of walleye spawning and incubation habitat. When river flow is greater than 275 cfs, GMP operates flows through both the bypass (via the downstream fish passage facility) and existing units, when river flows are greater than 100 cfs GMP operates flows through both the bypass and the minimum flow unit, and when flows are below 100 cfs GMP operates flows through the bypass.

Reservoir Fluctuation Limits

Time Period	Low Flow for Calendar Day	Maximum Allowed Flow Fluctuation
April 1 – May 15	na	None (ROR required)
May 16 – June 15	<1,000 cfs	None (ROR required)
	≥ 1,000 cfs	No limit
June 16 – Sept 30	< 450 cfs	None (ROR required)
	≥450 cfs	500 cfs
Oct 1 – March 31	< 450 cfs	None (ROR required)
	>450 cfs	No limit

Based on information provided in the application, it appears that concerns with not meeting minimum flows were expressed by VANR starting in 1999. The application also summarized actions taken by GMP to improve compliance. The installation of the minimum flow unit (commissioned on March 3, 2008) helped ensure compliance with the minimum flow requirements during low flow conditions. This improved GMP’s ability to maintain proper minimum flows during low flow periods (i.e. below 275 cubic feet per second (cfs)), when the river flow is below the combined flows of the fishway’s bypass flow of 50 cfs and the existing turbine’s minimum operating flow of 225 cfs). It appears that in 1997 GMP proposed to release 100 cfs to the downstream fish passage during fish passage season to enhance passage. This 100 cfs flow requirement to the fish bypass has not been incorporated into the WQC or FERC license.

Monitoring Plan Revisions and Flow Requirement Deviations:

Although not identified in the application by GMP, it appears that the 1995 Flow Monitoring Plan was revised. Initially FERC approved an “approach” to enhance operational management

on October 4, 2000. On December 28, 2000, GMP submitted the Flow Monitoring Plan Refinements which was approved, after review by VDEC, on February 20, 2001. As the refinements were intended to better manage flow fluctuations due to changing inflow to the Project from upstream peaking projects, GMP's approach was to utilize flows released at their upstream Bolton Project to estimate inflow to Essex 19 by incorporation of the Bolton data to Essex 19's SCADA system. As previously noted, the Bolton data was not being collected and used at Essex 19. This gap was identified when VDEC requested such data for 2015 from GMP in order to respond to GMP's request to them for a statement of compliance in support of their LIHI Certification application.

The FERC February 2001 Order, Directive (B) required testing of ways to better manage flow lag times by using the rubber dam. This Directive states:

“The licensee shall give the Vermont Agency of Natural Resources (VANR) opportunity to be present during the trials, using the rubber dam to avoid the lag time in the flow releases, which the licensee documented at the project. This is to be done by incrementally deflating the rubber dam as flow through the generating unit ceases, and incrementally inflating the dam as the project transitions from spilling to generation, allowing relatively smooth transitions between operations modes. The licensee shall provide the results of the trials to the agencies and to the Commission for review by October 31, 2001. Revisions to the refinements as necessary, incorporating VANR's comments and establishing operating procedures shall be filed with the Commission for approval. The licensee shall file, with the Commission, the necessary revisions to the plan including agency's comments by December 31, 2001.”

A review of records in FERC's eLibrary between 2001 and 2004 did not show such revisions. However, as it is possible that these eLibrary records are not complete.

GMP reported that three deviations from the license requirements occurred between 2009 and 2016, which were reported to VDEC and FERC as summarized below. FERC did not determine any of these to be violations of the license.

- On July 5, 2014 GMP experienced an incident of non-conformance with license Article 402's allowed maximum fluctuation in flows due to peaking operation. Starting at approximately 8:30 pm, a 4,000 cfs discharge spike in flows through the bypass river reach occurred for an estimated 1.5-hour period.
- On December 18, 2009 GMP informed the Commission of a possible impoundment surface elevation deviation at the Essex 19 Project. Under License Article 405, the Project must be operated such that the surface elevation of the impoundment is maintained between elevation 272 feet and 275 feet. On December 13, 2009, the impoundment level recorded above the Essex 19 Project reached an elevation of approximately 272.18 feet, and GMP initiated corrective actions. Although not confirmed that the impoundment ever fell below 272 feet, GMP made the notifications proactively.

- On September 23, 2009, the USGS station just below the Essex #19 facility recorded a reduction in flows for a short period of time of roughly 100 cfs. Due to declining inflow, a generating unit was taken off line to maintain the pond level, since the inflow would not sustain the minimum hydraulic capacity of the unit. While the pond was filling, a minimum flow deviation occurred. FERC concludes that the incident is not a violation of Project license as the flow deviation was caused by appropriate actions taken by GMP (taking a unit offline) in order to maintain the required impoundment elevation.

As previously noted, in their comment letter, VDEC provided information suggesting that other deviations occurred several times in 2015, based on data for 2015 provided to them by GMP. Such deviations do not appear to have been reported to FERC and were not reported in their LIHI application.

2018 update: Conditionally, YES. GMP provided additional information and documentation of agency consultation on flows in their October 31, 2018 application supplement (Appendix C). GMP had reviewed the seasonal run-of-river operations and compared the operations data to the upstream Bolton Falls Project outflows. The review found that Essex 19's seasonal run-of-river operations were depicted well with incorporation of the Bolton Falls inflow data to verify that outflow equals inflow from Bolton. GMP provided VDEC with Project operations data that incorporated the Bolton Falls inflows on March 29, 2018 for the agency's review of run-of-river compliance.

On September 6, 2018 VDEC completed their review and asked questions about Essex 19 operations during the 2014-2015 timeframe presented in the operations data. The VDEC email stated:

"I've had the opportunity to review the operations data in detail and have assembled my comments in the attached document. My hope is that this will keep our conversations moving forward, so that we can understand operations better and identify and address any issues."

On October 8, 2018 GMP responded to VDEC's questions, a majority of which stemmed from operations records during a time period when work was taking place at the downstream Gorge 18 facility. Pinpointed times of operational changes at Essex 19 were due to managing impoundment levels at Essex 19 to ensure safe construction conditions at Gorge 18. At this time, VDEC is reviewing GMP's response. Based on VDEC input that may be received, GMP may need to revise the Project operations plan and file it with agencies and FERC upon completion. Since GMP has completed everything they can at this time and any remaining effort is on hold pending VDEC's input, this final review finds that:

This Project conditionally passes the Ecological Flows Criterion, with the following condition.

Condition 1: The facility Owner shall continue to work collaboratively with VDEC to determine any additional needs for ongoing monitoring and reporting of operations and

flows, update the Project's operations compliance plan in consultation with resource agencies, and upon agency concurrence, file that plan with FERC. The Owner shall file quarterly updates with LIHI on the status of these efforts until the final plan has been filed with and approved by FERC.

B. WATER QUALITY

Goal: The Water Quality Criterion is designed to ensure that water quality in the river is protected.

Standard: Under the 2014 LIHI Handbook, the Water Quality Criterion had two parts. First, an Applicant must demonstrate that the facility is in compliance with state water quality standards, either through producing a recent Clean Water Act Section 401 Water Quality Certification (WQC) or providing other demonstration of compliance. Second, an applicant must demonstrate that the facility has not contributed to a state finding that the river has impaired water quality under Clean Water Act Section 303(d).

Criterion:

1) Is the Facility either:

- a) In compliance with all conditions issued pursuant to a Clean Water Act Section 401 water quality certification issued for the facility after December 31, 1986? Or in compliance with the quantitative water quality standards established by the state that support designated uses pursuant to the federal Clean Water Act in the Facility area and in the downstream reach? or**
- b) In Compliance with the quantitative water quality standards established by the state that support designated uses pursuant to the federal Clean Water Act in the Facility area and in the downstream reach?**

2017 Review: YES. – The Project's most recent WQC, issued on January 1, 1995, contains 20 conditions, the majority of which were incorporated in the FERC license. As previously noted, VANR waived its jurisdiction under Section 401 of the Clean Water Act (CWA) in 2006, given the commitment made by GMP to install an aspiration system with the new minimum flow unit designed to attain specified saturation values. Aspects of some WQC conditions, such as VANR having the authority of independently modify emergency exceedance requirements regarding minimum flows and peaking flow ramping rates and schedule control over fish passage installation deadlines were not adopted into the license. The majority of the conditions addressed flows and fish passage/protection issues as the means to ensure compliance with water quality standards.

Outreach to VDEC was made by the applicant to obtain confirmation that the Project has been operated in compliance with its WQC. VDEC initially responded via email on October 3, 2016, stating that they would not comment until several open issues regarding fish passage were resolved

between GMP, VT Department of Fish and Wildlife (VDFW) and US Fish and Wildlife Service (USFWS). They also replied to the reviewer’s inquiry with the same response, however, they ultimately sent a comment letter, but it did not address water quality (see Appendix B). Given their lack of discussion of water quality concerns and lack of any issues otherwise identified, the original reviewer believed that the Project’s operations must not be impacting the “chemical aspect” of water quality, although as already discussed, flows were a concern.

Go to B2

2) Is the Facility area or the downstream reach currently identified by the state as not meeting water quality standards (including narrative and numeric criteria and designated uses) pursuant to Section 303(d) of the Clean Water Act?

2017 Review: YES – Yes, per the State of Vermont’s 2014 List of Impaired Waters, three sections of the Winooski River have been identified as not meeting water quality standards pursuant to Section 303(d) of the Clean Water Act. Downstream of the Essex 19 dam from the Winooski One dam (to the mouth of the Winooski River (about 10.5 miles), the Winooski River is classified as impaired because of E. Coli presence. Upstream of the Essex 19 dam in both the upstream and downstream vicinity of the Montpelier Wastewater Treatment Facility (WWTF), the Winooski River is classified as impaired due to E. Coli presence.

Go to B3.

3) If the answer to question B.2 is yes, has there been a determination that the Facility does not cause, or contribute to, the violation?

2017 Review: YES - The Vermont DEC concluded that the presence of E. Coli downstream of the Winooski One Dam (FERC No. 2756) is caused by the City of Burlington’s combined sewer overflows (CSOs). The Presence of E. Coli upstream of the Project and in the upstream and downstream vicinity of the Montpelier WWTF is attributed to WWTF combined sewer overflows.

2018 update: No changes since the 2017 Review - Under the 2nd Edition Handbook, the Project would meet Standard B-1, Not Applicable/De Minimis Effect. While the Project’s WQC is more than 10 years old, the state has indicated that the facility is not the cause of listed water quality impairments in the Project vicinity.

This Project passes the Water Quality Criterion

C. FISH PASSAGE AND PROTECTION

Goal: The Fish Passage and Protection Criterion is designed to ensure that, where necessary, the facility provides effective fish passage for riverine, anadromous and catadromous fish, and protects fish from entrainment.

Standard: Under the 2014 LIHI Handbook for riverine, anadromous and catadromous fish, a certified facility must be in compliance with both recent mandatory prescriptions regarding fish passage and recent resource agency recommendations regarding fish protection. If anadromous or catadromous fish historically passed through the facility area but are no longer present, the facility will pass this criterion if the Applicant can show both that the fish are not extirpated or extinct in the area due in part to the facility and that the facility has made a legally binding commitment to provide any future fish passage recommended by a resource agency. When no recent fish passage prescription exists for anadromous or catadromous fish, and the fish are still present in the area, the facility must demonstrate either that there was a recent decision that fish passage is not necessary for a valid environmental reason, that existing fish passage survival rates at the facility are greater than 95% over 80% of the run, or provide a letter prepared for the application from the U.S. Fish and Wildlife Service or the National Marine Fisheries Service confirming the existing passage is appropriately protective.

Criterion:

1) Are anadromous and/or catadromous fish present in the Facility area or are they known to have been present historically?

2017 Review: YES. The Environmental Assessment developed for the 1995 FERC license process noted that Atlantic sturgeon likely formerly occurred in the Winooski River, although it unclear whether they could have migrated over Hubble Falls, where the current Essex 19 dam exists. Native Atlantic salmon were extirpated from the Lake Champlain Basin about 150 years ago, primarily due to habitat destruction in spawning tributaries and overfishing. Land-locked salmon, a potadromous species with strong migratory drive, exist in the river with the help of restoration efforts. Since operation of the trap and truck facility at the Winooski One Project starting in 1993, salmon migratory runs have been restored to the Winooski River.

A 2015 report by the USFWS, Lake Champlain Fish and Wildlife Resources Office on the status of American eels in the Lake Champlain Basin suggests that eels either historically or may continue to occur in the Winooski River basin. No specific records of eels in the Winooski River were found by GMP. Throughout the numerous recent discussions between GMP, USFWS and VDFW on fish passage, eel passage was never brought up by the agencies. The 2015 report states that the level of natural recruitment is insufficient to rebuild the eel stock in Lake Champlain. Brandon Kulik, a senior fisheries biologist with KA believes that one can reasonably conclude that eel presence in the Winooski river is limited, if any.

Go to C2

2) Is the Facility in Compliance with Mandatory Fish Passage Prescriptions for upstream and downstream passage of anadromous and catadromous fish issued by Resource Agencies after December 31, 1986?

2017 Review: NA. A Section 18 Mandatory Fish Passage Prescription was issued June 28, 1993 by the USFWS requiring the construction and operation of downstream passage for unspecified

species at Essex 19. Since anadromous species did not occur in the area at that time, and the status of eel cannot be confirmed, it is assumed that this mandate was intended to apply to land-locked salmon. See further discussion below under **Criterion C.6** as land-locked salmon are not an anadromous species.

Go to C3

3) Are there historic records of anadromous and/or catadromous fish movement through the Facility area, but anadromous and/or catadromous fish do not presently move through the Facility area (e.g., because passage is blocked at a downstream dam or the fish no longer have a migratory run)?

2017 Review: YES. See response to **Criterion C.1** and discussion of the passage of land-locked salmon under **Criterion C.6**.

3.a. If the fish are extinct or extirpated from the Facility area or downstream reach, has the Applicant demonstrated that the extinction or extirpation was not due in whole or part to the Facility?

2017 Review: YES. It appears that anadromous species were extirpated from the area (about 150 years ago) well before the current dam was constructed in 1917, although as discussed under the Project Description, a dam has been at this site, or immediately up or downstream of the current site, since the late 18th century. Although no specific records have been found showing the presence of American eel in the river near the Project, they may occur today in small numbers.

Go to C4

4) If, since December 31, 1986:

- a) Resource Agencies have had the opportunity to issue, and considered issuing, a Mandatory Fish Passage Prescription for upstream and/or downstream passage of anadromous or catadromous fish (including delayed installation as described in C2a above), and**
- b) The Resource Agencies declined to issue a Mandatory Fish Passage Prescription,**
- c) Was a reason for the Resource Agencies' declining to issue a Mandatory Fish Passage Prescription one of the following: (1) the technological infeasibility of passage, (2) the absence of habitat upstream of the Facility due at least in part to inundation by the Facility impoundment, or (3) the anadromous or catadromous fish are no longer present in the Facility area and/or downstream reach due in whole or part to the presence of the Facility?**

2017 Review: NA. As previous stated, a Mandatory Fish Passage Prescription was issued in 1995 without any target species identified; it has been assumed that it's focus was the restoration of land-locked salmon. See discussion below.

Go to C6

6) Is the Facility in Compliance with Mandatory Fish Passage Prescriptions for upstream or downstream passage of riverine fish?

2017 Review: CONDITIONALLY YES. It has been assumed that the Section 18 Mandatory Fish Passage Prescription applies to land-locked salmon that require movement from Lake Champlain to rivers and tributaries for spawning, as they are the focus of current restoration activities in the basin. This prescription also required that appropriate, although unspecified, flows must be released to enhance safe passage. It did not specify any requirement for effectiveness testing. A Reservation of Authority to prescribe upstream passage construction and operation and to modify the prescription in the future as needed, was also included in the FERC license.

In addition to the requirement for construction of the downstream passage (Article 407), the FERC license included a requirement to develop and implement a downstream passage monitoring plan including effectiveness testing (Article 410), and a requirement to establish a contractual relationship with the owner of the Winooski One Project to share the costs of the upstream trap and truck facility at that downstream project (Article 408). Article 409 reserved agency authority to prescribe upstream passage at a future date. Upstream migrating fish from the Winooski One fish lift are, in part, released just upstream of the Essex 19 dam. The facility is operated annually through a joint effort between Vermont Fish & Wildlife, USFWS, Burlington Electric Department (owner of Winooski One) and Green Mountain Power.

GMP constructed the downstream passage bypass, although the USFWS and VANR expressed opinions that certain aspects of the facility were different from the approved design and that these differences could be partially responsible for the lower than hoped for use of the downstream passage. Two rounds of effectiveness testing of the downstream passage were conducted in 1996 and 1997. The 1996 study was deemed inconclusive as only 16 of 23 juvenile salmon released arrived at the dam, and only six passed downstream, but all used the bypass. In 1997, 40 were released, 37 moved to the forebay, three had radio transmitter problems and of the remaining 34, two used the bypass, 8 went over the spillway, 11 were entrained and 13 never moved downstream. Both tests varied the flow passing through the passage way, and in both years, a flow of 100 cfs resulted in more fish being passed compared to 50 cfs flow.

Despite disagreement from the resource agencies, FERC issued an Order on March 30, 1998 stating that no further testing of the passage was needed. In the letter submitting the 1997 study results to FERC dated December 12, 1997, GMP agreed to make bypass modifications that were recommended by the agencies and appeared to agree to voluntarily release 100 cfs to the passage bypass if no further fish passage testing was required. Their position was that no further modifications would be reasonably possible even if new testing showed less than good results, and that expenditures of approximately \$100,000 would be better spent on installation of recirculating pumps to enable passage of 100 cfs flow than using that funding on additional testing. The FERC 1998 Order that stated that the testing requirements were completed, required that agency-recommended modifications to the bypass be made, but FERC did not include the requirement to pass 100 cfs to the bypass during downstream passage periods. It does not appear that all of these

modifications have been made. Based on communication with GMP during this LIHI review, GMP stated that it does not specifically release this flow amount. They also stated that data was not readily available to estimate, on average, the percentage of time 100 cfs was nonetheless released during the passage season.

These issues were detailed in a USFWS letter dated February 24, 2016 in response to inquiries made by GMP during preparation of the LIHI Certification application. A copy of this letter is in Appendix B. Based on recent meetings at the site, the USFWS identified four design issues at the bypass and made six recommendations to resolve them. Several of these were the same ones previously identified in the 1998 FERC Order. GMP apparently agreed to making five of the six modifications but stated they would not agree to performing additional testing as recommended by the USFWS. The USFWS also made recommendations for conditions should the site be certified by LIHI. In their LIHI comment letter, VDEC agreed with the fish passage issues raised by the USFWS and also made LIHI Certification condition recommendations.

Go to C7

7) Is the facility in Compliance with Resource Agency Recommendations for Riverine, anadromous and catadromous fish entrainment protection, such as tailrace barriers?

2017 Review: YES – Protective screening was required by the amended WQC and FERC license which has been satisfied by the installation of trash racks having one-inch clear spacing.

2018 Update for Overall Criterion Requirements: Conditionally YES. The 2nd Edition Handbook provides alternative standards for Upstream Fish Passage (Criterion C) and Downstream Fish Passage and Protection (new Criterion D). If the Project was being reviewed under the newer standards, it would satisfy C-2, Agency Recommendation for upstream passage based on the agreements to coordinate with the Winooski One fish lift and the agency reservation of authority to prescribe upstream passage in the future. The Project would conditionally meet standard D-2, Agency Recommendation for downstream passage and protection as discussed below.

GMP most recently implemented temporary downstream passage in July 2018 with an agency-approved temporary weir structure. Agencies met onsite in August 2018 and were supportive of the installation but made additional design recommendations for a permanent weir. Agency consultation on the final design of the permanent weir is ongoing at this time and the permanent passage is to be constructed in early 2019 once field conditions allow. Part of the consultation involved developing a standard operating procedure (SOP) which includes an adaptive management provision. GMP drafted the SOP in April 2018 and agency comments were submitted on September 13, 2018 via a July 27, 2018 from USFWS. The letter stated:

“The SOP includes descriptions of fishway gate operations, rubber dam operations, and modified conditions. The Service has reviewed the SOP and believes it contains relevant guidance to ensure the downstream bypass facility operates effectively. We do request that

GMP maintain records of headpond elevation and gate settings throughout the downstream passage facility operational periods to facilitate verification of compliance with the SOP.”

USFWS also requested that GMP formally amend with FERC the previously approved fish passage plan to include the SOP and shift the downstream passage season from April 1 – June 15 to April 15 – June 30 based on salmon smolt outmigration timing in the upstream Huntington River, a tributary that enters the Winooski River upstream of Essex 19. The passage season is being shifted for both Essex 19 and GMP’s downstream Gorge 18 project. GMP agreed to making these changes on October 22, 2018 and will file those changes and the SOP with FERC when finalized. Downstream passage monitoring and, if still required by agencies, effectiveness testing would not be expected to commence until after construction is complete. Since GMP has completed everything they can at this time and the remaining effort is in progress, this final review finds that:

The Project Conditionally Passes the 2014 Criterion C - Fish Passage and Protection, and the 2nd Edition Handbook Criterion C – Upstream Fish Passage, and Criterion D – Downstream Fish Passage and Protection with the following Condition:

Condition 2: *The facility Owner shall complete installation during the 2019 construction season of the permanent weir enhancements, including any needed plunge pool or rock modifications in consultation with VDEC and USFWS. The Owner shall file the revised downstream passage standard operating procedure (SOP) and agency-requested spring passage timing adjustment with FERC and provide a copy to LIHI. Upon commencement of passage operations and in consultation with resource agencies, the Owner shall implement the downstream passage monitoring and effectiveness testing in accordance with license Article 410 or associated updated requirements. The Owner shall report on the status of downstream passage in annual compliance statements submitted to LIHI.*

D. WATERSHED PROTECTION

Goal: The Watershed Protection criterion is designed to ensure that sufficient action has been taken to protect, mitigate and enhance environmental conditions in the watershed.

Standard: Under the 2014 LIHI Handbook, a certified facility must be in compliance with resource agency and Federal Energy Regulatory Commission (“FERC”) recommendations regarding watershed protection, mitigation or enhancement. In addition, the criterion rewards projects with an extra three years of certification that have a buffer zone extending 200 feet from the high-water mark or an approved watershed enhancement fund that could achieve within the project’s watershed the ecological and recreational equivalent to the buffer zone and has the agreement of appropriate stakeholders and state and federal resource agencies. A Facility can pass this criterion, but not receive extra years of certification, if it is in compliance with both state and

federal resource agencies recommendations in a license-approved shoreland management plan regarding protection, mitigation or enhancement of shorelands surrounding the project.

Criterion:

1) Is there a buffer zone dedicated for conservation purposes (to protect fish and wildlife habitat, water quality, aesthetics and/or low-impact recreation) extending 200 feet from the average annual high-water line for at least 50% of the shoreline, including all of the undeveloped shoreline?

2017 Review: NO, go to D2

2) Has the facility owner/operator established an approved watershed enhancement fund that: 1) could achieve within the project's watershed the ecological and recreational equivalent of land protection in D.1), and 2) has the agreement of appropriate stakeholders and state and federal resource agencies?

2017 Review: NO, go to D3

3) Has the facility owner/operator established through a settlement agreement with appropriate stakeholders, with state and federal resource agencies' agreement, an appropriate shoreland buffer or equivalent watershed land protection plan for conservation purposes (to protect fish and wildlife habitat, water quality, aesthetics and/or low impact recreation)

2017 Review: NO, go to D4

4) Is the facility in compliance with both state and federal resource agencies recommendations in a license approved shoreland management plan regarding protection, mitigation or enhancement of shorelands surrounding the project.

2017 Review: NOT APPLICABLE. No Shoreland Management Plan, buffer zone was required for the Essex 19 Project. License Article 414 however requires a landscape management plan to preserve and enhance the visual resources of the Project area. On June 21, 1996 GMP's Landscape Management Plan was approved by the FERC. The plan ensures the blending of Project works into the existing landscape character, maintenance of vegetation around the Project powerhouse and within the bypassed reach, as well as the planting of trees along street corridors. In 2010, a nearby resident identified some concern to FERC about the loss of tree screening near a distribution substation (outside the Project boundary). GMP promptly met with the Development Director of the Village of Essex Junction to coordinate activities to replace this screening with measures that would be amenable to the Town. At the same time, GMP replanted trees on two areas within the Project boundary. These areas were located in front of the powerhouse transformer and along the edge of route 2A between the bridge and driveway. GMP continues to operate in compliance with this plan.

2018 update: YES, no changes since the 2017 Review. The 2nd Edition Handbook provides alternative standards for Shoreline and Watershed Protection (new Criterion E). If the Project was being reviewed under the newer standards, it would satisfy E-1, Not Applicable/De Minimis Effect or alternatively E-2, Agency Recommendation. There are no ecologically significant lands associated with the facility and no Shoreline Management Plan is required, but the Project has a Landscape Management Plan to support vegetation management appropriate to the site.

The Project Passes the Shoreline and Watershed Protection Criterion

E. THREATENED AND ENDANGERED SPECIES PROTECTION

Goal: The Threatened and Endangered Species Protection Criterion is designed to ensure that the facility does not negatively impact state or federal threatened or endangered species.

Standard: Under the 2014 LIHI Handbook, for threatened and endangered species present in the facility area, the Applicant must either demonstrate that the facility does not negatively affect the species or demonstrate compliance with the species recovery plan and receive long term authority for a “take” (damage) of the species under federal or state laws.

Criterion:

1) Are threatened or endangered species listed under state or federal Endangered Species Acts present in the Facility area and/or downstream reach?

2017 Review: YES, potentially – Data provided in the application, based on review of documentation provided by the USFWS, identified that the northern long-eared bat (*Myotis septentrionalis*), a federally listed threatened species may be found in the Project area. This species is also listed as endangered by the state.

In the 2006 Environmental Assessment, only the bald eagle, which was a protected species at the time, was identified as having been observed nesting about five miles downstream from the Project. The bald eagle has since been removed from federal listing but is protected by the State of Vermont as an endangered species and by the Federal Bald and Golden Eagle Protection Act.

To date, the Vermont Natural Heritage Inventory, Vermont Fish & Wildlife Department, has not responded to GMP’s request for review of state protected species that may be expected to be in the Project area.

Go to E2

2) If a recovery plan has been adopted for the threatened or endangered species pursuant to Section 4(f) of the Endangered Species Act or similar state provision, is the Facility in Compliance with all recommendations in the plan relevant to the Facility?

2017 Review: YES. A recovery plan for the northern long-eared bat has not been developed by the state or USFWS, although takings are restricted through the 4(d) rule for the species that limits tree cutting during roosting season.¹ A recovery plan for Bald Eagle was issued in 2010 by the State of Vermont. As part of this report revision, a 2018 review of publicly available data indicates that bald eagles have been observed in the general vicinity of the Project, but none have been observed in the immediate Project area.²

Go to E3

3) If the Facility has received authority to Incidentally Take a listed species through: (i) Having a relevant agency complete consultation pursuant to ESA Section 7 resulting in a biological opinion, a habitat recovery plan, and/or (if needed) an incidental take statement; (ii) Obtaining an incidental take permit pursuant to ESA Section 10; or (iii) For species listed by a state and not by the federal government, obtaining authority pursuant to similar state procedures; is the Facility in Compliance with conditions pursuant to that authorization?

2017 Review: NA. Neither a Biological Opinion or Incidental Take Permit have been issued for the Essex 19 Project.

Go to E5

5) If E2 and E3 are not applicable, has the Applicant demonstrated that the Facility and Facility operations do not negatively affect listed species?

2017 Review: YES. In a letter dated May 22, 2006, UFSWS determined that the construction activities related to the installation of the new minimum flow unit would not affect the bald eagle (which was federally listed at the time) as activities would be limited to within the powerhouse. As no issue with continued operation of the project was identified as a concern in this letter, it can be assumed that the Project does not negatively affect eagle nesting or foraging habitat in the area. Recent correspondence from the USFWS indicated that critical habitat for the northern long-eared bat has not been identified in the project area. GMP stated that the bat may feed within the Project boundary.

As previously noted, no impacts to the bald eagle or northern long-eared bat are expected due to the lack of suitable habitat (except for feeding) within the Project boundary.

2018 update: YES. The 2nd Edition Handbook provides alternative standards for threatened and endangered species protection (new Criterion F). If the Project was being reviewed under the

¹ <https://www.fws.gov/midwest/endangered/mammals/nleb/4drule.html>

² <https://ebird.org/vt/map/baleag?neg=true&env.minX=-73.30737562548825&env.minY=44.35998781032904&env.maxX=-72.93315382373044&env.maxY=44.550890994596884&zh=true&gp=false&ev=Z&mr=1-12&bmo=1&emo=12&yr=all>

newer standards, it would satisfy standard F-2, Finding of No Negative Effect given that Project operations are unlikely to impact the listed species that may be present.

A November 1, 2018 review of publicly available data indicates that state-listed species present in Chittenden County include three flowering plants, the cobblestone tiger beetle (*Cicindela marginipennis*), and two additional bat species - Indiana Myotis (*Myotis sodalist*) and tricolored bat (*Perimyotis subflavus*). Within the Winooski River watershed, one plant species (Boott's Rattlesnake-root) is present, but its habitat requirements (it primarily occurs at higher elevations and in alpine/tundra habitats) preclude its presence in the project vicinity.³ The tricolored bat is present or has a range within the watershed and cobblestone tiger beetle is also present in the watershed.⁴ There is no indication that any beetles are present in the immediate Project area nor that Project operations would affect this species and agencies have not expressed any concerns of potential effects of Project flows on the species during all of the recent consultation on project flows.

The Project Passes the Threatened and Endangered Species Protection Criterion

F. CULTURAL RESOURCE PROTECTION

Goal: The Cultural Resource Protection Criterion is designed to ensure that the facility does not inappropriately impact cultural resources.

Standard: Under the 2014 LIHI Handbook, cultural resources must be protected either through compliance with FERC license provisions, or through development of a plan approved by the relevant state or federal agency.

Criterion:

1) If FERC-regulated, is the Facility in compliance with all requirements regarding Cultural Resource protection, mitigation or enhancement included in the FERC license or exemption?

2017 Review: YES. Per 1995 License Article 413, GMP implements the provisions of the “Programmatic Agreement Among the Federal Energy Regulatory Commission, the Advisory Council on Historic Preservation, and the Vermont State Historic Preservation Officer, for Managing Historic Properties that may be Affected by a License Issuing to Green Mountain Power Corporation for the Continued Operation of the Essex No. 19 Hydroelectric Power Project in Vermont” executed on December 8, 1994. On July 14, 1997, FERC issued an Order Approving Cultural Resource Management Plan prepared by GMP and required that GMP file an annual

³ http://explorer.natureserve.org/servlet/NatureServe?searchSpeciesUid=ELEMENT_GLOBAL.2.141656

⁴ <http://www.natureserve.org/conservation-tools/listed-and-imperiled-species-county-and-watershed/county-map>

report of activities conducted under the CRMP with the State Historic Preservation Office and FERC. These plans have been filed annually except for 2011 when Tropical Storm Irene curtailed the analysis required during the 2011 field season. FERC did not consider this a license violation.

In their application, GMP noted that they contacted Scott Dillon of the Vermont Division for Historic Preservation for comment on compliance of the Project. Mr. Dillon reported that due to work overload constraints at the Division, GMP should conduct a compliance review for the Project and provide a summary of the results to the Division for final review. That review was provided to the Division on September 9, 2016, and although several follow-up emails were sent to the Division regarding this submission, no response has been received to date. Nonetheless, this LIHI review indicates that there does not appear to be any reason to believe that non-compliance issues exist.

2018 update: YES, no changes since the 2017 Review. The 2nd Edition Handbook provides alternative standards for cultural and historic resource protection (new Criterion G). If the Project was being reviewed under the newer standards, it would satisfy standard G-2, Approved Plan.

The Project Passes the Cultural and Historic Resources Protection Criterion

G. RECREATION

Goal: The Recreation Criterion is designed to ensure that the facility provides access to the water without fee or charge and accommodates recreational activities on the public's river.

Standard. Under the 2014 LIHI Handbook, a certified facility must be in compliance with terms of its FERC license or exemption related to recreational access, accommodation and facilities. If not FERC-regulated, a certified facility must be in compliance with similar requirements as recommended by resource agencies. A certified facility must also provide the public access to water without fee or charge.

Criterion:

1) If FERC-regulated, is the Facility in Compliance with the recreational access, accommodation (including recreational flow releases) and facilities conditions in its FERC license or exemption?

2017 Review: YES. Per 1995 License Article 415 and Water Quality Certificate Conditions N & O, GMP has filed with the FERC a revised Recreation Plan for the Essex 19 Hydroelectric Project, which was approved on June 21, 1996. The Plan included eleven recreational features. Per the 2008 Environmental Inspection Report, improvements to the Project recreation facilities have been completed as proposed in the approved recreation plan. In addition, the 2008 Environmental Inspection Report states that all recreational facilities appear to be well maintained and in good condition, although updates to the Public Safety Plan was required. The updated Plan was submitted July 3, 2008 and accepted by FERC.

- 2) **If not FERC-regulated, does the Facility provide recreational access, accommodation (including recreational flow releases) and facilities, as Recommended by Resource Agencies or other agencies responsible for recreation?**

2017 Review: NA. *Go to G3*

- 3) **Does the Facility allow access to the reservoir and downstream reaches without fees or charges?**

2017 Review: YES. The application denotes that free access is provided to the recreational areas along the Project's reservoir and downstream reaches.

2018 Update: YES. A subsequent Environmental Inspection was conducted on August 7, 2018 and found minor items including a recreation sign covered with graffiti, excess vegetation around a recreation sign, and an outdated telephone number. GMP corrected these items and reported to FERC on October 5, 2018. The 2nd Edition Handbook provides alternative standards for recreation (new Criterion H). If the Project was being reviewed under the newer standards, it would satisfy standard H-2, Agency Recommendation.

The Project Passes the Recreation Criterion

H. FACILITIES RECOMMENDED FOR REMOVAL

Goal: The Facilities Recommended for Removal Criterion is designed to ensure that a facility is not certified if a natural resource agency concludes it should be removed.

Standard: Under the 2014 Handbook, if a resource agency has recommended removal of a dam associated with the facility, the facility will not be certified.

Criterion:

- 1) **Is there a Resource Agency recommendation for removal of the dam associated with the Facility?**

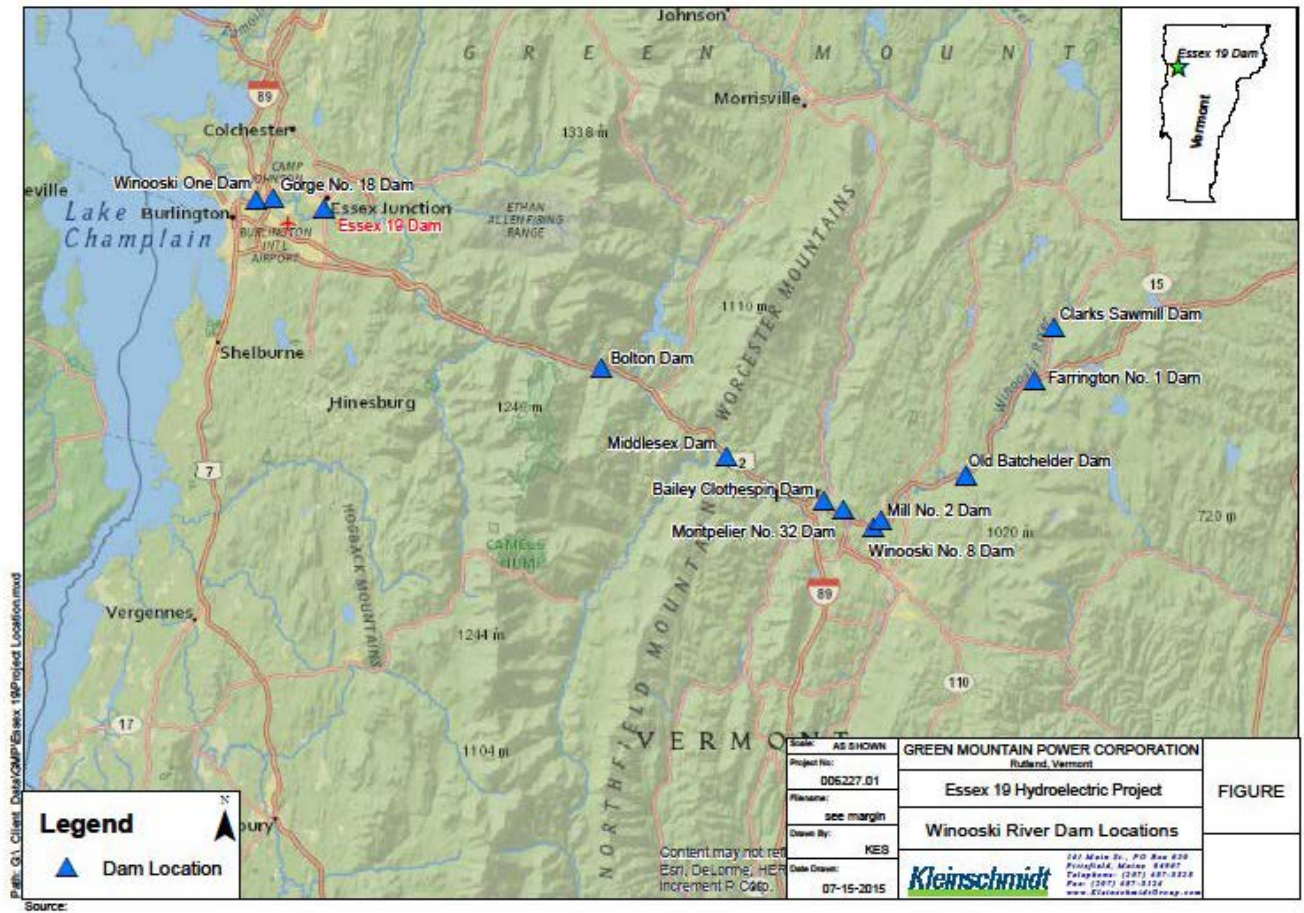
2017 Review: NO. No resource agency has recommended removal of this dam.

2018 Update: NO. This criterion is not included in the 2nd Edition Handbook, but dams recommended for removal by a resource agency are ineligible for LIHI Certification. If the Project was being reviewed under the newer standards, it would still be eligible for LIHI Certification.

The Project Passes the 2014 Criterion H -Facilities Recommended for Removal and meets the current 2nd Edition Handbook eligibility criteria.

Appendix A

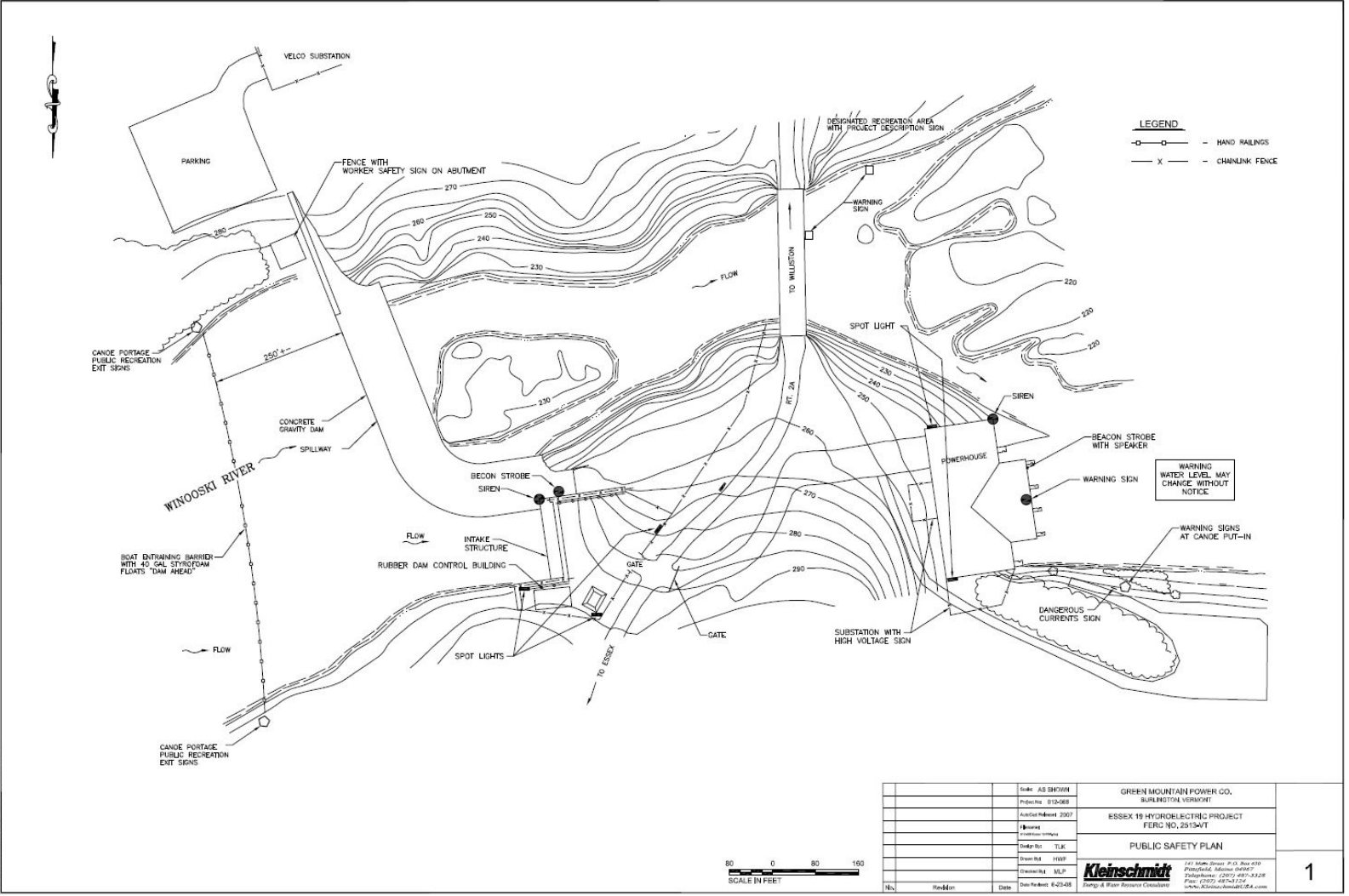
Maps and Photographs of the Project



Regional map showing Essex 19 and nearby dams

THE INFORMATION CONTAINED HEREIN IS UNCLASSIFIED EXCEPT WHERE SHOWN OTHERWISE. DATE OF DECLASSIFICATION IS INDEFINITE.

A:\ENR\Winooski\essex\011-2008 Essex 19 PSP.dwg
 Date: 10/20/08



Scale	AS SHOWN	GREEN MOUNTAIN POWHR CO. SURLINGTON VERMONT
Project No.	012-068	
Approval Date	2007	ESSEX 19 HYDROELECTRIC PROJECT FERC NO. 2513A/V1
Drawn By	TJK	PUBLIC SAFETY PLAN
Checked By	MSF	
Drawn By	MSF	
Checked By	MSF	
Drawn By	MSF	
Checked By	MSF	
Date	06-23-08	

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Overview of the Project



Side view of the dam



Upstream view of the powerhouse



Turbines

Appendix B

Agency Correspondence Referenced in the Report

Vermont Department of Environmental Conservation*Agency of Natural Resources*

Watershed Management Division

1 National Life Drive, Main 2

Montpelier, VT 05620-3522

<http://www.watershedmanagement.vt.gov>

[phone] 802-490-6180

[fax] 802-828-1544

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March 12, 2017

Low Impact Hydropower Institute

PO Box 194

Harrington Park, New Jersey

RE: Essex 19 Hydroelectric Project (FERC No. 2513)
Comments on Low Impact Hydropower Certification

Dear Ms. Ames,

On December 30, 2016, the Low Impact Hydropower Institute (LIHI) received a complete application from Green Mountain Power Corporation for low impact certification of the Essex 19 Hydroelectric project located on the Winooski River in Essex Junction and Williston, Vermont. Based on its review, the Agency has substantial concerns regarding compliance of the Essex 19 project with LIHI's low impact criteria. The Agency provides comments, herein.

Background

The Agency issued a water quality certification for the Essex 19 hydroelectric project on November 8, 1993, which was amended on January 1, 1995. Subsequently, FERC issued a new license for a major project on March 30, 1995. The Agency's LIHI certification review of the project focuses on conditions B, E, and K of the water quality certification issued for the project, specifically evaluating compliance with minimum flows, peaking constraints, and fish passage provisions.

Flows

The Applicant has not demonstrated compliance with LIHI's flow criterion. LIHI's flow criterion applicable to this application are:

“Compliance with Resource Agency Recommendations issued after December 31, 1986 regarding flow conditions for fish and wildlife protection, mitigation and enhancement (including in-stream flows, ramping, and peaking rate conditions, and seasonal and episodic instream flow variations) for both the reach below the tailrace and all bypassed reaches”

Condition B of the water quality certification issued for operation of the project specifies seasonal minimum flows that must be maintained in the bypassed reach and below the project. Pursuant to condition B, run-of-river operations (outflow equal to inflow on an instantaneous basis) are required from April 1 to May 15. Condition E of the water quality certification issued for operation of the project establishes constraints on peaking operations based on the low flow for a

given calendar day as measured below the project. Pursuant to Condition E, run-of-river operations are required under specific flow conditions.

Flows at the project are controlled to a large degree by the operation of upstream peaking projects including the Waterbury Hydroelectric Project, Mollys Falls Hydroelectric Project, and Bolton Falls Hydroelectric Project. Due to peaking operations upstream, flow transitions at the project have historically been problematic. While the LIHI application for the project correctly identifies that “Project compliance is enforced with the implementation of the December 8, 1995 FERC Approved Minimum Flow Monitoring Plan”, it does not discuss the modifications to this plan since its original approval.

FERC identified need for modifications in a February 3, 2000 letter that directed GMP to file for Commission approval an operating plan addressing operational problems and deficiencies that occurred in 1999. In response, GMP submitted a proposal to refine the previously approved flow monitoring plan, which identified “procedures to predict inflow and changes in inflow to the Essex 19 impoundment” as an area that may require refinement.¹ FERC approved GMP’s proposed plan, requiring “any necessary revisions to the plan including agency’s comments be filed by December 31, 2000”.² On December 28, 2000, GMP submitted a document entitled, Essex 19 Flow Monitoring Plan Refinements, which included the results of ongoing operational and monitoring refinements that were incorporated at the project during the spring, summer, and fall 2000.³ The refinements include incorporating an estimate of Bolton Falls outflow data in GMP’s SCADA system “to predict inflow to the Essex 19 impoundment during low flow periods and ROR operation” and procedures to “estimate and coordinate discharges at Bolton Falls and Essex 19 under low flow conditions”. FERC approved the refinements to the plan to monitor run-of-river and minimum flow under articles 403 and 404 on February 20, 2001.⁴

As part of its LIHI review, the Agency requested one year of operational records to evaluate the compliance of project operations over a range of flow conditions with certification conditions. The Agency received spreadsheets containing generation, headpond level, and flow at the downstream USGS gauge. Due to the influence of upstream peaking projects, the Agency requested the Bolton Falls outflow data and/or inflow estimates for the Essex 19 project to evaluate compliance with water quality certification conditions B and E when run-of-river operations are required. However, it does not appear that this data is currently being collected or utilized to inform operational decisions at the Essex 19 project. While the Agency acknowledges headpond level can serve as a proxy to quantify differences between inflow and outflow, it not a perfect substitute and its usefulness as a proxy decreases with increasing impoundment size as relatively small changes in water level cause increasingly large changes in downstream flow. Considering the refinements to the flow management plan include provisions to include Bolton Falls outflow in GMP’s SCADA system and estimate inflow into the Essex 19 impoundment, it does not appear that flow at the project is monitored consistent with the approved flow monitoring plan for the project.

While a robust evaluation of compliance with conditions B and E is not possible without inflow estimates, the Agency’s review has identified instances of potential non-compliance that merit further analysis. The Agency compared discharge at the gage below the Waterbury Hydroelectric

¹ Green Mountain Power. Refinements to Essex 19 Flow Monitoring Plan. June 1, 2000.

² Federal Energy Regulatory Commission. Order Amending Flow Release Plan. October 4, 2000.

³ Green Mountain Power. Essex 19 Flow Monitoring Plan Refinements. December 28, 2000.

⁴ Federal Energy Regulatory Commission. Order Modifying and Approving Flow Monitoring Plan Refinements under Articles 403 and 404. February 20, 2001.

Project on the Little River to discharge below the Essex 19 project to evaluate to some degree how upstream peaking operations affects flow at Essex 19. From May 22 – 31, 2015, the low flow for the calendar day below the Essex 19 project was less than 1000 cfs. Pursuant to condition E, the project is to be operated in run-of-river mode under these flow conditions. With the influence of the upstream peaking projects, one would expect flow increases below the project as the pulse of water moves through, but would not expect to see downstream flow curtailment associated with the upstream flow pulse. However, assuming inflow is represented by the period of relatively steady flow between peaks, the hydrograph indicates substantial curtailment of downstream flows (>300 cfs) after a peak passes and before run-of-river operations resumes. These conditions are shown on the hydrograph below in red and represent deviations from run-of-river operations. Such curtailments are likely due to a lag time of the turbines adjust to decreasing inflows, causing a small impoundment draw, and then an overcorrection of the turbines to decreasing headpond level. It is likely that the refinements to the flow management plan, specifically the inclusion of outflow data from Bolton Falls and estimates of inflow to Essex 19 impoundment would help to alleviate this condition. There appear to be two additional deviations from run-of-river operations in the hydrograph below shown in blue. These appear in the operations data provided for Agency review, the former in a headpond draw and the latter in turbine generation, however, the Agency does not have deviations on file to account for these events.

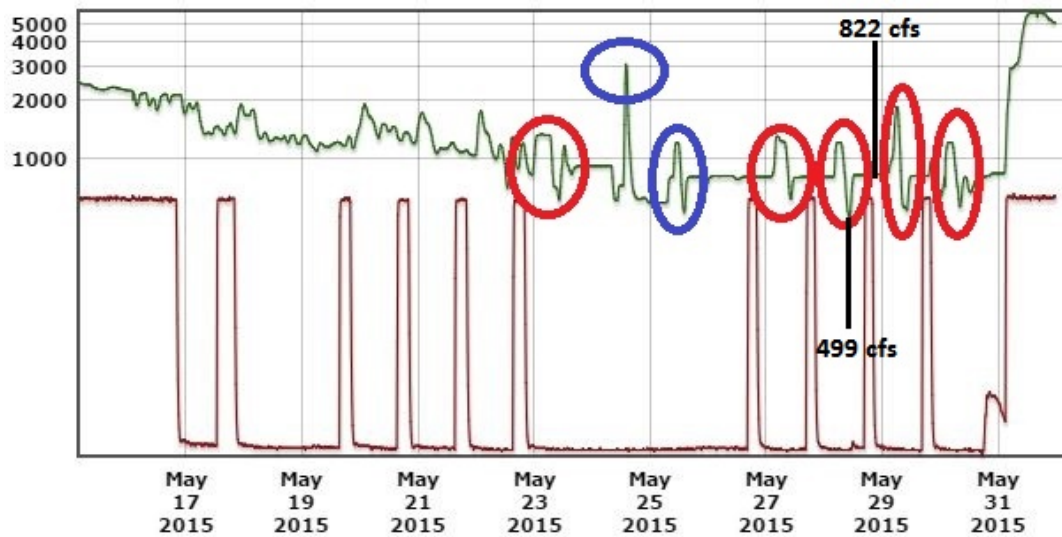


Figure 1. Hydrograph comparing discharge in cubic feet per second from the USGS gage below the Waterbury Hydroelectric Project on the Little River (Red) and the USGS gage below Essex 19 Hydroelectric Project on the Winooski River (green).

Fish Passage

The Applicant has not demonstrated compliance with LIHI's fish passage criterion. LIHI's fish passage criterion applicable to this application are:

“Compliance with Mandatory Fish Passage Prescriptions for upstream and downstream passage of anadromous and catadromous fish issued by Resource Agencies after December 31, 1986.”

Condition K of the water quality certification for the Essex 19 project concerns downstream passage and requires GMP to submit a plan for downstream fish passage to the Vermont Department of Fish and Wildlife (VDFW) and provide downstream passage 24 hours per day, from April 1 through June 15 and from September 15 through December 15. The condition requires the inclusion of provisions to minimize entrainment and impingement, and ultimately convey fish safely and effectively downstream of the facility.

Landlocked Atlantic salmon, native to Lake Champlain, were extirpated from the basin approximately 150 years ago. The U.S. Fish and Wildlife Service (USFWS), in partnership with VDFW and New York Department of Environmental Conservation, has been working to restore landlocked Atlantic salmon to Lake Champlain since 1972. Pursuant to a license article, GMP in part, supports a trap and truck program that transports fish returning to the most downstream dam on the Winooski River (Winooski One) above the Essex 19 project to provide fish with access to more than 20 miles of spawning and nursery habitat in the upper river and its tributaries. This program has recently resumed and has been quite successful in recent years with natural reproduction documented upstream and greater numbers returning to the fish lift to move upstream to spawn. These factors reinforce the importance of effective downstream passage at the project to the continued success of the restoration program.

In response to a request to confirm compliance of the Essex 19 project with several license articles in preparation of an application for LIHI certification, USFWS conducted a thorough file review.⁵ This review identified information that would be needed to confirm compliance. Following up on this review and to perform a fishway inspection, representatives of USFWS, the VDFW and GMP met at the Essex 19 project on September 23, 2016. After this meeting, the USFWS communicated a list of items to GMP that would need to be addressed to ensure proper operation of the fish bypass system. While there has been progress on a number of items, it is the Agency's understanding that a resolution has not yet been reached, meaning safe and effective passage, and therefore compliance with certification conditions, cannot be confirmed at this time.

Recommendation

As a result of its review, the Agency does not believe that the Essex 19 project has demonstrated compliance with water quality certification conditions, FERC license articles and LIHI criteria at the time of its application for low impact certification. As such, the Agency would recommend that certification of this project as "low impact" be contingent upon demonstrated compliance with the requirements specified above.

If LIHI certifies the Essex 19 project, the Agency would recommend the following conditions be included in any certification issued for the project.

1. GMP shall review the flow monitoring procedures at the Essex 19 project and assess compliance with the approved flow monitoring plan including the refinements identified in GMP's 2000 refinement plan. In consultation with VDEC, GMP shall establish a plan for implementing modifications required under the approved plan, and submit this plan to LIHI within 180 days.
2. GMP shall conduct a review of run-of-river operations at the Essex 19 project and determine if additional modifications are needed to ensure compliance with LIHI criteria. In

⁵ United States Fish and Wildlife Service. Letter to Ms. Katie Sellers, Kleinchmidt. February 5, 2016.

consultation with VDEC, GMP shall establish a plan for implementing any modifications identified, and submit this plan to LIHI within 180 days.

3. GMP shall re-initiate consultation on the downstream bypass facility with Vermont Department of Fish and Wildlife and U.S. Fish and Wildlife Service. GMP shall identify any modifications needed to conform with prior resource agency recommendations and develop a schedule for implementation within 180 days.
4. GMP, in consultation with Vermont Department and Fish and Wildlife and U.S. Fish and Wildlife Service, shall evaluate the performance bypass facility to verify that downstream passage is safe and effective. Results of this evaluation shall be provided to LIHI. If results of this evaluation indicate issues with safety or effectiveness, GMP shall commit to working with the agencies to identify reasonable measures to increase safety and effectiveness and shall document these efforts with an annual report to LIHI.

Thank you for the opportunity to comment.

Sincerely yours,



Eric Davis
River Ecologist

- c: Jeff Crocker, VTDEC
 Bernie Pientka, VTDFW
 Melissa Grader, USFWS
 Julianne Rosset, USFWS
 Nick Staats, USFWS
 William Ardren, USFWS
 Brett Towler, USFWS
 John Greenan, GMP
 Katie Sellers, Kleinschmidt Associates
 Pat McIlvaine, LIHI

ORIGINAL

United States Department of the Interior



FISH AND WILDLIFE SERVICE

New England Field Office
 70 Commercial Street, Suite 300
 Concord, NH 03301-5087
<http://www.fws.gov/newengland>

REF: Essex 19-FERC No. 2513

Ms. Katie Sellers
 Kleinschmidt
 75 Main Street
 Pittsfield, ME 04967

Dear Ms. Sellers:

This letter regards your request, transmitted via email dated October 21, 2015, to confirm the Essex 19 Project's compliance with several license articles as part of the application process for Green Mountain Power (GMP) receiving certification from the Low Impact Hydropower Institute (LIHI). The project is located on the Winooski River in Essex Junction, Vermont.

The U.S. Fish and Wildlife Service (Service) has conducted a thorough file review (detailed below) and offers the following comments and recommendations.

BACKGROUND

Downstream Fish Passage

GMP installed a downstream bypass facility at the Essex 19 Project in 1995. In 1996, a radio telemetry study was conducted to evaluate the effectiveness of the facility for passing landlocked salmon smolts. Results of that evaluation were deemed inconclusive due to the large number of fish that did not move past the project (only 16 of 23 test fish arrived at the Essex 19 Project and of those 16, only 6 passed the project). The Service agreed that it was likely that the test fish were not in the smolt stage and thus would not be expected to exhibit normal migratory behavior. However, of those fish that did move downstream, all six used the bypass. Five of those six fish passed when flow in the bypass was 100 cfs (versus 50 cfs). The Service made a number of recommendations for modifications to the study methodology for 1997.

The Federal Energy Regulatory Commission (FERC) issued an order approving an additional year of evaluation on January 29, 1997.

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GMP undertook the second-year evaluation and provided a report of the results to the agencies in November of 1997. Of the 40 fish that were released, 37 moved into the forebay. Three fish had radio transmitter problems. Of the remaining 34 test fish, 2 used the bypass, 8 went over the spillway, 11 were entrained in the turbines, and 13 failed to move downstream.

A site visit with agency staff and GMP was conducted on October 30, 1997. A Service fishway engineer participated and assessed bypass facility conditions. The engineer identified a number of design issues that likely impact fishway effectiveness: (1) doors above the bypass entrances create an orifice condition and surface turbulence; (2) horizontal bars on the grizzly racks created turbulence, catch debris and were a behavioral deterrent to passage; (3) debris on the trashracks exacerbated turbulence; and (4) the video indicated turbulent conditions and a drop insufficient to commit fish. The engineer provided recommendations to alleviate these problems: (1) raise or remove doors above the entrance galleries; (2) install a floating boom or increase frequency of rack cleaning to minimize debris at racks; (3) remove the horizontal bars behind the grizzly racks; (4) ensure there is a drop into the entrance galleries sufficient to commit the fish; (5) run 100 cfs into the galleries but only 50 cfs out of the flume (into the plunge pool); and (6) operate bag #1 (rubber bladder closest to station) first for spilling.

By memorandum dated November 12, 1997, GMP agreed to implement five of the six recommendations if the agencies agreed that no further fishway testing would be required.

By letter dated December 3, 1997 the Service expressed appreciation at GMP's willingness to implement most of the recommendations made by our fishway engineer, but maintained that additional monitoring would be needed in order to verify that the implemented changes were effective.

On March 30, 1998, FERC issued an order accepting the study results and approving fishway modifications. In that order, FERC required GMP to implement structural and operation changes to the bypass, but did not require additional monitoring.

On April 27, 1998, the Department of the Interior (Department) filed a rehearing request with FERC on the March 30, 1998 Order. The State filed a rehearing request the following day.

In October of 1998, GMP undertook work to modify the downstream fishway.

On December 24, 1998, FERC denied the Department's and the State's rehearing requests.

Flow/Water Quality

The license for the Essex 19 Project states that it should be operated as true run-of-river during dry springs (inflows of less than 1,000 cfs between May 16 and June 15).

On May 24, 1999, the Vermont Department of Environmental Conservation (VDEC) contacted GMP with concerns that the Essex No. 19 Project was not releasing minimum flows in compliance with their license terms and requested that FERC investigate this violation. The VDEC letter included a provisional copy of the river hydrograph from the USGS gauge station

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located directly below the facility. During May 15 to May 20, 1999 river flows fluctuated by 250 cfs each day and the transitions between high and low flows were rapid. In a subsequent email to FERC on August 4, 1999, the VDEC outlined flow spikes of 1,300 cfs in August followed by a rapid recession to 110 cfs.

On September 22, 1999, FERC released a memorandum regarding these flow violations. In its response to FERC, GMP attributed the non-compliance to drought conditions experienced during this period.

On October 11, 1999, the VDEC wrote another letter to FERC explaining GMP's failure to accurately estimate project inflow and set units to match that inflow to maintain a stable headpond. The August violation, however, was a result of GMP drawing the headpond down before a shutdown of the station and then attempting to notch the rubber flashboards to spill inflow and prevent interruption of downstream flow, which resulted in a discharge almost an order of magnitude higher than inflows. GMP then reinflated the bladder to reduce the notch size and this nearly dried up the River.

On February 3, 2000, FERC issued an enforcement letter requiring GMP to file an operating plan to address future operations in order to prevent further flow issues.

By letter dated May 31, 2000, the VDEC outlined the measures GMP had agreed to implement in order to improve flow management at the Project. These measures were to be implemented and tested during the summer of 2000. On October 4, 2000, FERC issued an order amending GMP's flow release plan.

On November 22, 2000, GMP's consultants submitted a draft Flow Monitoring Refinement Plan to the VDEC for review. By letter dated December 27, 2000, the VDEC provided comments and recommendations to the plan. GMP filed a final plan with FERC on January 3, 2001. On February 20, 2001, FERC issued an Order Modifying and Approving Flow Monitoring Plan Refinements. In general, FERC agreed to the proposed refinements, but also identified that they would not eliminate the lag time in flow releases and therefore, further testing would be required to assess whether manipulating the rubber bladders would address this issue.

On July 27, 2001, GMP requested VDEC approval of temporary flow and water level management modification in order to conduct repairs to the rubber dam system. The VDEC, by letter dated September 5, 2001, approved that request, with restrictions. On December 20, 2001, the VDEC sent a letter to GMP regarding a flow violation related to the repair work, as well as a separate violation that occurred on July 19, 2001, requesting additional information.

In 2005, GMP initiated consultation on a proposed low flow turbine that GMP stated would allow the Project to better meet its flow requirements. Documents in our file indicate that the VDEC was concerned with potential water quality impacts from diverting more flow through the turbines, particularly under low inflow conditions, due to the stressed condition of the River with respect to dissolved oxygen (DO) concentration. The VDEC recommended that GMP investigate whether turbine aspiration might be possible.

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By letter dated October 12, 2005, the Service provided comments on the new turbine proposal to GMP's consultant. We expressed concern with installing a new turbine because of its potential negative impact on the downstream fish bypass: (1) the low flow turbine would be on the left side of the intake, whereas the bypass entrances are located in the center and right side of the intake; (2) the new unit would operate first on and last off; therefore, during low flow periods when the downstream bypass is operating, it would create false attraction away from the bypass entrances; and (3) the intake velocity in front of the racks at the new turbine might exceed the Service's design criterion (when only the low flow turbine is operating). Our letter provided recommendations to avoid these potential problems, including: (1) not operating the new turbine during the downstream passage season when inflow is less than 275 cfs; (2) increasing the fishway flow and passing all of it through the bypass entrance closest to the new unit, or (3) maintaining the existing fish passage flow and reducing the flow going into the new turbine.

On November 7, 2005, GMP's consultant responded to the issues raised in our October 12, 2005 letter.

By email dated November 15, 2005, VDEC staff indicated that GMP's proposal to install a vented low flow turbine was acceptable, but that continuous monitoring would be required to ensure it was achieving the anticipated increase in DO concentration (1 mg/l).

On December 14, 2005, the Service sent a letter to GMP's consultant providing comments to the November 7, 2005 submittal. In that letter, we stated that the additional information contained in the November 7, 2005 submittal addressed our concerns and therefore, we would not object to GMP proceeding with an amendment to install the low flow turbine. Our letter did stipulate that any amendment application submitted by GMP to FERC should specify that, if the new unit is found to reduce the effectiveness of the downstream bypass, GMP would work with our office and the Vermont Department of Fish and Wildlife (VDFW) to resolve the issue.

On December 15, 2005, GMP submitted an amendment application to FERC. The Department provided comments and 10(j) recommendations on the application by letter dated January 30, 2006. The Department recommended installing a vented turbine with an associated monitoring program, as well as monitoring at the intake to the new turbine when it is the only unit operating during the fall and spring fish passage seasons, to determine if attraction to the bypass facility is compromised. If monitoring revealed fish concentrating in the left corner of the intake, the Licensee would concentrate fishway attraction flow through the center bypass entrance. If this still did not address the problem, the Licensee would cooperate with the Service and VDFW to resolve the issue.

The VDEC commented on the application by letter dated February 3, 2006. In that letter, VDEC requested that FERC include a license article requiring GMP to install a vented turbine that maintains DO saturation values of 90 percent or greater at the tailrace whenever the new turbine is the only unit operating during the period June 15 through September 15, from 2200 hours to 0800 hours, and that the device would be calibrated in consultation with VDEC staff.

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In a letter dated February 10, 2006, FERC directed GMP to respond to the agencies' comments. GMP provided a response on February 10, 2006. In that letter, GMP stated it did not object to FERC including an article requiring visual monitoring and subsequent follow-up should fish passage effectiveness become an issue after the new turbine became operational.

On April 4, 2006, the VDEC submitted a letter to FERC stating that it had reached agreement with GMP regarding language for the turbine venting and monitoring requirement; GMP now proposed to undertake sampling to define the actual reaeration achieved through spillage. On April 11, 2006, the Service sent a letter to FERC stating that we had no objection to the revised language and recommended its inclusion in any amendment issued for the Project.

On June 15, 2006, FERC issued an Order Amending License. While the Order did include a new article (419) stipulating a turbine aspiration system, it did not include a license article requiring GMP to undertake monitoring at the intake to the new unit (although it is referenced in the narrative of the Order). Due to staffing constraints, the Service was not able to provide comments on the Environmental Assessment or Order.

The turbine was installed and GMP submitted a Minimum Flow Turbine Aeration Study Plan for the VDEC's review and comment. By letter dated August 28, 2008, the VDEC provided comments on the plan to GMP, as well as support for GMP's request for an extension of time to perform the calibration testing (due to unusually high flows during the summer of 2008). GMP subsequently submitted a formal extension request with FERC and on September 25, 2008, FERC issued an Order Granting Extension of Time.

From that time up until now we have no further information in our files. We also did not find any additional filings related to the low flow turbine or fish passage facilities on FERC's Online E-Library for the period 2008 through 2015. Therefore, we do not know whether the calibration testing was ever conducted or if the river-left intake area was ever monitored.

Other Relevant Information

Outside of any FERC proceeding, a downstream fish passage study was conducted in the spring of 2014 by researchers from USGS-Leetown Science Center and Karlstad University (Sweden) in collaboration with the Service. This study is part of Daniel Nyquist's Ph.D. dissertation research at Karlstad University and results are currently in a draft manuscript form to be submitted for peer review publication in a scientific journal. Major findings from this research include:

Passage performance of n=40 smolts was evaluated during peak smolt outmigration (May 10 through June 9, 2014) via radio telemetry.

- 35% (n=14 fish) failed to pass the dam
- 32.5% (n=13 fish) utilized the downstream fish passage facility
- 17.5% (n=7) passed the dam via spill over the dam
- 15% (n=6) went through the turbines

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COMMENTS

Based on the information found during our review of the administrative record for this project, the Service has identified the following issues relevant to this LIHI consultation request:

Downstream Fish Passage

1. In November of 1997, GMP agreed to put 100 cfs through the downstream bypass and 50 cfs out of the flume. However, subsequent filings reference a 50 cfs bypass flow. In addition, GMP agreed to install a recirculation system so that they could pump back 50 cfs of the 100 cfs flow, but we have no documentation that this system was ever installed.
2. In November of 1997, GMP agreed to address a number of design issues with the downstream bypass system. Again, we lack documentation that any of those modifications were ever made.
3. The Service is on record as having opposed FERC's decision to not require additional monitoring/evaluation of the bypass facility after implementation of the improvements detailed in GMP's November 1997 correspondence. The most recent passage evaluation results (2014) suggest little to no improvement in passage rates through the bypass facility relative to previous investigations (Table 1); however, it is unclear if this is due to GMP not having implemented the requested modifications, GMP not releasing the agreed-to 100 cfs through the bypass facility, a combination of those two factors, or some as-yet unidentified issue.

Table 1. Results of smolt passage investigations at the Essex 19 Project. Values are the percent of radio-tagged smolts using each identified passage route.

Passage Route	Study Year		
	1996	1997	2014
Bypass	37.5	5.9	32.5
Turbine		32.3	15.0
Spillway		23.5	17.5
Failed to pass	62.5	38.2	35.0

Walleye Mortality Contingency Plan

We are not aware of the VDFW having triggered the need for development of this plan. We defer to VDFW regarding compliance with this requirement.

Trap and Truck Program

The New England Field Office has consulted with the Lake Champlain Fisheries Resources Office (LCFRO) regarding GMP's participation in the Winooski River Trap & Truck Program. It is our understanding that LCFRO staff are satisfied with the program and believe GMP to be in compliance with this requirement.

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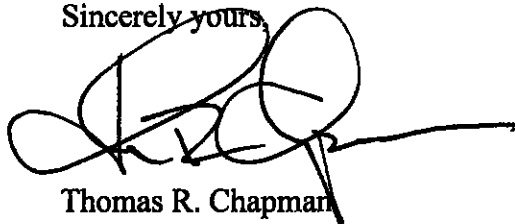
RECOMMENDATIONS

The Service recommends that any LIHI certification for the Essex 19 Project contain the following conditions:

- (1) GMP shall re-initiate consultation on the downstream bypass facility; Service engineers should assess which, if any, of the modifications agreed to in GMP's November 1997 letter have been implemented.
- (2) GMP shall verify through operations records that 100 cfs is being released into the bypass facility.
- (3) If any of the bypass modifications have not been implemented, GMP shall agree to implement them by the second spring downstream passage season after receiving LIHI certification.
- (4) If GMP has not been releasing 100 cfs into the bypass facility, it shall agree to do so every passage season during the term of its LIHI certification and shall maintain records sufficient to verify compliance with this requirement.
- (5) After implementing all of the measures above (which were previously agreed to by GMP, as documented in the administrative record), GMP shall commit to evaluating the bypass facility to verify that it is effective at passing outmigrating salmon smolts in a safe and timely manner. If study results continue to suggest low passage utilization, GMP shall commit to working with the agencies to identify impediments and to implement reasonable measures to address those impediments in an effort to increase bypass effectiveness.

We appreciate the opportunity to provide information relative to fish and wildlife issues in the Low Impact Hydropower Certification process and thank you for consulting with our office. If you have any questions, please contact Ms. Melissa Grader of this office at 413-548-8002, extension 8124.

Sincerely yours,

A handwritten signature in black ink, appearing to read 'T. Chapman', with a long horizontal line extending to the right.

Thomas R. Chapman
Supervisor
New England Field Office

Ms. Katie Sellers
February 5, 2016

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cc: Jon Soter
Green Mountain Power
163 Acorn Lane
Colchester, VT 05446-1949
VT DFW, Brian Chipman
VT DEC, Jeff Crocker
FWS-LCFRO, Bill Ardren
FERC- Div. Of Hydropower Administration and Compliance
Reading file
ES: MGrader:2-5-16:413-548-8002

Email forwarded by Katie Sellers to PBM work@maine.rr.com on Tuesday, March 7, 2017 4:59 PM

Peter and Pat – Our latest communications with Vermont DEC regarding Vergennes and Essex 19 Project reviews is included below for your inclusion in application reviews.

Best,
Katie

Katie Sellers
Regulatory Coordinator

Office: 207-416-1218
www.KleinschmidtGroup.com

From: Katie Sellers
Sent: Tuesday, March 07, 2017 4:56 PM
To: 'Davis, Eric' <Eric.Davis@vermont.gov>
Cc: Crocker, Jeff <Jeff.Crocker@vermont.gov>; Andy Qua <Andy.Qua@KleinschmidtGroup.com>; Greenan, John (John.Greenan@greenmountainpower.com) <John.Greenan@greenmountainpower.com>; Jennifer Jones <Jennifer.Jones@KleinschmidtGroup.com>
Subject: RE: LIHI Certification - Request For Vermont DEC Feedback on Essex 19 and Vergennes

Hi Eric, Thanks for the follow-up on these reviews. Our answers to your questions regarding Vergennes and Essex 19 are included below in red.

At Vergennes, periods in which the flashboards were out during the time period provided.

GMP does not have specific 2014/2015 data available to depict when flashboards were out or being replaced at the plant.

At Essex 19, outflows from the Bolton Falls project for the time period provided. The refinements to the flow monitoring plan (2001) state than an estimate of outflow from the Bolton Falls project is included in the project operating system. This data will be essential to verifying r-o-r ops when required and useful for peaking operations during low flow periods.

Kleinschmidt attempted to formulate some type of relationship between the Bolton Falls generation and headpond level data, provided by GMP, to determine the outflow data, as requested. An hourly energy model was set up using excel to back calculate the instantaneous flow releases downstream. The results of the model did not seem to be very accurate because broad assumptions were made on the efficiency, tailwater elevation, rubber dam configuration (inflatable crest sits atop a long, uneven dam), and general headloss. The calculated flow values were also very sporadic, only accounting for the times that showed generation values and didn't consider any spillway flows.

We have made a good faith effort to model it now, but it is currently impracticable to do so. We will look to address this issue within the forthcoming Bolton Falls Project licensing process (i.e. flow management plan).

Best,
Katie

Katie Sellers
Regulatory Coordinator

Office: 207-416-1218
www.KleinschmidtGroup.com

Appendix C
Additional Information Submitted
by GMP 10/31/2018



2152 Post Road
Rutland, Vermont 05701

October 31, 2018

VIA EMAIL

Ms. Maryalice Fischer
Low Impact Hydropower Institute
PO Box 424
Strafford, NH 03384

Final Report – LIHI Pre-Certification Conditions
Essex 19 Hydroelectric Project

Dear Ms. Fischer:

Green Mountain Power Corporation (GMP), owner and operator of the Essex 19 Hydroelectric Project (FERC No. 2513) (Project), herein provides a final report detailing GMP's accomplishments and progress in completing the suite of pre-certification conditions set forth by the Low Impact Hydropower Institute (LIHI). GMP and its consultant, Kleinschmidt Associates (Kleinschmidt), have worked diligently and collaboratively with resource agencies throughout the pre-certification process. GMP believes its work, summarized below, meets the purpose and intent of the pre-certification conditions assigned to the Essex 19 Project. GMP therefore respectfully requests that LIHI issues Project certification for the Essex 19 Hydroelectric Project and assumes certification would be conditioned on supplemental reporting requirements as proposed herein.

BACKGROUND

On April 27, 2017 LIHI issued a letter stating that given the uncertainty and lack of definitive data needed to determine compliance with flow and fish passage standards at the Essex 19 Project, LIHI was unwilling to issue Project certification at that time. However, LIHI stated that if GMP could demonstrate that it has reached agreement with appropriate resource agencies over the issues raised in Vermont Department of Environmental Conservation's (VDEC) letter dated March 17, 2017, and that GMP has implemented appropriate solutions, then LIHI certification would be granted. LIHI committed to holding the Essex 19 Project application open for one year or until May 1, 2018. Per GMP letter dated April 30, 2018 and LIHI letter dated May 29, 2018, GMP was granted an extension of time, until November 1, 2018, to further implement pre-certification measures.

The pre-application conditions set forth in VDEC's March 17, 2017 letter include the following:

Downstream Fish Passage

1. GMP shall re-initiate consultation on the downstream bypass facility with Vermont Department of Fish and Wildlife and U.S. Fish and Wildlife Service. GMP shall identify any modifications needed to conform with prior resource agency recommendations and develop a schedule for implementation.
2. GMP, in consultation with Vermont Department and Fish and Wildlife and U.S. Fish and Wildlife Service, shall evaluate the performance bypass facility to verify that downstream passage is safe and effective. Results of this evaluation shall be provided to LIHI. If results of this evaluation indicate issues with safety [i.e., safe passage of downstream migrating fish] or effectiveness, GMP shall commit to working with the agencies to identify reasonable measures to increase safety and effectiveness and shall document these efforts with an annual report to LIHI.

Flows

1. GMP shall review the flow monitoring procedures at the Essex 19 project and assess compliance with the approved flow monitoring plan including the refinements identified in GMP's 2000 refinement plan. In consultation with VDEC, GMP shall establish a plan for implementing modifications required under the approved plan and submit this plan to LIHI.
2. GMP shall conduct a review of run-of-river operations at the Essex 19 project and determine if additional modifications are needed to ensure compliance with LIHI criteria. In consultation with VDEC, GMP shall establish a plan for implementing any modifications identified and submit this plan to LIHI.

SUMMARY OF WORK

In response to VDEC and LIHI's pre-application conditions, GMP has completed the following at the Essex 19 Project:

Downstream Fish Passage

As described within the LIHI application, an initial site inspection was held with resource agencies on September 23, 2016 (after flow conditions during a May 2016 site visit proved to be too high for fishway inspection). In accordance with conditions found during the site visit, the U.S. Fish and Wildlife Service (USFWS), Vermont Fish and Wildlife Department (VTFW), and VDEC made the following recommendations for the Project's downstream fish passage facility:

1. Repair outboard-side downstream gate actuator/stem to ensure proper functioning.
2. Grind off/remove angle iron stub welded to downstream bypass entrance walls.
3. Re-seat and secure floor diffuser on downstream bypass supplementary water supply.
4. Ensure both gates operate in fully open/fully closed position (or modify the lip of the gate to approximate broad-crested weir geometry).
5. Repair bent turbine intake rack to meet 1" clear spacing requirements.

6. If necessary, installation of chute/floor for the slotted weir impounding plunge pool to ensure safe plunge.
7. Modify plunge pool and/or downstream chute to provide safe movement downstream.

GMP immediately addressed items 1-3 and 5, while items 4, 6, and 7 required further investigation or field investigation to determine the preferred solution.

To address items 6 and 7, GMP organized a field test to evaluate modifications to the plunge pool recommended during a conference call held with the USFWS, VTFW, VDEC, and Kleinschmidt on July 17, 2017. On August 22, 2017, USFWS, VTFW, VDEC, GMP, and Kleinschmidt met at the Essex 19 Project to test the modified plunge pool hydraulics. GMP inserted stop-logs in the plunge pool slotted weir to raise the level of the plunge pool water. Tomatoes were used as fish-surrogates and released down the fish passage to test for injury. The results of the field testing indicated that raising the plunge pool level could be effective in reducing injury to fish. However, the transition from the plunge pool downstream (at the slotted weir) needed modification to provide safe passage to the river below (see Attachment A for a summary of the field test). Within a USFWS letter dated November 17, 2017 and provided to GMP by VDEC on January 2, 2018, agencies recommended the following Project modifications to enhance safe passage from the plunge pool (Attachment B):

1. Maintain plunge pool level at elevated weir height (approximate top of wall, 227.25 ft USGS).
2. Remove rock obstructions immediately below plunge slide and in front of the weir.
3. Install bell-mouthed/broad-crested weir in place of plugged slotted weir. The Service advised that GMP should determine the proper slot width by means of building a temporary weir. The proper slot width should ensure the appropriate backwater in the plunge pool at the required discharge of 100 cfs.

Additionally, prior to the Essex 19 field test, Kleinschmidt provided resource agencies with an August 21, 2017 memo in response to item 4 on the original recommendations list (Attachment C). The purpose of this memo was to provide a review on how often the Essex 19 Project typically has the ability to pass the required 100 cfs for fish passage through one fully open gate during downstream fish passage season. The USFWS' November 17, 2017 letter additionally responded to item 4. In agreement with GMP's August 21, 2017 memo, it was determined that the ability of the fish entrance gates to pass the 100 cfs is dependent on pond elevation and gate position. At a pond elevation of 274.5 feet, one fully open gate will pass the required 100 cfs. The USFWS therefore recommended the following in the November 17 letter:

1. At a pond level of equal or greater than 274.5 ft, one fully open gate can be utilized for the downstream fish passage.
2. At pond levels less than 274.5 ft, one gate must be fully open and the second gate partially open to provide the full 100 cfs. The partially open gate must be modified to present a broad-crested lip to entering fish.

The November 17th letter also recommended that GMP prepare, in consultation with the USFWS and VTFW, a standard operating procedure (SOP) document for operation of the downstream fish passage facility.

A final recommendation included within the November 17, 2017 letter, requested that once all modifications are made to the downstream fish passage structure and operating procedures, that GMP verify the effectiveness of the system either before or during the upcoming FERC relicensing process.

In an email dated April 11, 2018 (Attachment D), Kleinschmidt, on GMP's behalf, committed to installing a temporary bell-mouthed/broad-crested weir as recommended in the USFWS letter and in accordance with the provided Alternative No. 1 design. GMP installed the temporary enhancements in July 2018 while repairing the Essex 19 rubber dam system (Photo 1 & 2, Attachment D).



PHOTO 1 TEMPORARY BROAD-CRESTED WEIR (DEWATERED POST CONSTRUCTION)



PHOTO 2 TEMPORARY BROAD CRESTED WEIR (IN OPERATION)

On August 7, 2018, the USFWS and VTFW participated in FERC's environmental inspection of the Essex 19 Project. Agencies had a chance to review the temporary weir arrangement during that time and were supportive of the results of the temporary weir configuration (Attachment D). Per email dated August 10, 2018, the USFWS provided a review of the temporary weir configuration and committed to providing revised sketches for a permanent weir configuration (Attachment D). Revised weir recommendations and sketches were provided to GMP on September 14, 2018 (Attachment D). These updated recommendations supersede previous recommendations included within the USFWS's November 2017 letter.

On October 17, 2018 GMP committed to installing the permanent weir enhancement, specifically the fabricated metal insert option, and is currently working with resource agencies to finalize design dimensions and minimum material characteristics (Attachment D). GMP and agencies have worked collaboratively to complete final designs for GMP to attain formal approval for the weir and plunge pool improvements, however, it has taken longer to finalize some critical design details than originally anticipated. As such, construction could not occur prior to field conditions becoming a limiting factor for 2018 (Attachment D), so GMP will complete final modification as soon as safe access conditions and temperatures needed to install certain material components (e.g., grout placement and curing) occur in the 2019 construction season. Once the weir modification is installed, GMP will work with agencies regarding the potential alteration of rocks downstream.

A draft Essex 19 Fish Passage Facility SOP document was provided to resource agencies for review on April 30, 2018 (Attachment D). The SOP document is intended to fulfill all requirements/requests related to operation of the fishway gates. Resource agencies provided their review and feedback of the SOP on September 13, 2018, via a USFWS letter dated July 27, 2018

(Attachment D). Within the September 13 letter, agencies jointly recommended that GMP formally amend the downstream spring fish passage season from April 1 – June 15 to April 15 – June 30. This request was made in light of Atlantic salmon smolt out-migration data collected pursuant to studies conducted on the upstream Huntington River¹. Agencies recommended that these changes also be implemented at GMP’s downstream Gorge 18 plant and be amended within the FERC approved fish passage plan and include the SOP within that plan.

In an email dated October 22, 2018, GMP agreed to implementing the shift in the downstream passage timeframe at both Essex 19 and at the downstream Gorge 18 facility (Attachment D). GMP is currently working towards filing the SOP and shift in fish passage timing and associated consultation with FERC.

To verify final effectiveness of the elevated plunge pool and permanently altered weir, GMP is open to working with resource agencies to test the effectiveness of these modifications during the upcoming relicensing process. GMP intends to file a Notice of Intent (NOI) and Pre-Application Document (PAD) with FERC no later than February 28, 2020. GMP anticipates that an appropriate scope and methodology for testing will be developed within the process and study scoping procedures within the FERC licensing process.

Flows

GMP reviewed run-of-river operations and compared the operations data with that of the upstream Bolton Falls Project (FERC No. 2879) outflows. The review found that the Project’s seasonal run-of-river operations were depicted well with incorporation of the Bolton Falls inflow data. Kleinschmidt, on behalf of GMP, provided VDEC with Essex 19 Project operations data with Bolton Falls inflows incorporated on March 29, 2018 for review of run-of-river compliance (Attachment E). On September 6, 2018 VDEC provided a review as well as questions on Essex 19 operations during the 2014-2015 timeframe presented in the operations data (Attachment E). In an October 8, 2018 memo, GMP provided answers to VDEC’s questions regarding project operations (Attachment E). The answers were developed by reviewing GMP’s Control Center operation logs and Power Production Worker (plant operator) logs. A majority of the questions regarding operations stemmed from a time period when work was taking place at the downstream Gorge 18 facility. Pinpointed times of operational changes at Essex 19 were due to managing impoundment levels at the Project to ensure safe construction conditions at Gorge 18.

VDEC is currently reviewing GMP’s October 8, 2018 memorandum. In accordance with discussions with VDEC, conclusions on Essex 19 operations may result in revisions to the Project operations plan (Condition 1). GMP is collaboratively working with VDEC through the operations review process first which will directly influence how next steps should be addressed. Additionally, GMP recently replaced two of three inflatable crests at the dam and is currently commissioning/troubleshooting crest operations. Any refinements of Essex 19 operations and protocols will be reviewed with VDEC and meet the requirements of Condition 1. GMP also continues to work on the control and operation of the minimum flow turbine for the project. GMP believes the turbine provides an opportunity to improve both production and compliance.

¹ The Huntington River is a tributary to the Winooski River, located upstream of the Essex 19 Project.

CONCLUSIONS

Throughout the pre-certification process, consultation has resulted in adaptive modifications to fish passage and operational procedures at Essex 19. GMP believes that the progress made at Essex 19 over the last year and a half has been marked and successful in achieving the intent of the pre-certification conditions. GMP understands there are still four outstanding needs to finalize, but also notes there is some practicality in resolving certain components in the context of the upcoming relicensing process for the Project. In an email dated October 30, 2018, GMP summarized the above stated information with VDEC and asked for VDEC's support of LIHI Certification based on the following proposed conditions (Attachment F):

1. GMP will complete installation of the permanent weir enhancement in the 2019 construction season and will notify agencies upon completion. GMP will work with agencies to determine if any rocks can be altered or moved in 2019 to help enhance flows over the weir once the weir enhancements are complete.
2. During the upcoming relicensing process, GMP will work with resource agencies to test the effectiveness of the fully modified plunge pool and weir set-up.
3. GMP will complete SOP and amended spring passage timing consultation with FERC.
4. GMP will continue to work collaboratively with VDEC to determine next steps for operations monitoring or reporting at the facility and potentially incorporating future monitoring into the relicensing through formalizing an updated operations compliance plan with FERC.

GMP believes the work put into the Essex 19 pre-certification conditions exceeds the intent of LIHI's requirements and that LIHI Certification of the Essex 19 Project is now appropriate. LIHI Certification will improve GMP's ability to continue to work collaboratively with resource agencies on fish passage and operational improvements in advance of the relicensing process. Should you have any questions regarding this summary of work, please contact me at 802.770.2195 or at john.greenan@greenmountainpower.com.

Sincerely,

John Greenan

Digitally signed by John Greenan
DN: cn=John Greenan, o=Green Mountain
Power, ou,
email=john.greenan@greenmountainpower
.com, c=US
Date: 2018.10.31 15:30:09 -0400

John Greenan, P.E.

Environmental Engineer

Enclosures: Attachment A – August 22, 2017 Essex 19 Site Visit Summary
Attachment B – USFWS November 17, 2017 Letter
Attachment C – August 21, 2017 Gate Operation Memo
Attachment D – GMP and Agency Consultation Emails on Fish Passage
Attachment E – Essex 19 Operations Data
Attachment F – VDEC Final LIHI Consultation

cc: Katie Sellers (Kleinschmidt)
Andy Qua (Kleinschmidt)

ATTACHMENT A

AUGUST 22, 2017 ESSEX 19 SITE VISIT SUMMARY

MEETING SUMMARY

GREEN MOUNTAIN POWER ESSEX 19 SITE VISIT

ATTENDEES: Bill Arden – USFWS
Brett Towler - USFWS
Jessica Pica - USFWS
Brian Chipman - VTFWD
Pete McHugh - VTFWD
Eric Davis - VTDEC
Katie Sellers - Kleinschmidt
Brandon Kulik - Kleinschmidt
Kevin White - GMP
Robert Young - GMP
Craig Lavilette - GMP
Jason Lisai - GMP
John Greenan – GMP

DATE: August 22, 2017

INTRODUCTION

In accordance with the Essex 19 application for Low Impact Hydropower Institute (LIHI) Certification, Green Mountain Power (GMP) and its consultant, Kleinschmidt Associates (Kleinschmidt), have been undergoing downstream fish passage consultation with the U.S. Fish and Wildlife Service (USFWS), Vermont Fish and Wildlife Department (VTFWD), and Vermont Department of Environmental Conservation (VTDEC). Among agency goals for safe and effective downstream fish passage is improvement of the Essex 19 plunge pool conditions.

Under original plunge pool conditions, a flow of 100 cubic feet per second (cfs) (required during fish passage seasons) exited the downstream fishway and projected across the surface of the plunge pool. Plunge pool depth is controlled by a concrete weir at the outlet of the pool. The weir has a vertical slot to focus pool and fish discharge so that they enter a downstream pool to continue migrating. At the controlling depth, fishway discharge energy was maintained all the way to the bedrock wall on the far side of the pool, as shown in Photo 1. Agency staff expressed concern that some fish could be injured if they were to collide with the bedrock.



PHOTO 1 FLOW OF APPROXIMATELY 100 CFS DISCHARGED FROM DOWNSTREAM FISHWAY UNDER ORIGINAL PLUNGE POOL CONDITIONS

GMP, USFWS, VTFW, and VTDEC agreed upon temporarily raising the water elevation of the plunge pool as a possible solution for reducing potential for injuries. This would be accomplished prior to an August 22 site visit by plugging the slot in the downstream weir, to raise the pool depth and set conditions to check if the raised water level better absorbs the discharge flow and could reduce injury potential. GMP and agencies agreed to test the temporarily modified plunge pool conditions with a fish surrogate (soft fruit) to gain a basic understanding on how fish passage injury may be improved.

Prior to field testing, GMP temporarily plugged the downstream weir with the use of wooden stop logs. Installation of the stop logs raised the level of the plunge pool by approximately 2 feet.



PHOTO 2 ORIGINAL DOWNSTREAM WEIR CONDITION (DE-WATERED)



PHOTO 3 DOWNSTREAM WEIR PLUGGED TO TEMPORARILY RAISE PLUNGE POOL ELEVATION (DE-WATERED)

SITE VISIT METHODS AND RESULTS

On August 22, 2017, USFWS, VTFW, VTDEC, GMP, and Kleinschmidt met at Essex 19 to test the modified plunge pool hydraulics.

Prior to the start of field testing, the downstream fishway gate located closest to the intake was set to a fully open position and a flow of approximately 100 cfs was provided through the downstream fishway. The headpond level was set at an elevation of 274.4 feet so to provide a continuous flow of approximately 100 cfs throughout the duration of field testing. Two units plus the minimum flow unit were operated during the test. River discharge¹ as measured at the downstream gage ranged from 690 cfs to 755 cfs and averaged 720 cfs for the duration of the testing. It was observed that the deeper pool submerged the fishway flume outlet and absorbed some of the hydraulic energy, whereas at the lower pool (original configuration), the outlet was above the pool surface and discharge skimmed across the surface unabated.

Kleinschmidt had previously tested a range of fish-surrogate objects ranging from balloons to different kinds of fruit, and Brandon Kulik recommended that tomatoes be used as they approximated the density of a fish, were not excessively buoyant, and had a fragile skin that would easily exhibit scrapes, gashes, or bruising upon contact with rough surfaces. Brett Towler concurred. Fifty tomatoes were released into the upstream end of the downstream fishway at 5-second intervals (Photo 5) and then retrieved from the plunge pool and in immediate downstream areas by Kleinschmidt, GMP, and VTFW staff using long handled dipnets. All recovered tomatoes were examined for evidence of bruising or damage.

¹ Provisional data from U.S. Geological Society (USGS), subject to revision.



PHOTO 4 DOWNSTREAM FISHWAY DISCHARGE AT APPROXIMATELY 100 CFS WITH ELEVATED POOL (COURTESY OF VTFW)



PHOTO 5 TEST OBJECTS (TOMATOES)

The group gathered to observe the recorded objects and discuss the findings. Most tomatoes were observed to eddy out of the discharge plume about mid pool; the plume energy appears to lessen about 2/3 of the distance across the pool whereas at the lower pool elevation the plume had continued all the way across the pool. No tomatoes were observed to collide with the bedrock wall of the pool. Eighteen tomatoes were recovered, while the remainder of the tomatoes passed downstream and out of reach of long handled nets. Ten of the recovered tomatoes had minor scrape marks and were otherwise relatively clean of other markings or “injuries.” These marks were scrapes that did not appear to be caused by collision with bedrock. Eight tomatoes recirculated in the pool eddies with debris and had bumped repeatedly against objects prior to being netted. These were eventually recovered later in the study period and were observed to have floated around within plunge pool currents and to have hit varying objects and shorelines without control, likely leading to their increased injury count. Tomatoes promptly retrieved after

downstream passage were clean of injuries, while tomatoes recovered later in the test or after fishway flow had been shut off (for safety purposes) displayed more injuries.

An additional five tomatoes recovered from below the modified downstream weir were not included within the recovery number. These tomatoes experienced clear impact injuries. Pete McHugh was collecting these objects and stated that these injuries likely occurred after they exited the plunge pool and were a result of landing on downstream rocks before he could retrieve them. This was because the temporary modified weir had a dispersing flow that allowed the objects to scatter laterally as they floated over the weir and missed the plunge pool downstream of the weir.

The group also moved downstream to observe the flow exiting the modified weir at both an approximate 100-cfs and a 50-cfs fishway discharge. It was observed that 100 cfs submerged boulders and created a better cushion for fish passing the weir than that which existed at 50 cfs.



PHOTO 6 FLOW EXITING THE MODIFIED WEIR AT APPROXIMATELY 100 CFS FISHWAY DISCHARGE (COURTESY OF VTFW)

CONCLUSIONS

Attendees concluded that the raised plunge pool water level improved hydraulics for entry of downstream migrants. The modified hydraulics dissipates the discharge energy and provides a hydraulic pillow for fish enter. GMP and resource agencies agreed that a permanent downstream weir plug that raises the pool level as a permanent measure would adequately resolve this issue.

To address the rough exit from the plunge pool and over the plugged weir, agencies recommended the implementation of a bell-mouthed/broad-crested weir that would direct fish into the next pool downstream and away from surrounding rocks and ledge. Before a permanent

broad-crested weir set-up is designed and implemented at the site, GMP agreed to adjust some rocks and smaller boulders in front of the weir to help channel water over the weir in the interim.

ACTION ITEMS

-GMP to work with Kleinschmidt to develop bell-mouthed/broad-crested weir design for the now plugged downstream weir.

-GMP to adjust some rocks and smaller boulders in front of the weir to help channel water over the weir.

-USFWS and Vermont Agency of Natural Resources (VANR) to provide final recommendations for plunge pool improvements.

ATTACHMENT B

USFWS NOVEMBER 17, 2017 LETTER



United States Department of the Interior



FISH AND WILDLIFE SERVICE

Lake Champlain Fish and Wildlife

Conservation Office

11 Lincoln St.

Essex Junction, VT 05452

Phone: (802)872-0629

Fax: (802)872-9704

Date: November 17, 2017

To: Eric Davis, Vermont Department of Environmental Conservation, Watershed Management Division

From: William Ardren, Senior Fish Biologist, U.S. Fish and Wildlife Service, Lake Champlain Fish and Wildlife Conservation Office

CC: Melissa Grader; Brett Towler; Nicholas Staats; Andrew Milliken – U.S. Fish and Wildlife Service; Brian Chipman, Bernie Pientka, Peter McHugh – Vermont Fish and Wildlife Department

Re: Essex 19 downstream fish passage

The U.S. Fish and Wildlife Service (Service) has been consulting with Green Mountain Power (GMP) and its consultant, Kleinschmidt Associates regarding the application for Low Impact Hydropower Institute (LIHI) Certification for Essex 19 dam. After the initial site visit on September 23, 2016 and subsequent conference calls, GMP made some recommended repairs, temporary modifications to the plunge pool, and conducted field testing of the downstream fish passage systems. The field testing was conducted on August 22, 2017 and staff from the Service and Vermont Fish and Wildlife Department were present to observe and assist. GMP (via Kleinschmidt) prepared a summary report of the testing and provided the report to the Service for review.

This memorandum summarizes the Service's initial recommendations, GMP's subsequent actions and review of the field testing and recommends additional improvements to the downstream fish passage facility at Essex 19.

September 23, 2016 Initial Inspection

The Service made the following recommendations to GMP after initial inspection of the facility:
Item/Action

1. Repair Outboard-side Downstream Gate Actuator/Stem to Ensure Proper Functioning
2. Grind Off/Remove Angle Iron Stub Welded to Downstream Bypass Entrance Walls
3. Re-Seat and Secure Floor Diffuser on Downstream Bypass Supplementary Water Supply
4. Ensure Both Gates Operate in Fully Open/Fully Closed Position (or modify the lip of the gate to approximate broad-crested weir geometry)

5. Repair Bent Turbine Intake Rack to Meet 1" Clear Spacing Requirements
6. Slotted Weir Impounding Plunge Pool May Require Chute/Floor to Ensure Safe Plunge
7. Modify Plunge Pool and/or Downstream Chute to Provide Safe Movement Downstream

Items 1-3 and 5 have been addressed. Items 4, 6 and 7 needed further investigation (field testing) to find the best solution.

August 22, 2017 Field Test

To address items 6 and 7, GMP conducted field tests to evaluate modifications to the plunge pool. GMP inserted stop-logs in the plunge pool slotted weir to raise the level of the plunge pool water. Tomatoes were used as fish-surrogates and released down the fish passage to test for injury. The results of the testing indicated that raising the plunge pool level could be effective in reducing injury to fish. However, the transition from the plunge pool downstream (at the slotted weir) needs to be modified to provide safe passage to the river below. Thus, the Service recommends:

1. Maintain plunge pool level at elevated weir height (approximate top of wall, 227.25 ft USGS).
2. Remove rock obstructions immediately below plunge slide and in front of weir.
3. Install bell-mouthed/broad-crested weir in place of plugged slotted weir. The Service advises that GMP should determine the proper slot width by means of building a temporary weir. The proper slot width should ensure the appropriate backwater in the plunge pool at the required discharge of 100 cfs (see Essex 19 DS weir modification attachment).

Item 4. Ensure Both Gates Operate in Fully Open/Fully Closed Position

GMP is required to pass 100 cfs through the fish passage entrance gate(s). The ability to pass this amount of flow is dependent on pond elevation and gate position. At pond elevation of 274.5 ft, one fully open gate will pass the required 100 cfs. The Service does not recommend operating these gates partially opened because they present a sharp-crested weir which does not promote fish passage. Therefore, the Service recommends:

1. At a pond level of equal or greater than 274.5 ft, one fully open gate can be utilized for the downstream fish passage.
2. At pond levels less than 274.5 ft, one gate must be fully open and the second gate partially open to provide the full 100 cfs. The partially open gate must be modified to present a broad-crested lip to entering fish.

Fish Passage Operational Procedures

The Service recommends that GMP prepare standard operating procedures (SOP) for the downstream fish passage facility. The SOP should be developed in consultation with the Service and Vermont Fish and Wildlife Department district fish biologists. The SOP should include the following:

1. Dates of operation
2. Procedures for operation
 - a. Gate operation
 - b. Bladder operation
3. Contact information

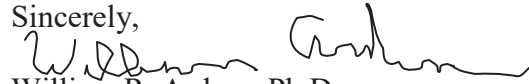
Research/study plans

Once all modifications are made to the downstream fish passage structure and operating procedures, GMP will need to verify the effectiveness of the system. We recommend pursuing downstream passage effectiveness studies, similar to Nyqvist et al. (2017), through LIHI first and if that is not successful, using the relicensing process - the project's FERC license is due to expire in 2025. The Service's Essex Junction, VT office would be available for consultation and/or collaboration on research designs for such a study.

Summary

This memo summarizes the status of downstream fish passage issues associated with the Essex 19 Hydropower Project. Please feel free to contact William Ardren at 802-662-5302 if you have any questions regarding this memorandum.

Sincerely,



William R. Ardren, Ph.D.

Senior Fisheries Biologist

William_Ardren@fws.gov

Attachments:

1. U.S. Fish and Wildlife Service Recommendation for Essex 19 DS weir modification.
2. Nyqvist, D., Greenberg, L.A., Goerig, E., Calles, O., Bergman, E., Ardren, W.R. and Castro Santos, T., 2017. Migratory delay leads to reduced passage success of Atlantic salmon smolts at a hydroelectric dam. *Ecology of Freshwater Fish*, 26(4), pp.707-718.

Essex 19 Hydroelectric Project

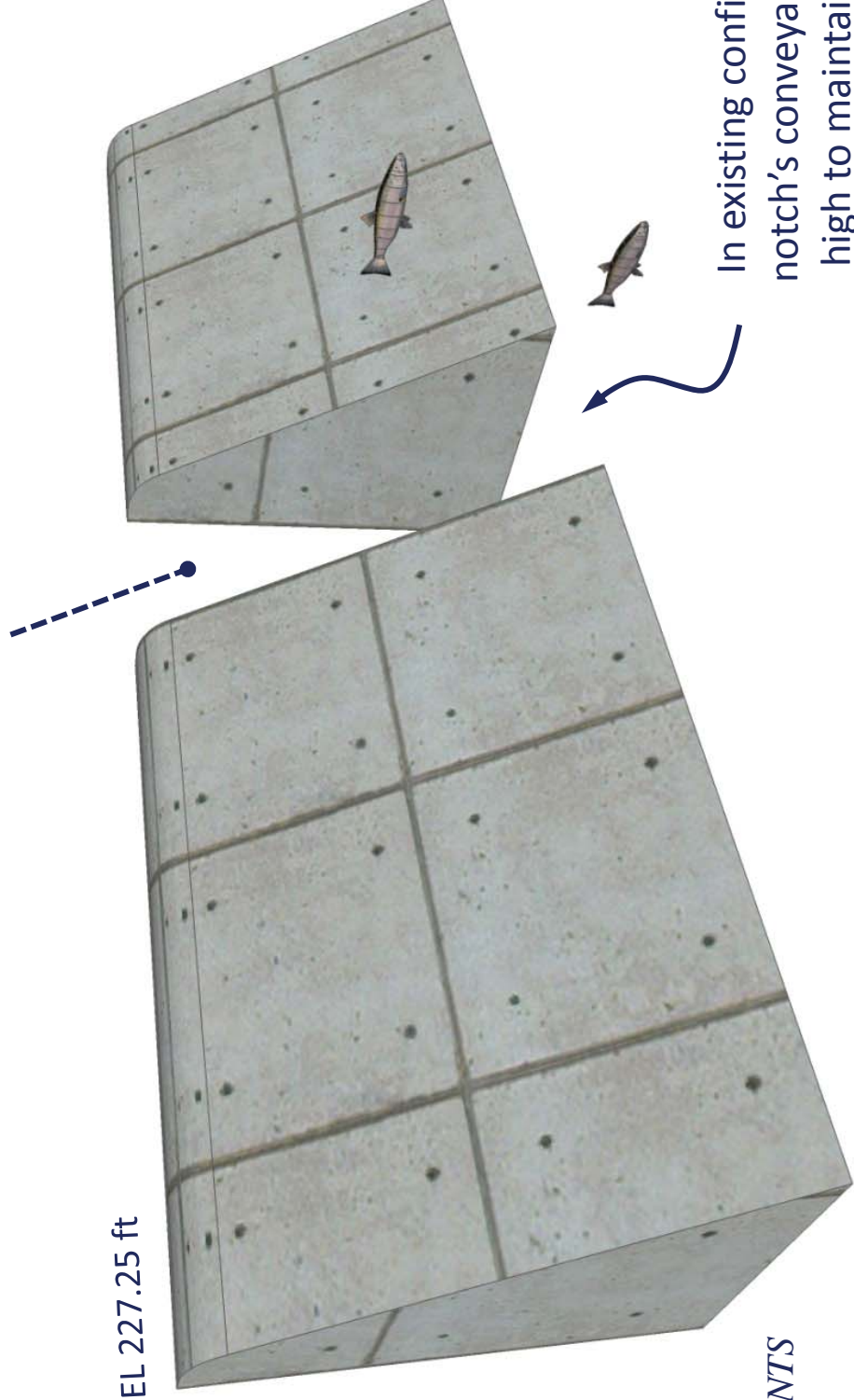
Recommended Modifications to Concrete Weir and Notch



B. Towler, USFWS, 11/3/2017

notch is 3 feet wide and
5.3 feet high (from sill to T.O.W.)

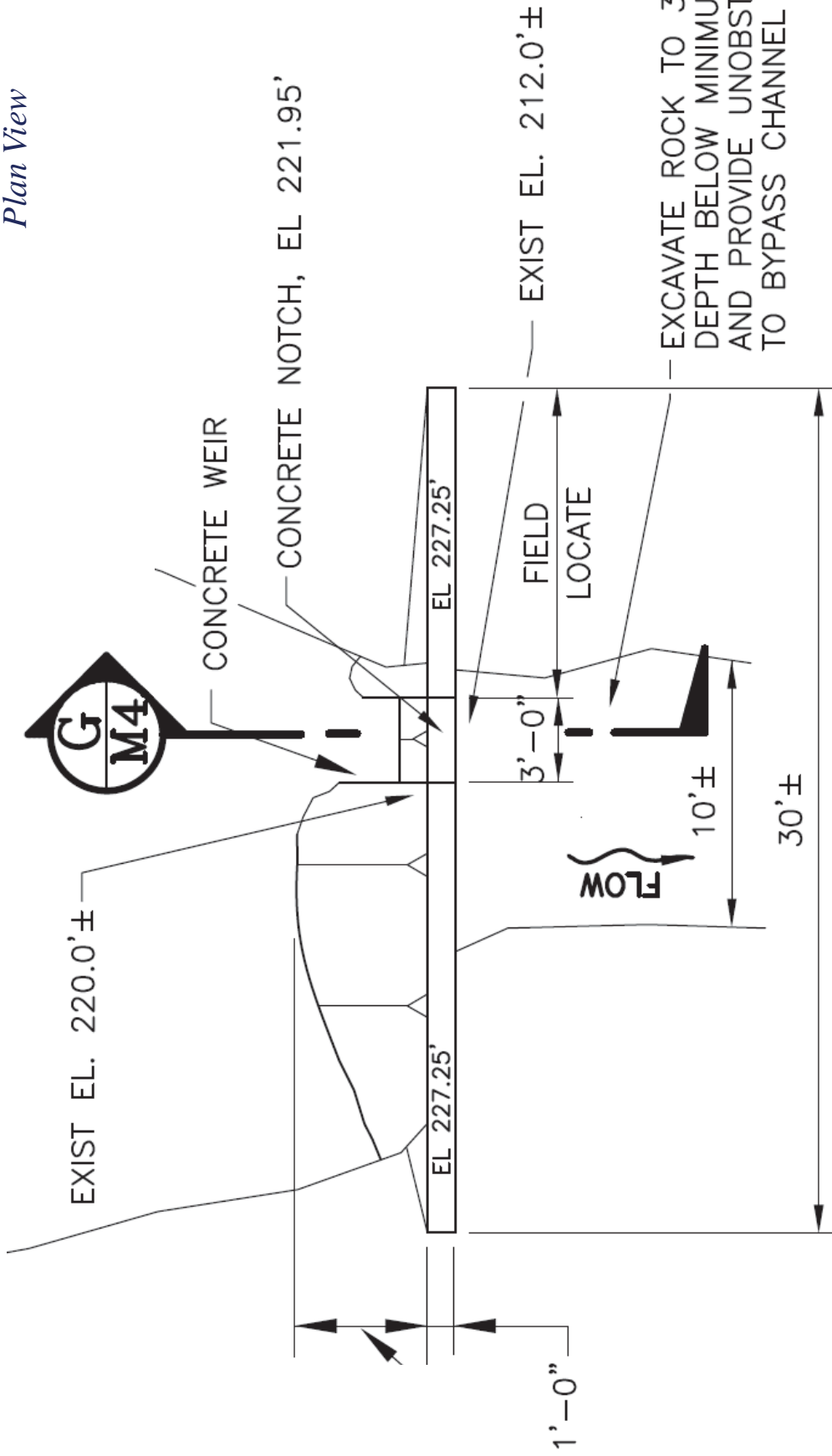
EL 227.25 ft



In existing configuration,
notch's conveyance is too
high to maintain plunge
pool at T.O.W.

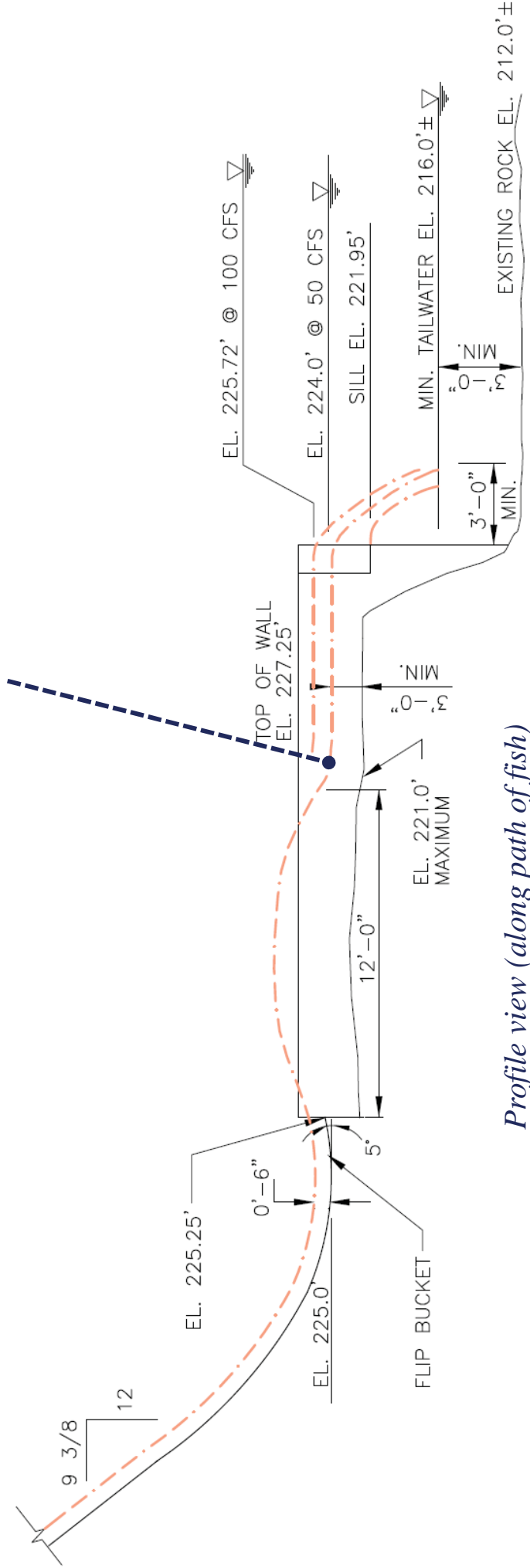
concrete weir view from the upstream plunge pool

Plan View



from Record Drawing D-2, 012-034-003 Kleinschmidt Assoc., 1/20/1995

Original plunge pool design called for a 3 foot deep pool. This is not consistent with current Service recommendations, see USFWS (2017) "Fish Passage Engineering Design Criteria" and, based on observations, a 3-foot-deep pool is insufficient to dampen the momentum in the jet exiting the bypass chute (at flip bucket) leading to jet impact against rock outcroppings on the southeast side of the plunge pool.



from Record Drawing D-4, 012-034-003 Kleinschmidt Assoc., 2/14/1995

Impoundment Stage v Bypass Gate Discharge

Essex 19 Weir #2 Downstream Fishway Entrance Gate				B. Towler, USFWS, 3/10/17				
Crest	269 (ft)	Fixed crest of Weir #2						
Width	3 (ft)	Lateral width of weir opening						
Length	7.5 (ft)	Long. length of weir #2 (approximate; scaled from drawings)						
		Long. Length of Weir (ft)						
		5	10	7.5				
WSE (ft USGS)	H _{weir} (ft)	C (-)		Q (cfs)	D _{app} (ft)	D _c (ft)	V _{app} (ft/s)	V _c (ft/s)
272	3	2.66	2.64	2.65	3.00	2.00	4.6	6.9
272.25	3.25	2.67	2.64	2.66	3.25	2.17	4.8	7.2
272.5	3.5	2.68	2.64	2.66	3.50	2.33	5.0	7.5
272.75	3.75	2.69	2.64	2.67	3.75	2.50	5.2	7.7
273	4	2.70	2.64	2.67	4.00	2.67	5.3	8.0
273.25	4.25	2.72	2.64	2.68	4.25	2.83	5.5	8.3
273.5	4.5	2.74	2.64	2.69	4.50	3.00	5.7	8.6
273.75	4.75	2.77	2.64	2.70	4.75	3.17	5.9	8.8
274	5	2.79	2.64	2.72	5.00	3.33	6.1	9.1
274.25	5.25	2.84	2.64	2.74	5.25	3.50	6.3	9.4
274.5	5.5	2.88	2.64	2.76	5.50	3.67	6.5	9.7
274.75	5.75	2.91	2.64	2.78	5.75	3.83	6.7	10.0
275	6	2.94	2.64	2.79	6.00	4.00	6.8	10.3

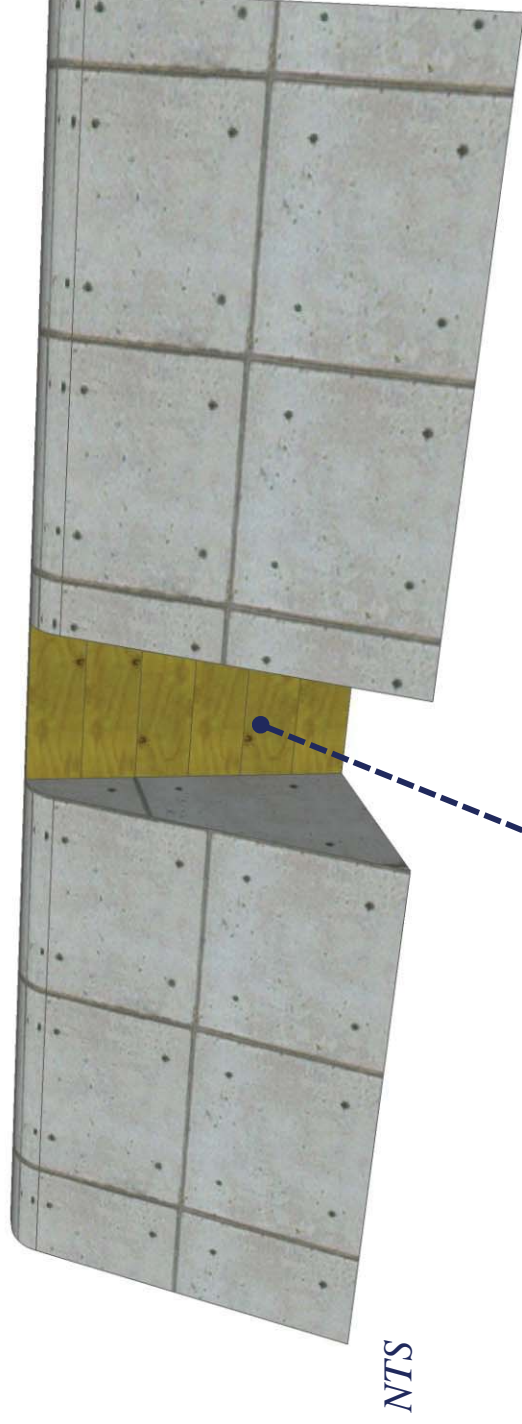
Variable	Definition
WSE	Water surface elevation of the impoundment
H _{weir}	head on the weir
C	Broad-crested weir coefficient (read and interpolated from "Weir Coeff" sheet)
Q	Discharge over weir
D _{app}	Depth of water in weir upon approach
D _c	Critical depth reached near end of weir
V _{app}	Velocity in weir upon approach
V _c	Critical Velocity reached near end of weir

With gate down, Weir #2 would operate as a broad-crested (BC) weir, not a sharp-crested (SC) weir. Generally, BC weirs produce lower discharges than SC for the same head (i.e., lower C values). For BC weirs, discharge is unaffected by submergence until downstream depth is > 50% head. Example, Tracy (1957) "Discharge Characteristics of Broad-Crested Weirs" pg. 11 indicates that submergence doesn't affect Q until downstream depth above crest is 85% of energy head. Service preference is to operate weirs in fully down position because BC weirs approximate UAWs (uniform acceleration weirs); gradual acceleration in UAW is more likely to capture smolts

Impoundment Stage v Bypass Gate Discharge

- Service calculations show that the head pond must be maintained at 274.4 ft USGS or higher to pass 100 cfs through a single bypass gate
- KA calculations (dated 10/25/2016) suggest 12% higher conveyance through the gate. At this time, we don't agree and recommend using our rating curve.
- If the pond is lowered below 274.4 ft USGS, an additional gate should be opened; preference is that this second gate is fully opened to promote entry into the bypass.
- This discharge through the bypass gate is balanced with the rating curve for the notch (and insert) to ensure adequate backwatering of the plunge pool.
- In current configuration (i.e., 3-foot open notch), the notch conveys too much water and creates unsafe, shallow plunge pool. Testing showed deeper pool dissipates energy/momentum in jet from the chute.
- To ensure the plunge pool is backwatered, Service recommends that the 3-foot wide concrete notch be contracted laterally. This will reduce conveyance while providing passage through the ensure depth of water.
- Temporary (inexpensive) timber solutions are offered: this will help calibrate desired slot width before a permanent installation is built. Initial width of slot should be 12" to 18" (contracted down from the current 3 ft wide notch).
- Permanent solution should be bell-mouthed and train the water to fall beyond the bedrock wall in the lower pool. Sketches of a permanent insert are offered.

On 8/22/2017, the Service and state agencies participated in a test with GMP and KA to determine if raising the water level would diminish the impact of the downstream bypass jet and enhance passage. Results of the hydraulic test (nominally at 100 cfs) and an evaluation of injury potential using a surrogate suggested that passage is enhanced if the plunge pool is maintained at the T.O.W. elevation of 227.25 ft.



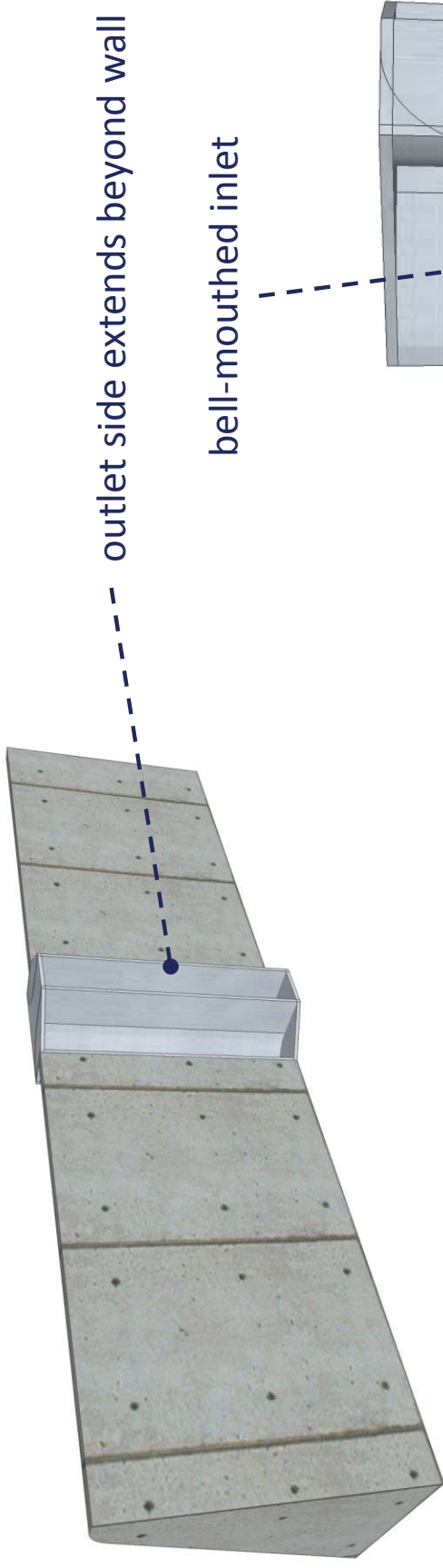
During testing, the pool was maintained by completely blocking the concrete notch with wooden boards. This is not a workable long-term fix because (as testing revealed) the increased height introduces additional injury hazard at the fall into the lower pool (downstream of the plunge pool). A long term fix must release less water but do so well below the T.O.W.

8/22/2017



- Concrete weir and notch from the downstream side
- Notch is blocked with boards to facilitate testing
 - No flow through the DS bypass

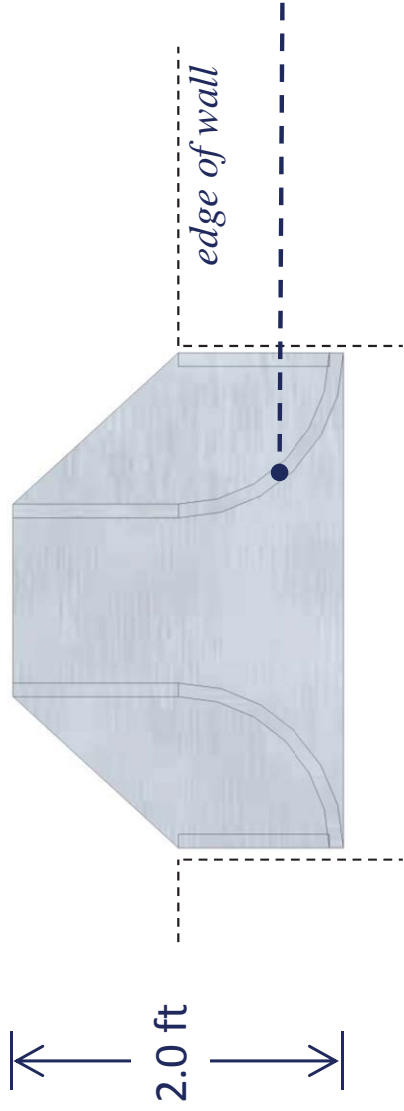
Recommended Permanent Solution: Bell-mouthed Vertical Slot Steel Insert



- 3 ft wide, 5.3 ft tall insert for concrete notch
- welded steel construction for year-round installation
- provides DS passage through full depth of water column
- restricts conveyance through notch, thereby backwatering plunge pool to 227.25 ft when 100 cfs is passed through bypass
- 1.0 foot wide opening suitable for salmon and smaller species
- bell-mouthed at inlet borrows from “uniform acceleration weir” concept; designed to eliminate rapid water accelerations created by sharp corners that lead to rejection behavior in DS migrating smolts
- Outlet side of insert extends 1.0” feet downstream of wall to train jet and ensure that water (and fish) do not impact bedrock below concrete wall



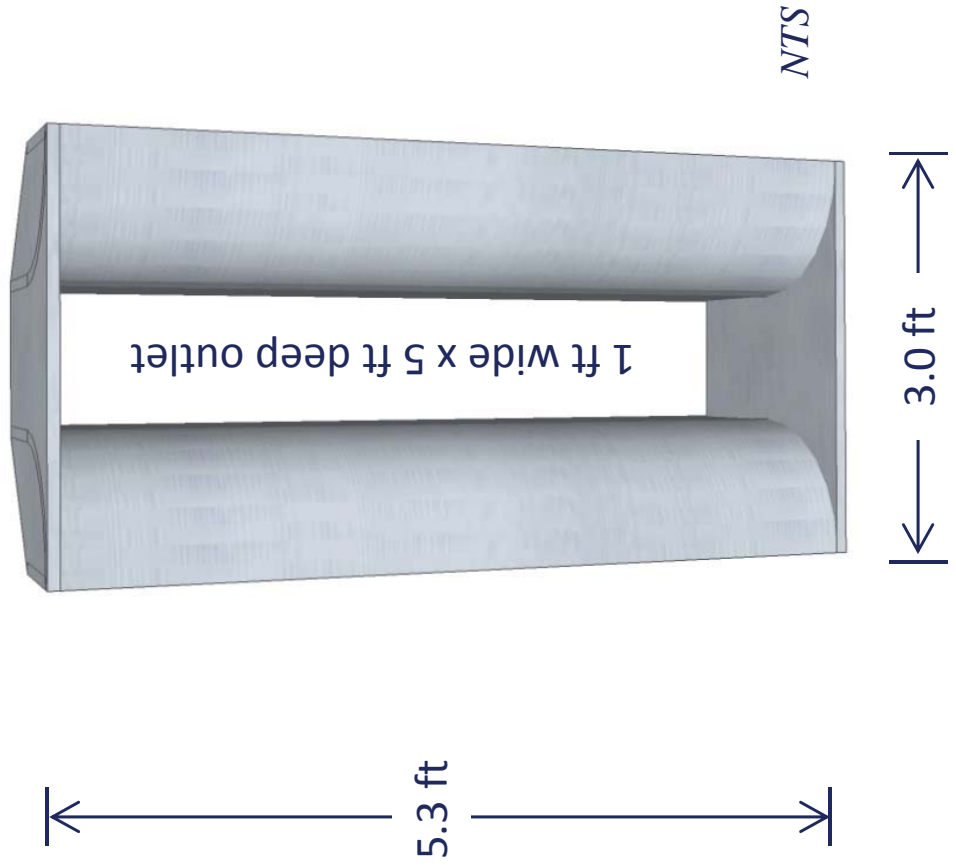
top view



outlet side extends beyond wall to train flow over bedrock

bell-mouth edges with radius of bend approximately 1.0 ft

front view

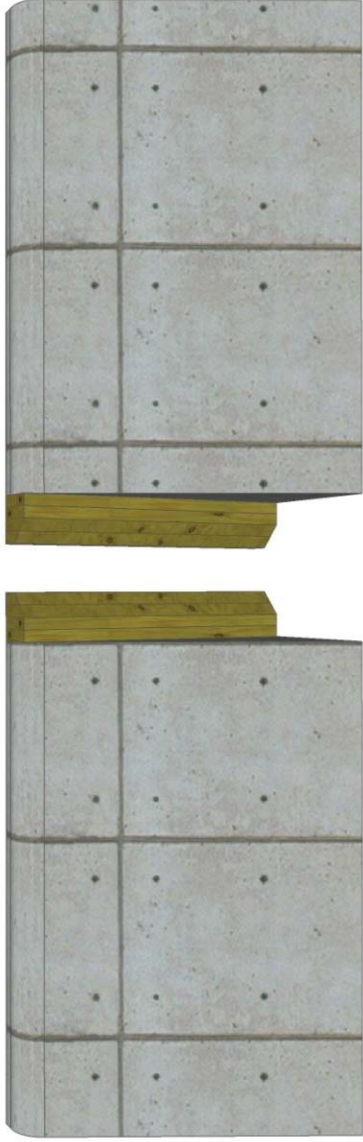


Steel insert could be attached to concrete wall via epoxied anchors

Outlet collects from the entire water column allow fish to escape plunge pool at depth (similar to original notch design)

Restricting the sides works to reduce conveyance and maintains backwatering in the plunge pool

Hydrodynamic shape projects nappe into lower pool (keeping water and fish off bedrock wall)



front view

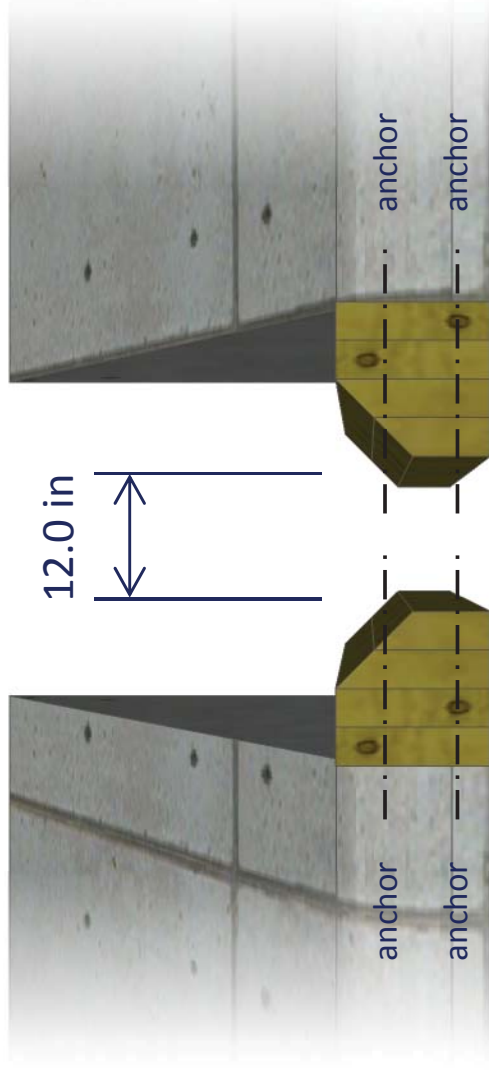


Recommended Temporary Solution:
Alternative 1

Mitered Timber Contracted Slot

Ideal temporary solution. Does not introduce a cross support into the flow. Unknown the condition of the concrete will support anchors (and timbers) under debris and ice loads.

Achieves a similar effect as bell-mouthed vertical slot steel insert by restricting conveyance



top view

Mitered timbers

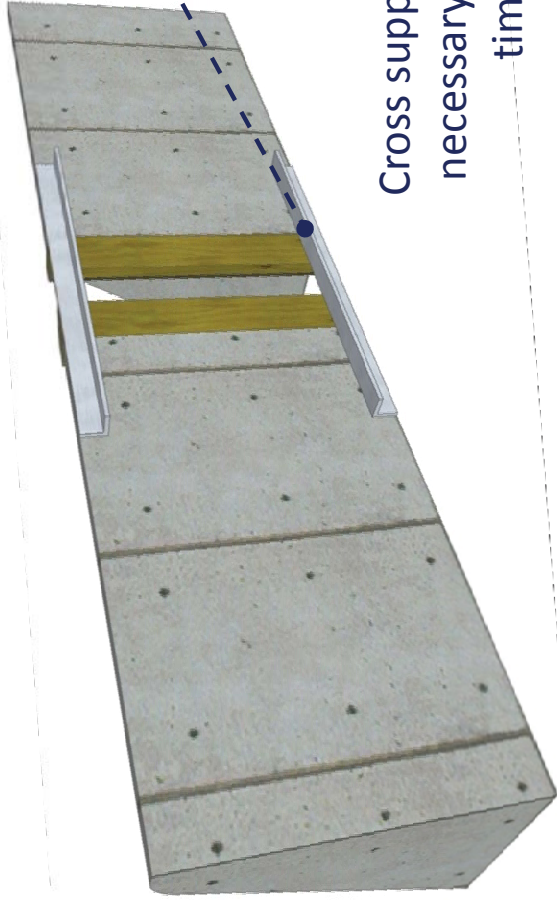
Built from a single rough cut 9" x 12" timber or composite of 4 rough cut 3" x 9"

Timbers are attached to the side walls of the notch using wedge anchors or epoxied anchors

edge of wall

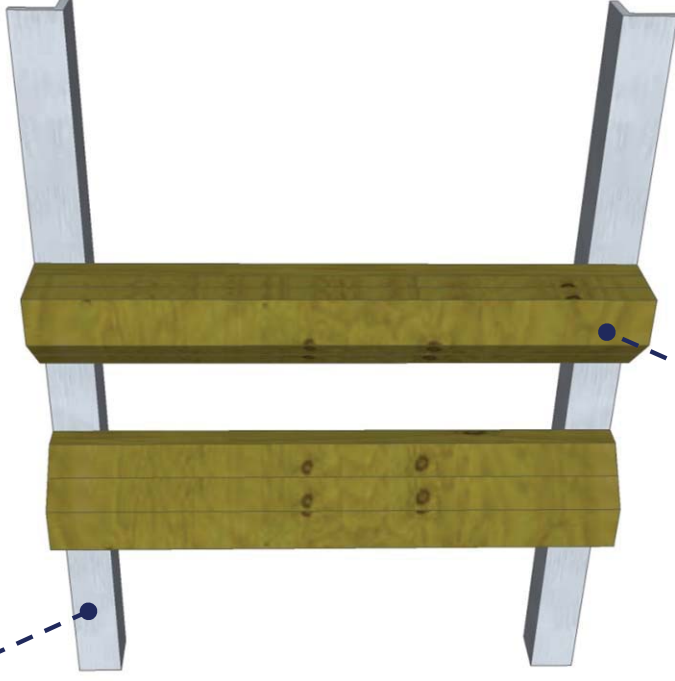
Recommended Temporary Solution:

Alternative 2, **Mitered Timber Contracted Slot with Cross Supports**



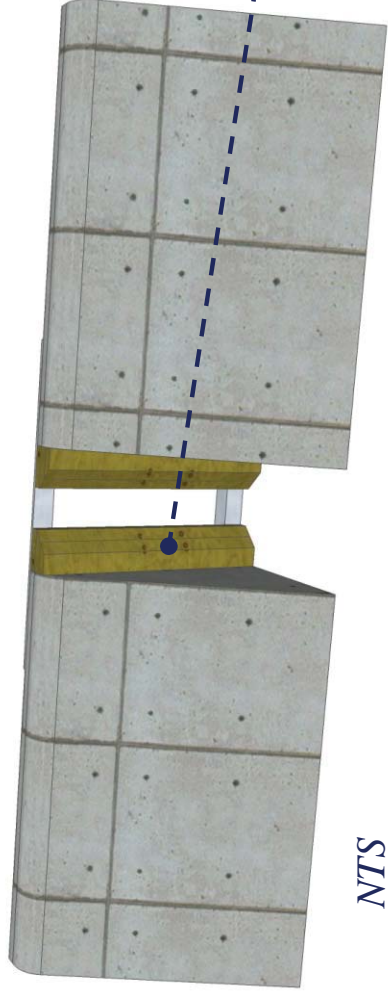
Steel cross-members provide support for timbers in notch

Cross supports may be necessary to support timbers.



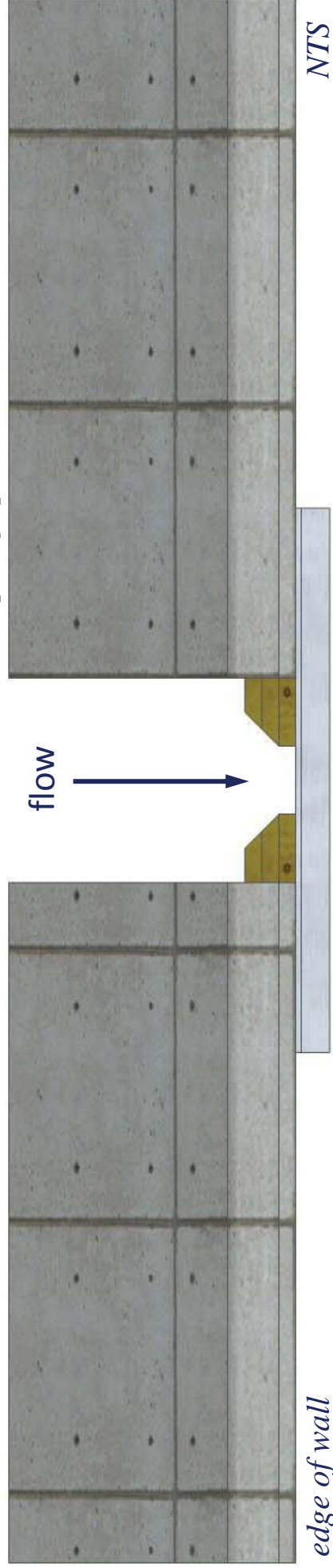
Timbers contract cross-section of notch

Achieves a similar effect as bell-mouthed vertical slot steel insert by restricting conveyance



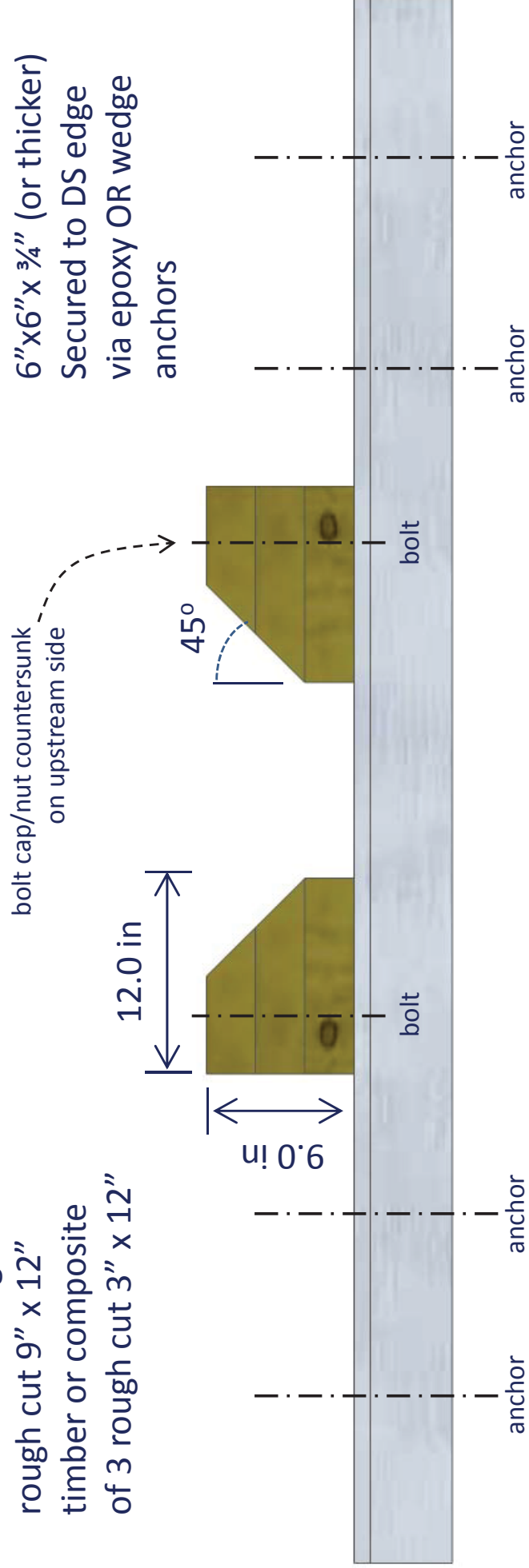
NTS

Recommended Temporary Solution: Alternative 2



Mitered timbers
Built from a single
rough cut 9" x 12"
timber or composite
of 3 rough cut 3" x 12"

Steel Cross Member
Galvanized A36 steel
6" x 6" x 3/4" (or thicker)
Secured to DS edge
via epoxy OR wedge
anchors



Migratory delay leads to reduced passage success of Atlantic salmon smolts at a hydroelectric dam

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Abstract

Passage of fish through hydropower dams is associated with mortality, delay, increased energy expenditure and migratory failure for migrating fish and the need for remedial measures for both upstream and downstream migration is widely recognised. A functional fish passage must ensure safe and timely passage routes that a substantial portion of migrating fish will use. Passage solutions must address not only the number or percentage of fish that successfully pass a barrier, but also the time it takes to pass. Here, we used radiotelemetry to study the functionality of a fish bypass for downstream-migrating wild-caught and hatchery-released Atlantic salmon smolts. We used time-to-event analysis to model the influence of fish characteristics and environmental variables on the rates of a series of events associated with dam passage. Among the modelled events were approach rate to the bypass entry zone, retention rates in both the forebay and the entry zone and passage rates. Despite repeated attempts, only 65% of the tagged fish present in the forebay passed the dam. Fish passed via the bypass (33%), via spill (18%) and via turbines (15%). Discharge was positively related to approach, passage and retention rates. We did not detect any differences between wild and hatchery fish. Even though individual fish visited the forebay and the entry zone on multiple occasions, most fish passed during the first exposures to these zones. This study underscores the importance of timeliness to passage success and the usefulness of time-to-event analysis for understanding factors governing passage performance.

KEYWORDS

downstream passage, fish passage, landlocked salmon, *Salmo salar*, smolt migration

1 | INTRODUCTION

Dams hinder fish from migrating between habitats, disrupt river connectivity and have caused declines and sometimes even local extinctions of migratory species (Jonsson, Waples, & Friedland, 1999; Marmulla, 2001; Northcote, 1998). Atlantic salmon (*Salmo salar*), a species that migrates between spawning and nursery habitats in streams and feeding areas at sea or in lakes, has experienced population declines in regulated rivers throughout its distribution (Jonsson &

Jonsson, 2011; MacCrimmon & Gots, 1979; Parrish, Behnke, Gephard, McCormick, & Reeves, 1998). This has led to numerous attempts to restore longitudinal connectivity: some successful, others less so (Noonan, Grant, & Jackson, 2012).

Despite the fact that the need for remedial measures for both upstream- and downstream-migrating fish has been recognised for hundreds of years, little has been done to facilitate downstream migration for Atlantic salmon (Calles, Rivinoja, & Greenberg, 2013; Montgomery, 2004). Downstream-migrating fish typically pass dams

through turbines, spillways or some type of bypass system (Larinier, 2008). Passage through turbines and other routes is associated with direct or delayed mortality (Ferguson, 2005; Ferguson, Absolon, Carlson, & Sandford, 2006; Muir, Smith, Williams, & Sandford, 2001). Hence, a functional downstream passage solution must ensure safe passage routes that a substantial portion of the migrating fish will use.

Effective fish passage must not only maximise the number or percentage of fish that successfully pass a barrier, but must also minimise the time it takes to pass. An often neglected cause of migratory failure in impounded rivers is the delay caused by the presence of dams (Marschall, Mather, Parrish, Allison, & McMenemy, 2011; Venditti, Rondorf, & Kraut, 2000). Delayed salmonid smolts may suffer predation, elevated energetic costs and decreased migration speed (Antolos et al., 2005; McCormick, Hansen, Quinn, & Saunders, 1998; Norrgård, Greenberg, Piccolo, Schmitz, & Bergman, 2012). In addition, an increase in time spent migrating may lead to loss of migratory motivation, reversion of physiological adaptations, lost feeding opportunities and mistimed sea (or lake) arrival in relation to food availability or other environmental condition (McCormick, Cunjak, Dempson, O'Dea, & Carey, 1999; Muir, Marsh, Sandford, Smith, & Williams, 2006; Tétard, Feunteun, et al., 2016).

Although fishways and other passage solutions can pass fish over hydropower dams, their successful application involves understanding fish behaviour in relation to local conditions at hydropower dams (Schilt, 2007). Typically, downstream-migrating salmonids are surface-oriented, follow the bulk flow of water (Coutant & Whitney, 2000) and avoid abrupt accelerations of flow (Enders, Gessel, Anderson, & Williams, 2012; Haro, Odeh, Noreika, & Castro-Santos, 1998; Vowles & Kemp, 2012). Light may also affect passage behaviour of fish, as many smolts migrate mainly during night (Aarestrup, Baktoft, Koed, del Villar-Guerra, & Thorstad, 2014; Hesthagen & Garnås, 1986), and passage often occurs at night (Scruton et al., 2007).

Evaluation of the functionality of fishways is needed to ensure that river connectivity is restored. Common evaluation measures include fish guidance efficiency – the percentage of fish that are successfully guided to a particular passageway – and passage efficiency – the overall or route-specific passage success ratio (Bunt, Castro-Santos, & Haro, 2012; Bunt, Katopodis, & McKinley, 1999; Noonan et al., 2012). Delay, if reported at all, is often considered separate from passage performance (Calles, Karlsson, Hebrand, & Comoglio, 2012; Scruton et al., 2007). However, there may be lengthy delays even if passage success is high (Larinier, 2008). Also, the proportion of fish passed increases over time, and so efficiency metrics are actually the result of time-dependent processes.

A more comprehensive approach to quantifying passage performance is through time-to-event analysis (Allison, 2010; Castro-Santos & Haro, 2003; Zabel, Burke, Moser, & Caudill, 2014). This provides a framework for quantifying effects of both fixed and time-varying covariates on the passage rate (Allison, 1995). It can appropriately define passage as a chain of separate events, such as retention in the forebay, approach to the fishway and passage via various routes. By modelling rates associated with each event, one can identify environmental conditions more or less conducive for passing fish as well as

passage rates in relation to various characteristics of the fish (Castro-Santos & Perry, 2012).

For salmonids, stocking of hatchery-reared smolts has been used to increase harvest, mitigate habitat losses, increase populations at low abundance (McClure et al., 2008) and evaluate passage performance (Haro et al., 1998). Because hatchery-reared smolts differ from wild smolts in size, physiology, swimming ability, experience, predator avoidance and natural migration survival (McCormick et al., 1998; Poole et al., 2003; Thorstad, Whoriskey, et al., 2012), one might expect differences in passage behaviour and success. This makes it important to study passage performance of both wild and hatchery-reared fish.

In this study, we used radiotelemetry and time-to-event analysis to evaluate the functionality of a fish bypass for smolts at the first hydropower dam that the smolts encounter during their downstream migration in the Winooski River, Vermont, USA. We studied the effects of environmental conditions and fish characteristics on the behaviour of both hatchery-reared and wild-caught Atlantic salmon smolts. We evaluated passage as a series of competing events, including upstream movements, approach to an area close to the bypass entrance and passage.

2 | MATERIAL AND METHODS

2.1 | Study area

Lake Champlain (44°32'N, 73°20'W) is located in eastern North America on the border between Vermont and New York in the USA and Quebec, Canada. Atlantic salmon were extirpated in the 19th century (Edmunds, 1874; Marsden & Langdon, 2012; Watson, 1876), but today fry and smolts of landlocked Lake Sebago (Maine, USA) origin are stocked in the Winooski River and other Lake Champlain tributaries (Chipman, Staats, & Gibson, 2013; Marsden & Langdon, 2012). The Winooski River has a mean annual discharge of 67 m³/s and three hydroelectric power dams that separate available spawning grounds from the lake (Fig. 1a). Upstream migrating Atlantic salmon are caught in a fish lift at the lowermost dam and transported upstream past the three hydroelectric power dams and then released to continue their spawning migration.

Essex 19 (44°28'56.60"N; 73° 6'54.28"W) is the first dam that the fish encounter on their downstream migration. The hydroelectric power plant is equipped with five Francis turbines and has a total capacity of 57 m³/s. The turbine intakes are protected by an intake rack with 25-mm spacing, extending to a depth of 3 m, with no physical structures separating the fish from the intake tubes below this point. There is a fish bypass (design discharge = 2.8 m³/s) connected to two separate entrances positioned close to the surface on the intake rack. During the study, only the eastern most bypass entrance was open (estimated discharge = 1.4 m³/s) as the other entrance was closed due to problems with debris clogging. The upper surface of the intake rack is covered by a solid steel plate that extends to just below the entrance to the bypass. The purpose of this plate is to guide surface-oriented smolts to the bypass entrance, but its effectiveness has never been quantified. Water not used in energy production or in the fish bypass

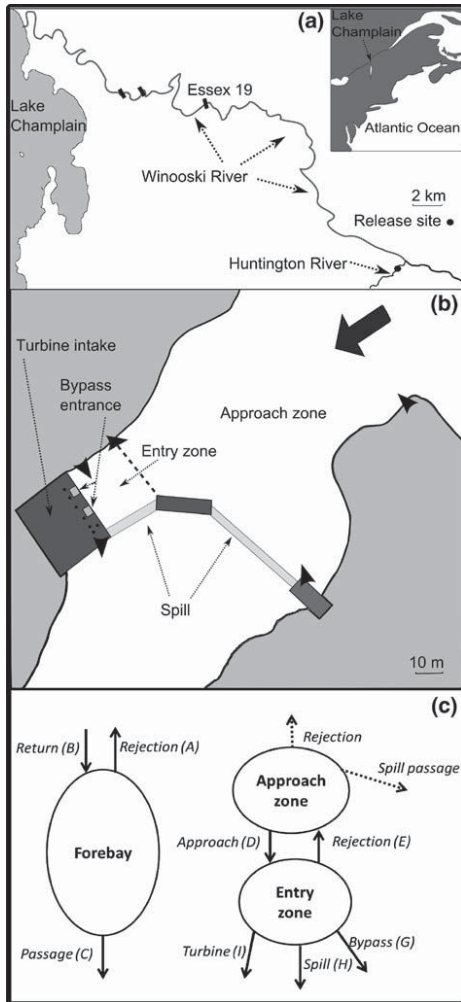


FIGURE 1 (a) A map of the Winooski River and Lake Champlain, showing the location of hydropower dams and the release site in the Huntington River. (b) A map of the hydropower plant area at Essex 19, showing the turbine intake, bypass entrances and spill gates. The forebay consists of the entry zone (downstream of the dotted line) and the approach zone (upstream of the dotted line). Yagi antennas as arrows and dropper antennas as circles. (c) A schematic diagram showing modelled events (arrows). Dotted arrows are events censored but not modelled. Approach zone and entry zone are both nested within forebay

is spilled from the surface (Fig. 1) (KleinschmidtAssociates, 1996; Unpublished, Green Mountain Power).

2.2 | Movement zones

In order to pass the dam, fish must traverse the forebay and locate a passage route. When there is no spill, the fish must approach the entrances of either the downstream bypass fishway or the turbines. In the area directly in front of the turbine intakes and the bypass entrance, the fish might detect these passage routes and decide to either pass through one of the routes or return upstream. Thus, the forebay can be thought of as comprising an entry zone (where fish might detect passage routes) and an approach zone (the forebay upstream of the entry zone). From each zone, a fish can advance or

reject the zone by moving upstream. Passage typically takes place from within the entry zone but spill might allow passage directly from the approach zone.

2.3 | Radiotelemetry

We used five Yagi antennas and seven dropper antennas with stationary automatic receivers (Model Orion; Sigma Eight Inc., Newmarket, ON, Canada) to track fish presence in the forebay, movement between zones and passage events (Evans & Stevenson, 2012). Radio detections within a zone defined presence. Departures from the different zones were inferred from intervals with no detections. Intervals of >2 hr were interpreted as departure from the forebay, whereas intervals of >10 min were interpreted as departure from the entry zone (breaks derived empirically from telemetry data; Castro-Santos & Perry, 2012).

2.4 | Statistical analysis

We used Cox regression, a type of time-to-event analysis, with a competing risks approach to model covariate effects on rates of passage and movement between zones (Castro-Santos & Haro, 2003; Castro-Santos & Perry, 2012; Hosmer, Lemeshow, & May, 2008). Under the competing risks framework, each rate is calculated, controlling for egress through alternate routes (Fig. 1c).

For fish present in the forebay, we modelled rejection (i.e. upstream movement away from the forebay) and the overall forebay passage rate as competing risks. All fish present in the forebay were included in calculating both rates for their entire forebay residency. Fish that passed were included as censored observations with respect to rejection rate, and fish that rejected the forebay were included as censored observations with respect to passage rate. These censored fish were considered available to pass or reject the forebay, and thus used in analysing these rates, until the censoring event occurred. Many fish occupied each zone several times (i.e. experienced multiple exposures), when returning they were again used for calculating the rates. To be able to use all data and avoid pseudoreplication, all models were stratified by exposure within zones (Allison, 1995).

We applied the same methodology to the approach and entry zones. For fish present in the approach zone, we modelled approach to the entry zone with fish that rejected or passed via spill included as censored observations. Finally, for fish present in the entry zone, we modelled rejection rate, overall passage rate and passage rates for each passage route, censored as above (Fig. 1b–c).

We also evaluated covariate effects on return rates of fish that rejected the forebay. In this case, no censoring was performed, and only fish that returned to the forebay were used in this analysis.

Minimisation of Akaike information criterion (AIC) was used to select the best model among all candidate models ($n = 32$) (Burnham & Anderson, 1998). Fixed and time-varying covariates were included in the candidate models (Allison, 1995; Castro-Santos & Haro, 2003; Castro-Santos & Perry, 2012). Fixed covariates were fish origin (wild/hatchery) and fish length (FL); time-varying covariates were degree

days (Σ daily mean temp) accumulated since the vernal equinox, spill (m^3/s , log transformed), hydropower generation (m^3/s ; log transformed) and day/night. Because number of degree days was correlated with spill ($r = -.41$) and generation ($r = -.66$), it was not allowed to co-occur with either of these variables in any candidate model. Fish origin and length were linked (Wilcoxon, $p < .01$) and both were therefore included in the same candidate model only together with their interaction. This was also the case for hydropower generation and spill ($r = 0.32$). For forebay re-approach rate, spill and generation were substituted by total discharge (m^3/s , log transformed). For all other events, total discharge and temperature were excluded from candidate models due to their strong correlation with spill ($r = .82$; $r = .57$) and generation ($r = .61$; $r = .61$).

All models with an AIC value of -2 from the null model or lower ($\Delta AIC_{Null} < -2$) and within 2 AIC units from the best model ($\Delta AIC_{min} > 2$) were considered good models (Burnham & Anderson, 1998). When multiple competing models were found to be good, all were used to describe the influence of the covariates on the event. Covariate coefficients with standard errors as large, or larger, than the coefficient themselves were not considered when describing influences on event rates.

The assumption of proportionality of hazard was explicitly tested (Fox, 2002) and violation of the assumption in a good model was followed up by a post hoc analysis of the nature of the disproportionality. The break in proportionality was then included in the model.

For the different passage routes, the number of events was small ($n = 6-14$). As a consequence, we limited the maximum number of explanatory variables to one. For all other modelled rates, the number of covariates (including interactions) in any given model was limited to four.

We used a log-rank test to test for differences in time to rejection curves between exposures within each zone (Therneau & Lumley, 2015). Nonparametric Wilcoxon–Mann–Whitney tests were used to describe differences between groups of fish (Pohlert, 2014). Two-sample Kolmogorov–Smirnov test was used to test for difference in size distribution between fish tagged and released and arriving at Essex. The relationship between exposure number and the likelihood of fish either passing or entering the entry zone was tested with logistic regressions. Statistical tests were performed using R (R Core Team, Austria; packages Hmisc v3.17, PMCMR v4.0 and Survival v2.38).

2.5 | Fish and tagging

Naturally reared, fry stocked smolts (from here after referred to as wild smolts) and hatchery smolts were tagged and released in the Huntington River, ca. 500 m upstream of its confluence with the Winooski River and 22 km upstream of Essex dam (Fig. 1). Wild smolts were caught in a rotary screw trap located just upstream of the release site, tagged and released within one day of capture (except for one fish, kept for two days before tagging). Hatchery smolts were reared at ambient temperature at the Eisenhower National Fish Hatchery (U.S. Fish and Wildlife Service, North Chittenden, VT) and transported to the Huntington River, tagged and released in three batches (Fig. 2c). Only fish without visible injuries were tagged.

Smolts were anaesthetised with MS-222 and surgically implanted with radio transmitters (Sigma Eight Inc.; tags measured $7.8 \times 6.7 \times 17.0$ mm and weighed 1.35 g, 20 bpm, tag life 40 days). The transmitters weighed on average 2.8% (range = 1.3–6.0%) of the fish's body mass, which is considered an acceptable tag to body mass ratio percentage (Brown, Cooke, Anderson, & McKinley, 1999). Transmitters were placed in the body cavity through an incision made on the ventral side of fish. The transmitter antenna exited the body cavity through a separate small opening posterior to the incision and trailed back along the body of the fish. The incision was closed using monofilament nylon sutures. Water flowed over the gills of the fish during the whole procedure, initially using anaesthesia-laden river water and then switching to pure river water towards the end of the surgery (Liedtke & Rub, 2012). After tagging, the fish were acclimatised in a cage in the river for approximately one hour before being released. All fish were released between 9:15 hr and 14:30 hr. Onset of migration after tagging and release, as well as migration in the upper free flowing reach of the river, is analysed in another paper (Nyqvist et al., In review).

3 | RESULTS

Twenty-one wild and sixty hatchery smolts were tagged and released between 6 May and 5 June 2014. Hatchery fish were on average larger (median = 175 mm, interquartile range = 164–182 mm; median = 56 g, IQR = 41–64 g) than wild fish (median = 155 mm, IQR = 148–167 mm; median = 39 g, IQR = 32–46 g; Wilcoxon, $p < .01$). Approximately half of the fish (30 hatchery and 10 wild) arrived at Essex 19; all smolts arrived between 10 May and 9 June (Fig. 2d). There was no difference in length between fish released and fish arriving at Essex 19 (K-S test, $D = 0.01$, $p = 1$).

Of the fish that arrived at the forebay, 35% (14 fish) did not pass the dam at all. Of these, most (71%) fish were last detected on the upstream antenna, but some (29%) were last detected in the forebay. More fish passed the dam via the bypass than via the turbines or the spill gates (Fig. 3). For fish that passed the dam, the median duration from first arrival to passage was 6.8 hr (IQR = 0.9–33.7 hr), whereas the fish that did not pass took a median of 7.6 days (IQR = 2.8–10.7 days) to finally reject the forebay. With the exception of one fish that passed 41 days postrelease, all passage and rejection times occurred before the expected minimum date of tag failure.

3.1 | Approach, passage and rejection

Individual fish entered the forebay 1 to 22 times (Fig. 4), and the duration of exposures was highly variable (median = 6.7 hr, IQR = 1.7–21.1 hr). Most passage events took place during the first forebay exposure (Fig. 4), and passage rate increased with increased river discharge as indicated by the increase in passage rate associated with increased generation or spill (Table 1C). Many fish rejected the forebay and moved upstream: this rejection rate was independent of the tested covariates (Table 1A).

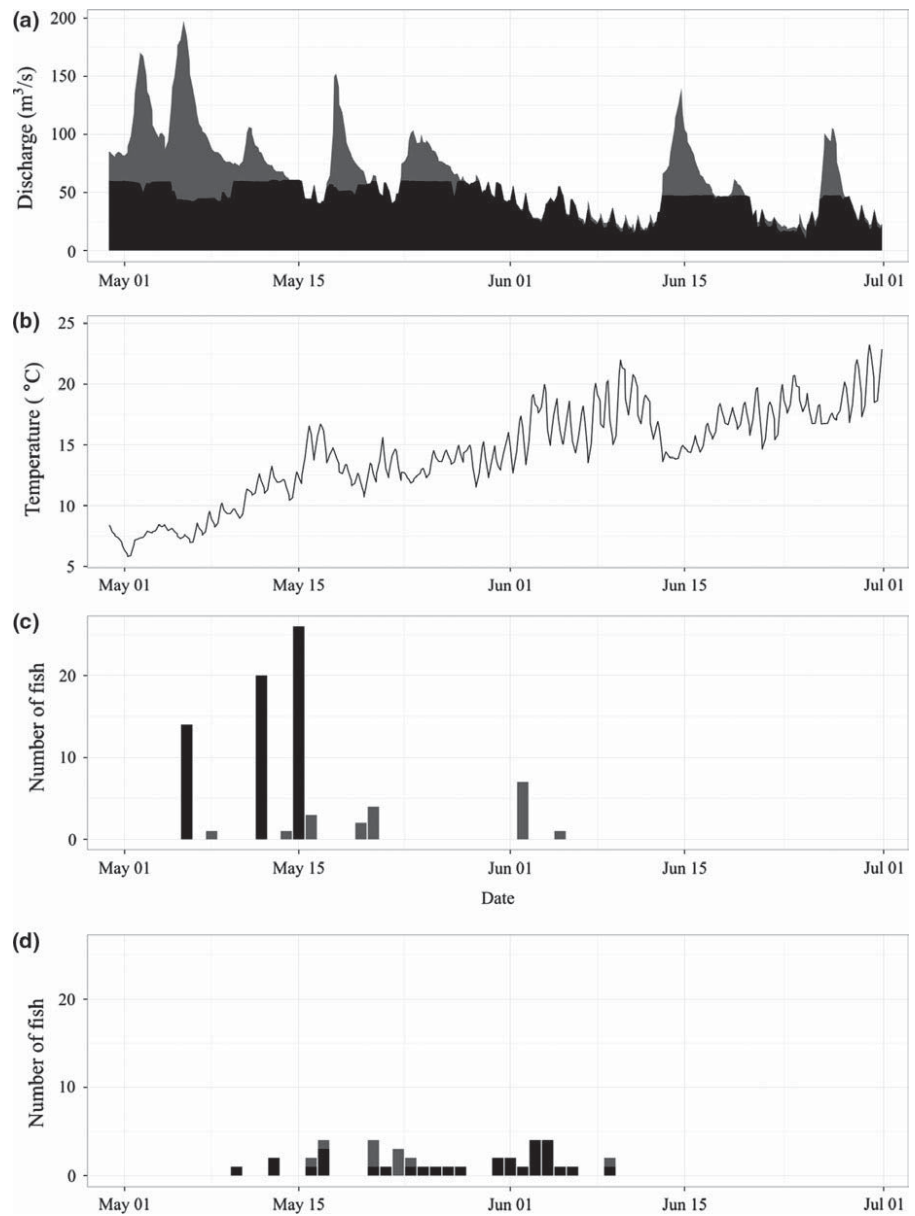


FIGURE 2 Seasonal pattern for (a) total discharge (m^3/s), turbine flow (black) and flow through the spill gates (grey). (b) River temperature ($^{\circ}C$). (c) Number of wild (grey) and hatchery (black) fish tagged over the course of the study. (d) Number of wild (grey) and hatchery (black) fish arriving at Essex 19 over the course of the study (data are first arrivals only)

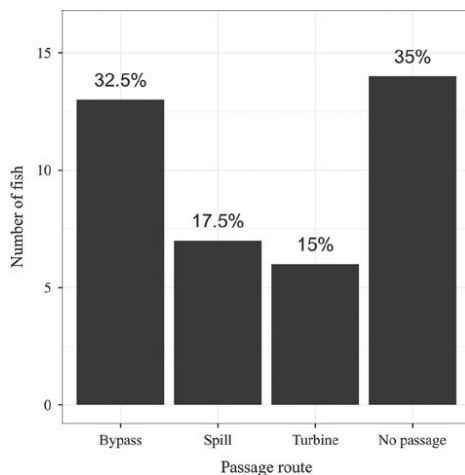


FIGURE 3 Fish in the forebay by dam passage route (bypass, spill or turbine). Fish that failed to pass are classified as “no passage”

Following forebay rejection, fish returned to the forebay after a median of 5.5 hr (IQR = 3.0–9.2 hr). Forebay return was faster at higher total discharge than at lower total discharge (Table 1B).

The median approach time to the entry zone was 27 min (IQR = 15–63 min) and approach rate decreased with increased generation (Table 1D). Fish were observed in the entry zone 1–153 times before passing, disappearing or returning upstream (Fig. 4c); the median entry zone exposure duration was 12.6 min (IQR = 3.9–33.2 min). Most passage events from the entry zone took place during the first entry zone exposures (Fig. 4c), although bypass passage took place at higher exposure numbers than spill and turbine passage (Wilcoxon, $p = .01$).

Overall passage rate from the entry zone increased with increasing spill and/or generation (Table 1F). For route-specific passage rates, the low number of passage events resulted in poor power to test for covariate effects. No effects were found for bypass passage (Table 1G).

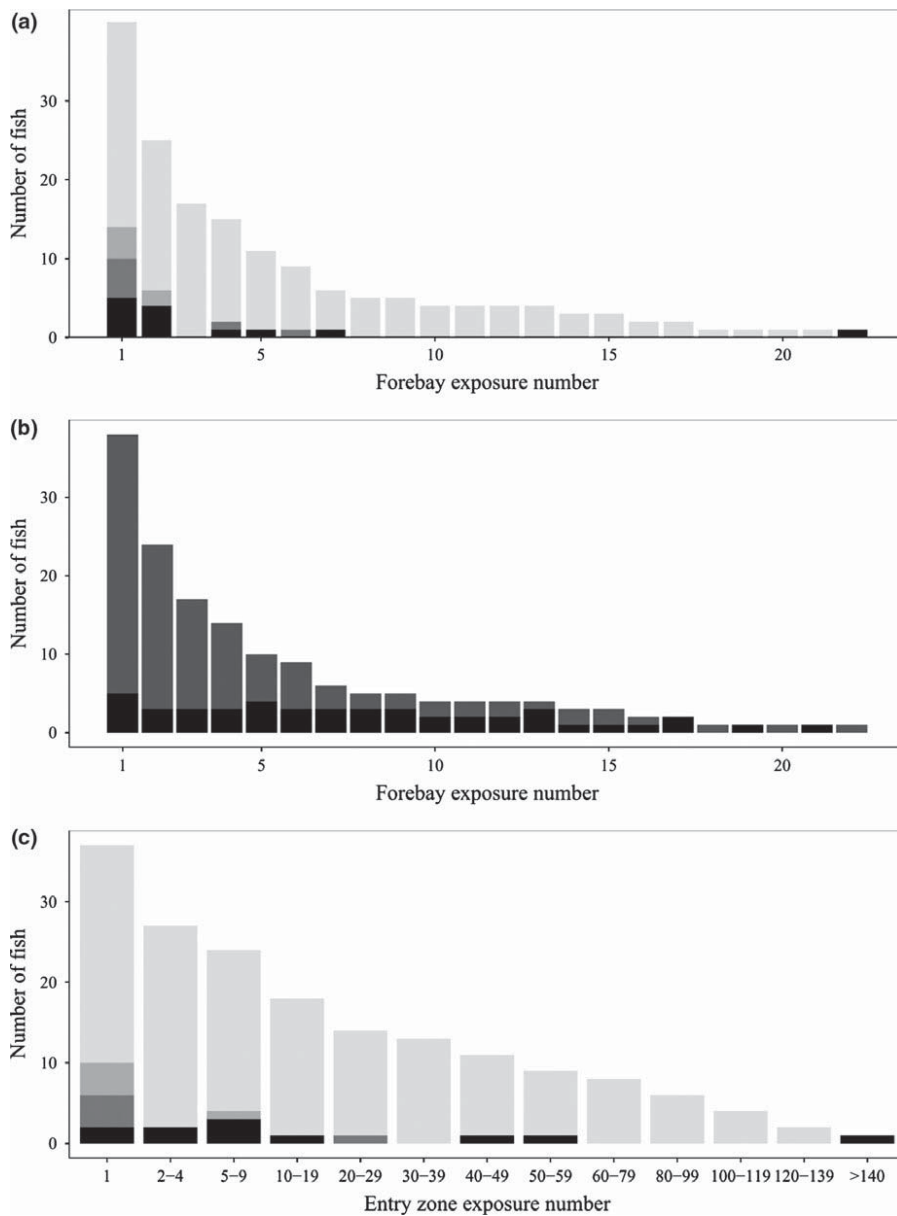


FIGURE 4 Exposure number and events. (a) The number of fish present that rejected the forebay (white) and passed via the bypass (black), the spill gate (dark grey) and the turbines (light grey) in relation to the number of forebay exposures. (b) The number of fish present in the forebay that approach (grey) or do not approach (black) the entry zone in relation to forebay exposure number. Note that the proportion approaching the entry zone decreased with increasing exposure number. (c) The number of fish present that rejected the entry zone (white) and passed via the bypass (black), the spill gate (dark grey) and the turbines (light grey) in relation to the number of entry zone exposures. Exposures are grouped into bins of 10, and each fish is counted only once per bin. Thus, black bars indicate one or more rejection events. Passage is indicated even if there were multiple rejections within that bin before the fish ultimately passed

However, some significant effects were detected: spill passage rate increased with increasing spill (Table 1H), and turbine passage rate decreased with increasing degree days and increased with increasing spill levels (Table 1I).

The proportional hazards assumption was violated for rejection of the entry zone and breaks in proportionality were included in the model. Rejection rate decreased with generation during the initial 1000 s, whereas the effect of generation was insignificant thereafter. Rejection rates were lower at night, and the effect was stronger after the initial 500 s. Lastly, longer fish rejected the entry zone at a marginally slower rate compared to shorter fish, but only during the initial 500 s (Table 1E).

The probability of approaching the entry zone decreased as the number of forebay exposures increased (Fig. 4b; Logistic regression, $\beta = -.14$, $SE = 0.04$, $p < .01$). Likewise, the proportion of fish passing from either the forebay (Fig. 4a; Logistic regression, $\beta = -.21$,

$SE = 0.08$, $p = .01$) or the entry zone (Fig. 4c; Logistic regression, $\beta = -.04$, $SE = 0.01$, $p < .01$) decreased with the number of exposures.

There were no differences in time to rejection of the forebay (log rank; $p = .3$, Fig. 5) or the entry zone (log rank; $p = .3$, Fig. 5) between exposures. Most downstream passage events took place early during the first exposures (Fig. 5). Also, passage via the bypass tended to take place after longer exposure durations than passage via spill or turbines (Wilcoxon, entry zone, $p = .05$; forebay, $p = .06$; Fig. 5).

4 | DISCUSSION

This study shows that low passage rate can be as important in limiting migratory success as route-specific mortality. At Essex 19, a substantial percentage of the fish failed to pass the dam (35%), despite making

TABLE 1 List of good models based on the Akaike information criterion (AIC). ΔAIC_{min} is the difference between AIC of the model and AIC of the best model, and ΔAIC_{null} is the difference between the AIC of model and AIC of the null model (without covariates, as stated in the table). Night and wild represent the binary variables for day or night and origin. Where time restrictions were imposed to account for proportionality of hazard, the interval over which the new variable applies is indicated by a subscript, that is Length₅₀₀ indicates the effect of length during the first 500 s of exposure

	AIC Without Covariates	AIC with Covariates	Delta AIC _{null}	Delta AIC _{min}	Variable	Coefficient	SE	p-value
A. Forebay- rejection								
Spill length	442.6	441.6	-1.0	0	No good model			
B. Forebay - re-approach								
Discharge Length	367.1	362.6	-4.5	0.0	Discharge	2.93	1.18	.01
					Length	-0.01	0.01	.07
Discharge	367.1	364.1	-3.0	1.5	Discharge	2.56	1.16	.03
Discharge Length Night	367.1	364.6	-2.5	1.9	Discharge	2.98	1.19	.01
					Length	-0.01	0.01	.07
					Night	-0.05	0.23	.82
C. Forebay - passage								
Spill Generation Generation*Spill	145.1	128.8	-16.3	0	Spill	8.72	3.36	.01
					Generation	3.59	1.28	.00
					Generation*Spill	-2.13	0.84	.01
Spill Generation Generation*Spill Length	145.1	130.0	-15.1	1.1	Spill	8.17	3.36	.02
					Generation	3.41	1.27	.01
					Generation*Spill	-1.99	0.84	.02
					Length	-0.01	0.01	.37
Spill Generation Generation*Spill Wild	145.1	130.4	-14.8	1.5	Spill	8.70	3.35	.01
					Generation	3.60	1.28	.05
					Generation*Spill	-2.12	0.83	.01
					Wild	0.33	0.48	.49
Spill Generation Generation*Spill Night	145.1	130.7	14.5	1.8	Spill	8.79	3.38	.00
					Generation	3.54	1.29	.00
					Generation*Spill	-2.14	0.84	.01
					Night	0.19	0.48	.69
D. Approach to entry zone								
Generation Length	3615.5	3 611.6	-3.9	0.0	Generation	-0.20	0.09	.03
					Length	0.00	0.00	.04
Spill Generation Generation*Spill Length	3615.5	3 612.8	-2.7	1.2	Spill	-0.39	0.24	.10
					Generation	-0.28	0.10	.01
					Generation*Spill	0.10	0.06	.11
					Length	0.00	0.00	.04
Generation Length Night	3615.5	3 612.8	-2.7	1.3	Generation	-0.18	0.09	.04
					Length	0.00	0.00	.05
					Night	-0.08	0.09	.39
E. Entry zone - rejection								
Generation + Generation ₁₀₀₀ + Length + Length ₅₀₀ + Night + Night ₅₀₀	3693.6	3 620.0	-73.6	0	Generation	-0.12	0.18	.51
					Generation ₁₀₀₀	-0.43	0.21	.04
					Length	0.00	0.00	.61
					Length ₅₀₀	-0.01	0.00	.01
					Night	-0.70	0.12	.00
					Night ₅₀₀	0.38	0.18	.04

(continues)

TABLE 1 (continued)

	AIC Without Covariates	AIC with Covariates	Delta AIC _{null}	Delta AIC _{min}	Variable	Coefficient	SE	p-value
F. Entry zone – passage								
Spill Generation Generation*Spill	106.9	92.6	-14.4	0	Spill	6.84	3.95	.08
					Generation	3.73	1.49	.01
					Spill*Generation	-1.64	0.99	.10
Spill Generation Generation*Spill Wild	106.9	93.5	-13.4	1.0	Spill	7.01	4.00	.08
					Generation	3.71	1.49	.01
					Spill*Generation	-1.69	1.00	.09
					Wild	0.57	0.55	.30
Spill Generation Generation*Spill Night	106.9	93.8	-13.2	1.2	Spill	7.28	4.01	.07
					Generation	3.75	1.53	.01
					Spill*Generation	-1.74	1.00	.08
					Night	0.54	0.60	.37
Spill Generation Generation*Spill Length	106.9	94.3	-12.7	1.7	Spill	6.73	3.85	.08
					Generation	3.63	1.48	.01
					Spill*Generation	-1.62	0.96	.09
					Length	-0.01	-0.02	.59
G. Entry zone – bypass passage								
Wild	44.4	42.8	-1.7	0	No good model			
H. Entry zone – spill passage								
Spill	30.4	14.8	-15.7	0	Spill	1.69	0.78	.03
I. Entry zone – turbine passage								
Spill	32.1	26.3	-5.8	0.0	Spill	0.62	0.29	.03
Degree days	32.1	26.5	-5.5	0	Degree Days	-0.01	0.01	.02
Generation	32.1	27.7	-4.3	1.4	Generation	10.70	7.66	.16

repeated attempts. The migration failure caused by nonpassage is therefore important in comparison with any route-specific mortality (e.g. turbine mortality) that might have occurred.

A low proportion of migrating fish passing a hydropower dam has been reported from other rivers (Nettles & Gloss, 1987) and presumably comes with high costs (e.g. energy spent, missed growth opportunities, riverine mortality) for the fish that do not pass. At Essex 19, the fish not passing the dam typically approached both the forebay and the entry zones multiple times, spending on average several days in the forebay. The smolts' reluctance to swim through or dive down under the intake rack present at the surface of the turbine intakes likely contributed to low levels of turbine passage, delayed overall passage and passage failure (Aarestrup & Koed, 2003; Arnekleiv, Kraabøl, & Museth, 2007). Although more fish passed via the bypass than any other passage route, the passage rate through this route was insufficient to avoid delay and passage failure.

The overall passage rate is the result of a series of events. Following arrival to the forebay, the fish should ideally approach the entry zone and pass via the bypass (or via spill). Retention of the fish in the entry zone, or any other zone of passage, is a precondition for passage. Rejection rates are therefore important for the overall passage rate. By modelling the rates of this series of events, we can

better understand the behaviour and passage performance of the fish in the area upstream of the dam. Spill, hydropower generation and their interaction were implicated as important factors in many of our modelled event rates. However, both spill and generation were correlated to total discharge and to each other, making it difficult to evaluate their relative effects. Nevertheless, the reoccurrence of these discharge-related factors in our modelled event rates points to the general importance of hydraulic conditions for passage performance. This is accentuated by the increase of overall passage rates from both the forebay and the entry zone with increased spill and/or generation.

Also related to discharge, the retention of fish in the entry zone was positively affected by increased generation, particularly during the initial exposure. One interpretation of this result is that high discharge influences fish movements such that they are drawn back repeatedly to possible passage routes and retained within the zone of presence. Although water velocities in the entry zone are most likely within the physical swimming capability of the smolts (Peake & McKinley, 1998), elevated flows might displace randomly searching fish towards the dam. Increased flow may also help fish orient downstream and attract them to the intakes (Coutant & Whitney, 2000). The decreased effect of generation with time indicates habituation to the hydraulic environment (Vowles & Kemp, 2012) and that when the fish are more familiar

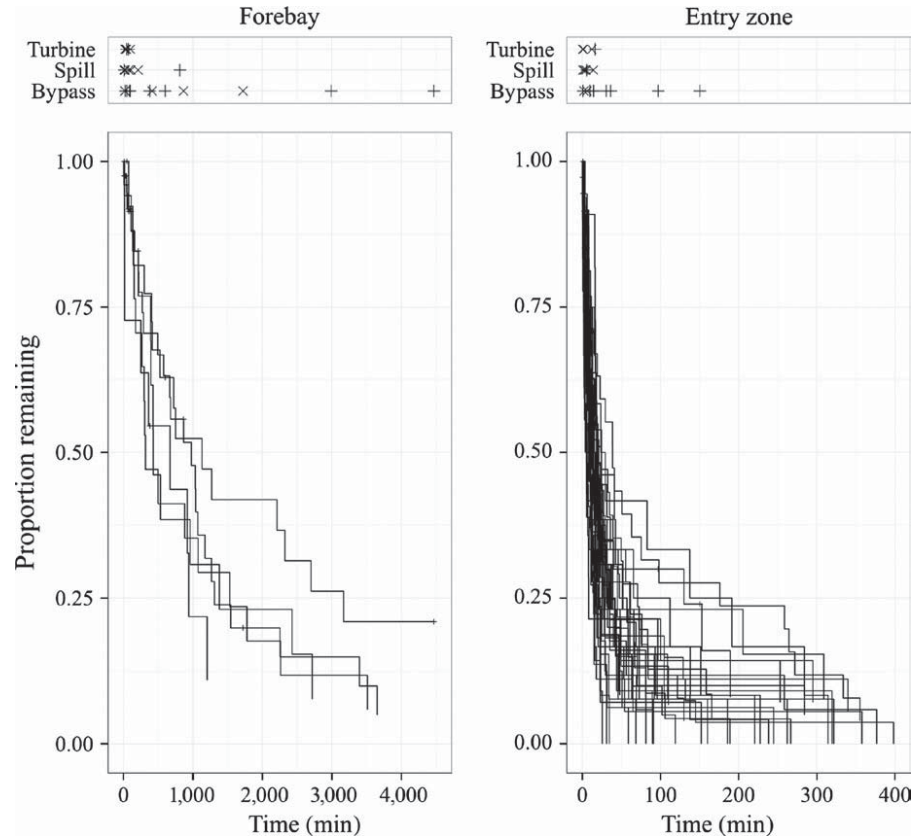


FIGURE 5 Kaplan–Meier curves showing time to rejection with passage censored for the forebay (left) and the entry zone (right) for exposures with 10 fish or more. One curve represents one exposure. Above are passage events as points (x = first exposure, + = later exposures) on the same timescale

with the zone, other factors become more important in driving the decision to remain or leave.

Rate of approach to the entry zone was inversely related to generation, which is probably an effect of discharge and the correlation between hydropower generation and spill. Increased spill outside of the entry zone might attract fish away from entering this zone (Coutant & Whitney, 2000). Because water is also spilled from within the entry zone, the effect of spill on entry zone attraction will differ depending on where water is spilled. An alternative explanation is that high generation could be associated with a different sound environment that might make fish more reluctant to approach the entry zone (Knudsen, Enger, & Sand, 1994).

Even though we could separate individual choice of passage routes, our sample sizes were small and we could not find a satisfactory model to explain the rate of bypass passage. For route-specific passage rates, spill passage and spill level were positively related to each other, probably a consequence of a greater portion of the water allocated to this passage route at higher spill levels (Coutant & Whitney, 2000; Schilt, 2007).

Turbine passage rate decreased as the season progressed (degree days), possibly related to a change in motivation and behaviour (e.g. activity) of the fish (Giorgi, Swan, Zaugg, Coley, & Barila, 1988; McCormick et al., 1999; Tétard, Lemaire, De Oliveira, & Martin, 2016). Turbine passage rate also increased at increasing spill levels. Spill levels, in addition to being correlated to generation, affect the hydraulic environment in the entry zone, possibly causing the fish to be repelled and attracted to different areas during different spill levels (Adams

et al. 2014; Coutant & Whitney, 2000). Perhaps, acceleration of water flow close to the spillway repelled the fish towards the turbine intakes (Haro et al., 1998; Vowles & Kemp, 2012). Further studies on the hydraulic conditions in the entry zone might help interpret this result.

Rejection rates of the entry zone were lower at night than during the day. This might be explained by lower fish activity levels at night (Kemp & Williams, 2009; Vowles, Anderson, Gessel, Williams, & Kemp, 2014), by the fish being attracted to the illuminated area near the intakes (Greenberg, Calles, Andersson, & Engqvist, 2012; Haymes, Patrick, & Onisto, 1984) or by increased migratory urge during night (Hesthagen & Garnås, 1986; Jonsson & Ruud-Hansen, 1985; Thorpe & Morgan, 1978).

Despite widely reported differences between wild and hatchery-reared smolts in the literature (McCormick et al., 1998; Thorstad, Whoriskey, et al., 2012), fish origin was not an important factor for any of our modelled event rates. However, our sample sizes were small and statistical nonsignificant findings should be interpreted with caution. More data are needed and it is important to remember that hatchery regime has been shown to affect the behaviour of stocked hatchery-raised fish (Lans et al., 2011). However, the lack of effect of fish origin for our modelled passage behaviour may encourage the use of actively migrating hatchery-reared fish in future fish passage studies, at least as a supplement to studies of wild fish.

Passage ratios as well as the approach ratio to the entry zone decreased with increased exposure numbers. Even though individual fish experienced up to 22 exposures to the forebay, most passage events took place during the first and second exposure. Likewise

within the entry zone relatively more passage events took place during the first exposures. The percentage of fish present in the forebay but not approaching the entry zone also increased with forebay exposures. A lower proportion of fish passing or approaching the entry zone at higher exposure numbers can be explained by a change in the status of the fish present (e.g. learning or desmoltification; Kieffer & Colgan, 1992; McCormick et al., 1998; Odling-Smee, Giles, Fuyuno, Cyranoski, & Marris, 2007) or by individual differences in ability to pass the dam (e.g. fish personality; Mittelbach, Ballew, Kjølvik, & Fraser, 2014), resulting in changed composition of fish present over time (Zabel et al., 2014). Patterns suggesting change over time are seen also within exposures, where the consistency in retention times between exposures is high while most passage events take place relatively early, especially for spill and turbine passage.

Delays at hydropower dams are associated with predation mortality (Aarestrup & Koed, 2003; Venditti et al., 2000). Almost one-third of our tagged fish that did not pass the dam disappeared from within the forebay. The tags' battery life was longer than the time from release to last detection for all disappeared fish, and missed detections for fish leaving in an upstream direction are deemed unlikely. A likely alternative explanation is that these fish suffered predation. Avian predators are abundant in this area: although we lack definitive data, these probably account for a substantial portion of the losses. Likewise, there may have been some aquatic predation (or nonpredation mortality) followed by tags dropping to depths outside of radio detection reach. However, we observed no transition in behavioural patterns that suggested we were tracking smolts consumed by predators. For future studies, three-dimensional positioning telemetry (Thorstad, Uglem, et al., 2012), predation tags (Ehrenberg, Bill, Johnston, & Hemmings, 2015) and predated tag retention studies (Schultz, Kumagai, & Bridges, 2015) can provide more detailed information on forebay predation and mortality.

In general, low flow bypasses are favoured for their potential for passing fish with relatively little discharge, leaving high portion of water for electricity production (Johnson and Dauble 2006). Their functionality, however, is highly variable and site dependent (Johnson and Dauble 2006) requiring evaluations as part of fishway design. In this study, many fish made repeated visits to the intake zone without entering the bypass. The intake rack might have prevented turbine passage and retained fish in the forebay, but was not part of an effective fish passage solution. Improving passage performance at the dam should ideally follow an adaptive management approach where successive modifications are evaluated by quantifying rates of passage, controlling for exposure to the actual conditions (Castro-Santos, 2012). Operating both bypass entrances simultaneously or inexpensive modification of existing spillway operations might improve passage performance. Gradually increasing flow velocities can enhance passage rates and can be achieved with minor modifications to existing entrances (Haro et al., 1998; Adams et al. 2014). Otherwise, a low-sloping (angled) turbine intake rack, that uses the natural water current to guide the downstream-migrating fish towards the bypass entrance (Calles, Karlsson, Vezza, Comoglio, & Tielman, 2013; Gosset, Travade, Durif, Rives, & Elie, 2005; Nettles and Gloss 1987), might be applicable, at least during low spill, to facilities like the Winooski dam.

To conclude, this study shows that failure to pass can substantially affect migration success. Thirty-five per cent of smolts that approached the dam failed to pass, despite extensive stays in the dam area and repeated approaches to various available passage routes. This result underscores that functional fish passage depends on more than route selection and passage survival and that prevention of turbine passage alone does not guarantee effective protection. Timely passage is important for passage success, maybe especially for migrating smolts tied to a narrow window of migration. This study points to the need for studies on passage performance to emphasise time-based passage rates and demonstrates the potential usefulness of time-to-event analysis for modelling fish behaviour and to evaluate passage performance.

ACKNOWLEDGEMENTS

We acknowledge Brian Chipman and Nicholas Staats for their contribution in planning and organising the study and Madeleine Lyttle, Ryan Cross and Jaime Masterson for assistance in the field. Daniel Nyqvist was financed by Fortum Generation AB (32%), Fortum Environmental Fund, through sales of ecolabelled 'Good Environmental Choice' electricity (32%), the EU INTERREG project "Open migration routes for Lake Vänern salmon" through the County Board of Värmland (23%) and Karlstad University (13%). Elsa Goerig's contribution was funded by a fellowship from the Fonds de recherche Nature et technologies du Québec. USGS, S.O. Conte Anadromous Fish Research Center provided equipment and expertise, particularly Micah Kieffer and Stephen D. McCormick for assistance with telemetry deployments and surgeries. U.S. Fish and Wildlife Service Lake Champlain Fisheries Conservation Office provided additional equipment and captured wild smolts and housing for researchers was provided by Vermont Department of Fish and Wildlife. We also acknowledge Green Mountain Power for making their facility available for our study and Eisenhower National Fish Hatchery for the supplying hatchery fish, as well as interested and helpful personnel at both companies. Any use of trade, product or firm names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

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ATTACHMENT C

AUGUST 21, 2017 GATE OPERATION MEMO

MEMORANDUM

TO: John Greenan, Green Mountain Power Corporation
FROM: Jennifer Jones, Kleinschmidt Associates
CC: Brandon Kulik and Katie Sellers, Kleinschmidt Associates
DATE: August 21, 2017
RE: Typical Essex 19 Gate Flows During Downstream Fish Passage Seasons

***Purpose:** The purpose of this memo is to provide a review on how often Green Mountain Power's (GMP) Essex 19 Hydroelectric Project typically has the ability to pass the required 100 cfs for fish passage through one fully open gate during downstream passage seasons.*

In accordance with the Essex 19 application for Low Impact Hydropower Institute (LIHI) Certification, GMP and its consultant, Kleinschmidt, have been undergoing downstream fish passage consultation with the U.S. Fish and Wildlife Service (USFWS) and Vermont Fish and Wildlife Department. Two agency goals during consultations are to 1) pass a minimum of 100 cfs through the facility's bypass gate(s) and; 2) to operate the gate(s) in fully down (broad-crested) position to prevent adverse accelerations over the (sharp-crested) gate lip. At issue, was whether GMP could meet both goals by fully opening one gate.

Upon analysis of gate hydraulics under broad-crested weir conditions, it was determined that at a normal headpond level of 273.0 feet one gate can pass approximately 64 cfs. Under these normal headpond conditions, one fully opened gate cannot pass the desired flow of 100 cfs.

Although a headpond of 273.0 feet is unfavorable for use of one gate, it was determined through consultation that at a headpond level of 274.5 feet, one gate is capable of passing the desired 100 cfs flow. In an effort to understand how frequently the Essex 19 headpond level reaches elevation 274.5 feet and therefore how often GMP typically has the ability to pass 100 cfs through one fully open gate during downstream fish passage seasons, Kleinschmidt analyzed operations and flow data available from the 2014/2015 fish passage seasons (April 1 – June 15 and September 15 – December 15) (Attachment A).

As depicted within the attached graphs, green lines and red lines represent headpond level in feet and generation output in megawatt hours, respectively. Both the headpond levels and generation data were downloaded from GMP's supervisory control and data acquisition (SCADA) system. Blue lines represent Essex 19 inflow as measured from the upstream Bolton Falls Hydroelectric Project (FERC No. 2879). A single red line is placed at September 15 and December 15 to mark the fall downstream fish passage timeframe and at April 1 and June 15 to mark the spring passage timeframe.

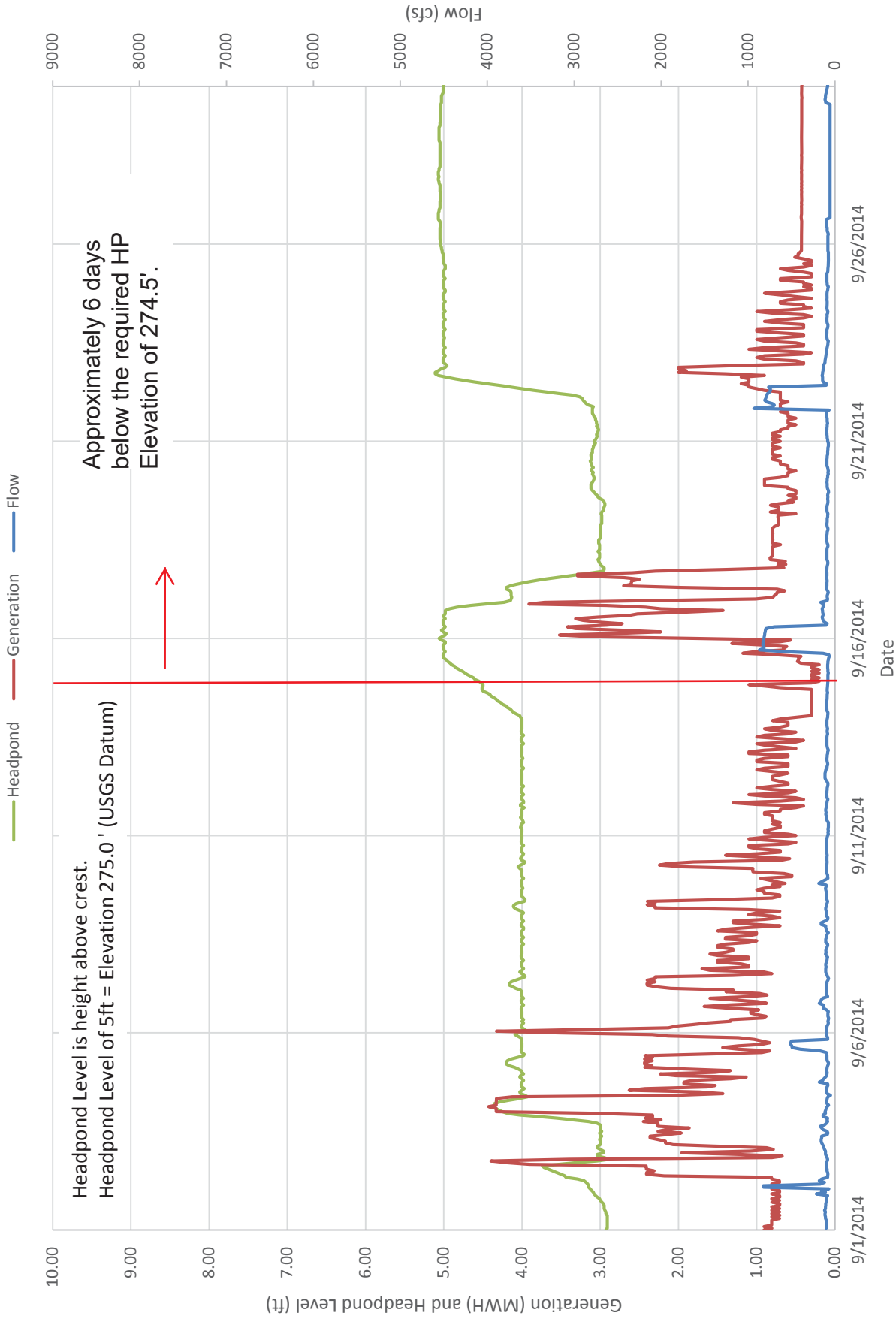
As described within the 2014/2015 data, Essex 19 headpond levels were most often either at 274.5 feet or above. The data shows that the headpond levels only fell below the desired headpond of Elevation 274.5 feet for approximately 6 continuous days. GMP staff indicate that the Essex 19 facility was likely undergoing maintenance activities throughout the duration of the identified 6 continuous day outage.

In accordance with this dataset, it is found that GMP's typical operations protocols occur above the headpond level of 273.0 feet during downstream fish passage seasons and a pond elevation of 274.5 or above allows for the ability to pass approximately 100 cfs or more through one fully opened gate.

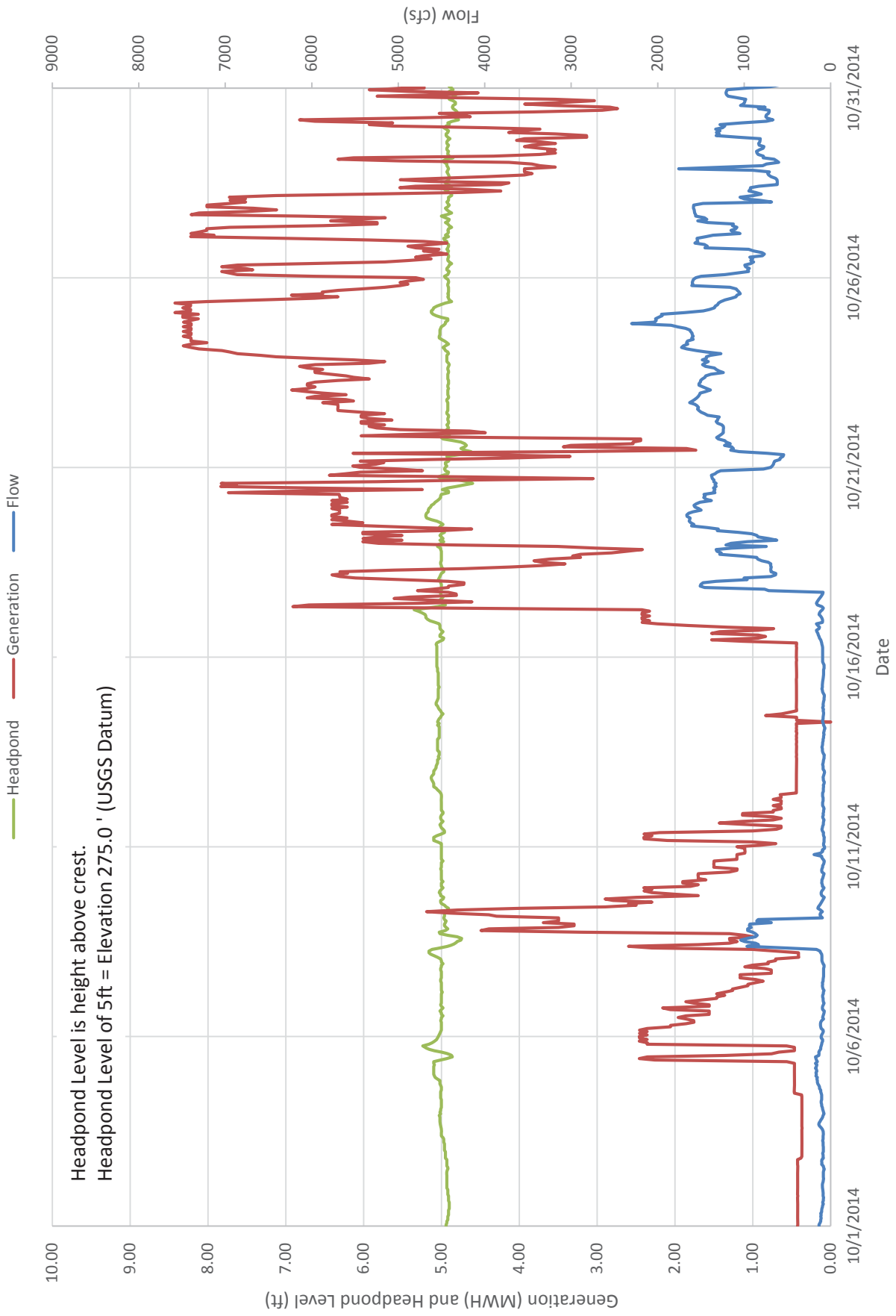
ATTACHMENT A

**ESSEX 19 GENERATION, FLOW, AND HEADPOND DATA
FOR 2014/2015 FISH PASSAGE SEASONS**

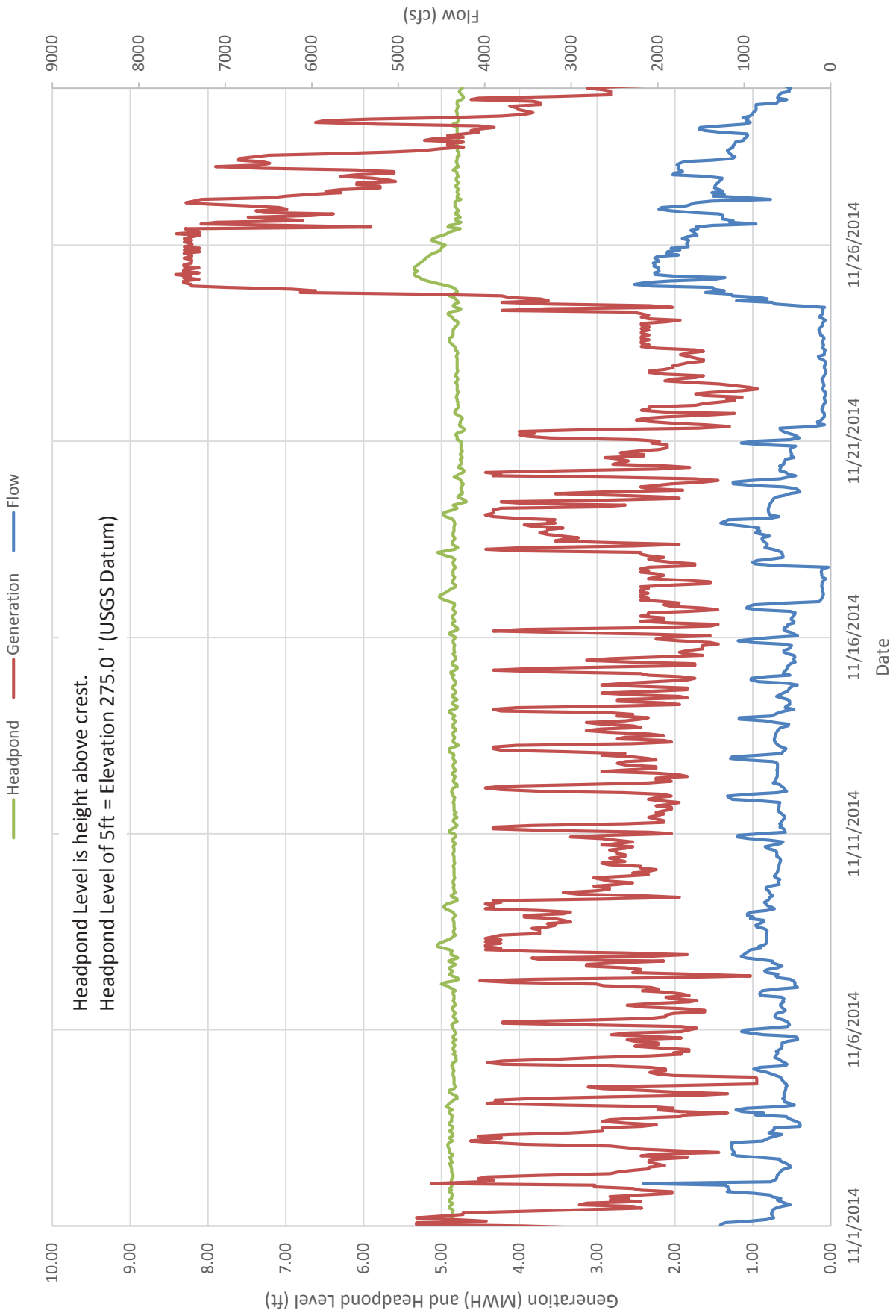
Essex - Generation, Flow, Headpond Data - September 2014



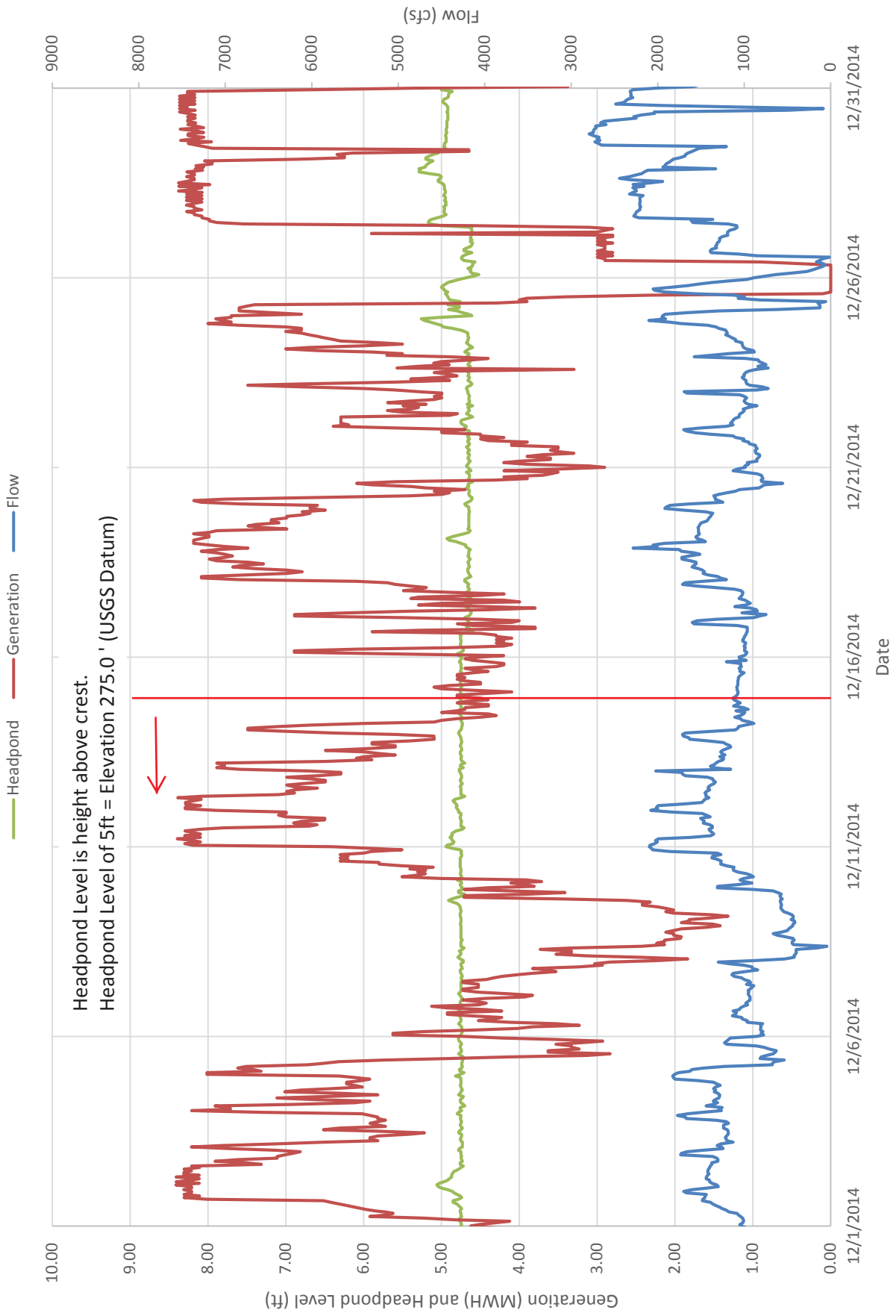
Essex - Generation, Flow, Headpond Data - October 2014



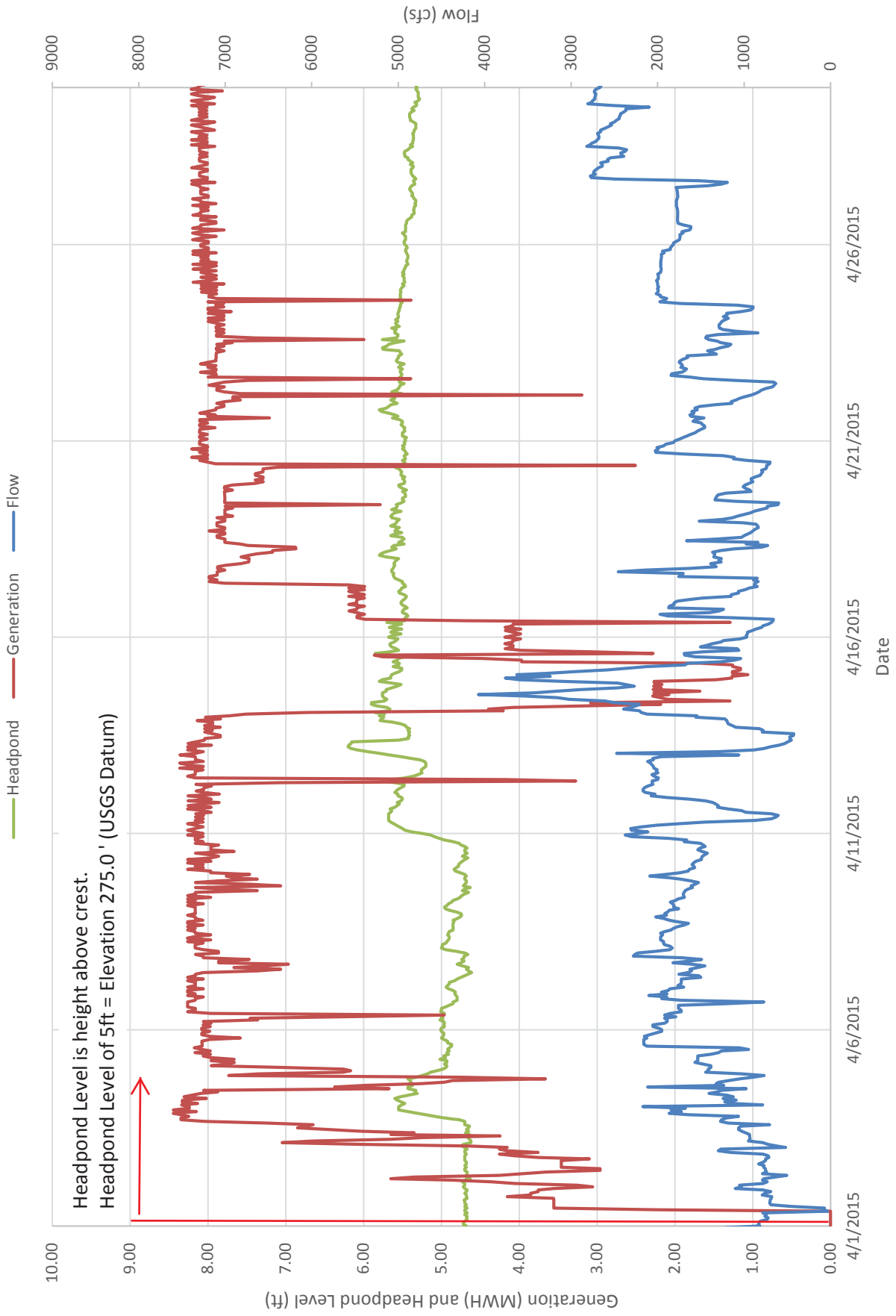
Essex - Generation, Flow, Headpond Data - November 2014



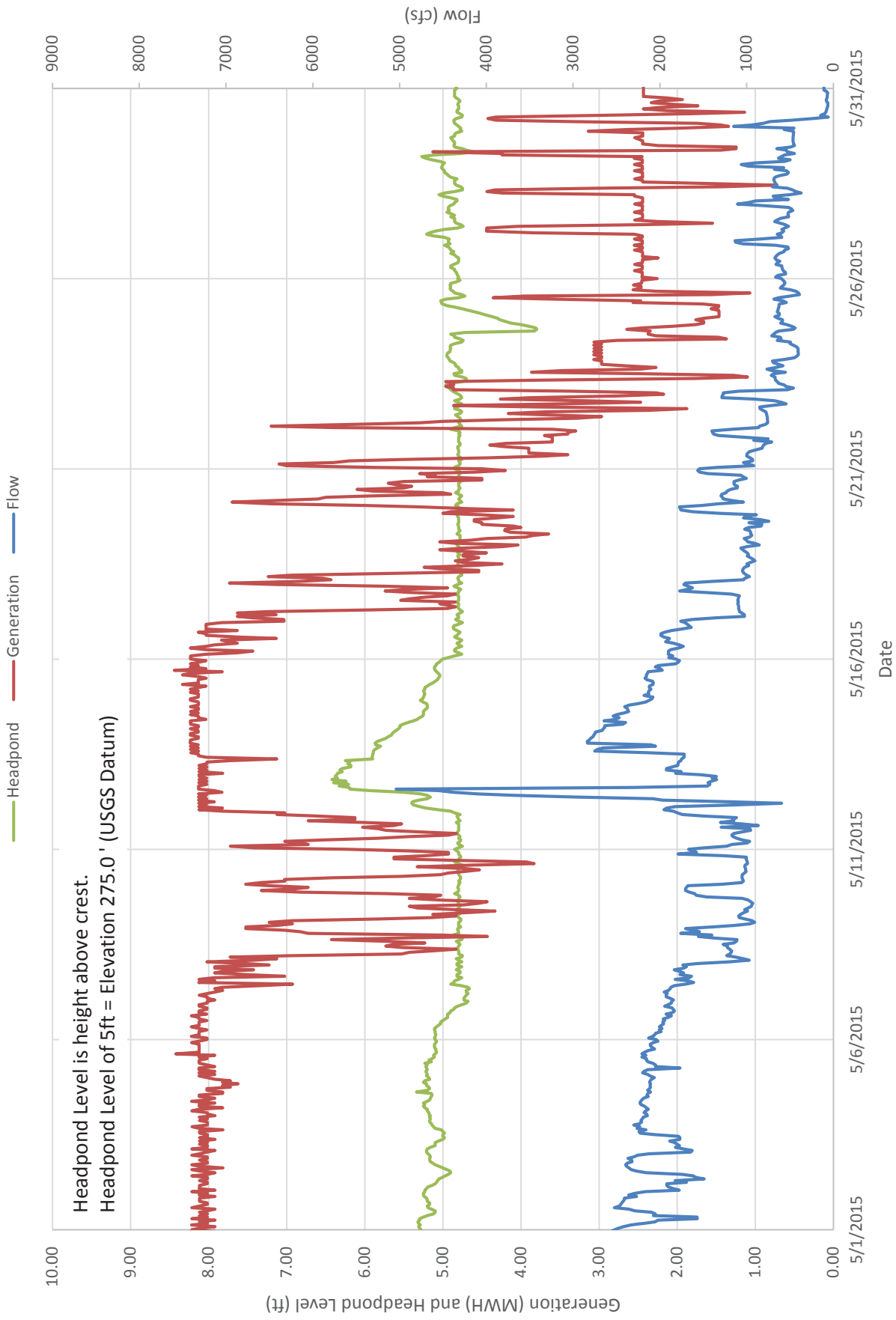
Essex - Generation, Flow, Headpond Data - December 2014



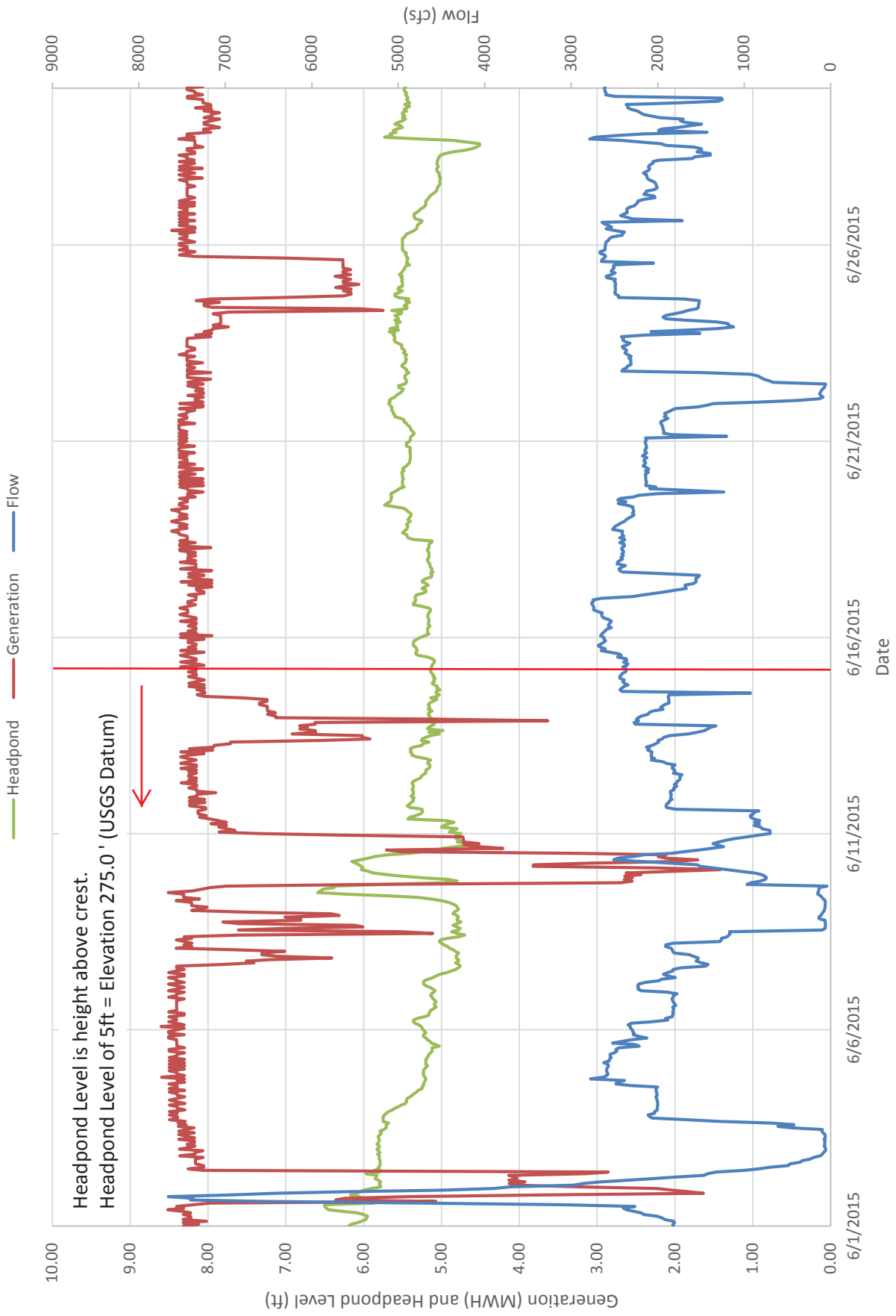
Essex - Generation, Flow, Headpond Data - April 2015



Essex - Generation, Flow, Headpond Data - May 2015



Essex - Generation, Flow, Headpond Data - June 2015



ATTACHMENT D

GMP AND AGENCY CONSULTATION EMAILS ON FISH PASSAGE

From: Katie Sellers
To: ["Towler, Brett"; Greenan, John](#)
Cc: [William Ardren](#); [Staats, Nick](#); [Grader, Melissa](#); [Brandon Kulik](#)
Subject: RE: [EXTERNAL] RE: Essex 19 DS fishway improvements
Date: Wednesday, October 17, 2018 11:28:00 AM
Attachments: [Essex 19 permanent DS weir concept PC Markups.pdf](#)

Hi Brett (& all),

Thank you for quickly turning these revised permanent weir recommendations around. Upon review with contractors and internal team members, GMP commits to proceeding forward with the fabricated metal insert option.

GMP is communicating with a contractor and fabricator now in hopes of installing late this fall (if feasible) or once flows have receded in the spring. That said, the contractor has a few questions regarding dimensions and minimum material requirements. These questions are included in the attached mark-up – would you mind reviewing and providing any feedback that you might have?

Thank you!

Katie

Katie E. Sellers, M.S.
Regulatory Coordinator

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From: Towler, Brett <brett_towler@fws.gov>
Sent: Friday, September 14, 2018 2:31 PM
To: Greenan, John <John.Greenan@greenmountainpower.com>
Cc: William Ardren <william_ardren@fws.gov>; Staats, Nick <Nick.Staats@vermont.gov>; Grader, Melissa <melissa_grader@fws.gov>; Brandon Kulik <Brandon.Kulik@KleinschmidtGroup.com>; Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>
Subject: Re: [EXTERNAL] RE: Essex 19 DS fishway improvements

John, Katie,

Attached is a PDF with details on the permanent weir slot concept and the areas of interest in the lower fishway. This is a modification of the previously recommended insert (from my 11/3/17 PDF) that now includes an inclined ramp at the base to get the lower nappe of the outlet to spring above the bedrock. It also provides some guidance on how far to remove bedrock (in the path of the outlet jet) based on projectile motion equations. In general, I think we've addressed (to the extent we can without testing fish) the entry into and exit from the plunge pool, these suggestions also help improve passage through the lower pool (which is where we noted damage to tomatoes).

Let us know next steps.

Brett

On Tue, Aug 14, 2018 at 9:09 AM, Greenan, John <John.Greenan@greenmountainpower.com> wrote:

Hi Brett-

Yes, it was great to catch up at Essex 19 last week. I thought the FERC inspection provided a forum for several productive discussions plus the ongoing construction afforded a unique view of the project.

Thanks for your comments and insights on the plunge pool. I concur with your suggested course of action below. Please discuss it with your team, forward your updated sketches and then we can reconvene with the entire group to discuss a plan and schedule.

Best,

John G

From: Towler, Brett [mailto:brett_towler@fws.gov]
Sent: Friday, August 10, 2018 10:33 AM
To: Greenan, John
Cc: William Ardren; Staats, Nick; Grader, Melissa
Subject: Essex 19 DS fishway improvements

John,

Good seeing you Tuesday. The wooden contractions at the outlet of the plunge pool look good. They appear to backwater the plunge pool and allow fish movement through the entire water column. Thank you for making these enhancements. The long drive back gave me an opportunity to consider next steps towards a more permanent solution at Essex 19.

Generally speaking, I think our goal is to replace the wooden slot with a more permanent structure (i.e., concrete or steel slot) and enhance safety of fish movement into and out of the lower pool. My thoughts on how to accomplish the latter are consistent with our previous discussions (e.g., floor chute integrated with the vertical slot, minor removal of ledge outcroppings below vertical slot, backwatering lower pool by moving available large rock).

If its OK with you (and Nick, Bill and Melissa, of course), my suggestion would be this:

I'll update my concept sketches and recommendations, email it to you for review (w KA?), and then we circulate back with the group to collect input and finalize a plan and schedule.

Does this sound OK? If so, I'll get you the updated sketches/recommendations within 2 weeks.

Thanks,
Brett



--

Brett Towler, Ph.D., P.E., P.H.
Hydraulic Engineer, Fish Passage Engineering
Fish and Aquatic Conservation
U.S. Fish and Wildlife Service
[300 Westgate Center Drive](#)
[Hadley, MA 01035-9589](#)
413-253-8727
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Essex 19 Hydroelectric Project

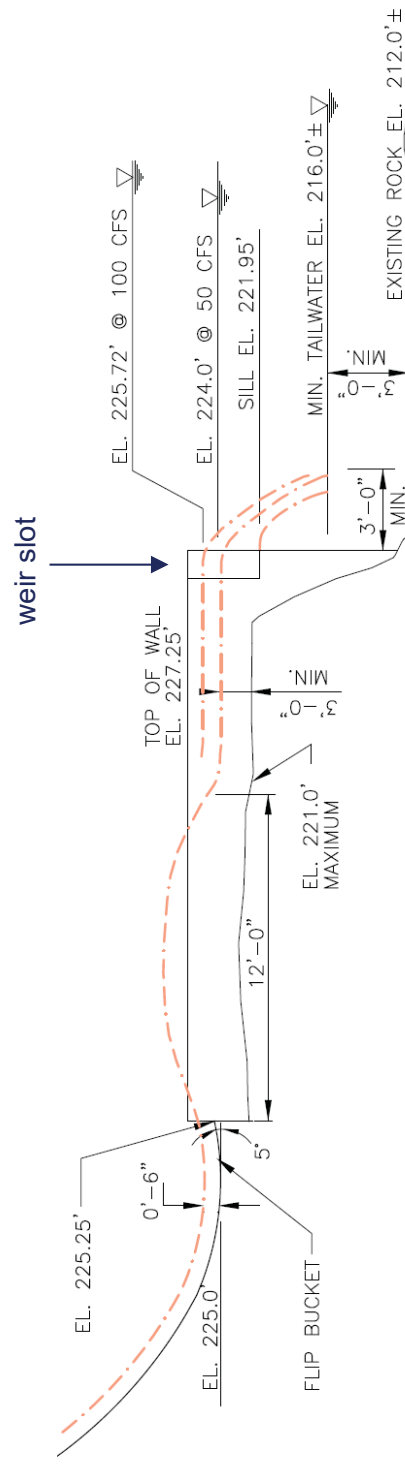
Proposed Permanent Downstream Passage Modifications



B. Towler, USFWS, 9/12/2018

Background:

- In November of 2017, the Service provided concepts for a weir slot constriction at the outlet of the plunge pool; in its “Recommended Modifications to Concrete Weir and Notch” dated 11/3/17, the Service included a temporary and permanent concept for this weir slot.
- The goal was to a) backwater the plunge pool to improve safety of fish entering the pool from the (high velocity) DS chute, and b) promote timely movement of fish out of the plunge pool by replacing the existing weir with a vertical slot (that would allow movement through more of the water column);
- On August 22, 2017, GMP, KA, USFWS and VT participated in a field study to evaluate the improved DS chute jet hydraulics created by backwatering the plunge pool; in July of 2018, GMP installed a temporary weir slot consistent with Service recommendation;
- On August 7, 2018, GMP and the Service discussed next steps on site and specifically the need for a permanent solution to replace the temporary weir slot
- The concept presented here is a modification of the permanent solution proposed in the 11/3/17 document.



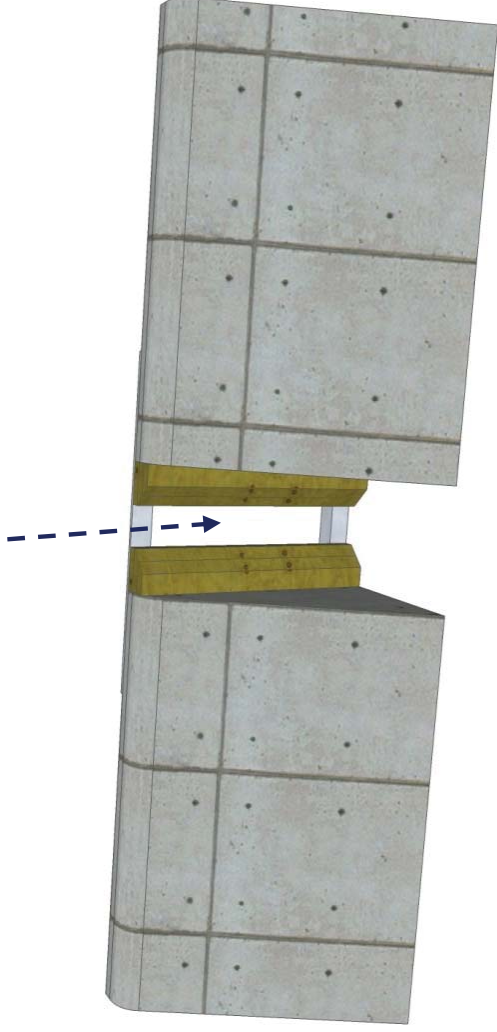
from Record Drawing D-4, 012-034-003 Kleinschmidt Assoc., 2/14/1995

Temporary Solution:
Timber Contracted Slot

DS weir slot as installed
by GMP, July 2018

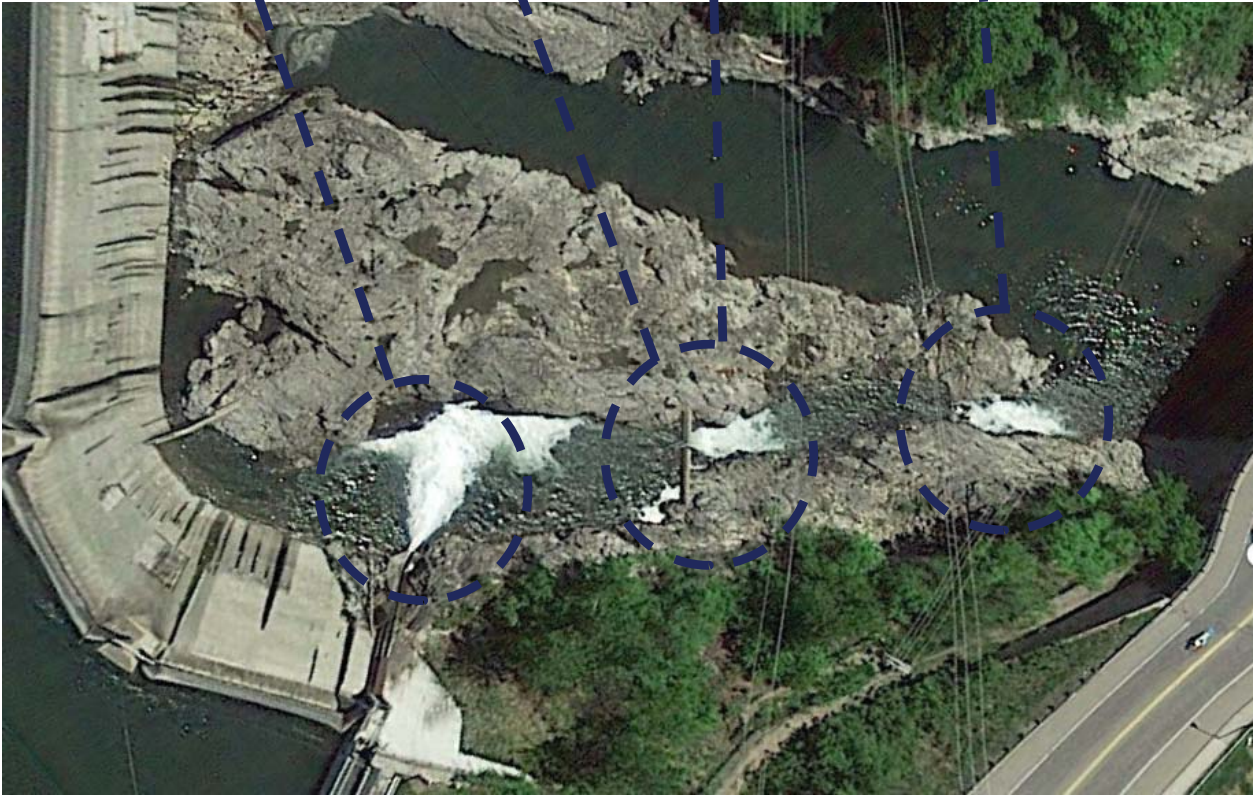


weir slot concept recommend by
Service 11/3/17



Elements of DS Passage in Lower Fishway

- 1. Improving hydraulics of DS chute jet as it enters the plunge pool. *Addressed in August 2017.*
- 2. Modify existing weir into a weir slot. *Temporary solution installed in July 2018*
- 3. Ensure transition into lower pool is safe. Jet must fall into 4 ft + of receiving water and nappe must not impact bedrock
- 4. Backwater lower pool with rock to provide at least 4 ft depth of water

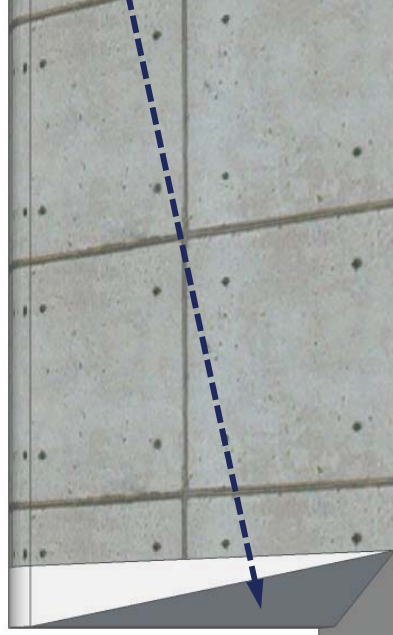


Characteristics of Permanent Weir Slot

Permanent modifications could be constructed out of concrete. Details:

1. Contraction should be set to 1 ft (sufficient to backwater plunge pool while large enough to promote movement of out-migrating smelts and kelts)
2. Base of slot should be sloped upwards (longitudinally); this will allow lower nappe to spring over some exposed bedrock; however, additional bedrock may need to be removed from lower pool (see page 7)

Slope up ~ 9 inches along base of slot



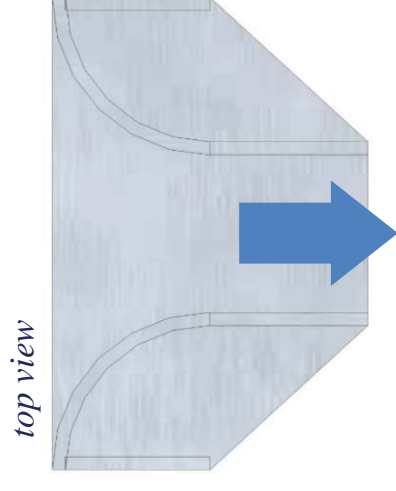
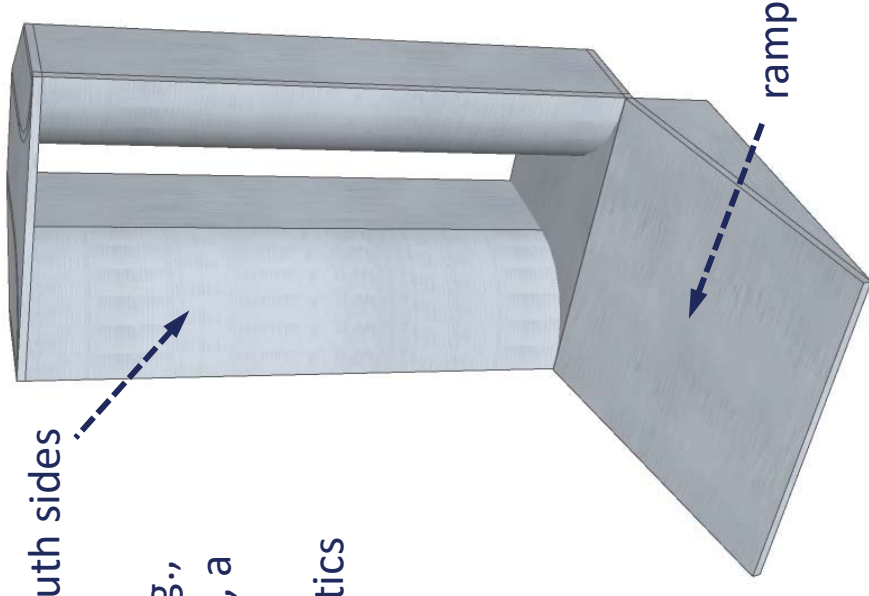
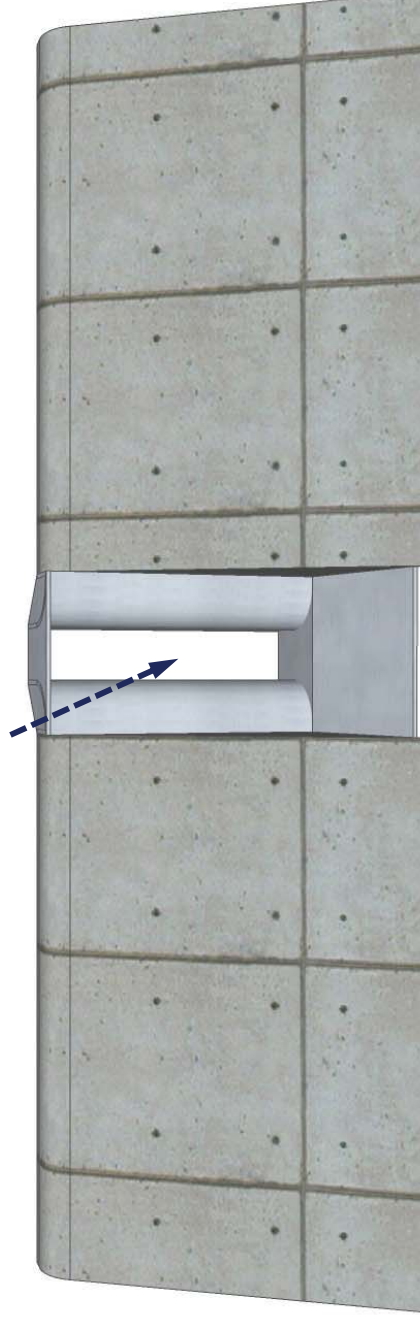
Gradual slot contraction to prevent flow separation and promote gentle accelerations

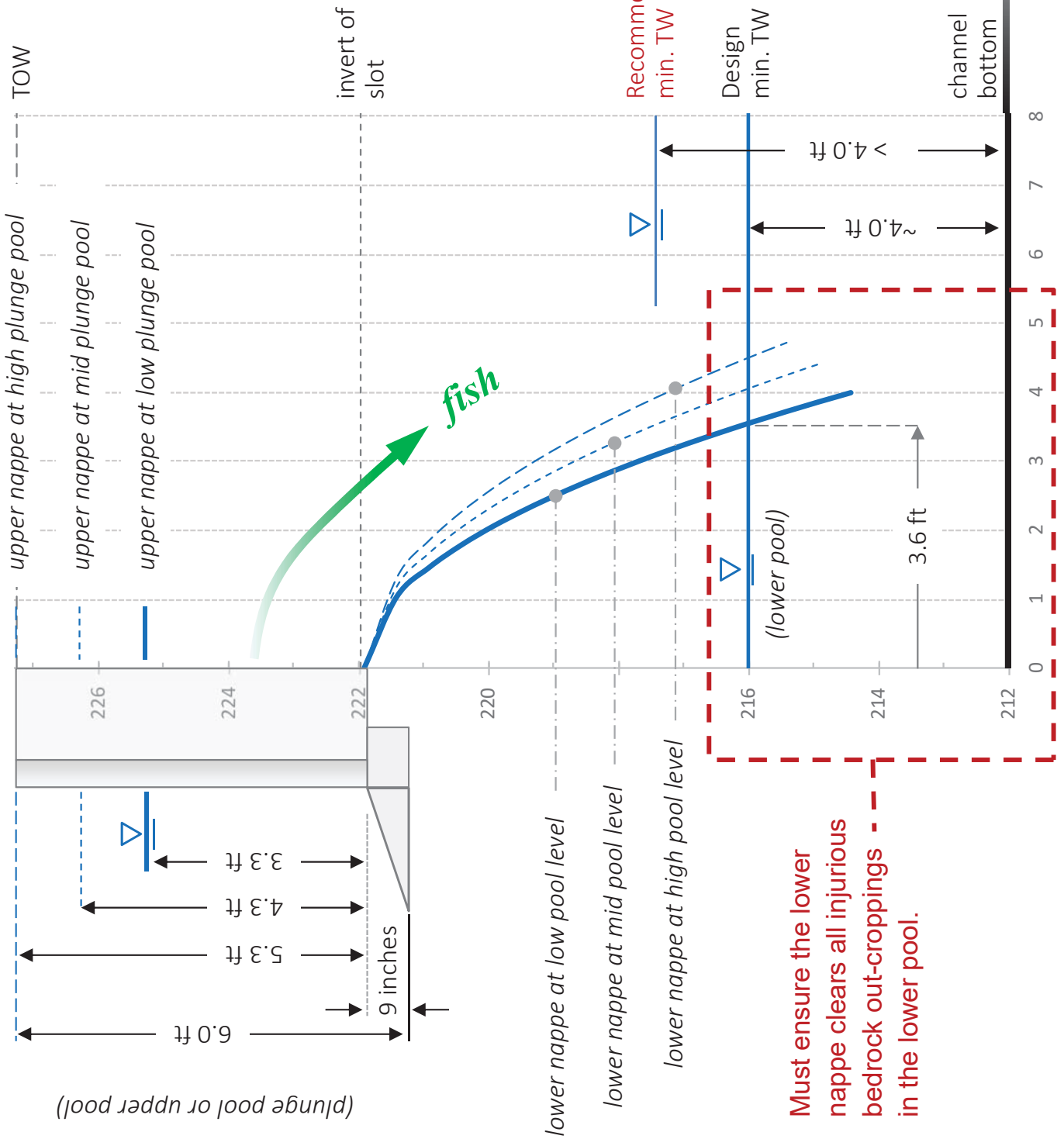
Permanent Weir Slot (insert)

A concrete permanent weir slot may prove difficult to construct (e.g., complicated form work, bonding to existing concrete). Additionally, a concrete weir slot cannot be removed. Alternatively, GMP could consider a fabricated metal insert with the same design characteristics (this is a variant of the insert proposed in 11/3/17 document):

1. 3-ft wide, 6-ft tall insert (SS or alum)
2. Bottom 9-inch ramp to elevate lower nappe; upper 5.25 ft vertical slot
3. Bell-mouthed sides to promote gentle spatial acceleration known to enhance smolt migration

Fabricated metal insert;
permanent weir slot w/ramp





Note: nappe profiles calculated using projectile motion equations with initial velocities estimated from orifice equation (C=0.75 for vertical slot)

Longitudinal distance from outlet of vertical slot

From: Katie Sellers
To: ["Staats, Nick"](#); ["Greenan, John"](#)
Cc: [Brandon Kulik](#); [Jesse Waldrip](#); [Jennifer Jones](#); ["Jessica_Pica@fws.gov"](#); ["Melissa Grader"](#); ["Davis, Eric"](#); ["Towler, Brett"](#); ["McHugh, Peter"](#); ["Bill Ardren"](#); ["Pientka, Bernie"](#); ["Chipman, Brian"](#)
Subject: RE: Plunge pool site visit.
Date: Thursday, July 26, 2018 5:33:00 PM
Attachments: [Image-1.jpg](#)
[IMG_2563.JPG](#)
[IMG_2565.JPG](#)

All – The temporary weir modifications have been installed (photos attached).
Nick & Bill - Sounds like this should work out nicely for your August 7th site visit.

Best!
KATIE

Katie E. Sellers, M.S.
Regulatory Coordinator

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From: Katie Sellers
Sent: Monday, July 23, 2018 11:15 AM
To: 'Staats, Nick' <Nick.Staats@vermont.gov>; Greenan, John <John.Greenan@greenmountainpower.com>
Cc: Brandon Kulik <Brandon.Kulik@KleinschmidtGroup.com>; Jesse Waldrip <Jesse.Waldrip@KleinschmidtGroup.com>; Jennifer Jones <Jennifer.Jones@KleinschmidtGroup.com>; Jessica_Pica@fws.gov; Melissa Grader <melissa_grader@fws.gov>; Davis, Eric <Eric.Davis@vermont.gov>; Towler, Brett <brett_towler@fws.gov>; McHugh, Peter <Peter.McHugh@vermont.gov>; Bill Ardren <William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian <Brian.Chipman@vermont.gov>
Subject: RE: Plunge pool site visit.

Hi Nick – Thanks for checking in. The contractor is planning to work on the weir in the next two weeks (aiming for an early August completion). We will let you know when the work is complete.

Thanks for moving the SOP forward. Feel free to let us know if you want to hold a call to discuss any questions or comments.

Best!
Katie

Katie E. Sellers, M.S.
Regulatory Coordinator

Kleinschmidt

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From: Staats, Nick <Nick.Staats@vermont.gov>

Sent: Thursday, July 12, 2018 8:01 AM

To: Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>; Greenan, John <John.Greenan@greenmountainpower.com>

Cc: Brandon Kulik <Brandon.Kulik@KleinschmidtGroup.com>; Jesse Waldrip <Jesse.Waldrip@KleinschmidtGroup.com>; Jennifer Jones <Jennifer.Jones@KleinschmidtGroup.com>; Jessica_Pica@fws.gov; Melissa Grader <melissa_grader@fws.gov>; Davis, Eric <Eric.Davis@vermont.gov>; Towler, Brett <brett_towler@fws.gov>; McHugh, Peter <Peter.McHugh@vermont.gov>; Bill Ardren <William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian <Brian.Chipman@vermont.gov>

Subject: RE: Plunge pool site visit.

John, Katie,

It looks like you started work on the Essex 19 bladder. Great conditions for that! Hope it goes smoothly. Did you have a timeline for when the downstream modifications will be completed? I want get that on Brett Towler's radar so he can get up here for a visit one completed.

Also, we should be wrapping up the review of the SOP and moving that forward. Thanks for your patience.

Nick

Nicholas Staats
US Fish and Wildlife Service
111 West Street, Essex Junction VT 05452
Phone: (802) 879 5679
Cell: 802-377-5656
Email: nick.staats@vermont.gov
Email: Nicholas_Staats@fws.gov

From: Staats, Nick

Sent: Wednesday, June 13, 2018 3:37 PM

To: 'Katie Sellers' <Katie.Sellers@KleinschmidtGroup.com>; Greenan, John <John.Greenan@greenmountainpower.com>

Cc: Brandon Kulik <Brandon.Kulik@KleinschmidtGroup.com>; Jesse Waldrip <Jesse.Waldrip@KleinschmidtGroup.com>; Jennifer Jones <Jennifer.Jones@KleinschmidtGroup.com>; Jessica_Pica@fws.gov; Melissa Grader <melissa_grader@fws.gov>; Davis, Eric <Eric.Davis@vermont.gov>; Towler, Brett <brett_towler@fws.gov>; McHugh, Peter <Peter.McHugh@vermont.gov>; Bill Ardren <William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian <Brian.Chipman@vermont.gov>
Subject: RE: Plunge pool site visit.

Thanks Katie,

The SOP looks good. I will move that along asap.

Great to hear the plunge pool work will happen. If flows stay the way they are, should be good working conditions.

Nick

Nicholas Staats
US Fish and Wildlife Service
111 West Street, Essex Junction VT 05452
Phone: (802) 879 5679
Cell: 802-377-5656
Email: nick.staats@vermont.gov
Email: Nicholas_Staats@fws.gov

From: Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>
Sent: Wednesday, June 13, 2018 8:24 AM
To: Staats, Nick <Nick.Staats@vermont.gov>; Greenan, John <John.Greenan@greenmountainpower.com>
Cc: Brandon Kulik <Brandon.Kulik@KleinschmidtGroup.com>; Jesse Waldrip <Jesse.Waldrip@KleinschmidtGroup.com>; Jennifer Jones <Jennifer.Jones@KleinschmidtGroup.com>; Jessica_Pica@fws.gov; Melissa Grader <melissa_grader@fws.gov>; Davis, Eric <Eric.Davis@vermont.gov>; Towler, Brett <brett_towler@fws.gov>; McHugh, Peter <Peter.McHugh@vermont.gov>; Bill Ardren <William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian <Brian.Chipman@vermont.gov>
Subject: RE: Plunge pool site visit.

Hi Nick – Just following-up on agency review of the SOP. Please let us know if you have any questions upon review.

Also for the plunge pool, want to confirm that GMP will indeed be pursuing installation of Temporary Alternative No. 1 this summer in tandem with Essex 19 rubber dam replacement work. Rubber dam

work mobilization is scheduled to start in early July.

Best
Katie

Katie E. Sellers, M.S.
Regulatory Coordinator

Kleinschmidt

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From: Katie Sellers

Sent: Monday, April 30, 2018 9:49 AM

To: 'Staats, Nick' <Nick.Staats@vermont.gov>; Greenan, John
<John.Greenan@greenmountainpower.com>

Cc: Brandon Kulik <Brandon.Kulik@KleinschmidtGroup.com>; Jesse Waldrip
<Jesse.Waldrip@KleinschmidtGroup.com>; Jennifer Jones
<Jennifer.Jones@KleinschmidtGroup.com>; Jessica_Pica@fws.gov; Melissa Grader
<melissa_grader@fws.gov>; Davis, Eric <Eric.Davis@vermont.gov>; Towler, Brett
<brett_towler@fws.gov>; McHugh, Peter <Peter.McHugh@vermont.gov>; Bill Ardren
<William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian
<Brian.Chipman@vermont.gov>

Subject: RE: Plunge pool site visit.

Good Morning Nick. Attached for your review please find the draft Essex 19 Downstream Fishway SOP. This SOP was developed in close coordination with GMP's Essex 19 operators.

Should you have any questions upon review please let us know.

Thank you!
Katie

Katie E. Sellers, M.S.
Regulatory Coordinator

Kleinschmidt

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From: Staats, Nick [<mailto:Nick.Staats@vermont.gov>]

Sent: Wednesday, April 11, 2018 8:45 AM

To: Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>; Greenan, John
<John.Greenan@greenmountainpower.com>

Cc: Brandon Kulik <Brandon.Kulik@KleinschmidtGroup.com>; Jesse Waldrip

<Jesse.Waldrip@KleinschmidtGroup.com>; Jennifer Jones
<Jennifer.Jones@KleinschmidtGroup.com>; Jessica_Pica@fws.gov; Melissa Grader
<melissa_grader@fws.gov>; Davis, Eric <Eric.Davis@vermont.gov>; Towler, Brett
<brett_towler@fws.gov>; McHugh, Peter <Peter.McHugh@vermont.gov>; Bill Ardren
<William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian
<Brian.Chipman@vermont.gov>

Subject: RE: Plunge pool site visit.

Thanks Kate!

Nick

From: Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>

Sent: Wednesday, April 11, 2018 8:39 AM

To: Staats, Nick <Nick.Staats@vermont.gov>; Greenan, John
<John.Greenan@greenmountainpower.com>

Cc: Brandon Kulik <Brandon.Kulik@KleinschmidtGroup.com>; Jesse Waldrip
<Jesse.Waldrip@KleinschmidtGroup.com>; Jennifer Jones
<Jennifer.Jones@KleinschmidtGroup.com>; Jessica_Pica@fws.gov; Melissa Grader
<melissa_grader@fws.gov>; Davis, Eric <Eric.Davis@vermont.gov>; Towler, Brett
<brett_towler@fws.gov>; McHugh, Peter <Peter.McHugh@vermont.gov>; Bill Ardren
<William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian
<Brian.Chipman@vermont.gov>

Subject: RE: Plunge pool site visit.

Hi Nick – Thanks for touching base. We are currently in the midst of finalizing an Essex 19 Downstream Fishway SOP as recommended within the USFWS November 17, 2017 memo. We will have the draft SOP out for group review very shortly (hopefully at the end of this week). Per communications with Essex 19 operators on Friday March 30th, Gate #2 is currently 100% open with a headpond of 274.5'. The gate was fully opened on Friday March 30th in advance of GMP's downstream passage requirement that started on April 1st. Gate #1 will open fully when high waters recede.

As for the plunge pool, GMP has reviewed the options presented in the memo and intends to install Temporary Alternative No. 1 this summer, potentially in tandem with scheduled Essex 19 rubber dam replacement work. The rubber dam replacement work is scheduled to occur July 2018 - August 2018 (after completion of the spring fish passage season but before initiation of the fall passage season). Since contractors will already be mobilized at the site, we believe it makes sense timing wise to try and install the temporary weir configuration then. We will communicate a firmer installation plan once details become finalized with the rubber dam work.

We will follow-up with the draft SOP shortly.

Best
Katie

Katie E. Sellers, M.S.
Regulatory Coordinator

Kleinschmidt

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From: Staats, Nick [<mailto:Nick.Staats@vermont.gov>]

Sent: Monday, April 02, 2018 12:06 PM

To: Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>; Greenan, John
<John.Greenan@greenmountainpower.com>

Cc: Brandon Kulik <Brandon.Kulik@KleinschmidtGroup.com>; Jesse Waldrip
<Jesse.Waldrip@KleinschmidtGroup.com>; Jennifer Jones
<Jennifer.Jones@KleinschmidtGroup.com>; Jessica_Pica@fws.gov; Melissa Grader
<melissa_grader@fws.gov>; Davis, Eric <Eric.Davis@vermont.gov>; Towler, Brett
<brett_towler@fws.gov>; McHugh, Peter <Peter.McHugh@vermont.gov>; Bill Ardren
<William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian
<Brian.Chipman@vermont.gov>

Subject: RE: Plunge pool site visit.

Hi Katie and John,

Hope things are going well. Two questions related to Essex 19.

1. Can you update the group on the status of your review of the Fish and Wildlife Services November 17, 2017 memo to Vermont DEC regarding recommendations on the downstream fish passage at Essex 19?
2. What is GMP's plan for this spring's downstream fish passage operations? Will there be any temporary modifications to the plunge pool?

Salmon smolt out-migration will begin this month and continue into June. I would suggest at a minimum for downstream passage to operate from April 15 – June 30th.

I will be operating the salmon smolt trap on the Huntington River again this spring and would be happy to update you on the numbers of fish captured.

Thanks

Nick

Nicholas Staats
US Fish and Wildlife Service
111 West Street, Essex Junction VT 05452
Phone: (802) 879 5679
Cell: 802-377-5656
Email: nick.staats@vermont.gov
Email: Nicholas_Staats@fws.gov

From: Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>

Sent: Tuesday, January 02, 2018 4:12 PM

To: Davis, Eric <Eric.Davis@vermont.gov>; Staats, Nick <Nick.Staats@vermont.gov>; Towler, Brett <brett_towler@fws.gov>; McHugh, Peter <Peter.McHugh@vermont.gov>; Greenan, John <John.Greenan@greenmountainpower.com>; Bill Ardren <William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian <Brian.Chipman@vermont.gov>; Melissa Grader <melissa_grader@fws.gov>; Jessica_Pica@fws.gov

Cc: Brandon Kulik <Brandon.Kulik@KleinschmidtGroup.com>; Jesse Waldrip <Jesse.Waldrip@KleinschmidtGroup.com>; Jennifer Jones <Jennifer.Jones@KleinschmidtGroup.com>

Subject: RE: Plunge pool site visit.

Thank you Eric – We will review as a group and will touch base shortly.

Happy new year and stay warm everyone,
Katie

From: Davis, Eric [<mailto:Eric.Davis@vermont.gov>]

Sent: Tuesday, January 02, 2018 3:42 PM

To: Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>; Staats, Nick <Nick.Staats@vermont.gov>; Towler, Brett <brett_towler@fws.gov>; McHugh, Peter <Peter.McHugh@vermont.gov>; Greenan, John <John.Greenan@greenmountainpower.com>; Bill Ardren <William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian <Brian.Chipman@vermont.gov>; Melissa Grader <melissa_grader@fws.gov>; Jessica_Pica@fws.gov

Cc: Brandon Kulik <Brandon.Kulik@KleinschmidtGroup.com>; Jesse Waldrip <Jesse.Waldrip@KleinschmidtGroup.com>; Jennifer Jones <Jennifer.Jones@KleinschmidtGroup.com>

Subject: RE: Plunge pool site visit.

Hi Katie,

Please find attached a memorandum prepared by the USFWS and addressed to Vermont DEC regarding downstream fish passage at the Essex 19 project. The memorandum summarizes the Service's initial recommendations, GMP's actions to date, provides a review of the field testing performed on August 22, 2017, and includes additional recommendations, many of which were discussed on site during the field testing. When you have an opportunity, please review the memorandum with the GMP team and let us know where GMP is on the modifications we discussed on-site and your thoughts on any additional modifications.

Thank you (and Happy New Year!),
Eric

Eric Davis, *River Ecologist*

1 National Life Drive, Main 2
Montpelier, VT 05620-3522
802-490-6180 / eric.davis@vermont.gov
<http://www.watershedmanagement.vt.gov/rivers>
(Please note my new e-mail address, effective July 27, 2015)



See what we're up to on our [Blog](#). [Flow](#).

From: Katie Sellers [<mailto:Katie.Sellers@KleinschmidtGroup.com>]
Sent: Friday, December 15, 2017 3:38 PM
To: Staats, Nick <Nick.Staats@vermont.gov>; Towler, Brett <brett_towler@fws.gov>; McHugh, Peter <Peter.McHugh@vermont.gov>; Greenan, John <John.Greenan@greenmountainpower.com>; Bill Ardren <William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian <Brian.Chipman@vermont.gov>; Davis, Eric <Eric.Davis@vermont.gov>; Melissa Grader <melissa_grader@fws.gov>; Jessica_Pica@fws.gov
Cc: Brandon Kulik <Brandon.Kulik@KleinschmidtGroup.com>; Jesse Waldrip <Jesse.Waldrip@KleinschmidtGroup.com>; Jennifer Jones <Jennifer.Jones@KleinschmidtGroup.com>
Subject: RE: Plunge pool site visit.

Great, thank you Nick for the update.

Best
Katie

From: Staats, Nick [<mailto:Nick.Staats@vermont.gov>]
Sent: Friday, December 15, 2017 2:18 PM
To: Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>; Towler, Brett <brett_towler@fws.gov>; McHugh, Peter <Peter.McHugh@vermont.gov>; Greenan, John <John.Greenan@greenmountainpower.com>; Bill Ardren <William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian <Brian.Chipman@vermont.gov>; Davis, Eric <Eric.Davis@vermont.gov>; Melissa Grader <melissa_grader@fws.gov>; Jessica_Pica@fws.gov
Cc: Brandon Kulik <Brandon.Kulik@KleinschmidtGroup.com>; Jesse Waldrip <Jesse.Waldrip@KleinschmidtGroup.com>; Jennifer Jones <Jennifer.Jones@KleinschmidtGroup.com>
Subject: RE: Plunge pool site visit.

Hi Katie,

The Fish and Wildlife Service has provided Vermont with our review of the August 22, 2017 downstream fish passage field test results. We included in that review a summary of what GMP has resolved following the initial site visit in September, 2016. The Service has made recommendations

to improve fish passage at the site which include detailed drawings of the plunge pool and potential plunge pool weir modifications. Vermont received our recommendations on November 17 and I suspect they are reviewing them. I will see what I can find out.

Thank you for your patience,
Nick

Nicholas Staats
US Fish and Wildlife Service
111 West Street, Essex Junction VT 05452
Phone: (802) 879 5679
Cell: 802-377-5656
Email: nick.staats@vermont.gov
Email: Nicholas_Staats@fws.gov

From: Katie Sellers [<mailto:Katie.Sellers@KleinschmidtGroup.com>]
Sent: Friday, December 15, 2017 1:35 PM
To: Staats, Nick <Nick.Staats@vermont.gov>; Towler, Brett <brett_towler@fws.gov>; McHugh, Peter <Peter.McHugh@vermont.gov>; Greenan, John <John.Greenan@greenmountainpower.com>; Bill Ardren <William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian <Brian.Chipman@vermont.gov>; Davis, Eric <Eric.Davis@vermont.gov>; Melissa Grader <melissa_grader@fws.gov>; Jessica_Pica@fws.gov
Cc: Brandon Kulik <Brandon.Kulik@KleinschmidtGroup.com>; Jesse Waldrip <Jesse.Waldrip@KleinschmidtGroup.com>; Jennifer Jones <Jennifer.Jones@KleinschmidtGroup.com>
Subject: RE: Plunge pool site visit.

Hi Nick – Following-up on this topic. What is the status on agency review/recommendations?

Thank you
Katie

Katie E. Sellers, M.S.
Regulatory Coordinator

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From: Katie Sellers
Sent: Wednesday, September 20, 2017 5:16 PM
To: 'Staats, Nick' <Nick.Staats@vermont.gov>; Towler, Brett <brett_towler@fws.gov>; McHugh, Peter <Peter.McHugh@vermont.gov>; Greenan, John <John.Greenan@greenmountainpower.com>; Bill Ardren <William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman,

Brian <Brian.Chipman@vermont.gov>; Davis, Eric <Eric.Davis@vermont.gov>; Melissa Grader <melissa_grader@fws.gov>; Jessica_Pica@fws.gov

Cc: Brandon Kulik <Brandon.Kulik@KleinschmidtGroup.com>; Jesse Waldrip <Jesse.Waldrip@KleinschmidtGroup.com>; Jennifer Jones <Jennifer.Jones@KleinschmidtGroup.com>

Subject: RE: Plunge pool site visit.

Thanks Nick for the update, much appreciated. We will keep you posted regarding movement on plunge pool weir ideas.

Best!

Katie

Katie E. Sellers, M.S.
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From: Staats, Nick [<mailto:Nick.Staats@vermont.gov>]

Sent: Monday, September 18, 2017 2:48 PM

To: Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>; Towler, Brett <brett_towler@fws.gov>; McHugh, Peter <Peter.McHugh@vermont.gov>; Greenan, John <John.Greenan@greenmountainpower.com>; Bill Ardren <William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian <Brian.Chipman@vermont.gov>; Davis, Eric <Eric.Davis@vermont.gov>; Melissa Grader <melissa_grader@fws.gov>; Jessica_Pica@fws.gov

Cc: Brandon Kulik <Brandon.Kulik@KleinschmidtGroup.com>; Jesse Waldrip <Jesse.Waldrip@KleinschmidtGroup.com>; Jennifer Jones <Jennifer.Jones@KleinschmidtGroup.com>

Subject: RE: Plunge pool site visit.

Katie,

Thanks for the summary of the site visit. The Service is reviewing the document and modifications that have been completed on the Essex 19 downstream fish passage facility. Our review and any additional recommendations will be forwarded to Vermont. We appreciate the efforts by GMP to improve the passage facility. The elevated plunge pool appears to reduce possible injuries to passing smolts and with some minor modifications to the slotted weir transition from the pool to river below I think things are looking much better.

We hope to have our review/recommendations to Vermont by mid-October. If GMP would like to get started on improving the plunge pool weir, perhaps we can get some ideas to you earlier than that. Let me know.

Thanks

Nick

Nicholas Staats
US Fish and Wildlife Service
111 West Street, Essex Junction VT 05452
Phone: (802) 879 5679
Cell: 802-377-5656
Email: nick.staats@vermont.gov
Email: Nicholas_Staats@fws.gov

From: Katie Sellers [<mailto:Katie.Sellers@KleinschmidtGroup.com>]
Sent: Monday, September 18, 2017 2:32 PM
To: Staats, Nick <Nick.Staats@vermont.gov>; Towler, Brett <brett_towler@fws.gov>; McHugh, Peter <Peter.McHugh@vermont.gov>; Greenan, John <John.Greenan@greenmountainpower.com>; Bill Ardren <William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian <Brian.Chipman@vermont.gov>; Davis, Eric <Eric.Davis@vermont.gov>; Melissa Grader <melissa_grader@fws.gov>; Jessica_Pica@fws.gov
Cc: Brandon Kulik <Brandon.Kulik@KleinschmidtGroup.com>; Jesse Waldrip <Jesse.Waldrip@KleinschmidtGroup.com>; Jennifer Jones <Jennifer.Jones@KleinschmidtGroup.com>
Subject: RE: Plunge pool site visit.

Hi All – Just following-up on this summary. Please let me know if you have any comments or additions to the document.

Also, thinking in terms of next steps for this topic, about when should we expect agency recommendations from the site visit?

Thank you,
Katie

Katie E. Sellers, M.S.
Regulatory Coordinator

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From: Katie Sellers
Sent: Wednesday, September 06, 2017 2:35 PM

To: Staats, Nick <Nick.Staats@vermont.gov>; Towler, Brett <brett_towler@fws.gov>; McHugh, Peter <Peter.McHugh@vermont.gov>; Greenan, John <John.Greenan@greenmountainpower.com>; Bill Ardren <William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian <Brian.Chipman@vermont.gov>; Davis, Eric <Eric.Davis@vermont.gov>; Melissa Grader <melissa_grader@fws.gov>; 'Jessica_Pica@fws.gov' <Jessica_Pica@fws.gov>
Cc: Brandon Kulik <Brandon.Kulik@KleinschmidtGroup.com>; Jesse Waldrip <Jesse.Waldrip@KleinschmidtGroup.com>; Jennifer Jones <Jennifer.Jones@KleinschmidtGroup.com>
Subject: RE: Plunge pool site visit.

Afternoon All – Attached for your review please find our August 22nd Essex 19 site meeting summary.

Please let me know if I have missed anything or if you have any edits to add.

Thank you again for taking time to meet with us on site.

Katie

Katie E. Sellers, M.S.
Regulatory Coordinator

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From: Brandon Kulik

Sent: Friday, August 18, 2017 2:49 PM

To: Staats, Nick <Nick.Staats@vermont.gov>; Towler, Brett <brett_towler@fws.gov>; McHugh, Peter <Peter.McHugh@vermont.gov>; Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>

Cc: Greenan, John <John.Greenan@greenmountainpower.com>; Bill Ardren <William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian <Brian.Chipman@vermont.gov>; Davis, Eric <Eric.Davis@vermont.gov>; Melissa Grader <melissa_grader@fws.gov>

Subject: Plunge pool site visit. SCHEDULE ADJUSTMENT ALERT!!!

Importance: High

Good afternoon everyone,

Just a quick note to advise you that we have been asked to delay the Essex 19 site meeting until 12:30 on Tuesday to better accommodate travel needs of some attendees. Hopefully this won't be a problem for anyone. We believe we can accomplish everything that we need to do in approximately a 2 hour time frame.

Have a great weekend

Brandon

From: Brandon Kulik

Sent: Thursday, August 17, 2017 3:47 PM

To: 'Staats, Nick' <Nick.Staats@vermont.gov>; Towler, Brett <brett_towler@fws.gov>; McHugh, Peter <Peter.McHugh@vermont.gov>; Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>

Cc: Greenan, John <John.Greenan@greenmountainpower.com>; Bill Ardren <William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian <Brian.Chipman@vermont.gov>; Davis, Eric <Eric.Davis@vermont.gov>; Melissa Grader <melissa_grader@fws.gov>

Subject: Plunge pool site visit. Green Mountain Power - Essex 19

Hi All,

Just a brief notice to confirm that we will be meeting at Essex 19 to view how modifications to the plunge pool outlet weir affect downstream fish passage hydraulics. The notch in the outlet weir has been temporarily sealed, and this does in fact significantly deepen the plunge pool. We are proposing that we all assemble on site no later than 10 AM on August 22. Regarding safety gear, please plan to bring a life vest and secure footwear. We will begin with introductions, a safety tailboard briefing, then a recap of recent activities and information, and then move to the fishway hydraulics assessment. We are currently working out the final logistical details.

Let me know if you have any questions. Otherwise we look forward to seeing you on August 22 at 10 AM

Sincerely,

Brandon

Brandon H. Kulik
Senior Fisheries Scientist

Kleinschmidt

Pittsfield, Maine

207-487-3328

From: Staats, Nick [<mailto:Nick.Staats@vermont.gov>]

Sent: Tuesday, August 15, 2017 8:18 AM

To: Brandon Kulik <Brandon.Kulik@KleinschmidtGroup.com>; Towler, Brett

<brett_towler@fws.gov>; McHugh, Peter <Peter.McHugh@vermont.gov>; Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>

Cc: Greenan, John <John.Greenan@greenmountainpower.com>; Bill Ardren <William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian <Brian.Chipman@vermont.gov>; Davis, Eric <Eric.Davis@vermont.gov>; Melissa Grader <melissa_grader@fws.gov>

Subject: RE: Doodle Poll for plunge pool site visit. Green Mountain Power - Essex 19

Brandon,

So, is August 22 the day? I see boards have been placed in the weir slot in the plunge pool.. Bill Ardren will take my place because, unfortunately I will be out of town.

Thanks
Nick

Nicholas Staats
US Fish and Wildlife Service
111 West Street, Essex Junction VT 05452
Phone: (802) 879 5679
Cell: 802-377-5656
Email: nick.staats@vermont.gov
Email: Nicholas_Staats@fws.gov

From: Brandon Kulik [<mailto:Brandon.Kulik@KleinschmidtGroup.com>]

Sent: Wednesday, July 26, 2017 2:43 PM

To: Towler, Brett <brett_towler@fws.gov>; McHugh, Peter <Peter.McHugh@vermont.gov>; Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>

Cc: Greenan, John <John.Greenan@greenmountainpower.com>; Staats, Nick <Nick.Staats@vermont.gov>; Bill Ardren <William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian <Brian.Chipman@vermont.gov>; Davis, Eric <Eric.Davis@vermont.gov>; Melissa Grader <melissa_grader@fws.gov>

Subject: RE: Doodle Poll for plunge pool site visit. Green Mountain Power - Essex 19

Good afternoon,

The Doodle Poll seems to have run its course; Looks like potential dates are August 22, 29, or 30. If 8/22 we lose Peter McHugh and if the other dates we lose Brian Chipman, who notes that he feels his attendance isn't mandatory. If Peter doesn't object, I would suggest we hold 8/22 open as the target, but either 8/29 or 8/30 as alternative rain dates. If Peter feels strongly about attending then we will shift to 8/29 or 8/30.

Brandon

From: Brandon Kulik

Sent: Tuesday, July 18, 2017 4:09 PM

To: 'Towler, Brett' <brett_towler@fws.gov>; 'McHugh, Peter' <Peter.McHugh@vermont.gov>; Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>

Cc: Greenan, John <John.Greenan@greenmountainpower.com>; Staats, Nick <Nick.Staats@vermont.gov>; Bill Ardren <William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian <Brian.Chipman@vermont.gov>; Davis, Eric <Eric.Davis@vermont.gov>; Melissa Grader <melissa_grader@fws.gov>

Subject: Doodle Poll for plunge pool site visit. Green Mountain Power - Essex 19

Please forgive me if I have overlooked anyone who needs to attend. If there are multiple dates that are mutually workable let's keep a couple of them tentatively reserved pending a better idea regarding suitable field conditions

<http://doodle.com/poll/fscpcxip5vyzqswx>

Brandon

Brandon H. Kulik

Senior Fisheries Scientist

Kleinschmidt

Pittsfield, Maine

207-487-3328

From: Katie Sellers
To: ["Davis, Eric"](#); [Staats, Nick](#); [Greenan, John](#)
Cc: [Brandon Kulik](#); [Jesse Waldrip](#); [Jennifer Jones](#); [Jessica_Pica@fws.gov](#); [Melissa Grader](#); [Towler, Brett](#); [McHugh, Peter](#); [Bill Ardren](#); [Pientka, Bernie](#); [Chipman, Brian](#); [Crocker, Jeff](#)
Subject: RE: Essex 19 Fish Passage Consultation
Date: Monday, October 22, 2018 5:09:00 PM

Hi Eric (& all), Thank you for providing a review of this SOP. GMP has considered and understands agency desire to shift timing of spring passage from April 1 - June 15 to April 15 - June 30 and commits to implementing this spring passage shift at both Essex 19 and at the downstream Gorge 18 facility. GMP will work with FERC to have this SOP and amended fish passage dates memorialized in the Project docket.

Best, Katie

Katie E. Sellers, M.S.
Regulatory Coordinator

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From: Davis, Eric <Eric.Davis@vermont.gov>
Sent: Thursday, September 13, 2018 1:37 PM
To: Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>; Staats, Nick <Nick.Staats@vermont.gov>; Greenan, John <John.Greenan@greenmountainpower.com>
Cc: Brandon Kulik <Brandon.Kulik@KleinschmidtGroup.com>; Jesse Waldrip <Jesse.Waldrip@KleinschmidtGroup.com>; Jennifer Jones <Jennifer.Jones@KleinschmidtGroup.com>; Jessica_Pica@fws.gov; Melissa Grader <melissa_grader@fws.gov>; Towler, Brett <brett_towler@fws.gov>; McHugh, Peter <Peter.McHugh@vermont.gov>; Bill Ardren <William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian <Brian.Chipman@vermont.gov>; Crocker, Jeff <Jeff.Crocker@vermont.gov>
Subject: Essex 19 Fish Passage Consultation

Good morning Katie and John,

You'll recall in VTANR's comment letter on LIHI certification, the Agency recommended re-initiation of consultation on the downstream bypass facility at the Essex 19 project with Vermont Department of Fish and Wildlife and U.S. Fish and Wildlife Service. Subsequent to re-initiation, the USFWS recommended that GMP develop a Standard Operating Protocol (SOP) to codify fishway operations. Consistent with this recommendation, GMP developed an SOP, which was previously distributed to Stakeholders.

The SOP has been reviewed by the USFWS in consultation with VTDFW. USFWS prepared the attached comments and recommendations on the plan. VTDEC concurs with these

recommendations. Please let us know your thoughts after you've had an opportunity to review.

Thank you for your continued work improving downstream passage at Essex 19,
Eric

Eric Davis, River Ecologist

1 National Life Drive, Main 2
Montpelier, VT 05620-3522
802-490-6180 / eric.davis@vermont.gov
<http://www.watershedmanagement.vt.gov/rivers>



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From: Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>

Sent: Thursday, July 26, 2018 5:34 PM

To: Staats, Nick <Nick.Staats@vermont.gov>; Greenan, John <John.Greenan@greenmountainpower.com>

Cc: Brandon Kulik <Brandon.Kulik@KleinschmidtGroup.com>; Jesse Waldrip <Jesse.Waldrip@KleinschmidtGroup.com>; Jennifer Jones <Jennifer.Jones@KleinschmidtGroup.com>; Jessica_Pica@fws.gov; Melissa Grader <melissa_grader@fws.gov>; Davis, Eric <Eric.Davis@vermont.gov>; Towler, Brett <brett_towler@fws.gov>; McHugh, Peter <Peter.McHugh@vermont.gov>; Bill Ardren <William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian <Brian.Chipman@vermont.gov>

Subject: RE: Plunge pool site visit.

All – The temporary weir modifications have been installed (photos attached).

Nick & Bill - Sounds like this should work out nicely for your August 7th site visit.

Best!

KATIE

Katie E. Sellers, M.S.
Regulatory Coordinator

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From: Katie Sellers

Sent: Monday, July 23, 2018 11:15 AM

To: 'Staats, Nick' <Nick.Staats@vermont.gov>; Greenan, John <John.Greenan@greenmountainpower.com>

Cc: Brandon Kulik <Brandon.Kulik@KleinschmidtGroup.com>; Jesse Waldrip <Jesse.Waldrip@KleinschmidtGroup.com>; Jennifer Jones <Jennifer.Jones@KleinschmidtGroup.com>; Jessica_Pica@fws.gov; Melissa Grader <melissa_grader@fws.gov>; Davis, Eric <Eric.Davis@vermont.gov>; Towler, Brett <brett_towler@fws.gov>; McHugh, Peter <Peter.McHugh@vermont.gov>; Bill Ardren <William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian <Brian.Chipman@vermont.gov>

Subject: RE: Plunge pool site visit.

Hi Nick – Thanks for checking in. The contractor is planning to work on the weir in the next two weeks (aiming for an early August completion). We will let you know when the work is complete.

Thanks for moving the SOP forward. Feel free to let us know if you want to hold a call to discuss any questions or comments.

Best!

Katie

Katie E. Sellers, M.S.

Regulatory Coordinator

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From: Staats, Nick <Nick.Staats@vermont.gov>

Sent: Thursday, July 12, 2018 8:01 AM

To: Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>; Greenan, John <John.Greenan@greenmountainpower.com>

Cc: Brandon Kulik <Brandon.Kulik@KleinschmidtGroup.com>; Jesse Waldrip <Jesse.Waldrip@KleinschmidtGroup.com>; Jennifer Jones <Jennifer.Jones@KleinschmidtGroup.com>; Jessica_Pica@fws.gov; Melissa Grader <melissa_grader@fws.gov>; Davis, Eric <Eric.Davis@vermont.gov>; Towler, Brett <brett_towler@fws.gov>; McHugh, Peter <Peter.McHugh@vermont.gov>; Bill Ardren <William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian <Brian.Chipman@vermont.gov>

Subject: RE: Plunge pool site visit.

John, Katie,

It looks like you started work on the Essex 19 bladder. Great conditions for that! Hope it goes smoothly. Did you have a timeline for when the downstream modifications will be completed? I

want get that on Brett Towler's radar so he can get up here for a visit one completed.

Also, we should be wrapping up the review of the SOP and moving that forward. Thanks for your patience.

Nick

Nicholas Staats
US Fish and Wildlife Service
111 West Street, Essex Junction VT 05452
Phone: (802) 879 5679
Cell: 802-377-5656
Email: nick.staats@vermont.gov
Email: Nicholas_Staats@fws.gov

From: Staats, Nick
Sent: Wednesday, June 13, 2018 3:37 PM
To: 'Katie Sellers' <Katie.Sellers@KleinschmidtGroup.com>; Greenan, John <John.Greenan@greenmountainpower.com>
Cc: Brandon Kulik <Brandon.Kulik@KleinschmidtGroup.com>; Jesse Waldrip <Jesse.Waldrip@KleinschmidtGroup.com>; Jennifer Jones <Jennifer.Jones@KleinschmidtGroup.com>; Jessica_Pica@fws.gov; Melissa Grader <melissa_grader@fws.gov>; Davis, Eric <Eric.Davis@vermont.gov>; Towler, Brett <brett_towler@fws.gov>; McHugh, Peter <Peter.McHugh@vermont.gov>; Bill Ardren <William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian <Brian.Chipman@vermont.gov>
Subject: RE: Plunge pool site visit.

Thanks Katie,

The SOP looks good. I will move that along asap.

Great to hear the plunge pool work will happen. If flows stay the way they are, should be good working conditions.

Nick

Nicholas Staats
US Fish and Wildlife Service
111 West Street, Essex Junction VT 05452
Phone: (802) 879 5679
Cell: 802-377-5656

Email: nick.staats@vermont.gov
Email: Nicholas_Staats@fws.gov

From: Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>
Sent: Wednesday, June 13, 2018 8:24 AM
To: Staats, Nick <Nick.Staats@vermont.gov>; Greenan, John <John.Greenan@greenmountainpower.com>
Cc: Brandon Kulik <Brandon.Kulik@KleinschmidtGroup.com>; Jesse Waldrip <Jesse.Waldrip@KleinschmidtGroup.com>; Jennifer Jones <Jennifer.Jones@KleinschmidtGroup.com>; Jessica_Pica@fws.gov; Melissa Grader <melissa_grader@fws.gov>; Davis, Eric <Eric.Davis@vermont.gov>; Towler, Brett <brett_towler@fws.gov>; McHugh, Peter <Peter.McHugh@vermont.gov>; Bill Ardren <William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian <Brian.Chipman@vermont.gov>
Subject: RE: Plunge pool site visit.

Hi Nick – Just following-up on agency review of the SOP. Please let us know if you have any questions upon review.

Also for the plunge pool, want to confirm that GMP will indeed be pursuing installation of Temporary Alternative No. 1 this summer in tandem with Essex 19 rubber dam replacement work. Rubber dam work mobilization is scheduled to start in early July.

Best
Katie

Katie E. Sellers, M.S.
Regulatory Coordinator

The logo for Kleinschmidt, featuring the word "Kleinschmidt" in a bold, blue, sans-serif font with a green underline.

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From: Katie Sellers
Sent: Monday, April 30, 2018 9:49 AM
To: 'Staats, Nick' <Nick.Staats@vermont.gov>; Greenan, John <John.Greenan@greenmountainpower.com>
Cc: Brandon Kulik <Brandon.Kulik@KleinschmidtGroup.com>; Jesse Waldrip <Jesse.Waldrip@KleinschmidtGroup.com>; Jennifer Jones <Jennifer.Jones@KleinschmidtGroup.com>; Jessica_Pica@fws.gov; Melissa Grader <melissa_grader@fws.gov>; Davis, Eric <Eric.Davis@vermont.gov>; Towler, Brett <brett_towler@fws.gov>; McHugh, Peter <Peter.McHugh@vermont.gov>; Bill Ardren <William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian <Brian.Chipman@vermont.gov>

Subject: RE: Plunge pool site visit.

Good Morning Nick. Attached for your review please find the draft Essex 19 Downstream Fishway SOP. This SOP was developed in close coordination with GMP's Essex 19 operators.

Should you have any questions upon review please let us know.

Thank you!

Katie

Katie E. Sellers, M.S.
Regulatory Coordinator

Kleinschmidt

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*Providing **practical** solutions for **complex** problems affecting energy, water, and the environment*

From: Staats, Nick [<mailto:Nick.Staats@vermont.gov>]

Sent: Wednesday, April 11, 2018 8:45 AM

To: Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>; Greenan, John <John.Greenan@greenmountainpower.com>

Cc: Brandon Kulik <Brandon.Kulik@KleinschmidtGroup.com>; Jesse Waldrip <Jesse.Waldrip@KleinschmidtGroup.com>; Jennifer Jones

<Jennifer.Jones@KleinschmidtGroup.com>; Jessica_Pica@fws.gov; Melissa Grader

<melissa_grader@fws.gov>; Davis, Eric <Eric.Davis@vermont.gov>; Towler, Brett

<brett_towler@fws.gov>; McHugh, Peter <Peter.McHugh@vermont.gov>; Bill Ardren

<William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian

<Brian.Chipman@vermont.gov>

Subject: RE: Plunge pool site visit.

Thanks Kate!

Nick

From: Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>

Sent: Wednesday, April 11, 2018 8:39 AM

To: Staats, Nick <Nick.Staats@vermont.gov>; Greenan, John <John.Greenan@greenmountainpower.com>

Cc: Brandon Kulik <Brandon.Kulik@KleinschmidtGroup.com>; Jesse Waldrip <Jesse.Waldrip@KleinschmidtGroup.com>; Jennifer Jones

<Jennifer.Jones@KleinschmidtGroup.com>; Jessica_Pica@fws.gov; Melissa Grader

<melissa_grader@fws.gov>; Davis, Eric <Eric.Davis@vermont.gov>; Towler, Brett

<brett_towler@fws.gov>; McHugh, Peter <Peter.McHugh@vermont.gov>; Bill Ardren

<William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian

<Brian.Chipman@vermont.gov>

Subject: RE: Plunge pool site visit.

Hi Nick – Thanks for touching base. We are currently in the midst of finalizing an Essex 19 Downstream Fishway SOP as recommended within the USFWS November 17, 2017 memo. We will have the draft SOP out for group review very shortly (hopefully at the end of this week). Per communications with Essex 19 operators on Friday March 30th, Gate #2 is currently 100% open with a headpond of 274.5'. The gate was fully opened on Friday March 30th in advance of GMP's downstream passage requirement that started on April 1st. Gate #1 will open fully when high waters recede.

As for the plunge pool, GMP has reviewed the options presented in the memo and intends to install Temporary Alternative No. 1 this summer, potentially in tandem with scheduled Essex 19 rubber dam replacement work. The rubber dam replacement work is scheduled to occur July 2018 - August 2018 (after completion of the spring fish passage season but before initiation of the fall passage season). Since contractors will already be mobilized at the site, we believe it makes sense timing wise to try and install the temporary weir configuration then. We will communicate a firmer installation plan once details become finalized with the rubber dam work.

We will follow-up with the draft SOP shortly.

Best
Katie

Katie E. Sellers, M.S.
Regulatory Coordinator

Kleinschmidt

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From: Staats, Nick [<mailto:Nick.Staats@vermont.gov>]

Sent: Monday, April 02, 2018 12:06 PM

To: Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>; Greenan, John <John.Greenan@greenmountainpower.com>

Cc: Brandon Kulik <Brandon.Kulik@KleinschmidtGroup.com>; Jesse Waldrip <Jesse.Waldrip@KleinschmidtGroup.com>; Jennifer Jones

<Jennifer.Jones@KleinschmidtGroup.com>; Jessica_Pica@fws.gov; Melissa Grader

<melissa_grader@fws.gov>; Davis, Eric <Eric.Davis@vermont.gov>; Towler, Brett

<brett_towler@fws.gov>; McHugh, Peter <Peter.McHugh@vermont.gov>; Bill Ardren

<William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian

<Brian.Chipman@vermont.gov>

Subject: RE: Plunge pool site visit.

Hi Katie and John,

Hope things are going well. Two questions related to Essex 19.

1. Can you update the group on the status of your review of the Fish and Wildlife Services November 17, 2017 memo to Vermont DEC regarding recommendations on the downstream fish passage at Essex 19?
2. What is GMP's plan for this spring's downstream fish passage operations? Will there be any temporary modifications to the plunge pool?

Salmon smolt out-migration will begin this month and continue into June. I would suggest at a minimum for downstream passage to operate from April 15 – June 30th.

I will be operating the salmon smolt trap on the Huntington River again this spring and would be happy to update you on the numbers of fish captured.

Thanks

Nick

Nicholas Staats
US Fish and Wildlife Service
111 West Street, Essex Junction VT 05452
Phone: (802) 879 5679
Cell: 802-377-5656
Email: nick.staats@vermont.gov
Email: Nicholas_Staats@fws.gov

From: Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>

Sent: Tuesday, January 02, 2018 4:12 PM

To: Davis, Eric <Eric.Davis@vermont.gov>; Staats, Nick <Nick.Staats@vermont.gov>; Towler, Brett <brett_towler@fws.gov>; McHugh, Peter <Peter.McHugh@vermont.gov>; Greenan, John <John.Greenan@greenmountainpower.com>; Bill Ardren <William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian <Brian.Chipman@vermont.gov>; Melissa Grader <melissa_grader@fws.gov>; Jessica_Pica@fws.gov

Cc: Brandon Kulik <Brandon.Kulik@KleinschmidtGroup.com>; Jesse Waldrip <Jesse.Waldrip@KleinschmidtGroup.com>; Jennifer Jones <Jennifer.Jones@KleinschmidtGroup.com>

Subject: RE: Plunge pool site visit.

Thank you Eric – We will review as a group and will touch base shortly.

Happy new year and stay warm everyone,
Katie

From: Davis, Eric [<mailto:Eric.Davis@vermont.gov>]

Sent: Tuesday, January 02, 2018 3:42 PM

To: Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>; Staats, Nick <Nick.Staats@vermont.gov>; Towler, Brett <brett_towler@fws.gov>; McHugh, Peter <Peter.McHugh@vermont.gov>; Greenan,

John <John.Greenan@greenmountainpower.com>; Bill Ardren <William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian <Brian.Chipman@vermont.gov>; Melissa Grader <melissa_grader@fws.gov>; Jessica_Pica@fws.gov

Cc: Brandon Kulik <Brandon.Kulik@KleinschmidtGroup.com>; Jesse Waldrip <Jesse.Waldrip@KleinschmidtGroup.com>; Jennifer Jones <Jennifer.Jones@KleinschmidtGroup.com>

Subject: RE: Plunge pool site visit.

Hi Katie,

Please find attached a memorandum prepared by the USFWS and addressed to Vermont DEC regarding downstream fish passage at the Essex 19 project. The memorandum summarizes the Service's initial recommendations, GMP's actions to date, provides a review of the field testing performed on August 22, 2017, and includes additional recommendations, many of which were discussed on site during the field testing. When you have an opportunity, please review the memorandum with the GMP team and let us know where GMP is on the modifications we discussed on-site and your thoughts on any additional modifications.

Thank you (and Happy New Year!),
Eric

Eric Davis, *River Ecologist*

1 National Life Drive, Main 2
Montpelier, VT 05620-3522
802-490-6180 / eric.davis@vermont.gov
<http://www.watershedmanagement.vt.gov/rivers>
(Please note my new e-mail address, effective July 27, 2015)



See what we're up to on our [Blog](#). [Flow](#).

From: Katie Sellers [<mailto:Katie.Sellers@KleinschmidtGroup.com>]

Sent: Friday, December 15, 2017 3:38 PM

To: Staats, Nick <Nick.Staats@vermont.gov>; Towler, Brett <brett_towler@fws.gov>; McHugh, Peter <Peter.McHugh@vermont.gov>; Greenan, John <John.Greenan@greenmountainpower.com>; Bill Ardren <William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian <Brian.Chipman@vermont.gov>; Davis, Eric <Eric.Davis@vermont.gov>; Melissa Grader <melissa_grader@fws.gov>; Jessica_Pica@fws.gov

Cc: Brandon Kulik <Brandon.Kulik@KleinschmidtGroup.com>; Jesse Waldrip <Jesse.Waldrip@KleinschmidtGroup.com>; Jennifer Jones <Jennifer.Jones@KleinschmidtGroup.com>

Subject: RE: Plunge pool site visit.

Great, thank you Nick for the update.

Best
Katie

From: Staats, Nick [<mailto:Nick.Staats@vermont.gov>]
Sent: Friday, December 15, 2017 2:18 PM
To: Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>; Towler, Brett <brett_towler@fws.gov>; McHugh, Peter <Peter.McHugh@vermont.gov>; Greenan, John <John.Greenan@greenmountainpower.com>; Bill Ardren <William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian <Brian.Chipman@vermont.gov>; Davis, Eric <Eric.Davis@vermont.gov>; Melissa Grader <melissa_grader@fws.gov>; Jessica_Pica@fws.gov
Cc: Brandon Kulik <Brandon.Kulik@KleinschmidtGroup.com>; Jesse Waldrip <Jesse.Waldrip@KleinschmidtGroup.com>; Jennifer Jones <Jennifer.Jones@KleinschmidtGroup.com>
Subject: RE: Plunge pool site visit.

Hi Katie,

The Fish and Wildlife Service has provided Vermont with our review of the August 22, 2017 downstream fish passage field test results. We included in that review a summary of what GMP has resolved following the initial site visit in September, 2016. The Service has made recommendations to improve fish passage at the site which include detailed drawings of the plunge pool and potential plunge pool weir modifications. Vermont received our recommendations on November 17 and I suspect they are reviewing them. I will see what I can find out.

Thank you for your patience,
Nick

Nicholas Staats
US Fish and Wildlife Service
111 West Street, Essex Junction VT 05452
Phone: (802) 879 5679
Cell: 802-377-5656
Email: nick.staats@vermont.gov
Email: Nicholas_Staats@fws.gov

From: Katie Sellers [<mailto:Katie.Sellers@KleinschmidtGroup.com>]
Sent: Friday, December 15, 2017 1:35 PM
To: Staats, Nick <Nick.Staats@vermont.gov>; Towler, Brett <brett_towler@fws.gov>; McHugh, Peter <Peter.McHugh@vermont.gov>; Greenan, John <John.Greenan@greenmountainpower.com>; Bill Ardren <William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian <Brian.Chipman@vermont.gov>; Davis, Eric <Eric.Davis@vermont.gov>; Melissa Grader <melissa_grader@fws.gov>; Jessica_Pica@fws.gov

Cc: Brandon Kulik <Brandon.Kulik@KleinschmidtGroup.com>; Jesse Waldrip <Jesse.Waldrip@KleinschmidtGroup.com>; Jennifer Jones <Jennifer.Jones@KleinschmidtGroup.com>

Subject: RE: Plunge pool site visit.

Hi Nick – Following-up on this topic. What is the status on agency review/recommendations?

Thank you
Katie

Katie E. Sellers, M.S.
Regulatory Coordinator

Kleinschmidt

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From: Katie Sellers

Sent: Wednesday, September 20, 2017 5:16 PM

To: 'Staats, Nick' <Nick.Staats@vermont.gov>; Towler, Brett <brett_towler@fws.gov>; McHugh, Peter <Peter.McHugh@vermont.gov>; Greenan, John <John.Greenan@greenmountainpower.com>; Bill Ardren <William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian <Brian.Chipman@vermont.gov>; Davis, Eric <Eric.Davis@vermont.gov>; Melissa Grader <melissa_grader@fws.gov>; Jessica_Pica@fws.gov

Cc: Brandon Kulik <Brandon.Kulik@KleinschmidtGroup.com>; Jesse Waldrip <Jesse.Waldrip@KleinschmidtGroup.com>; Jennifer Jones <Jennifer.Jones@KleinschmidtGroup.com>

Subject: RE: Plunge pool site visit.

Thanks Nick for the update, much appreciated. We will keep you posted regarding movement on plunge pool weir ideas.

Best!
Katie

Katie E. Sellers, M.S.
Regulatory Coordinator

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From: Staats, Nick [<mailto:Nick.Staats@vermont.gov>]

Sent: Monday, September 18, 2017 2:48 PM

To: Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>; Towler, Brett <brett_towler@fws.gov>; McHugh, Peter <Peter.McHugh@vermont.gov>; Greenan, John <John.Greenan@greenmountainpower.com>; Bill Ardren <William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian <Brian.Chipman@vermont.gov>; Davis, Eric <Eric.Davis@vermont.gov>; Melissa Grader <melissa_grader@fws.gov>; Jessica_Pica@fws.gov
Cc: Brandon Kulik <Brandon.Kulik@KleinschmidtGroup.com>; Jesse Waldrip <Jesse.Waldrip@KleinschmidtGroup.com>; Jennifer Jones <Jennifer.Jones@KleinschmidtGroup.com>
Subject: RE: Plunge pool site visit.

Katie,

Thanks for the summary of the site visit. The Service is reviewing the document and modifications that have been completed on the Essex 19 downstream fish passage facility. Our review and any additional recommendations will be forwarded to Vermont. We appreciate the efforts by GMP to improve the passage facility. The elevated plunge pool appears to reduce possible injuries to passing smolts and with some minor modifications to the slotted weir transition from the pool to river below I think things are looking much better.

We hope to have our review/recommendations to Vermont by mid-October. If GMP would like to get started on improving the plunge pool weir, perhaps we can get some ideas to you earlier than that. Let me know.

Thanks

Nick

Nicholas Staats
US Fish and Wildlife Service
111 West Street, Essex Junction VT 05452
Phone: (802) 879 5679
Cell: 802-377-5656
Email: nick.staats@vermont.gov
Email: Nicholas_Staats@fws.gov

From: Katie Sellers [<mailto:Katie.Sellers@KleinschmidtGroup.com>]

Sent: Monday, September 18, 2017 2:32 PM

To: Staats, Nick <Nick.Staats@vermont.gov>; Towler, Brett <brett_towler@fws.gov>; McHugh, Peter <Peter.McHugh@vermont.gov>; Greenan, John <John.Greenan@greenmountainpower.com>; Bill Ardren <William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian <Brian.Chipman@vermont.gov>; Davis, Eric <Eric.Davis@vermont.gov>; Melissa Grader <melissa_grader@fws.gov>; Jessica_Pica@fws.gov

Cc: Brandon Kulik <Brandon.Kulik@KleinschmidtGroup.com>; Jesse Waldrip <Jesse.Waldrip@KleinschmidtGroup.com>; Jennifer Jones

<Jennifer.Jones@KleinschmidtGroup.com>

Subject: RE: Plunge pool site visit.

Hi All – Just following-up on this summary. Please let me know if you have any comments or additions to the document.

Also, thinking in terms of next steps for this topic, about when should we expect agency recommendations from the site visit?

Thank you,
Katie

Katie E. Sellers, M.S.

Regulatory Coordinator

Kleinschmidt

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From: Katie Sellers

Sent: Wednesday, September 06, 2017 2:35 PM

To: Staats, Nick <Nick.Staats@vermont.gov>; Towler, Brett <brett_towler@fws.gov>; McHugh, Peter <Peter.McHugh@vermont.gov>; Greenan, John <John.Greenan@greenmountainpower.com>; Bill Ardren <William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian <Brian.Chipman@vermont.gov>; Davis, Eric <Eric.Davis@vermont.gov>; Melissa Grader <melissa_grader@fws.gov>; 'Jessica_Pica@fws.gov' <Jessica_Pica@fws.gov>

Cc: Brandon Kulik <Brandon.Kulik@KleinschmidtGroup.com>; Jesse Waldrip <Jesse.Waldrip@KleinschmidtGroup.com>; Jennifer Jones <Jennifer.Jones@KleinschmidtGroup.com>

Subject: RE: Plunge pool site visit.

Afternoon All – Attached for your review please find our August 22nd Essex 19 site meeting summary.

Please let me know if I have missed anything or if you have any edits to add.

Thank you again for taking time to meet with us on site.

Katie

Katie E. Sellers, M.S.

Regulatory Coordinator

Kleinschmidt

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From: Brandon Kulik

Sent: Friday, August 18, 2017 2:49 PM

To: Staats, Nick <Nick.Staats@vermont.gov>; Towler, Brett <brett_towler@fws.gov>; McHugh, Peter <Peter.McHugh@vermont.gov>; Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>

Cc: Greenan, John <John.Greenan@greenmountainpower.com>; Bill Ardren <William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian <Brian.Chipman@vermont.gov>; Davis, Eric <Eric.Davis@vermont.gov>; Melissa Grader <melissa_grader@fws.gov>

Subject: Plunge pool site visit. SCHEDULE ADJUSTMENT ALERT!!!

Importance: High

Good afternoon everyone,

Just a quick note to advise you that we have been asked to delay the Essex 19 site meeting until 12:30 on Tuesday to better accommodate travel needs of some attendees. Hopefully this won't be a problem for anyone. We believe we can accomplish everything that we need to do in approximately a 2 hour time frame.

Have a great weekend

Brandon

From: Brandon Kulik

Sent: Thursday, August 17, 2017 3:47 PM

To: 'Staats, Nick' <Nick.Staats@vermont.gov>; Towler, Brett <brett_towler@fws.gov>; McHugh, Peter <Peter.McHugh@vermont.gov>; Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>

Cc: Greenan, John <John.Greenan@greenmountainpower.com>; Bill Ardren <William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian <Brian.Chipman@vermont.gov>; Davis, Eric <Eric.Davis@vermont.gov>; Melissa Grader <melissa_grader@fws.gov>

Subject: Plunge pool site visit. Green Mountain Power - Essex 19

Hi All,

Just a brief notice to confirm that we will be meeting at Essex 19 to view how modifications to the plunge pool outlet weir affect downstream fish passage hydraulics. The notch in the outlet weir has been temporarily sealed, and this does in fact significantly deepen the plunge pool. We are proposing that we all assemble on site no later than 10 AM on August 22. Regarding safety gear, please plan to bring a life vest and secure footwear. We will begin with introductions, a safety tailboard briefing, then a recap of recent activities and information, and then move to the fishway hydraulics assessment. We are currently working out the final logistical details.

Let me know if you have any questions. Otherwise we look forward to seeing you on August 22 at 10 AM

Sincerely,

Brandon

Brandon H. Kulik
Senior Fisheries Scientist

Kleinschmidt

Pittsfield, Maine
207-487-3328

From: Staats, Nick [<mailto:Nick.Staats@vermont.gov>]

Sent: Tuesday, August 15, 2017 8:18 AM

To: Brandon Kulik <Brandon.Kulik@KleinschmidtGroup.com>; Towler, Brett <brett_towler@fws.gov>; McHugh, Peter <Peter.McHugh@vermont.gov>; Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>

Cc: Greenan, John <John.Greenan@greenmountainpower.com>; Bill Ardren <William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian <Brian.Chipman@vermont.gov>; Davis, Eric <Eric.Davis@vermont.gov>; Melissa Grader <melissa_grader@fws.gov>

Subject: RE: Doodle Poll for plunge pool site visit. Green Mountain Power - Essex 19

Brandon,

So, is August 22 the day? I see boards have been placed in the weir slot in the plunge pool.. Bill Ardren will take my place because, unfortunately I will be out of town.

Thanks

Nick

Nicholas Staats
US Fish and Wildlife Service
111 West Street, Essex Junction VT 05452
Phone: (802) 879 5679
Cell: 802-377-5656
Email: nick.staats@vermont.gov
Email: Nicholas_Staats@fws.gov

From: Brandon Kulik [<mailto:Brandon.Kulik@KleinschmidtGroup.com>]
Sent: Wednesday, July 26, 2017 2:43 PM
To: Towler, Brett <brett_towler@fws.gov>; McHugh, Peter <Peter.McHugh@vermont.gov>; Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>
Cc: Greenan, John <John.Greenan@greenmountainpower.com>; Staats, Nick <Nick.Staats@vermont.gov>; Bill Ardren <William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian <Brian.Chipman@vermont.gov>; Davis, Eric <Eric.Davis@vermont.gov>; Melissa Grader <melissa_grader@fws.gov>
Subject: RE: Doodle Poll for plunge pool site visit. Green Mountain Power - Essex 19

Good afternoon,

The Doodle Poll seems to have run its course; Looks like potential dates are August 22, 29, or 30. If 8/22 we lose Peter McHugh and if the other dates we lose Brian Chipman, who notes that he feels his attendance isn't mandatory. If Peter doesn't object, I would suggest we hold 8/22 open as the target, but either 8/29 or 8/30 as alternative rain dates. If Peter feels strongly about attending then we will shift to 8/29 or 8/30.

Brandon

From: Brandon Kulik
Sent: Tuesday, July 18, 2017 4:09 PM
To: 'Towler, Brett' <brett_towler@fws.gov>; 'McHugh, Peter' <Peter.McHugh@vermont.gov>; Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>
Cc: Greenan, John <John.Greenan@greenmountainpower.com>; Staats, Nick <Nick.Staats@vermont.gov>; Bill Ardren <William_Ardren@fws.gov>; Pientka, Bernie <Bernie.Pientka@vermont.gov>; Chipman, Brian <Brian.Chipman@vermont.gov>; Davis, Eric <Eric.Davis@vermont.gov>; Melissa Grader <melissa_grader@fws.gov>
Subject: Doodle Poll for plunge pool site visit. Green Mountain Power - Essex 19

Please forgive me if I have overlooked anyone who needs to attend. If there are multiple dates that are mutually workable let's keep a couple of them tentatively reserved pending a better idea regarding suitable field conditions

<http://doodle.com/poll/fscpcxip5yyzqswx>

Brandon

Brandon H. Kulik
Senior Fisheries Scientist



United States Department of the Interior



FISH AND WILDLIFE SERVICE
Lake Champlain Fish and Wildlife
Conservation Office
11 Lincoln St.
Essex Junction, VT 05452
Phone: (802)872-0629
Fax: (802)872-9704

Date: July 27, 2018

To: Eric Davis, VT Department of Environmental Conservation, Watershed Management Division

From: William Ardren, Senior Fish Biologist and Nicholas Staats, Fish Biologist, Lake Champlain Fish and Wildlife Conservation Office

CC: Melissa Grader; Brett Towler; Andrew Milliken – USFWS; Brian Chipman, Bernie Pientka, Peter McHugh – Vermont Department of Fish and Wildlife

Re: Review of GMP's draft SOP for Downstream Fish Passage Facility (FERC No. 2513)

The U.S. Fish and Wildlife Service (Service) has been consulting with Green Mountain Power (GMP) and its consultant, Kleinschmidt Associates (KA) with respect to the application for Low Impact Hydropower Institute (LIHI) Certification at Essex 19 Dam on the Winooski River. After the initial site visit on September 23, 2016 and subsequent conference calls, GMP made some recommended repairs, temporary modifications to the plunge pool, and conducted field testing of the downstream fish passage systems. KA undertook field testing on August 22, 2017 and staff from the US Fish and Wildlife Service (Service), Vermont Agency of Natural Resources and Vermont Department of Fish and Wildlife were present to observe and assist. KA, on behalf of GMP, prepared a summary report of the testing and provided the report to the Service for review. Subsequent to that review, the Service made several recommendations including a request that GMP prepare a standard operating procedure (SOP) for the operation of the downstream fish passage facility. GMP and KA drafted the SOP utilizing the results of the field testing with respect to pond elevation and gate operation and provided it to the Service for review on April 30, 2018.


The SOP includes descriptions of fishway gate operations, rubber dam operations, and modified conditions. The Service has reviewed the SOP and believes it contains relevant guidance to ensure the downstream bypass facility operates effectively. We do request that GMP maintain records of headpond elevation and gate settings throughout the downstream passage facility operational periods to facilitate verification of compliance with the SOP.

Recommendations

The Service, after consultation with the Vermont Department of Fish and Wildlife, recommends amending the spring operating period from April 1 – June 15 to April 15 – June 30. This request is made in light of Atlantic salmon smolt out-migration data collected pursuant to studies conducted on the Huntington River since 2004, which indicate the onset of downstream migration occurs later in April and can continue through the month of June. These amended operational dates also should apply to Gorge 18.

In addition, we request that GMP revise the FERC-approved fish passage plan to incorporate the newly developed SOP (including the proposed new operational dates).

Sincerely,



William R. Ardren, Ph.D.

Senior Fisheries Biologist

William_Ardren@fws.gov

**ESSEX 19 HYDROELECTRIC PROJECT (FERC No. 2513)
DOWNSTREAM FISH PASSAGE FACILITY STANDARD OPERATING PROCEDURES**

INTRODUCTION

The Essex 19 Hydroelectric Project (FERC No. 2513) (Project), owned and operated by Green Mountain Power Corporation (GMP), is located at river mile 17.6 on the Winooski River in Chittenden County, Vermont. The Project consists of: a) a 495-foot-long concrete gravity dam consisting of a 66-foot-long by 50-foot-high south concrete abutment section and a 345-foot-long by 45-foot-high spillway section topped with 5-foot-high inflatable flashboards with a top elevation of 275.0-feet; b) a 352 acre impoundment at a normal water surface elevation of 275.0-feet; c) an intake structure with a 36-foot-high headwall with two concrete wing walls; d) two 3-foot-diameter steel penstocks and four 9-foot-diameter steel penstocks extend from the dam to the powerhouse; e) reinforced concrete and brick powerhouse 156.5-feet-long, 65-feet-wide, and 55-feet-high; f) four horizontal Francis-type turbines with an installed capacity of 2,223 kW each, and a minimum flow unit with an installed capacity of 874 kW; g) downstream fish passage facility with two entrance gates integral with the intake trash racks.

On April 27, 2017, GMP received a preliminary Low Impact Hydropower Institute (LIHI) Certification for the Essex 19 Project. In accordance with agency consultation surrounding improvements to the Project's downstream fish passage facility, a final LIHI Certification need, the U.S. Fish and Wildlife Service (USFWS) issued a letter on November 17, 2017 recommending that GMP prepare a standard operating procedure (SOP) document for Essex 19's downstream fishway in consultation with the USFWS and the Vermont Fish and Wildlife Department (VFWD).

The following SOP was developed in consultation with the USFWS and VFWD. Comments from USFWS were received on **BLANK** and comments from the VFWD were received on **BLANK**.

DOWNSTREAM FISH PASSAGE STANDARD OPERATING PROCEDURES

The Essex 19 Project provides downstream fish passage via the use of two entrance gates integral with the intake trash racks which are located at the west end of the spillway. One entrance is located near the north end of the intake trash racks and the other is located closer to the center of the intake trash racks. The two entrances each feed into a collection chamber behind

the trash racks. The two collection chambers are connected via a 54-inch diameter steel pipe which transports fish to an open channel sluice down the adjacent spillway and into a plunge pool. The plunge pool water level is controlled by a concrete weir with a bell-mouthed vertical slot which discharges flow and fish into the bypass reach below.

In accordance with FERC License Article 407, GMP operates the downstream fish passage facility 24 hours a day from April 1 – June 15 and from September 15 – December 15. During passage season, GMP passes 100 cfs through the downstream fish passage facility.

The elevation of the top of the inflatable flashboards (or rubber dam) is 275.0-feet, which is equivalent to the normal headpond water surface elevation. The elevation of the top of the permanent concrete spillway crest is 270.0-feet. The elevation of the invert of the two downstream fish passage entrances is 269.0-feet.

The ability to pass the required 100 cfs flow effectively through the downstream fish passage facility is dependent on headpond elevation and entrance gate positions. To ensure effective facility operations during downstream fish passage season, GMP follows the following operational procedures as developed in consultation with the USFWS and VFWD:

a) Fishway Gate Operations

At headpond elevations of 274.5-feet or greater, GMP fully opens the entrance gate located near the center of the Project intake trash racks to provide the required 100 cfs flow. Elevation 274.5-feet or higher is the typical level of Essex 19 headpond operation.

b) Rubber Dam Operations

The Essex 19 rubber dam is split into three separate sections (Sections No. 1, 2, 3). Section 1 is closest to the intake, Section 2 is along the curve in the spillway, and Section 3 is at the south end of the spillway (farthest upstream). The rubber dam controls have a manual mode of operation and an automatic mode of operation. The manual mode is used by operators to deflate and inflate individual bladder sections as needed for maintenance such as cleaning trash racks and sluicing ice and debris. The automatic mode is used to prevent the headpond from rising above a set level. When river flow increases above the hydraulic capacity of the hydro units and the headpond begins to spill over the rubber dam, the controls automatically deflate the individual bladder sections incrementally to

maintain the headpond at the set level. The automatic controls are typically set such that Section 1 is the first section to start deflating.

c) Modified Conditions

1. At headpond elevations less than 274.5-feet, GMP fully opens both of the fish passage entrance gates to maintain flow into the fishway at or above the required 100 cfs target. Both of the fully open gates present broad-crested inlets to entering fish.
2. In the event of a failure of one or more of the sections of rubber dam, GMP will fully open both of the fish passage entrance gates when the headpond drops below El. 274.5-feet. If/when the headpond drops to El. 271.0-feet (one foot above the concrete spillway crest and two feet above the invert of the fishway entrances), GMP will begin to curtail hydro unit operations to maintain a minimum depth of two feet in the fish passage entrances, as long as inflow is available to maintain that headpond level. If the rubber dam failure persists for more than 48-hours, GMP will notify the USFWS and VFWD of the incident and provide a plan and schedule for addressing the issue.
3. In the event of a large incoming river debris load, GMP will close both fish passage gate entrances, shut down generating units, and adjust the rubber dam so to allow flow over the dam and minimize the debris load on the intake trash racks and downstream fishway entrances.

MAINTENANCE

The downstream fish passage facility and downstream plunge pool weir are inspected daily, Monday through Friday and occasionally on weekends during times of high flow and/or times of heavy river debris loads. A rack rake or pike pole is used to clear out debris when build-up occurs. Debris is cleared when access is deemed safe for GMP operators. If obstructions to or within the downstream fish passage facility occur for more than 48-hours or if the facility needs to be shut down, GMP will notify USFWS and VFWD of the incident and provide a plan and schedule for addressing the incident.

The fishway entrance chambers are dewatered and inspected twice, annually. Inspections typically occur at the end of the spring fish passage season and before the fall fish passage season begins.

ADAPTIVE MANAGEMENT

Going forward with this SOP, GMP, USFWS, and VFWD will work together to adaptively manage this protocol. Protocol amendments will be implemented as GMP, USFWS, and VFWD collectively see fit.

CONTACT INFORMATION

John Greenan
Environmental Engineer
Green Mountain Power Corporation
802-770-3213
John.Greenan@greenmountainpower.com

DRAFT

From: [Philip Bourn](#)
To: [Katie Sellers](#); "[John Greenan](#)"
Cc: [Travis Tremblay](#); [Justin Reed](#)
Subject: RE: Essex 19 - Weir Alteration Sketches
Date: Tuesday, October 30, 2018 11:33:07 AM

Katie, have you heard anything back from the Fish and Wildlife Folks regarding the clarifications I requested?

John, I was down there today taking field measurements and determined that we will definitely need to grout the new weir insert into place.

The existing concrete isn't plumb, flat or square and the variances are large enough that if we don't do something to fill the voids, I fear debris

will get trapped between the steel and the existing concrete and ice could possibly cause damage.

The grouting isn't a problem, but the timing

could be. Realistically we are probably looking at early December for install at this point. This can still be done, but if it's something that could

be done in the spring / early summer when below freezing temperatures and ice aren't a threat, that may be a better option.

Please let me know when the alterations need to be complete.

Thanks

phil

From: Philip Bourn
Sent: Friday, October 12, 2018 3:16 PM
To: 'Katie Sellers' <Katie.Sellers@KleinschmidtGroup.com>
Cc: Travis Tremblay <ttremblay@pcconstruction.com>; Justin Reed <JReed@pcconstruction.com>; 'John Greenan' <John.Greenan@greenmountainpower.com>
Subject: RE: Essex 19 - Weir Alteration Sketches

Good afternoon Katie,

I have a few questions regarding critical dimensions and materials of construction for the weir insert.

I've attached a marked up version of the model with my questions noted in RED. In the meantime, we will work on getting down there to get solid field measurements and PC will then submit the final shop drawings prior to fabrication.

Please see attached and advise.

Thanks

Phil

From: Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>
Sent: Thursday, October 11, 2018 3:32 PM
To: Justin Reed <jreed@pcconstruction.com>; 'John Greenan' <John.Greenan@greenmountainpower.com>

Cc: Philip Bourn <pbourn@pconstruction.com>; Travis Tremblay <ttremblay@pconstruction.com>

Subject: RE: Essex 19 - Weir Alteration Sketches

Hi Justin – Thank you for looking into this. John and I just reviewed and would like for you to move forward with this fabrication and installation as you recommend (with hopes of mid-November install if possible). I reviewed these designs with our engineers a few weeks back and they also agreed that this is something that doesn't require a stamp.

I'll touch base with the agencies to let them know we are moving forward with this and will continue to keep e 19 permits open from this summer.

Best
Katie

Katie E. Sellers, M.S.
Regulatory Coordinator

Kleinschmidt

Office: 207-416-1218

www.KleinschmidtGroup.com

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From: Justin Reed <jreed@pconstruction.com>

Sent: Thursday, October 11, 2018 8:34 AM

To: Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>; 'John Greenan' <John.Greenan@greenmountainpower.com>

Cc: Philip Bourn <pbourn@pconstruction.com>; Travis Tremblay <ttremblay@pconstruction.com>

Subject: RE: Essex 19 - Weir Alteration Sketches

Katie/John,

Following up with our fact finding mission, we've reached out to fabricators for budget pricing and availability and have the following to offer:

Attached, please find our proposed edits to the concept, for review/feedback, and assistance in developing a design, (not necessarily something that needs a stamp?); to include material thickness', finish, and anchoring points/sizes and quantities. This will facilitate the development of shop/erection drawings, followed by confirmation with field dimensions, in order to complete the fabrication. If the development of the details, and field measurements can occur over the next couple of weeks, and assuming that we use Stainless Steel, the fabrication could be turned around in about 2-3 weeks, for an install in mid, most likely late November. This would require that any spillage over the dam, will have to be sent over the far side section of the dam, for both the field dimensions and the install.

Conceptual Budget

Detailing, Field Dimensions and Shop Fabrication -	\$8,500.00
Installation Labor and Equipment (assuming 2 days of crane work) -	\$10,500.00
Total -	\$19,000.00

Please review and advise as to what you would like to do next.

Thanks,

Justin

From: Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>
Sent: Tuesday, October 2, 2018 1:30 PM
To: Justin Reed <jreed@pcconstruction.com>
Cc: Greenan, John <John.Greenan@greenmountainpower.com>; Philip Bourn <pbourn@pcconstruction.com>
Subject: RE: Essex 19 - Weir Alteration Sketches

Thanks Justin.

From: Justin Reed <jreed@pcconstruction.com>
Sent: Tuesday, October 02, 2018 1:16 PM
To: Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>
Cc: Greenan, John <John.Greenan@greenmountainpower.com>; Philip Bourn <pbourn@pcconstruction.com>
Subject: RE: Essex 19 - Weir Alteration Sketches

We will look into this and advise.

From: Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>
Sent: Tuesday, October 2, 2018 10:43 AM
To: Justin Reed <jreed@pcconstruction.com>
Cc: Greenan, John <John.Greenan@greenmountainpower.com>
Subject: RE: Essex 19 - Weir Alteration Sketches

Hi Justin – Following-up on this. Would you mind checking in with a manufacturer to see when they could get this metal option fabricated and how much it would cost? Ultimately, would fall installation be an option? If we could install this pre-fab option this fall that would be ideal from both a permits and Low Impact Hydropower Institute perspective.

Thanks
Katie

Katie E. Sellers, M.S.
Regulatory Coordinator



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From: Justin Reed <jreed@pcconstruction.com>
Sent: Monday, October 01, 2018 1:48 PM
To: Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>
Cc: Greenan, John <John.Greenan@greenmountainpower.com>
Subject: RE: Essex 19 - Weir Alteration Sketches

Good Afternoon Katie,

Given the lack of access, either option is going to be difficult to construct. I would recommend going with the pre-fabricated metal option, assuming that it can be designed/fabricated in such a way that it can be assembled in place in the field. I think that this would be the most cost effective approach, as well as the one that would require the least amount of future maintenance.

Justin

From: Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>
Sent: Monday, October 1, 2018 10:31 AM
To: Justin Reed <jreed@pcconstruction.com>
Cc: Greenan, John <John.Greenan@greenmountainpower.com>
Subject: Essex 19 - Weir Alteration Sketches

Hi Justin – John and I have been consulting with resource agencies on enhancement of downstream fish passage at Essex 19. After constructing a temporary timber slot in the weir located directly downstream of the dam (page 3 of the attached pdf), Agencies have approved of the concept and are now asking that a permanent alteration be made to the weir. USFWS recommended two potential options for the weir (concrete vs metal insert) and have provided sketches of their recommendations (pages 5&6 of the attached pdf).

When you have a moment, could you provide a review of these two sketches from a constructability standpoint? I understand the location of the weir is difficult to access, so the metal insert could possibly be the more preferred option...but don't want to dismiss the concrete option if there is a fairly straightforward way to make that work.

Thank you!
Katie

Katie E. Sellers, M.S.
Regulatory Coordinator



ATTACHMENT E

ESSEX 19 OPERATIONS DATA

From: Katie Sellers
To: ["Davis, Eric"](#)
Cc: [Andy Qua](#); [Greenan, John](#); [Jennifer Jones](#); ["White, Kevin"](#)
Subject: RE: Essex 19 Operations Data
Date: Monday, October 08, 2018 12:01:00 PM
Attachments: [0012157_ME_GMP_Response_to_VANR_Essex_19_Operations.pdf](#)

Hi Eric – Thanks again for providing a review of this dataset. Attached you will find GMP’s answers to your questions regarding Essex 19 operations over the 2014-2015 timeframe. The answers are a product of reviewing GMP’s Control Center operation logs and plant operator logs. The attached should shed a more in-depth understanding of Essex 19 operations during that timeframe and overall.

In light of Essex 19 operations, GMP invites you to come visit Essex 19 to learn more about the nuisances of operations there. If you are interested, let us know and we can get a site visit scheduled.

Please let us know if you have any follow-up questions while reviewing.

Best!
Katie

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Regulatory Coordinator

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From: Davis, Eric <Eric.Davis@vermont.gov>
Sent: Thursday, September 06, 2018 3:39 PM
To: Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>
Cc: Andy Qua <Andy.Qua@KleinschmidtGroup.com>; Greenan, John <John.Greenan@greenmountainpower.com>; Jennifer Jones <Jennifer.Jones@KleinschmidtGroup.com>
Subject: RE: Essex 19 Operations Data

Good afternoon all,

I’ve had the opportunity to review the operations data in detail and have assembled my comments in the attached document. My hope is that this will keep our conversations moving forward, so that we can understand operations better and identify and address any issues. Please let me know your thoughts after you’ve had a chance to review.

Thanks,
Eric

Eric Davis, River Ecologist

1 National Life Drive, Main 2
Montpelier, VT 05620-3522
802-490-6180 / eric.davis@vermont.gov
<http://www.watershedmanagement.vt.gov/rivers>



See what we're up to on our [Blog](#), [Flow](#).

From: Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>
Sent: Thursday, August 09, 2018 10:56 AM
To: Davis, Eric <Eric.Davis@vermont.gov>
Cc: Andy Qua <Andy.Qua@KleinschmidtGroup.com>; Greenan, John <John.Greenan@greenmountainpower.com>; Jennifer Jones <Jennifer.Jones@KleinschmidtGroup.com>
Subject: RE: Essex 19 Operations Data

Morning Eric- Also following up on this data review.

LIHI's deadline for this work is coming up on November 1 and I am hoping to start bundling up at least this phase of the project up as best as possible. Condition 1 still needs addressing, but want to receive feedback and direction on this operations review before working on that component.

Keep us posted with any additional questions you might have.

Thanks for all your help!
Katie

From: Katie Sellers
Sent: Monday, June 04, 2018 8:38 AM
To: 'Davis, Eric' <Eric.Davis@vermont.gov>
Cc: Andy Qua <Andy.Qua@KleinschmidtGroup.com>; Greenan, John <John.Greenan@greenmountainpower.com>; Jennifer Jones <Jennifer.Jones@KleinschmidtGroup.com>
Subject: RE: Essex 19 Operations Data

This message contains attachments delivered via [ShareFile](#).

- Essex Monthly Gen-Flow-HP Graphs with Bolton Inflow_6_2018.xlsb (9.1 MB)
Download the attachments by [clicking here](#).

Thanks Eric for working through this review.

For #1 - Yes, the intent was to describe 401 Condition E as well as Condition B. I have gone ahead and updated the language such that it matches the 401 Document for simplicity sake. The updated spreadsheet is attached via ShareFile.

For #2 - Indeed that is Bolton outflow data. GMP supplied Kleinschmidt with an existing spreadsheet that is used for monitoring flows at Bolton Falls and Essex 19. The spreadsheet includes unit leakage, dam leakage, and rubber dam discharge to derive Bolton's outflow. The Bolton outflow is then multiplied by 1.19 to gain projected Essex 19 inflow in 10 hours. This information was then included into the provided excel spreadsheet. I have ccd Jenny Jones here as well in case you have any more questions about the spreadsheet/calculations as she pulled this together for us.

Feel free to let us know if any other questions come up or if a phone call to discuss would be helpful.

Best!

Katie

Katie E. Sellers, M.S.

Regulatory Coordinator

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From: Davis, Eric [<mailto:Eric.Davis@vermont.gov>]

Sent: Thursday, May 24, 2018 4:33 PM

To: Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>

Cc: Andy Qua <Andy.Qua@KleinschmidtGroup.com>; Greenan, John <John.Greenan@greenmountainpower.com>

Subject: RE: Essex 19 Operations Data

Good afternoon Katie, Andy, and John,

I've conducted a review of the Essex 19 operations data to further our progress on condition 2 included in Katie's e-mail included below. I'm in the process of working up notes for specific dates and flow conditions that I'd like to discuss in more detail, but to assist me in fleshing those out (and may also help us make progress on condition 1), I have two high level questions on the downstream flow conditions and new Bolton Falls data.

1. The Essex 19 Station Operations Data Review spreadsheet contains a tab entitled "Background Info" Notes 1-4 describe the operations of the project in terms of minimum flows and downstream flows. The terminology for downstream flows includes "...when flows are greater than equal to". This seems to imply instantaneous flow conditions, where as the 401 in condition E describes the "low flow for the calendar day" being the threshold for peaking operations. I acutely understand the challenge in translating tables into narrative form, so the intent here may be to describe condition E, but I just want to confirm what value is being used as the determinant for engaging in peaking operations.

2. The tab entitled, "Operations & Flow Data" includes data in column I that appears to be the Bolton Falls outflow data. Could you describe how these values were derived? I presume this data was derived by translating generation into flow utilizing the turbine rating curves. Does it also include spillage, leakage, or anything else? Here, I'm just trying to understand how the values derived and what the range of accuracy might be.

Thanks,
Eric

Eric Davis, River Ecologist

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<http://www.watershedmanagement.vt.gov/rivers>



See what we're up to on our [Blog, Flow](#).

From: Katie Sellers <Katie.Sellers@KleinschmidtGroup.com>
Sent: Thursday, March 29, 2018 4:41 PM
To: Davis, Eric <Eric.Davis@vermont.gov>
Cc: Andy Qua <Andy.Qua@KleinschmidtGroup.com>; Greenan, John <John.Greenan@greenmountainpower.com>
Subject: Essex 19 Operations Data

Hi Eric – As I noted on the phone last week we are finalizing the SOP for the downstream fish passage at Essex 19 and will have that out for agency review shortly. As we are moving towards wrapping up the fish passage front for the LIHI Certification requirements, we are now looking towards the operations component for Essex 19 LIHI Certification.

For Essex 19 operations, the two LIHI conditions read as follows:

Condition 1) GMP shall review the flow monitoring procedures at the Essex 19 project and assess compliance with the approved flow monitoring plan including the refinements identified in GMP's 2000 refinement plan. In consultation with VDEC, GMP shall establish a plan for implementing modifications required under the approved plan, and submit this plan to LIHI.

Condition 2) GMP shall conduct a review of run-of-river operations at the Essex 19 project and determine if additional modifications are needed to ensure compliance with LIHI criteria. In consultation with VDEC, GMP shall establish a plan for implementing any modifications identified, and submit this plan to LIHI.

In accordance with Condition 2, we have incorporated Bolton Falls Project inflow data into the Essex 19 operations data (The data previously submitted for DEC review incorporated flow data from the downstream USGS gage). After a review of the data with this updated inflow data, the data really seems to clarify any original questions with the Essex 19 operations and relationship to Bolton operations, especially during the run-of-river timeframes. That said, take a look and see what you think of the updated dataset. From there we can work together on a pathway forward for complying with Condition 2.

With respect to Condition 1, GMP is in parallel internally reviewing the latest flow monitoring plan to make sure it is being complied with/checking to see if there should be any alterations that should be made (an especially good time given the upcoming rubber bladder repairs at the site). We will provide the monitoring plan for your review as soon as possible.

Thank you
Katie

Katie E. Sellers, M.S.
Regulatory Coordinator

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Essex 19 Operations Review
Vermont ANR

Purpose

Ongoing discussions have been occurring over the past several years between ANR and GMP (and facilitated) by Kleinschmidt to understand operations at Essex 19 and address any compliance issues before resubmitting a LIHI application. The purpose of this review is to identify potential compliance issues so that they may either be better understood by ANR or addressed by GMP.

Operations - September 2014

Several of the Larger flow fluctuations in this month appear to resemble store and release operations, when instantaneous run-of-river is required. The occasions that may warrant further discussion are highlighted below:

- 9/2: The minimum flow for the calendar day is less than 450, meaning operations should be run-of-river. Water levels are ponded for approximately 16 hours raising the impoundment by a foot before generation responds. This is consistent with a store and release mode of operation.
- 9/4: The minimum flow for calendar day greater than 450, meaning peaking permitted to 950 cfs. Ponding occurs over an eight hour period, but flows below project reach 1100 cfs.
- 9/14 & 9/15: The minimum flow for the calendar day is less than 450, meaning operations should be run-of-river. Water is stored during this period to bring level back to 275'.
- 9/17: The minimum flow for the calendar day is less than 450, meaning operations should be run-of-river. Pond draw occurs of over 1 ft associated with generation.
- 9/22: The minimum flow for the calendar day is less than 450, meaning operations should be run-of-river. A sustained release upstream is not passed through the project in a run-of-river manner, but as significant storage occurs (2 feet) over this period.

Smaller fluctuations (not peaking) occur throughout the month during time periods when instantaneous run-of-river operations are required. For example, the period from 9/7 to 9/8 between when upstream peaks are passed through (not the peaks themselves, which are close to r-o-r) or the period from 9/22 to 9/25. These flow fluctuations are generally about a 100 cfs from peak to valley.

Why do these occur? It may be the sensitivity of the equipment to changes in impoundment level or the sensitivity of wicket gates/units to changes. These may seem minor, but "flow release fluctuations during low flow periods" is one of the areas that brought about the 2000 refinements plan and called for procedures to predict inflows and procedures for bringing additional unit(s) on line during low flow periods and ROR operations to reduce potential flow fluctuations).

Maintaining the impoundment level closer to the crest may help accomplish this. In fact, the 2000 flow Management contemplated maintaining the pond level at crest of the rubber dam with all three sections fully inflated to aid transitions. Is this being done consistently? It was not during September.

October 2014

Unlike September, the issues highlighted below appear to be associated with equipment sensitivity or fine tuning, rather than a departure from required operating mode. However, the issue should still be identified and addressed.

- 10/5: The minimum flow for calendar day is less than 450, meaning operations should be r-o-r. Two peaks from less than 400 to 700 & 850. Generation associated with impoundment draw with storage in between. This looks like it may be an issue with the sensitivity of the level control and units. Bringing on the unit originally dropped the pond level tripping it off, not until the second time it was brought on and throttled down were r-o-r operations able to be maintained.
- 10/8: The minimum flow for calendar day is less than 450, meaning operations should be r-o-r. Similar issue as above.

November 2014

No issues identified as flows supported peaking the whole month with no limit. It is worth noting that the headpond fluctuations were generally less than the September/October examples described above.

December 2014 & January 2015

Data is not available for the winter period, so a full evaluation is not possible, but there do not appear to be any issues of concern.

February 2015

Data is not available for the winter period, so a full evaluation is not possible, but for the most part, operations appear to be simply passing upstream flows through the project (r-o-r), however there are a couple of occasions towards the month (2/21, 2/23, and 2/24) where it appears that utilization some degree of use of storage occurs. These may be potential issues.

March 2015

Data is not available for the winter period, so a full evaluation is not possible, but there do not appear to be any issues of concern.

April 2015

No potential issues identified, run-of-river operations look good.

May 2015

Run-of-river operations look good. Two potential issues occur later in the month that warrant further discussion are highlighted below.

- May 24: There is a large spike in downstream flows associated with an extremely quick pond drawdown, not associated with generation. What happened here? Bladder failure?

- May 25: The minimum flow for calendar day is less than 1000 cfs, meaning operations should be r-o-r. A spike in generation to 4 MWs coincides with a downstream flow of to 1160 cfs, this does not appear to be associated with upstream generation.

June 2015

No potential issues identified.

July 2015

No potential issues identified.

August 2015

No potential issues identified, during the beginning of the month. However, after 8/19, generation and downstream flow variability occur, when flows dictate instantaneous r-o-r. This pattern is similar to the smaller, tighter peaks described during the September 2014 period. For example on 8/19, downstream flows reach a low of 422, but bounce up to 750 and fluctuate in between these levels. Similar patterns occur throughout the latter portion of the month. This is clearly not peaking, but could be an issue with the sensitivity of the equipment as discussed previously. Consistent with the 2000 flow refinements plan, flow fluctuations during low flow periods should be addressed.

MEMORANDUM

TO: Eric Davis, Vermont Agency of Natural Resources

FROM: John Greenan, Green Mountain Power

CC: Katie Sellers, Kleinschmidt Associates
Andy Qua, Kleinschmidt Associates
Jennifer Jones, Kleinschmidt Associates

DATE: October 8, 2018

RE: **Response to Vermont ANR Essex 19 Operations Review Provided September 6, 2018**

On September 6, 2018, the Vermont Agency of Natural Resources (ANR) provided Green Mountain Power (GMP) with a review of 2014-2015 operations data for the Essex 19 Project (Federal Energy Regulatory Commission [FERC] No. 2513) (Project or Essex 19). This review was provided as part of ongoing consultation for the Essex 19 Low Impact Hydropower Institute application. Vermont ANR's review included specific questions regarding Project operations and Project compliance throughout the 2014-2015 timeframe. This memorandum provides GMP's answers to Vermont ANR's questions regarding Project operations for 2014-2015. The provided answers are a product of reviewing GMP's Control Center operation logs and plant operator (Power Production Worker) logs. Vermont ANR's questions are included in italics and GMP's corresponding responses are included below.

September 2014

Several of the Larger flow fluctuations in this month appear to resemble store and release operations, when instantaneous run-of-river is required. The occasions that may warrant further discussion are highlighted below:

- *9/2: The minimum flow for the calendar day is less than 450, meaning operations should be run-of-river. Water levels are ponded for approximately 16 hours raising the impoundment by a foot before generation responds. This is consistent with a store and release mode of operation.*
- *9/4: The minimum flow for calendar day greater than 450, meaning peaking permitted to 950 cfs. Ponding occurs over an eight hour period, but flows below project reach 1100 cfs.*
- *9/14 & 9/15: The minimum flow for the calendar day is less than 450, meaning operations should be run-of-river. Water is stored during this period to bring level back to 275'.*
- *9/17: The minimum flow for the calendar day is less than 450, meaning operations should be run-of-river. Pond draw occurs of over 1 ft associated with generation.*

- *9/22: The minimum flow for the calendar day is less than 450, meaning operations should be run-of-river. A sustained release upstream is not passed through the project in a run-of-river manner, but as significant storage occurs (2 feet) over this period.*

September to October 2014 was the installation of the Obermeyer pneumatic rubber dam system at Gorge 18 dam (Gorge 18), approximately 1.5 river hours downstream of Essex 19. Several drawdowns of the Gorge 18 pond were required during construction and water was released further upstream and sometimes impounded or released at Essex 19 to support the work. Essex 19 was operated below normal full pond to provide a safety margin to catch sudden inflows during the construction project. The construction activities mentioned herein included the completion of required notifications and permits.

September 2, 2014: Gorge 18 pond was pulled below crest for a concrete pour. Water was impounded at Essex 19.

September 4, 2014: Water was impounded at Essex 19 during Gorge 18 cement cure. Water was then released from Essex 19 to reestablish a safety margin in the Essex 19 pond.

September 14 and September 15, 2014: Water was impounded at Essex 19 to allow divers behind Gorge 18 on September 16 to remove temporary bulkheads. On September 17, workers were on the crest of Gorge 18 to remove an above water bulkhead structure.

September 21 and September 22, 2014: Little River release to refill the Essex 19 pond to normal operational level. Major construction activities on Gorge 18 complete.

Smaller fluctuations (not peaking) occur throughout the month during time periods when instantaneous run-of-river operations are required. For example, the period from 9/7 to 9/8 between when upstream peaks are passed through (not the peaks themselves, which are close to r-o-r) or the period from 9/22 to 9/25. These flow fluctuations are generally about a 100 cfs from peak to valley.

Why do these occur? It may be the sensitivity of the equipment to changes in impoundment level or the sensitivity of wicket gates/units to changes. These may seem minor, but “flow release fluctuations during low flow periods” is one of the areas that brought about the 2000 refinements plan and called for procedures to predict inflows and procedures for bringing additional unit(s) on line during low flow periods and ROR operations to reduce potential flow fluctuations).

These smaller fluctuations are related to equipment responsiveness. To help prevent the fluctuations, GMP refurbished the turbine governors and worked on control software upgrades in September and October 2017. The results of this work were marginal and GMP continues to work to improve responsiveness of the entire system.

The Essex 19 (Bridgestone) system is designed to provide steady pond elevation, not the precise flow regulation provided by steel plates lifted by a rubber pillow system such as the Obermeyer system at Gorge 18. The Essex 19 inflatable crests operate within a pressure deadband. The Bridgestone system spills more as the air pressure inside the crest bleeds down. When the

pressure reaches the bottom of the deadband, the inflatable crest is then inflated to the top of the deadband and spillage is quickly reduced. Some oscillation in downstream flow seems inherent due to the three inflatable crests at the dam. GMP operates the system to minimize this variation as much as possible (i.e. inflating bag #3 to a higher setpoint so that dam #1 manages inflow and the largest dam does not spill when the plant is off line during low flows). For most of the 2014 period in question, the pond was well below the crest and the variation was primarily caused by unit (turbine) responses. GMP has also learned that calibrating the system for one set of river conditions may reduce fluctuations but then a change in river conditions may cause the calibrated system to create fluctuations.

Maintaining the impoundment level closer to the crest may help accomplish this. In fact, the 2000 flow Management contemplated maintaining the pond level at crest of the rubber dam with all three sections fully inflated to aid transitions. Is this being done consistently? It was not during September.

During normal operating conditions, the impoundment level is operated closer to the crest of the rubber dam to aid with transitions. This was not feasible, though, while managing the Essex 19 pond for downstream construction at Gorge 18.

As noted above, a “fully inflated” system is not always a steady state at the facility. GMP has worked extensively with the Programmable Logic Controller programming and configured the three individual dam systems to tighten the operating pressure deadband as much as possible. The best compliance with instantaneous run of river ultimately comes when controlling flow with the units. Upgrades to the minimum flow unit is currently underway and GMP expects this will improve the precision of the overall system which should also improve compliance and reduce deviations.

October 2014

Unlike September, the issues highlighted below appear to be associated with equipment sensitivity or fine tuning, rather than a departure from required operating mode. However, the issue should still be identified and addressed.

- *10/5: The minimum flow for calendar day is less than 450, meaning operations should be r-o-r. Two peaks from less than 400 to 700 & 850. Generation associated with impoundment draw with storage in between. This looks like it may be an issue with the sensitivity of the level control and units. Bringing on the unit originally dropped the pond level tripping it off, not until the second time it was brought on and throttled down were r-o-r operations able to be maintained.*
- *10/8: The minimum flow for calendar day is less than 450, meaning operations should be r-o-r. Similar issue as above.*

October 1, 2014: Pulled Gorge 18 pond below crest for surveyors.

October 5 to October 8, 2014: Little River release to refill Gorge 18 pond for required dissolved oxygen testing.

February 2015

Data is not available for the winter period, so a full evaluation is not possible, but for the most part, operations appear to be simply passing upstream flows through the project (r-o-r), however there are a couple of occasions towards the month (2/21, 2/23, and 2/24) where it appears that utilization some degree of use of storage occurs. These may be potential issues.

February 21 to February 24, 2015: A System Control and Data Acquisition upgrade and commissioning project occurred at Essex 19. Units cycled in and out of service to commission the 'pond control' mode of operation with auto loading/unloading. The U.S. Geological Survey gauge downstream was iced in. Responsiveness problems were encountered as turbine/generator #4 was not tracking pond level changes correctly.

May 2015

Run-of-river operations look good. Two potential issues occur later in the month that warrant further discussion are highlighted below.

- *May 24: There is a large spike in downstream flows associated with an extremely quick pond drawdown, not associated with generation. What happened here? Bladder failure?*
- *May 25: The minimum flow for calendar day is less than 1000 cfs, meaning operations should be r-o-r. A spike in generation to 4 MWs coincides with a downstream flow of to 1160 cfs, this does not appear to be associated with upstream generation.*

May 24, 2015 (Sunday, Memorial Day weekend): The inflation/deflation, compressed air line which supplies rubber dam #3 (the largest, longest of the three inflatable crests) ruptured at 13:18. The line was repaired by 15:09. The rapid deflation of the crest caused a large water release downstream. Rapid inflow at Gorge 18 caused rubber dams to auto-deflate in pond control. Loss of pond made it impossible to take Gorge 18 unit off line without water spilling after the high water passed.

May 25, 2015: Essex 19 pond recovered to spilling with one unit fully loaded; therefore, GMP tried running a second unit to split the load, but could not sustain both units with available inflow. The units were taken off line. The System Operator may have attempted to spill at Gorge 18 to get that unit off line because flow could not sustain the unit without losing pond elevation further.

August 2015

No potential issues identified, during the beginning of the month. However, after 8/19, generation and downstream flow variability occur, when flows dictate instantaneous r-o-r. This pattern is similar to the smaller, tighter peaks described during the September 2014 period. For

example on 8/19, downstream flows reach a low of 422, but bounce up to 750 and fluctuate in between these levels. Similar patterns occur throughout the latter portion of the month. This is clearly not peaking, but could be an issue with the sensitivity of the equipment as discussed previously. Consistent with the 2000 flow refinements plan, flow fluctuations during low flow periods should be addressed.

August 2015: Essex 19 pond drawn down to 3 feet above crest to facilitate concrete resurfacing on spillways #1 and #2. Inflow was above 450 cubic feet per second (cfs) requiring a maximum flow delta of 500 cfs for the day. Units 2 and 3 were on line at minimum loading; the pond elevation dropped so Unit #2 was taken off line at 03:23am. Load raise on Unit 3 did not respond quickly enough and flow dropped below 450 cfs downstream. Similar brief deviations below 450 cfs occurred with a single large unit on line throughout the days that followed. Load changes to the unit appear to over and under respond to setpoint changes. The construction activities mentioned herein involved the completion of required notifications and permits.

Summer 2017

In the summer of 2017, all four mechanical governors that control unit response to load changes were extensively serviced. Control logic was also updated to allow faster response to load setpoint changes.

ATTACHMENT F
VDEC FINAL LIHI CONSULTATION

From: [Katie Sellers](#)
To: [Davis, Eric](#)
Cc: [Greenan, John](#); [Andy Oua](#)
Subject: Essex 19 - Final LIHI Pre-Certification Conditions Report
Date: Tuesday, October 30, 2018 4:18:00 PM
Attachments: [0012157 Essex 19 Report to VTDEC on LIHI Progress.pdf](#)

Hi Eric,

Attached, please find a letter detailing GMP's progress in completing the suite of Low Impact Hydropower Institute (LIHI) pre-certification conditions for the Essex 19 Hydroelectric Project. GMP's pre-certification period for Essex 19 ends on November 1st. In this letter we respectfully ask for Vermont DEC's support of Essex 19 LIHI certification based on substantial completion of pre-certification conditions and construction plans which are nearly finalized with USFWS/VTFW for the few remaining fish passage improvements which will be completed in the 2019 construction season.

A similar letter will be sent to LIHI momentarily to provide an update on Essex 19's current status and provide GMP's request for certification based on substantive completion of pre-certification conditions achieved through ongoing collaboration with agencies.

Please let us know if you have any questions upon review. Thank you for your help throughout this process,
Katie

Katie E. Sellers, M.S.
Regulatory Coordinator

Kleinschmidt

Office: 207-416-1218

www.KleinschmidtGroup.com

*Providing **practical** solutions for **complex** problems affecting energy, water, and the environment*



October 30, 2018

VIA EMAIL

Mr. Eric Davis
Vermont Department of Environmental Conservation
1 National Life Drive, Main 2
Montpelier, VT 05620-3522

Final Report – LIHI Pre-Certification Conditions
Essex 19 Hydroelectric Project

Dear Eric:

Kleinschmidt Associates (Kleinschmidt), on behalf of Green Mountain Power Corporation (GMP) owner and operator of the Essex 19 Hydroelectric Project (FERC No. 2513) (Project), herein provides a final report detailing GMP's accomplishments and progress in completing the suite of pre-certification conditions set forth by the Low Impact Hydropower Institute (LIHI). GMP has worked diligently and collaboratively with resource agencies throughout the pre-certification process. GMP believes its work, summarized below, meets the purpose and intent of the pre-certification conditions assigned to the Essex 19 Project. GMP therefore respectfully asks for Vermont Department of Environmental Conservation (VDEC) support for LIHI Certification of the Essex 19 Hydroelectric Project and assumes certification would be conditioned on supplemental reporting requirements as proposed herein.

BACKGROUND

On April 27, 2017 LIHI issued a letter stating that given the uncertainty and lack of definitive data needed to determine compliance with flow and fish passage standards at the Essex 19 Project, LIHI was unwilling to issue Project certification at that time. However, LIHI stated that if GMP could demonstrate that it has reached agreement with appropriate resource agencies over the issues raised in the VDEC letter dated March 17, 2017, and that GMP has implemented appropriate solutions, then LIHI certification would be granted. LIHI committed to holding the Essex 19 Project application open for one year or until May 1, 2018. Per GMP letter dated April 30, 2018 and LIHI letter dated May 29, 2018, GMP was granted an extension of time, until November 1, 2018, to further implement pre-certification measures.

The pre-application conditions set forth in VDEC's March 17, 2017 letter include the following:

Downstream Fish Passage

1. GMP shall re-initiate consultation on the downstream bypass facility with Vermont Department of Fish and Wildlife and U.S. Fish and Wildlife Service. GMP shall identify any modifications needed to conform with prior resource agency recommendations and develop a schedule for implementation.

2. GMP, in consultation with Vermont Department and Fish and Wildlife and U.S. Fish and Wildlife Service, shall evaluate the performance bypass facility to verify that downstream passage is safe and effective. Results of this evaluation shall be provided to LIHI. If results of this evaluation indicate issues with safety [i.e., safe passage of downstream migrating fish] or effectiveness, GMP shall commit to working with the agencies to identify reasonable measures to increase safety and effectiveness and shall document these efforts with an annual report to LIHI.

Flows

1. GMP shall review the flow monitoring procedures at the Essex 19 project and assess compliance with the approved flow monitoring plan including the refinements identified in GMP's 2000 refinement plan. In consultation with VDEC, GMP shall establish a plan for implementing modifications required under the approved plan and submit this plan to LIHI.
2. GMP shall conduct a review of run-of-river operations at the Essex 19 project and determine if additional modifications are needed to ensure compliance with LIHI criteria. In consultation with VDEC, GMP shall establish a plan for implementing any modifications identified and submit this plan to LIHI.

SUMMARY OF WORK

In response to VDEC and LIHI's pre-application conditions, GMP has completed the following at the Essex 19 Project:

Downstream Fish Passage

As described within the LIHI application, an initial site inspection was held with resource agencies on September 23, 2016 (after flow conditions during a May 2016 site visit proved to be too high for fishway inspection). In accordance with conditions found during the site visit, the U.S. Fish and Wildlife Service (USFWS), Vermont Fish and Wildlife Department (VTFW), and VDEC made the following recommendations for the Project's downstream fish passage facility:

1. Repair outboard-side downstream gate actuator/stem to ensure proper functioning.
2. Grind off/remove angle iron stub welded to downstream bypass entrance walls.
3. Re-seat and secure floor diffuser on downstream bypass supplementary water supply.
4. Ensure both gates operate in fully open/fully closed position (or modify the lip of the gate to approximate broad-crested weir geometry).
5. Repair bent turbine intake rack to meet 1" clear spacing requirements.
6. If necessary, installation of chute/floor for the slotted weir impounding plunge pool to ensure safe plunge.
7. Modify plunge pool and/or downstream chute to provide safe movement downstream.

GMP immediately addressed items 1-3 and 5, while items 4, 6, and 7 required further investigation or field investigation to determine the preferred solution.

To address items 6 and 7, GMP organized a field test to evaluate modifications to the plunge pool recommended during a conference call held with the USFWS, VTFW, VDEC, and Kleinschmidt on July 17, 2017. On August 22, 2017, USFWS, VTFW, VDEC, GMP, and Kleinschmidt met at the Essex 19 Project to test the modified plunge pool hydraulics. GMP inserted stop-logs in the plunge pool slotted weir to raise the level of the plunge pool water. Tomatoes were used as fish-surrogates and released down the fish passage to test for injury. The results of the field testing indicated that raising the plunge pool level could be effective in reducing injury to fish. However, the transition from the plunge pool downstream (at the slotted weir) needed modification to provide safe passage to the river below (see Attachment A for a summary of the field test). Within a USFWS letter dated November 17, 2017 and provided to GMP by VDEC on January 2, 2018, agencies recommended the following Project modifications to enhance safe passage from the plunge pool (Attachment B):

1. Maintain plunge pool level at elevated weir height (approximate top of wall, 227.25 ft USGS).
2. Remove rock obstructions immediately below plunge slide and in front of the weir.
3. Install bell-mouthed/broad-crested weir in place of plugged slotted weir. The Service advised that GMP should determine the proper slot width by means of building a temporary weir. The proper slot width should ensure the appropriate backwater in the plunge pool at the required discharge of 100 cfs.

Additionally, prior to the Essex 19 field test, Kleinschmidt provided resource agencies with an August 21, 2017 memo in response to item 4 on the original recommendations list (Attachment C). The purpose of this memo was to provide a review on how often the Essex 19 Project typically has the ability to pass the required 100 cfs for fish passage through one fully open gate during downstream fish passage season. The USFWS' November 17, 2017 letter additionally responded to item 4. In agreement with GMP's August 21, 2017 memo, it was determined that the ability of the fish entrance gates to pass the 100 cfs is dependent on pond elevation and gate position. At a pond elevation of 274.5 feet, one fully open gate will pass the required 100 cfs. The USFWS therefore recommended the following in the November 17 letter:

1. At a pond level of equal or greater than 274.5 ft, one fully open gate can be utilized for the downstream fish passage.
2. At pond levels less than 274.5 ft, one gate must be fully open and the second gate partially open to provide the full 100 cfs. The partially open gate must be modified to present a broad-crested lip to entering fish.

The November 17th letter also recommended that GMP prepare, in consultation with the USFWS and VTFW, a standard operating procedure (SOP) document for operation of the downstream fish passage facility.

A final recommendation included within the November 17, 2017 letter, requested that once all modifications are made to the downstream fish passage structure and operating procedures, that GMP verify the effectiveness of the system either before or during the upcoming FERC relicensing process.

In an email dated April 11, 2018 (Attachment D), Kleinschmidt, on GMP's behalf, committed to installing a temporary bell-mouthed/broad-crested weir as recommended in the USFWS letter and in accordance with the provided Alternative No. 1 design. GMP installed the temporary enhancements in July 2018 while repairing the Essex 19 rubber dam system (Photo 1 & 2, Attachment D).



PHOTO 1 TEMPORARY BROAD-CRESTED WEIR (DEWATERED POST CONSTRUCTION)



PHOTO 2 TEMPORARY BROAD CRESTED WEIR (IN OPERATION)

On August 7, 2018, the USFWS and VTFW participated in FERC's environmental inspection of the Essex 19 Project. Agencies had a chance to review the temporary weir arrangement during that time and were supportive of the results of the temporary weir configuration (Attachment D). Per email dated August 10, 2018, the USFWS provided a review of the temporary weir configuration and committed to providing revised sketches for a permanent weir configuration (Attachment D). Revised weir recommendations and sketches were provided to GMP on September 14, 2018 (Attachment D). These updated recommendations supersede previous recommendations included within the USFWS's November 2017 letter.

On October 17, 2018 GMP committed to installing the permanent weir enhancement, specifically the fabricated metal insert option, and is currently working with resource agencies to finalize design dimensions and minimum material characteristics (Attachment D). GMP and agencies have worked collaboratively to complete final designs for GMP to attain formal approval for the weir and plunge pool improvements, however, it has taken longer to finalize some critical design details than originally anticipated. As such, construction could not occur prior to field conditions becoming a limiting factor for 2018 (Attachment D), so GMP will complete final modification as soon as safe access conditions and temperatures needed to install certain material components (e.g., grout placement and curing) occur in the 2019 construction season. Once the weir modification is installed, GMP will work with agencies regarding the potential alteration of rocks downstream.

A draft Essex 19 Fish Passage Facility SOP document was provided to resource agencies for review on April 30, 2018 (Attachment D). The SOP document is intended to fulfill all requirements/requests related to operation of the fishway gates. Resource agencies provided their review and feedback of the SOP on September 13, 2018, via a USFWS letter dated July 27, 2018 (Attachment D). Within the September 13 letter, agencies jointly recommended that GMP formally amend the downstream spring fish passage season from April 1 – June 15 to April 15 – June 30. This request was made in light of Atlantic salmon smolt out-migration data collected pursuant to studies conducted on the upstream Huntington River¹. Agencies recommended that these changes also be implemented at GMP's downstream Gorge 18 plant and be amended within the FERC approved fish passage plan and include the SOP within that plan.

In an email dated October 22, 2018, GMP agreed to implementing the shift in the downstream passage timeframe at both Essex 19 and at the downstream Gorge 18 facility (Attachment D). GMP is currently working towards filing the SOP and shift in fish passage timing and associated consultation with FERC.

To verify final effectiveness of the elevated plunge pool and permanently altered weir, GMP is open to working with resource agencies to test the effectiveness of these modifications during the upcoming relicensing process. GMP intends to file a Notice of Intent (NOI) and Pre-Application Document (PAD) with FERC no later than February 28, 2020. GMP anticipates that an appropriate scope and methodology for testing will be developed within the process and study scoping procedures within the FERC licensing process.

¹ The Huntington River is a tributary to the Winooski River, located upstream of the Essex 19 Project.

Flows

GMP reviewed run-of-river operations and compared the operations data with that of the upstream Bolton Falls Project (FERC No. 2879) outflows. The review found that the Project's seasonal run-of-river operations were depicted well with incorporation of the Bolton Falls inflow data. Kleinschmidt, on behalf of GMP, provided VDEC with Essex 19 Project operations data with Bolton Falls inflows incorporated on March 29, 2018 for review of run-of-river compliance (Attachment E). On September 6, 2018 VDEC provided a review as well as questions on Essex 19 operations during the 2014-2015 timeframe presented in the operations data (Attachment E). In an October 8, 2018 memo, GMP provided answers to VDEC's questions regarding project operations (Attachment E). The answers were developed by reviewing GMP's Control Center operation logs and Power Production Worker (plant operator) logs. A majority of the questions regarding operations stemmed from a time period when work was taking place at the downstream Gorge 18 facility. Pinpointed times of operational changes at Essex 19 were due to managing impoundment levels at the Project to ensure safe construction conditions at Gorge 18.

VDEC is currently reviewing GMP's October 8, 2018 memorandum. In accordance with discussions with VDEC, conclusions on Essex 19 operations may result in revisions to the Project operations plan (Condition 1). GMP is collaboratively working with VDEC through the operations review process first which will directly influence how next steps should be addressed. Additionally, GMP recently replaced two of three inflatable crests at the dam and is currently commissioning/troubleshooting crest operations. Any refinements of Essex 19 operations and protocols will be reviewed with VDEC and meet the requirements of Condition 1. GMP also continues to work on the control and operation of the minimum flow turbine for the project. GMP believes the turbine provides an opportunity to improve both production and compliance.

CONCLUSIONS

Throughout the pre-certification process, consultation has resulted in adaptive modifications to fish passage and operational procedures at Essex 19. GMP believes that the progress made at Essex 19 over the last year and a half has been marked and successful in achieving the intent of the pre-certification conditions. GMP understands there are still four outstanding needs to finalize, but also notes there is some practicality in resolving certain components in the context of the upcoming relicensing process for the Project. GMP therefore asks for VDEC's support of LIHI Certification based on the following proposed conditions:

1. GMP will complete installation of the permanent weir enhancement in the 2019 construction season and will notify agencies upon completion. GMP will work with agencies to determine if any rocks can be altered or moved in 2019 to help enhance flows over the weir once the weir enhancements are complete.
2. During the upcoming relicensing process, GMP will work with resource agencies to test the effectiveness of the fully modified plunge pool and weir set-up.
3. GMP will complete SOP and amended spring passage timing consultation with FERC.
4. GMP will continue to work collaboratively with VDEC to determine next steps for operations monitoring or reporting at the facility and potentially incorporating future

monitoring into the relicensing through formalizing an updated operations compliance plan with FERC.

GMP believes the work put into the Essex 19 pre-certification conditions exceeds the intent of LIHI's requirements and that LIHI Certification of the Essex 19 Project is now appropriate. LIHI Certification will improve GMP's ability to continue to work collaboratively with resource agencies on fish passage and operational improvements in advance of the relicensing process. Should you have any questions regarding this summary of work, please contact me at 207.416.1218 or at katie.sellers@kleinschmidtgroup.com.

Sincerely,



Katie Sellers
Regulatory Coordinator

KES:TMJ

Enclosures: Attachment A – August 22, 2017 Essex 19 Site Visit Summary
Attachment B – USFWS November 17, 2017 Letter
Attachment C – August 21, 2017 Gate Operation Memo
Attachment D – GMP and Agency Consultation Emails on Fish Passage
Attachment E – Essex 19 Operations Data

cc: John Greenan (GMP)
Andy Qua (Kleinschmidt)